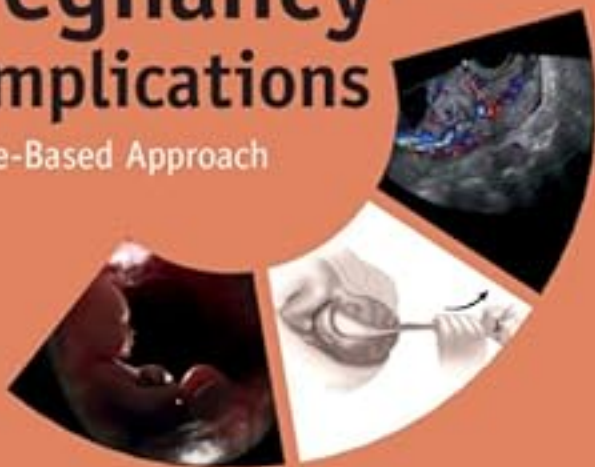


Pregnancy Complications

A Case-Based Approach



EDITED BY:

Peter F. Schnatz, D. Yvette LaCoursiere,
Christopher M. Morosky, Jonathan Schaffir,
Vanessa Torbenson and David Chelmow

Pregnancy Complications

This unique book, designed to support obstetrician-gynecologists, midwives, and family medicine specialists caring for obstetric patients, will guide clinicians to a clear understanding of the ways to recognize, manage, and importantly prevent obstetrical complications. Utilizing clinical vignettes combined with comprehensive, authoritative discussions from experienced clinicians, this book is an essential resource to support practice and preparation for various certification examinations.

Following the same effective approach as other titles in this series, *Acute and Emergency Care Gynecology: A Case-Based Approach*, *Office Gynecology: A Case-Based Approach*, and *Surgical Gynecology: A Case-Based Approach*, this book is the perfect guide to navigate common and rare obstetrical complications.

Dr. Peter F. Schnatz is an internist and obstetrician-gynecologist. He is a professor at Drexel University and Medical Director of the FaithCare-PA Health Center. He is a past president of the Menopause Society and the Obstetrical Society of Philadelphia. He is Vice Chair for the Society for Academic Specialists in General Obstetrics and Gynecology (SASGOG)'s Pearls Publications Committee. He is on the Board of Directors of the International Menopause Society (IMS), FaithCare, Inc., and the Advancing Health after Hysterectomy Foundation (AHAH). He has served as an editor and reviewer for multiple journals and books. He is also an American Board of Obstetrics and Gynecology (ABOG) oral board examiner.

Dr. D. Yvette LaCoursiere is a professor and Vice Chair of Clinical Affairs in the Department of Obstetrics, Gynecology and Reproductive Sciences and Clinical Director in the Office of Faculty Affairs at University of California, San Diego School of Medicine. She was a scholar in the Women's Reproductive Health Research Program. In addition, she served as the University of California, San Diego's Residency Director, American Board of Obstetrics and Gynecology Specialty Boards Examiner, and reviewer/moderator for CREOG-APGO, SASGOG, and ACOG conferences. She worked on the SASGOG Presidential Task Force and the Board of Directors and currently participates on the SASGOG-Green Journal Editorial Fellow Task Force and serves on ACOG's Committee on Clinical Consensus – Obstetrics.

Dr. Christopher M. Morosky is Professor of Obstetrics and Gynecology at the University of Connecticut School of Medicine. He serves as the Vice Chair for Education and Generalist Division Director for the Department of Obstetrics and Gynecology at UCONN HEALTH. He is the immediate past cochair of the Connecticut Perinatal Quality Collaborative and recently finished his service on the Association of Professors of Gynecology and Obstetrics Undergraduate Medical Education Committee. He is the past chair of the SASGOG Resident Reporter Committee.

Dr. Jonathan Schaffir is Professor of Obstetrics and Gynecology at the Ohio State University. He currently serves as Vice Chair for Education for the department. He is a past board member of the Association of Professors of Gynecology and Obstetrics and currently serves on its Undergraduate Medical Education Committee. He is a Specialty Certifying Examiner for the American Board of Obstetrics and Gynecology and a previous member of SASGOG's Pearls Publications Committee. He is coeditor of the journal *Clinical Obstetrics and Gynecology*.

Dr. Vanessa Torbenson is a consultant and assistant professor in the Department of Obstetrics and Gynecology at the Mayo Clinic where she works as an OB Hospitalist. She is the current Residency Program Director. She is past president of the Society of OB/GYN Hospitalists and is a current member of ACOG's Committee on Clinical Practice Guidelines-OB.

Dr. David Chelmow is the Leo J. Dunn Professor and Chair of Obstetrics and Gynecology at Virginia Commonwealth University. He was the inaugural President of the Society for Academic Specialists in General Obstetrics and Gynecology and is past President of the American Society for Colposcopy and Cervical Pathology and the Council of University Chairs of Obstetrics and Gynecology. He is a current member of the US Preventive Services Task Force. He has previously served as Chair of the Women's Preventive Services Initiative Multidisciplinary Steering Committee and ACOG's Committee on Practice Bulletins – Gynecology.

Pregnancy Complications

A Case-Based Approach

Edited by

Peter F. Schnatz

Drexel University College of Medicine

D. Yvette LaCoursiere

University of California, San Diego School of Medicine

Christopher M. Morosky

University of Connecticut School of Medicine

Jonathan Schaffir

The Ohio State University College of Medicine

Vanessa Torbenson

Mayo Clinic Alix School of Medicine

David Chelmow

Virginia Commonwealth University School of Medicine



CAMBRIDGE
UNIVERSITY PRESS



Shaftesbury Road, Cambridge CB2 8EA, United Kingdom

One Liberty Plaza, 20th Floor, New York, NY 10006, USA

477 Williamstown Road, Port Melbourne, VIC 3207, Australia

314–321, 3rd Floor, Plot 3, Splendor Forum, Jasola District Centre,
New Delhi – 110025, India

103 Penang Road, #05–06/07, Visioncrest Commercial, Singapore 238467

Cambridge University Press is part of Cambridge University Press & Assessment,
a department of the University of Cambridge.

We share the University's mission to contribute to society through the pursuit of
education, learning and research at the highest international levels of excellence.

www.cambridge.org

Information on this title: www.cambridge.org/9781009413794

DOI: [10.1017/9781009413787](https://doi.org/10.1017/9781009413787)

© The Society for Academic Specialists in General Obstetrics and Gynecology 2025

This publication is in copyright. Subject to statutory exception and to the provisions
of relevant collective licensing agreements, no reproduction of any part may take
place without the written permission of Cambridge University Press & Assessment.

When citing this work, please include a reference to the DOI [10.1017/9781009413787](https://doi.org/10.1017/9781009413787)

First published 2025

Printed in Great Britain by Ashford Colour Press Ltd.

A catalogue record for this publication is available from the British Library

Library of Congress Cataloging-in-Publication Data

Names: Schnatz, Peter F., editor.

Title: Pregnancy complications : a case-based approach / edited by Peter F. Schnatz, D. Yvette
LaCoursiere, Christopher M. Morosky, Jonathan Schaffir, Vanessa Torbenson, David
Chelmow.

Description: Cambridge, United Kingdom ; New York, NY : Cambridge University Press, 2025. |
Includes bibliographical references and index.

Identifiers: LCCN 2024046903 (print) | LCCN 2024046904 (ebook) | ISBN 9781009413794
(paperback) | ISBN 9781009413787 (epub)

Subjects: MESH: Pregnancy Complications | Case Reports

Classification: LCC RG571 (print) | LCC RG571 (ebook) | NLM WQ 240 |
DDC 618.3–dc23/eng/20250204

LC record available at <https://lcn.loc.gov/2024046903>

LC ebook record available at <https://lcn.loc.gov/2024046904>

ISBN 978-1-009-41379-4 Paperback

Cambridge University Press & Assessment has no responsibility for the persistence
or accuracy of URLs for external or third-party internet websites referred to in this
publication and does not guarantee that any content on such websites is, or will
remain, accurate or appropriate.

.....

Every effort has been made in preparing this book to provide accurate and up-to-date infor-
mation that is in accord with accepted standards and practice at the time of publication.
Although case histories are drawn from actual cases, every effort has been made to disguise the
identities of the individuals involved. Nevertheless, the authors, editors, and publishers can make
no warranties that the information contained herein is totally free from error, not least because
clinical standards are constantly changing through research and regulation. The authors, editors,
and publishers therefore disclaim all liability for direct or consequential damages resulting from
the use of material contained in this book. Readers are strongly advised to pay careful attention
to information provided by the manufacturer of any drugs or equipment that they plan to use.

Contents

List of Contributors x

Preface xiii

Note from the Editor-in-Chief xiv

Normal Laboratory Values (Conventional Units) xv

Section 1 Antepartum (Early Pregnancy)

- Case 1 **A Patient of Ashkenazi Jewish Ancestry Presents for Preconception Counseling** 1
Emily R. Rosen
- Case 2 **A Patient with a Subchorionic Hematoma Presents with Early Vaginal Bleeding** 4
Rima Rana
- Case 3 **A 25-Year-Old with a Twin Gestation at 9 Weeks** 7
Tara A. Nielsen
- Case 4 **A 35-Year-Old with HSIL Cervical Cytology at 10 Weeks** 10
Margaret E. Long
- Case 5 **A 20-Year-Old with a Molar Pregnancy at 8 Weeks** 13
Sarah Alhaddad Tout
- Case 6 **A 20-Year-Old with Anxiety and Depression at 7 Weeks** 16
Meleen Chuang
- Case 7 **A 40-Year-Old with Nausea, Vomiting, and Weight Loss at 7 Weeks** 19
William Po
- Case 8 **A 30-Year-Old with Worsening Migraine Headaches at 14 Weeks** 22
Ariana Lewis
- Case 9 **A 30-Year-Old with Isoimmunization at 9 Weeks** 26
Eileen O'Connor

-
- Case 10 **A 25-Year-Old with an Early Pregnancy and Bicornuate Uterus** 29
Sarah H. Milton

- Case 11 **Recommended Vaccinations at an 8-Week Prenatal Intake** 32
Corinne A. Bazella

Section 2 Antepartum (Mid-trimester)

- Case 12 **A 25-Year-Old with Cervical Insufficiency at 18 Weeks** 37
Kiran Kavipurapu
- Case 13 **A 25-Year-Old with an Echogenic Cardiac Focus at 19 Weeks' Gestation** 40
Mallory E. Kremer
- Case 14 **A 20-Year-Old with Right Lower Quadrant Pain at 15 Weeks' Gestation** 43
Juan J. Diaz Quinones
- Case 15 **A 40-Year-Old with Decreased Libido at 29 Weeks** 46
Amy Boone
- Case 16 **A 35-Year-Old with a Left Breast Mass at 35 Weeks** 48
Myrlene Jeudy
- Case 17 **A 25-Year-Old at 14 Weeks' Gestation with Pelvic Pain and Inability to Void** 51
Blenda Yun
- Case 18 **A 35-Year-Old with Abdominal Cramping and Pelvic Pain at 24 Weeks' Gestation** 54
Amber A. Bondurant-Sullivan

- Case 19 **Appendicitis Presenting as Nausea, Vomiting, and Abdominal Pain at 16 Weeks** 57
Joseph De Nagy

Section 3 Antepartum (Late Pregnancy)

- Case 20 **A Patient with Regular Painful Uterine Contractions at 32 Weeks** 61
Jacqueline Sanchez
- Case 21 **A 25-Year-Old Presents at 22 Weeks' Gestation with Leaking Clear Fluid** 65
Julie A. Hurvitz
- Case 22 **A 40-Year-Old with Worsening Itching at 34 Weeks' Gestation** 69
Lauren Coyne
- Case 23 **A 25-Year-Old Presents at 30 Weeks' Gestation Following a Motor Vehicle Accident** 71
Emily Barrows
- Case 24 **A 20-Year-Old Presents at 34 Weeks' Gestation with Pruritic Abdominal Rash** 75
Vaibhavi Umesh
- Case 25 **A 30-Year-Old Presents at 18 Weeks' Gestation with Severe Right Back and Flank Pain** 78
Bani Maheshwari Ratan
- Case 26 **A 30-Year-Old at 18 Weeks' Gestation with Fever, Dysuria, Worsening Flank Pain, and Hydronephrosis** 81
Esther Fuchs
- Case 27 **A 35-Year-Old with Abdominal Wall Bulge at 24 Weeks' Gestation** 84
Denise De Los Santos
- Case 28 **A 30-Year-Old Presents for a Prenatal Visit at 41 Weeks' Gestation** 87
Michelle Tang
- Case 29 **A 40-Year-Old Presents at 34 Weeks' Gestation with Absent Fetal Movement** 89
Taylor Gilmore
- Case 30 **A 25-Year-Old at 36 Weeks' Gestation Presents with Severe Bilateral Wrist Pain** 92
Vanessa H. Gregg
- Case 31 **A 20-Year-Old Presents at 31 Weeks' Gestation with Severe Abdominal Pain and Constipation** 94
Paris N. Stowers

Section 4 Antepartum (Medical Complications)

- Case 32 **A 35-Year-Old Presents at 25 Weeks' Gestation with Abnormal Glucose Tolerance Testing** 97
Sneha Subhash
- Case 33 **A 25-Year-Old Presents at 35 Weeks' Gestation with Hypertension, Proteinuria, and Seizure** 100
Omari J. Young
- Case 34 **A 25-Year-Old at 32 Weeks' Gestation with Hypertension and Right Upper Quadrant Pain** 103
Amy M. Burkett
- Case 35 **A 35-Year-Old Presents at 8 Weeks' Gestation with Tremor and Exophthalmos** 106
Lindsey Pflugner
- Case 36 **A 23-Year-Old Primigravida at 8 Weeks' Gestation with Fatigue, Constipation, and Cold Intolerance** 109
Jorge Luis Casquero Leon
- Case 37 **A 25-Year-Old with Elevated Hemoglobin A2 on Initial Prenatal Labs** 112
Logan C. Peterson
- Case 38 **A 30-Year-Old at 10 Weeks' Gestation with a New Positive HIV Test** 115
Denise M. S. Willers

Section 5 Antepartum (Infectious Complications)

- Case 39 **A 30-Year-Old at 14 Weeks' Gestation Presents after Exposure to a Child with CMV** 119
Rita Tsai
- Case 40 **A 20-Year-Old with Positive Rapid Plasma Reagin on Initial Prenatal Labs** 121
Katherine Strafford
- Case 41 **A 35-Year-Old at 26 Weeks' Gestation Presents with Fever and Diarrhea after Shopping at a Farmer's Market** 124
Brandi N. Ring
- Case 42 **A 20-Year-Old with a History of Herpes Presents for a New Obstetrical Visit** 128
Eduardo F. Estrella

Case 43 **A 40-Year-Old at 16 Weeks' Gestation Whose Toddler Has Chicken Pox** 131
Stephanie Marshall Lee

Case 44 **A 35-Year-Old at 19 Weeks' Gestation Whose Toddler Was Diagnosed with Parvovirus** 134
Tara Harris

Case 45 **A 20-Year-Old Presents at 12 Weeks' Gestation with Septic Arthritis and Petechial Skin Rash** 137
Maria Shaker

Section 6 Intrapartum/Delivery

Case 46 **A 40-Year-Old at 41 Weeks with a Closed Cervix after 12 Hours of Induction** 141
Jessica Kline

Case 47 **A 25-Year-Old at 39 Weeks' Gestation Presents with Regular Contractions and Minimal Cervical Change** 143
Jonathan D. Emery and Peter F. Schnatz

Case 48 **A 35-Year-Old at 40 Weeks with Ruptured Membranes and Arrest of Cervical Dilation at 7 cm for 3 Hours** 146
Jennifer R. Hamm

Case 49 **A 30-Year-Old at 36 Weeks' Gestation with Breech Presentation** 149
Kelly L. Ferroni

Case 50 **A 25-Year-Old at 39 Weeks' Gestation with Brow Presentation at 9 cm Dilation** 152
Jordan Hylton

Case 51 **A 30-Year-Old at 39 Weeks' Gestation with Fever in Labor** 154
Elizabeth A. Deckers

Case 52 **A 20-Year-Old at 39 Weeks' Gestation with Persistent Occiput Posterior Presentation, Arrest of Descent, and Worsening Fetal Heart Rate Tracing** 157
Michael L. Galloway

Case 53 **A 25-Year-Old at 40 Weeks' Gestation with a Cesarean Delivery after a Failed Vacuum** 161
Vanessa Torbenson

Case 54 **A 25-Year-Old at 40 Weeks' Gestation with Broad Ligament Extension during Cesarean Delivery** 165
Laura Calder Parsons

Case 55 **A 25-Year-Old at 40 Weeks' Gestation with Urine Noted in Operative Field during Repeat Cesarean** 168
Eric R. Craig

Case 56 **A 20-Year-Old with a Fourth-Degree Perineal Laceration** 171
L. David Moore

Case 57 **A 25-Year-Old at 39 Weeks' Gestation with Abdominal Pain, Vaginal Bleeding, and Worsening Fetal Heart Rate Tracing during TOLAC** 174
Clodagh Mullen

Case 58 **A 40-Year-Old at 39 Weeks' Gestation Becomes Unresponsive during the Second Stage of Labor** 177
Sarah M. Page-Ramsey

Case 59 **A 45-Year-Old at 39 Weeks' Gestation Presents in Ventricular Fibrillation Undergoing CPR** 180
Jody Stonehocker

Case 60 **A 35-Year-Old with a Vaginal Mass and Hemorrhage Immediately after Delivery** 183
Rebecca Hunt

Case 61 **A 30-Year-Old with an Undelivered Placenta 30 Minutes Following Delivery** 186
Sona Jasani

Case 62 **A 30-Year-Old at 38 Weeks' Gestation with "Turtle Sign" Noted at Delivery** 189
Lauren R. Baker

Section 7 Postpartum

Case 63 **A 20-Year-Old with Vaginal Bleeding and Enlarging Fundus Following a Cesarean Delivery** 193
Aaron Goldberg

Case 64 **A 25-Year-Old with Post-cesarean Endometritis and Fever Unresponsive to Antibiotics** 196
Enid Rivera-Chiauzzi

Case 65 **A 40-Year-Old with Severe Obesity and Painful Right Pedal Edema** 199
Michelle Larzelere

Case 66 **A 20-Year-Old 3 Weeks' Postpartum Presents with Anhedonia and Insomnia** 202
Szilvia Nagy

- Case 67 **A 40-Year-Old 1 Week after Vaginal Delivery Presents with Shortness of Breath and Orthopnea** 205
Soha S. Patel
- Case 68 **A 30-Year-Old with Postural Headache 12 Hours after a Vaginal Delivery with Use of an Epidural** 208
Ann Williford
- Case 69 **A 35-Year-Old Develops Agitation, Dyspnea, Hypotension, and Cardiovascular Collapse Immediately Postpartum** 211
Amy R. Harrington
- Case 70 **A 25-Year-Old Presents with Bright Red Vaginal Bleeding 3 Weeks' Postpartum** 215
Cynthia Abraham
- Case 71 **A 25-Year-Old Presents Immediately Postpartum with Severe Pubic Pain Limiting Ambulation** 218
Cristina Wallace Huff
- Case 72 **A 20-Year-Old with Right Breast Pain and Fever while Breast-Feeding** 221
Shannon DeGross
- Case 73 **A 25-Year-Old 6 Hours' Postpartum with Severe Hypertension, Seizures, and Confusion** 224
Mokerrum Fatima Malik

Section 8 Fetal Complications

- Case 74 **A 40-Year-Old at 28 Weeks' Gestation with a Well Dated Pregnancy and a Fundal Height Measuring 24 cm** 229
Sarah Smithson
- Case 75 **A 45-Year-Old at 37 Weeks' Gestation with Gestational Diabetes and an Estimated Fetal Weight of 4,600 g** 232
Amanda Haines Ritter
- Case 76 **A 20-Year-Old at 37 Weeks with a Twin Gestation Presents for Delivery Planning** 235
Eric Strand
- Case 77 **A 25-Year-Old at 18 Weeks' Gestation Presents with a Monochorionic/Diamniotic Twin Pregnancy** 238
Shari M. Lawson
- Case 78 **A 25-Year-Old at 22 Weeks' Gestation with Mild Fetal Renal Pelvis Dilation on an Anatomic Survey Ultrasound** 242
Marcia Little

Section 9 Placental Complications

- Case 79 **A 35-Year-Old with Three Prior Cesarean Deliveries and a Possible Accreta on Her Anatomy Ultrasound** 245
Priyanka Raju and Peter F. Schnatz
- Case 80 **A 30-Year-Old at 20 Weeks' Gestation Presents with Vaginal Bleeding and Placenta Previa** 249
Joseph Chappelle
- Case 81 **A 20-Year-Old at 22 Weeks' Gestation with Circumvallate Placenta on Ultrasound** 252
Courtney Rhoades
- Case 82 **A 25-Year-Old at 33 Weeks' Gestation Presents with Abdominal Pain and Vaginal Bleeding** 255
Jaime L. Dickerson
- Case 83 **A 35-Year-Old Presents after Fetal Demise at 34 Weeks' Gestation to Discuss the Results of Her Placental Pathology Report** 258
Ryan McDonald

Section 10 Complications of the Cord, Amnion, and Gravid Uterus

- Case 84 **A 30-Year-Old Presents at 34 Weeks' Gestation with Gestational Diabetes and a Fundal Height of 38 cm** 261
Porshia Underwood
- Case 85 **A 30-Year-Old at 31 Weeks' Gestation Presents with Oligohydramnios and Decreased Fetal Movement** 264
Amanda E. Owens
- Case 86 **A 35-Year-Old at 36 Weeks' Gestation with a Unicornuate Uterus Desires an External Cephalic Version for Breech Presentation** 267
Allison A. C. Eubanks
- Case 87 **A 40-Year-Old at 24 Weeks' Gestation Presents with Multiple Fibroids Seen on Ultrasound** 272
Erin M. Conroy
- Case 88 **A 25-Year-Old at 13 Weeks' Gestation Presents with Vaginal Spotting** 275
Olivia Lisa Dziadek

- Case 89 **A 35-Year-Old at 28 Weeks' Gestation Presents with a Velamentous Cord Insertion Seen on Ultrasound** 278
Robyn A. Gray-Puleo

Section 11 Psychosocial Considerations

- Case 90 **A 40-Year-Old at 24 Weeks' Gestation Presents with Food and Housing Insecurity** 283
Stacey L. Holman
- Case 91 **A 30-Year-Old at 25 Weeks' Gestation Presents after a Fall with Back Pain and Bruising** 286
Kamilah Dixon
- Case 92 **A 25-Year-Old at 29 Weeks' Gestation Presents with Opioid Use Disorder and Nausea, Vomiting, and Abdominal Pain** 289
Molly Zielenbach
- Case 93 **A 35-Year-Old Somali-Speaking Patient at 40 Weeks' Gestation Presents in Active Labor with Her Husband as Her Interpreter** 292
Heather Wolfe

- Case 94 **A 25-Year-Old Presents 1 Week after a Cesarean Delivery with Erratic Behavior** 295
Holly E. Metzgar

- Case 95 **A 30-Year-Old Presents for a First Prenatal Visit with a Previous Emergency Operative Delivery Requesting a Planned Primary Cesarean** 298
Cheryl Godcharles

- Case 96 **26-Year-Old Presents Late to Prenatal Care with Her Partner and Has a Flat Affect and Limited English Proficiency** 301
Deepti Sharma

- Case 97 **A 25-Year-Old Primigravida with a History of Female Genital Mutilation** 304
Yvonne S. Butler Tobah

Index 308

Color plates can be found between pages 192 and 193.

Contributors

Cynthia Abraham, MD, Icahn School of Medicine at Mount Sinai, New York, NY

Lauren R. Baker, DO, The Ohio State University, Columbus, OH

Emily Barrows, MD, Virginia Commonwealth University School of Medicine, Richmond, VA

Corinne A. Bazella, MD, FACOG, University Hospital, Case Western Reserve School of Medicine, Chagrin Falls, OH

Amber A. Bondurant-Sullivan, MD, The Ohio State University Wexner Medical Center, Columbus, OH

Amy Boone, MD, University of Alabama at Birmingham, Birmingham, AL

Amy M. Burkett, MD, Cleveland Clinic Akron General, Uniontown, OH

Yvonne S. Butler Tobah, MD, FACOG, Mayo Clinic, Rochester, MN

Laura Calder Parsons, MD, MPH, FACOG, University of Virginia, Charlottesville, VA

Jorge Luis Casquero Leon, MD, FACOG, University of Texas Rio Grande Valley, Edinburg, TX

Joseph Chappelle, MD, Stony Brook University Hospital, Stony Brook, NY

Meleen Chuang, MD, New York University Langone, New York, NY

Erin M. Conroy, MD, EM-CQSL, Maimonides Medical Center, New York, NY

Lauren Coyne, MD, University of Iowa Hospitals and Clinics, Coralville, IA

Eric R. Craig, MD, FACOG, Naval Medical Center San Diego, San Diego, CA

Denise De Los Santos, MD, University of Texas Health Science Center at San Antonio, TX

Joseph De Nagy, DO, MPH, FACOG, Loma Linda University, Los Angeles, CA

Elizabeth A. Deckers, MD, Hartford Healthcare, Hartford, CT

Shannon DeGroff, MD, University of Connecticut, Farmington, CT

Juan J. Diaz Quinones, MD, MBA, FACOG, FACS, University of Miami Miller School of Medicine, Palmetto Bay, FL

Jaime L. Dickerson, MD, University of Miami, Miami, FL

Kamilah Dixon, MD, MA, The Ohio State University Wexner Medical Center, Columbus, OH

Olivia Lisa Dziadek, MD, The University of Texas Health Science Center at Houston, Houston, TX

Jonathan D. Emery, MD, FACOG, Cleveland Clinic Chagrin Falls Family Health Center, Chagrin Falls, OH

Eduardo F. Estrella, MD, FACOG, Wellstar Kennestone Regional Medical Center, Marietta, GA

Allison A. C. Eubanks, MD, US Naval Hospital Rota, Rota, Spain

Kelly L. Ferroni, MD, The University of Iowa Hospitals and Clinics, Iowa City, IA

Esther Fuchs, MD, University of Washington, Seattle, WA

Michael L. Galloway, DO, MBA, Texas Tech University HSC, Midland, TX

Taylor Gilmore, MD, University of Virginia Health, Charlottesville, VA

Cheryl Godcharles, MD, FACOG, IBCLC, University of South Florida Morsani College of Medicine, Tampa, FL

Aaron Goldberg, MD, MSHA, Virginia Commonwealth University, Richmond, VA

Robyn A. Gray-Puleo, DO, MHL, Dartmouth Hitchcock Medical Center, Lebanon, NH

Vanessa H. Gregg, MD, MBA, University of Virginia Health, Charlottesville, VA

Jennifer R. Hamm, MD, University of Louisville, Louisville, KY

Amy R. Harrington, MD, University of Rochester Medical Center, Rochester, NY

Tara Harris, MD, Baylor College of Medicine, Houston, TX

Stacey L. Holman, MD, FACOG, Louisiana State University Health Sciences Center, New Orleans, LA

Rebecca Hunt, MD, FACOG, Maine Medical Center, Portland, ME

Julie A. Hurvitz, MD, University of Maryland School of Medicine, Baltimore, MD

Jordan Hylton, DO, Virginia Commonwealth University, Richmond, VA

Sona Jasani, MD, FACOG, Yale School of Medicine, New Haven, CT

Myrlene Jeudy, MD, Virginia Commonwealth University, Richmond, VA

Kiran Kavipurapu, DO, JD, MPH, FACOG, University of California, Los Angeles, Los Angeles, CA

Jessica Kline, MD, FACOG, University of Louisville School of Medicine, Louisville, KY

Mallory E. Kremer, MD, University of Washington, Seattle, WA

Michelle Larzelere, MD, University of Florida, Gainesville, FL

Shari M. Lawson, MD, MBA, FACOG, Howard University College of Medicine, Washington, DC

Stephanie Marshall Lee, MD, Virginia Commonwealth University Health System, Richmond, VA

Ariana Lewis, MD, University of Texas Health Science Center at San Antonio, TX

Marcia Little, MD, FACOG, Wellstar Kennestone Regional Medical Center, Marietta, GA

Margaret E. Long, MD, Mayo Clinic, Rochester, MN

Mokerrum Fatima Malik, MD, University of Maryland School of Medicine, Baltimore, MD

Ryan McDonald, MD, University of Wisconsin School of Medicine and Public Health, Madison, WI

Holly E. Metzgar, DO, FACOG, Reading Hospital/Tower Health, West Reading, PA

Sarah H. Milton, MD, Virginia Commonwealth University School of Medicine, Richmond, VA

L. David Moore, MD, FACOG, Texas Tech University Health Sciences Center, Odessa, TX

Clodagh Mullen, MD, The MetroHealth System, Cleveland, OH

Szilvia Nagy, MD, FACOG, Weill Cornell Medicine, New York, NY

Tara A. Nielsen, DO, MPH, Vanderbilt University Medical Center, Brentwood, TN

Eileen O'Connor, DO, University of Iowa, Iowa City, IA

Amanda E. Owens, DO, FACOG, Walter Reed National Military Medical Center, Bethesda, MD

Sarah M. Page-Ramsey, MD, University of Texas Health Science Center at San Antonio, San Antonio, TX

Soha S. Patel, MD, MSPH, Vanderbilt University Medical Center, Nashville, TN

Logan C. Peterson, MD, FACOG, Uniformed Services University of the Health Sciences, Bethesda, MD

Lindsey Pflugner, MD, VCU Health, Richmond, VA

William Po, MD, Oklahoma State University Center for Health Sciences, Tulsa, OK

Priyanka Raju, MD, Reading Hospital/Tower Health, West Reading, PA

Rima Rana, DO, Hackensack Meridian Health, Neptune, NJ

Bani Maheshwari Ratan, MD, Baylor College of Medicine, Houston, TX

Courtney Rhoades, DO, MBA, University of Florida Jacksonville, Jacksonville, FL

Brandi N. Ring, MD, MA, MBA, Baylor College of Medicine, Houston, TX

Amanda Haines Ritter, MD, VCU Health, Richmond, VA

Enid Rivera-Chiauzzi, MD, Mayo Clinic, Rochester, MN

Emily R. Rosen, MD, University of Colorado Hospital, Denver, CO

Jacqueline Sanchez, MD, FACOG, MSCP, University of Miami, Miami, FL

Peter F. Schnatz, DO, MBA, FACOG, FACP, MSCP, Drexel University, Philadelphia, PA

Maria Shaker, MD, University Hospitals Cleveland Medical Center, Cleveland, OH

Deepti Sharma, MD, University of Alabama at Birmingham, Birmingham, AL

Sarah Smithson, DO, MS, Loma Linda University, Loma Linda, CA

Jody Stonehocker, MD, Vanderbilt University, Nashville, TN

Paris N. Stowers, MD, University of Hawai'i John A. Burns School of Medicine, Hilo, HI

Katherine Strafford, MD, The Ohio State University Wexner Medical Center, Columbus, OH

Eric Strand, MD, University Hospitals Cleveland Medical Center, Cleveland, OH

Sneha Subhash, MD, MBA, Olive View-University of California, Los Angeles Medical Center, Sylmar, CA

Michelle Tang, MD, University of California, San Diego Health System, San Diego, CA

Vanessa Torbenson, MD, FACOG, Mayo Clinic College of Medicine, Rochester, MD

Sarah Alhaddad Tout, MD, University Hospitals MacDonald Women's Hospital, Cleveland Heights, OH

Rita Tsai, MD, The University of Texas at Austin Dell Medical School, Austin, TX

Vaibhavi Umesh, MD, MS, FACOG, Stony Brook University, Stony Brook, NY

Porshia Underwood, MD, University of Washington, Seattle, WA

Cristina Wallace Huff, MD, University of Texas Health Science Center at San Antonio, TX

Denise M. S. Willers, MD, Washington University in St. Louis, St. Louis, MO

Ann Williford, MD, University of Tennessee, Nashville, TN

Heather Wolfe, MD, University of Virginia, Fairfax, VA

Omari J. Young, MD, Hurley Medical Center/Michigan State University, Grand Blanc, MI

Blenda Yun, MD, Mayo Clinic Health System, Eau Claire, WI

Molly Zielenbach, MD, MPH, Olive View-University of California, Los Angeles Medical Center, Los Angeles, CA

Preface

On behalf of the Society for Academic Specialists in General Obstetrics and Gynecology (SASGOG), I am extremely honored to be introducing the fourth book in our growing case-based series. Previous books in the series covered acute care and emergency gynecology, office gynecology, and surgical gynecology. Outside of the series, SASGOG has also published a book on the well woman visit. After four predominantly gynecology focused books, expansion to obstetrical topics is the natural next step. This book focuses on pregnancy complications.

There are many available resources on pregnancy complications, but most are written as traditional textbooks or journal articles. Many practitioners are more comfortable with other adult learning approaches, especially case-based learning formats. To the best of our knowledge, this is the only available case-based book on pregnancy complications geared for clinicians. *Pregnancy Complications: A Case-Based Approach* promotes learning from clinical scenarios. The book is meant for the multiple types of clinicians who provide pregnancy care including midwives and obstetrical and family physicians. The book is written at a level appropriate for clinicians in practice but should also be useful to residents and students. Cases were chosen to be representative of general obstetrical practices and do not routinely include cases typically managed by maternal fetal medicine subspecialists.

We deliberately chose a range of topics, mixing common problems with important but less frequent diagnostic and management issues. Cases were written to be a good reference when

similar cases present in a busy clinical practice and to update readers on these important topics. We chose approximately 100 pregnancy problems and created cases that were frequently inspired by patients under the care of our authors. Cases have been created to maximize educational value and, even if originally inspired by an actual patient, have been sufficiently altered to maintain patient confidentiality. In discussing case management, current major society guidelines are presented whenever available and applicable. How to best integrate them into patient care is an important focus. When evidence-based guidelines are not available, we present a carefully reviewed and reasoned expert opinion consistent with standard of care. Management alternatives and how to choose among them are an additional important focus. A current literature search was performed for all topics, and useful references included. When supportive research is presented, we relied heavily on recent systematic reviews. As in the other books in the series, this approach allowed us to include many common problems and frequently encountered incidental findings.

As editors, we are tremendously grateful to SASGOG. When we begin one of these books, we present a call to the membership to write the individual cases. For the fourth time in the series, 100 authors rapidly stepped forward. The authors enthusiastically and diligently created educational cases, reviewed guidelines and literature, and wrote high-quality discussions, supplemented by useful images and tables. We are extremely grateful for their hard work. We trust you will enjoy and benefit from this book.

Note from the Editor-in-Chief

As editor-in-chief, I want to express my gratitude to my co-editors – Dr. LaCoursiere, Dr. Morosky, Dr. Schaffir, and Dr. Torbenson – for their dedication and hard work. I extend my heartfelt thanks to our senior editor, Dr. Chelmow, for his expertise, availability, and invaluable guidance throughout this journey. I am also deeply appreciative of the nearly 100 authors who contributed to this exceptional project. Finally, and most importantly, I thank my wife, Melanie, and my children – Rebekah, Abigail, Sarah, and David – for their patience and support, allowing me the time to pursue these professional

activities. Although endeavors like this demand significant time away from family, I am encouraged by seeing each of you develop a strong work ethic, commitment to goals, and a sense of responsibility. I hope my involvement in projects like this serves as an inspiration to engage in activities that positively impact others. My heartfelt thanks to everyone who helped bring this book to life and who supports the promotion of excellent care for women for years to come.

Peter F. Schnatz, DO, MBA, FACOG, FACP, MSCP

Normal Laboratory Values (Conventional Units) [1]

Hematology:

Hemoglobin (Hgb) (female): 12.0–16.0 g/dL
Hematocrit (Hct) (female): 36.0–47.0%
Mean corpuscular volume: 80–100 fL (femtoliters)
White blood cell (WBC) count: 4,500–11,000/ μ L
Segmented neutrophils: 40–60% [2]
Bands: 0–5% [2]
Immature granulocytes: 0–1% [2]
Platelet (Plt) count: 150,000–350,000/ μ L

Glucose and Electrolytes:

1-hour glucose screen: 70–135 mg/dL [3]
Glucose (fasting): 70–105 mg/dL
Potassium: 3.5–5.0 mEq/L
Sodium: 136–145 mEq/L
Chloride: 98–106 mEq/L
Bicarbonate: 23–28 mEq/L

Renal Function:

Urea nitrogen (BUN): 8–20 mg/dL
Creatinine (Cr) (female): 0.5–1.0 mg/dL

Coagulation and Blood Chemistry:

Fibrinogen: 150–350 mg/dL
Prothrombin time (PT): 11–13 seconds
Partial thromboplastin time (PTT), activated (aPTT): 25–35 seconds
International normalized ratio (INR): 0.8–1.1
Lactate (SI units): 0.67–1.8 mmol/L
Bilirubin, total: 0.3–1.2 mg/dL
Bilirubin, direct: 0–0.3 mg/dL

Aspartate aminotransferase (AST): <35 IU/L
Alanine aminotransferase (ALT): <35 IU/L
Lipase: <95 U/L

Thyroid Function:

Thyroid-stimulating hormone (TSH): 0.5–5.0 mIU/L
Free thyroxine (T4): 0.9–2.4 ng/dL

Cardiac Markers:

B-type natriuretic peptide (BNP): <100 pg/mL
Troponin: <0.04 ng/mL

Urine Analysis:

Specific gravity:	1.002–1.030
pH:	5–7
Blood:	Negative
Glucose:	Negative
Protein:	Negative
Ketones:	Negative
Nitrites	Negative
Leukocyte esterase:	Negative

Reproductive and Women's Health:

Beta-hCG (human chorionic gonadotropin): <5 mIU/mL
Alpha-fetoprotein (for neural tube defect screening): <2.5 MoM (multiples of the median) [4]
Fetal fibronectin: Negative (<50 ng/mL, 22–34 weeks) [5]

Reference:

- 1 Merck Manual Professional Version. Normal Laboratory Values. Reviewed/Revised December 2021; modified September 2022. www.merckmanuals.com/professional/resources/normal-laboratory-values/
- 2 US National Institutes of Health, National Cancer Institute. SEER Training Modules. <https://training.seer.cancer.gov/> (accessed November 7, 2023).
- 3 Sacks DA, Abu-Fadil S, Karten GJ, Forsythe AB, Hackett JR. Screening for Gestational Diabetes with the One-Hour 50-g Glucose Test. *Obstet Gynecol.* 1987;70(1):89–93.
- 4 Bradley L, Palomaki G, McDowell G, et al. Technical Standards and

Guidelines: Prenatal Screening for Open Neural Tube Defects: This New Section on “Prenatal Screening for Open Neural Tube Defects,” Together with the New Section on “Prenatal Screening for Down Syndrome,” Replaces the Previous Section H of the

- American College of Medical Genetics Standards and Guidelines for Clinical Genetics Laboratories. *Genet Med.* 2005;7:355–369.
- 5 Berghella V, Saccone G. Fetal Fibronectin Testing for Reducing the

Risk of Preterm Birth. *Cochrane Database Syst Rev.* 2019;7: CD006843. <http://dx.doi.org/10.1002/14651858.CD006843.pub3> (accessed November 14, 2023).

A Patient of Ashkenazi Jewish Ancestry Presents for Preconception Counseling

Emily R. Rosen

History of Present Illness

A 30-year-old nulligravid patient presents to the clinic for preconception counseling. She is recently married and is planning to start a family. She is worried about conceiving as her sister had a child diagnosed with cystic fibrosis (CF) earlier this year. She wants to make sure that she is as healthy as possible before becoming pregnant and asks to discuss any testing or recommendations to have a healthy pregnancy. She currently has an intrauterine device (IUD) in place for contraception. Her gynecologic history is otherwise unremarkable. She denies any medical or surgical history. There is no family history of birth defects, developmental delay, or cancer. She does not take any medications and has no known drug allergies.

Physical Examination

General appearance: Alert, in no distress

Vital signs:

Temperature: 37.1°C

Pulse: 76 beats per minute

Blood pressure: 110/65 mmHg

Respiratory rate: 15 breaths per minute

Body mass index (BMI): 26.1 kg/m²

Abdomen: Soft, non-tender, non-distended, no masses

Pelvic: Normal external genitalia, normal vaginal epithelium without lesions or discharge, cervix normal in appearance, 8 week–sized anteverted mobile uterus, normal adnexa without tenderness or masses palpated

Laboratory studies:

Cervical cytology: Negative for intraepithelial lesion or malignancy

Human papillomavirus (HPV): Not detected

How Would You Manage This Patient?

This patient presents for preconception counseling. A thorough review of her personal and family genetic histories is completed and reveals a niece with CF. This patient was counseled on maintaining a healthy lifestyle, and recommendations to minimize health risks were discussed. After genetic counseling, the patient elected for expanded carrier screening given her family history and Ashkenazi Jewish ancestry. Genetic testing was positive for CF- and Canavan disease-carrier status. Subsequent testing of her husband was negative. She received appropriate post-test counseling, her IUD was removed, and she started a prenatal vitamin. She represented three months later with a viable intrauterine pregnancy.

Preconception Counseling

Preconception counseling can be completed at any patient encounter with a patient of reproductive potential and should occur multiple times during a patient's lifespan (Table 1.1). The goal of preconception counseling is to educate patients about healthy pregnancies, adjust risk factors, and identify and treat any underlying conditions to promote maternal health and decrease the risk of maternal and neonatal morbidity and mortality [1].

Comprehensive Health Assessment

Starting with a thorough medical history is imperative to identify and subsequently decrease any risk factors for pregnancy. Certain medical conditions, such as hypertension, diabetes, and thyroid disease, are associated with pregnancy-related complications. Optimizing management of known medical illnesses can improve pregnancy outcomes [1]. A review of all the patient's prescription and nonprescription medications as well as supplements should be performed to assess their safety and potential teratogenicity. In a shared decision-making model, there should be a discussion of the risks and benefits of use, and a determination of which medications should be continued. Patients should be questioned about the use of alcohol, tobacco, and illicit substance use, counseled appropriately, and provided resources as indicated. Assessment for intimate partner violence is also recommended during preconception counseling [2].

Lifestyle Modifications

Lifestyle and behavioral assessments are vital. Nutritional status and physical activity should be discussed. Since low and high BMI are associated with both maternal and fetal complications, patients should be encouraged to achieve a BMI in the normal range between 18.5 and 24.9 kg/m² [3]. Preventative care, including offering testing for sexually transmitted infections (STIs), performing cervical cancer screening, and confirming immunization status, is recommended. It is important to review the patient's immunization states for tetanus, diphtheria, and pertussis (Tdap); measles, mumps, and rubella (MMR); hepatitis B; varicella; and HPV vaccination in accordance with the current guidances, and to offer any pending vaccinations to ensure completion of the recommended vaccination series. Annual influenza and COVID-19 vaccinations to patients of reproductive age are recommended at a preconception visit if they are not already completed [1]. Lastly, pre-pregnancy folic acid

Table 1.1 Overview of preconception counseling recommendations

History	Medical: Address any chronic medical conditions Family: Obtain a complete history Social: Inquire about use of alcohol, tobacco, or illicit substances Psychiatric: Assess for mental health concerns
Lifestyle	Diet/exercise: Encourage a normal BMI Environmental and occupational exposures: Assess for teratogen exposure (e.g. pesticides, heavy metals, radiation, etc.)
Preventative care	Immunizations: Assess immunization status for Tdap, MMR, hepatitis B, varicella, and HPV vaccines; recommend annual influenza and COVID-19 vaccination Cervical cancer screening: Confirm patient is up to date STI screening: Offer STI testing Screening for intimate partner violence
Medications	Review prescription and nonprescription medications and potential risks/benefits in pregnancy Encourage pre-pregnancy folic acid supplementation
Genetic testing	Identify individuals at increased risk of inherited conditions Offer screening for CF and SMA to all patients Offer additional screening based on patient risk and patient preference after counseling

supplementation to reduce the risk of neural tube defects should be recommended [1].

Genetic Counseling and Screening

In addition to ensuring optimal maternal health, a genetic history and ethnic background of the patient, her partner, and their families should be discussed. Education about carrier screening should be given to every patient. The purpose of carrier screening is to identify asymptomatic individuals who carry a pathogenic variant allele within a gene that is associated with a specific diagnosis. Ideally, carrier testing is completed prior to pregnancy to provide patients with an understanding of their genetic risks so they may consider the full spectrum of reproduction options, including preimplantation genetic testing.

The increasing complexity and accessibility of genetic testing have made counseling more complicated. Pre-test counseling including result possibilities, risks, benefits, costs, and limitations should be discussed prior to testing, and appropriate timely post-test counseling is needed [4]. If a patient is identified as a carrier for a specific disease, the patient's partner should be tested. If both individuals are positive for the same genetic condition, referral for genetic counseling should be provided [5].

Screening for spinal muscular atrophy (SMA) and CF should be offered to all women who are pregnant or who are considering pregnancy [5]. Certain populations, including individuals of Eastern and Central European Jewish descent, are at increased risk of carrying a pathogenic variant for clinically significant autosomal recessive conditions [6]. For example, the carrier risk of SMA and CF in the Ashkenazi Jewish population is 1:41 and 1:24 versus 1:117 and 1:58 in the Hispanic white population, respectively. Sickle cell trait is

present in approximately 10% of African American patients, and a hemoglobin electrophoresis should be completed if there is a suspicion of hemoglobinopathy based on ethnicity or complete blood count (CBC) indices [5]. Although different organizations have recommended specific carrier screening in unique populations, other experts have advocated for a more universal approach to carrier screening that is not limited to specific racial or ethnic populations. More research on benefits, feasibility, and opinions of patients and providers is needed before expanded carrier screening is offered to the general population [7].

Contraception to Conception

Time to ovulation is variable depending on the type and mechanism of action of contraceptive being used (whether the method prevents ovulation, thickens cervical mucus, or acts as a spermicide). It is possible to become pregnant immediately after discontinuation of certain forms of contraception, or it may take many months before a patient's cycle returns to normal. Discussion of the menstrual cycle including the follicular and luteal phases should be provided so that patients can understand their unique cycle patterns to optimize conception. Education that ovulation occurs fourteen days prior to menses can help patients predict the timing of ovulation and time intercourse on the most fertile days.

Fertility Concerns and Infertility Evaluation

The diagnosis of infertility is made after not having conceived after 12 months of regular intercourse without the use of contraception in patients under the age of 35 and after 6 months of the same in patients aged 35 and older. The majority of couples will conceive in the first year, but the rates of conception decrease over time and with increasing age of the female partner.

Infertility affects up to 15% of couples [8]. Infertility can have any number of causes. Female factors including ovulatory dysfunction, tubal damage, endometriosis, and uterine factors should be considered. Male factors can contribute to 30–50% of the causes of infertility. Between 10 and 30% of cases of infertility will remain unexplained after a thorough workup [8]. If a patient is unable to conceive in the anticipated time frame, further evaluation and workup are recommended. If a patient has a condition known to cause infertility, early evaluation is warranted.

Health Equity and Preconception Care

It is imperative to consider the social, structural, and environmental determinants of health that affect reproductive health care to address health disparities and provide equitable care for all individuals [9].

Although LGBTQIA+ and gender-nonconforming individuals are an increasingly recognized community, many barriers in accessing equitable health care remain [10]. Inquiring about a patient's gender identity, assigned sex at birth, pronouns, and preferred name can establish an inclusive and affirmative medical setting. Family building can occur through

multiple modalities, and it is important to discuss any desire for genetically related children and physically carrying a pregnancy to provide comprehensive counseling and care [11]. Information on timing, implications, and the limited research of testosterone treatment on conception and pregnancy should be discussed, as well as consideration of embryo or oocyte cryopreservation. It is also important to review any surgical treatments that may affect the ability to carry or contribute genetically to a child [11]. Additional medical considerations for this population include delivery preferences, chest-/breast-feeding, and postpartum care.

In addition to medical needs, there are many psychological considerations. There is often a discordance between one's identity and the idea of what a pregnant or gestational parent is, as defined by societal norms. Additionally, in a population with an increased rate of depression and suicide,

mental health care from preconception through parenting is crucial [11].

Additional training for health care professionals, enhanced social understanding, and further research are needed to provide inclusive, equitable, and comprehensive reproductive health care to the entire health community.

Key Teaching Points

- Preconception counseling should be offered to all reproductive-aged patients.
- Providing preconception education, adjusting risk factors, and optimizing maternal health can reduce maternal and fetal reproductive complications.
- All women should receive genetic counseling and be offered genetic testing.

References

- 1 Committee Opinion No. 762. Prepregnancy Counseling. *Obstet Gynecol.* 2019;133:e78–89.
- 2 Committee Opinion No. 618. Intimate Partner Violence. *Obstet Gynecol.* 2012;119:412–417.
- 3 Practice Bulletin No. 230. Obesity in Pregnancy. *Obstet Gynecol.* 2021;137:e128–e144.
- 4 Committee Opinion No. 693. Counseling about Genetic Testing and Communication of Genetic Test Results. *Obstet Gynecol.* 2017;129:e96–e101.
- 5 Committee Opinion No. 691. Carrier Screening for Genetic Conditions. *Obstet Gynecol.* 2017;129:e41–e55.
- 6 Monaghan KG, Feldman GL, Palomaki GE, et al. Technical Standards and Guidelines for Reproduction Screening in the Ashkenazi Jewish Population. *ACMG Practice Guidelines.* 2008;10:57–72.
- 7 Ioannides AS. Preconception and Prenatal Genetic Counseling. *Best Pract Res Clin Obstet Gynaecol.* 2017;42:2–10.
- 8 Committee Opinion No. 781. Infertility Workup for the Women's Health Specialist. *Obstet Gynecol.* 2019;133:e377–e384.
- 9 Hemsing N, Greaves L, Poole N. Preconception Health Care Interventions: A Scoping Review. *Sex Reprod Healthc.* 2017;14:24–32.
- 10 Committee Opinion No. 749. Marriage and Family Building Equality for Lesbian, Gay, Bisexual, Transgender, Queer, Intersex, Asexual, and Gender Nonconforming Individuals. *Obstet Gynecol.* 2018;132:e82–e86.
- 11 Obedin-Maliver J, Makadon HJ. Transgender Men and Pregnancy. *Obstet Med.* 2016;9(1):4–8.

A Patient of Ashkenazi Jewish Ancestry Presents for Preconception Counseling

Emily R. Rosen

History of Present Illness

A 30-year-old nulligravid patient presents to the clinic for preconception counseling. She is recently married and is planning to start a family. She is worried about conceiving as her sister had a child diagnosed with cystic fibrosis (CF) earlier this year. She wants to make sure that she is as healthy as possible before becoming pregnant and asks to discuss any testing or recommendations to have a healthy pregnancy. She currently has an intrauterine device (IUD) in place for contraception. Her gynecologic history is otherwise unremarkable. She denies any medical or surgical history. There is no family history of birth defects, developmental delay, or cancer. She does not take any medications and has no known drug allergies.

Physical Examination

General appearance: Alert, in no distress

Vital signs:

Temperature: 37.1°C

Pulse: 76 beats per minute

Blood pressure: 110/65 mmHg

Respiratory rate: 15 breaths per minute

Body mass index (BMI): 26.1 kg/m²

Abdomen: Soft, non-tender, non-distended, no masses

Pelvic: Normal external genitalia, normal vaginal epithelium without lesions or discharge, cervix normal in appearance, 8 week–sized anteverted mobile uterus, normal adnexa without tenderness or masses palpated

Laboratory studies:

Cervical cytology: Negative for intraepithelial lesion or malignancy

Human papillomavirus (HPV): Not detected

How Would You Manage This Patient?

This patient presents for preconception counseling. A thorough review of her personal and family genetic histories is completed and reveals a niece with CF. This patient was counseled on maintaining a healthy lifestyle, and recommendations to minimize health risks were discussed. After genetic counseling, the patient elected for expanded carrier screening given her family history and Ashkenazi Jewish ancestry. Genetic testing was positive for CF- and Canavan disease-carrier status. Subsequent testing of her husband was negative. She received appropriate post-test counseling, her IUD was removed, and she started a prenatal vitamin. She represented three months later with a viable intrauterine pregnancy.

Preconception Counseling

Preconception counseling can be completed at any patient encounter with a patient of reproductive potential and should occur multiple times during a patient's lifespan (Table 1.1). The goal of preconception counseling is to educate patients about healthy pregnancies, adjust risk factors, and identify and treat any underlying conditions to promote maternal health and decrease the risk of maternal and neonatal morbidity and mortality [1].

Comprehensive Health Assessment

Starting with a thorough medical history is imperative to identify and subsequently decrease any risk factors for pregnancy. Certain medical conditions, such as hypertension, diabetes, and thyroid disease, are associated with pregnancy-related complications. Optimizing management of known medical illnesses can improve pregnancy outcomes [1]. A review of all the patient's prescription and nonprescription medications as well as supplements should be performed to assess their safety and potential teratogenicity. In a shared decision-making model, there should be a discussion of the risks and benefits of use, and a determination of which medications should be continued. Patients should be questioned about the use of alcohol, tobacco, and illicit substance use, counseled appropriately, and provided resources as indicated. Assessment for intimate partner violence is also recommended during preconception counseling [2].

Lifestyle Modifications

Lifestyle and behavioral assessments are vital. Nutritional status and physical activity should be discussed. Since low and high BMI are associated with both maternal and fetal complications, patients should be encouraged to achieve a BMI in the normal range between 18.5 and 24.9 kg/m² [3]. Preventative care, including offering testing for sexually transmitted infections (STIs), performing cervical cancer screening, and confirming immunization status, is recommended. It is important to review the patient's immunization states for tetanus, diphtheria, and pertussis (Tdap); measles, mumps, and rubella (MMR); hepatitis B; varicella; and HPV vaccination in accordance with the current guidances, and to offer any pending vaccinations to ensure completion of the recommended vaccination series. Annual influenza and COVID-19 vaccinations to patients of reproductive age are recommended at a preconception visit if they are not already completed [1]. Lastly, pre-pregnancy folic acid

Table 1.1 Overview of preconception counseling recommendations

History	Medical: Address any chronic medical conditions Family: Obtain a complete history Social: Inquire about use of alcohol, tobacco, or illicit substances Psychiatric: Assess for mental health concerns
Lifestyle	Diet/exercise: Encourage a normal BMI Environmental and occupational exposures: Assess for teratogen exposure (e.g. pesticides, heavy metals, radiation, etc.)
Preventative care	Immunizations: Assess immunization status for Tdap, MMR, hepatitis B, varicella, and HPV vaccines; recommend annual influenza and COVID-19 vaccination Cervical cancer screening: Confirm patient is up to date STI screening: Offer STI testing Screening for intimate partner violence
Medications	Review prescription and nonprescription medications and potential risks/benefits in pregnancy Encourage pre-pregnancy folic acid supplementation
Genetic testing	Identify individuals at increased risk of inherited conditions Offer screening for CF and SMA to all patients Offer additional screening based on patient risk and patient preference after counseling

supplementation to reduce the risk of neural tube defects should be recommended [1].

Genetic Counseling and Screening

In addition to ensuring optimal maternal health, a genetic history and ethnic background of the patient, her partner, and their families should be discussed. Education about carrier screening should be given to every patient. The purpose of carrier screening is to identify asymptomatic individuals who carry a pathogenic variant allele within a gene that is associated with a specific diagnosis. Ideally, carrier testing is completed prior to pregnancy to provide patients with an understanding of their genetic risks so they may consider the full spectrum of reproduction options, including preimplantation genetic testing.

The increasing complexity and accessibility of genetic testing have made counseling more complicated. Pre-test counseling including result possibilities, risks, benefits, costs, and limitations should be discussed prior to testing, and appropriate timely post-test counseling is needed [4]. If a patient is identified as a carrier for a specific disease, the patient's partner should be tested. If both individuals are positive for the same genetic condition, referral for genetic counseling should be provided [5].

Screening for spinal muscular atrophy (SMA) and CF should be offered to all women who are pregnant or who are considering pregnancy [5]. Certain populations, including individuals of Eastern and Central European Jewish descent, are at increased risk of carrying a pathogenic variant for clinically significant autosomal recessive conditions [6]. For example, the carrier risk of SMA and CF in the Ashkenazi Jewish population is 1:41 and 1:24 versus 1:117 and 1:58 in the Hispanic white population, respectively. Sickle cell trait is

present in approximately 10% of African American patients, and a hemoglobin electrophoresis should be completed if there is a suspicion of hemoglobinopathy based on ethnicity or complete blood count (CBC) indices [5]. Although different organizations have recommended specific carrier screening in unique populations, other experts have advocated for a more universal approach to carrier screening that is not limited to specific racial or ethnic populations. More research on benefits, feasibility, and opinions of patients and providers is needed before expanded carrier screening is offered to the general population [7].

Contraception to Conception

Time to ovulation is variable depending on the type and mechanism of action of contraceptive being used (whether the method prevents ovulation, thickens cervical mucus, or acts as a spermicide). It is possible to become pregnant immediately after discontinuation of certain forms of contraception, or it may take many months before a patient's cycle returns to normal. Discussion of the menstrual cycle including the follicular and luteal phases should be provided so that patients can understand their unique cycle patterns to optimize conception. Education that ovulation occurs fourteen days prior to menses can help patients predict the timing of ovulation and time intercourse on the most fertile days.

Fertility Concerns and Infertility Evaluation

The diagnosis of infertility is made after not having conceived after 12 months of regular intercourse without the use of contraception in patients under the age of 35 and after 6 months of the same in patients aged 35 and older. The majority of couples will conceive in the first year, but the rates of conception decrease over time and with increasing age of the female partner.

Infertility affects up to 15% of couples [8]. Infertility can have any number of causes. Female factors including ovulatory dysfunction, tubal damage, endometriosis, and uterine factors should be considered. Male factors can contribute to 30–50% of the causes of infertility. Between 10 and 30% of cases of infertility will remain unexplained after a thorough workup [8]. If a patient is unable to conceive in the anticipated time frame, further evaluation and workup are recommended. If a patient has a condition known to cause infertility, early evaluation is warranted.

Health Equity and Preconception Care

It is imperative to consider the social, structural, and environmental determinants of health that affect reproductive health care to address health disparities and provide equitable care for all individuals [9].

Although LGBTQIA+ and gender-nonconforming individuals are an increasingly recognized community, many barriers in accessing equitable health care remain [10]. Inquiring about a patient's gender identity, assigned sex at birth, pronouns, and preferred name can establish an inclusive and affirmative medical setting. Family building can occur through

multiple modalities, and it is important to discuss any desire for genetically related children and physically carrying a pregnancy to provide comprehensive counseling and care [11]. Information on timing, implications, and the limited research of testosterone treatment on conception and pregnancy should be discussed, as well as consideration of embryo or oocyte cryopreservation. It is also important to review any surgical treatments that may affect the ability to carry or contribute genetically to a child [11]. Additional medical considerations for this population include delivery preferences, chest-/breast-feeding, and postpartum care.

In addition to medical needs, there are many psychological considerations. There is often a discordance between one's identity and the idea of what a pregnant or gestational parent is, as defined by societal norms. Additionally, in a population with an increased rate of depression and suicide,

mental health care from preconception through parenting is crucial [11].

Additional training for health care professionals, enhanced social understanding, and further research are needed to provide inclusive, equitable, and comprehensive reproductive health care to the entire health community.

Key Teaching Points

- Preconception counseling should be offered to all reproductive-aged patients.
- Providing preconception education, adjusting risk factors, and optimizing maternal health can reduce maternal and fetal reproductive complications.
- All women should receive genetic counseling and be offered genetic testing.

References

- 1 Committee Opinion No. 762. Prepregnancy Counseling. *Obstet Gynecol.* 2019;133:e78–89.
- 2 Committee Opinion No. 618. Intimate Partner Violence. *Obstet Gynecol.* 2012;119:412–417.
- 3 Practice Bulletin No. 230. Obesity in Pregnancy. *Obstet Gynecol.* 2021;137:e128–e144.
- 4 Committee Opinion No. 693. Counseling about Genetic Testing and Communication of Genetic Test Results. *Obstet Gynecol.* 2017;129:e96–e101.
- 5 Committee Opinion No. 691. Carrier Screening for Genetic Conditions. *Obstet Gynecol.* 2017;129:e41–e55.
- 6 Monaghan KG, Feldman GL, Palomaki GE, et al. Technical Standards and Guidelines for Reproduction Screening in the Ashkenazi Jewish Population. *ACMG Practice Guidelines.* 2008;10:57–72.
- 7 Ioannides AS. Preconception and Prenatal Genetic Counseling. *Best Pract Res Clin Obstet Gynaecol.* 2017;42:2–10.
- 8 Committee Opinion No. 781. Infertility Workup for the Women's Health Specialist. *Obstet Gynecol.* 2019;133:e377–e384.
- 9 Hemsing N, Greaves L, Poole N. Preconception Health Care Interventions: A Scoping Review. *Sex Reprod Healthc.* 2017;14:24–32.
- 10 Committee Opinion No. 749. Marriage and Family Building Equality for Lesbian, Gay, Bisexual, Transgender, Queer, Intersex, Asexual, and Gender Nonconforming Individuals. *Obstet Gynecol.* 2018;132:e82–e86.
- 11 Obedin-Maliver J, Makadon HJ. Transgender Men and Pregnancy. *Obstet Med.* 2016;9(1):4–8.

A Patient with a Subchorionic Hematoma Presents with Early Vaginal Bleeding

Rima Rana

History of Present Illness

A 25-year-old primigravid patient at 8 2/7 weeks by her last menstrual period presents to the emergency department with vaginal bleeding. She reports that the vaginal bleeding started two days ago; initially, it was bright red, and now it is dark brown. She initially noticed it as red spotting on her underwear and has required one pantyliner per day. She denies abdominal pain or cramps. She reports increased nausea since she missed her period, but she has been able to tolerate small meals. She denies dizziness, lightheadedness, or shortness of breath. She decided to come in today because the bleeding continued, and she was worried. She reported having intercourse 1 week ago. This is an unplanned but desired pregnancy. She took a home pregnancy test that was positive 3 weeks ago. Her initial prenatal visit is scheduled for next week.

She denies any medical problems or surgeries in the past. She denies any allergies. She is not currently taking any medications or vitamins. This is her first pregnancy. Her prior gynecologic history is significant for a normal pap smear one year ago, and no history of sexually transmitted diseases, ovarian cysts, or fibroids. She is sexually active with one male partner. She drinks alcohol socially and occasionally uses marijuana but has stopped both since her positive pregnancy test. She denies any other substance use.

Physical Examination

General appearance: Well-developed, well-appearing, in no acute distress

Vital signs:

Temperature: 36.9°C

Pulse: 74 beats per minute

Blood pressure: 106/72 mmHg

Respiratory rate: 12 breaths per minute

BMI: 23.9 kg/m²

Cardiopulmonary: Regular rate and rhythm, lung sounds clear to auscultation bilaterally

Abdomen: Soft, non-tender, non-distended. No rebound, tenderness, or guarding. No masses palpated

Pelvic: Normal-appearing bilateral labia majora and minora. On speculum exam, the vaginal wall rugae are normal in appearance, and there is scant dark brown blood in the vagina. The cervix appears without lesions and appears closed, no active bleeding noted.

On bimanual exam, the uterus is anteverted, mobile,

and measures about 10 cm with no masses or tenderness. The adnexa are non-palpable and non-tender bilaterally.

Neurological/psychological: Normal affect, appears anxious, good insight and judgment

Laboratory studies:

Urine pregnancy test: Positive

WBC: 7,000/μL

Hgb: 9.4 g/dL

Beta-human chorionic gonadotropin (beta-hCG): 67,000 IU/L

Blood type: B Positive

Imaging:

Transvaginal ultrasound shows an intrauterine gestational sac and yolk sac. There is an embryo with a crown rump length (CRL) of 1.5 mm consistent with a gestational age of 8 weeks and 3 days. Fetal cardiac activity is identified and is 138 beats per minute. The cervix is closed. There is an 11 mm × 5 mm × 4 mm subchorionic hematoma.

How Would You Manage This Patient?

This patient is presenting with first-trimester vaginal bleeding. The differential diagnosis includes threatened abortion, incomplete or complete abortion, ectopic pregnancy, subchorionic hematoma, normal pregnancy, cervical lesion or polyp, trauma, and infection. A complete history and physical were obtained. Questions focused on determining the characteristics of the bleeding, including quantity, if it is intermittent or constant, and whether it was associated with pelvic pain, cramps, or contractions. The history included a detailed obstetric and gynecologic history, including prior pregnancies, history of sexually transmitted infections (STIs) or pelvic inflammatory disease, or other risk factors for ectopic pregnancies.

Vital signs were reviewed to assess hemodynamic stability. An abdominal exam was performed, assessing each quadrant. A speculum exam was performed to assess the amount of bleeding, the color of the blood, whether there was active bleeding, and whether there were blood clots or tissue present. The appearance of the cervix was assessed. Important laboratory testing for patients presenting with first-trimester bleeding includes a CBC, quantitative beta-hCG, and a type and screen. A transvaginal ultrasound was obtained and showed an intrauterine pregnancy with fetal cardiac activity. The ultrasound also showed a subchorionic hematoma.

Given that the patient was hemodynamically stable, with light bleeding that was not active, no pain, a closed cervix, and a viable intrauterine pregnancy, the patient was counseled on the slightly increased risk of pregnancy loss associated with a subchorionic hematoma. Given the small size of the hematoma, she was advised to start prenatal vitamins and follow up with her routine prenatal visit. Instructions and precautions were reviewed. This patient followed up for a routine ultrasound at 12 weeks' gestation, and the hematoma was reduced in size. She had not had any further bleeding. At her 20-week anatomy ultrasound, the subchorionic hematoma had completely resolved.

Subchorionic Hematoma

A subchorionic hematoma, also known as a subchorionic hemorrhage, refers to a collection of blood found on a first-trimester ultrasound. It is a finding that can be a cause of anxiety among expecting patients. The developing fetus and its surrounding amniotic fluid are surrounded by fetal membranes. The inner membrane is the amnion, and it lines the amniotic cavity. The outer membrane is the chorion, which is opposed to the maternal decidua [1]. A subchorionic hematoma is one of several types of hematomas that can develop in the maternal-placental-fetal unit (Table 2.1) [2]. Subchorionic hematoma refers to a collection of blood between the chorionic membrane and the decidua due to a separation of these layers [3]. The causes of subchorionic hematoma are not completely understood. Risk factors are also not well-defined, although some association exists with in vitro fertilization [4].

A subchorionic hematoma is diagnosed with imaging studies, usually on a first-trimester ultrasonography performed for vaginal bleeding or on a routine obstetric ultrasound with an incidence of 3.1–18.4% [3]. Other studies report the incidence at 0.5–22% [5]. The diagnosis can also be made with computed tomography (CT) and magnetic resonance imaging (MRI), however, ultrasound is the most common imaging modality used when a subchorionic hematoma is identified [5]. On ultrasound, a subchorionic hematoma appears as a crescent-shaped area behind the fetal membranes and is hyperechoic to isoechoic in the first week, then becomes hypoechoic at 1–2 weeks, and anechoic after 2 weeks [5,2]. Typically, these are small on ultrasound and have no clinical consequence [2]. A systematic review and meta-analysis concluded that a subchorionic hematoma in the first trimester was associated with a one- to three-fold increased risk of miscarriage and no significant association with preterm delivery, fetal growth restriction, preeclampsia, or cesarean delivery [3]. Other studies show that patients with subchorionic hematomas are at slightly increased risk for early and late pregnancy loss, preterm premature rupture of membranes, preterm delivery, and an increased risk of placental abruption. Currently, no specific interventions exist to prevent these outcomes [5].

According to Naert et al., most subchorionic hematomas diagnosed in the first trimester resolve by the second

Table 2.1 Four types of hematomas in the maternal-placental-fetal unit

Types of hematomas	Location
Retroplacental hematoma	Between placenta and decidua
Marginal hematoma	At placental periphery between chorion and decidua, known as subchorionic hemorrhage
Subchorial thrombosis	Beneath chorionic plate
Subamniotic hematoma	Beneath amnion, of fetal vessel origin

trimester and are not associated with adverse pregnancy outcomes at 20 weeks' gestation. The size of the subchorionic hematoma also does not correlate with negative pregnancy outcomes. In this study, 90.7% of subchorionic hematomas resolved by the second trimester [6]. Despite a slight increased risk of pregnancy loss and other adverse pregnancy outcomes, most subchorionic hematomas resolve and result in healthy live births. Patients should be reassured of this. Typically, patients with subchorionic hematomas do not have life-threatening bleeding. Oftentimes the bleeding is light, without pain, and the patient is hemodynamically stable. Patients should be counseled on the risks of pregnancy loss and preterm delivery. There are no specific interventions to prevent these outcomes, and conservative management with follow-up is sufficient. There is no evidence that bed rest, pelvic rest, and increased frequency of monitoring with ultrasound or nonstress tests result in improved obstetrical outcomes [7]. Larger hematomas can be followed more closely, as the larger size may have an increased risk of miscarriage. However, this is not based on evidence, and currently, no guidelines exist in the follow-up and management of subchorionic hematoma [8]. Patients should be counseled to return to the emergency room if bleeding occurs with greater than one to two pads soaked every hour for more than two consecutive hours or with severe pain. If the patient is Rh negative, consideration should be given to administering Rho(D) immune globulin (RhoGAM).

Key Teaching Points

- Subchorionic hematoma is a common ultrasound finding for patients presenting with first-trimester vaginal bleeding or incidentally identified on a routine pregnancy ultrasound.
- It is associated with a slightly increased risk of pregnancy loss and preterm delivery, although most spontaneously resolve and result in healthy live births.
- Conservative management with follow-up ultrasonography is appropriate.
- Patients should be counseled and treated with empathy and provided reassurance.

References

- 1 Mercer BM, Chien EKS. Premature Rupture of the Membranes. In: Gabbe's Obstetrics: Normal and Problem Pregnancies, Chapter 37. Philadelphia: Elsevier; 2021. 694–707.
- 2 Placental Abnormalities. In: Cunningham F, Leveno KJ, Dashe JS, et al. (eds.). *Williams Obstetrics*, 26th ed. New York: McGraw-Hill Medical; 2022.
- 3 Yan X, Xu H, Li J, et al. Subchorionic Hematoma and Risk of Preterm Delivery: A Systematic Review and Meta-analysis. *Am J Obstet Gynecol MFM*. 2023;5(1):100791.
- 4 Pagan M, Monson J, Strebeck R, Edwards S, Magann EF. Subchorionic Hemorrhage in the Second and Third Trimesters of Pregnancy: A Review. *Obstet Gynecol Surv*. 2022;77(12):745–752.
- 5 Tuuli MG, Norman SM, Odibo AO, et al. Perinatal Outcomes in Women with Subchorionic Hematoma: A Systematic Review and Meta-analysis. *Obstet Gynecol*. 2011;117(5):1205–1212.
- 6 Naert MN, Muniz Rodriguez A, Khadraoui H, et al. Association between First-Trimester Subchorionic Hematomas and adverse Pregnancy Outcomes after 20 Weeks of Gestation in Singleton Pregnancies. *Obstet Gynecol*. 2019;134(4):863–868.
- 7 Hull AD, Resnick R, Silver RM. Placenta Previa and Accreta, Vasa Previa, Subchorionic Hemorrhage and Abruptio Placenta. In: *Creasy and Resnik's Maternal Fetal Medicine*, Chapter 43. Philadelphia: Elsevier; 2023. 799–809.
- 8 White R, Kilgour Venables H. The Significance of Ultrasound Features of Sub-chorionic Haemorrhage as a Predictor of Adverse Perinatal Outcome: A Retrospective Review. *Eur J Obstet Gynecol Reprod Biol*. 2023;289:23–28.

A 25-Year-Old with a Twin Gestation at 9 Weeks

Tara A. Nielsen

History of Present Illness

A 25-year-old gravida 3 para 1 at 9 0/7 weeks' gestational age by her last menstrual period presents to your office for her first prenatal visit. She complains of daily nausea with emesis one to two times per week. She has gained a total of 4 pounds since finding out she was pregnant. She denies bleeding, pelvic pain, or any vaginal complaints. She otherwise feels well. She has a history of one prior missed abortion requiring a suction dilation and curettage at 6 weeks and one prior spontaneous vaginal delivery (SVD) at term of a 7-pound 4-ounce infant. She denies a history of gestational diabetes, gestational hypertension, preeclampsia, or postpartum hemorrhage. She takes a prenatal vitamin daily, and vitamin B6 with doxylamine as needed for nausea. She is allergic to sulfa medications, which cause a rash.

Physical Examination

General appearance: Well-appearing, no acute distress

Vital signs:

Temperature: 36.7°C

Pulse: 86 beats per minute

Blood pressure: 105/65 mmHg

Respiratory rate: 19 breaths per minute

BMI: 23.29 kg/m²

Cardiopulmonary: Regular rate and rhythm without murmur, rub, or gallop. Lungs clear to auscultation bilaterally

Abdomen: Soft, non-distended, non-tender to palpation, three-finger diastasis recti noted

Pelvic: Normal-appearing external genitalia without lesions, vagina well estrogenized, cervix with Chadwick's sign, uterus 8–10 weeks in size, mobile, non-tender, adnexa without masses or tenderness

Imaging:

Bedside ultrasound reveals two fetuses separated by a thick dividing membrane with the presence of the twin peak sign. Crown-rump-length measurements of 9 0/7 weeks' gestational age and 9 1/7 weeks' gestational age. A 2.2 cm × 3.4 cm corpus luteal cyst is seen in the left ovary. The right ovary is normal in appearance.

How Would You Manage This Patient?

This patient was diagnosed with a dichorionic-diamniotic (DCDA) pregnancy at 9 weeks' gestation. She was counseled on nutritional needs, weight gain goals, neonatal and obstetrical risks, recommended antenatal testing, and delivery recommendations for DCDA pregnancies. She had a low-risk

noninvasive perinatal screening and declined further diagnostic testing. She received third-trimester growth ultrasounds with a 5% growth discordance noted. She developed preeclampsia without severe features at 37 weeks' gestation and was delivered via primary low transverse cesarean section due to fetal malpresentation. The neonates Apgar scores were 8, 9, and 7, 9. Her postpartum course was uncomplicated. The patient and her babies were discharged home on postoperative day three.

Twin Gestations

Zygosity refers to the genetic composition of a twin pregnancy. Dizygosity results from two separate ova being fertilized by two separate spermatozoa in a single ovulatory cycle, often referred to as fraternal twins. Monozygosity refers to a fertilized ovum that has split, resulting in identical twins. Chorionicity or type of placentation is determined by the mechanism of twinning specific to monozygotic twins and the timing of the split. If cleavage occurs within the first 72 hours of fertilization, two embryos, two amnions, and two chorions develop, resulting in a monozygotic, DCDA twin pregnancy. Cleavage occurring between days 4 and 7 results in a monozygotic, monochorionic-diamniotic (MCDA) twin pregnancy. Cleavage between days 8 and 12 will result in a monozygotic, monochorionic-monoamniotic (MCMA) twin pregnancy. Although rare, cleavage after this point will result in conjoined twins. Dizygotic gestations will always be DCDA.

It is estimated that 1–1.5% of natural conceptions result in dizygotic twin pregnancies. Monozygotic twin pregnancies are estimated to occur in 0.4% of all natural conceptions. Risk factors for dizygotic twin gestations include advancing maternal age, maternal family history, and race, particularly women of African descent. Risk factors for monozygotic twin pregnancies are less understood, and rates apart from the use of assisted reproductive technologies (ART) are consistent across all variables [1]. The incidence of twin gestations drastically increased from the 1980s until the early 2000s largely due to ART and an increase in maternal age at childbirth. However, the National Vital Statistics show a steady decrease in twin births in the United States from 2014 to 2022. This is hypothesized to be due to refinements and regulations in ART. However, numbers are recently on the rise again, showing a 2% increase in twin gestations from 2020 to 2021. In 2021, the incidence of twin births in the United States was 31.2 per 1,000 live births [2].

Compared to singleton gestations, twin pregnancies are associated with increased maternal risk of hyperemesis, gestational diabetes, hypertensive diseases of pregnancy, anemia, cesarean delivery, postpartum hemorrhage, and

postpartum depression. All twin pregnancies are at increased risk of fetal complications including prematurity, fetal congenital anomalies, and growth restriction, as well fetal and neonatal mortality. Due to an imbalance of blood supply to each fetus caused by arteriovenous malformations within the placenta and the potential imbalance of oxygenation and nutrients, a condition known as twin-to-twin transfusion syndrome, monochorionic pregnancies are at even higher risk of complications, leading to additional interventions and antenatal testing [3,4]. Table 3.1 shows data from the Birth in Brazil Study, a large population-based survey conducted between 2011 and 2012. Data collected from 266 hospitals across Brazil, including 23,746 singleton and 277 twin gestations, demonstrated an increased percentage of both maternal and neonatal complications for twin gestations [3].

First-trimester ultrasonography is clinically important for determining chorionicity, assisting with risk counseling, and

delivery timing. Imaging beyond the early second trimester becomes less reliable for accurate diagnoses. If an ultrasound assessment clearly shows two separate gestational sacs separated by a thick membrane ≥ 2 mm, different sexes, or two distinct placentas, the pregnancy is DCDA. If only one placenta is observed, it is helpful to look for a twin peak sign, also called a delta or lambda sign. This will have the same echogenicity of the placenta, extending from the placental interface in a triangular-like projection into a hair-like dividing membrane, suggesting a DCDA pregnancy. The absence of a twin peak sign is predictive of a monochorionic pregnancy. Early in MCDA pregnancies, two separate yolk sacs and/or an inter-twin membrane without involving chorion may be observed. The inter-twin membrane in an MCDA gestation will appear more like a “T” rather than a “Y,” as seen in the twin peak sign (Figure 3.1).

Ultrasound imaging of MCMA pregnancies, the highest risk of all twin gestations, often shows cord entanglement with the absence of an inter-twin membrane. If monochorionicity is determined, monozygosity is confirmed. If dichorionicity is present with the same sex of each fetus, genetic testing would be indicated to definitively determine zygosity [1].

All patients should be offered genetic screening for aneuploidy. Options for screening include first-trimester screen, quad screen, sequential, or integrated screening. Nuchal translucency measurements can further evaluate each individual fetus. Noninvasive perinatal screening or cell-free fetal DNA has a sensitivity for trisomy 21 that may be similar to singleton gestations for completed tests. However, a high rate of test failure is present, and the detection rate for trisomy 18 and 13 is yet to be determined [4].

Patients with twin pregnancies must be counseled on adequate nutritional needs and weight gain specific to their twin gestation. It is well known that twin pregnancies are associated with low birth weights and prematurity. While these contributions are largely multifactorial, recognizing nutritional differences for twin gestations can be beneficial to reducing neonatal morbidity. Patients can expect to gain more weight than those carrying a singleton due to an increase in

Table 3.1 Maternal and neonatal outcomes for twin and singleton gestations [3]

	Twin gestations (n=277 [%])	Singleton gestations (n=23,746 [%])
Maternal complications		
Hypertensive disorders of pregnancy	51 (18.5)	2,584 (10.9)
Eclampsia	3 (1.1)	135 (0.6)
Gestational diabetes	27 (9.7)	1,955 (8.2)
Emergency cesarean	89 (38.5)	3,043 (24.9)
Neonatal complications		
Low birth weight (<2,500 g)	353 (63.7)	2,116 (8.9)
Small for gestational age	202 (36.5)	1,822 (7.7)
Fetal growth restriction	103 (18.6)	746 (3.1)
Neonatal ICU admission	172 (31)	1,497 (6.3)
Stillbirth	6 (1.1)	263 (1.1)
Neonatal death	27 (4.9)	241 (1.0)

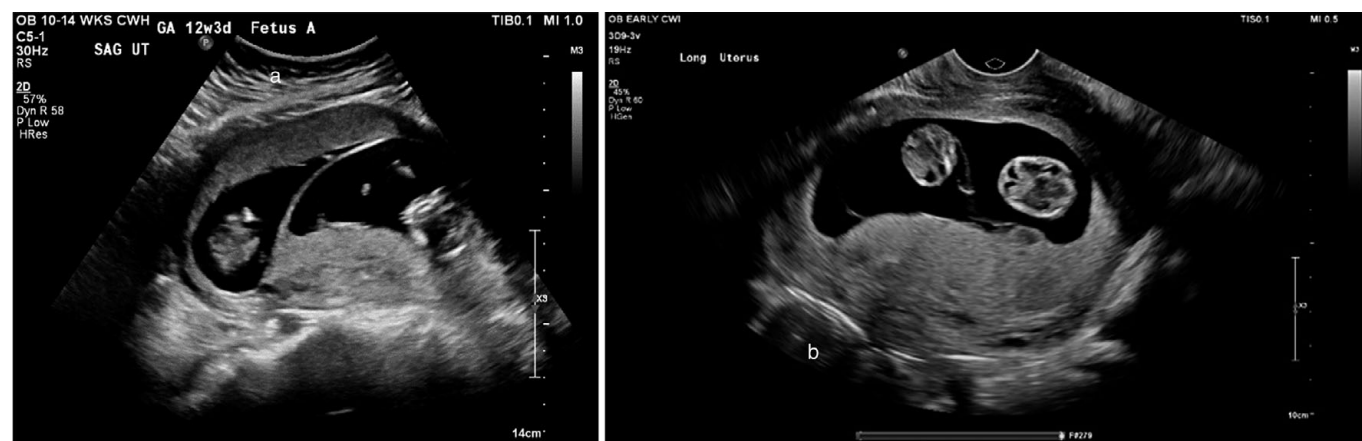


Figure 3.1 Ultrasound imaging of twin gestations. (a) A thick dividing membrane or twin peak sign is observed between an anterior and posterior placenta, demonstrating a DCDA gestation. (b) A thin dividing membrane with a single placenta denotes an MCDA gestation.

both maternal tissue and intrauterine contents. The National Academy of Medicine recommends patients with a normal body mass index (BMI) (18.5–24.9 kg/m²) can expect a cumulative weight gain between 17 and 25 kg [5,6]. To do this, patients carrying twins need an additional 300 kcal/day from those carrying a singleton, or a total of 600 kcal/day in addition to the standard 2,000 kcal/day for a nonpregnant individual. Micronutrient recommendations for twin gestations include calcium 1,500–2,500 mg/day, vitamin D 1,000 IU/day, magnesium 400–800 mg/day, zinc 15–30 mg/day, DHA/EPA 300–500 mg/day, folic acid 1 mg/day, vitamin C 500–1,000 mg/day, and vitamin E 400 IU/day. A single multivitamin with 30 mg elemental iron is recommended in the first trimester, whereas two vitamins can be taken during the second and third trimesters to meet growing micronutrient demands later in advancing gestation. Due to the potential teratogenic effects of excess vitamin A supplementation, care is taken to avoid excesses of >8,000 IU/day [5].

The stillbirth rate increases with gestational age for twin gestations. While there is no known evidence-based recommendation for fetal growth surveillance, most guidelines recommend serial growth ultrasounds after 20 weeks for DCDA gestations. Discordant growth is defined as >20% difference in estimated fetal weights (EFWs). Discordant growth has been associated with an increase in adverse perinatal outcomes and may warrant further evaluation and surveillance. While there is not an established optimal age for initiating antenatal testing in patients with dichorionic pregnancies, in the absence of other risk factors, initiation of weekly testing may be considered at 36 0/7 weeks' gestation, with delivery at 38 0/7–38 6/7 weeks' gestation.

This rate of stillbirth is significantly greater for those with monochorionic pregnancies. Due to the risk of twin-to-twin transfusion syndrome in MCDA and MCMA pregnancies,

ultrasound evaluation is generally recommended every 2 weeks, starting at 16 weeks' gestation, with antenatal testing recommended to start at 32 0/7 weeks' gestation. In the absence of complications, MCDA gestations undergo delivery between 34 0/7 and 37 6/7 weeks' gestation, and uncomplicated MCMA gestations are recommended for delivery between 32 0/7 and 34 0/7 weeks' gestation [4].

The route of delivery for DCDA and MCDA pregnancies is determined by the presenting twin and the experience of the delivering clinician. It is generally acceptable to consider a vaginal delivery if the EFWs are concordant, gestational age is >32 0/7 weeks' gestation, and the presenting twin is cephalic, regardless of the second twin's presentation. Patients with MCMA gestations should be delivered by cesarean section due to the risk of cord-related complications [4,7].

Key Teaching Points

- First-trimester and early second-trimester ultrasound is important in establishing chorionicity and determining risk assessment.
- Compared to singleton gestations, twin pregnancies are associated with an increased risk of both maternal and neonatal morbidity and mortality.
- Twin gestations should be offered genetic testing.
- Twin gestations have unique weight gain recommendations and micronutrient needs.
- Due to the increased risk of stillbirth with advancing gestational age, twin gestations are delivered earlier than singleton gestations.
- The route of delivery for DCDA and MCDA gestations is largely dependent on the presenting twin and the experience of the delivering clinician.
- MCMA gestations should be delivered by cesarean section.

References

- 1 Landon MB, Galan HL, Jauniaux ERM, et al. *Gabbe's Obstetrics Normal and Problem Pregnancies*, 8th ed. Philadelphia: Elsevier; 2021.
- 2 Horon I, Martin J. Changes in Twin Births in the United States, 2019–2021. *Natl Vital Stat Rep*. 2022;71(9):1–11.
- 3 Esteves-Pereira AP, Da Cunha AJLA, Nakamura-Pereira M, et al. Twin Pregnancy and Perinatal Outcomes Data from “Birth in Brazil Study”. *PLoS ONE*. 2021;16(1):e0245152.
- 4 Multifetal Gestations Twin Triplet and Higher Order Multifetal Pregnancies: ACOG Practice Bulletin, Number 231. *Obstet Gynecol*. 2021;137(6):1140–1143.
- 5 Goodnight W, Newman R. Optimal Nutrition for Improved Twin Pregnancy Outcome. *Obstet Gynecol*. 2009;114(5):1112–1134.
- 6 Wierzejska RE. Review of Dietary Recommendations for Twin Pregnancy: Does Nutrition Science Keep Up with the Growing Incidence of Multiple Gestations? *Nutrients*. 2022;14:1143.
- 7 Dathan-Stumpf A, Winkel K, Stepan H. Delivery of Twin Gestation (≥ 32.0 weeks): The Vaginal Route as a Practicable and Safe Alternative to Cesarean Section. *Geburtshilfe Frauenheilkd*. 2020;80(10):1033–1040.

A 35-Year-Old with HSIL Cervical Cytology at 10 Weeks

Margaret E. Long

History of Present Illness

A 35-year-old gravida 3 para 2 at 10 1/7 weeks is found to have a high-grade squamous intraepithelial lesion (HSIL) on cervical cytology with positive high-risk human papilloma virus (HPV) types other than 16 or 18 on her recent screening. She has no prior abnormal cervical cancer screening but has not undergone screening since the birth of her child 7 years ago, and these results are unavailable. She has no previous HPV testing. She recalls having the HPV vaccine in college. She reports previous tobacco use but none since her first pregnancy. She denies any vaginal bleeding or abnormal discharge. She is concerned about her cervical cancer risk but does not want to do anything that might cause harm to her pregnancy.

Physical Examination

General appearance: Alert, in no apparent distress

Vital signs:

Temperature: 37.2°C

Pulse: 73 beats per minute

Blood pressure: 114/74 mmHg

Respiratory rate: 16 breaths per minute

BMI: 26.2 kg/m²

Inguinal lymph nodes: No inguinal adenopathy

Pelvic exam: Parous cervix without gross lesions

Laboratory studies:

Cervical cytology: Satisfactory for evaluation, endocervical component present. Epithelial cell abnormality: HSIL. High-risk HPV nucleic acid amplification test: positive for types other than 16 or 18

Imaging:

Viable, single intrauterine pregnancy. Unremarkable uterus and cervix

How Would You Manage This Patient?

Colposcopy was recommended, and this was performed at 13 weeks' gestation. During colposcopy, the complete transformation zone was visualized. The colposcopic impression was high-grade due to the presence of acetowhite changes and a focus of mosaicism. There were no findings suspicious for cancer. A single ectocervical biopsy revealed cervical intraepithelial neoplasia (CIN) 2. An endocervical brushing was negative.

After discussing with the patient, she decided to proceed with surveillance colposcopy during pregnancy. During follow-up colposcopy at 32 weeks' gestation, she was found to have a stable lesion, and biopsies were not performed.

Diagnostic cotesting noted HPV+/HSIL. She had an uncomplicated vaginal delivery at 40 weeks' gestation. At her 6-week postpartum visit, diagnostic cotesting revealed HPV+/low-grade squamous intraepithelial lesion (LSIL). At 11 weeks' postpartum, colposcopic evaluation included two biopsies of lesions and an endocervical curettage (ECC). The ECC was negative, and the biopsies returned as CIN 1. She was advised to undergo HPV-based testing and colposcopy in 6 months as conservative follow-up of her initial CIN 2 [1]. Once her annual surveillance phase was satisfactorily completed, she was recommended to have follow-up that included HPV-based testing every 3 years until 25 years after her CIN 2 biopsy.

Cervical Dysplasia Management during Pregnancy

The goal of cervical cancer screening is to prevent cervical cancer by identifying and treating lesions that pose a risk for cancer. Outside of pregnancy, all CIN 3 lesions and many CIN 2 lesions are to be promptly treated. Care during pregnancy requires attention to short- and long-term maternal health while minimizing pregnancy complications.

Survival is improved when cervical cancer is diagnosed in pregnancy compared to 6 months after delivery. Cervical cancer diagnosed during pregnancy has similar survival rates to age-matched nonpregnant controls [2]. However, the risk of progression from CIN 2 or 3 to cancer in pregnancy is very low. For those with histologic HSIL (CIN 2–3), the rate of progression to cancer during pregnancy was 1% (95% CI 0–2%) in a meta-analysis of 10 studies [3]. Increased risk of complications has been observed with cervical excisional procedures performed during pregnancy, including bleeding, infection, and preterm labor [4]. The meta-analysis also noted regression rates of 59% (95% CI 54–65%) for CIN 2 and 29% (95% CI 25–33%) for CIN 3, while persistence rates were 40% (95% CI 35–45%) and 70% (95% CI 65–73%), respectively, at postpartum follow-up [3]. Given the low risk of progression to cancer during pregnancy, the high rate of disease regression, and the possibility of short-term harm from an excisional procedure, treatment of histologic HSIL is not recommended during pregnancy [1].

The 2019 American Society for Colposcopy and Cervical Pathology (ASCCP) management guidelines rely on current HPV and cytology results, biopsy results, and prior screening history to recommend management based on risk thresholds [1]. Human papillomavirus-based testing (cotesting [cytology and HPV] or primary HPV testing with reflex cytology) is preferred for cervical cancer screening in individuals 30 years and older and for surveillance of abnormal results in

Table 4.1 Immediate risk of CIN 3+ (CIN 3 or cancer+) in % with unknown prior screening history

	HPV+	HPV-	HPV 16+	HPV 18+	Other 12 HPV+
HSIL	49	25	60	30	35
ASC-H	26	3.4	28	15	9.5
AGC	26	1.1	36	33	5.4
LSIL	4.3	1.1	11	3.1	3.7
ASC-US	4.4	0.04	9.0	3.5	2.8
Normal	2.1	0.0	5.3	3.0	1.3

AGC, atypical glandular cells; ASC-H, atypical squamous cells, cannot exclude high-grade intraepithelial lesion; ASC-US, atypical squamous cells of undetermined significance [1,5,6]

individuals 25 years and older. Human papillomavirus-based testing is more sensitive, and negative HPV testing has a more durable risk reduction compared to cytology alone. Inadequate or absent screening increases the risk of cancer and is associated with most cases of cervical cancer in the United States.

Pregnancy does not alter the risk threshold for colposcopy, which is an immediate risk of CIN 3+ of $\geq 4\%$ [1]. While combinations of prior low-grade screening results can reduce the incident risk of CIN 3+, the five high-risk screening results (bold font in Table 4.1) always require colposcopy either due to their immediate CIN3+ risk or due to special circumstances for HPV type 18, atypical glandular cells (AGC), and atypical squamous cells, cannot exclude high-grade intraepithelial lesion (ASC-H) [1]. Some patients with low-risk results that slightly exceed the 4% immediate CIN 3+ threshold and with access to colposcopy postpartum may reasonably choose to defer colposcopy during pregnancy.

Risk estimates aid joint decision-making regarding the timing of colposcopy for those with abnormal screening results during pregnancy. Other factors to consider include gestational age, availability of follow-up care, and personal preferences. The availability of postpartum medical care may be impacted by factors including future access to insurance coverage. If access to postpartum medical care is limited, colposcopy during pregnancy may be required to ensure timely availability of indicated treatment postpartum. A multi-institutional study noted a postpartum follow-up rate of 57% for abnormal pap test results diagnosed during pregnancy [7]. Colposcopy during pregnancy may be the best opportunity for evaluating abnormal results [1].

Pregnancy changes can complicate colposcopy, and evaluation is preferably performed by providers with experience in performing colposcopy for pregnant individuals [1]. Endocervical curettage, endometrial biopsy, and expedited excisional treatment are all contraindicated during pregnancy. A gentle cytobrush collection can be performed instead of an ECC. While concerns about increased bleeding with cervical biopsy in pregnancy have been cited, ectocervical biopsy is not associated with adverse pregnancy outcomes [4]. Application of pressure and hemostatic agents immediately after cervical

biopsy can reduce bleeding. Some providers choose to delay colposcopy until the early second trimester to reduce the possibility of the procedure being erroneously associated with early pregnancy loss. Biopsies performed before the window of preterm labor evaluation avoid confusion between biopsy and preterm labor-associated spotting.

Excisional procedures in pregnancy are reserved for circumstances where invasive disease is likely and cannot be confirmed on biopsy [1]. A repeat colposcopy with biopsy, potentially by a more expert examiner, may also be considered in this situation. Notably, advancing gestation improves visualization of the transformation zone so that most are fully visible by 20 weeks' gestation.

If cervical cancer is diagnosed, consultation with or transfer of care to a gynecologic oncologist and a maternal-fetal medicine specialist is indicated. The diagnosis of cervical cancer may impact the timing and route of delivery, while the pregnancy may impact the timing and recommendations for cancer therapy. Adenocarcinoma in situ is ideally managed by a gynecologic oncologist or alternatively a colposcopist with experience in the diagnosis and treatment of this disease [1].

Pregnant patients with CIN 2–3 or adenocarcinoma in situ are preferably monitored with colposcopy and HPV-based testing every 12–24 weeks until complete colposcopic evaluation or treatment can occur postpartum [1]. Colposcopy during pregnancy can be scheduled to avoid the technical challenges and discomfort of colposcopy late in gestation and to avoid an interval of more than 24 weeks between evaluations in pregnancy and postpartum. Cervical biopsy is repeated if the monitored lesion has changed or has become suspicious for cancer. Deferral of surveillance colposcopy during pregnancy is an acceptable alternative.

In patients with cervical dysplasia, the mode and timing of delivery are based on obstetric indications only [4]. The mode of delivery has not been found to impact progression or regression rates [8].

Management Postpartum and Beyond

When the colposcopic examination during pregnancy is deferred or does not include all elements recommended for risk-based colposcopy [9], follow-up colposcopy should occur at least 4 weeks after delivery, but within a few months postpartum [1].

The patient's level of risk, preferences, and access to care postpartum may impact decisions regarding repeat colposcopy and testing postpartum versus an expedited loop electrical excisional procedure (LEEP). With expedited LEEP, if colposcopy on the day of the planned LEEP identifies a lesion but no findings suggesting cervical cancer, the LEEP proceeds without interval biopsies [1]. If repeat cervical cancer screening results are received postpartum prior to colposcopy, lower-grade results do not eliminate the need for postpartum colposcopy. These results can help inform risk-based colposcopy or expedited excisional therapy. If not collected at an

earlier postpartum visit, HPV-based testing is collected at the time of colposcopy.

Due to the risk of CIN 2+, those with prior CIN 2–3 require intensive initial surveillance per the ASCCP guidelines, and then surveillance every 3 years with HPV-based testing for 25 years after the CIN 2–3 diagnosis [1].

Key Teaching Points

- Pregnancy poses a unique opportunity to provide cervical cancer screening and diagnostic evaluation for those who have not accessed care outside of pregnancy.
- When the immediate risk of CIN 3+ crosses 4%, colposcopy and ectocervical biopsy of lesions concerning for HSIL are appropriate during pregnancy.
- Cervical biopsy during pregnancy evaluates for cancer and can facilitate timely postpartum treatment by identifying CIN 2–3.
- Surveillance of CIN 2–3 during pregnancy consists of colposcopy with HPV-based testing every 12–24 weeks until full postpartum evaluation or treatment can occur.
- Excisional biopsies are only indicated during pregnancy if required to diagnose cancer and that diagnosis would alter the management of the pregnancy.

References

- 1 Perkins RB, Guido RS, Castle PE, et al. 2019 ASCCP Risk-Based Management Consensus Guidelines Committee. 2019 ASCCP Risk-Based Management Consensus Guidelines for Abnormal Cervical Cancer Screening Tests and Cancer Precursors. *J Low Genit Tract Dis.* 2020;24(2):102.
- 2 Sood AK, Sorosky JI, Mayr N, et al. Cervical Cancer Diagnosed Shortly after Pregnancy: Prognostic Variables and Delivery Routes. *Obstet Gynecol.* 2000;95(6 Pt. 1):832–838.
- 3 Chen C, Xu Y, Huang W, et al. Natural History of Histologically Confirmed High-Grade Cervical Intraepithelial Neoplasia during Pregnancy: Meta-analysis. *BMJ Open.* 2021;11:e048055.
- 4 Hunter MI, Monk BJ, Tewari KS. Cervical Neoplasia in Pregnancy. Part 1: Screening and Management of Preinvasive Disease. *Am J Obstet Gynecol.* 2008;199(1):3–9.
- 5 Demarco M, Egemen D, Raine-Bennett TR, et al. A Study of Partial Human Papillomavirus Genotyping in Support of the 2019 ASCCP Risk-Based Management Consensus Guidelines. *J Low Genit Tract Dis.* 2020;24:144–147.
- 6 Egemen D, Cheung LC, Chen X, et al. Risk Estimates Supporting the 2019 ASCCP Risk-Based Management Consensus Guidelines. *J Low Genit Tract Dis.* 2020;24:132–143.
- 7 Fader AN, Alward EK, Niederhauser A, et al. Cervical Dysplasia in Pregnancy: A Multi-institutional Evaluation. *Am J Obstet Gynecol.* 2010;203(2):113.e1.
- 8 Douligeris A, Pergialiotis V, Pappa K, et al. The Effect of the Delivery Mode on the Evolution of Cervical Intraepithelial Lesions during Pregnancy: A Meta-analysis. *J Gynecol Obstet Hum Reprod.* 2022;51(10):102462.
- 9 Wentzensen N, Massad LS, Mayeaux EJ, Jr., et al. Evidence-Based Consensus Recommendations for Colposcopy Practice for Cervical Cancer Prevention in the United States. *J Low Genit Tract Dis.* 2017;21:230–234.

A 20-Year-Old with a Molar Pregnancy at 8 Weeks

Sarah Alhaddad Tout

History of Present Illness

A 20-year-old primigravid patient at 8 0/7 weeks' gestation by the last menstrual period presents for her initial pregnancy visit. She reports nausea, vomiting, and vaginal bleeding. Her nausea has been present for four weeks, with progressive worsening. However, her weight has been stable. She reports that her vaginal bleeding began last week and has been intermittent and light. She endorses monthly menses. She has no significant past medical or surgical history. She is taking prenatal vitamins and has no known drug allergies. She denies smoking, alcohol use, or recreational drug use.

Physical Examination

General appearance: Well-developed, ill-appearing

Vital signs:

Temperature: 36.7°C

Pulse: 107 beats per minute

Blood pressure: 112/67 mmHg

Respiratory rate: 16 breaths per minute

SpO₂: 100% on room air

Cardiopulmonary: Tachycardia, regular rhythm, lungs clear to auscultation bilaterally

Abdominal: Soft, non-tender, non-distended

Genitourinary: Scant blood in the vagina without bleeding from the cervical os. The cervix is closed. The uterus is slightly enlarged and globular, and the adnexa are normal.

Laboratory studies:

Hgb: 12.4 g/dL

Hct: 36.5%

ABO/Rh: B negative

Antibody (Ab) screen: Negative

Beta-hCG: 22,827 mIU/mL

Imaging:

Transabdominal (left) and transvaginal (right) ultrasound images demonstrate a multicystic intrauterine mass, with a possible gestational sac, no yolk sac or fetal pole, no adnexal masses, or free fluid in the pelvis (see Figure 5.1).

How Would You Manage This Patient?

This patient presents in the first trimester with a high hCG level and ultrasound findings suggestive of a complete hydatidiform mole. She was counseled on the implications of this diagnosis and the recommendation for surgical management. Blood products were prepared preoperatively. The patient underwent suction dilation and curettage under ultrasound guidance, with uterotonics administered at the time of uterine evacuation. The surgical specimen was sent for histologic evaluation, ultimately confirming the diagnosis of a complete molar pregnancy. She was treated with RhoGAM on the day of surgery and discharged home in stable condition. She was counseled on the importance of serial serum hCG monitoring postoperatively. Contraceptive options for pregnancy prevention during the monitoring period were reviewed to assure accurate postoperative surveillance. She selected depot medroxyprogesterone acetate, which was administered on the day of surgery. Serum hCG values were trended weekly until normalization. Three subsequent hCG levels were obtained at monthly intervals. She conceived again and experienced an uncomplicated pregnancy and term vaginal birth.



Figure 5.1 Sonographic imaging of molar pregnancy. (a) Transabdominal and (b) transvaginal images of an intrauterine molar pregnancy

The placental pathology was unremarkable, and a serum hCG level at 8 weeks' postpartum was negative.

Molar Pregnancy

The hydatidiform mole represents a benign form of gestational trophoblastic disease (GTD) but bears the potential for malignant sequelae. The two subtypes, complete (CM) and partial (PM) mole, differ in their clinicopathologic features, as illustrated in Table 5.1 [1]. Molar pregnancy accounts for 1–2 per 1,000 pregnancies in more economically developed countries, including the United States [2]. The obstetric provider is likely to encounter several patients with molar pregnancy over their time in practice. Recognition of the sometimes subtle characteristics of a patient's presentation that should raise suspicion for the diagnosis and provision of timely management and appropriate follow-up are critical to prevent short-term morbidity and mortality and to detect the malignant sequela of post-molar gestational trophoblastic neoplasia (GTN).

The classic pedagogical presentation of a hydatidiform mole was dramatic, featuring pronounced second-trimester vaginal bleeding, early-onset preeclampsia, thyroid storm, and respiratory distress. Fortunately, with routine use of first-trimester ultrasound, increasing ultrasound resolution, and availability of high-sensitivity hCG assays such presentations are now less common [5]. As the first-trimester clinical presentation, laboratory, and sonographic findings may be more subtle, a high index of suspicion must be maintained to diagnose the condition [3,7]. Sonographic findings may be nonspecific, with features suggestive of the diagnosis of CM and PM noted in Table 5.1. Serum hCG values at diagnosis may also be more difficult to interpret with earlier diagnosis. Whereas those diagnosed in the late first to early second trimester may have hCG values in the hundreds of thousands of mIU/mL with CM, those diagnosed in the early first trimester typically have hCG values of <100,000, and sometimes in the normal range [7]. Careful attention to the hCG level in comparison to the structures visualized sonographically may help guide clinical suspicion. In the patient with no fetal pole, an hCG level of even 25,000 IU/L might be suspicious, as this result falls above the 90th percentile of hCG values at which a

fetal pole would be expected to be visualized in a normal pregnancy [6]. Ultimately, histology of the products of conception is needed to confirm the diagnosis.

All authorities issuing clinical practice guidelines for the management of molar pregnancy agree that suction curettage is the mainstay of therapy for this condition, with most adding that ultrasound guidance should be employed whenever possible, both to assure complete uterine evacuation and to reduce the risk of uterine perforation [2,8]. Suction curettage provides tissue for diagnosis and carries a lower risk of life-threatening hemorrhage and post-molar GTN than medical management [2]. The Society for Gynecologic Oncology (SGO) practice statement, which is endorsed by the American College of Obstetricians and Gynecologists (ACOG), further notes that hysterectomy may be considered for those with a presumed CM who have completed childbearing and reduces the risk of post-molar GTN by as much as 80%. In those managed with suction curettage who are Rh antigen negative, RhoGAM should be administered, regardless of molar subtype, as RhD is expressed on trophoblast tissue [2]. While rates of life-threatening hemorrhage are decreased with first-trimester diagnosis and management, uterotonics should be available at the time of uterine evacuation, with some experts recommending routine use at the time of curettage [5]. Blood products should be available for emergency transfusion if needed. The routine use of prophylactic chemotherapy at the time of uterine evacuation is not recommended by most experts [1,3,5].

Postoperatively, surveillance of serum hCG levels is critical to detect the development of post-molar GTN. Monitoring is performed weekly until normalization, then on a monthly recurring basis to assure continued negative values. While the recommended duration for hCG surveillance after normalization varies in the literature [4], the ACOG-endorsed SGO practice statement on the management of GTD recommends three negative monthly surveillance hCG values after normalization for patients with CM, and one negative value 1 month after normalization for patients with PM [2]. Patients should be informed of the importance of avoiding pregnancy in order to assure adequate post-evacuation surveillance and should be counseled on and provided with contraception [8].

Table 5.1 Clinicopathologic features of molar pregnancy by subtype

	Incidence	Suggestive US findings	Laboratory	Histology	Karyotype and genetic origin	Associated incidence of GTN
CM	1–3/1,000 [3]	Multicystic echogenic intrauterine mass, or anembryonic gestation [3]	hCG >100,000 or hCG greater than expected for structures present for GA [2,4]	Edematous and dysmorphic villi, entirely trophoblast with no amnion or fetus [1]	46 XX, paternal origin, fertilization of ovum with inactivated maternal DNA by single sperm with duplication of paternal genome 46XY, paternal origin, dispermic fertilization of ovum with inactivated maternal DNA [1]	All cases: 7–30% [5] Cases with hCG normalization: 0.35% [6]
PM	3/1,000 [3]	Missed abortion with cystic placenta, ± embryo [3]	hCG may be normal [2]	Less villous edema and trophoblast proliferation compared to CM, fetus and amnion usually present [1]	46 XXY or 46 XXX 2/3 paternal, 1/3 maternal – dispermic fertilization of genetically normal ovum [1]	All cases: 2.5–7.5% [5] Cases with hCG normalization: 0.03% [6]

The majority of patients who develop post-molar GTN will be diagnosed based on a failure of hCG to normalize during post-evacuation surveillance [6]. A plateauing of hCG, $\pm 10\%$, for four consecutive values over 3 weeks, a rise in the hCG level of $\geq 10\%$ for three values over 2 weeks, a histologic diagnosis of choriocarcinoma, or radiographic and/or clinical evidence of metastases is diagnostic of post-molar GTN. Patients diagnosed with GTN should be referred to a gynecologic oncologist. Persistence of hCG for 6 months after evacuation is no longer considered a diagnostic criterion for GTN, provided the aforementioned criteria are not met.

Rarely, molar pregnancy occurs with a coexistent viable fetus. While evidence is limited to case reports and series, live births can occur in those with coexistent molar-twin pregnancies, with rates as high as 40–60% [1,5]. Patients in this rare situation should be counseled regarding the significantly higher rates of obstetric complications, such as hypertensive disorders and life-threatening bleeding, potentially necessitating pregnancy termination, as well as the substantially increased risk of subsequent GTN, with greater associated morbidity [5].

Following the resolution of molar pregnancy, patient counseling regarding long-term risk is also essential. Patients can be reassured that the likelihood of a subsequent normal pregnancy following treatment for CM or PM is high [2]. However, the risk of recurrence should be discussed. A history of one molar pregnancy confers a 10-fold increased risk over the general population of subsequent molar pregnancy. A history of two molar pregnancies confers a 100-fold

increased risk [2,3]. As a result, early first-trimester ultrasound in any subsequent pregnancy is recommended to assure a normal-appearing gestation. In addition, following any gestational event, a serum hCG level should be assessed 6–8 weeks following pregnancy completion to assess for non-molar GTN. Placental pathology at the time of delivery should also be considered.

Key Teaching Points

- The clinical presentation of molar pregnancy in the first trimester may be subtle. The diagnosis should be included in the differential for any patient with first-trimester vaginal bleeding.
- Suction curettage is the preferred initial therapy for the majority of patients diagnosed with molar pregnancy. Medical management is not recommended.
- Close surveillance of serum hCG levels is required postoperatively to monitor for the development of post-molar GTN.
- Prompt referral to a gynecologic oncologist is indicated if diagnostic criteria for post-molar GTN are met.
- Patient-centered contraceptive planning is essential to help assure accurate postoperative surveillance of patients with molar pregnancy.
- Patients should be counseled that a history of molar pregnancy increases the risk of future molar pregnancy, and early evaluation of any future pregnancy is recommended.

References

- 1 Gestational Trophoblastic Disease. In: Hoffman B, Shorge J, Schaffer J, et al. (eds.). *Williams Gynecology*. New York: McGraw Hill Medical; 2012. 898–915.
- 2 Horowitz NS, Eskander RN, Adelman MR, et al. Epidemiology, Diagnosis, and Treatment of Gestational Trophoblastic Disease: A Society of Gynecologic Oncology Evidenced-Based Review and Recommendation. *Gynecol Oncol*. 2021;163(3):605–613.
- 3 Ngan HY, Seckl MJ, Berkowitz RS, et al. Update on the Diagnosis and Management of Gestational Trophoblastic Disease. *Int J Gynecol Obstet*. 2018;143:79–85.
- 4 Connolly A, Ryan DH, Stuebe AM, et al. Reevaluation of Discriminatory and Threshold Levels for Serum β -hCG in Early Pregnancy. *Obstet Gynecol*. 2013;121(1):65–70.
- 5 Soper JT. Gestational Trophoblastic Disease: Current Evaluation and Management. *Obstet Gynecol*. 2021;137(2):355.
- 6 Albright BB, Shorter JM, Mastroyannis SA, et al. Gestational Trophoblastic Neoplasia after Human Chorionic Gonadotropin Normalization Following Molar Pregnancy: A Systematic Review and Meta-analysis. *Obstet Gynecol*. 2020;135(1):12–23.
- 7 Sun SY, Melamed A, Goldstein DP, et al. Changing Presentation of Complete Hydatidiform Mole at the New England Trophoblastic Disease Center over the Past Three Decades: Does Early Diagnosis Alter Risk for Gestational Trophoblastic Neoplasia? *Gynecol Oncol*. 2015;138(1):46–49.
- 8 Tsakiridis I, Giouleka S, Kalogiannidis I, et al. Diagnosis and Management of Gestational Trophoblastic Disease: A Comparative Review of National and International Guidelines. *Obstet Gynecol Surv*. 2020;75(12):747–756.

A 20-Year-Old with Anxiety and Depression at 7 Weeks

Meleen Chuang

History of Present Illness

A 20-year-old primigravid patient presents with her mother for an initial prenatal visit at 7 weeks' gestation by her last menstrual period. The patient has a long-standing history of severe anxiety and depression. She previously took sertraline and clonazepam daily as prescribed by her psychiatrist. The patient had experienced improvement in her symptoms for the last 10 months. Upon learning about her pregnancy, she ceased all medications due to concerns about potential harm to the early pregnancy. Presently, she denies experiencing suicidal ideations or thoughts of self-harm. She is feeling anxious about the pregnancy and her ability to provide financial support for her baby. Her relationship with her partner is positive, and her mother serves as a supportive role model.

Physical Examination

General appearance: Well-appearing, with an anxious affect

Vital signs:

Temperature: 37.2°C

Pulse: 80 beats per minute

Blood pressure: 120/70 mmHg

Respiratory rate: 12 breaths per minute

BMI: 26.2 kg/m²

Cardiopulmonary: Regular rate and rhythm, without murmur, rub, or gallop. Lungs are clear upon bilateral auscultation.

Abdomen: The abdomen is soft and non-tender.

Pelvic: Normal external genitalia, with no lesions or masses.

Imaging:

A singleton viable intrauterine pregnancy at 7 1/7 weeks, determined by CRL. Positive fetal cardiac activity detected at a rate of 167 beats per minute

How Would You Manage This Patient?

This patient is concerned about exposure to potentially teratogenic medication during the first trimester and is here for counseling and adjustment of her medications. She has taken the first step in conservative management by seeking medication adjustment and is already engaged in behavioral therapy. At-risk patients should be screened for depression, and early integration of psychiatric help into pregnancy care has been shown to improve depression treatment. The obstetrician should discuss the need to continue counseling and medication treatment for depression during pregnancy. Behavioral therapy and counseling have been demonstrated to be the most beneficial treatment for preventing worsening depression

and are endorsed by both the United States Preventive Services Task Force (USPSTF) and American College of Obstetricians and Gynecologists (ACOG) [1].

Counseling about medication exposure in pregnancy entails balancing evidence-based risks to her baby with potential harms to the patient resulting from medication discontinuation. The provider should address the patient's concerns and reassure her to continue sertraline as prescribed. No known fetal congenital anomalies are associated with sertraline. Titration of sertraline might be necessary, necessitating collaboration between the psychiatrist and the obstetrician. Evidence-based risk assessments of selective serotonin reuptake inhibitor (SSRI) exposure during pregnancy indicate no increased risk of miscarriage, preterm delivery, or long-term developmental issues. It is safe for postpartum patients to continue using SSRIs during lactation. The risks of untreated depression for both the mother and fetus may outweigh the risks of taking SSRIs.

It is advisable for the patient to discontinue clonazepam during pregnancy, particularly by the third trimester, as some exposed infants may experience trouble breathing, poor circulation, and low muscle tone. Clonazepam passes into breast milk in small amounts. Due to its potential to cause sedation and accumulate in the infant's body, other medications might be preferred during lactation. The patient should undergo an early anatomy scan and be encouraged to attend regular prenatal care visits. Additionally, screening for substance use disorders and intimate partner violence is recommended.

Major Depression in Pregnancy

Major depression is common during pregnancy due to physiological changes and the stress associated with this significant life event. Depression during pregnancy is frequently underdiagnosed and undertreated. Approximately 20% of women will experience a major depressive episode during pregnancy, and the use of antidepressants during pregnancy is prevalent. Nearly 8% of all pregnancies involve exposure to antidepressant medications, with 2.8% of women maintaining treatment throughout pregnancy. Reasons for undertreatment may include personal reluctance to initiate antidepressant treatment, providers' discomfort with prescribing antidepressants to pregnant patients, and a lack of consensus among studies in the literature [2]. The risks of untreated depression during pregnancy are substantial. A clear association exists between untreated depression and poor nutrition, substance use disorders, inadequate prenatal care, and an increased risk of preterm birth, lower birth weight, and lower Apgar scores. Studies indicate a 68% relapse rate among patients who discontinue antidepressant therapy during pregnancy. Suicide remains a leading cause of maternal mortality in the

postpartum period, accounting for 20% of all maternal deaths in the first year after birth.

Screening for Perinatal Depression

Patients are generally receptive to screening for perinatal depression. Early identification of at-risk patients allows for timely intervention in routine pregnancy care. This increases the likelihood of detecting and treating undiagnosed patients, reducing stigma, and providing timely access to tailored care. The recommendation of ACOG is that obstetricians screen patients at least once during the perinatal period for depression and anxiety symptoms using a standardized, validated tool. A comprehensive postpartum visit should also include a full assessment of mood and emotional well-being, including screening for postpartum depression and anxiety using a validated instrument. If a patient is screened for depression and anxiety during pregnancy, additional screening should also occur during the comprehensive postpartum visit. The goal of screening is to determine a patient's risk of mood disorders, thereby enabling interventions before symptoms arise [3].

Cognitive Behavioral Therapy and Interpersonal Psychotherapy for Depression in Pregnancy

Treatment options for pregnant patients with depression should encompass psychotherapy and pharmacotherapy. Psychotherapy interventions such as cognitive behavioral therapy (CBT) and interpersonal psychotherapy (IPT) are effective in managing perinatal depression. Cognitive behavioral therapy focuses on the concept that positive changes in mood and behavior can be achieved by addressing and managing negative thoughts, beliefs, and attitudes, while increasing positive events and activities. Interpersonal psychotherapy is a form of psychotherapy that focuses on alleviating symptoms by improving interpersonal functioning. It operates on the belief that psychological symptoms can arise in response to current difficulties in everyday relationships with others. Collaboration between psychiatrists, behavioral health specialists, and obstetricians during a patient's prenatal care has been demonstrated to assist pregnant patients with mild to moderate depressive or anxiety symptoms, potentially reducing the risk of postnatal anxiety disorders. Structured integration of CBT and IPT through psychiatry visits during a patient's prenatal care enhances both compliance with pregnancy visits and treatment efficacy.

Antidepressants and the Potential Risk of Teratogenicity in Pregnancy

The most used antidepressants in the United States are SSRIs, particularly sertraline. Antidepressants can cross the placenta and the fetal blood–brain barrier, increasing the potential risks of teratogenesis as well as antepartum and postnatal effects. The initial treatment for pregnant patients with severe major depression involves psychotherapy, with antidepressants

administered as an adjunct. Citalopram and escitalopram can also be used with minimal to no risk of teratogenicity in the first trimester. Fluoxetine is not a first-line choice due to its longer half-life, which can also lead to its accumulation in breastmilk. A large meta-analysis reported that SSRIs are not associated with higher rates of birth defects or long-term changes in mental development after adjusting for confounding factors linked to underlying psychiatric illness [4].

The most extensively studied are SSRIs. Antenatal SSRIs have not been found to be associated with major congenital malformations. The use of SSRIs is more widely accepted for antenatal depression than other antidepressants, and more is known about the antenatal risks of SSRIs. Most authoritative reviewers consider sertraline a preferred antidepressant during lactation. Paroxetine is an exception, and pregnant patients as well as those planning pregnancy should avoid it. Fetal echocardiography should be considered for patients exposed to paroxetine during early pregnancy due to conflicting evidence of cardiac anomalies associated with paroxetine exposure. Associations of preterm birth (<37 weeks' gestational age) are associated with SSRIs but not with low birth weight or perinatal death. Mothers taking an SSRI during pregnancy and postpartum may face challenges with lactation and might require additional lactation support [5].

Non-SSRI Antidepressants Are Not as Well Studied

Non-SSRI antidepressants are used less frequently, and less is known about potential adverse consequences associated with their use. Selective norepinephrine reuptake inhibitors such as duloxetine and venlafaxine do not appear to be associated with an increased risk of congenital malformations, small-for-gestational-age infants, or preterm birth. Atypical antidepressants such as bupropion may be linked to spontaneous abortion but not to preterm birth, low birth weight, or small-for-gestational-age infants. Clonazepam should be avoided prior to the second trimester and should not be used in combination with diphenhydramine, anticonvulsants, or other central nervous system depressants. Expert consensus guidelines suggest that low-dose clonazepam can be used in pregnancy to treat restless leg syndrome. Maternal clonazepam use may cause sedation in breastfed infants and should be used cautiously during lactation. Evidence regarding cleft lip and palate associated with benzodiazepines has not been confirmed in multiple small studies [6].

Lithium exposure is linked to an increased risk of fetal cardiac anomalies, with an absolute risk of Ebstein's anomaly of 6 per 1,000. Antipsychotics have not been associated with an increase in birth defects. Risperidone and paliperidone have been potentially linked to a higher risk of miscarriage and, after delivery, a greater likelihood of neonatal withdrawal symptoms, requiring close monitoring of the infant a few days after birth. Olanzapine and quetiapine may elevate the risk of gestational diabetes. Monoamine oxidase inhibitors (MAOIs) should not be used during pregnancy due to insufficient evidence supporting their safety. The use of MAOIs during labor may lead to hypertensive crisis.

Summary

The objectives of perinatal mental health treatment are to mitigate the physical, mental, and psychosocial impacts of the patient's mental health disorder on the pregnancy. Patients previously treated with antidepressants should generally continue the same pharmacotherapy during pregnancy. Regular symptom monitoring and dose adjustments during pregnancy to maintain efficacy can improve both the patient's mental health and pregnancy outcomes. MotherToBaby provides valuable patient resources offering evidence-based information about medications during pregnancy and lactation [7]. The LactMed database contains information about drugs and other chemicals to which lactating patients may be exposed, along with possible adverse effects on breastfeeding infants [8].

Key Teaching Points

- Counseling regarding medication exposure in pregnancy involves balancing evidence-based risks to the fetus with

potential harms to the patient from medication discontinuation.

- It is generally safe to continue SSRIs during pregnancy. Unless there's a specific reason to use another class of antidepressants, SSRIs are usually the first-line choice during pregnancy.
- It is advisable to consider using an antidepressant that the patient has responded to in the past, to avoid unnecessary exposures during pregnancy.
- Psychotherapy and antidepressants are often used together for the best outcomes.
- To minimize both illness and medication exposure, use the lowest effective dose while avoiding undertreatment. If possible, avoid polypharmacy with multiple psychotropic medications.
- Exposure to untreated illness can be minimized through preconception counseling, education about treatment risks and benefits, close clinical monitoring, and a well-crafted treatment plan tailored to each patient's needs.

References

- 1 Treatment and Management of Mental Health Conditions during Pregnancy and Postpartum: ACOG Clinical Practice Guideline No. 5. *Obstet Gynecol.* 2023;141:1262–1288.
- 2 Becker M, Weinberger T, Chandy A, et al. Depression during Pregnancy and Postpartum. *Curr Psychiatry Rep.* 2016;18(3):32.
- 3 ACOG Committee Opinion No. 757: Screening for Perinatal Depression. *Obstet Gynecol.* 2018;132(5):e208–e212.
- 4 Creeley CE, Denton LK. Use of Prescribed Psychotropics during Pregnancy: A Systematic Review of Pregnancy, Neonatal, and Childhood Outcomes. *Brain Sci.* 2019;9(9):235.
- 5 Gao SY, Wu QJ, Sun C, et al. Selective Serotonin Reuptake Inhibitor Use during Early Pregnancy and Congenital Malformations: A Systematic Review and Meta-analysis of Cohort Studies of More Than 9 Million Births. *BMC Med.* 2018;16(1):205.
- 6 Betcher HK, Wisner KL. Psychotropic Treatment during Pregnancy: Research Synthesis and Clinical Care Principles. *J Womens Health (Larchmt).* 2020; 29(3):310–318.
- 7 MotherToBaby. www.mothersbaby.org (accessed September 23, 2024).
- 8 National Institute of Child Health and Human Development. Drugs and Lactation Database (LactMed®). www.ncbi.nlm.nih.gov/books/NBK501922/#IX-C (accessed September 23, 2024).

A 40-Year-Old with Nausea, Vomiting, and Weight Loss at 7 Weeks

William Po

History of Present Illness

A 40-year-old gravid 3 para 1-0-1-1 at 7 1/7 weeks' gestation presents with nausea, vomiting, and weight loss. Her symptoms have been present for 3 weeks. Her nausea and vomiting are constant throughout the day with periods of worsening at night. Certain odors trigger emesis and dry heaving. She denies fever, headache, diarrhea, hematochezia, or abdominal pain. There is no vaginal bleeding or fluid leakage. She has tried ginger and over-the-counter pyridoxine with no relief. She lost body weight from a pre-pregnancy weight of 80.7 kg to now 73.5 kg. She has not consumed any unusual foods, and there are no other sick family members. She denies a history of thyroid, liver, or gastrointestinal disorders.

Physical Examination

General appearance: Visibly nauseated

Vital signs:

Temperature: 37.1°C

Pulse: 85 beats per minute

Blood pressure: 110/66 mmHg

Respiratory rate: 20 breaths per minute

BMI: 27.81 kg/m²

Cardiopulmonary: Regular rate and rhythm, lungs clear on auscultation bilaterally

Neck: No thyromegaly, no nodules palpated

Mouth: Dry mucous membranes

Abdomen: Soft, non-tender, non-distended, normal active bowel sounds, no rebound or guarding, no masses or hernias, no hepatosplenomegaly

Pelvic: Normal external genitalia, vaginal and cervical mucosa normal, cul-de-sac unobstructed, uterus slightly enlarged appropriate for 7 weeks, normal adnexa with no masses or tenderness

Laboratory studies:

Hgb: 11.4 g/dL

Cr: 0.65 mg/dL

Sodium: 139 mEq/L

Potassium: 3.0 mEq/L

Beta-hCG: 125,933 mIU/mL

AST: 12 IU/L

ALT: 15 IU/L

TSH: 0.5 mIU/L

Urinalysis: Specific gravity 1.030, 4+ Ketones

Imaging:

Pelvic ultrasound demonstrates a singleton intrauterine pregnancy with an overall size consistent with the

gestational age. A fetal pole with positive fetal cardiac activity is visualized. The rest of the pelvic anatomy, including the adnexa, appears unremarkable.

How Would You Manage This Patient?

Nausea and vomiting of pregnancy and its extreme manifestation, hyperemesis gravidarum, are diagnoses of exclusion. Symptoms of hyperemesis usually occur before 9 weeks' gestation. Those that are present before pregnancy or after 9 weeks may indicate other causes. Headache, fever, and abdominal pain are not typical. It is important to determine associated symptoms, duration, intensity, frequency, time of day, or other circumstances that improve or worsen symptoms. A careful assessment of the degree of dehydration and symptom severity should be made. One validated tool that can be used in assessing the severity of the patient's symptoms is the Pregnancy-Unique Quantification of Emesis and nausea (PUQE) index. It is short, quick, and considers the mother's perception and quality of life [1,2].

A physical exam to rule out other possible causes of nausea, such as pancreatitis, appendicitis, and pyelonephritis, should be performed. Laboratory assessment can include a urinalysis for specific gravity and the presence of ketones. A metabolic panel can help determine the severity of the condition. Hyperemesis itself can cause laboratory abnormalities such as increased liver enzymes (usually <300 units/L), serum bilirubin (<4 mg/dL), and serum amylase or lipase concentrations (up to five-times greater than normal levels). Between 5 and 66% of patients with hyperemesis gravidarum will have suppressed TSH levels or elevated free thyroxine concentrations. With no history of thyroid disease and no goiter, thyroid medications are not indicated [1,3]. In assessing the pregnancy, an ultrasound is sufficient to document viability, rule out multiple gestations, or a molar pregnancy.

The mainstay of management is the determination of the level of support required and if the patient needs hospital admission, intravenous (IV) fluids, antiemetics, and electrolyte or vitamin replacement. Careful planning for outpatient follow-up is critical to prevent recurrent hospitalization and maternal weight loss.

Hyperemesis Gravidarum

There is no standard definition for hyperemesis gravidarum. Generally, the criteria include persistent vomiting not related to other causes, a measure of acute starvation (usually large ketonuria), and documented weight loss, most often at least 5% of pre-pregnancy weight. Electrolyte, thyroid, and liver

abnormalities may also be present. Hyperemesis gravidarum can be thought of as the severe end of the spectrum of nausea and vomiting of pregnancy. The incidence of hyperemesis gravidarum is approximately 0.3–3% of pregnancies, but the reported incidence varies because of different diagnostic criteria and ethnic variation in study populations [4].

Risk factors include women with increased placental mass (molar gestation or multiple gestation), a history of motion sickness, migraine headaches, a family history, and a history of hyperemesis gravidarum in a previous pregnancy. Daughters and sisters of patients who had hyperemesis gravidarum are more likely to have the same condition, as are patients carrying a female fetus [1].

Levels of hCG may be a factor. During the first trimester, hCG levels peak, corresponding to the typical onset of hyperemesis symptoms. Studies show a correlation between higher hCG concentrations and hyperemesis. However, these data have not been consistent [5]. Estrogen is also thought to contribute to nausea and vomiting in pregnancy. Estradiol levels increase early in pregnancy and decrease later, mirroring the typical course of nausea and vomiting in pregnancy. Additionally, nausea and vomiting are the known side effects of estrogen-containing medications. As the level of estrogen increases, so does the incidence of vomiting [6].

Nausea and vomiting in pregnancy are common, usually starting before 9 weeks with the majority resolving by 20 weeks. Approximately 3% of patients will continue their symptoms into the third trimester. In contrast, about 10% of patient with the more severe hyperemesis gravidarum will have symptoms throughout the entirety of the pregnancy.

Mortality from hyperemesis is rare, but there can be significant morbidity. Wernicke encephalopathy, splenic avulsion, esophageal rupture, pneumothorax, and acute tubular necrosis have been reported. Wernicke encephalopathy related to hyperemesis gravidarum has been associated with maternal death or permanent neurologic disability. There can also be significant psychosocial morbidity caused by hyperemesis, resulting in a decision for pregnancy termination. A systematic review of psychological morbidity in relation to hyperemesis gravidarum demonstrated significantly higher depression and anxiety scale scores in patients with hyperemesis compared to controls [1,3,7]. Fetal effects are dependent on the severity of the disease. With mild or moderate vomiting, there is little effect on pregnancy outcomes, and there is no significant association of hyperemesis gravidarum with congenital anomalies. A review and meta-analysis reported an association of a higher incidence of low birth weight, small-for-gestational-age, and prematurity with hyperemesis, but the included studies were limited by small population sizes [1,3,7,8].

The treatment of hyperemesis gravidarum focuses on relieving symptoms and preventing serious morbidity such as Wernicke encephalopathy, renal impairment, and extreme weight loss. Treatment can be approached in three general overlapping levels. First-line treatments include simple lifestyle changes such as eating small amounts often, avoiding dietary triggers and strong odors, eating high-carbohydrate,

low-fat foods, and over-the-counter remedies such as vitamin B6 (pyridoxine), ginger, and sea bands (an acupressure wristband that stimulates the Pericardium P6 acupressure point). All these methods have limited conflicting data on efficacy [3].

Second-line treatments are typically prescribed when a patient first presents to medical care, and include a range of antiemetic medications, as well as IV fluid and electrolyte replacement for patients who are dehydrated and ketotic. No single medication has been proven to be more effective than another but can include pyridoxine alone or in combination with doxylamine [3]. Dopamine antagonists, such as metoclopramide and various phenothiazine medications (promethazine, prochlorperazine, or chlorpromazine), have been described in the medical literature for the treatment of nausea and vomiting of pregnancy. These medications may be given orally, rectally, intramuscularly, or intravenously but have the side effects of sedation, dry mouth, and drowsiness [3,9].

Antihistamines (such as dimenhydrinate and diphenhydramine) have been shown to be effective in controlling nausea and vomiting symptoms of pregnancy. Common adverse effects include sedation, dry mouth, lightheadedness, and constipation [3,9]. Evidence is limited regarding the safety and efficacy of the serotonin 5-HT₃ inhibitors, such as ondansetron. Common adverse effects include headache, drowsiness, fatigue, and constipation. Ondansetron can prolong the QT interval, especially in patients with underlying heart problems, and can cause hypokalemia or hypomagnesemia. A possible association of ondansetron use in the first trimester with a cleft palate has been reported, but the data are limited. Individual studies of the association between ondansetron and congenital malformations are inconsistent, with some showing an increase in birth defects and others showing no difference. The use of ondansetron before 10 weeks' gestation should be individualized based on the known risks and potential benefits to the patient [3,9].

Third-line treatments are for those with severe, persistent symptoms and are initiated in a hospital setting. These include corticosteroids and supportive therapy, such as enteral feeding.

Several case series have suggested a benefit of corticosteroids in the treatment of hyperemesis. Three studies have confirmed an association between oral clefts and methylprednisolone use in the first trimester. The teratogenic effect appears to be weak. However, in view of this data, corticosteroid use for hyperemesis should be used with caution and avoided as a first-line agent before 10 weeks' gestation. The most described regimen is methylprednisolone 48 mg/day for 3 days, given orally or intravenously. Patients who do not respond within 3 days are not likely to respond, and treatment should be stopped. For those who do respond, the dose may be tapered over a period of 2 weeks. For recurrent vomiting, the tapering may be stopped, and the patient continued on the effective dose for up to 6 weeks. To limit serious maternal adverse effects, corticosteroids should not be continued beyond this period. Treatment may work in refractory cases, but the risk profile of methylprednisolone suggests it should be a last-resort treatment [1,3,9].

Enteral tube feeding (nasogastric or nasoduodenal) should be initiated to provide nutritional support to patients with hyperemesis gravidarum who are not responsive to medical therapy and cannot maintain their weight. Total parenteral nutrition is a potentially life-threatening intervention because of associated sepsis and thromboembolic events. The use of total parenteral nutrition in women with hyperemesis should be considered if enteral feeding fails; however, its use should be weighed against the adverse neonatal outcomes that have been reported [1,3,9].

Key Teaching Points

- The diagnosis of hyperemesis gravidarum is one of exclusion and includes a combination of severe nausea and vomiting, dehydration, and weight loss.
- Intravenous hydration should be used for the patient who cannot tolerate oral liquids for a prolonged period or if clinical signs of dehydration are present. Correction of ketosis and vitamin deficiency should be strongly considered. Dextrose and vitamins should be included in the therapy when prolonged vomiting is present, and thiamine should be administered before dextrose infusion to prevent Wernicke encephalopathy.
- The treatment of hyperemesis gravidarum with methylprednisolone may be useful in refractory cases; however, the risk profile of methylprednisolone suggests it should be a last-resort treatment.
- Enteral tube feeding should be used to provide nutritional support to patients with hyperemesis gravidarum who are not responsive to medical therapy and cannot maintain their weight.
- Peripherally inserted central catheters should not be used routinely given the significant complications associated with this intervention.

References

- 1 ACOG Practice Bulletin No. 189: Nausea and Vomiting of Pregnancy. *Obstet Gynecol.* 2018;131(1):e15–e30.
- 2 Koren G, Piwko C, Ahn E, et al. Validation Studies of the Pregnancy Unique-Quantification of Emesis (PUQE) Scores. *J Obstet Gynaecol.* 2005;25:241–244.
- 3 McParlin C, O'Donnell A, Robson SC, et al. Treatments for Hyperemesis Gravidarum and Nausea and Vomiting in Pregnancy: A Systematic Review. *JAMA.* 2016;316(13):1392–1401.
- 4 London V, Grube S, Sherer DM, et al. Hyperemesis Gravidarum: A Review of Recent Literature. *Pharmacology.* 2017;100(3–4):161–171.
- 5 Soules MR, Hughes CL, Garcia JA, et al. Nausea and Vomiting of Pregnancy: Role of Human Chorionic Gonadotropin and 17-hydroxyprogesterone. *Obstet Gynecol.* 1980;55(6):696–700.
- 6 Goldzieher JW, Moses LE, Averkin E, et al. A Placebo-Controlled Double-Blind Crossover Investigation of the Side Effects Attributed to Oral Contraceptives. *Fertil Steril.* 1971;22(9):609–623.
- 7 McCarthy FP, Lutonski JE, Greene RA. Hyperemesis Gravidarum: Current Perspectives. *Int J Womens Health.* 2014;6:719–725.
- 8 Dodds L, Fell DB, Joseph KS, et al. Outcomes of Pregnancies Complicated by Hyperemesis Gravidarum. *J Obstet Gynecol.* 2006;107:285–292.
- 9 Boelig RC, Barton SJ, Saccone G, et al. Interventions for Treating Hyperemesis Gravidarum: A Cochrane Systematic Review and Meta-analysis. *J Matern Fetal Neonatal Med.* 2018;31(18):2492–2505.

A 30-Year-Old with Worsening Migraine Headaches at 14 Weeks

Ariana Lewis

History of Present Illness

A 30-year-old gravida 4 para 2 at 14 0/7 weeks' gestation presents to the emergency room with the chief complaint of a worsening headache. She describes a throbbing, left-sided headache that has been present for 3 days. She has had four episodes of emesis today and feels weak and fatigued. She has been taking acetaminophen 650 mg every 4 hours with minimal relief. Prior to this pregnancy, she would get twice-monthly migraine headaches that were managed with sumatriptan. She stopped taking sumatriptan when she found out she was pregnant. She stays home from work when the headaches occur because she has trouble functioning. Her headaches have never been this severe in the past. She has no other past medical history, and her surgical history is notable for a laparoscopic cholecystectomy 10 years ago. She denies tobacco, alcohol, or drug use. She denies fever, confusion, trauma, or vision changes.

Physical Examination

General appearance: Tearful, appears distressed

Vital signs:

Temperature: 37.1°C

Pulse: 94 beats per minute

Blood pressure: 126/74 mmHg

Respiratory rate: 18 breaths per minute

Height: 160 cm

Weight: 64.9 kg

BMI: 25.3 kg/m²

Head/neck: Normocephalic, atraumatic, neck is supple

Eyes: Pupils are equally round and reactive to light

Cardiopulmonary: Regular rate and rhythm, no murmurs, rubs, or gallops. Lungs clear to auscultation bilaterally

Abdomen: Soft, non-tender, non-distended

Neurologic: Alert and oriented × 3, cranial nerves II–XII intact, sensation intact, 5/5 strength in all extremities

Fetal assessment: 140 beats per minute

Laboratory studies:

Urine specific gravity: 1.035

WBC: 8,500/μL

Sodium: 135 mEq/L

Potassium: 3.1 mEq/L

How Would You Manage This Patient?

This patient presents with a worsening headache in the setting of early pregnancy, specifically <20 weeks' gestation. She does not have warning symptoms that warrant imaging to evaluate causes of secondary headaches. Her history of migraine and current symptoms of nausea and fatigue indicate that this is likely an intractable migraine headache. Additionally, her urinalysis and basal metabolic panel reveal that she is dehydrated and has mild hypokalemia secondary to emesis. Due to her recent use of acetaminophen and oral intolerance, she was treated with IV metoclopramide and diphenhydramine. She received a 1-liter bolus of lactated Ringer's solution and IV potassium chloride. Her symptoms did not completely resolve, so she was treated with 30 mg of IV ketorolac. She was admitted for observation overnight and continued to receive maintenance IV fluids, metoclopramide, and diphenhydramine. Given the initial lack of improvement with treatment and a new onset of blurry vision, an magnetic resonance imaging (MRI) of her brain was performed. The imaging showed no intracranial abnormalities. Next, a single dose of subcutaneous sumatriptan was administered. The patient had resolution of her symptoms by the next morning and was tolerating oral intake. She was discharged home with instructions for analgesic and abortive treatments of her migraine headaches.

Headache in Pregnancy

Headaches are known to occur in approximately 25% of reproductive-aged women [1]. Consequently, headaches are a common antenatal diagnosis. It is vital to differentiate primary from secondary headaches in the initial evaluation of patients. A thorough history is needed to determine features of baseline headaches, acute changes, and medication use. A detailed physical examination is required to rule out neurological deficits and vision changes.

The three primary headaches are tension, migraine, and cluster. Tension headaches tend to present as a squeezing or aching bifrontal or bioccipital pain that can last for several hours (episodic) or a few days (chronic). Tension headaches are not associated with aura and do not have prodromal symptoms. Cluster headaches occur three times more often in men than women and are described as unilateral, penetrating pain. Unilateral lacrimation, ptosis, and conjunctival injection can be associated with cluster headaches [2]. Cluster headaches tend to last 30–90 minutes.

Migraine headaches present with prodromal symptoms of decreased energy, mood changes, irritability, food craving,

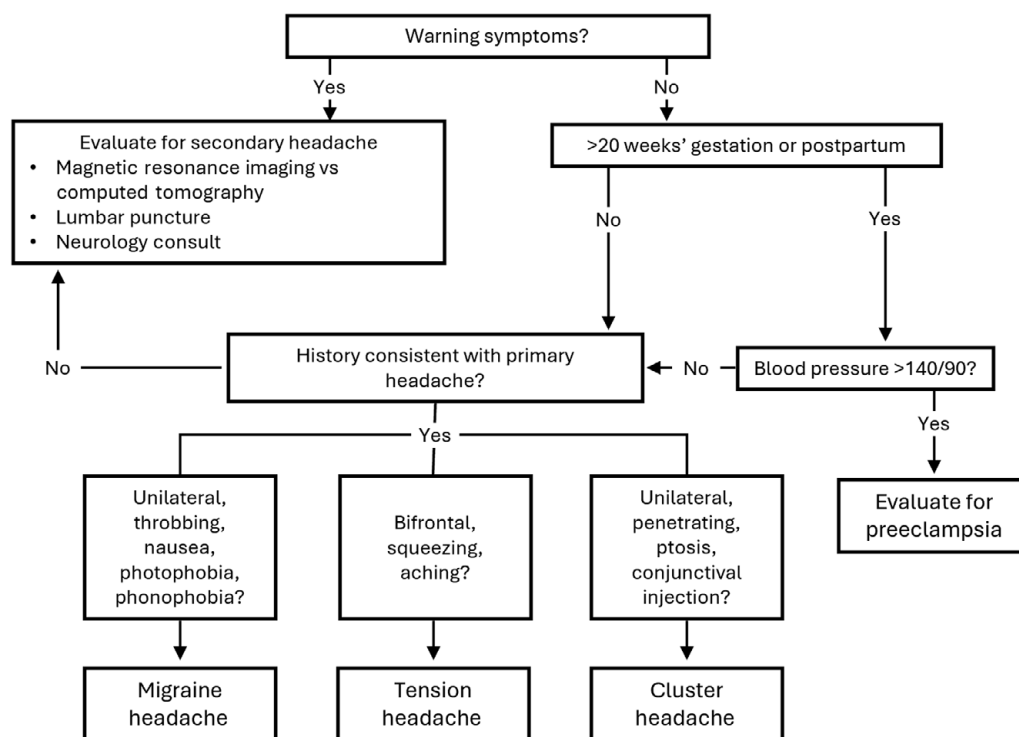


Figure 8.1 Evaluation of headache in pregnancy

yawning, neck stiffness, or fatigue. This prodrome lasts 1–2 days and is followed by throbbing, pulsating, unilateral pain. About one in four patients will experience focal neurological symptoms known as auras, which last for up to 1 hour. Most auras are visual, but some may be auditory, motor, or speech related. Migraines also present with at least one of the following symptoms: nausea, emesis, photophobia, and/or phonophobia [1]. Migraine headaches last from 4 to 72 hours. There is a known association between migraine headaches and serum estradiol levels. Studies have shown that low estradiol levels make patients more susceptible to migraines. This is seen in patients who suffer from menstrual migraines during the onset of menstruation when estrogen levels are lowest. For this reason, up to 80% of women see improvement in their headaches due to elevated estrogen levels during pregnancy [3]. However, a small percentage of pregnant patients may have more severe and/or more frequent migraine headaches.

Any intractable or severe headache warrants further evaluation for a secondary etiology. Warning symptoms include the presence of neurological deficits, post-traumatic onset, abrupt onset, fever, seizure, altered mental status, vision changes, or severe headaches that differ from prior primary headaches (Figure 8.1) [4]. If any of these criteria are met, the patient may warrant evaluation with brain imaging, a lumbar puncture, or consultation with a neurologist. If brain imaging is needed in pregnancy, MRI is the preferred methodology. Computed tomography (CT) should be utilized if MRI is unavailable [5]. Use of gadolinium contrast, which is known to cross the placenta, should be avoided unless the potential fetal risk is outweighed by the potential maternal benefit. The same caution applies to iodinated contrast for CT scans. The differential diagnosis of

secondary headache includes subarachnoid hemorrhage, ischemic stroke, intracerebral hemorrhage, idiopathic intracranial hypertension, meningitis, encephalitis, substance use, substance withdrawal, and neoplasm. Lastly, preeclampsia should be considered in patients >20 weeks' gestation with a blood pressure of >140/90 mmHg.

Management of migraine headache in pregnancy focuses on analgesic treatment with the lowest risk for both the patient and the fetus. Consideration should be given to non-pharmacologic options for migraine headache treatment and prevention as well. Many patients with migraine headaches benefit from lifestyle changes that optimize the quality of sleep, management of stress, and avoidance of triggers. Patients should avoid emotional stressors, practice good sleep hygiene, avoid skipping meals, and exercise regularly. Although evidence is limited, patients may benefit from cognitive behavioral therapy (CBT), yoga, meditation, acupuncture, and physical therapy [6].

The first-line pharmacologic therapy is oral acetaminophen 1,000 mg every 6 hours [7]. This can be used in combination with oral caffeine 130 mg. It is important to remember that the maximum doses of these medications are 4,000 mg of acetaminophen and 200 mg of caffeine in 24 hours. If no improvement is seen with acetaminophen, treatment with oral metoclopramide 10 mg and diphenhydramine 25 mg should be initiated [7]. The adjunct use of diphenhydramine helps to offset akathisia and other dystonic reactions associated with dopamine antagonists. Lastly, nonsteroidal anti-inflammatory drugs (NSAIDs) may be used in pregnancy, but use is limited to the second trimester and should not last more than 48 hours. Third-trimester use of NSAIDs is associated with premature closure of the ductus arteriosus, interventricular hemorrhage, necrotizing enterocolitis, and

Table 8.1 Acute treatment of migraine headache in pregnancy

Medication	Pharmacologic classification	Route	Dose	Notes
Acetaminophen	Analgesic	Oral, IV	1,000 mg every 6 hours	Maximum daily dose 4,000 mg
Caffeine	Methylxanthine	Oral	130 mg	Maximum daily dose 200 mg
Metoclopramide	Antidopaminergic	Oral, IV	10 mg every 6 hours	Risk of dystonic reaction
Diphenhydramine	Anticholinergic	Oral, IV	25 mg	Use with antidopaminergics to prevent dystonic reaction
Ketorolac	Analgesic	IV	30 mg	Use is limited to the second trimester
Ibuprofen	Analgesic	Oral	600 mg	Use is limited to the second trimester
Sumatriptan	Triptan	Subcutaneous	4–6 mg	Maximum daily dose 12 mg
		Oral	50–100 mg	Maximum daily dose 200 mg
		Intranasal	5–20 mg	Maximum daily dose 40 mg
Magnesium sulfate	Mineral and electrolyte	IV	1–2 g	Adverse effects: hypotension and respiratory depression
Prednisone	Corticosteroid	Oral	20 mg QID	Do not use for longer than 48 hours

QID, four times per day

periventricular leukomalacia. In addition to analgesic medications, it is important to treat the symptoms caused by severe migraine headaches. Often, patients are hypovolemic, have electrolyte abnormalities, and feel weak and fatigued. Treatment should consist of placing patients in a dark, quiet room, administering IV fluids, and correcting electrolyte imbalances. Antiemetics should be given for persistent nausea as well.

If these first-line medications do not relieve the patient's headache, there are many second-line options that may be considered. Although studies are limited, there is no literature that shows harm to the patient or the fetus with the medications listed in Table 8.1. Sumatriptan works well for refractory migraine headaches. Triptan medications work through vasoconstriction. It remains unclear if there is any effect on the uterine vessels. Studies show no increased risk of fetal anomalies with the antenatal use of triptan medications [8]. Routes of administration include subcutaneous (4–6 mg), intranasal (5–20 mg), and oral (50–100 mg). Intravenous magnesium is another alternative approach to treatment. Since magnesium sulfate has been used in pregnant patients for fetal neuroprotection and for eclamptic seizure prophylaxis, it has a proven safety profile in pregnancy. Lastly, a short course of corticosteroids may be necessary to decrease the risk of recurrent severe migraine headaches in some patients.

There are multiple medications that should be avoided in pregnancy. Medications containing butalbital should be avoided because of the association with medication overuse headache (MOH). This is related to the short half-life of butalbital. It has a low efficacy for treating migraines and usually requires multiple doses in a short period of time [3]. There is also an association with neonatal abstinence syndrome. Similarly,

opioids should not be used for the treatment of migraine headaches. They are known to cause MOH, neonatal opiate withdrawal syndrome, and dependence. Lastly, ergot alkaloids, which are vasoconstrictive agents, are proven to cause uterine contractions. Therefore, any antenatal use is inappropriate.

Patients with severe, refractory migraines will require daily prophylactic treatment. Propranolol is the preferred agent given its known safety profile in the antenatal period. Dosing ranges from 20 to 80 mg orally three times per day [9]. Potential fetal side effects from the use of beta-blockers in pregnancy include fetal growth restriction, preterm birth, and respiratory distress syndrome [10].

Key Teaching Points

- Migraine headaches during pregnancy should be managed with analgesics, and consideration should be given to both efficacy and minimizing risk to the pregnancy when selecting treatment options.
- When headaches present with warning signs or do not respond to initial treatment, it is necessary to investigate possible secondary causes of severe headaches with brain imaging.
- The best imaging modality for evaluating structural abnormalities in the brain during pregnancy is MRI. Gadolinium should be avoided when possible due to the unknown risk of teratogenic effects.
- Butalbital-containing medications and opiates should be avoided in pregnancy because of the risk of MOH, neonatal abstinence syndrome, and the potential for dependence.

References

- 1 Burch R. Headache in Pregnancy and the Puerperium. *Neurologic Clinics*. 2019;37(1):31–51.
- 2 Van Casteren DS, van den Brink AM, Terwindt GM. Migraine and Other Headache Disorders in Pregnancy. *Handb Clin Neurol*. 2020;172:187–199.
- 3 Committee on Clinical Practice Guidelines-Obstetrics. Clinical Practice Guideline No 3: Headaches in Pregnancy and Postpartum. *Obstet Gynecol*. 2022;139:944–965.
- 4 Magro I, Nurimba M, Doherty JK. Headache in Pregnancy. *Otolaryngol Clin North Am*. 2022;55(3):681–696.
- 5 Jamieson DG, McVige JW. Neuroimaging during Pregnancy and the Postpartum Period. *Obstet Gynecol Clin North Am*. 2021;48(1):97–129.

- 6 Rayhill M. Headache in Pregnancy and Lactation. *Continuum (Minneapolis)*. 2022;28(1):72–92.
- 7 Childress K, Dothager C, Gavard J, et al. Metoclopramide and Diphenhydramine: A Randomized Controlled Trial of a Treatment for Headache in Pregnancy when Acetaminophen Alone Is Ineffective (MAD Headache Study). *Am J Perinatol*. 2018;35(13):1281–1286.
- 8 Saldanha JJ, Cao W, Bhuma MR, et al. Management of Primary Headaches during Pregnancy, Postpartum, and Breastfeeding: A Systematic Review. *Headache*. 2021;61(1):11–43.
- 9 Cunningham F, Leveno KJ, Bloom SL, et al. Neurological Disorders. In: *Williams Obstetrics*, 24th ed. New York: McGraw Hill; 2014. 1187–1189.
- 10 Negro A, Delaruelle Z, Ivanova TA, et al. Headache and Pregnancy: A Systematic Review. *J Headache Pain*. 2017;18(1):106.

A 30-Year-Old with Isoimmunization at 9 Weeks

Eileen O'Connor

History of Present Illness

A 30-year-old gravida 5 para 2 presents to the office for confirmation of pregnancy. This is a planned and desired pregnancy. Her menstrual cycles are regular, with her last menstrual cycle beginning approximately 9 weeks ago. She reports some nausea and breast tenderness but is overall feeling well. She denies any vaginal bleeding or cramping. Her history is significant for two missed abortions, both managed medically without complications, and two previous full-term vaginal deliveries. The most recent delivery was complicated by an obstetrical hemorrhage secondary to a retained placenta, which was removed manually. She did not require a transfusion of blood products. Her pregnancies were otherwise uncomplicated. She is married and lives at home with her husband and their two children. She reports feeling safe at home. She is otherwise healthy and without previous surgeries. She is taking a prenatal vitamin daily and has no allergies.

Physical Examination

General appearance: Well-appearing, in no acute distress

Vital signs:

Temperature: 37.1°C

Pulse: 85 beats per minute

Blood pressure: 108/62 mmHg

Respiratory rate: 14 breaths per minute

BMI: 32.2 kg/m²

Cardiopulmonary: Regular rate and rhythm, no murmurs, rubs, or gallops. Lungs clear to auscultation bilaterally

Abdomen: Soft, non-tender to palpation, no guarding or rebound

Pelvic: Normal-appearing external genitalia, pink and moist vaginal mucosa with multiparous appearing closed cervix without lesions, no blood in the vagina

Fetal assessment: 155 beats per minute with handheld Doppler

Laboratory studies:

Routine prenatal labs are all normal except her type and screen, which is significant for a positive anti-D antibody.

Imaging:

A transvaginal ultrasound shows a viable intrauterine singleton pregnancy. Crown rump length measures 9 2/7 weeks, consistent with menstrual dating. No adnexal masses

How Would You Manage This Patient?

This patient has a positive anti-D antibody screen, which resulted in a titer of 1:4. The first step in the patient's care was to confirm paternity. This patient had certain paternity, and her husband was available for testing. He was tested and found to be homozygous for the Rh D antigen. Maternal titers were monitored every 4 weeks throughout her pregnancy, which remained stable until 32 weeks when they increased to 1:32. At this time, screening was transitioned to weekly Doppler flow studies of the middle cerebral artery (MCA), which remained <1.5 multiples of the median (MoM). She was induced at 38 weeks' gestation and had an uncomplicated vaginal delivery of a female infant.

Isoimmunization

Isoimmunization is an immunologic response to a foreign red blood cell antigen following a previous exposure. This leads to the production of immunoglobulin G, which can then cross the placenta during pregnancy and direct a response toward the fetal erythrocytes if the antigen is present. This can lead to fetal anemia, hydrops fetalis, and even death.

Many antigens that can stimulate such a response exist on human erythrocytes, though anti-E, anti-D, and anti-Kell are the most common causes of isoimmunization [1]. Expression of the Rh D antigen varies by ethnicity. People of European or North American ancestry have the highest prevalence of the Rh D negative phenotype (15–17%), while people of Asian or Native American descent have the lowest (<2%) [2,3].

A sensitizing event is required for isoimmunization to occur. With the Rh D antigen, this most often occurs due to a fetal-maternal hemorrhage (FMH) during a previous pregnancy. During FMH, the fetal cells enter the maternal circulation. If the fetal cells express the Rh D antigen and the mother does not, an immune response is initiated. An antiglobulin titer typically becomes present 5–16 weeks later [1]. Events that lead to FMH include delivery, miscarriage, ectopic pregnancy, invasive testing such as chorionic villus sampling, amniocentesis, cordocentesis, abdominal trauma, external cephalic version, and manual removal of the placenta. As many as 45% of women who deliver in the third trimester will have an FMH, with 0.3% having "excessive" FMH, defined as >30 mL of fetal whole blood [1,2]. Volumes as small as 0.1 mL of fetal red blood cells are enough to cause isoimmunization [3].

All pregnant patients should have a type and screen completed as part of routine prenatal labs at the first visit of pregnancy to evaluate for isoimmunization, as well as at 28 weeks. If the antibody screen is positive for anti-D, isoimmunization is confirmed. Any positive antibody screen should be

followed by a titer to measure the degree of response. Variation in titers can occur between institutions, and each institution sets a value for what is considered a “critical titer,” which is the level at which there is a significant risk for fetal anemia or hydrops. This is often 1:8 to 1:32 for anti-D [1,3,4].

Once isoimmunization is diagnosed, the next step in management is to identify paternity. If paternity is certain and the biological father is available for testing, they should undergo genotyping for the Rh D gene. Paternal homozygosity guarantees that the fetus would inherit the Rh D gene and express the antigen, in which case, continued surveillance is warranted. If paternal testing reveals heterozygosity, fetal genotype should be evaluated directly [1,3,4]. In the United States, this is most often done with amniocentesis. Chorionic villous sampling could also be considered if early enough in the pregnancy; however, this has higher rates of worsening isoimmunization, so it is not preferred [2]. If the fetus is confirmed to be Rh positive, then additional surveillance should continue. If the fetus is found to be Rh negative, then no additional monitoring is required. Of interest, noninvasive cell-free fetal DNA is utilized in countries outside of the United States for determination of fetal blood type and Rh status, however, this is not 100% reliable. For this reason, along with questionable cost efficacy, this approach has not been widely used within the United States [1,3,4].

Serial titers should be monitored at least every 4 weeks, with some recommendations suggesting increased frequency if titers are increasing or with increasing gestational age [1,3,4]. If titers cross the threshold for critical titers, then surveillance should transition to weekly Doppler evaluation of the MCA peak systolic velocity (PSV) [1,3,4]. If the patient has a history of a previously affected pregnancy, then titers are not considered to be reliable and monitoring of MCA PSV should begin at 16–20 weeks [1,3,4].

Middle cerebral artery dopplers are measured in MoM based on gestational age. Values >1.5 MoM are considered to represent moderate to high risk for fetal anemia [1,3]. Measurement of MCA PSV is dependent on the operator and requires trained personnel for accuracy. The study should be performed at a time of fetal rest, as fetal activity can falsely depress measurements [1]. The proximal MCA should be identified at the level of the sphenoid bone. The vessel closest to the probe should be measured with the angle between the probe and direction of blood flow as close to 0° as possible, though corrections can be made up to 30°. Three to ten consecutive waveforms should be measured. The highest point is measured for the PSV. This should be repeated three times, with the highest value used to guide decision-making [4,5].

If MCA PSV is >1.5 MoM, fetal anemia should be confirmed with cordocentesis. If fetal anemia is confirmed by a hematocrit <30% on cordocentesis, intrauterine transfusion should be offered with the goal hematocrit following transfusion ranging from 40 to 65%. Transfusions of greater volumes offer the benefit of greater time between required intrauterine transfusions; however, they also increase fetal blood viscosity to a greater degree [1,4]. There is debate over the frequency of

when repeat transfusions should be performed. Some opt for intervals based on the anticipated decline in fetal hematocrit of 1% per day or an adjusted MCA PSV threshold of >1.69 MoM, while others utilize predetermined set time intervals. Regardless of the method, most neonates require additional transfusions following delivery. All blood used for fetal transfusions should be cytomegalovirus negative, leukocyte reduced, irradiated, and concentrated to a final hematocrit of 75–85% [1,4]. A common practice is to aim for a final transfusion at approximately 35 weeks with subsequent delivery at 37–38 weeks’ gestation [1,3,4].

Prevention of Rh D isoimmunization is imperative and is the only red cell antigen for which such an option exists. Rh D immune globulin was first introduced in the United States in 1968 and has since drastically decreased the rate of anti-D isoimmunization. Derived from human plasma, Rh D immune globulin is only effective in preventing sensitization from occurring and has no role after a sensitizing event has occurred [4]. Administration of 300 µg is recommended antenatally at 28 weeks and within 72 hours of delivery if the infant is found to be Rh positive, in addition to any additional sensitizing events. While the fetal blood volume is low enough to warrant a decreased dose of 50 µg for sensitizing events up to 12 weeks, the standard dose is an acceptable alternative. If delivery occurs within 3 weeks of Rh D immune globulin administration, a repeat dose is not necessary [1,2].

Equation 9.1 is for proper dosing of Rh D immune globulin.

$$\text{vials of Rh D immune globulin}^* = \frac{(\% \text{ fetal blood cells}) \times 50}{30} + 1 \quad (9.1)$$

*rounded up to nearest whole number

In cases of excessive FMH, higher doses may be required, as the standard dosing only covers up to 30 mL of whole blood or 15 mL of red blood cells. To identify those needing additional dosing, a test to quantify the amount of fetal blood cells in circulation should be performed. The percentage of fetal blood cells should then be multiplied by 50 and the total divided by 30. The result should be rounded up to the nearest whole number, and that number of vials (300 µg each) should be given. Often, an additional vial is given to ensure sufficient coverage (Equation 9.1). Quantification of FMH should occur after any delivery of an Rh-negative mother, as 50% of patients requiring additional dosing would be missed if only selectively preformed based on risk factors. While administration within 72 hours is recommended, there may still be some benefit up to 28 days later [1,2].

Key Teaching Points

- Routine administration of Rh D immune globulin at 28 weeks’ gestation and postpartum is imperative for the prevention of anti-D isoimmunization in Rh-negative patients.
- Isoimmunization can cause profound fetal anemia, hydrops fetalis, and even fetal death.

- After isoimmunization is confirmed, paternal testing should be completed if paternity is known and available for testing.
- Pregnancies at risk for fetal anemia should undergo surveillance with serial maternal titers and MCA PSV dopplers if titers reach critical values.
- Middle cerebral artery PSV dopplers >1.5 MoM are concerning for moderate to severe fetal anemia and should prompt percutaneous umbilical blood sampling and subsequent intrauterine transfusions if fetal anemia is confirmed.

References

- 1 Moise KJ, Queenan J. Hemolytic Disease of the Fetus and Newborn. In: Resnick R, Lockwood CJ (eds.). *Creasy and Resnick's Maternal-Fetal Medicine: Principles and Practice*, 8th ed. Philadelphia: Elsevier; 2019. 632–644.
- 2 ACOG Practice Bulletin No. 181: Prevention of Rh D Alloimmunization. *Obstet Gynecol.* 2017;130: e57–e70.
- 3 ACOG Practice Bulletin No. 192: Management of Alloimmunization during Pregnancy. *Obstet Gynecol.* 2018;131:e82–e90.
- 4 Society for Maternal-Fetal Medicine (SMFM) Clinical Guideline #8: The Fetus at Risk for Anemia – Diagnosis and Management. *Am J Obstet Gynecol.* 2015;212: 697–710.
- 5 ISUOG Practice Guidelines: Use of Doppler Ultrasonography in Obstetrics. *Ultrasound Obstet Gynecol.* 2013;41: 233–239.

CASE 10

A 25-Year-Old with an Early Pregnancy and Bicornuate Uterus

Sarah H. Milton

History of Present Illness

A 25-year-old gravida 2 para 0 patient presents for pregnancy care and is diagnosed with an early intrauterine gestation. In the patient's prior pregnancy, she had first-trimester bleeding, and a related ultrasound showed an 8-week nonviable intrauterine pregnancy in the right horn of a bicornuate uterus. She subsequently underwent a suction dilation and curettage performed under ultrasound guidance. Given this history, the patient is very anxious about her current pregnancy. She reports mild nausea and otherwise feels well. Her last menstrual period was 7 weeks ago. Her medical and surgical history are both noncontributory.

Physical Examination

General appearance: Well-appearing, well-developed female in no apparent distress

Vital signs:

Temperature: 36.6°C

Pulse: 91 beats per minute

Blood pressure: 128/78 mmHg

Respiratory rate: 16 breaths per minute

BMI: 28 kg/m²

Abdomen: Soft, non-distended, non-tender

Pelvic: External genitalia are normal. Vaginal epithelium is normal without lesions or discharge. The cervix is normal in appearance without lesions or discharge. Bimanual examination is normal, and the uterus is 7-week size

Laboratory studies:

HIV serology: Negative

Gonorrhea: Negative

Chlamydia: Negative

Trichomonas: Negative

Hepatitis B serology: Negative

Hepatitis C serology: Negative

Syphilis serology: Negative

Ultrasound: Single, viable intrauterine pregnancy measuring 7 2/7 weeks in the left uterine horn with fetal cardiac activity. Normal cervix, and right uterine horn with moderate endometrial thickening (Figure 10.1)

How Would You Manage This Patient?

This patient was reassured that most patients with a bicornuate uterus achieve a normal pregnancy outcome with a term delivery and vaginal birth. The patient was also counseled

about pregnancy complications that occur in patients with congenital uterine abnormalities including the increased risk of first-trimester pregnancy loss, preterm birth, and fetal malpresentation. Counseling emphasized that there are no proven interventions to decrease these risks. Provision of early anticipatory guidance was undertaken to alert the patient of symptoms associated with pregnancy loss and preterm birth and to help guide the patient's expectations for future delivery planning should malpresentation occur. The patient had a follow-up ultrasound in the third trimester given the association between congenital uterine anomalies and poor fetal growth, but it showed normal growth. The pregnancy progressed to term and the fetus was confirmed to be in cephalic presentation. She had a SVD of a healthy neonate.

Uterine Anomalies in Pregnancy

Congenital anomalies of the female reproductive tract are the result of deviations from normal embryologic development [1]. As with most organ systems, embryologic development of genitourinary structures begins early in the embryonic period. The upper urinary system derives from the mesonephric ducts that develop into the kidney and ureter. The urogenital sinus develops into the bladder, urethra, and the distal vagina. The paramesonephric or Müllerian ducts develop into the upper vagina, cervix, uterus, and fallopian tubes [1]. Failure of any of these embryologic developmental steps can result in

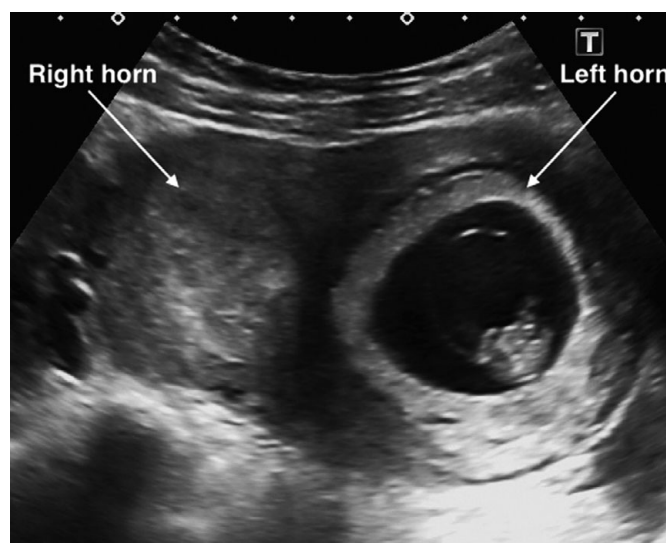


Figure 10.1 Ultrasound of early gestation in left horn of bicornuate uterus. Reproduced with permission from Pillai M. *Pregnancy Ultrasound for SRH Work*. In Pillai M, Briggs P, and Bridson JM (eds). *Ultrasound in Reproductive Healthcare Practice*. London: Cambridge University Press, 2017

congenital anomalies of the genitourinary tract. While diverse in their clinical presentation and associated medical complications, all congenital genitourinary tract abnormalities can impact reproductive health and pregnancy [1,2].

Congenital uterine anomalies result from a few specific failures in embryologic development of the Müllerian ducts.

1. Failure of Müllerian duct formation: If bilateral, failed formation results in Müllerian agenesis and pregnancy would not be possible. However, unilateral failure of Müllerian duct formation results in a unicornuate uterus where pregnancy is possible.
2. Complete failure of Müllerian duct fusion: Complete failed fusion results in a uterus didelphys. Although there are variations on the classic presentation, typically patients with uterus didelphys will have two uteri, two cervixes and a septum in the upper vagina (which may obstruct outflow from one cavity, resulting in an earlier diagnosis).
3. Partial or incomplete Müllerian duct fusion: Partial or incomplete fusion results in a bicornuate uterus. In this circumstance, a patient will typically have one cervix that splits in the lower to mid uterus into a bivalued uterine cavity.
4. Failure of the midline septum to resorb: Failure to resorb results in a septate uterus [1].

Specificity of diagnosis is imperative for appropriate counseling and management of uterine anomalies in pregnancy. In 2021, the American Society for Reproductive Medicine (ASRM) published a new and robust classification system that maintains the simplicity of prior classification systems while also integrating the more nuanced complexities of diagnosis to make the tool more comprehensive and more widely applicable [3]. The classification is most easily accessed via a web-based tool that allows users to not only classify the abnormality, but also appreciate variations in presentation, symptoms, and examination. It also provides guidance regarding appropriate imaging techniques [4].

The incidence of Müllerian anomalies in the general population is 0.4–10% but is markedly higher in patients with infertility (8%) and recurrent pregnancy loss (24.5%) [1,5]. In patients with these diagnoses, thoughtful consideration of the uterine morphology is necessary to rule out a uterine anomaly. Uterine anomalies may first come to clinical attention during routine first-trimester sonography, and therefore, decisions for further diagnostic testing may be limited by intrauterine gestation [1,2]. Several imaging modalities can be considered for diagnosis including 2D and 3D sonography, hysterosalpingogram, MRI, laparoscopy, and hysteroscopy. Balancing risk, cost, and accuracy of diagnosis the best initial test is 3D sonography, which has a diagnostic accuracy of 97% [1,2,6]. If after 3D sonography the diagnosis is in doubt, MRI is highly sensitive and specific [2].

The relationship between the embryologic development of the mesonephric and paramesonephric ducts leads to a common association between congenital anomalies of the vagina, cervix, and uterus and anomalies of the renal system. Around 50% of people with congenital reproductive tract

anomalies will have a concomitant renal or ureteral anomaly, with unilateral renal agenesis being the most common [1]. Evaluation of the renal system is essential at the time of diagnosis of a congenital uterine anomaly and ultrasound, MRI, or IV pyelography can all be considered for renal evaluation [1].

While most patients achieve a normal pregnancy outcome, congenital uterine anomalies have been linked to several pregnancy complications including early pregnancy loss, malpresentation, preterm birth, and poor fetal growth [1,2]. The anatomic variations in congenital uterine anomalies have varying reproductive consequences. Patients with septate uteri have the highest incidence of reproductive complications with a near threefold increased risk of infertility, an over twofold increased risk of first-trimester pregnancy loss and preterm birth, and a sixfold increased risk of malpresentation [7]. While not associated with infertility, patients with a bicornuate or unicornuate uterus have a 3.5-fold increased risk of first-trimester pregnancy loss, a 2.5-fold increased risk of preterm birth and an over fivefold increased risk of fetal malpresentation [7]. Patients with a uterus didelphys have a 3.5-fold increased risk of preterm labor and an almost fourfold increased risk of fetal malpresentation [7]. Poor fetal growth in patients with congenital uterine anomalies is thought to be due to comparatively poor placental perfusion resulting from reduced uterine blood flow related to the anatomic defect [6]. In one study, birth weight less than the 10th percentile was noted in 3.8% of patients with a normal uterus, 50% of patients with uterus didelphys, 28.3% of patients with a bicornuate uterus, and 18.8% of patients with a unicornuate uterus [8].

Despite the association of congenital uterine anomalies with pregnancy complications, interventions to offset these risks are relatively limited. In patients with a uterine septum and infertility or recurrent pregnancy loss, hysteroscopic excision of the septum can be considered and is associated with improved pregnancy retention rates [2]. Surgical interventions for bicornuate or didelphic uteri, like metroplasty, are not recommended and have not been proven to improve reproductive outcomes [2]. Aside from hysteroscopic septum excision, there are no proven interventions or treatments for first-trimester loss, preterm birth, or fetal malpresentation associated with uterine anomalies [1,2,6]. Counseling patients regarding these risks early in pregnancy is essential for shared decision-making. Providing anticipatory guidance regarding preterm labor symptoms and the potential impact of a diagnosis of uterine anomaly on delivery planning (both as it related to malpresentation and preterm birth risk) is essential for setting patient expectations. Given the association between congenital uterine anomalies and poor fetal growth, it is reasonable to consider a third-trimester growth scan in pregnant patients with these conditions.

Vaginal delivery is generally achievable in patients with congenital uterine anomalies except in the case of fetal malpresentation [1,2]. If malpresentation exists, a trial of external cephalic version is reasonable [1]. Due to malpresentation, risk of cesarean section in this population is higher than in patients with a normal uterus. Research on trial of labor after cesarean

section (TOLAC) in this patient population is limited with mixed results, and therefore shared decision-making must be carefully undertaken in patients who desire TOLAC with a congenital uterine abnormality [1]. In the event that a uterine anomaly is diagnosed at the time of cesarean section, intraoperative survey and operative documentation should carefully outline the nature of the abnormality [1].

Key Teaching Points

- Congenital uterine anomalies are the result of deviations in embryologic development and can be associated with concomitant renal abnormalities.
- As reproductive outcomes differ with the various Müllerian abnormalities, specific diagnosis is imperative to drive counseling. The American Society for Reproductive Medicine has a robust classification system and web-based application to aid in classification.
- Normal pregnancy and birth outcomes are common in patients with congenital uterine anomalies.
- Pregnancy-associated complications in patients with congenital uterine anomalies include increased risk of first-trimester pregnancy loss, preterm birth, fetal malpresentation, and poor fetal growth. The degree of risk varies based on the type of uterine anomaly.
- Vaginal birth should be attempted in patients with congenital uterine anomalies unless there is fetal malpresentation or other maternal or fetal indication for cesarean section.

References

- 1 Congenital Genitourinary Abnormalities. In Cunningham F, Leveno KJ, Dashe JS, et al. (eds.). *Williams Obstetrics*, 26th ed. New York: McGraw Hill. <https://accessmedicine-mhmedical-com.proxy.library.vcu.edu/content.aspx?bookid=2977&sectionid=253194215> (accessed September 23, 2024).
- 2 Akhtar MA, Saravelos SH, Li TC, Jayaprakasan K, on behalf of the Royal College of Obstetricians and Gynaecologists. Reproductive Implications and Management of Congenital Uterine Anomalies. *Scientific Impact Paper No. 62. BJOG*. 2020;127:e1–e13.
- 3 Pfeifer SM, Attaran M, Goldstein J, et al. ASRM Müllerian Anomalies Classification 2021. *Fertil Steril*. 2021;116(5):1238–1252.
- 4 ASRM MAC 2021. The Goals of the ASRM Müllerian Anomalies Classification 2021. <https://connect.asrm.org/education/asrm-mac-2021/asrm-mac-2021?ssopc=1> (accessed September 23, 2024).
- 5 Chan YY, Jayaprakasan K, Zamora J, et al. The Prevalence of Congenital Uterine Anomalies in Unselected and High-Risk Populations: A Systematic Review. *Hum Reprod Update*. 2011;17:761–771.
- 6 Dietrich JE, Millar DM, Quint EH. Non-Obstructive Müllerian Anomalies. *J Pediatr Adolesc Gynecol*. 2014;27(6):386–395. <http://dx.doi.org/10.1016/j.jpog.2014.07.001> (accessed September 23, 2024).
- 7 Chan YY, Jayaprakasan K, Tan A, et al. Reproductive Outcomes in Women with Congenital Uterine Anomalies: A Systematic Review. *Ultrasound Obstet Gynecol*. 2011;38:371–382.
- 8 Hua M, Odibo AO, Longman RE, et al. Congenital Uterine Anomalies and Adverse Pregnancy Outcomes. *Am J Obstet Gynecol*. 2011;205:558.e1.

Recommended Vaccinations at an 8-Week Prenatal Intake

Corinne A. Bazella

History of Present Illness

An 18-year-old, gravida 1 para 0 patient, presents at 8 weeks for a new prenatal visit. She has no significant past history. Her family history is negative for congenital malformations and inherited genetic mutations. She is in a monogamous relationship, is estranged from her parents, and recently moved into a group home for homeless teens. She does not smoke, drink alcohol, or use illicit substances.

She has little information on her vaccination or past medical history and does not remember having chicken pox. She is taking only prenatal vitamins, has no allergies, is concerned about her lack of vaccinations to diseases that could affect her pregnancy, and would like to be vaccinated if it is safe.

Physical Examination

Vital signs:

Temperature: 37.2°C

Pulse: 78 beats per minute

Blood pressure: 112/70 mmHg

BMI: 23 kg/m²

Abdomen: soft, non-tender

Pelvic: Normal external genitalia and cervix with an 8-week size mobile, non-tender, uterus

Laboratory studies:

Urine pregnancy test: Positive

Rubella IgG Ab: Negative

Varicella zoster IgG Ab: Negative

HBsAg: Negative

Anti-HBsAb: Negative

Anti-HCV Ab: Negative

How Would You Manage This Patient?

This patient should be offered all routine and indicated inactivated vaccines during pregnancy including the COVID-19, influenza, hepatitis B, tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis (Tdap) vaccines [1]. She is living in a group home, has housing instability, and should receive hepatitis A and meningococcal quadrivalent vaccine (ACWY) as homelessness and residential housing, respectively, are risk factors for these diseases [2,3]. There have not been any community outbreaks of vaccine-preventable diseases in her community, lowering her risk of other vaccine preventable diseases.

She will complete two additional doses of Tdap, one in 4 weeks and the last at 6–12 months after the initial Tdap. In the postpartum period, she will receive the human

papilloma virus (HPV) vaccine, measles, mumps, and rubella (MMR) vaccine, polio (IPV), and the varicella vaccine series [3]. Due to her excellent health, she does not qualify for the pneumococcal conjugate vaccine. She was counseled about the risks of varicella in pregnancy and avoidance of nonvaccinated people to decrease risk.

Vaccinations in Pregnancy

Vaccine acceptance and confidence in the United States health system has been historically and persistently low, a significant public health challenge during the COVID-19 pandemic. Factors that influence a patient's decision to receive a vaccine include patient awareness of individual vaccines and their benefits, worry about side effects, risk of harm, prior vaccination history, and most importantly recommendations from health care professionals [4]. Obstetrical care providers have a unique opportunity to inform pregnant individuals of the threefold benefits of vaccines to protect from infections that can lead to increased morbidity in pregnancy, protect fetuses from congenital infections, and protect the neonate through passive immunity.

Pregnancy presents a window of opportunity to use the physiology of maternal fetal circulation and passive immunity to prevent disease in newborns. Transplacental antibody passage is primarily of the IgG subtype and is dependent on both gestational age and maternal levels of IgG. In the first and second trimesters, concentrations of IgG in the fetus are low; however, during the third trimester, levels start to increase and by 36 weeks, fetal IgG is equivalent or higher to concentrations of IgG in maternal circulation [4]. When a patient receives a vaccination in pregnancy, maternal IgG levels reach their peak within 4 weeks of administration. Therefore, vaccines used for the goal of neonatal immunity in pregnancy, like Tdap, should be administered in the beginning of the third trimester to ensure peak antibody transmission at term [4].

Preconception Vaccination

Maternal immunization is commonly limited by barriers to health care and unplanned pregnancy. When the opportunity for preconception care does present, performing serologic testing for rubella immunity is recommended. In contrast to rubella testing, commercial assays for varicella can be used to assess disease-induced immunity, but they lack sensitivity to detect vaccine-induced immunity (i.e. yielding false-negative results) [5]. Therefore, routine testing for varicella immunity after two doses of vaccine is not recommended, as documented receipt of two doses of varicella vaccine supersedes

results of serologic testing (see Case 43 for further information on confirming varicella immunity) [5]. Varicella and MMR vaccines should be administered if indicated by nonimmune serologic testing for rubella or lack of vaccination history for either of the vaccines. Due to these being live-attenuated vaccines, patients should be counseled to delay pregnancy for 4 weeks after the last vaccine administration.

There is limited evidence of harm by inactivated vaccines for either the pregnant individual or the fetus, excluding the extremely rare anaphylaxis or Guillain-Barré that are difficult to study [6]. There is no epidemiologic evidence of adverse fetal effects from inactivated vaccines such as stillbirth, preterm labor, or infant complications [6]. There is risk of common and local adverse reactions for all vaccines such as injection site tenderness, erythema, swelling, induration, bruising, and itching. The Vaccine Adverse Event Reporting System monitors rates of stillbirth, miscarriage, and congenital anomalies for post-licensed vaccines and there is no data to suggest an increase in these events compared to United States baseline rates [6].

Live Vaccinations

During pregnancy, live vaccines have a theoretical potential for harm due to the risk of transplacental infection of the fetus. Therefore, live vaccines are not recommended unless the risk of serious morbidity or mortality of a natural infection is higher than the risk of the vaccine, such as with a disease outbreak. Consultation with an infectious disease physician to help weigh the risk of disease and risk of vaccine is recommended in these settings. Administration of a live vaccine during pregnancy is not an indication for pregnancy termination as there is substantial observational literature from disease outbreaks requiring live vaccinations in pregnant individuals and unintentional vaccinations in pregnant individuals that show no increased adverse outcomes compared to the general population [7]. In a meta-analysis of rubella, IPV, yellow fever (YF), and dengue vaccines, no association was found between vaccination and miscarriage, stillbirth, malformations, prematurity, or neonatal death although the studies had heterogeneity in designs, data collection, and settings [7]. For the smallpox vaccine, there was an increased risk of malformation and miscarriage if the vaccine was given in the first trimester [7]. Toxoid-containing vaccines and conjugate vaccines including protein-toxoid, peptide-protein, and protein-protein conjugates are considered safe in pregnancy. Messenger RNA vaccine platforms also have substantial evidence supporting safe use in pregnancy [8].

In patients who have not received routine vaccinations, the risks of vaccine preventable diseases, risks of potential exposure to an infection, and risks of harm to the mother and fetus should be discussed with the patient. Immunization in pregnancy is as effective as in nonpregnant patients, with patients mounting a robust immune response to vaccines, despite the immunologic changes of pregnancy. In the current patient, the risk of a vaccine-preventable disease is more than the risk of

the vaccines [7]. Due to the patient's housing at a group home and potential for homelessness, both hepatitis A and the ACWY are recommended. The hepatitis A vaccine is recommended for pregnant women not previously vaccinated who have liver disease, clotting factor disorders, or substance abuse disorders. The meningococcal vaccine is recommended for individuals aged 11–18 years old, with HIV infections, asplenia, complement deficiency, and who have occupational exposure to *Neisseria meningitidis* [2]. There are no randomized controlled trials on the use of the serogroup B meningococcal vaccine (MenB) in pregnancy, therefore, deferring to the postpartum period is recommended. For IPV, although no adverse outcomes have been noted in studies, the prevalence of polio is quite low in the United States, therefore risks from the disease is low and vaccines can be delayed until postpartum [7]. The Centers for Disease Control and Prevention (CDC) recommends waiting until the postpartum period to give the HPV vaccine due to limited data. Live vaccines, MMR and varicella, are theoretically contraindicated in pregnancy and can also be administered in the postpartum period [2]. See Table 11.1 for a summary of immunization administration based on pregnancy timing.

The CDC and American College of Obstetricians and Gynecologists (ACOG) recommend that all pregnant patients receive Tdap during each pregnancy for the passive immunity of the infant [9]. With the influenza vaccine, although there are benefits of passive immunity, the vaccine is primarily for the prevention of morbidity and mortality in the pregnant individual. Therefore, the influenza vaccine should be administered as soon as it is available during influenza season, October to May, ensuring immunity prior to high influenza activity [10].

Pneumococcal vaccination, the last among the routine vaccines, is recommended in pregnancy for patients who have a high risk of pneumococcal disease such as immunocompromising conditions, diabetes, heart disease, lung disease, liver disease, diabetes, patients at increased risk for meningitis, cigarette smoking, along with alcohol, cardiac, pulmonary, liver, and sickle cell diseases [2]. The two pneumococcal vaccines are the conjugate vaccines (PVC-20 and PCV-15) and the polysaccharide vaccine (PPSV23). There is limited data on the conjugate vaccines in pregnancy and more data on the polysaccharide vaccine, therefore, preference for this vaccine administration is recommended.

With the common travel vaccines, yellow fever (YF) and typhoid, the risk of vaccination should be evaluated with the ability to avoid travel and infection risk, as recommendations are based on observational studies. Yellow fever is a viral mosquito-transmitted hemorrhagic fever with high prevalence in tropical regions of South America and Sub-Saharan Africa. The YF vaccine is a live attenuated virus, therefore, if travel to those areas is unavoidable during pregnancy, the risks for YF vaccination are seen to outweigh the risk of YF due to a high fatality rate [7]. Typhoid is transmitted through contaminated food and water in areas of Asia, Africa, and Latin America. Typhoid vaccination is an inactive, capsular polysaccharide vaccine and is recommended in pregnancy if risk of exposure

Table 11.1 Immunization administration based on pregnancy timing

Vaccine	Recommended in pregnancy	Recommended postpartum and with breast-feeding	Vaccine type	Vaccine indication
COVID-19	Yes	Yes	mRNA	>6 months of age
Hepatitis A	Yes	Yes	Inactivated	Desires protection from hepatitis A, HIV, substance abuse, homelessness, travel, or work exposure
Hepatitis B	Yes	Yes	Inactivated	Routine at birth and childhood series, >60 years of age, at risk for hepatitis b, liver disease, HIV, sexual exposure risk, substance abuse, routine exposure to blood, incarceration, or travel
HPV	Not recommended due to poor data	Yes	Inactivated	Age 9–14 years, two-dose series Age 15–45 years, three-dose series
Influenza (inactivated)	Yes, each flu season	Yes	Inactivated	Annually for all age groups
Influenza (live attenuated influenza vaccine)	No, contraindicated as live	Yes	Live	Annually for all age groups
Pneumococcal vaccine	Yes, in high-risk individuals	Yes	Inactivated	Any unvaccinated individual, sickle cell disease, asplenia, immunodeficiency, HIV, renal disease, cancer, or immunosuppression
MMR	No, contraindicated as live	Yes	Live	Any unvaccinated individual, two-dose series, 4-week interval
ACWY	Yes, in high-risk individuals	Yes	Inactivated	Age 11–18 years, HIV, asplenia, complement deficiency, and exposure to <i>N. meningitidis</i>
MenB	No	Yes	Inactivated	Age 16–23 years, asplenia, complement deficiency, or complement inhibitor use
Tdap	Yes, each pregnancy	Yes	Toxoid/ inactivated	One dose each pregnancy, regardless of interval since last Tdap. Wound management
Varicella	No, contraindicated as live	Yes	Live	Any unvaccinated individual without evidence of immunity, two-dose series, 4-week interval
IPV	Not recommended with low geographic prevalence	Yes	Inactivated	Any unvaccinated individual, travel, or outbreak

to typhoid is unavoidable, although there is minimal data on use of typhoid vaccine in pregnancy [2].

Key Teaching Points

- At wellness and preconception counseling visits, vaccine and infection history should be elucidated to ensure that patients receive all recommended vaccines prior to pregnancy.
- During pregnancy, Tdap and influenza vaccines are recommended during each pregnancy and each influenza season.
- Clear communication regarding vaccine recommendations from trusted health care providers influence patient decisions on vaccine administration and can influence public health.

References

- American College of Obstetricians and Gynecologists. Maternal Immunization. Practice Advisory October 2022. www.acog.org/clinical/clinical-guidance/practice-advisory/articles/2022/10/maternal-immunization?utm_source=higher-logic&utm_medium=email&utm_content=oct-5&utm_campaign=acog2022-digest (accessed September 23, 2024).
- United States Centers for Disease Control and Prevention. Advisory Committee on Immunization Practices (ACIP): Guidance for Vaccine Recommendations in Pregnant and Breastfeeding Women. www.cdc.gov/vaccines-pregnancy/hcp/vaccination-guidelines/index.html (accessed October 21, 2024).
- Murthy N, Wodi AP, Bernstein H, et al. Advisory Committee on Immunization Practices Recommended Immunization Schedule for Adults Aged 19 Years or Older – United States, 2022. *MMWR Morb Mortal Wkly Rep.* 2022;71:229–233. <http://dx.doi.org/10.15585/mmwr.mm7107a1> (accessed September 23, 2024).
- Etti M, Calvert A, Galiza E, et al. Maternal Vaccination: A Review of Current Evidence and Recommendations. *Am J Obstet Gynecol.* 2022;226:459–474.
- United States Centers for Disease Control and Prevention. Chickenpox (Varicella) for Healthcare Professionals. www.cdc.gov/chickenpox/hcp/clinical-overview/ (accessed October 21, 2024).
- Gidengil C, Bidwell Goetz M, Newberry S, et al. Safety of Vaccines Used for Routine Immunization in the United States: An Updated Systematic

- Review and Meta-analysis. *Vaccine*. 2021;39(28):3696–3716.
- 7 Laris-González A, Bernal-Serrano D, Jarde A, et al. Safety of Administering Live Vaccines during Pregnancy: A Systematic Review and Meta-analysis of Pregnancy Outcomes (Review). *Vaccines*. 2020; 8(1):124.
- 8 ACOG Committee Opinion No 718: Update on Immunization and Pregnancy: Tetanus, Diphtheria, and Pertussis Vaccination. *Obstet Gynecol*. 2017;130:e153–e157.
- 9 ACOG Committee Opinion No. 732: Influenza Vaccination during Pregnancy. *Obstet Gynecol*. 2018;131:e109–e114.
- 10 ACOG Committee Opinion No. 741: Maternal Immunization. *Obstet Gynecol*. 2018;131:e214.

CASE 12

A 25-Year-Old with Cervical Insufficiency at 18 Weeks

Kiran Kavipurapu

History of Present Illness

A 25-year-old primigravid patient at 18 0/7 weeks' gestation presents to the Emergency Department with a 1-day history of increasing pelvic pressure and bloody mucus vaginal discharge. She states that she woke up earlier this morning with a feeling of pelvic and vaginal pressure as though her bladder was full. When she used the restroom, she noticed a small amount of bloody mucus discharge when she wiped. She denies feeling any cramping pain or contractions. Her pelvic and vaginal pressure increased throughout the morning, and she continued to have bloody mucus discharge every time she wiped.

This pregnancy has been complicated by mild nausea and vomiting until approximately 11 weeks. She completed non-invasive prenatal testing, which resulted in a low risk for trisomy 13, 18, and 21 with normal female sex chromosomes. She underwent a normal nuchal translucency ultrasound at 13 weeks' gestation that showed a cervical length of 3.2 cm. She also had a normal second-trimester maternal serum alpha-fetoprotein testing at 16 weeks. Her fetal anatomy ultrasound is scheduled in 2 weeks. She has no significant past medical or surgical history and is only taking prenatal vitamins. She has no known drug allergies.

Physical Examination

General appearance: Obese, no acute distress

Vital signs:

Temperature: 37.2°C

Pulse: 85 beats per minute

Blood pressure: 119/69 mmHg

Respiratory rate: 18 breaths per minute

BMI: 31.9 kg/m²

Abdomen: Soft, normal bowel sounds, non-tender.

No hepatosplenomegaly. Gravid uterus palpable 2 cm below the umbilicus, non-tender uterine fundus

Pelvic: Normal external genitalia. Blood-tinged mucus discharge noted on speculum exam. No vaginal lesions. The cervix is 4 cm dilated and 70% effaced with bulging amniotic membranes noted at the level of the external cervical os.

The fetal breech is at -3 station. Negative pooling on speculum exam with an equivocal nitrazine test and negative ferning

Laboratory studies:

WBC: 12,100/μL

Hgb: 11.1 g/dL

Plt: 190,000/μL

Imaging:

Transabdominal ultrasound shows an intrauterine pregnancy with an active fetus in the breech presentation. The fetal biometry is consistent with 18 0/7 weeks' gestation, and the fetal heart rate is 155 beats per minute. A fetal anatomy survey was conducted, revealing no anomalies. The placenta is anterior and fundal with no gross abnormalities, and the amniotic fluid level is appropriate for gestational age. There are no apparent uterine or adnexal masses visible. The cervix is not adequately visualized on transabdominal ultrasound. Transvaginal ultrasound shows a shortened cervix at 0.9 cm and cervical funneling. The internal cervical os is dilated at 3.9 cm, with amniotic membranes protruding to the level of the external cervical os.

How Would You Manage This Patient?

This patient's advanced painless cervical dilation in the second trimester without evidence of contractions or other labor signs is consistent with the diagnosis of cervical insufficiency. Given the advanced painless cervical dilation, the patient was counseled on the options of expectant management, pregnancy termination, or an attempt at placing a physical exam-indicated cerclage. Expectant management would likely result in further cervical dilation and premature expulsion of the pregnancy. She was counseled that the placement of a cerclage in the setting of advanced cervical dilation and protruding amniotic membranes carries both maternal and fetal risks, including intraamniotic or uterine infection, inadvertent rupture of membranes, bleeding, cervical lacerations, and fetal death. The patient elected to move forward with a cerclage placement. The patient was appropriately consented and taken to the operating room for cervical cerclage placement using a modified Shirodkar method. Following the procedure, a transvaginal ultrasound showed a new cervical length of 2 cm with no funneling. She was monitored overnight and discharged home on post-operative day one. She continued to have routine prenatal care, including regular cervical length measurements until 28 weeks. At 36 weeks, her cerclage was removed, and she spontaneously went into labor at 38 weeks, resulting in an uncomplicated vaginal delivery.

Diagnosis and Treatment of Cervical Insufficiency

Cervical insufficiency is defined as the inability of the uterine cervix to retain a pregnancy with the eventual expulsion of the

pregnancy in the absence of signs and symptoms consistent with labor, placental abruption, or both in the second trimester [1]. While cervical insufficiency may occur in a single isolated pregnancy, the diagnosis is often confirmed when it recurs in multiple pregnancies. The pathophysiology of cervical insufficiency is not well understood; however, there are several risk factors that increase the risk of cervical insufficiency. Generally, it is believed that a structural weakness of the cervix is the likely cause of many second-trimester losses. The risk factors for cervical insufficiency include cervical conization or loop electrosurgical excisional procedures, obstetrical lacerations, and dilation of the cervix during dilation and curettage procedures. Rare physiologic or genetic risk factors may include disorders affecting collagen such as Ehlers–Danlos syndrome, Müllerian anomalies, and in utero exposure to diethylstilbestrol [2,3]. It is important to note that none of these risk factors are associated specifically with cervical insufficiency and thus do not warrant intervention based on risk factors alone. Infection or inflammation, bleeding at the interface of the decidua and placenta, or uterine overdistention can also cause biochemical changes in the cervix that lead to premature cervical shortening. These issues tend to be singular and nonrecurrent and therefore do not meet the criteria for cervical insufficiency.

Cervical insufficiency is not always a clear diagnosis due to the lack of absolute diagnostic criteria. The diagnosis is made based on the patient's history of painless cervical dilation after the first trimester with subsequent expulsion of the pregnancy before 24 weeks. The diagnosis cannot be made or excluded in nonpregnant individuals as there is no specific examination for this condition outside of the pregnant state [3]. There are three main ways to diagnose cervical insufficiency, as outlined in Table 12.1 [1].

Physical exam findings for cervical insufficiency are not always consistent. Patients often will present with pelvic pressure or changes in vaginal discharge, including increased discharge volume and color changes from clear, white, yellow, pink, tan, or blood-tinged [3]. The presence of labor, placental abruption, infection, or rupture of amniotic membranes negates the diagnosis of cervical insufficiency. A shortened cervical length, defined as <25 mm in the second trimester, may be an important predictor of preterm labor and delivery, yet is not a specific marker for the diagnosis of cervical insufficiency

[1]. Decreasing serial cervical lengths over time may indicate a risk of cervical insufficiency or preterm delivery, but alone are not diagnostic.

Both medical and surgical methods have been investigated as treatment of cervical insufficiency. Nonsurgical modalities including bed rest, activity restriction, and pelvic rest have not been proven to be effective for the treatment of cervical insufficiency and thus are not recommended. Similarly, the use of vaginal pessaries has been proposed for the treatment of cervical insufficiency, yet a meta-analysis of randomized trials comparing the use of a cervical pessary with standard care (no pessary or vaginal progesterone) in asymptomatic patients with a cervical length ≤ 25 mm who were at high risk for preterm birth did not find pessaries effective in preventing spontaneous preterm birth or improving perinatal outcomes [4]. Vaginal progesterone use has been studied in the setting of an incidentally detected short cervical length in the second trimester. Specifically, in asymptomatic patients with a singleton gestation without prior preterm birth, and a very short cervical length ≤ 20 mm before or at 24 weeks' gestation, vaginal progesterone is recommended as a management option to reduce the risk of preterm delivery. However, it is important to note that an incidentally found shortened cervix in asymptomatic women without a prior history of preterm birth is not diagnostic of cervical insufficiency, and the use of vaginal progesterone alone in the treatment of cervical insufficiency is not supported [3].

Surgical approaches to treating cervical insufficiency rely primarily on the placement of transvaginal or transabdominal cervical cerclages. The two primary transvaginal methods include modifications of the McDonald and Shirodkar cerclage techniques. The superiority of one suture type or technique has not been established [5]. The McDonald technique involves a simple purse-string nonabsorbable suture, typically polyester fiber or polypropylene, inserted around the cervix at the cervicovaginal junction. The Shirodkar technique requires surgical dissection of the vaginal epithelium underlying the bladder and rectum from the cervix in a cephalad direction so that a nonabsorbable suture can be placed as close to the internal cervical os as possible. Transabdominal cervicoisthmus cerclage placement, done via laparoscopy or laparotomy, is reserved for patients where anatomical limitations prevent transvaginal placement, or in cases of failed transvaginal cerclages that resulted in subsequent second-trimester loss [1,6].

When the diagnosis of cervical insufficiency is made based on the patient's obstetrical history, a history-indicated cerclage is often placed between 13 and 14 weeks' gestation before cervical effacement or dilation typically occurs [1,6]. For patients who present with advanced cervical dilation and meet criteria for a physical exam–based diagnosis of cervical insufficiency, an exam-indicated cerclage may be placed. A cerclage placed via a transvaginal approach is removed between 36 and 37 weeks in the absence of complications. If preterm rupture of membranes occurs, removal or retention of the transvaginal cerclage is done on an individualized basis. Certainly, in the setting of preterm labor, cerclage removal is indicated to

Table 12.1 Three clinical settings to diagnose cervical insufficiency

1. Obstetrical history	One or more second-trimester pregnancy losses related to painless cervical dilation in the absence of labor or placental abruption
2. Physical examination	Painless advanced cervical dilation and/or effacement in the second trimester in the absence of labor or placental abruption
3. Ultrasound findings with a history of prior preterm birth	Current singleton pregnancy, prior spontaneous preterm birth <34 weeks' gestation, and short cervix (<25 mm) before 24 weeks' gestation*

*Not diagnostic of cervical insufficiency, but used as an indicator for prophylactic cerclage placement to reduce preterm birth outcomes

prevent cervical lacerations. A transabdominal cerclage is left in situ, and cesarean delivery is planned at 37 weeks in the absence of complications [1,6].

Key Teaching Points

- Cervical insufficiency is not well understood but is believed to be the result of an inherent weakness in the cervix that results in spontaneous pregnancy loss prior to 24 weeks in the absence of labor or placental abruption.
- While a sonographic shortened cervix is a risk factor for preterm birth, the diagnosis of cervical insufficiency is made by documenting painless cervical dilation on physical exam.
- Transvaginal and transabdominal cerclages are associated with improved pregnancy outcomes, while nonsurgical methods like bed rest and pessaries show limited efficacy.
- Patients with advanced cervical dilation can opt for expectant management, termination, or cerclage, guided by an understanding of the associated maternal and fetal risks. Cerclages should be timed and chosen according to individual patient circumstances and surgeon experience.

References

- 1 American College of Obstetricians and Gynecologists. ACOG Practice Bulletin No.142: Cerclage for the Management of Cervical Insufficiency. *Obstet Gynecol.* 2014;123:372–379.
- 2 Kiwi R, Neuman MR, Merkatz IR, et al. Determination of the Elastic Properties of the Cervix. *Obstet Gynecol.* 1988;71:568–574.
- 3 American College of Obstetricians and Gynecologists. ACOG Practice Bulletin No.234: Prediction and Prevention of Spontaneous Preterm Birth. *Obstet Gynecol.* 2021;138:e65–90.
- 4 Saccone G, Ciardulli A, Xodo S, et al. Cervical Pessary for Preventing Preterm Birth in Singleton Pregnancies with Short Cervical Length: A Systematic Review and Meta-analysis. *J Ultrasound Med.* 2017;36(8):1535.
- 5 Shennan AH, Story L; Royal College of Obstetricians, Gynaecologists. Cervical Cerclage: Green-Top Guideline No. 75. *BJOG.* 2022;129:1178–1210.
- 6 van Dijk CE, Breuking SH, Jansen S, et al. Perioperative Complications of a Transvaginal Cervical Cerclage in Singleton Pregnancies: A Systematic Review and Meta-analysis. *Am J Obstet Gynecol.* 2023;228(5):521–534.

CASE 12

A 25-Year-Old with Cervical Insufficiency at 18 Weeks

Kiran Kavipurapu

History of Present Illness

A 25-year-old primigravid patient at 18 0/7 weeks' gestation presents to the Emergency Department with a 1-day history of increasing pelvic pressure and bloody mucus vaginal discharge. She states that she woke up earlier this morning with a feeling of pelvic and vaginal pressure as though her bladder was full. When she used the restroom, she noticed a small amount of bloody mucus discharge when she wiped. She denies feeling any cramping pain or contractions. Her pelvic and vaginal pressure increased throughout the morning, and she continued to have bloody mucus discharge every time she wiped.

This pregnancy has been complicated by mild nausea and vomiting until approximately 11 weeks. She completed non-invasive prenatal testing, which resulted in a low risk for trisomy 13, 18, and 21 with normal female sex chromosomes. She underwent a normal nuchal translucency ultrasound at 13 weeks' gestation that showed a cervical length of 3.2 cm. She also had a normal second-trimester maternal serum alpha-fetoprotein testing at 16 weeks. Her fetal anatomy ultrasound is scheduled in 2 weeks. She has no significant past medical or surgical history and is only taking prenatal vitamins. She has no known drug allergies.

Physical Examination

General appearance: Obese, no acute distress

Vital signs:

Temperature: 37.2°C

Pulse: 85 beats per minute

Blood pressure: 119/69 mmHg

Respiratory rate: 18 breaths per minute

BMI: 31.9 kg/m²

Abdomen: Soft, normal bowel sounds, non-tender.

No hepatosplenomegaly. Gravid uterus palpable 2 cm below the umbilicus, non-tender uterine fundus

Pelvic: Normal external genitalia. Blood-tinged mucus discharge noted on speculum exam. No vaginal lesions. The cervix is 4 cm dilated and 70% effaced with bulging amniotic membranes noted at the level of the external cervical os.

The fetal breech is at -3 station. Negative pooling on speculum exam with an equivocal nitrazine test and negative ferning

Laboratory studies:

WBC: 12,100/μL

Hgb: 11.1 g/dL

Plt: 190,000/μL

Imaging:

Transabdominal ultrasound shows an intrauterine pregnancy with an active fetus in the breech presentation. The fetal biometry is consistent with 18 0/7 weeks' gestation, and the fetal heart rate is 155 beats per minute. A fetal anatomy survey was conducted, revealing no anomalies. The placenta is anterior and fundal with no gross abnormalities, and the amniotic fluid level is appropriate for gestational age. There are no apparent uterine or adnexal masses visible. The cervix is not adequately visualized on transabdominal ultrasound. Transvaginal ultrasound shows a shortened cervix at 0.9 cm and cervical funneling. The internal cervical os is dilated at 3.9 cm, with amniotic membranes protruding to the level of the external cervical os.

How Would You Manage This Patient?

This patient's advanced painless cervical dilation in the second trimester without evidence of contractions or other labor signs is consistent with the diagnosis of cervical insufficiency. Given the advanced painless cervical dilation, the patient was counseled on the options of expectant management, pregnancy termination, or an attempt at placing a physical exam-indicated cerclage. Expectant management would likely result in further cervical dilation and premature expulsion of the pregnancy. She was counseled that the placement of a cerclage in the setting of advanced cervical dilation and protruding amniotic membranes carries both maternal and fetal risks, including intraamniotic or uterine infection, inadvertent rupture of membranes, bleeding, cervical lacerations, and fetal death. The patient elected to move forward with a cerclage placement. The patient was appropriately consented and taken to the operating room for cervical cerclage placement using a modified Shirodkar method. Following the procedure, a transvaginal ultrasound showed a new cervical length of 2 cm with no funneling. She was monitored overnight and discharged home on post-operative day one. She continued to have routine prenatal care, including regular cervical length measurements until 28 weeks. At 36 weeks, her cerclage was removed, and she spontaneously went into labor at 38 weeks, resulting in an uncomplicated vaginal delivery.

Diagnosis and Treatment of Cervical Insufficiency

Cervical insufficiency is defined as the inability of the uterine cervix to retain a pregnancy with the eventual expulsion of the

pregnancy in the absence of signs and symptoms consistent with labor, placental abruption, or both in the second trimester [1]. While cervical insufficiency may occur in a single isolated pregnancy, the diagnosis is often confirmed when it recurs in multiple pregnancies. The pathophysiology of cervical insufficiency is not well understood; however, there are several risk factors that increase the risk of cervical insufficiency. Generally, it is believed that a structural weakness of the cervix is the likely cause of many second-trimester losses. The risk factors for cervical insufficiency include cervical conization or loop electrosurgical excisional procedures, obstetrical lacerations, and dilation of the cervix during dilation and curettage procedures. Rare physiologic or genetic risk factors may include disorders affecting collagen such as Ehlers–Danlos syndrome, Müllerian anomalies, and in utero exposure to diethylstilbestrol [2,3]. It is important to note that none of these risk factors are associated specifically with cervical insufficiency and thus do not warrant intervention based on risk factors alone. Infection or inflammation, bleeding at the interface of the decidua and placenta, or uterine overdistention can also cause biochemical changes in the cervix that lead to premature cervical shortening. These issues tend to be singular and nonrecurrent and therefore do not meet the criteria for cervical insufficiency.

Cervical insufficiency is not always a clear diagnosis due to the lack of absolute diagnostic criteria. The diagnosis is made based on the patient's history of painless cervical dilation after the first trimester with subsequent expulsion of the pregnancy before 24 weeks. The diagnosis cannot be made or excluded in nonpregnant individuals as there is no specific examination for this condition outside of the pregnant state [3]. There are three main ways to diagnose cervical insufficiency, as outlined in Table 12.1 [1].

Physical exam findings for cervical insufficiency are not always consistent. Patients often will present with pelvic pressure or changes in vaginal discharge, including increased discharge volume and color changes from clear, white, yellow, pink, tan, or blood-tinged [3]. The presence of labor, placental abruption, infection, or rupture of amniotic membranes negates the diagnosis of cervical insufficiency. A shortened cervical length, defined as <25 mm in the second trimester, may be an important predictor of preterm labor and delivery, yet is not a specific marker for the diagnosis of cervical insufficiency

[1]. Decreasing serial cervical lengths over time may indicate a risk of cervical insufficiency or preterm delivery, but alone are not diagnostic.

Both medical and surgical methods have been investigated as treatment of cervical insufficiency. Nonsurgical modalities including bed rest, activity restriction, and pelvic rest have not been proven to be effective for the treatment of cervical insufficiency and thus are not recommended. Similarly, the use of vaginal pessaries has been proposed for the treatment of cervical insufficiency, yet a meta-analysis of randomized trials comparing the use of a cervical pessary with standard care (no pessary or vaginal progesterone) in asymptomatic patients with a cervical length ≤ 25 mm who were at high risk for preterm birth did not find pessaries effective in preventing spontaneous preterm birth or improving perinatal outcomes [4]. Vaginal progesterone use has been studied in the setting of an incidentally detected short cervical length in the second trimester. Specifically, in asymptomatic patients with a singleton gestation without prior preterm birth, and a very short cervical length ≤ 20 mm before or at 24 weeks' gestation, vaginal progesterone is recommended as a management option to reduce the risk of preterm delivery. However, it is important to note that an incidentally found shortened cervix in asymptomatic women without a prior history of preterm birth is not diagnostic of cervical insufficiency, and the use of vaginal progesterone alone in the treatment of cervical insufficiency is not supported [3].

Surgical approaches to treating cervical insufficiency rely primarily on the placement of transvaginal or transabdominal cervical cerclages. The two primary transvaginal methods include modifications of the McDonald and Shirodkar cerclage techniques. The superiority of one suture type or technique has not been established [5]. The McDonald technique involves a simple purse-string nonabsorbable suture, typically polyester fiber or polypropylene, inserted around the cervix at the cervicovaginal junction. The Shirodkar technique requires surgical dissection of the vaginal epithelium underlying the bladder and rectum from the cervix in a cephalad direction so that a nonabsorbable suture can be placed as close to the internal cervical os as possible. Transabdominal cervicoisthmus cerclage placement, done via laparoscopy or laparotomy, is reserved for patients where anatomical limitations prevent transvaginal placement, or in cases of failed transvaginal cerclages that resulted in subsequent second-trimester loss [1,6].

When the diagnosis of cervical insufficiency is made based on the patient's obstetrical history, a history-indicated cerclage is often placed between 13 and 14 weeks' gestation before cervical effacement or dilation typically occurs [1,6]. For patients who present with advanced cervical dilation and meet criteria for a physical exam–based diagnosis of cervical insufficiency, an exam-indicated cerclage may be placed. A cerclage placed via a transvaginal approach is removed between 36 and 37 weeks in the absence of complications. If preterm rupture of membranes occurs, removal or retention of the transvaginal cerclage is done on an individualized basis. Certainly, in the setting of preterm labor, cerclage removal is indicated to

Table 12.1 Three clinical settings to diagnose cervical insufficiency

1. Obstetrical history	One or more second-trimester pregnancy losses related to painless cervical dilation in the absence of labor or placental abruption
2. Physical examination	Painless advanced cervical dilation and/or effacement in the second trimester in the absence of labor or placental abruption
3. Ultrasound findings with a history of prior preterm birth	Current singleton pregnancy, prior spontaneous preterm birth <34 weeks' gestation, and short cervix (<25 mm) before 24 weeks' gestation*

*Not diagnostic of cervical insufficiency, but used as an indicator for prophylactic cerclage placement to reduce preterm birth outcomes

prevent cervical lacerations. A transabdominal cerclage is left in situ, and cesarean delivery is planned at 37 weeks in the absence of complications [1,6].

Key Teaching Points

- Cervical insufficiency is not well understood but is believed to be the result of an inherent weakness in the cervix that results in spontaneous pregnancy loss prior to 24 weeks in the absence of labor or placental abruption.
- While a sonographic shortened cervix is a risk factor for preterm birth, the diagnosis of cervical insufficiency is made by documenting painless cervical dilation on physical exam.
- Transvaginal and transabdominal cerclages are associated with improved pregnancy outcomes, while nonsurgical methods like bed rest and pessaries show limited efficacy.
- Patients with advanced cervical dilation can opt for expectant management, termination, or cerclage, guided by an understanding of the associated maternal and fetal risks. Cerclages should be timed and chosen according to individual patient circumstances and surgeon experience.

References

- 1 American College of Obstetricians and Gynecologists. ACOG Practice Bulletin No.142: Cerclage for the Management of Cervical Insufficiency. *Obstet Gynecol.* 2014;123:372–379.
- 2 Kiwi R, Neuman MR, Merkatz IR, et al. Determination of the Elastic Properties of the Cervix. *Obstet Gynecol.* 1988;71:568–574.
- 3 American College of Obstetricians and Gynecologists. ACOG Practice Bulletin No.234: Prediction and Prevention of Spontaneous Preterm Birth. *Obstet Gynecol.* 2021;138:e65–90.
- 4 Saccone G, Ciardulli A, Xodo S, et al. Cervical Pessary for Preventing Preterm Birth in Singleton Pregnancies with Short Cervical Length: A Systematic Review and Meta-analysis. *J Ultrasound Med.* 2017;36(8):1535.
- 5 Shennan AH, Story L; Royal College of Obstetricians, Gynaecologists. Cervical Cerclage: Green-Top Guideline No. 75. *BJOG.* 2022;129:1178–1210.
- 6 van Dijk CE, Breuking SH, Jansen S, et al. Perioperative Complications of a Transvaginal Cervical Cerclage in Singleton Pregnancies: A Systematic Review and Meta-analysis. *Am J Obstet Gynecol.* 2023;228(5):521–534.

A 25-Year-Old with an Echogenic Cardiac Focus at 19 Weeks' Gestation

Mallory E. Kremer

History of Present Illness

A 25-year-old gravida 2 para 0, at 19 6/7 weeks by her last menstrual period consistent with a 10-week ultrasound presents for routine prenatal care. She completed her second-trimester anatomy ultrasound earlier today. She reviewed the anatomy ultrasound report on her electronic patient portal this morning. She is curious if this result is suggestive of an elevated risk for Down syndrome and would like to know if additional testing is recommended. She is beginning to appreciate fetal movement and has no contractions or vaginal bleeding.

Physical Examination

General appearance: Well-appearing, comfortable

Vital signs:

Temperature: 37.5°C

Pulse: 86 beats per minute

Blood pressure: 101/65 mmHg

Respiratory rate: 14 breaths per minute

BMI: 24.2 kg/m²

Abdomen: Gravid, non-tender, fundal height is 20 cm

Fetal assessment: Fetal heart tones 145 beats per minute

Laboratory studies:

Routine genetic screening was previously completed.

A cell-free fetal DNA test was performed at 12 weeks. The sex chromosomes were XX with a low risk for trisomy 21. An alpha-fetoprotein drawn in the second trimester was normal at 1.06 multiples of the median (MoM). The remainder of her prenatal labs were within normal limits.

Imaging:

An anatomy ultrasound was performed. The placenta was anterior, and there was normal amniotic fluid. There was a single intrauterine pregnancy. The fetus was well-grown with an estimated fetal weight at the 35th percentile for gestational age. The anatomy survey was remarkable solely for a single echogenic intracardiac focus (EIF) (Figure 13.1).

How Would You Counsel This Patient?

The patient completed her second-trimester ultrasound for structural fetal abnormalities within the recommended time frame of 18–22 weeks' gestation [1]. She had a normal anatomic survey with no detected major anatomic anomalies, such as cardiac malformations or neuro-anatomic abnormalities. She had previously completed a cell-free fetal DNA test at



Figure 13.1 Image of an EIF on a routine prenatal anatomic ultrasound performed at 21 weeks. This finding is “bright as bone” and visible on at least two ultrasound views

12 weeks with a low-risk result. She has not had a previous pregnancy affected by trisomy 21.

Given this context and prior testing, she can be advised that an isolated EIF is considered a normal anatomic variant [2]. This isolated finding is unlikely to be of clinical consequence for this low-risk patient. The anatomic survey for the fetus was completed, including a normal four-chamber view and outflow tracts of the fetal heart, and no additional cardiac imaging was indicated [3]. Routine prenatal care was recommended. A third-trimester growth ultrasound would be recommended only for the usual indications.

“Soft Markers” on Fetal Ultrasound

First reported and studied in the 1980s, an EIF is thought to represent a microcalcification near the papillary muscles of the fetal heart ventricle, most often occurring on the left side [4]. On ultrasound, an echogenic nodule in the heart will appear “bright as bone” and should be visible on at least two heart views. This nodule has higher echo density or “reflectiveness” compared to the surrounding heart muscle. There can be single or bilateral EIFs noted on imaging, and they can be detected as early as 11 weeks’ gestation [5]. An EIF does not represent a structural abnormality and has no bearing on cardiac function. An EIF can be detected in 15–30% of fetuses with trisomy 21 and 4–7% of euploid fetuses [3]. An EIF may be noted to persist or resolve on subsequent ultrasounds in the third trimester.

Echogenic intracardiac focus has a historic distinction as a “soft marker” on antenatal ultrasound, meaning there are no structural or functional abnormalities with the involved organ; however, the presence of the soft marker has been associated with a slightly increased risk for trisomy 21 in some studies [6,7]. There are several ultrasound findings that have been described as soft markers in addition to EIF, such as choroid plexus cysts, thickened nuchal fold, and absent or hypoplastic nasal bone. In low-risk populations, these findings have

low sensitivity and specificity for predicting trisomy 21 (Table 13.1). Follow-up imaging for an isolated finding of an EIF (i.e. with an otherwise completely normal anatomic survey and negative cell-free DNA testing) is not recommended by the Society for Maternal-Fetal Medicine (SMFM) [8]. Postnatal ultrasound is also not required.

Prior to the development of high-sensitivity serum screening, the presence of soft markers on second-trimester ultrasound was referred to as the “genetic sonogram.” The presence of markers helped guide decision-making regarding the need for amniocentesis for the diagnosis of trisomy 21 to improve the detection rate of aneuploidy over age-based risk assessment alone [9]. Ultrasound markers that confer a moderate or substantially increased risk of trisomy 21 include ventriculomegaly, short femur or humerus, and echogenic bowel, and may lead to diagnostic testing [10]. The presence of multiple soft markers or other anatomic abnormalities confers an elevated risk of aneuploidy as well.

In the literature, the risk of aneuploidy with soft markers is often described by the likelihood ratio (LR). An LR in the range of 1.5 to 5 gives a small additional increase in the overall likelihood of a particular outcome [8]. For this 25-year-old patient, a negative cell-free DNA screening test result has reduced the risk of trisomy 21 by 300-fold. Even with the addition of a slightly positive LR for an isolated EIF, her risk for aneuploidy is still negligible [8].

Anticipatory Guidance Regarding Ultrasound Results

The increasing resolution of ultrasound can lead to the description of various imaging findings with debatable clinical significance. These findings can cause significant patient distress or worry. Patient anxiety can be further amplified by the automatic release of results on electronic medical records. Anticipatory guidance about the possibility of seeing an abnormal finding

Table 13.1 Recommended management for isolated soft markers in the second trimester that require none or minimal additional follow-up, adapted from SMFM Consult Series # 57 [8]

Soft marker	Likelihood ratio (LR) range	Evaluation	Antenatal management	Follow-up imaging
EIF	1.4–1.8, with confidence interval extending below 1.0	If cell-free DNA or serum screen negative, no additional evaluation recommended. If no previous screening, noninvasive testing for aneuploidy recommended	Routine care	None
Choroid plexus cysts	0.5–5.6, best estimate for the LR is <2 for isolated finding	If cell-free DNA or serum screen negative, no additional evaluation recommended. If no previous screening, noninvasive testing for aneuploidy recommended	Routine care	None
Absent or hypoplastic nasal bone	Studies with estimated LR as high as 23, best estimate for LR is 6.6 for isolated finding	If cell-free DNA negative, no additional evaluation recommended. If serum screen negative, offer no further testing vs. cell-free DNA vs. invasive testing. If no previous screening, noninvasive testing for aneuploidy recommended vs. invasive testing for aneuploidy	Routine care	None
Thickened nuchal fold	Prior studies estimated range of 11–23, best estimate of LR is 3.8 for isolated finding	If cell-free DNA negative, no additional evaluation recommended. If serum screen negative, offer no further testing vs. cell-free DNA vs. invasive testing. If no previous screening, noninvasive testing for aneuploidy recommended vs. invasive testing for aneuploidy	Routine care	None

on patient portals can be reviewed with patients prior to ordering these tests. In the setting of low-risk aneuploidy screening such as integrated screening or cell-free DNA, an isolated EIF is considered a normal anatomic variant, and reassurance should be provided to patients. In other words, in patients who have completed high-sensitivity screening tests for Down syndrome, many isolated soft marker ultrasound findings are clinically insignificant.

Throughout prenatal care, it is important to acknowledge that there remains a residual risk for other genetic disorders even with negative screening results for the common aneuploidies. Utilizing language that acknowledges this space without heightening anxiety, such as referring to screening results as “low risk” or “reassuring” instead of “negative test” or “normal baby” can reinforce this concept.

Key Teaching Points

- The description of various soft markers on fetal anatomy ultrasound can contribute to patient anxiety. Anticipatory guidance about the possibility of seeing a report of an abnormal finding on patient portals can be helpful.
- In the setting of low-risk aneuploidy screening such as negative cell-free fetal DNA, an isolated EIF is a normal anatomic variant and clinically irrelevant. Follow-up imaging for EIF is not needed. As an isolated finding, EIF is not a reason to recommend invasive diagnostic testing for aneuploidy.
- If multiple soft markers on anatomy screening or major structural abnormalities are noted, then genetic counseling and/or consultation with a subspecialist is recommended.

References

- 1 Committee on Practice Bulletins—Obstetrics, American College of Obstetricians and Gynecologists. Practice Bulletin No. 175: Ultrasound in Pregnancy. *Obstet Gynecol.* 2016; 128(6):e241–e256.
- 2 American College of Obstetricians and Gynecologists’ Committee on Practice Bulletins—Obstetrics, Committee on Genetics, Society for Maternal-Fetal Medicine. Screening for Fetal Chromosomal Abnormalities: ACOG Practice Bulletin, Number 226. *Obstet Gynecol.* 2020;136(4):e48–e69.
- 3 Reddy UM, Abuhamad AZ, Levine D, et al. Fetal Imaging: Executive Summary of a Joint Eunice Kennedy Shriver National Institute of Child Health and Human Development, Society for Maternal-Fetal Medicine, American Institute of Ultrasound in Medicine, American College of Obstetricians and Gynecologists, American College of Radiology, Society for Pediatric Radiology, and Society of Radiologists in Ultrasound Fetal Imaging Workshop. *Obstet Gynecol.* 2014;123:1070–1082.
- 4 Huang SY, Shaw SW, Cheuh HY, et al. Intracardiac Echogenic Focus and Trisomy 21 in a Population Previously Evaluated by First-Trimester Combined Screening. *Acta Obstet Gynecol Scand.* 2010;89(8):1017–1023.
- 5 Whitlow BJ, Lazanakis ML, Kadir RA, et al. The Significance of Choroid Plexus Cysts, Echogenic Heart Foci and Renal Pyelectasis in the First Trimester. *Ultrasound Obstet Gynecol.* 1998;12(6):385–390.
- 6 Agathokleous M, Chaveeva P, Poon LC, et al. Meta-analysis of Second-Trimester Markers for Trisomy 21. *Ultrasound Obstet Gynecol.* 2013;41(3):247–261.
- 7 Nyberg DA, Souter VL, El-Bastawissi A, et al. Isolated Sonographic Markers for Detection of Fetal Down Syndrome in the Second Trimester of Pregnancy. *J Ultrasound Med.* 2001;20:1053–1063.
- 8 Society for Maternal-Fetal Medicine, Prabhu M, Kuller JA, et al. Society for Maternal-Fetal Medicine Consult Series #57: Evaluation and Management of Isolated Soft Ultrasound Markers for Aneuploidy in the Second Trimester. *Am J Obstet Gynecol.* 2021;225(4):B2–B15.
- 9 Aagaard-Tillery KM, Malone FD, Nyberg DA, et al. First and Second Trimester Evaluation of Risk Research Consortium. Role of Second-Trimester Genetic Sonography after Down Syndrome Screening. *Obstet Gynecol.* 2009;114:1189–1196.
- 10 Shanahan M. Ultrasound Markers for Down Syndrome. SASGOG’s Pearls of Excellence. www.excellence.org/list-of-pearls/ultrasound-markers-for-down-syndrome/?categoryName=&searchTerms=&featured=False&bookmarked=False&sortColumn=date&sortDirection=Descending (accessed September 25, 2024).

A 20-Year-Old with Right Lower Quadrant Pain at 15 Weeks' Gestation

Juan J. Diaz Quinones

History of the Present Illness

A 20-year-old primigravid patient at 15 2/7 weeks' gestation by her last menstrual period presented to the Emergency Room complaining of a sudden onset of right lower quadrant pain. A transvaginal pelvic ultrasound showed a 5 cm corpus luteal cyst on the right. A viable single intrauterine pregnancy was visualized. Her abdomen was soft and non-tender. She was discharged home as the pain had resolved spontaneously. Fifteen hours later she returns to the Emergency Room complaining of excruciating, nonradiating, sharp right lower quadrant pain that is not improved with acetaminophen. The pain is now accompanied by nausea and vomiting. She reports no vaginal bleeding, leaking of fluid, fever, diarrhea, constipation, or urinary complaints.

Physical Examination

General appearance: Distressed and diaphoretic

Vital signs:

Temperature: 37.1°C

Pulse: 105 beats per minute

Blood pressure: 130/67 mmHg

Respiratory rate: 22 breaths per minute

Oxygen saturation: 100% on room air

BMI: 24.1 kg/m²

Abdomen: Tender mass in the right lower quadrant with positive rebound and guarding. Bowel sounds are present

Pelvic: Normal external genitalia. The cervix is closed.

No blood, discharge, or fluid noted in the vagina. The right adnexa measures 10 cm and is tender to palpation. The left adnexa is normal.

Laboratory studies:

Urinalysis: Negative

WBC: 11,000/μL

Hgb: 10.1 g/dL

Plt: 290,000/μL

Imaging:

Transabdominal ultrasound demonstrates a single intrauterine pregnancy of 15 0/7 weeks with a fetal heart rate of 160 beats per minute. The left ovary measures 2.0 × 1.4 × 1.7 cm. The right ovary measures 6.3 × 5.4 × 4.7 cm. In the right adnexa, a 5.1 × 5.2 × 4.5 cm simple cyst arising within the right ovary is visualized. The right ovary is hyperechoic with peripherally displaced follicles. A moderate amount of free intraperitoneal fluid is visualized. Arterial blood flow is present in both ovaries.

How Would You Manage This Patient?

The patient's clinical picture and the ultrasound findings are highly suggestive of ovarian torsion. Establishing an accurate and timely diagnosis of ovarian torsion optimizes maternal and fetal outcomes. The definitive diagnosis of ovarian torsion is made by diagnostic surgery. Due to the anatomic and physiologic changes of pregnancy, there are surgical principles that must be followed to ensure the well-being of the mother and fetus [1,2]. This patient was extensively counseled about the risks that surgery may pose to her and the fetus, including an increased risk of preterm delivery and intrauterine growth restriction [3]. A fetal heart rate was obtained in the operating room before proceeding with laparoscopy. Perioperative pneumatic compression devices were placed for venous thromboembolism prophylaxis. The patient was induced under general endotracheal anesthesia, and a nasogastric tube was inserted. The patient was placed in a dorsal-lithotomy position. An open entry technique was performed by making a 3-cm supraumbilical incision. The Hasson's cannula was introduced under direct visualization. A 12-mmHg pneumoperitoneum was created. Upon entry, the right ovary was purple in color and twisted twice at the infundibulopelvic ligament. Two 5-mm trocars were placed under direct visualization on the left and right upper quadrants 6 cm from the uterine fundus. The right ovary was untwisted, and an ovarian cystectomy was performed. The cyst was placed into a specimen bag and removed through the umbilical incision. At the end of the procedure, a fetal heart rate was obtained again. Postoperatively, early ambulation was encouraged.

Ovarian Torsion Occurring during Pregnancy

Establishing the diagnosis of acute abdominal and pelvic pain in pregnancy is difficult due to multiple confounding factors related to normal pregnancy, such as physiologic leukocytosis, displacement of abdominal and pelvic organs, limitations of abdominal and pelvic examinations due to the gravid uterus, and pregnancy-related nausea and vomiting. The most common cause of an acute abdomen in pregnancy is appendicitis. Other common causes include cholecystitis, pancreatitis, small bowel obstruction, ovarian torsion, degenerating myoma, and uterine rupture [4]. Sixty-four percent of ovarian torsion occurs on the right side. The lower rate on the left side is attributed to the protective nature of the descending colon. Almost without exception, torsion occurs when the ovary is enlarged secondary to a cyst or neoplasm. The risk of torsion increases with pelvic masses that exceed 5 cm [1]. The incidence of ovarian torsion

increases fivefold during pregnancy. The most common cause of ovarian torsion in pregnancy is a corpus luteum cyst. Therefore, ovarian torsion occurs most frequently in the first trimester, occasionally in the second trimester, and rarely in the third trimester [5].

The most common symptoms of adnexal torsion are intermittent, nonradiating, pelvic pain associated with nausea and vomiting. Specifically, nausea and vomiting are reported in 62 and 67% of patients presenting with ovarian torsion, respectively. Rebound and peritoneal signs are present in only 12–27% of patients. Pelvic ultrasound is the imaging modality of choice, with a sensitivity of 92% and specificity of 96% in detecting ovarian torsion. The findings of unilateral ovarian enlargement, ovarian edema with peripherally displaced follicles, and the presence of intraperitoneal free fluid are highly specific for ovarian torsion. A coiled vascular pedicle, known as a whirlpool sign, is also highly specific but technically difficult to visualize on ultrasound. Changes to arterial Doppler blood flow to the ovaries are not always detected in the setting of adnexal torsion. The presence of arterial flow in the setting of ovarian torsion may be explained by intermittent torsion, collateral blood supply from the utero-ovarian vessels or infundibulopelvic vessels, or torsion of a paratubal cyst. The presence or absence of arterial Doppler flow alone should not guide clinical decision-making [1]. In a retrospective study that compared the clinical presentation and ultrasound findings between pregnant and nonpregnant patients with ovarian torsion, the only clinical difference was that a palpable abdominal mass was more likely to be present in nonpregnant patients. The sonographic detection of ovarian torsion was higher in pregnant patients due to ovarian edema being more obvious in pregnant patients [6].

When ultrasound findings are equivocal or uncertain, magnetic resonance imaging (MRI) is useful in the work-up of an acute abdomen in pregnancy. The principal advantage of an MRI over ultrasonography and CT is the ability to image deep soft structures in a manner that is not operator-dependent and does not use ionizing radiation [7].

Rapid intervention is recommended during cases of ovarian torsion to maintain ovarian function and to preserve future fertility. Although the ovary can appear ischemic, multiple studies have shown a return in ovarian function with the preservation of the ovary. If an ovarian cyst is present, the adnexa is untwisted, and an ovarian cystectomy should be attempted. Drainage of the ovarian cyst should be performed if cystectomy is not possible [1].

In a study using the American College of Surgeons National Surgical Quality Improvement Program database, there was no significant difference in the overall morbidity or 30-day mortality rates in pregnant and nonpregnant matched patients undergoing similar general surgical operations [8]. However, a retrospective study by Baldwin et al. revealed that patients undergoing nonobstetrical surgery after 23 weeks' gestation showed a high rate of subsequent preterm delivery (<37 weeks) of 41%, with a mean interval from the surgery to delivery of 7.7 weeks [9]. In a study published from the Swedish Birth Registry, where 5,405 operations were

Box 14.1 Guidelines recommended by SAGES for laparoscopic surgery in pregnant patients

Intraoperative CO₂ monitoring
Fetal heart tone monitoring pre- and post-operatively
Lateral recumbent position if the gestational age is beyond the first trimester
Open Hasson, Veress needle, or optical trocar technique can be safely accomplished if the entry location is adjusted according to fundal height
Trocars placement should be altered to account for the increased size of the uterus
Perioperative pneumatic compression devices and early ambulation

performed in a population of 720,000 pregnant patients, the incidence of congenital malformations and stillbirths was not increased in the offspring of patients having an operation. However, the incidence of very-low- and low-birth-weight infants was increased; these were the result of both prematurity and intrauterine growth restriction [3]. There is no evidence that in utero human exposure to anesthetic or sedative drugs has any effect on the developing fetal brain [10].

There is some debate regarding laparoscopy being contraindicated during pregnancy due to concerns for injury of the gravid uterus from trocar placement and decreased placental perfusion due to pneumoperitoneum. Several studies have shown the safety of laparoscopy in pregnancy and now it is the preferred modality for many surgical diseases that occur during pregnancy. In 2017, the Society of American Gastrointestinal Endoscopic Surgeons (SAGES) published their guidelines for laparoscopic surgery in pregnant patients (Box 14.1). The first recommendation is that after the first trimester, the lateral recumbent position is advised to reduce pressure on the vena cava and maintain adequate venous return. The open Hasson technique is preferred for initial entry because it provides optimal visualization to avoid inadvertent injury to the uterus. The initial trocar should be placed 6 cm above the uterine fundus or in the left upper quadrant. Some recommend an intraabdominal pressure of no greater than 12 mmHg to avoid worsening pulmonary physiology in gravid patients. Others are of the opinion that pressures of 15 mmHg in pregnant patients can be used without increasing adverse outcomes to the patient or the fetus. Fetal acidosis with insufflation has not been documented in the human fetus, but concern over potential detrimental effects of acidosis has led to the recommendation for maternal CO₂ monitoring [2].

If the fetus is considered previable, it is generally sufficient to ascertain the fetal heart rate with Doppler before and after the procedure. Because pregnancy is considered a hypercoagulable state, preoperative pneumatic compression devices and early postoperative ambulation are encouraged. Corticosteroid administration for fetal benefit should be considered with viable premature gestational ages, and patients should be monitored in the perioperative period for signs and symptoms of preterm labor if clinically indicated [10]. If removal of the corpus luteum occurs at less than 12 weeks' gestation, progesterone therapy should be initiated [2].

Key Teaching Points

- The incidence of ovarian torsion increases fivefold during pregnancy. The most common cause of ovarian torsion in pregnancy is a corpus luteum cyst.
- Establishing an accurate and timely diagnosis of an acute abdomen during pregnancy optimizes maternal and fetal outcomes.
- Laparoscopic surgery is safe for the patient and the fetus. Pregnant patients undergoing surgery may have an increased risk of preterm delivery and intrauterine growth restriction.
- If a laparoscopic procedure is required after the first trimester, the lateral recumbent position is advised. The open Hasson technique is preferred for initial entry.

References

- 1 Adnexal Torsion in Adolescents: ACOG Committee Opinion No. 783. *Obstet Gynecol.* 2019;134(2):e56–e63.
- 2 Pearl JP, Price RP, Tonkin AE, et al. SAGES Guidelines for the Use of Laparoscopy during Pregnancy. May 2017. www.sages.org/publications/guidelines/guidelines-for-diagnosis-treatment-and-use-of-laparoscopy-for-surgical-problems-during-pregnancy (accessed September 25, 2024).
- 3 Mazze RI, Källén B. Reproductive Outcome after Anesthesia and Operation during Pregnancy: A Registry Study of 5405 Cases. *Am J Obstet Gynecol.* 1989;161(5):1178–1185.
- 4 Parikh B, Hussain FN, Brustman L. Acute Abdomen in Pregnancy. *Top Obstet Gynecol.* 2019;39(7):1–7.
- 5 Ventolini G, Hunter L, Drollinger D, et al. Ovarian Torsion during Pregnancy. HCP Live. December 2007. www.hcplive.com/view/2005-09_04 (accessed September 25, 2024).
- 6 Feng JL, Zheng J, Lei T, et al. Comparison of Ovarian Torsion between Pregnant and Non-pregnant Women at Reproductive Ages: Sonographic and Pathological Findings. *Quant Imaging Med Surg.* 2020;10(1):137–147.
- 7 Committee Opinion No. 723: Guidelines for Diagnostic Imaging during Pregnancy and Lactation. *Obstet Gynecol.* 2017;130(4):e210–e216.
- 8 Moore HB, Juarez-Colunga E, Bronsert M, et al. Effect of Pregnancy on Adverse Outcomes after General Surgery. *JAMA Surg.* 2015;150(7):637–643.
- 9 Baldwin EA, Borowski KS, Brost BC, et al. Antepartum Nonobstetrical Surgery at ≥ 23 Weeks' Gestation and Risk for Preterm Delivery. *Am J Obstet Gynecol.* 2015;212(2):232.e1–232.e5.
- 10 Committee Opinion No. 775: Nonobstetric Surgery during Pregnancy. *Obstet Gynecol.* 2019;133(4):e285–e286.

A 40-Year-Old with Decreased Libido at 29 Weeks

Amy Boone

History of Present Illness

A 40-year-old gravida 3 para 0 at 29 2/7 weeks' gestation presents to the office for a routine prenatal visit. During the visit, she expresses concern regarding the new onset of decreased libido. She is nervous to bring this up during the visit. Her past medical history is significant for mild asthma. Her pregnancy has been overall uncomplicated. She is employed full time in sales and lives with her partner.

Physical Examination

General appearance: No acute distress, well-appearing

Vital signs:

Temperature: 36.3°C

Pulse: 87 beats per minute

Blood pressure: 107/68 mmHg

Respiratory rate: 16 breaths per minute

BMI: 27.0 kg/m²

Cardiopulmonary: Regular rate and rhythm, lungs clear to auscultation bilaterally, nonlabored respirations

Abdomen: Gravid, non-tender, fundal height 29 cm

Neurological/psychological: Alert, cooperative

Fetal assessment: Fetal heart rate 145 beats per minute by Doppler

How Would You Manage This Patient?

Through questioning you learn that this patient does not have a history of sexual dysfunction and is in a committed relationship with a long-term supportive partner. She has had two previous spontaneous abortions and reveals that she is concerned that sexual activity could put this pregnancy at risk. She is relieved to understand that there is little risk to her current uncomplicated pregnancy from sexual activity. She plans to relay this information to her partner, who has similar fears regarding intercourse during pregnancy. She is counseled that adding a silicone- or oil-based lubricant can help address the physiologic vaginal dryness commonly encountered during pregnancy. You also discuss specific positions for sexual activity that can decrease low back and hip discomfort during intercourse. Recommending various strategies to increase partner connectedness through typical daily and pregnancy-related stressors can nurture the relationship and thus increase the desire for physical intimacy.

Sexuality in Pregnancy

The World Health Organization defines sexual health as “a state of physical, emotional, mental, and social well-being related to sexuality; it is not merely the absence of disease,

dysfunction, or infirmity” [1]. Sexuality is an important component of a person's life, as evidenced by data linking sexual dysfunction to significantly decreased physical and emotional health [2,3]. The puerperal period is marked by dramatic physiologic, psychologic, anatomic, and hormonal changes, all of which can alter sexuality [1,3]. Reported rates of sexual dysfunction in pregnancy vary widely from 37 to 94%, owing to the lack of a standardized definition [2]. There is a consensus that sexual function continually declines as pregnancy progresses in gestational age [1,2]. This alteration can begin as soon as a patient discovers that she is pregnant. With the knowledge of conception, sexual interest and the number of sexual intercourse or orgasmic activities often decrease [2].

The physiologic changes of the first trimester commonly result in physical symptoms that may include nausea, vomiting, breast sensitivity, and fatigue. These symptoms, in addition to the fear of miscarriage, result in around 40% of sexually active patients reporting diminished sexual satisfaction resulting from lower sexual desire [3,4]. Many see an increase in sexual interest during the second trimester as symptoms dissipate, the threat of early pregnancy loss lessens, and pregnancy acceptance grows [2,4]. However, as the pregnancy progresses, further physical changes result in lessened clitoral sensitivity and increased dyspareunia, and thus a decreased ability to orgasm [1]. In the third trimester, factors such as fetal head engagement, urinary incontinence, and loosening of connective tissues in the pubic symphysis and sacroiliac joints can result in sexual discomfort [5]. Partners may also become reluctant to participate in sexual activity due to changes in appearance or out of fear of harming their partner or the baby [2].

Psychological and emotional changes further contribute to sexual dysfunction as patients reconcile their evolving parental role and self-esteem changes that come with an alteration in body shape [6]. Pregnancy can be a catalyst for changes in a couple's relationship dynamic, anxiety surrounding impending parenthood, perceived lack of attractiveness, and sexual guilt stemming from decreased desire or intercourse frequency [5]. For many couples, general stress tends to increase during pregnancy, which can be confounded by the unique stressors arising from pregnancy-specific concerns negatively impacting intimacy and contributing to sexual dysfunction [7].

The lowest mean scores on the Female Sexual Function Index in all domains of sexual function are seen in the third trimester [4]. This is particularly significant in the desire, arousal, satisfaction, and pain categories relative to earlier in gestation [2]. As the abdomen increases in size, the types of sexual acts performed can be limited [3]. Positioning may be challenging due to discomfort, fatigue, and vulvar varicosities [1,3]. Moreover, vaginal connective tissue decreases while

muscle fibers thicken in preparation for birth, which reduces the orgasmic response. Vasocongestion and decreased lubrication commonly result in dyspareunia [1]. Anxiety often heightens in the third trimester with concerns about preterm labor or rupturing the membranes [2].

The route of delivery has been shown to contribute to postpartum sexual function. Patients who undergo planned cesarean deliveries have an earlier return of sexual function than those who have vaginal deliveries. Trauma to the pudendal nerve, the pelvic floor, and the perineum commonly occur during vaginal delivery, all of which increase the rate of postpartum dyspareunia. The highest rate of postpartum sexual dysfunction has been demonstrated in patients who experienced vacuum or forceps application during delivery [5]. On average, most patients resume intercourse 6–8 weeks' postpartum. There is a slow return to baseline sexual frequency after 6–12 months. Those who breastfeed for a prolonged period tend to have a later return to intercourse, report lower sexual interest, and have higher rates of discomfort with sex [1].

Management Strategies

There is a general tendency among both providers and patients to limit or avoid discussing the subject of sexuality [1]. Discussions regarding intercourse in pregnancy have traditionally focused solely on safety [6]. The regular scheduling of both prenatal and postpartum clinical visits offers an auspicious time to initiate a discussion about sexuality to identify modifiable risk factors for sexual dysfunction [1]. If not discussed with a health care provider, the abrupt and unexpected decline in sexual function that comes with pregnancy can be distressing [6]. It is imperative for providers to counsel pregnant patients that the alterations in sexual function that occur during this time are normal and are seen in most antepartum patients [5].

Anxiety negatively influences sexual function, and therefore clear counseling about the lack of associations between intercourse with miscarriage, rupture of membranes, preterm labor, and fetal harm is necessary to quell these fears [1,2]. Recommending abstinence from intercourse may strengthen these concerns and should not be encouraged outside of complications such as placenta previa, preterm premature rupture

of membranes, or preterm labor [1]. Moreover, sexuality has often been defined solely from the patient's point of view. It is tantamount to assess other sources of relationship stress and the partner's perspective to effectively manage dysfunction [1]. Feeling supported within the relationship allows patients to contend with daily stressors more aptly, and this partner connectedness increases the desire for physical intimacy [7]. In addition to the widely accepted models of female sexuality, Basson described that the desire for emotional intimacy is a common motivator for women to engage in sexual activity [5].

To address the physical limitations, obstetricians should counsel patients on the range of safe positions that alter the angle and depth of vaginal penetration, as well as the use of supports such as pillows. Some of these positions include side-lying, receptive partner-on-top, hands-and-knees, and rear-entry. Utilizing noncoital means of sexual contact can also increase partner intimacy [1]. Lubricants, particularly those made of oil or silicone, can combat the dyspareunia associated with vaginal dryness. There is a paucity of evidence evaluating the effects of pelvic floor muscle exercises antenatally, but it is a reasonable strategy if dyspareunia is felt to result from pelvic floor muscle dysfunction [8]. Lastly, sex therapy using cognitive behavioral techniques can increase a couple's sexual satisfaction [6].

Key Teaching Points

- Sexual health is an important component of a person's overall well-being.
- Physiologic, psychologic, anatomic, and hormonal changes inherent to pregnancy can negatively affect sexual function.
- Sexual frequency and satisfaction often progressively decline over the course of pregnancy, worsening in the third trimester.
- Initiating a discussion regarding sexuality during pre- and post-natal care can lessen the degree of sexual dysfunction.
- Additional management strategies include relationship nurturing, stress management, and addressing physical limitations that commonly arise with advancing gestation.

References

- 1 Grussu P, Vicini B, Quatraro RM. Sexuality in the Perinatal Period: A Systematic Review of Reviews and Recommendations for Practice. *Sex Reprod Healthc.* 2021;30:100668.
- 2 Daud S, Zahid AZM, Mohamad M, et al. Prevalence of Sexual Dysfunction in Pregnancy. *Arch Gynecol Obstet.* 2019;300(5):1279–1285.
- 3 Cassis C, Mukhopadhyay S, Morris E, et al. What Happens to Female Sexual Function during Pregnancy? *Eur J Obstet Gynecol Reprod Biol.* 2021;258:265–268.
- 4 Galazka I, Drosdzol-Cop A, Narowska B, et al. Changes in Sexual Function during Pregnancy. *J Sex Med.* 2015;12(2):445–454.
- 5 Johnson CE. Sexual Health during Pregnancy and the Postpartum. *J Sex Med.* 2011;8(5):1267–1284.
- 6 Vennier SA, Rosen NO. Sexual Distress and Sexual Problems during Pregnancy: Associations with Sexual and Relationship Satisfaction. *J Sex Med.* 2017;14(3):387–395.
- 7 Kumar SA, Brock RL, DiLillo D. Partner Support and Connection Protect Couples during Pregnancy: A Daily Diary Investigation. *J Marriage Fam.* 2022;84(2):494–514.
- 8 Sobhgo SS, Priddis H, Smith CA, et al. The Effect of Pelvic Floor Muscle Exercise on Female Sexual Function during Pregnancy and Postpartum: A Systematic Review. *Sex Med Rev.* 2019;7(1):13–28.

A 35-Year-Old with a Left Breast Mass at 35 Weeks

Myrlene Jeudy

History of Present Illness

A 35-year-old gravida 3 para 2 at 35 1/7 weeks presents for a routine prenatal visit concerned about a left breast mass that she palpated. She denies any associated pain, nipple discharge, nipple inversion, or any other skin changes on her left breast. She has had no trauma to her breast.

Her past medical history is unremarkable. She denies having any surgeries. She denies ever having a breast biopsy. She breastfed her two children for a total of 24 months without any complications. Her maternal grandmother had breast cancer at the age of 75. She denies any other family history of breast, ovarian, prostate, pancreatic, colon, or endometrial cancer. Her only current medication is a prenatal vitamin. She has no known drug allergies.

Physical Examination

General appearance: Well-appearing, in no apparent distress

Vital signs:

Temperature: 37.0°C

Pulse: 96 beats per minute

Blood pressure: 110/78 mmHg

Respiratory rate: 18 breaths per minute

Height: 165 cm

Weight: 77.1 kg

BMI: 28.3 kg/m²

Breast examination: Left breast with a 3-cm, smooth, mobile, non-tender mass noted at the 10 o'clock position 6 cm from the nipple. No nipple discharge expressed. No axillary or cervical adenopathy palpated. No skin changes or nipple inversion appreciated

Abdomen: Gravid uterus with fundal height at 35 cm

Fetal assessment: 140 beats per minute

How Would You Manage This Patient

The patient presents with a self-detected breast mass during pregnancy. She does not have a history of previous breast disease or any breast biopsies. On clinical exam, there was a soft, well-circumscribed, mobile, non-tender mass corresponding to the patient's area of concern. A breast ultrasound was ordered for further characterization of the mass. On ultrasound, a hypoechoic oval mass with circumscribed margins measuring 3.5 × 1.5 × 3.2 cm is imaged at the site of concern (see Figure 16.1). Ultrasound of the left axilla was performed and was unremarkable. A left breast biopsy was obtained. This revealed benign breast tissue with lactational changes suggestive of a lactational adenoma. The patient was counseled regarding this diagnosis. A risk assessment was performed, and she was not noted to be at increased risk for breast cancer. Breast health awareness was reviewed. The benefits of breast-feeding were discussed. Expectant management of the left breast mass was recommended.



Figure 16.1 Well circumscribed breast mass seen on ultrasound

Breast Masses in Pregnancy

Patients who present with a palpable breast mass in pregnancy or 1-year postpartum should be immediately evaluated. It is important to perform a clinical breast exam for any patient presenting with a mass in pregnancy. Clinical breast exams may be challenging due to the physiological changes that occur in the breasts due to pregnancy and lactation. During pregnancy, the breasts undergo both anatomic and physiologic changes for lactation. Increases in the levels of prolactin, human chorionic somatomammotropin, estrogen, and progesterone lead to complete breast development. In the first trimester, estrogen promotes ductal proliferation and elongation as well as an increase in glandular vascularity [1]. Estrogen causes a decrease in adipose tissue. During the second trimester, progesterone promotes lobular hyperplasia and thus breast enlargement. In the third trimester, the ductal system continues to expand, dilate, and fill with colostrum. After delivery, the levels of estrogen and progesterone precipitously drop and thus remove the inhibitory effects on prolactin [1]. Stimulation of the nipple by the newborn induces release of prolactin and oxytocin. High levels of prolactin cause dilation of the lobular glands of the breast due to the accumulation of milk. These physiologic changes lead to changes in breast composition, nodularity, and breast volume, thus making the clinical exam and imaging more challenging in the evaluation of a patient presenting in pregnancy or lactation with a breast mass.

Breast ultrasound is the initial imaging modality used to evaluate a mass in pregnancy. This is preferred due to minimizing radiation risk, ease of use, and increased breast density due to physiological changes that occur in the breast. On ultrasound during pregnancy, the breast is typically hypoechoic due to increased fibroglandular tissue, while during lactation, the breast is diffusely echogenic due to increased vascularity [1]. However, in many studies, the sensitivity of breast ultrasound for palpable masses in pregnancy has been reported to be 100% [2]. The American College of Radiology (ACR) recommends additional imaging with mammography or digital breast tomosynthesis (DBT) if ultrasound is negative in a patient with a breast mass or if suspicious features are noted on the ultrasound [3].

Mammography is safe and can be used as an adjunct in the evaluation of breast concerns in pregnant and lactating patients. The fetal radiation dose from a four-view mammogram is <0.03 mGy. No teratogenic effects have been demonstrated with doses below 50 mGy [3]. Lactating individuals should be advised to breastfeed or express breast milk before breast imaging, as this will decrease parenchymal density and thus improve the sensitivity of the mammogram. The sensitivity of mammography ranges from 74 to 90% [3]. Ultrasound has not been studied as a stand-alone option for breast cancer screening in pregnant and lactating patients and thus is used in conjunction with mammography. Ultrasound is less sensitive than mammography in detecting calcifications and architectural distortion.

Digital breast tomosynthesis (DBT) may improve visualization of breast masses in pregnant patients. There are no studies specifically evaluating DBT in pregnancy. The increased breast density seen in the hormonally altered breast of pregnant patients is more likely to conceal small lesions; therefore, this population may benefit from the ability of 3D mammography to decrease the masking effect of dense breast tissue. Breast magnetic resonance imaging (MRI) is not recommended during pregnancy for the evaluation of a breast mass because gadolinium crosses the placenta. The physiologic increase of breast vascularity in pregnancy and lactation may limit the sensitivity of the dynamic contrast-enhanced breast MRI [3]. If a suspicious mass is noted on breast imaging, image-guided core biopsy should be obtained. However, if breast imaging does not demonstrate an etiology for a clinically suspicious palpable mass, non-image-guided biopsy should be obtained [3].

With any patient presenting with a breast mass, it is important to do a breast cancer risk assessment. This includes evaluating several factors that can affect risk such as family history of cancers such as breast, ovarian, prostate, colon, pancreatic, and other types of germline mutation-associated cancers in first-, second-, and third-degree relatives [4]. Other factors to evaluate include age, reproductive risk factors, history of breast biopsy or breast disease, or a history of chest radiation. Patients with a potentially increased risk should be referred for further assessment by a genetic counselor or health care provider with specialized training in cancer genetics and breast health. Individualized risk assessment and the possibility of risk-reducing strategies such as lifestyle modifications, genetic testing, risk-reducing medications, increased breast surveillance with imaging, and risk-reducing surgery potentially can be lifesaving.

Traditionally, pregnancy-associated breast cancer (PABC) is defined as breast cancer that occurs in pregnancy, within 12 months postpartum, or during lactation. However, some argue that breast cancer occurring in pregnancy is biologically different from breast cancer occurring in the postpartum period with different prognosis and thus these should be defined differently [5]. Although PABC occurs in 0.3 out of 1,000 pregnancies, it is the most common cancer noted in pregnancy and is the most common cause of cancer-related deaths in pregnant and lactating patients [6]. Due to the physiologic changes in pregnancy, there is often a delay in diagnosing PABC. As a result, PABC is often diagnosed at later stages and associated with greater morbidity and mortality. It is associated with a 50% increase in mortality rate when compared to breast cancer that is not associated with pregnancy, postpartum, or lactation [7]. As patients are delaying childbirth, the incidence of PABC is expected to increase.

A breast mass that is present in pregnancy, postpartum, or during lactation most often does not represent malignancy. Greater than 80% of palpable masses noted in pregnancy will likely be benign. The differential diagnosis for a benign breast mass includes galactocele, lactational adenoma, fibroadenoma, breast abscess, idiopathic granulomatous mastitis, accessory breast tissue, and fat necrosis (Table 16.1).

Table 16.1 Differential diagnosis for a benign breast mass

Benign breast condition	Clinical presentation	Diagnostic evaluation	Treatment options
Galactocele	Palpable mass ($\pm$ tenderness); presents in third trimester, lactation	Ultrasound, diagnosis confirmed with aspiration	Expectant management, aspiration, incision, and drainage
Lactational adenoma	Firm, painless, mobile mass, often in upper outer quadrant	Ultrasound, mammogram, core needle biopsy	Expectant management (surgical management not typically recommended in pregnancy or lactation)
Fibroadenoma	Well circumscribed mobile mass $\pm$ tenderness	Ultrasound, mammogram, core needle biopsy	Expectant management (surgical management not typically recommended in pregnancy or lactation)
Breast abscess	Fluctuant, tender mass with possible overlying erythema and induration	Ultrasound	Antibiotics, aspiration, incision and drainage
Idiopathic granulomatous mastitis	Tender mass, erythema, warmth	Ultrasound, mammogram	Variable treatment including steroids, methotrexate, surgical excision
Accessory breast tissue	Palpable mass often presents in axilla (can be bilateral)	Ultrasound $\pm$ mammogram	Expectant management
Fat necrosis	Painful, ill-defined mass	Ultrasound $\pm$ mammogram	Expectant management

Lactational adenomas are benign tumors that can occur in both pregnant and lactating patients. They are typically seen in the third trimester or during lactation and are thought to evolve due to hormonal stimulation. Clinically, they present as a non-tender, firm, mobile mass. Ultrasound is the initial imaging modality used to assess for lactational adenoma. On imaging, they appear as a solid, ovoid, or macrolobulated mass with well-defined margins with parallel orientation [8]. Typically, they have a homogenous and hypoechoic appearance on ultrasound and on mammography they present as a circumscribed mass without calcifications. However, they can have features that are indistinguishable from malignancy and thus biopsy of the mass is generally recommended to confirm the diagnosis. Lactational adenomas typically regress upon the cessation of breast-feeding and thus they are usually managed

expectantly. They are not associated with an increased risk of breast cancer.

Key Teaching Points

- The majority of breast masses in pregnancy are benign.
- Pregnant or lactating patients with a palpable breast mass should be evaluated with physical exam, ultrasound, and possibly a diagnostic mammogram.
- Breast cancer risk assessment should be performed when evaluating a patient with a breast mass.
- Lactational adenomas are benign breast masses that occur from hormonal stimulation. They present similar to fibroadenomas and typically resolve upon cessation of breast-feeding.

References

- 1 Canoy JM, Mitchell GS, Unold D, et al. A Radiologic Review of Common Breast Disorders in Pregnancy and the Perinatal Period. *Semin Ultrasound CT MR*. 2012;33(1):78–85.
- 2 Ahn BY, Kim HH, Moon WK, et al. Pregnancy- and Lactation-Associated Breast Cancer: Mammographic and Sonographic Findings. *J Ultrasound Med*. 2003;22(5):491–497; quiz 498–499.
- 3 Expert Panel on Breast, diFlorio-Alexander RM, Slanetz PJ, et al. ACR Appropriateness Criteria® Breast Imaging of Pregnant and Lactating Women. *J Am Coll Radiol*. 2018;15(11S):S263–S275.
- 4 Practice Bulletin Number 179: Breast Cancer Risk Assessment and Screening in Average-Risk Women. *Obstet Gynecol*. 2017;130(1):e1–e16.
- 5 Amant F, Lefrère H, Borges VF, et al. The Definition of Pregnancy-Associated Breast Cancer Is Outdated and Should No Longer Be Used. *Lancet Oncol*. 2021;22(6):753–754.
- 6 Perez F, Bragg A, Whitman G. Pregnancy Associated Breast Cancer. *J Clin Imaging Sci*. 2021;11:49.
- 7 Ong A, Mullen L, Harvey S. Pregnancy Associated Breast Cancer and Other Breast Disease: A Radiologic Review. *Appl Radiol*. 2020;49:10–17.
- 8 Ravikanth R, Kamalasekar K. Imaging of Lactating Adenoma: Differential Diagnosis of Solid Mass Lesion in a Lactating Woman. *J Med Ultrasound*. 2019;27(4):208–210.

CASE 17

A 25-Year-Old at 14 Weeks' Gestation with Pelvic Pain and Inability to Void

Blenda Yun

History of Present Illness

The patient is a 25-year-old primigravida at 16 4/7 weeks' gestational age who presents for a routine prenatal visit. Her pregnancy has been uncomplicated. She reports concerns with urination that have been increasing over the past 2 weeks. She is a physician assistant in the Emergency Department and reports that she often holds her bladder for extended periods of time. Recently she has been straining with increasing effort to void. She denies any pain with urination but has been having worsening pelvic pressure and pain.

Physical Examination

General appearance: No acute distress

Vital signs:

Temperature: 37.2°C

Pulse: 94 beats per minute

Blood pressure: 124/74 mmHg

Respiratory rate: 14 breaths per minute

BMI: 24 kg/m²

Abdomen: Difficult to palpate the fundus of the uterus

Pelvic: Speculum exam reveals that the cervix is perpendicular to the spine just under the pubic symphysis. The uterus fills the cul de sac. A straight catheterization is performed for 1,500 mL of clear yellow urine.

Fetal assessment: Fetal heart tones are difficult to auscultate with the fetal Doppler. Ultrasound reveals a fetal heart rate of 152 beats per minute.

Laboratory studies:

Urinalysis: Within normal limits.

Imaging:

A transabdominal ultrasound of the pelvis shows a retroverted uterus with a sharp curve posteriorly, suggesting an incarcerated gravid uterus (Figure 17.1).

How Would You Manage This Patient?

The patient was diagnosed with an incarcerated uterus. The risks, benefits, and alternatives to reduction of the incarcerated uterus were discussed with the patient, and she consented to the procedure. Attempts were made in the office to reduce the uterus. The first attempt was made in the dorsal lithotomy position. A second attempt was made in the knee chest position. Neither attempt was successful. The same approaches

were attempted using the transvaginal ultrasound transducer. However, the patient was unable to tolerate the procedure. A Foley catheter was placed, and she was scheduled the following day for reduction in the operating room. Under spinal anesthesia, the obstetrician's hand was placed in the vagina, and the uterus was able to be elevated out of the pelvis. However, 5 days later, the incarceration recurred. She was brought back to the operating room for reduction under spinal anesthesia. After the uterus was reduced, a Hodge pessary was inserted to assist the uterus in maintaining its position. The patient was able to remove, clean, and replace the pessary herself. She discontinued use of the pessary at 20 weeks' gestation.

Uterine Incarceration

About 15–20% of uteruses are retroverted. In most pregnancies, the uterus will straighten and lift out of the pelvis as the pregnancy progresses. However, about 1:3,000 gravid uteruses instead become wedged between the sacral promontory and the pubic symphysis – preventing the uterus from elevating into the abdomen [1]. This is called uterine incarceration. Risk factors for uterine incarceration include a retroverted or retroflexed uterus, fibroids, previous pelvic adhesions, or a previous uterine incarceration.



Figure 17.1 Ultrasound image of a 16-week incarcerated gravid uterus, revealing a sharp downward angle of the cervix

The symptoms of uterine incarceration are difficulty urinating, urinary retention, abdominal pain, constipation, and rectal pressure. It is commonly diagnosed around 14 weeks' gestation. Given that the symptoms are vague and are common complaints in early pregnancy, it is important to have a high index of suspicion. Urinary retention in the late first or early second trimester should be considered uterine incarceration until ruled out otherwise. Diagnosis prior to 20 weeks' gestation is associated with improved outcomes and a significant reduction in morbidity [2].

Some uterine incarcerations will resolve spontaneously. There are reports of spontaneous resolution after Foley catheter placement, spinal anesthesia, or bowel preparation. A Foley catheter can be placed, and patients can be instructed to trial knee chest maneuvers. This will sometimes allow the uterus to elevate outside the pelvis. However, if conservative measures are not successful or the patient is over 16 weeks' gestation, the incarceration should be manually reduced. This can be attempted in an office setting. A bimanual exam is performed to try to elevate the fundus out of the pelvis. A transvaginal ultrasound transducer can also be used for this purpose. However, if this is unsuccessful or the patient cannot tolerate the procedure, it should be done under anesthesia. Spinal anesthesia or general anesthesia via a laryngeal mask airway is appropriate. If manual replacement under anesthesia is not successful, there are reports of success with a colonoscopy approach or with placement of a vaginal balloon. However, if these methods are not successful, a laparoscopy or laparotomy may also be indicated [3].

A high index of suspicion is required for early diagnosis of this condition. The later that an incarcerated uterus is diagnosed in the pregnancy, the more difficult it can be to correct. In addition, delayed diagnosis can lead to severe complications including renal failure, hypertension, and bladder or rectal ischemia [4]. Pregnancy complications include fetal growth restriction, preterm labor, uterine rupture, and distorted anatomy at the time of cesarean delivery [3].

There are case reports of patients going undiagnosed with a uterine incarceration. Due to the distorted anatomy, some of patients are misdiagnosed as having placenta previa, as a posterior placenta in a sharply retroverted uterus can appear adjacent to the abnormally elongated cervix. In the third trimester it is no longer possible to reduce the uterus. In these cases, there is a high risk of intrauterine growth restriction. Although there are no published standards for antenatal testing for this condition, it is reasonable to follow fetal growth and conduct antenatal testing after 32 weeks. There is also a high risk of uterine rupture given the abnormal thinning of the anterior midportion of the uterus. Precautions should be shared with the patient, and early timing of delivery should be considered due to the risk of uterine rupture.

Patients who progress to the third trimester with a uterine incarceration should be delivered by a planned

cesarean section. A multidisciplinary team is needed. As such, delivery at a tertiary care center is preferable. A preoperative magnetic resonance imaging (MRI) is helpful in identifying the distorted anatomy. A vertical incision should be used for the laparotomy to ensure exposure of the abnormally stretched lower uterine segment. Attempts should be made to restore the normal uterine position prior to the hysterotomy incision. If this is not successful, care should be taken with the hysterotomy incision as the vagina, cervix, and bladder will be abnormally stretched. With a routine low transverse hysterotomy incision, it is possible to enter the vagina and bladder prior to reaching the uterus. There are case reports of the uterus being amputated from the cervix in this setting. A preoperative MRI is the imaging of choice to identify the location of the cervix and bladder to help ensure a well-placed hysterotomy incision [5].

These patients are also at an increased risk for thromboembolism in the postpartum period due to the risk of venous thrombosis in the pelvic veins from chronic compression by the incarcerated uterus [6]. These pregnancies and the complex planning for a preterm cesarean delivery are often traumatic to patients. It is important to ensure that the patient not only receives the appropriate level of medical care but also emotional support throughout the pregnancy and delivery.

Uterine incarceration is associated with a high risk of recurrence. If the incarceration can be attributed to uterine fibroids or pelvic adhesions and these issues are corrected after delivery, the risk of recurrence can be substantially decreased. However, often there is no inciting risk factor. In any subsequent pregnancy, a high index of suspicion for recurrence needs to be maintained so the problem can be corrected early in the second trimester. Again, resolution prior to 20 weeks' gestation significantly decreases the morbidity of this condition. There is no data to support the prophylactic use of a pessary to maintain uterine position in the first and early second trimester to prevent recurrence of uterine incarceration in a subsequent pregnancy.

Key Teaching Points

- Maintain a high index of suspicion for uterine incarceration.
- Urinary retention in the late first or early second trimester is uterine incarceration unless proven otherwise.
- Conservative management with Foley catheter placement, treatment of constipation, and frequent knee chest positioning can be attempted. However, if not successful, manual reduction is necessary.
- If uterine incarceration is not discovered until later in the pregnancy, the patient should be delivered by cesarean section. Care should be by a multidisciplinary team. A preoperative MRI is helpful in identifying the distorted anatomy prior to delivery.

References

- 1 Shnaekel K, Wendel M, Rabie N, et al. Incarceration of the Gravid Uterus. *Obstet Gynecol Surv.* 2016; 71(10):613–619.
- 2 Pina Moreno JM, Ruiz Minaya M, Fraile López A, et al. Importance of the Early Diagnosis of Incarcerated Gravid Uterus: Case Report and Systematic Review. *Int J Gynaecol Obstet.* 2023;162:193–201.
- 3 Kim YS, Kwon BS, Lee YJ. Clinical Approach and Management of Uterine Incarceration According to Trimester of Pregnancy: Case Report and Literature Review. *Taiwan J Obstet Gynecol.* 2021;60:911–915.
- 4 Newell SD, Crofts JF, Grant SR. The Incarcerated Gravid Uterus: Complications and Lessons Learned. *Obstet Gynecol.* 2014;123(2 Pt. 2): 423–427.
- 5 Samejima K, Matsunaga S, Takai Y, et al. Efficacy of Well-Planned Management in Patients with Incarcerated Gravid Uterus: A Case Series and Literature Review. *Taiwan J Obstet Gynecol.* 2021;60:679–684.
- 6 Gardner CS, Jaffe TA, Hertzberg BS, et al. The Incarcerated Uterus: A Review of MRI and Ultrasound Imaging Appearances. *AJR Am J Roentgenol.* 2013;201(1):223–229.

A 35-Year-Old with Abdominal Cramping and Pelvic Pain at 24 Weeks' Gestation

Amber A. Bondurant-Sullivan

History of Present Illness

The patient is a 35-year-old gravida 2 para 0 at 24 3/7 weeks' gestation who presents to the obstetric triage unit with the acute onset of abdominal cramping and pelvic pain. The pain woke her from sleep and has been constant since. She describes the pain as dull, achy, and primarily located in the left lower abdomen. This is her first experience of such pain. She states that the pain improves when she lies down and lifts her knees off the bed but worsens with standing or movement. She denies nausea, vomiting, diarrhea, constipation, or urinary complaints. Additionally, she denies any sick contacts. She reports normal fetal movement. She denies vaginal bleeding, discharge, recent intercourse, or trauma. The patient's pregnancy has been complicated by class three obesity and known uterine fibroids. At her initial first-trimester ultrasound, the patient was noted to have a 6.2 × 5.3 cm left fundal fibroid.

Physical Examination

General appearance: Alert, responsive, uncomfortable

Vital signs:

Temperature: 36.8°C

Pulse: 66 beats per minute

Blood pressure: 131/67 mmHg

Respiratory rate: 16 breaths per minute

Oxygen saturation: 98%

Height: 165 cm

Weight: 96.7 kg

BMI: 35.4 kg/m²

Cardiopulmonary: Regular rate and rhythm, lungs clear to auscultation bilaterally

Abdomen: Gravid, soft, non-distended. Rebound is present on the left side of the abdomen but no guarding. There is a palpable mass on the left middle abdomen within the uterus. Focal tenderness is present on palpation of the mass.

Pelvic: Vulva normal in appearance. Vagina normal, no discharge noted. Cervix visually closed. No vaginal bleeding. Uterus size 24 weeks with a large mass on the left. No costovertebral angle tenderness

Extremities: Extremities normal, atraumatic, no cyanosis or edema

Fetal heart rate: 140 beats per minute

Laboratory studies:

WBC: 12,100/μL

Hgb: 11.7 g/dL

Plt: 230,000/μL

Segmented neutrophils: 46%

Immature granulocytes: 0.05%

Bilirubin, total: 0.4 mg/dL

Bilirubin, direct: 0.1 mg/dL

ALT: 11 IU/L

AST: 13 IU/L

Lipase: 20 U/L

Cr: 0.51 mg/dL

Urinalysis: Negative

Pelvic ultrasound: Single live intrauterine pregnancy in breech presentation with measurements consistent with 24 weeks' gestation. Within the left fundus, there is a round heterogeneous structure measuring 10.2 × 8.4 × 7.3 cm with a central anechoic region consistent with a large intramural degenerating cystic fibroid (Figure 18.1). The right and left ovaries are normal in appearance with normal Doppler flow. The urinary bladder is normal in appearance. There is free fluid in the pelvic cul-de-sac.

How Would You Manage This Patient?

Preterm labor, nephrolithiasis, and urinary tract infection were ruled out. The patient's presentation, physical exam, and ultrasound findings were consistent with pain from fibroid degeneration. The patient was admitted overnight for observation. She was given intravenous (IV) hydration and started on an oral course of indomethacin 50 mg every 6 hours



Figure 18.1 Heterogeneous echogenic pattern with cystic changes on ultrasound indicating the development of red degeneration

to complete a 48-hour course. Her pain improved, and she was able to be discharged on hospital day one to finish her indomethacin course at home.

Fibroid Degeneration during Pregnancy

Leiomyomata are the most common uterine neoplasms, occurring in at least 20–25% of all reproductive-age patients. The prevalence of uterine myomas among pregnant patients ranges from 0.1 to 3.9%, and it is likely to increase as more patients delay childbearing until later in life [1].

Leiomyomata have been associated with several pregnancy complications, including first-trimester bleeding, miscarriage, preterm labor, premature rupture of membranes, placental abruption, pelvic pain, intrauterine growth restriction, and pain. Pain is the most reported complication of fibroids in pregnancy, with approximately 10–30% of patients with uterine fibroids developing pain during pregnancy [1]. Acute pain episodes can be severe enough to warrant hospitalization and analgesia in certain instances and therefore present a significant complication for pregnant patients with fibroids.

Pain from uterine fibroids during pregnancy is thought to be due to red degeneration, which is defined as hemorrhagic infarction of a previously hyalinized myoma caused by ischemic necrosis [2]. Although this was previously thought to be caused by rapid fibroid growth during pregnancy, recent studies suggest that these painful episodes appear to be unrelated to the absolute fibroid size [3]. Alternative theories for the cause of this phenomenon will be explored here.

The typical presentation of fibroid red degeneration pain is a patient in the second or third trimester with known uterine fibroids who presents with the sudden onset of uterine pain over the area of the fibroid. The pain is typically constant and can last for prolonged periods. Although uterine contractions can occur during these episodes, there is generally no association with cervical change or preterm labor [1]. The pain may also be associated with mild leukocytosis, nausea and vomiting, or mild pyrexia, although these associated symptoms vary in presentation [1]. Ultrasound findings typically demonstrate cystic changes within the uterine fibroid associated with the pain.

Natural Course of Uterine Fibroids in Pregnancy

Theories regarding the change of size of uterine fibroids during pregnancy have been controversial. It has been standard teaching that myomas grow under the influence of hormonal stimulation during pregnancy. This notion stems from literature that predates the ultrasound era. Numerous more recent ultrasound-based studies have contradicted this notion. Estrogen and progesterone receptor levels are higher in myoma cells compared to the myometrium, and because of this, it has been thought that the increased hormonal stimulation during pregnancy would lead to rapid fibroid growth, which would then lead to red degeneration and pain. However, the relationship between hormonal stimulation of

myoma cells has since been shown to be more complex, with progesterone demonstrating both stimulatory and inhibitory effects on growth depending on the local growth factor environment [4]. This finding has been demonstrated in ultrasound-based studies that have shown fibroid growth during pregnancy is much more limited than what was previously thought.

Prospective studies using ultrasound to follow the size of uterine fibroids throughout pregnancy have shown that most fibroids (60–78%) do not demonstrate any significant change in volume during pregnancy [5]. Of the up to 30% that increase in volume, most of that growth is limited to the first trimester, specifically the first 10 weeks of gestation, with very little growth in the second or third trimesters [5]. There is conflicting data as to whether smaller fibroids (<6 cm) have different growth patterns than larger fibroids in the second trimester, with some data suggesting that the larger fibroids do not grow or decrease in size, while smaller fibroids may increase in size at higher rates. In the third trimester, all fibroids tend to decrease in size [6].

Pathophysiology of Fibroid Degeneration

The severe pain associated with fibroids during pregnancy has been shown to be due to red degeneration. This is seen most often in patients with large fibroids (>5 cm) during the second and third trimesters of pregnancy [1]. In a study of 113 pregnant patients, 9% of fibroids showed a heterogeneous echogenic pattern or cystic changes on ultrasound, indicating the development of red degeneration. Of these patients, 70% (7 of 10) had severe abdominal pain compared to 11.7% (12 of 103) of patients with fibroids that showed no echogenic changes on ultrasound.

Three main theories have been proposed to explain the severe pain associated with red degeneration. First, rapid fibroid growth results in the tissue outgrowing its blood supply, leading to tissue anoxia, necrosis, and infarction [1]. Second, the growing uterus results in a change in the architecture (kinking) of the blood supply to the fibroid, leading to ischemia and necrosis even in the absence of fibroid growth [7]. Third, pain results from the release of prostaglandins from cellular damage within the fibroid [8]. This is supported by the observation that prostaglandin synthetase inhibitors effectively and rapidly control fibroid pain.

Treatment Options of Fibroid Pain in Pregnancy

Fibroid pain during pregnancy is usually managed conservatively with bed rest, hydration, and analgesics. Prostaglandin synthase inhibitors such as indomethacin (25–50 mg by mouth every 6 hours) are the first-line treatment options, but they should be used with caution, especially with prolonged use (>48 hours) in the third trimester (>32 weeks), where they have been associated with both fetal and neonatal adverse effects, including premature closure of the fetal ductus arteriosus, pulmonary hypertension, necrotizing enterocolitis,

intracranial hemorrhage, and oligohydramnios [9]. Pain that does not improve within 48 hours of medical treatment should prompt evaluation of alternative etiologies. Rarely, severe pain may necessitate additional pain medication with narcotic analgesia, epidural analgesia, or surgical management with myomectomy.

Key Teaching Points

- Uterine fibroids during pregnancy are very common in patients of reproductive age. Most are asymptomatic; however, severe localized abdominal pain can occur if a fibroid undergoes red degeneration. This is most often seen in patients with fibroids of >5 cm during the second and third trimesters.
- Pain is the most common complication of fibroids during pregnancy. The symptoms can usually be controlled with conservative treatment (bed rest, hydration, and nonsteroidal anti-inflammatory drug [NSAID] analgesics).
- Ultrasound findings associated with this pain syndrome are a heterogeneous echogenic pattern or cystic changes.
- Prospective studies using ultrasound to follow the size of uterine fibroids throughout pregnancy have shown that most fibroids (60–78%) do not demonstrate any significant change in volume during pregnancy. Most fibroid growth occurs in the first trimester, with minimal growth or even a decrease in fibroid size in the second and third trimesters.
- The use of NSAIDs are first-line therapy. Due to potential fetal side effects, they are recommended to be administered up to 32 weeks' gestation and for a short course of 48 hours or less.

References

- 1 Katz VL, Dotters DJ, Droegemueller W. Complications of Uterine Leiomyomas in Pregnancy. *Obstet Gynecol.* 1989;73(4):593–596.
- 2 Coronado GD, Marshall LM, Schwartz SM. Complications in Pregnancy, Labor, and Delivery with Uterine Leiomyomas: A Population-Based Study. *Obstet Gynecol.* 2000;95(5):764–769.
- 3 Hammoud AO, Asaad R, Berman J, et al. Volume Change of Uterine Myomas during Pregnancy: Do Myomas Really Grow? *J Minim Invasive Gynecol.* 2006;13(4):386–390.
- 4 Maruo T, Ohara N, Wang J, et al. Sex Steroidal Regulation of Uterine Leiomyoma Growth and Apoptosis. *Hum Reprod Update.* 2004;10(3):207–220.
- 5 Aharoni A, Reiter A, Golan D, et al. Patterns of Growth of Uterine Leiomyomas during Pregnancy: A Prospective Longitudinal Study. *Br J Obstet Gynaecol.* 1988;95(5):510–513.
- 6 Rosati P, Exacoustos C, Mancuso S. Longitudinal Evaluation of Uterine Myoma Growth during Pregnancy: A Sonographic Study. *J Ultrasound Med.* 1992;11(11):511–515.
- 7 Parker WH. Etiology, Symptomatology, and Diagnosis of Uterine Myomas. *Fertil Steril.* 2007;87(4):725–736.
- 8 Rice JP, Kay HH, Mahony BS. The Clinical Significance of Uterine Leiomyomas in Pregnancy. *Am J Obstet Gynecol.* 1989;160(5 Pt. 1):1212–1216.
- 9 Norton ME, Merrill J, Cooper BA, et al. Neonatal Complications after Administration of Indomethacin for Preterm Labor. *N Engl J Med.* 1993;329(22):1602–1607.

CASE 19

Appendicitis Presenting as Nausea, Vomiting, and Abdominal Pain at 16 Weeks

Joseph De Nagy

History of Present Illness

A 30-year-old gravida 2 para 1 at 16 3/7 weeks presents to the office with worsening malaise, nausea, vomiting, and abdominal pain over the last week. The pain was originally periumbilical but has settled into the right lower quadrant as the symptoms have worsened. The patient reported a fever of 38.7°C last night. Her last bowel movement was 3 days ago. She denies any obstetric complaints, and her prenatal care up to this point has been unremarkable. She has a history of a previous term vaginal birth two years ago, and her surgical history is significant only for wisdom teeth extraction. Her social history is also unremarkable.

Physical Examination

General appearance: Uncomfortable appearing

Vital signs:

Temperature: 38.1°C

Pulse: 99 beats per minute

Blood pressure: 117/71 mmHg

Respiratory rate: 22 breaths per minute

Cardiopulmonary: Regular rate and rhythm with a wide split of S1. Lungs are clear bilaterally

Abdomen: Suprapubic fullness consistent with gestational age. Right lower quadrant tenderness with guarding and rebound

Pelvic: External genitalia appear normal. The vagina has physiologic discharge with normal rugation. The cervix is closed, thick, high, and non-tender. The uterus is gravid to 16 weeks and non-tender. There is discomfort to palpation of the right adnexa. The left adnexa is unremarkable.

Fetal assessment: Fetal heart rate 166 beats per minute on Doppler

How Would You Manage This Patient?

While abdominal and flank pain is a common finding in pregnancy, the constellation of right-sided abdominal pain with fever and gastrointestinal symptoms should raise appendicitis to high in the differential of diagnoses. Evaluation in the Emergency Department is indicated. A complete blood count with a differential demonstrating leukocytosis with left shift, along with a thickened appendix with surrounding edema on magnetic resonance imaging (MRI), would support the diagnosis, and emergent consultation of general surgery for appendectomy is warranted. This patient was taken to the operating room for laparoscopic appendectomy, where a

dilated, inflamed appendix was identified and removed. Observation of the patient after surgery revealed a rapid improvement in symptoms. The patient was able to tolerate a regular diet within the next 24 hours, was without fever during that duration, and was subsequently discharged home.

Appendicitis in Pregnancy

Recent studies place the incidence of appendicitis in pregnancy at between 1:700 and 1:1,500 pregnancies, with 1 out of every 20 patients presenting with appendicitis being pregnant, making this disease one of the most common causes of emergent surgical intervention in pregnancy [1]. Timely surgical intervention is required to prevent perforation and worsening maternal and fetal outcomes, including maternal sepsis and preterm delivery [2]. Evaluation in the Emergency Department is warranted to expedite laboratory evaluation and imaging.

The diagnosis of acute appendicitis in pregnancy can be challenging. Complaints of abdominal pain are common in pregnancy. The acuity, severity, and natural history of the pain can point to the correct diagnosis. Appendiceal pain often starts periumbilical, with gradual migration to the region of the appendix. Nausea, vomiting, loss of appetite, and constipation are common [3]. Also, as the second and third trimesters progress, the appendix is raised into the abdomen, which can lead to pain in the right flank or even the right upper quadrant. A retrocecal appendix may present as more generalized abdominal pain, with pain more directly elicited on pelvic or rectal exam than abdominal exam [3].

Pregnant patients with appendicitis will have an elevated white blood cell count and absolute neutrophil count compared to baseline but may still be within the normal range for the second or third trimester [4,5]. While ultrasound may seem like the ideal option for imaging, the sensitivity for appendicitis in pregnancy can be low, at 69% in the first trimester, 63% in the second, and 51% in the third, with the corresponding figures for specificity being 85, 85, and 65% [6]. As such, there is an argument to be made to use other imaging modalities first. The American College of Obstetricians and Gynecologists supports the use of MRI for imaging deeper soft tissues due to the lack of ionizing radiation involved with its use, and for the fact that MRI is not as operator-dependent and has been verified to be highly accurate in pregnancy, with pooled sensitivity and specificity of 92 and 98%, respectively [7]. There are negative perinatal consequences to negative appendectomy, such as prematurity, so accurate diagnosis is critical to obtaining optimal outcomes [2].

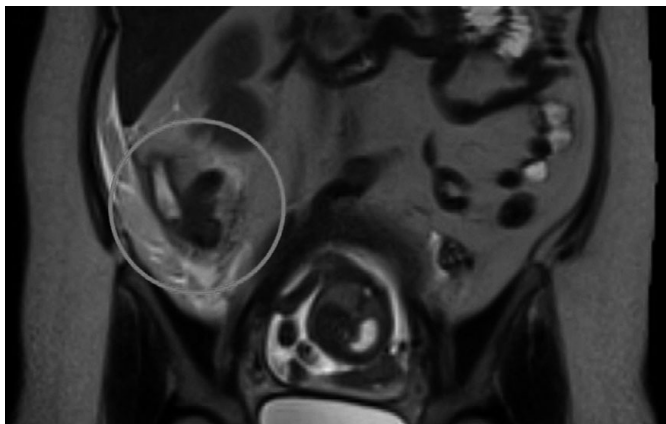


Figure 19.1 Coronal view of pregnant pelvis on T2-weighted MRI without contrast, with appendix circled, demonstrating peri-appendiceal inflammation and fluid

In settings where MRI is not available, computed tomography (CT) may be the best alternative to ultrasound. Despite theoretical concerns regarding irradiation of the fetus during pelvic imaging, low-dose exposure technique should be adequate for diagnosis and well below any teratogenic threshold for the fetus [8]. Sensitivity and specificity for abdominal CT in pregnancy, after a negative or inconclusive ultrasound, has been cited in review at 85 and 97%, respectively [9]. As ultrasound is usually easy to access in an emergency setting, considering ultrasound first, and then proceeding to MRI or CT imaging with negative or inconclusive ultrasound results and a high clinical suspicion is reasonable. If the clinical setting allows expedited access to MRI, proceeding directly to MRI would be indicated. Findings on MRI consistent with appendicitis include inflammation, fluid, and fecalith (Figures 19.1 and 19.2).

For all practical purposes, an emergent surgical consult is required for management. The method of surgical approach should be planned in consultation with general surgery, as anatomy and laparoscopic access later in pregnancy can be complicated by the mass effect of the gravid uterus. Current anesthetic use should pose no harm to a fetus at any gestational age [10]. Assessment of fetal well-being should be performed before and after the surgery, either with Doppler assessment for previable fetuses or electronic fetal monitoring for viable fetuses, including an assessment of preterm labor. Intraoperative monitoring could be considered for viable fetuses in the setting of maternal hemodynamic compromise, provided there is appropriate personnel and support for emergent cesarean delivery [10]. Corticosteroid administration for prematurity should be considered, given the probability of preterm labor in the postoperative period [10].

Management of complicated or perforated appendicitis in pregnancy requires immediate action. In the nonpregnant population, conservative management of simple appendicitis, without peritonitis, perforation, abscess, appendicolith, or

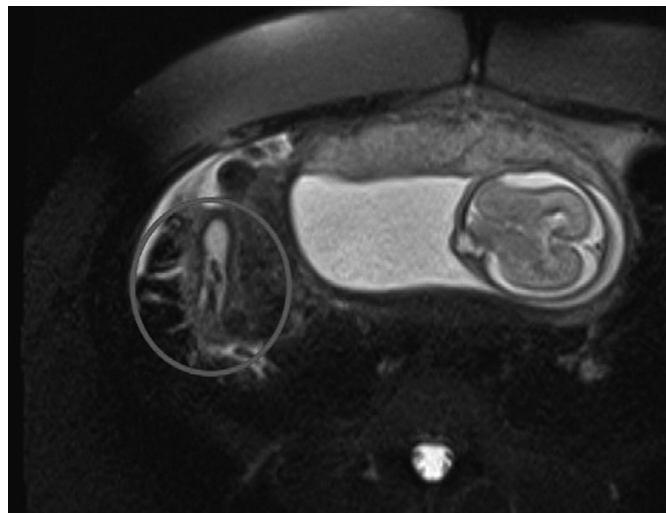


Figure 19.2 Axial view of pregnant pelvis on T2-weighted MRI without contrast, with appendix circled, demonstrating fecaliths and peri-appendiceal inflammation

tumor, can be considered in younger patients [11]. These protocols usually include intravenous cephalosporin with metronidazole, penicillin with a beta-lactamase inhibitor, or carbapenem [12]. In nonpregnant, clinically stable patients with a contained appendiceal abscess, percutaneous drainage is sometimes performed, allowing resolution of inflammation before delayed exploration [13]. In pregnancy, conservative management is associated with a substantial failure rate (32%) and a higher odds of preterm labor or abortion. Delayed surgical intervention is associated with a daily 23% increase in preterm delivery or abortion. Even successful non-operative management is linked to an increased probability of intraamniotic infection and maternal sepsis [1].

Key Teaching Points

- Due to the consequences of delayed management of appendicitis in pregnancy, maintain a high index of suspicion for the diagnosis in pregnant patients with rapidly worsening, usually right-sided abdominal pain, fever, or gastrointestinal complaints.
- Magnetic resonance imaging should be considered the first-line imaging method for evaluating appendicitis in pregnancy, due to its high sensitivity and specificity. Computed tomography imaging with low-dose technique should be considered safe in pregnancy if necessary.
- Immediate surgical management of both simple and complicated appendicitis is crucial to achieving the best possible outcomes for the patient and should not be withheld because of pregnancy.
- Antenatal corticosteroids should be administered preoperatively when indicated by gestational age due to the risk of postoperative premature delivery.

References

- 1 Ashbrook M, Cheng V, Sandhu K, et al. Management of Complicated Appendicitis during Pregnancy in the US. *JAMA Network Open*. 2022;5(4):e227555.
- 2 Aggenbach L, Zeeman GG, Cantineau AEP, et al. Impact of Appendicitis during Pregnancy: No Delay in Accurate Diagnosis and Treatment. *Int J Surg*. 2015;15:84–89.
- 3 Guidry SP, Poole GV. The Anatomy of Appendicitis. *Am Surg*. 1994;60(1):68.
- 4 Choi YS, Seo JH, Yi JW, et al. Clinical Characteristics of Acute Appendicitis in Pregnancy: 10-Year Experience at a Single Institution in South Korea. *J Clin Med*. 2023;12:3277.
- 5 Abbassi-Ghanavati M, Greer LG, Cunningham FG. Pregnancy and Laboratory Studies: A Reference Table for Clinicians. *Obstet Gynecol*. 2009;114(6):1326–1331.
- 6 Moghadam MN, Salarzaei M, Shahraki Z. Diagnostic Accuracy of Ultrasound in Diagnosing Acute Appendicitis in Pregnancy: A Systematic Review and Meta-analysis. *Emerg Radiol*. 2022;29(3):437–448.
- 7 Motavaselian M, Bayati F, Amani-Beni R, et al. Diagnostic Performance of Magnetic Resonance Imaging for Detection of Acute Appendicitis in Pregnant Women; a Systematic Review and Meta-Analysis. *Arch Acad Emerg Med*. 2022;10(1):e81.
- 8 Committee Opinion No. 723: Guidelines for Diagnostic Imaging during Pregnancy and Lactation. *Obstet Gynecol*. 2017;130:e210–e216.
- 9 Basaran A, Basaran M. Diagnosis of Acute Appendicitis during Pregnancy: A Systematic Review. *Obstet Gynecol Surv*. 2009;64(7):481–499.
- 10 ACOG Committee Opinion No. 775: Nonobstetric Surgery during Pregnancy. *Obstet Gynecol*. 2019;133:e285–e286.
- 11 Talan DA, Di Saverio S. Treatment of Acute Uncomplicated Appendicitis. *N Engl J Med*. 2021;385(12):1116–1123.
- 12 Talan DA, Saltzman DJ, DeUgarte DA, et al. Methods of Conservative Antibiotic Treatment of Acute Uncomplicated Appendicitis: A Systematic Review. *J Trauma Acute Care Surg*. 2019;86(4):722–736.
- 13 Brown CV, Abrishami M, Muller M, et al. Appendiceal Abscess: Immediate Operation or Percutaneous Drainage? *Am Surg*. 2003;69(10):829–832.

CASE 20

A Patient with Regular Painful Uterine Contractions at 32 Weeks

Jacqueline Sanchez

History of Present Illness

A 35-year-old gravida 2 para 1 at 32 2/7 weeks' gestation presents to the hospital with regular, painful contractions that began 4 hours ago. The contractions are 3–4 minutes apart and 7 out of 10 in intensity. She also complains of pelvic pressure and low back pain. The patient reports that she had experienced contractions a couple of days ago, but they were irregular and not this strong. She denies vaginal bleeding or leakage of fluid from the vagina.

Her obstetric history is significant for an uncomplicated term vaginal delivery 3 years ago. Her pregnancy has been uncomplicated. She also denies any medical or surgical history. She takes prenatal vitamins and a daily low-dose aspirin.

Physical Examination

General appearance: Mild distress

Vital signs:

Temperature: 37.4°C

Pulse: 88 beats per minute

Blood pressure: 132/77 mmHg

Respiratory rate: 18 breaths per minute

Body mass index (BMI): 31.3 kg/m²

Cardiopulmonary: Normal respiratory effort and chest rise

Abdomen: Gravid. Soft and nontender.

Contractions palpable.

Pelvic: Normal external female genitalia. A sterile speculum exam shows the cervix to be visually dilated, with intact membranes noted. There is a small amount of red blood in the vagina. There is no active bleeding from the cervix, foul-smelling discharge, or pooling. A sterile digital exam reveals the cervix to be 5 cm dilated, 80% effaced, and the fetal station is 0.

Fetal assessment: 140 beats per minute, moderate variability, occasional accelerations, no decelerations, category one tracing. Tocometer: contractions occurring every 3 minutes

Laboratory studies:

Nitrazine: Negative

Fetal fibronectin: Positive

Urinalysis: Negative

Genital culture: Positive for bacterial vaginosis. Group B streptococcus (GBS) pending

Imaging:

Transabdominal ultrasound demonstrates an intrauterine gestation consistent with 32 2/7 weeks.

Cephalic presentation, placenta anterior. Amniotic fluid index (AFI) within normal limits. Biophysical profile 8/8. The cervix is not visualized.

How Would You Manage This Patient?

The patient is diagnosed with preterm labor based on her regular uterine contractions and cervical dilation. Her speculum exam and testing confirm intact membranes. After counseling the patient and her family members on her preterm labor, she is admitted to Labor and Delivery for management. Continuous fetal monitoring and tocometry are initiated. An intravenous (IV) drip is started, and she is given an IV crystalloid bolus. She is given nifedipine 20 mg orally as a loading dose for tocolysis and betamethasone 12 mg intramuscularly to begin her course of antenatal corticosteroids. Intravenous penicillin is begun for GBS prophylaxis as her GBS status is unknown. A consult is placed with the neonatology service, and the neonatal intensive care unit (NICU) is alerted. Shortly after admission, the patient experiences a spontaneous rupture of membranes with clear fluid. She proceeds to undergo a vaginal delivery of a viable male infant, weighing 2,025 g. The patient is discharged on postpartum day number two, and the baby is discharged to home without any complications after 4 weeks in the NICU.

Preterm Labor

Preterm labor is characterized by contractions leading to cervical dilation, effacement, or both between 20 0/7 and 36 6/7 weeks' gestation. However, less than 10% of women exhibiting clinical signs of labor will undergo a preterm delivery within 7 days of symptom onset. Although preterm labor spontaneously resolves in approximately 30% of all cases, it accounts for 50% of all preterm births annually [1]. In 2021, preterm births accounted for 10.5% of all births in the United States, with the rate approximately 50% higher in African American women than for White and Hispanic women [2]. Preterm birth is the leading cause of neonatal mortality and can cause sequelae such as cerebral palsy, neurodevelopmental disability, chronic lung disease, behavioral issues, and hearing and vision impairments [3]. Therefore, effective management strategies are crucial to improving neonatal outcomes.

Preterm birth has been associated with various factors, including maternal medical and obstetric history, maternal demographics such as age, race, and socioeconomic status, and maternal characteristics such as nutritional status and educational attainment. Some modifiable risk factors are short interpregnancy interval, low pre-pregnancy weight, and tobacco, alcohol, or drug use. Qualities of the current pregnancy may also play a role, such as a multifetal gestation, conception by assisted reproductive technologies (ART), amniotic fluid derangements, or fetal anomaly [4].

Preterm labor is recognized as a complex syndrome that can be triggered by various pathogenic processes such as infection, uterine overdistension leading to cervical ripening, maternal stress leading to premature activation of the fetal hypothalamic–pituitary–adrenal axis, and decidual hemorrhage. In many instances, however, a specific mechanism cannot be definitively identified. In these cases, risk factors associated with preterm birth have been used to explain preterm labor. As such, on presentation of a patient who may be in preterm labor, one must assess for placental abruption, chorioamnionitis, vaginal or urinary tract infections (UTIs), and preterm premature rupture of membranes (PROM) [5]. If the preterm labor is thought to be idiopathic, management is then directed based on gestational age. The following sections are summarized in the preterm labor algorithm in Figure 20.1.

Diagnostic Tools

Measuring the cervix with transvaginal ultrasonography has been shown to identify women at increased risk for preterm birth. Shortening of the cervical length before 24 0/7 weeks' gestation is more predictive of preterm delivery than shortening in later pregnancy. Therefore, routine assessment of the cervix should be performed as part of the 18 0/7–22 6/7 week anatomy assessment [4].

Use of biomarkers found in biological fluids for the prediction of preterm birth have also been studied, with fetal fibronectin being the most significant. As fetal fibronectin is typically absent from cervicovaginal secretions from 24 weeks' gestation until near term, its absence in women with preterm labor symptoms has a high negative predictive value. Conversely, the presence of fetal fibronectin has a low positive predict value in asymptomatic women and is therefore not recommended as a primary screening test for preterm birth [4,5].

At-home contraction monitoring has not been shown to reduce the risk of preterm birth. While studies have demonstrated an association between contraction frequency and preterm birth, uterine contractions are not predictive of preterm birth in singleton pregnancies because of the wide variation of frequency in normal pregnancy [4,5].

Additionally, risk scoring systems have been developed to identify pregnant individuals at an increased risk for preterm birth. A systematic review of five prediction models revealed that none of the models had the ability to predict spontaneous preterm birth [6].

Use of Tocolytics

Tocolytics are used to abort uterine contractions in patients at the highest risk for spontaneous preterm birth and are generally only effective for 48 hours [1]. Therefore, tocolysis should only be considered for patients who would benefit from a delay in delivery. These include patients needing transfer to a higher acuity hospital, those who are awaiting antenatal corticosteroid completion, or allowing for an underlying disease process that can cause preterm labor to improve [7].

Tocolytics are generally not used in women who are over 34 weeks' gestational age and are not indicated before viability. Although there is no definitive first-line medication, indomethacin (used before 32 weeks' gestation to prevent closure of the fetal ductus arteriosus) and nifedipine are the most used. The choice to use tocolytics should be individualized. Overall, tocolysis is contraindicated when the risk of prolonging pregnancy or the risks associated with these agents outweigh the risks of prematurity [1].

Use of Magnesium Sulfate

When delivery is expected, IV magnesium sulfate is used to mitigate the severity and potential occurrence of cerebral palsy in preterm infants under 32 weeks' gestation. This is supported by a meta-analysis conducted in 2009 that evaluated the effects of magnesium sulfate when used specifically for neuroprotection [8]. Multiple regimens with various durations and differing inclusion criteria exist, as studied in the large trials of Crowther, Marret, and Rouse, respectively. The American College of Obstetricians and Gynecologists (ACOG) encourages physicians to develop treatment regimens in accordance with one of these studies. The Rouse study recommends magnesium sulfate therapy be given for 12 hours and then stopped, and again restarted when delivery is imminent [9]. Although magnesium sulfate can be used for tocolysis, there is sufficient data to suggest that it does not significantly prolong pregnancy [8].

Administration of Antenatal Corticosteroids

Antenatal corticosteroids are given for fetal lung maturity and have been shown to decrease neonatal morbidity and mortality. A single course of intramuscular steroids (with two 12 mg doses of betamethasone given 24 hours apart or a dexamethasone equivalent) is recommended for pregnant women between 24- and 34 weeks' gestation who are at risk of delivering within 7 days. This recommendation stands even if the full course of steroids may not be completed prior to delivery. For gestations of 34 0/7–36 6/7 weeks, administration of corticosteroids should also be considered in women who are at risk of delivery within 7 days and who have not previously had a course of steroids [1].

GBS Prophylaxis

Group B streptococcus colonization of the patient is the leading cause of newborn infection and can lead to invasive GBS disease. The ACOG recommendation is universal

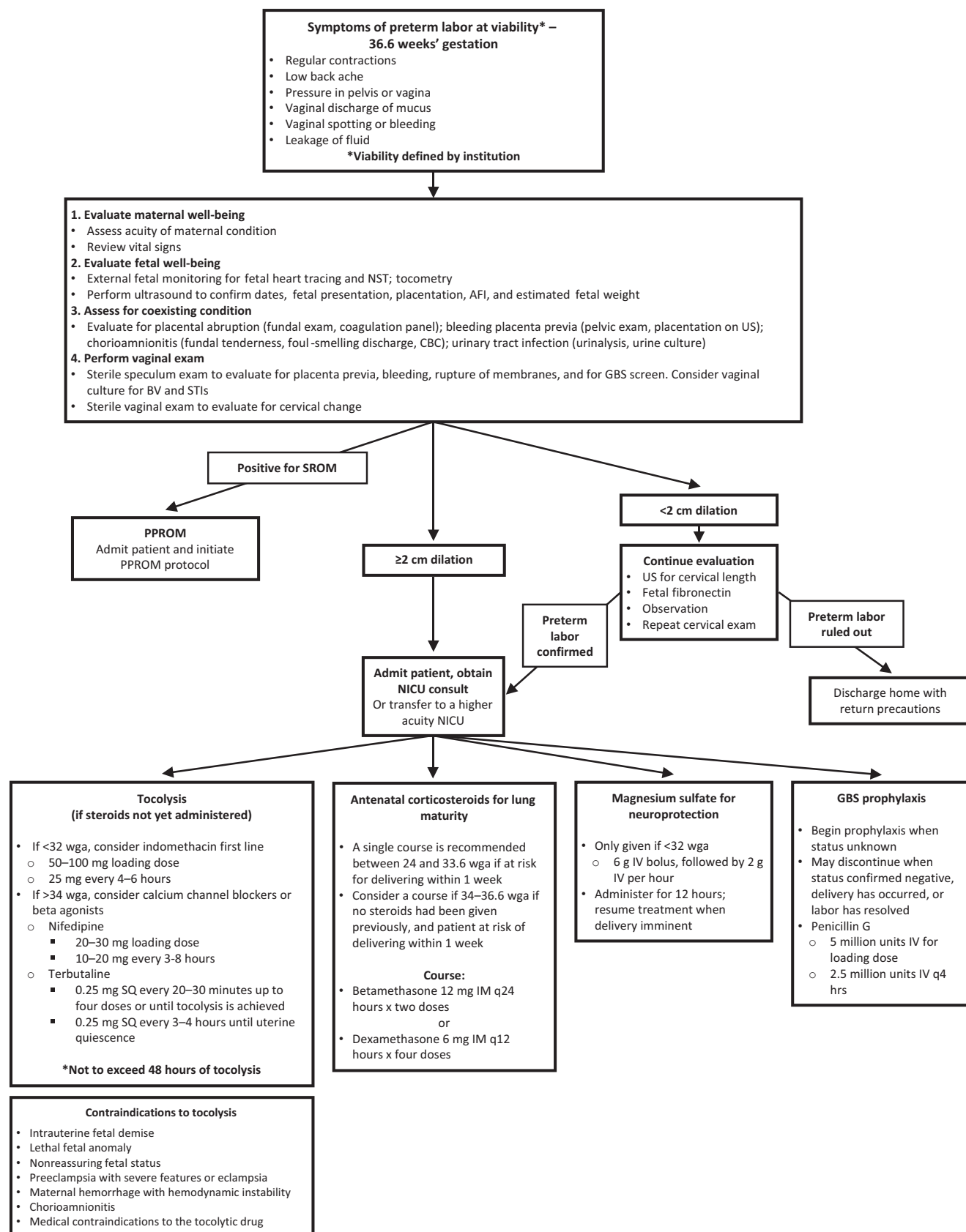


Figure 20.1 Preterm labor evaluation and management algorithm. BV, bacterial vaginosis; CBC, complete blood count; IM, intramuscular; NST, nonstress test; q, every; SQ, subcutaneous; STI, sexually transmitted infection; US, ultrasound; wga, weeks gestational age

screening for GBS colonization at 36 weeks' gestation. Therefore, most patients presenting with preterm labor will have an unknown GBS status. Consequently, a GBS culture should be obtained on admission, and intrapartum antibiotic prophylaxis should be started to prevent invasive GBS disease. Antibiotic prophylaxis is continued until the patient's GBS status is confirmed negative, labor has resolved, or delivery has occurred [10].

Mode of Delivery

While the ideal method of delivery for preterm infants has not been concluded, consideration should be given to vaginal birth if the fetus is reassuring and with vertex presentation [11]. Retrospective cohort studies have demonstrated that birth by cesarean delivery (CD) did not lead to improved neonatal outcomes in preterm infants, showing no benefit with this delivery method. However, in cases of extreme prematurity, a meta-analysis of 14 studies showed that CD was associated with a significant decrease in the adjusted odds of death in extremely preterm vertex infants <28 weeks' gestation [12].

Planned vaginal delivery of a breech fetus may also be an option. Decisions regarding breech delivery should consider the experience of the obstetrician, patient's wishes, and detailed informed consent. Patients should be properly selected to mitigate risk. The fetus should be in frank or complete breech presentation, have no fetal anomalies on ultrasound, and should have an estimated fetal weight (EFW) between 2,500 and 4,000 g [13].

Future Implications

Women who have had a prior spontaneous preterm birth are at higher risk for having recurrent preterm birth. In these patients especially, a short cervix is associated with preterm birth. Thus, these women are recommended to have serial transvaginal ultrasounds in their subsequent pregnancies to evaluate cervical length. Cervical length screening should begin at 16 weeks' gestation and continue until 23 6/7 weeks' gestation. If at any time during this period the cervix is noted to be <25 mm in length, the patient should be offered a cerclage [4].

Key Teaching Points

- Management of preterm labor can improve neonatal outcomes and decrease the incidence of the sequelae of prematurity.
- Tocolytics such as indomethacin and nifedipine are used before 34 weeks' gestation to prolong delivery for 48 hours.
- Intravenous magnesium sulfate is used in pregnancies less than 32 weeks' gestation for the prevention of cerebral palsy.
- A single course of antenatal corticosteroids is recommended before 34 weeks' gestation for women at risk for delivery within 7 days.
- Intravenous GBS prophylaxis should be given until GBS status is confirmed negative, labor has resolved, or delivery has occurred.

References

- 1 American College of Obstetricians and Gynecologists' Committee on Practice Bulletins–Obstetrics. Practice Bulletin No. 171: Management of Preterm Labor. *Obstet Gynecol.* 2016;128:e155–e164.
- 2 Osterman MJK, Hamilton BE, Martin JA, et al. Births: Final Data for 2021. *Natl Vital Stat Rep.* 2023;72(1). www.cdc.gov/nchs/data/nvsr/nvsr72/nvsr72-01.pdf (accessed October 15, 2023).
- 3 World Health Organization. *WHO Recommendations on Antenatal Corticosteroids for Improving Preterm Birth Outcomes.* Geneva: World Health Organization; 2022.
- 4 American College of Obstetricians and Gynecologists. Prediction and Prevention of Spontaneous Preterm Birth. ACOG Practice Bulletin No. 234. *Obstet Gynecol.* 2021;138:e65–e90.
- 5 Goldenberg RL, Culhane JF, Iams JD, et al. Epidemiology and Causes of Preterm Birth. *Lancet.* 2008;371(9606):75–84.
- 6 Meertens LJE, van Montfort P, Scheepers HCJ, et al. Prediction Models for the Risk of Spontaneous Preterm Birth Based on Maternal Characteristics: A Systematic Review and Independent External Validation. *Acta Obstet Gynecol Scand.* 2018; 97(8):907–920.
- 7 Vogel JP, Nardin JM, Doswell T, et al. Combination of Tocolytic Agents for Inhibiting Preterm Labour. *Cochrane Database Syst Rev.* 2014;(7):CD006169. <http://dx.doi.org/10.1002/14651858.CD006169.pub2> (accessed October 14, 2023).
- 8 American College of Obstetricians and Gynecologists. Magnesium Sulfate before Anticipated Preterm Birth for Neuroprotection. Committee Opinion No. 455. *Obstet Gynecol.* 2010;115:669–671.
- 9 Rouse DJ, Hirtz DG, Thom E, et al. A Randomized, Controlled Trial of Magnesium Sulfate for the Prevention of Cerebral Palsy. *N Engl J Med.* 2008;359(9):895–905.
- 10 American College of Obstetricians and Gynecologists. Prevention of Group B Streptococcal Early-Onset Disease in Newborns: ACOG Committee Opinion No. 797. *Obstet Gynecol.* 2020;135:e51–e72.
- 11 Racusin DA, Antony KM, Haase J, et al. Mode of Delivery in Premature Neonates: Does It Matter? *AJP Rep.* 2016;6(3):e251–e259.
- 12 Jarde A, Feng YY, Viaje KA, et al. Vaginal Birth vs Cesarean Section for Extremely Preterm Vertex Infants: A Systematic Review and Meta-analyses. *Arch Gynecol Obstet.* 2020;301(2):447–458.
- 13 American College of Obstetricians and Gynecologists. Mode of Term Singleton Breech Delivery: ACOG Committee Opinion No. 745. *Obstet Gynecol.* 2018;132:e60–e63.

CASE 20

A Patient with Regular Painful Uterine Contractions at 32 Weeks

Jacqueline Sanchez

History of Present Illness

A 35-year-old gravida 2 para 1 at 32 2/7 weeks' gestation presents to the hospital with regular, painful contractions that began 4 hours ago. The contractions are 3–4 minutes apart and 7 out of 10 in intensity. She also complains of pelvic pressure and low back pain. The patient reports that she had experienced contractions a couple of days ago, but they were irregular and not this strong. She denies vaginal bleeding or leakage of fluid from the vagina.

Her obstetric history is significant for an uncomplicated term vaginal delivery 3 years ago. Her pregnancy has been uncomplicated. She also denies any medical or surgical history. She takes prenatal vitamins and a daily low-dose aspirin.

Physical Examination

General appearance: Mild distress

Vital signs:

Temperature: 37.4°C

Pulse: 88 beats per minute

Blood pressure: 132/77 mmHg

Respiratory rate: 18 breaths per minute

Body mass index (BMI): 31.3 kg/m²

Cardiopulmonary: Normal respiratory effort and chest rise

Abdomen: Gravid. Soft and nontender.

Contractions palpable.

Pelvic: Normal external female genitalia. A sterile speculum exam shows the cervix to be visually dilated, with intact membranes noted. There is a small amount of red blood in the vagina. There is no active bleeding from the cervix, foul-smelling discharge, or pooling. A sterile digital exam reveals the cervix to be 5 cm dilated, 80% effaced, and the fetal station is 0.

Fetal assessment: 140 beats per minute, moderate variability, occasional accelerations, no decelerations, category one tracing. Tocometer: contractions occurring every 3 minutes

Laboratory studies:

Nitrazine: Negative

Fetal fibronectin: Positive

Urinalysis: Negative

Genital culture: Positive for bacterial vaginosis. Group B streptococcus (GBS) pending

Imaging:

Transabdominal ultrasound demonstrates an intrauterine gestation consistent with 32 2/7 weeks.

Cephalic presentation, placenta anterior. Amniotic fluid index (AFI) within normal limits. Biophysical profile 8/8. The cervix is not visualized.

How Would You Manage This Patient?

The patient is diagnosed with preterm labor based on her regular uterine contractions and cervical dilation. Her speculum exam and testing confirm intact membranes. After counseling the patient and her family members on her preterm labor, she is admitted to Labor and Delivery for management. Continuous fetal monitoring and tocometry are initiated. An intravenous (IV) drip is started, and she is given an IV crystalloid bolus. She is given nifedipine 20 mg orally as a loading dose for tocolysis and betamethasone 12 mg intramuscularly to begin her course of antenatal corticosteroids. Intravenous penicillin is begun for GBS prophylaxis as her GBS status is unknown. A consult is placed with the neonatology service, and the neonatal intensive care unit (NICU) is alerted. Shortly after admission, the patient experiences a spontaneous rupture of membranes with clear fluid. She proceeds to undergo a vaginal delivery of a viable male infant, weighing 2,025 g. The patient is discharged on postpartum day number two, and the baby is discharged to home without any complications after 4 weeks in the NICU.

Preterm Labor

Preterm labor is characterized by contractions leading to cervical dilation, effacement, or both between 20 0/7 and 36 6/7 weeks' gestation. However, less than 10% of women exhibiting clinical signs of labor will undergo a preterm delivery within 7 days of symptom onset. Although preterm labor spontaneously resolves in approximately 30% of all cases, it accounts for 50% of all preterm births annually [1]. In 2021, preterm births accounted for 10.5% of all births in the United States, with the rate approximately 50% higher in African American women than for White and Hispanic women [2]. Preterm birth is the leading cause of neonatal mortality and can cause sequelae such as cerebral palsy, neurodevelopmental disability, chronic lung disease, behavioral issues, and hearing and vision impairments [3]. Therefore, effective management strategies are crucial to improving neonatal outcomes.

Preterm birth has been associated with various factors, including maternal medical and obstetric history, maternal demographics such as age, race, and socioeconomic status, and maternal characteristics such as nutritional status and educational attainment. Some modifiable risk factors are short interpregnancy interval, low pre-pregnancy weight, and tobacco, alcohol, or drug use. Qualities of the current pregnancy may also play a role, such as a multifetal gestation, conception by assisted reproductive technologies (ART), amniotic fluid derangements, or fetal anomaly [4].

Preterm labor is recognized as a complex syndrome that can be triggered by various pathogenic processes such as infection, uterine overdistension leading to cervical ripening, maternal stress leading to premature activation of the fetal hypothalamic–pituitary–adrenal axis, and decidual hemorrhage. In many instances, however, a specific mechanism cannot be definitively identified. In these cases, risk factors associated with preterm birth have been used to explain preterm labor. As such, on presentation of a patient who may be in preterm labor, one must assess for placental abruption, chorioamnionitis, vaginal or urinary tract infections (UTIs), and preterm premature rupture of membranes (PROM) [5]. If the preterm labor is thought to be idiopathic, management is then directed based on gestational age. The following sections are summarized in the preterm labor algorithm in Figure 20.1.

Diagnostic Tools

Measuring the cervix with transvaginal ultrasonography has been shown to identify women at increased risk for preterm birth. Shortening of the cervical length before 24 0/7 weeks' gestation is more predictive of preterm delivery than shortening in later pregnancy. Therefore, routine assessment of the cervix should be performed as part of the 18 0/7–22 6/7 week anatomy assessment [4].

Use of biomarkers found in biological fluids for the prediction of preterm birth have also been studied, with fetal fibronectin being the most significant. As fetal fibronectin is typically absent from cervicovaginal secretions from 24 weeks' gestation until near term, its absence in women with preterm labor symptoms has a high negative predictive value. Conversely, the presence of fetal fibronectin has a low positive predict value in asymptomatic women and is therefore not recommended as a primary screening test for preterm birth [4,5].

At-home contraction monitoring has not been shown to reduce the risk of preterm birth. While studies have demonstrated an association between contraction frequency and preterm birth, uterine contractions are not predictive of preterm birth in singleton pregnancies because of the wide variation of frequency in normal pregnancy [4,5].

Additionally, risk scoring systems have been developed to identify pregnant individuals at an increased risk for preterm birth. A systematic review of five prediction models revealed that none of the models had the ability to predict spontaneous preterm birth [6].

Use of Tocolytics

Tocolytics are used to abort uterine contractions in patients at the highest risk for spontaneous preterm birth and are generally only effective for 48 hours [1]. Therefore, tocolysis should only be considered for patients who would benefit from a delay in delivery. These include patients needing transfer to a higher acuity hospital, those who are awaiting antenatal corticosteroid completion, or allowing for an underlying disease process that can cause preterm labor to improve [7].

Tocolytics are generally not used in women who are over 34 weeks' gestational age and are not indicated before viability. Although there is no definitive first-line medication, indomethacin (used before 32 weeks' gestation to prevent closure of the fetal ductus arteriosus) and nifedipine are the most used. The choice to use tocolytics should be individualized. Overall, tocolysis is contraindicated when the risk of prolonging pregnancy or the risks associated with these agents outweigh the risks of prematurity [1].

Use of Magnesium Sulfate

When delivery is expected, IV magnesium sulfate is used to mitigate the severity and potential occurrence of cerebral palsy in preterm infants under 32 weeks' gestation. This is supported by a meta-analysis conducted in 2009 that evaluated the effects of magnesium sulfate when used specifically for neuroprotection [8]. Multiple regimens with various durations and differing inclusion criteria exist, as studied in the large trials of Crowther, Marret, and Rouse, respectively. The American College of Obstetricians and Gynecologists (ACOG) encourages physicians to develop treatment regimens in accordance with one of these studies. The Rouse study recommends magnesium sulfate therapy be given for 12 hours and then stopped, and again restarted when delivery is imminent [9]. Although magnesium sulfate can be used for tocolysis, there is sufficient data to suggest that it does not significantly prolong pregnancy [8].

Administration of Antenatal Corticosteroids

Antenatal corticosteroids are given for fetal lung maturity and have been shown to decrease neonatal morbidity and mortality. A single course of intramuscular steroids (with two 12 mg doses of betamethasone given 24 hours apart or a dexamethasone equivalent) is recommended for pregnant women between 24- and 34 weeks' gestation who are at risk of delivering within 7 days. This recommendation stands even if the full course of steroids may not be completed prior to delivery. For gestations of 34 0/7–36 6/7 weeks, administration of corticosteroids should also be considered in women who are at risk of delivery within 7 days and who have not previously had a course of steroids [1].

GBS Prophylaxis

Group B streptococcus colonization of the patient is the leading cause of newborn infection and can lead to invasive GBS disease. The ACOG recommendation is universal

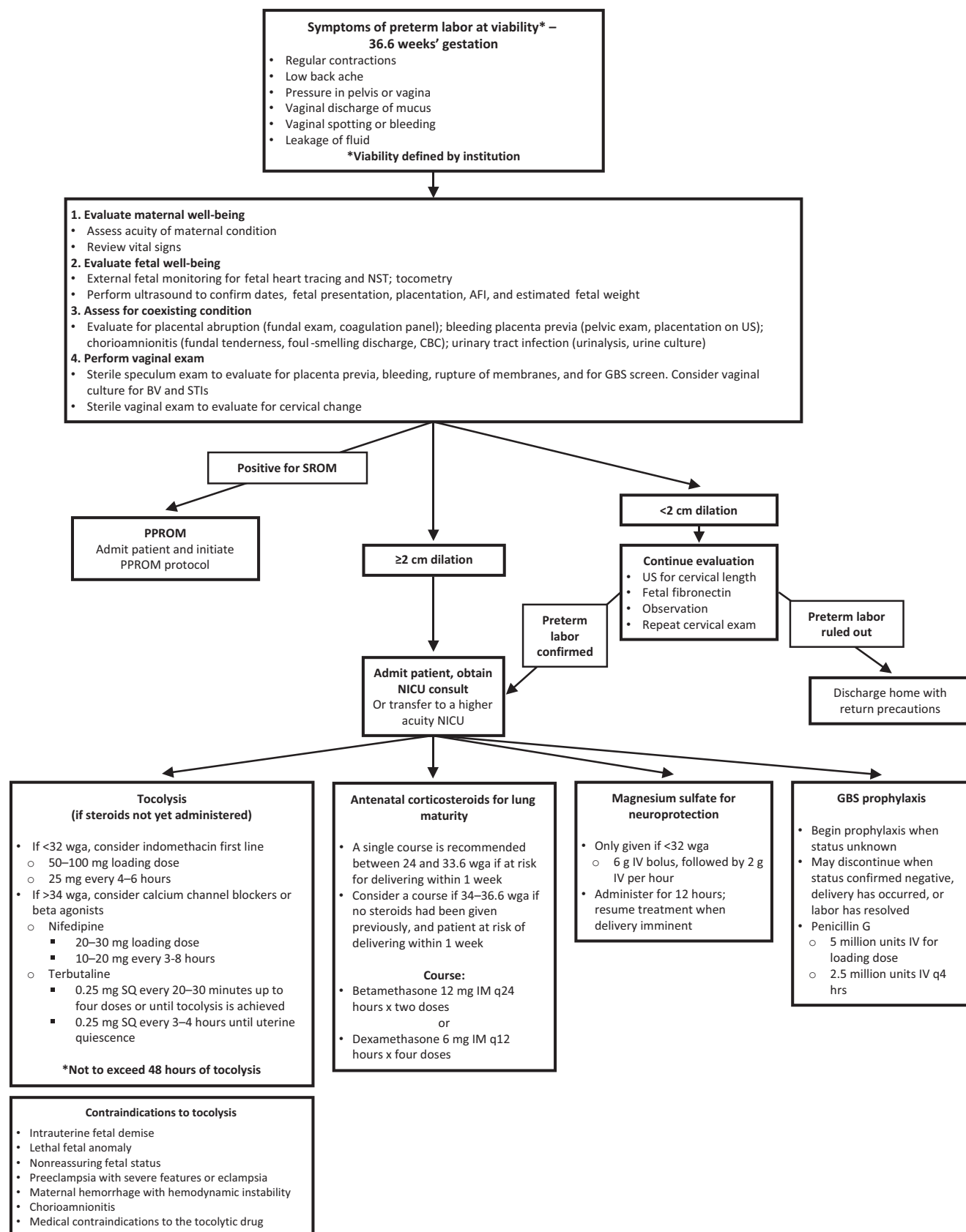


Figure 20.1 Preterm labor evaluation and management algorithm. BV, bacterial vaginosis; CBC, complete blood count; IM, intramuscular; NST, nonstress test; q, every; SQ, subcutaneous; STI, sexually transmitted infection; US, ultrasound; wga, weeks gestational age

screening for GBS colonization at 36 weeks' gestation. Therefore, most patients presenting with preterm labor will have an unknown GBS status. Consequently, a GBS culture should be obtained on admission, and intrapartum antibiotic prophylaxis should be started to prevent invasive GBS disease. Antibiotic prophylaxis is continued until the patient's GBS status is confirmed negative, labor has resolved, or delivery has occurred [10].

Mode of Delivery

While the ideal method of delivery for preterm infants has not been concluded, consideration should be given to vaginal birth if the fetus is reassuring and with vertex presentation [11]. Retrospective cohort studies have demonstrated that birth by cesarean delivery (CD) did not lead to improved neonatal outcomes in preterm infants, showing no benefit with this delivery method. However, in cases of extreme prematurity, a meta-analysis of 14 studies showed that CD was associated with a significant decrease in the adjusted odds of death in extremely preterm vertex infants <28 weeks' gestation [12].

Planned vaginal delivery of a breech fetus may also be an option. Decisions regarding breech delivery should consider the experience of the obstetrician, patient's wishes, and detailed informed consent. Patients should be properly selected to mitigate risk. The fetus should be in frank or complete breech presentation, have no fetal anomalies on ultrasound, and should have an estimated fetal weight (EFW) between 2,500 and 4,000 g [13].

Future Implications

Women who have had a prior spontaneous preterm birth are at higher risk for having recurrent preterm birth. In these patients especially, a short cervix is associated with preterm birth. Thus, these women are recommended to have serial transvaginal ultrasounds in their subsequent pregnancies to evaluate cervical length. Cervical length screening should begin at 16 weeks' gestation and continue until 23 6/7 weeks' gestation. If at any time during this period the cervix is noted to be <25 mm in length, the patient should be offered a cerclage [4].

Key Teaching Points

- Management of preterm labor can improve neonatal outcomes and decrease the incidence of the sequelae of prematurity.
- Tocolytics such as indomethacin and nifedipine are used before 34 weeks' gestation to prolong delivery for 48 hours.
- Intravenous magnesium sulfate is used in pregnancies less than 32 weeks' gestation for the prevention of cerebral palsy.
- A single course of antenatal corticosteroids is recommended before 34 weeks' gestation for women at risk for delivery within 7 days.
- Intravenous GBS prophylaxis should be given until GBS status is confirmed negative, labor has resolved, or delivery has occurred.

References

- 1 American College of Obstetricians and Gynecologists' Committee on Practice Bulletins–Obstetrics. Practice Bulletin No. 171: Management of Preterm Labor. *Obstet Gynecol.* 2016;128:e155–e164.
- 2 Osterman MJK, Hamilton BE, Martin JA, et al. Births: Final Data for 2021. *Natl Vital Stat Rep.* 2023;72(1). www.cdc.gov/nchs/data/nvsr/nvsr72/nvsr72-01.pdf (accessed October 15, 2023).
- 3 World Health Organization. *WHO Recommendations on Antenatal Corticosteroids for Improving Preterm Birth Outcomes.* Geneva: World Health Organization; 2022.
- 4 American College of Obstetricians and Gynecologists. Prediction and Prevention of Spontaneous Preterm Birth. ACOG Practice Bulletin No. 234. *Obstet Gynecol.* 2021;138:e65–e90.
- 5 Goldenberg RL, Culhane JF, Iams JD, et al. Epidemiology and Causes of Preterm Birth. *Lancet.* 2008;371(9606):75–84.
- 6 Meertens LJE, van Montfort P, Scheepers HCJ, et al. Prediction Models for the Risk of Spontaneous Preterm Birth Based on Maternal Characteristics: A Systematic Review and Independent External Validation. *Acta Obstet Gynecol Scand.* 2018; 97(8):907–920.
- 7 Vogel JP, Nardin JM, Doswell T, et al. Combination of Tocolytic Agents for Inhibiting Preterm Labour. *Cochrane Database Syst Rev.* 2014;(7):CD006169. <http://dx.doi.org/10.1002/14651858.CD006169.pub2> (accessed October 14, 2023).
- 8 American College of Obstetricians and Gynecologists. Magnesium Sulfate before Anticipated Preterm Birth for Neuroprotection. Committee Opinion No. 455. *Obstet Gynecol.* 2010;115:669–671.
- 9 Rouse DJ, Hirtz DG, Thom E, et al. A Randomized, Controlled Trial of Magnesium Sulfate for the Prevention of Cerebral Palsy. *N Engl J Med.* 2008;359(9):895–905.
- 10 American College of Obstetricians and Gynecologists. Prevention of Group B Streptococcal Early-Onset Disease in Newborns: ACOG Committee Opinion No. 797. *Obstet Gynecol.* 2020;135:e51–e72.
- 11 Racusin DA, Antony KM, Haase J, et al. Mode of Delivery in Premature Neonates: Does It Matter? *AJP Rep.* 2016;6(3):e251–e259.
- 12 Jarde A, Feng YY, Viaje KA, et al. Vaginal Birth vs Cesarean Section for Extremely Preterm Vertex Infants: A Systematic Review and Meta-analyses. *Arch Gynecol Obstet.* 2020;301(2):447–458.
- 13 American College of Obstetricians and Gynecologists. Mode of Term Singleton Breech Delivery: ACOG Committee Opinion No. 745. *Obstet Gynecol.* 2018;132:e60–e63.

CASE 21

A 25-Year-Old Presents at 22 Weeks' Gestation Leaking Clear Fluid

Julie A. Hurvitz

History of Present Illness

A 25-year-old gravida 1 para 0 at 22 0/7 weeks' gestation presents to Labor and Delivery with complaints of leaking clear fluid from the vagina. She states she was in her usual state of health and when she woke up noted her clothes and the bed were soaked. She has continued to leak clear fluid since. The fluid is clear and odorless and there is no additional vaginal discharge. She denies vaginal bleeding and notes occasional nonpainful cramping. She reports normal fetal movement. She denies fevers, chills, abdominal pain, nausea/vomiting, or dysuria. She has no significant past medical or surgical history, is taking only prenatal vitamins, and has no known drug allergies.

Physical Examination

General appearance: Well-developed, no apparent distress

Vital signs:

Temperature: 37.2°C

Pulse: 82 beats per minute

Blood pressure: 113/67 mmHg

Respiratory rate: 16 breaths per minute

BMI: 24.1 kg/m²

Abdomen: Gravid, soft, non-tender, no fundal tenderness, non-distended, normal bowel sounds, fundal height 21 cm

Pelvic: Normal external genitalia, normal-appearing vagina with pooling of clear fluid coming from os, cervix appears 1 cm dilated

Cervical exam deferred

Fetal assessment: Fetal heart rate (FHR) 155 beats per minute by Doppler. Tocometer: no contractions

Laboratory studies:

WBC: 10,000/μL

Hgb: 11.2 g/dL

Hct: 33.7%

Plt: 206,000/μL

Nitrazine: Positive

Wet preparation: Negative

Ferning: Positive

Potassium hydroxide: Negative

Imaging:

Transabdominal ultrasound: singleton intrauterine pregnancy in cephalic presentation measuring 458 g with normal anatomy, anterior placenta, maximum vertical pocket 2.1 cm

How Would You Manage This Patient?

This patient presents with periviable preterm prelabor rupture of membranes (PPROM). Management of patients presenting with periviable PPRM is complex and dependent upon patient desires as well as availability of neonatal care, termination capabilities, and local laws. Initial evaluation after diagnosis of periviable PPRM includes evaluation for preterm labor, intra-amniotic infection, and placental abruption. This patient has no evidence of these and therefore no contraindication to pregnancy continuation. This patient would be counseled on the maternal and fetal risks of continuing the pregnancy, including but not limited to intra-amniotic infection and its potential sequelae including maternal sepsis and death, risk of preterm delivery, and fetal risks such as pulmonary hypoplasia, limb contractures, and neonatal death. In this counseling, it is important to know your facility's capabilities and policies for neonatal resuscitation and pregnancy termination. After being counseled on the pregnancy prognosis, the patient may opt for pregnancy continuation or for pregnancy termination either by dilation and evacuation (D&E) or labor induction. In this patient, if she opted to continue the pregnancy, she would be offered admission and antibiotic therapy for latency.

Pre and Periviable PPRM

Periviability is defined as 20 0/7–25 6/7 weeks' gestation [1]. A pregnancy is considered previable <20 weeks. Rupture of membranes in the periviable period complicates approximately 0.4% of pregnancies [2]. It may be spontaneous or related to a procedure such as amniocentesis or cerclage placement; procedure-related cases of PPRM tend to have an overall better prognosis [3]. Incidence of concomitant intra-amniotic infection is high and it may be either a cause or a consequence of PPRM. Chorioamnionitis is the most common maternal morbidity from periviable PPRM, with rates found at 37% [4]. In pregnancies affected by periviable PPRM, about half will result in live births, but only approximately 26% will survive until discharge from the hospital. Latency to delivery after periviable PPRM is variable. Generally, longer latency is associated with earlier gestational age at rupture. It is difficult to discern a true median and mean latency at periviability as most studies either include previable PPRM as well or include pregnancies up to 28 weeks' gestation; however, for those with PPRM between 14 and 24 weeks, median latency is approximately 6–13 days and mean latency is 14–39 days [4]. Rupture of membranes at >22 weeks and latency of >7 days are associated with overall improved neonatal prognosis [5].

* Indicates required field

*Gestational Age
(Best estimate in completed weeks)

22

*Birth Weight
(from 401-1000 grams)

404

* Infant Sex

☐ Male ☒ Female

* Singleton Birth

☒ Yes ☐ No

* Antenatal Steroids

☒ Yes ☐ No

Clear

Submit

Infants Receiving Active TreatmentAverage Survival: 27%
Hospital Range: 17 - 41%**All Infants, Including Infants Not Actively Treated**Average Survival: 10%
Hospital Range: 5 - 17%**Outcomes At 18-26 Months' Corrected Age Among Infants Who Survive: (About the Data)**Profound
Neurodevelopmental
Impairment

5 - 11%

Moderate-Severe
Neurodevelopmental Impairment

37 - 78%

Blindness Deafness

< 1%

2 - 11%

Moderate-Severe
Cerebral Palsy

9 - 22%

Cognitive
Developmental Delay

35 - 67%

PLEASE NOTE: Information from this website is not intended to be the only basis for making care decisions for an individual infant, nor is it intended to be a definitive means of predicting infant outcomes. Users should keep in mind that every infant is an individual, and that factors beyond those described on this website influence infant survival and development.

Figure 21.1 Example of Extremely Preterm Birth Outcomes Tool (from www.nichd.nih.gov/research/supported/EPBO/use)

There have been improvements in neonatal resuscitative abilities in the past decades that have resulted in increased survivability for neonates in the periviable period. Recent data show 23–27% survival at 23 weeks, with this number increasing to 67–76% by 25 weeks. The Eunice Kennedy Shriver National Institute of Child Health and Human Development Neonatal Research Network offers a calculator with variables input such as fetal sex and estimated fetal weight (EFW) that may give families an idea of the chance of neonatal survival as well as intact survival without significant morbidity. As expected, survival and intact survival rates increase with increasing gestational age [6]. The calculator is available at www.nichd.nih.gov/research/supported/EPBO/use (Figure 21.1). Center-specific rates may be available for more targeted counseling.

Initial management of a patient with periviable PPROM includes maternal assessment with evaluation for preterm labor, concomitant infection, or placental abruption. Vital signs should be assessed for evidence of fever, tachycardia, or hypotension, which may reveal signs of intra-amniotic infection, hemorrhage, or sepsis. Abdominal exam with special attention paid to the presence or absence of fundal tenderness or palpable contractions and a speculum exam to

evaluate for evidence of purulence or bleeding as well as a visual assessment of cervical dilation should be performed. Digital assessment of the cervix is deferred pending patient counseling as it has been associated with infection [7]. Laboratory assessment of infection and anemia should be obtained (consider white blood cell count with differential, hemoglobin, and coagulation studies). A tocometer is applied to evaluate for contractions. Fetal evaluation with ultrasound for presentation, EFW, and heart rate should be performed.

Periviable PPROM management includes complex options counseling and may require transfer of care to different facility pending ability for neonatal resuscitation at these early gestational ages. If the patient opts for pregnancy continuation, some practices may recommend admission. However, once no evidence of infection or abruption is found, discharge home with planned readmission at viability/when the patient desires intervention for fetal indications is reasonable. These patients should be counseled to perform evaluation for fever at home once or twice daily and to re-present for symptoms or signs of intra-amniotic infection (e.g. temperature of $\geq 38^{\circ}\text{C}$), placental abruption, or preterm labor. Follow-up with weekly

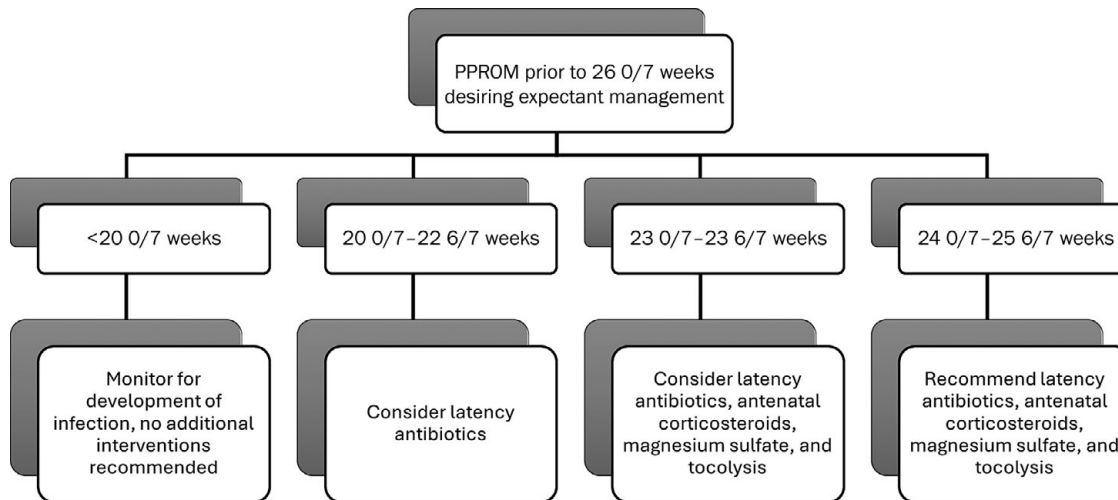


Figure 21.2 Algorithm for approach to the patient with PPROM <26 weeks desiring expectant management

prenatal visits and ultrasound can be used to assess maternal and fetal well-being. Labs to assess for early evidence of infection such as WBC or C-reactive protein (CRP) can also be utilized at these weekly visits.

If possible, joint counseling should occur with the obstetrical and neonatal teams, with information given to the patient and family including likelihood of neonatal survival and intact survival. Patient desires for fetal monitoring and/or intervention for fetal distress or preterm labor in the setting of malpresentation should also be elicited and documented. Per the Obstetric Care Consensus on Preterm Birth, a document published jointly by ACOG and the Society for Maternal-Fetal Medicine (SMFM), neonatal assessment for resuscitation should be considered between 22 0/7 and 23 6/7 weeks and is recommended after 24 0/7 weeks [1]. This may, however, vary between institutions and regions based on local resuscitative abilities. Per this guideline, CD for fetal indications is not recommended prior to 23 0/7 weeks, but again this varies between institutions. Depending on the patient's desires for intervention, a fetal monitoring regimen ranging from daily FHR to continuous fetal monitoring can be implemented.

In terms of interventions, it is reasonable to offer antibiotic prophylaxis for pregnancy prolongation or "latency antibiotics" as early as 20 weeks' gestation [1]. This may involve a short-term hospitalization followed by discharge home and readmission to the hospital at a pre-determined date of viability/patient desire for intervention. Antenatal corticosteroids have been shown to decrease death and neurodevelopmental impairment in infants born at 23–26 weeks' gestation, though this trend was not seen in those born at 22 weeks [1]. It may be appropriate to offer short-term tocolytic therapy while the patient is undergoing steroid treatment for fetal lung maturation. Magnesium sulfate prophylaxis for reduction of cerebral palsy risk has been shown to be efficacious starting at 24

weeks. There is a paucity of data in the periviable neonate prior to 24 weeks, but it is to be considered starting at 23 weeks, with no benefit being shown in the limited studies evaluating those at 22 weeks' gestation [1]. Cerclage placement is contraindicated with rupture of membranes. An algorithm for approach to the patient with PPROM prior to 26 weeks desiring expectant management is included in Figure 21.2.

In patients desiring termination of pregnancy, this may be accomplished by either labor induction or D&E. Dilation and evacuation is associated with fewer complications and shorter hospitalizations. Studies have quoted a risk of retained placenta requiring dilation and curettage in as high as 22% of patients who undergo labor induction in the second trimester [8].

Pre and periviable PPROM is a complex clinical entity with significant maternal and neonatal morbidity. Management of these patients requires a multidisciplinary team and detailed counseling of patients and families to ensure patient safety and autonomy.

Key Teaching Points

- Management of previable and periviable PPROM in the absence of preterm labor, intra-amniotic infection, or abruption must be individualized to the patient, family, and local resuscitative and termination abilities.
- Adequate care for these patients may require transport to a higher level of care.
- Antenatal steroids, magnesium sulfate, and short-term tocolytics are recommended in certain patients with periviable PPROM and in most circumstances, patients at 23 0/7 weeks' gestation or later are candidates for these interventions. Administration of antibiotics to prevent infection or "latency antibiotics" is reasonable as early as 20 0/7 weeks' gestation.

References

- 1 American College of Obstetricians and Gynecologists; Society for Maternal-Fetal Medicine. Obstetric Care Consensus No. 6. Periviable Birth. *Obstet Gynecol.* 2017;130:e187–e199.
- 2 Society for Maternal-Fetal Medicine; Battarbee AN, Osmundson SS, et al. Society for Maternal-Fetal Medicine Consult Series #71: Management of Previa and Periviable Preterm Prelabor Rupture of Membranes. *Am J Obstet Gynecol.* 2024;231(4):B2–B15. [www.ajog.org/article/S0002-9378\(24\)00759-2/fulltext](https://www.ajog.org/article/S0002-9378(24)00759-2/fulltext) (accessed November 13, 2024).
- 3 Sim WH, Araujo Júnior E, Da Silva Costa F, et al. Maternal and Neonatal Outcomes Following Expectant Management of Preterm Prelabor Rupture of Membranes before Viability. *J Perinat Med.* 2017;45(1):29–44.
- 4 Waters TP, Mercer BM. The Management of Preterm Premature Rupture of the Membranes Near the Limit of Fetal Viability. *Am J Obstet Gynecol.* 2009;201(3):230–240.
- 5 Kibel M, Asztalos E, Barrett J, et al. Outcomes of Pregnancies Complicated by Preterm Premature Rupture of Membranes between 20 and 24 Weeks of Gestation. *Obstet Gynecol.* 2016;128(2):313–320.
- 6 Stoll BJ, Hansen NI, Bell EF, et al.; Eunice Kennedy Shriver National Institute of Child Health and Human Development Neonatal Research Network. Neonatal Outcomes of Extremely Preterm Infants from the NICHD Neonatal Research Network. *Pediatrics.* 2010;126(3):443–456.
- 7 Ayyar A, Moufarrij S, Turrentine M. Infectious Morbidity of Speculum versus Digital Examinations in Preterm Prelabor Rupture of Membranes: A Systematic Review and Meta-analysis. *J Matern Fetal Neonatal Med.* 2022;35(25):8905–8911.
- 8 Whitley KA, Trinchere K, Prutsman W, et al. Midtrimester Dilation and Evacuation versus Prostaglandin Induction: A Comparison of Composite Outcomes. *Am J Obstet Gynecol.* 2011;205(4):386.e1–386.e7.

A 40-Year-Old at 34 Weeks' Gestation with Worsening Itching

Lauren Coyne

History of Present Illness

A 40-year-old gravida 4 para 1001 at 34 weeks' gestation presents to her routine obstetric visit. She reports worsening itching throughout her body, worse along her palms and the soles of her feet. This has been present for 4 days and is progressively worsening in severity. She denies any noticeable skin changes. She has not used any new soaps, detergents, lotions, or perfumes and cannot recall any concerning dermal exposures. She has not tried any topical or over the counter remedies. She endorses fetal movement.

This pregnancy has been uncomplicated. She has a history of one prior full-term spontaneous vaginal delivery (SVD) after an uncomplicated pregnancy. She denies any history of medical problems or surgeries. Her medications are a daily prenatal vitamin and daily baby aspirin.

Physical Examination

General appearance: Well-developed, well-nourished female in no acute distress

Vital signs:

Temperature: 36.8°C

Pulse: 78 beats per minute

Blood pressure: 125/76 mmHg

Respiratory rate: 14 respirations per minute

BMI: 35.69 kg/m²

Oxygen saturation: 98% on room air

Cardiopulmonary: Clear to auscultation bilaterally. Regular rate and rhythm

Abdomen: Gravid, soft, non-tender to palpation. Fundal height 34 cm. FHR 135 beats per minute

Pelvic: Deferred

Extremities: Trace dependent edema, no calf tenderness

Neurologic/psychologic: Alert and oriented × 3

Skin: Scattered excoriations at abdomen

Laboratory studies:

WBC: $6.9 \times 10^9/L$

Hgb: 10.5 g/dL

Plt: 287,000/ μL

ALT: 99 U/L

AST: 52 U/L

Cr: 0.7 mg/dL

Urine protein: creatinine ratio: 0.15

Bile acids: 60 $\mu mol/L$

How Would You Manage This Patient?

This patient presents with new onset, worsening diffuse itching in the third trimester of pregnancy. There are several benign conditions that may cause itching during pregnancy. However, due to potential adverse fetal effects, intrahepatic cholestasis of pregnancy (ICP) must be ruled out. The elevation in bile acids ($>10 \mu mol/L$) and transaminases, supports the diagnosis of ICP. Antenatal fetal monitoring was initiated. This can be done in a variety of ways. This is typically started at diagnosis or at 32 weeks' gestational age and can be carried out with weekly modified biophysical profiles until delivery. This patient was started on ursodeoxycholic acid and, given her bile acid level of 60 $\mu mol/L$, delivered at 37 weeks.

Intrahepatic Cholestasis of Pregnancy

Intrahepatic cholestasis of pregnancy is a disorder that occurs during the second and third trimesters. It is characterized by pruritis without a rash and elevated serum bile acids. The pattern of pruritis is most often described as affecting the palms and soles of feet, but can occur diffusely. This is often more severe at night. This condition does not pose a risk to the mother, is self-limited, and will resolve after delivery. However, ICP increases fetal risks of preterm delivery, meconium presence in amniotic fluid, and stillbirth [1].

In the United States, the prevalence of ICP is estimated to be 0.001–0.32% and has been described as high as 15% in some South American populations [1,2]. The pathophysiology is multifactorial involving genetic susceptibility, abnormalities in hormone metabolism, and possible environmental factors [2]. Women with preexisting hepatobiliary disease such as hepatitis, nonalcoholic cirrhosis, gallstones, cholecystitis, and nonalcoholic pancreatitis are at higher risk of developing ICP [1,3].

Intrahepatic cholestasis of pregnancy is associated with complications including stillbirth, meconium-stained amniotic fluid, and preterm birth (both spontaneous and induced) [1]. The stillbirth rate of the US population at ≥ 37 weeks is estimated to be 0.1–0.3%. The stillbirth rate at ≥ 37 weeks for those with ICP is estimated to be 1.2% [1,4]. The stillbirth risk is thought to be associated with total bile acid levels, with the greatest risk being when total bile acid levels $>100 \mu mol/L$.

Pruritis alone is a common complaint in pregnancy and affects an estimated 23% of gestations [1,5]. The differential diagnosis for this includes ICP, atopic eruption of pregnancy, polymorphic eruption of pregnancy (PEP), and pemphigoid

gestationis [1,4]. When evaluating a pregnant patient with new onset pruritis it is necessary to include a history and physical exam, evaluating for other potential causes for pruritic [1]. Intrahepatic cholestasis of pregnancy does not produce a primary rash, but may produce secondary skin changes due to scratching. Laboratory evaluation is necessary to diagnose ICP. Total and fractionated bile acid levels can be measured using mass spectrometry and liquid chromatography (results available in 4–14 days) [1]. Enzymatic assay are routinely used to measure total bile acid levels and results are available in 4 hours to 4 days [1]. Most often, laboratories do not provide a specific reference range or pregnancy specific range for interpretation of results. In these cases, the upper limit of 10 $\mu\text{mol/L}$ is utilized, with values greater than this being diagnostic for ICP [1]. While serial bile acid testing is not recommended, follow-up testing in severe cases may help guide timing of delivery [1].

Treatment is initiated to both provide symptomatic relief and may decrease the risk of adverse outcomes. Ursodeoxycholic acid is the first-line treatment for ICP. This works to relieve itching and improve laboratory values. The starting dose is 10–15 mg/kg/day, divided into two to three doses. Typically resulting in an initial dose of 300 mg twice daily. This can be titrated based on symptoms to a maximum dose of 21 mg/kg/day in divided dosing [1]. The most reported side effects are nausea and dizziness, which is reported in as high as 25% of patients [1]. Symptomatic relief may be seen within 1–2 weeks and laboratory improvement can be seen within 3–4 weeks [1].

Secondary agents include cholestyramine, adenosylmethionine, corticosteroids, and antihistamines. Specifically, sedating, first-generation antihistamines (e.g. Atarax and Benadryl) can target nocturnal pruritis. The mechanism of fetal death has yet to be elucidated. Proposed mechanism have included increased bile acid, leading to deposition in the fetal myocardium and placental vessel spasm [6]. These potential etiologies are supportive of the association seen between rising levels and fetal death. Given the unknown etiology, antenatal

fetal testing should be initiated at diagnosis or 32 weeks. Even with normal testing, fetal death has been reported. As such, delivery timing is modified. Delivery timing is directed by level of bile acids. If $>100 \mu\text{mol/L}$, delivery at 36 0/7 weeks is recommended. If bile acids are $>10 \mu\text{mol/L}$ but less than 100 $\mu\text{mol/L}$, delivery is recommended between 36 0/7 and 39 0/7 weeks [1]. If delivery is going to occur <37 0/7 weeks, antenatal corticosteroids for fetal lung maturity should be administered [1].

Resolution of ICP typically occurs within the first week. Patients with persistent itching, right upper quadrant pain, or jaundice should be reevaluated with liver function tests and bile acids, and referred to a hepatologist to assess for nonobstetric conditions. Additionally, patients should be counseled regarding the recurrence risk of as high as 90% [1].

Key Teaching Points

- Intrahepatic cholestasis of pregnancy is defined as pruritis without a rash with an elevation in serum bile acids.
- There is little maternal risk associated with ICP and pruritis will resolve post-delivery. Significant fetal risks exist, which include preterm delivery, meconium presence in amniotic fluid, and stillbirth.
- Antenatal fetal testing is indicated. It is initiated once the diagnosis of ICP is made or at a gestational age at which one would intervene for abnormal testing.
- Ursodeoxycholic acid is the first-line therapy for both maternal symptomatic relief and for improvement of laboratory values. Antihistamines and corticosteroids can be added.
- Delivery timing is based on the level of bile acids. If $\geq 100 \mu\text{mol/L}$, delivery should be offered at 36 0/7 weeks' gestation. If $\leq 100 \mu\text{mol/L}$, delivery should be offered between 36 0/7 and 39 0/7 weeks. If delivery is performed <37 0/7 weeks' gestational age, corticosteroids should be administered.

References

- 1 Society for Maternal-Fetal Medicine; Lee RH, Greenberg M, et al. Society for Maternal-Fetal Medicine Consult Series #53: Intrahepatic Cholestasis of Pregnancy: Replaces Consult #13, April 2011. *Am J Obstet Gynecol*. 2021;224(2):B2–B9.
- 2 Adams A, Jacobs K, Vogel RI, et al. Bile Acid Determination after Standardized Glucose Load in Pregnant Women. *AJP Rep*. 2015;5:e168–e171.
- 3 Ropponen A, Sund R, Riikonen S, et al. Intrahepatic Cholestasis of Pregnancy as an Indicator of Liver and Biliary Diseases: A Population-Based Study. *Hepatology*. 2006;43:723–728.
- 4 Bechtel MA, Plotner A. Dermatoses of Pregnancy. *Clin Obstet Gynecol*. 2015;58:104–111.
- 5 Kenyon AP, Tribe RM, Nelson-Piercy C, et al. Pruritus in Pregnancy: A Study of Anatomical Distribution and Prevalence in Relation to the Development of Obstetric Cholestasis. *Obstet Med*. 2010;3:25–29.
- 6 Association of Adverse Perinatal Outcomes of Intrahepatic Cholestasis of Pregnancy with Biochemical Markers: Results of Aggregate and Individual Patient Data Meta-analyses. *Lancet*. 2019;393:899–909.

A 25-Year-Old Presents at 30 Weeks' Gestation Following a Motor Vehicle Accident

Emily Barrows

History of Present Illness

A 25-year-old primigravida presents at 30 weeks' gestation via ambulance following a motor vehicle accident (MVA). She was driving at 25 miles per hour and sustained impact to the passenger side of her vehicle, at which point airbags deployed. She was wearing her seatbelt. She reports the presence of fetal movement since her accident and denies any abdominal pain or contractions. Her pregnancy has thus far been uncomplicated, she has no significant medical or surgical history, no allergies, and her only medication is prenatal vitamins.

Physical Examination

General appearance: Well-developed, well-nourished, no acute distress

Vital signs:

Temperature: 36.9°C

Pulse: 99 beats per minute

Blood pressure: 109/61 mmHg

Respiratory rate: 18 breaths per minute

BMI: 29.1 kg/m²

Head: Normocephalic, atraumatic; pupils equal, round and reactive to light

Neck: Cervical collar in place

Chest: Mild skin abrasion across left shoulder, no chest wall tenderness. Lungs clear to auscultation bilaterally

Cardiovascular (CV): Tachycardia with regular rhythm, no murmurs or arrhythmias

Abdomen: Uterine fundus non-tender, measuring 30 cm; mild tenderness to deep palpation across lower abdomen; no rebound, no guarding

Pelvic: Normal external genitalia. Vagina with physiologic discharge, no bleeding. Cervix closed, long, and high

Extremities: Right wrist with tenderness to palpation and movement, otherwise no abnormal findings

Neurologic/psychologic: Alert and oriented × 3

Fetal assessment: Baseline 135 beats per minute; moderate variability, accelerations present, decelerations absent.

Tocometer: Irregular contractions

Laboratory studies:

Hgb: 11.1 g/dL

Plt: 138,000/μL

PT: 10 seconds

aPTT: 30 seconds

INR: 1.0

Fibrinogen: 450mg/dL

Blood type: A-

Antibody (Ab) screen: Negative

Imaging:

Right wrist series: No evidence of fracture

How Would You Manage This Patient?

This early third-trimester patient presents following a trauma with impact to her abdomen. Initially evaluated in the Emergency Department, she was found to have no major injury. During her secondary survey, the obstetrics team confirmed that the fundal height was consistent with 30 weeks' gestation and visualized a viable fetus on ultrasound. Once the trauma team confirmed she was stable with no major injuries she was transferred to Labor and Delivery for further monitoring. There, continuous fetal monitoring with tocometry was initiated and revealed a category 1 fetus as well as intermittent uterine contractions. She had a total of seven contractions during her first hour of monitoring and was therefore admitted for 24 hours of observation with continuous fetal monitoring. Due to her Rhesus (Rh)-negative status, she received Rh immune globulin and underwent a Kleihauer-Betke test. This test showed no fetal maternal hemorrhage so no additional Rh immune globulin was provided. Her contractions ceased after the first few hours of monitoring and her fetal monitoring remained category 1 throughout her 24 hours of observation. She was discharged home in good condition with plans for outpatient follow-up within the week.

Abdominal Trauma in Pregnancy

Trauma is the most common cause of non-obstetric maternal mortality worldwide [1,2], affecting 6–8% of pregnancies [2,3]. More than half of these traumas occur in the third trimester [4]. The most common causes of trauma in pregnancy are domestic violence, MVAs, and falls [2,3]. When examining these various types of trauma for morbidity, violent trauma is nearly twice as common in pregnant women as nonpregnant women, and has a 3.14-fold increased death rate compared with accidental trauma [1,2]. Motor vehicle accidents are the most common cause of non-obstetric trauma associated with fetal death [5], and falls, while accounting for up to 31% of maternal traumas, are only associated with significant maternal or fetal complications <10% of the time [6].

Maternal trauma can result in direct adverse effects on maternal health, but even minor trauma that leaves the mother without major injury can negatively impact the fetus. The most common adverse outcomes include placental abruption, fetomaternal hemorrhage (FMH), isoimmunization, preterm labor, PROM, uterine rupture, and spontaneous abortion [1,3]. Direct fetal injury is also possible, but in the absence of penetrating injury this is very rare as the impact of blunt trauma is typically absorbed by maternal soft tissues and amniotic fluid [1]. One large meta-analysis showed the pooled incidence of maternal death following MVA (compared to non-MVA trauma) was 3.6 per 1,000 women and the incidence of perinatal death (fetal death or stillbirth) was 6.6 per 1,000 women. There are increased odds of abruption, antepartum hemorrhage, and maternal death following an MVA [5]. If delivery occurs immediately following an MVA, perinatal outcomes are worse, but importantly if an MVA does not precipitate delivery, there appears no increased rate of preterm birth or perinatal death as the pregnancy progresses [7].

Some have investigated the role that safety devices such as seat belts and airbags have on perinatal outcomes following an MVA. Ultimately, improper seat belt use is associated with adverse outcomes, including fetal death [2,5]. Seat belt use is especially beneficial for the driver as proper use helps prevent abdominal impact with the steering wheel [5]. Airbag deployment has been associated with placental abruption, uterine rupture, and fetal death; however, this is typically reflective of the severity of the accident rather than the airbags themselves causing adverse outcomes. It is not recommended to disable airbags in pregnancy, especially given their importance in preventing direct maternal injury [6].

Even minor trauma to the abdomen without significant physical findings is a risk for placental abruption. Therefore all practitioners should maintain a high index of suspicion after any abdominal trauma. Abruption occurs due to the relative elasticity of the uterus that allows for deformation of the uterine wall upon traumatic impact. This deformation leads to shearing forces at the placental attachment site and causes abrupt changes in amniotic fluid pressure. Together, these events can result in separation of the placenta from the uterine wall [1,6]. Additionally in an MVA, intra-abdominal forces are increased when abrupt deceleration generates significant forward displacement of the uterus, causing negative pressure and a countercoup effect. The folding of the maternal body over the abdomen also increases intra-abdominal pressure and together these forces are powerful enough to cause placental shearing and abruption [2].

Another complication that is possible with only minor abdominal trauma is FMH. Fetomaternal hemorrhage can result in maternal isoimmunization as well as fetal anemia, supra ventricular tachycardia, and death. Fetomaternal hemorrhage is reported in 10–30% of pregnant trauma patients. While mostly small in volume, as little as 0.001 mL of fetal blood can cause sensitization of the Rh-negative mother [6]. The presence of FMH is not reliably predicted by the severity of a trauma, but the volume of the FMH is predicted by trauma severity [1].

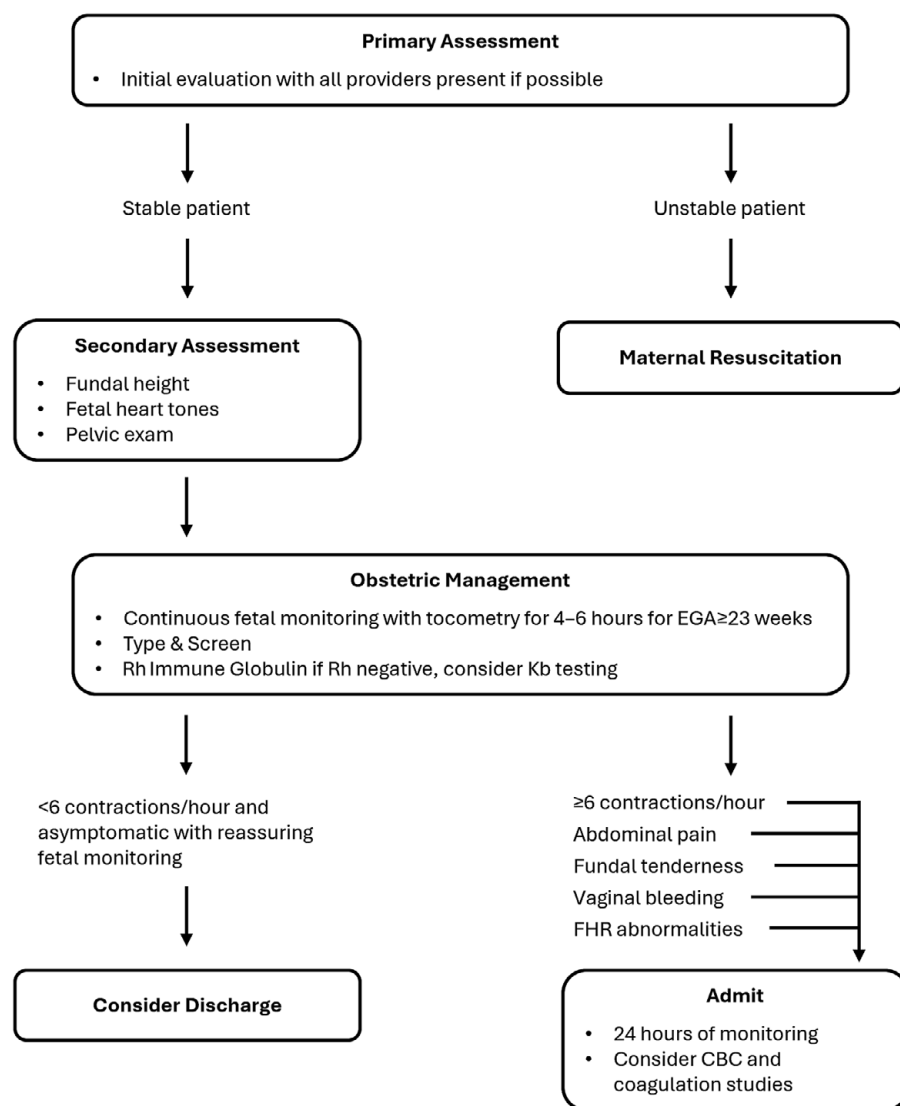
Management of Abdominal Trauma

Initial management of any trauma in pregnancy should always focus first on maternal resuscitation. The primary survey should follow nonpregnancy guidelines [2]. If possible, the emergency or trauma providers and the obstetricians should be present simultaneously for all initial exams. Typically, the emergency providers will act as the primary team with the obstetricians present as consultants [2,3]. During the secondary survey, a fundal height should be performed, fetal heart tones obtained, and a pelvic exam performed to assess for bleeding, cervical dilation, or rupture of membranes. Given that abruption typically begins to develop shortly after a traumatic event, continuous fetal monitoring with tocometry should be initiated as soon as possible for any gestations at fetal viability or beyond, typically around 23 weeks [1].

Appropriate laboratory testing is generally dictated by specifics of the trauma and the patient's injuries. A type and screen should be drawn and if there is suspicion of abruption, it is appropriate to obtain CBCs and coagulation studies. If a patient is Rh negative, Kleihauer–Betke testing should be considered to facilitate appropriate dosing of Rh immune globulin [1,3,6]. Within 72 hours of the trauma event, 300 µg of Rh immune globulin should be administered to all Rh-negative trauma patients. This dose will neutralize up to 30cc of fetal whole blood and further doses can be provided if needed based on the results of Kleihauer–Betke testing [1]. Administration of betamethasone should be considered [3]. If the patient has a traumatic wound that is contaminated, penetrating, or contains devitalized tissue, assess for tetanus vaccination.

Imaging studies should be performed as necessary without deferral for possible effects to the developing fetus [2,6]. Radiation doses <50 mGy have not been associated with any risk of fetal anomalies, growth restriction, or abortion and all typical diagnostic testing is below this threshold [8]. The use of gadolinium-based contrast agents should be limited to occasions when maternal benefits clearly outweigh fetal risks [6,8].

While it should not take precedence over maternal resuscitation, fetal monitoring should be initiated as soon as feasible following an abdominal trauma of any severity. Fetal signs indicating possible abruption include loss of variability, late decelerations, tachycardia, bradycardia, and a sinusoidal pattern. Additionally, tocometry should be initiated as contractions are predictive of abruption [1]. Studies have shown that for most patients with abruption following a trauma, there were six or more contractions per hour in the first four hours of monitoring and no abruptions were reported when there were fewer than one contraction in any 10-minute interval over the first 4 hours of monitoring [1,2]. Taking these findings with the knowledge that abruption is mostly reported within 24 hours following a traumatic insult, various monitoring protocols have been proposed [2]. While specifics vary, the widely accepted standard for monitoring involves an initial 4–6 hours of continuous monitoring if the patient presents within 24 hours of the traumatic event. Monitoring should be extended through 24 hours if more than four to six contractions are present per hour [1,3]. If fewer contractions are present and the patient is without abdominal

Figure 23.1 Sample protocol for managing obstetric trauma victims

tenderness or vaginal bleeding and has reassuring fetal monitoring, then discharge can be considered [2]. Figure 23.1 provides a sample protocol for management of the pregnant trauma patient.

Key Teaching Points

- Trauma is the most common cause of non-obstetric mortality worldwide and is most commonly caused by domestic violence, MVA, and falls.
- Placental abruption and FMH can occur with minor traumas where no major maternal injury is present.
- Initial management of any trauma should focus on maternal stabilization and resuscitation.
- Cardiotocography should be initiated as soon as possible and continued for at least 4 hours to monitor fetal well-being and screen for signs of placental abruption.
- If there are fewer than six contractions per hour and the patient is otherwise stable and asymptomatic, discharge can be considered. If there are six or more contractions per hour, FHR abnormalities, pain, bleeding, or fundal tenderness are present, the patient should be admitted for 24 hours of monitoring.

References

- 1 Chames MC, Pearlman MD. Trauma during Pregnancy: Outcomes and Clinical Management. *Clin Obstet Gynecol.* 2008;51(2): 398–408.
- 2 Mendez-Figueroa H, Dahlia JD, Vrees RA, et al. Trauma in Pregnancy: An Updated Systemic Review. *Am J Obstet Gynecol.* 2013;209(1):1–10.
- 3 Huls CK, Detlefs C. Trauma in Pregnancy. *Semin Perinatol.* 2018;42(1):13–20.
- 4 La Rosa M, Loaiza S, Zambrano MA, et al. Trauma in Pregnancy. *Clin Obstet Gynecol.* 2020;63(2): 447–454.
- 5 Amezcua-Prieto C, Ross J, Rogozińska E, et al. Maternal Trauma Due to Motor Vehicle Crashes and Pregnancy

- Outcomes: A Systematic Review and Meta-analysis. *BMJ Open*. 2020;10(10): 1–12.
- 6 Jain V, Chari R, Maslovitz S, et al. Guidelines for the Management of the Pregnant Trauma Patient. *J Obstet Gynaecol Can*. 2015;37(6): 553–574.
 - 7 Vivian-Taylor J, Roberts CL, Chen JS, et al. Motor Vehicle Accidents during Pregnancy: A Population-Based Study. *BJOG*. 2012;119(4):499–503.
 - 8 Committee Opinion No. 723: Guidelines for Diagnostic Imaging during Pregnancy and Lactation. *Obstet Gynecol*. 2017;130(4): e210–e216.

A 20-Year-Old Presents at 34 Weeks' Gestation with Pruritic Abdominal Rash

Vaibhavi Umesh

History of Present Illness

A 30-year-old gravida 1 para 0 at 34 weeks' gestation presents to her prenatal visit complaining of intense itching and wide-spread skin rash. She states the itching started approximately 2 weeks ago and has become progressively worse. The itching is worse at night and has been affecting her ability to sleep. The rash started on her abdomen and spread to her thighs, buttocks, and upper arms. She denies any associated fever, chills, malaise, nausea, or diarrhea. She denies any new environmental exposures or sick contacts. She was diagnosed with gestational diabetes at 25 weeks, which has been diet controlled, and she reports a 40 lb weight gain. She denies any other medical conditions, surgical history, allergies, or previous dermatological problems.

Physical Examination

General appearance: Well-appearing, in no acute distress

Vital signs:

Temperature: 36.8°C

Pulse: 102 beats per minute

Blood pressure: 126/80 mmHg

Respiratory rate: 24 breaths per minute

BMI: 30 kg/m²

Cardiopulmonary: Lungs are clear to auscultation, respirations are nonlabored. Heart normal rate, regular rhythm

Breast examination: No masses or tenderness. Large urticarial wheals noted on the upper chest

Abdomen: Soft, gravid, non-tender. Large abdominal striae lined with erythematous papules and urticarial wheals throughout

Integumentary: Multiple erythematous papules, plaques, and urticarial wheals distributed primarily on her abdomen, extending to her thighs, buttocks, chest, and upper arms. The lesions are excoriated and mildly edematous

Fetal assessment: 140 beats per minute; moderate variability, accelerations present, no decelerations. Tocometer: No contractions or uterine irritability

Sono: Biophysical profile 8/8

Laboratory studies:

Urinalysis: Trace ketones

How Would You Manage This Patient?

This patient presents with new-onset pruritic small erythematous and edematous papules along her abdominal striae with subsequent spreading to the trunk and extremities resulting in larger urticarial plaques, which is characteristic of pruritic urticarial papules and plaques of pregnancy (PUPPP) (see Figure 24.1). Based on the patient's history and physical exam findings, PUPPP is the most likely diagnosis. It is a generally benign condition that resolves after delivery. Managing the uncomfortable symptoms of this condition is the mainstay of treatment. As such, this patient's treatment plan includes the use of emollients and nonsedating antihistamines for pruritus along with low- to moderate-potency topical corticosteroids for localized persistent lesions. The patient was educated on avoiding hot showers, irritating fabrics, and scratching to prevent the exacerbation of symptoms. She was also encouraged to use cool compresses and wear loose-fitting clothes to alleviate discomfort. The patient was seen weekly for the next month to monitor symptom progression and treatment efficacy. She reported significant improvement in her symptoms over the next few weeks and complete resolution of symptoms in the postpartum period.

Pruritic Urticarial Papules and Plaques of Pregnancy

Pruritic urticarial papules and plaques of pregnancy, which is also known as PEP, is a benign, self-limiting, pruritic, inflammatory pregnancy-associated skin disorder. It is characterized by pruritic urticarial papules and plaques starting along the abdominal striae and extending to the thighs, buttocks, and arms. It has no specific laboratory or histopathological features. It has been described under various names including toxemic rash of pregnancy and late-onset prurigo of pregnancy (PP) [1]; however, it was Lawley et al. who coined the term "pruritic urticarial papules and plaques of pregnancy" in 1979 in a small study that described pruritic eruption in the third trimester of pregnancy with complete resolution of symptoms within 2 weeks postpartum [2]. Neither PUPPP nor its treatment adversely influences the outcome of pregnancy.

Epidemiology and Risk Factors

Pruritic urticarial papules and plaques of pregnancy is the most common gestational dermatosis, with a reported

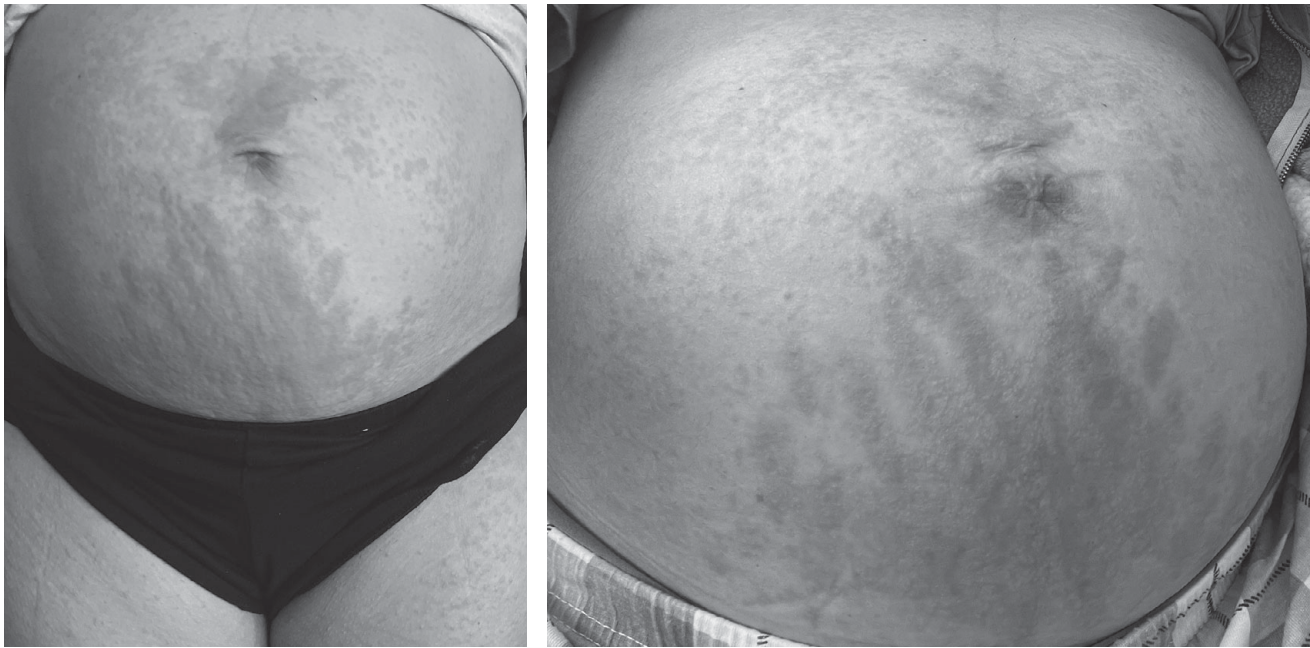


Figure 24.1 Examples of PUPPP

incidence of 1 in 200 (0.5%) in singleton pregnancies. The reported incidence is higher in twin (2.9%) and triplet pregnancies (14%) [3]. The condition is most common in nulliparous, caucasian patients in the third trimester [4].

Etiology and Pathophysiology

The pathophysiology of PUPPP is not well understood. Proposed theories include damage to the connective tissue within striae, abdominal distention, peripheral chimerism, and the interplay of these factors. For example, abdominal distention secondary to excessive maternal weight gain, increased newborn weight, or multiple gestations result in rapid skin stretching, which is thought to cause connective tissue damage. Damaged tissue may result in exposure of dermal antigens that trigger a lymphohistiocytic inflammatory reaction, resulting in PUPPP [5]. Another theory suggests peripheral chimerism (deposition of fetal DNA) is the inciting factor for the development of PUPPP since it occurs primarily in the third trimester and favors skin with damaged collagen [6]. Histopathology findings in patients with PUPPP are nonspecific and direct/indirect immunofluorescence is negative [7].

Clinical Presentation

Pruritic urticarial papules and plaques of pregnancy is a clinical diagnosis. Patients typically present with small erythematous papules and plaques within abdominal striae. The papules can also be edematous and intensely itchy. Periumbilical sparing is usually noted. The lesions will then coalesce into larger urticarial plaques surrounded by blanched halos. The rash usually spreads in a matter of days and the pattern of spread is typically from the abdomen to the trunk and extremities but rarely involves the face, palms, soles, and mucous membranes [8]. The term PUPPP is derived from the fact that

the rash develops polymorphic features as the disease evolves, including widespread erythema, targetoid lesions, tiny vesicles, and eczematous patches. The rash resolves in the postpartum period or spontaneously over an average of 4 weeks during pregnancy. No permanent skin changes or scarring is usually present after the rash resolves. Importantly, there does not appear to be an elevated recurrence risk.

Differential Diagnosis

The differential diagnosis for PUPPP includes Intrahepatic cholestasis of pregnancy (ICP), herpes gestationis (HG), prurigo of pregnancy (PP), and impetigo herpetiformis (IH).

ICP presents with sudden onset pruritis on the palms and soles that quickly becomes generalized. Though a skin eruption is not typical with ICP, patients can present with excoriations secondary to scratching. Laboratory abnormalities associated with ICP include elevated bile acid levels and transaminitis.

Herpes gestationis is also known as pemphigoid gestationis and typically presents earlier in pregnancy. It is associated with exacerbations and recurrences during pregnancy, the postpartum period, and subsequent pregnancies. Lesions of HG are characterized by targetoid vesicles and bullae that favor the umbilicus as compared to PUPPP lesions, which spare the umbilicus. Herpes gestationis and PUPPP do share similar clinical features, so histological and immunological studies are required to make the distinction. Herpes gestationis lesions have positive direct/indirect immunofluorescence while PUPPP lesions have negative direct/indirect immunofluorescence. Unlike PUPPP, HG is associated with increased maternal morbidity and fetal morbidity and mortality.

Prurigo of pregnancy is a benign pruritic rash that typically occurs on the extensor surface of extremities and can have

facial involvement. Truncal involvement is rare, which is one way to distinguish this condition from PUPPP. Furthermore, unlike PUPPP, PP can occur in either the second or third trimester and can recur in subsequent pregnancies [9].

Impetigo herpetiformis is a variant of pustular psoriasis and is triggered by pregnancy. It presents as groups of small painful pustules in a herpetiform pattern and is associated with constitutional symptoms such as fever, malaise, diarrhea, and vomiting. Similar to PUPPP, IH typically presents in the third trimester of pregnancy and rapidly resolves in the postpartum period. A biopsy is recommended to diagnose IH as it is associated with intrauterine fetal demise (IUFD) [10].

Management and Treatment

Pruritus is a hallmark of PUPPP and its intensity can cause insomnia. As such, the primary goal of treatment is to alleviate pruritus and minimize discomfort. Topical low- to moderate-potency corticosteroids such as fluticasone or hydrocortisone are often prescribed to reduce inflammation and relieve pruritus but do not alter the course of the disease. Additionally, oral antihistamines such as chlorpheniramine or diphenhydramine can help control pruritus and facilitate sleep. Nonsedating antihistamines can be substituted for daytime use. Additionally, lifestyle modifications such as the use of cold compresses, oatmeal baths, frequent application of emollients, wearing of loose-fitting cotton clothing, and avoidance

of hot showers and harsh soaps can offer additional symptom relief. For severe disease refractory to initial treatment, a short course of systemic corticosteroids with a taper (prednisolone, 40–60 mg/day) may be prescribed for the resolution of symptoms. Apart from the discomfort PUPPP poses to the patient, maternal prognosis is unaffected and there are no direct risks to the fetus. Hence, early delivery for symptom relief alone is not typically indicated. It resolves after delivery and does not usually affect subsequent pregnancies.

Key Teaching Points

- Pruritic urticarial papules and plaques of pregnancy is the most common gestational dermatosis that typically affects nulliparous patients in their third trimester.
- It is characterized by urticarial papules and plaques starting along the abdominal striae and extending to the thighs, buttocks, and arms.
- It is a benign, self-limiting skin condition that resolves approximately 4 weeks after onset or after delivery. It does not typically recur in subsequent pregnancies.
- Treatment options for PUPPP focus on relieving itching and discomfort with agents such as topical corticosteroids, antihistamines, or soothing emollients.
- It does not pose a direct risk to the developing fetus and does not require early delivery.

References

- 1 Kroumpouzos G, Cohen LM. Specific Dermatoses of Pregnancy: An Evidence-Based Systematic Review. *Am J Obstet Gynecol*. 2003;188(4):1083–1092. <http://dx.doi.org/10.1067/mob.2003.129> (accessed September 26, 2024).
- 2 Lawley TJ, Hertz KC, Wade TR, et al. Pruritic Urticarial Papules and Plaques of Pregnancy. *JAMA*. 1979;241(16):1696–1699.
- 3 Elling SV, McKenna P, Powell FC. Pruritic Urticarial Papules and Plaques of Pregnancy in Twin and Triplet Pregnancies. *J Eur Acad Dermatol Venereol*. 2000;14(5):378–381. <http://dx.doi.org/10.1046/j.1468-3083.2000.00026.x> (accessed September 26, 2024).
- 4 Rudolph CM, Al-Fares S, Vaughan-Jones SA, et al. Polymorphic Eruption of Pregnancy: Clinicopathology and Potential Trigger Factors in 181 Patients. *Br J Dermatol*. 2006;154(1):54–60. <http://dx.doi.org/10.1111/j.1365-2133.2005.06856.x> (accessed September 26, 2024).
- 5 Cohen LM, Capeless EL, Krusinski PA, et al. Pruritic Urticarial Papules and Plaques of Pregnancy and Its Relationship to Maternal-Fetal Weight Gain and Twin Pregnancy. *Arch Dermatol*. 1989;125(11):1534–1536.
- 6 Aractingi S, Berkane N, Bertheau P, et al. Fetal DNA in Skin of Polymorphic Eruptions of Pregnancy. *Lancet*. 1998;352(9144):1898–1901. [http://dx.doi.org/10.1016/S0140-6736\(98\)05121-6](http://dx.doi.org/10.1016/S0140-6736(98)05121-6) (accessed September 26, 2024).
- 7 Vaughan Jones SA, Hern S, Nelson-Piercy C, et al. A Prospective Study of 200 Women with Dermatoses of Pregnancy Correlating Clinical Findings with Hormonal and Immunopathological Profiles. *Br J Dermatol*. 1999;141(1):71–81. <http://dx.doi.org/10.1046/j.1365-2133.1999.02923.x> (accessed September 26, 2024).
- 8 Lehrhoff S, Pomeranz MK. Specific Dermatoses of Pregnancy and Their Treatment. *Dermatol Ther*. 2013;26(4):274–284. <http://dx.doi.org/10.1111/dth.12078> (accessed September 26, 2024).
- 9 Brzoza Z, Kasperska-Zajac A, Oleś E, et al. Pruritic Urticarial Papules and Plaques of Pregnancy. *J Midwifery Womens Health*. 2007;52(1):44–48. <http://dx.doi.org/10.1016/j.jmwh.2006.09.007> (accessed September 26, 2024).
- 10 Kondo RN, Araújo FM, Pereira AM, et al. Pustular Psoriasis of Pregnancy (Impetigo Herpetiformis): Case Report. *An Bras Dermatol*. 2013;88(6 Suppl. 1):186–189. <http://dx.doi.org/10.1590/abd1806-4841.20132134> (accessed September 26, 2024).

A 30-Year-Old Presents at 18 Weeks' Gestation with Severe Right Back and Flank Pain

Bani Maheshwari Ratan

History of Present Illness

A 30-year-old gravida 3 para 1011 at 18 weeks' gestation presents to the Emergency Room with sudden onset of severe right-sided abdominal pain that started 2 hours ago. The pain is described as sharp and crampy, and it radiates to her lower abdomen and back in waves. In addition to the pain, she feels nauseous and has vomited once. She is unable to find a comfortable position. Her current pregnancy has been uncomplicated so far, and she has no history of sexually transmitted infections, fibroids, or ovarian cysts. She did experience a miscarriage in the first trimester approximately 3 years ago. The patient has no other significant medical or surgical history. She is taking prenatal vitamins and has no known drug allergies.

Physical Examination

General appearance: Appears restless and uncomfortable

Vital signs:

Temperature: 37°C

Pulse: 99 beats per minute

Blood pressure: 124/76 mmHg

Respiratory rate: 16 breaths per minute

Oxygen saturation: 99% on room air

Abdomen: Mild tenderness to deep palpation in right lower quadrant. No distention, rebound, or guarding noted

Pelvic: Normal external female genitalia. No masses or lesions noted. Vagina with physiologic discharge. Normal appearing cervix. Uterus 2 cm below umbilicus, non-tender. Right adnexal tenderness present, no left adnexal tenderness

Chest: Clear to auscultation bilaterally

CV: Regular rate and rhythm

Back: Significant right-sided costovertebral angle tenderness

Laboratory studies:

WBC: 8,600 with 54% neutrophils

Hgb: 11.5 g/dL

Plt: 289,000

Electrolytes: Within normal limits

Liver function tests: Within normal limits

Urinalysis: 2+ blood, trace ketones, otherwise normal

Imaging:

Bedside obstetric ultrasound: Fetus at 18 weeks' gestation with normal biometry and fetal heart tones in 150s.

Posterior placenta. MVP 5.2

Renal Ultrasound:

Urinary bladder: Non-distended with positive left jet.

Right jet not visualized

Ureters: Non-dilated left ureter. A 1.3 cm obstructive stone is visualized at the level of the pelvic brim.

Concurrent right hydroureter measuring 1.4 cm at widest margin is visualized to the level of right kidney

Right kidney: Grade 3 hydronephrosis noted with dilated renal collecting system and renal parenchyma. Length normal at 11.4 cm. Normal position with no increased echogenicity. No masses or cysts

Left kidney: Non-dilated collecting system, no increased echogenicity, no masses or cysts. Length normal at 11.6 cm

How Would You Manage This Patient?

This pregnant patient presented with acute right-sided back and flank pain, as well as restlessness and associated nausea and emesis. The differential for right-sided abdominal and pelvic pain in pregnancy is broad. With the costovertebral angle tenderness, hematuria, and renal ultrasound suspicious for stone causing ureteral blockage, nephrolithiasis is the most likely diagnosis. This patient's pain was treated with opioids and intravenous (IV) hydration was started. Urology was consulted due to the size of the stone and the obstruction of the urinary tract. After risks and benefits were discussed with the patient, the plan was made by urology for ureteral stenting in the operating room. A right ureteral stent was placed without complication with relief of the obstruction and significant improvement in pain.

Nephrolithiasis in Pregnancy

Nephrolithiasis, the formation of kidney stones, has an estimated occurrence of 1% during pregnancy [1]. Although low absolute occurrence, it is one of the most common reasons for non-obstetrical hospitalizations for pain management during pregnancy [2]. It poses diagnostic and clinical challenges due to normal physiological changes in pregnancy and risks of radiation and anesthesia to the fetus. This condition is more likely to occur in patients with Type 2 diabetes, chronic kidney disease, hypertension, and multiparity [2]. In addition, nephrolithiasis in pregnancy can lead to complications such as urinary tract infections (UTIs), preterm labor, and fetal growth restriction [1]. Understanding the risk factors and management approaches for nephrolithiasis in pregnancy is critical for ensuring best outcomes.

At baseline, physiological changes during pregnancy can contribute to stone formation, including hormonal alterations that reduce urinary flow rate, increased urinary calcium excretion, and higher urinary pH [3]. Additionally, anatomical changes, such as functional hydronephrosis, ureteral dilation, and bladder compression, can affect urinary tract dynamics and lead to stone development [4,5]. The most common types of stone encountered during pregnancy are calcium stones. While calcium oxalate stones are predominant in the general population, the renal excretory changes and higher urine pH contribute to calcium phosphate stones being found in up to 74% of pregnant patients with kidney stones [6].

The most frequent presenting symptom for nephrolithiasis in pregnancy is flank pain, often radiating to the lower abdomen. Patients may also present with a pathognomonic restlessness, with difficulty finding a comfortable position. Associated nausea and urinary symptoms, including frequency, urgency, and hematuria, may also be present [2]. However, differentiating these symptoms from normal changes of pregnancy can be difficult. With the physical exam, particular attention to costovertebral angle tenderness can help distinguish symptoms from normal pregnancy or other pathologies of gynecologic and gastrointestinal origins. In addition, urinalysis and renal imaging are often the most helpful diagnostic studies, with a CBC and metabolic profiles usually being within normal limits with uncomplicated nephrolithiasis.

Imaging of the urinary tract should be carefully considered to minimize fetal exposure to ionizing radiation, while still obtaining an accurate diagnosis. Ultrasonography is recommended due to its safety and effectiveness to detect the majority of kidney stones, providing information on size, location, and potential obstruction [2]. If non-diagnostic, magnetic resonance imaging (MRI) or computed tomography (CT) may be considered for further characterization weighing the potential risks and benefits involved [1,7]. While MRI offers a more expensive and somewhat less sensitive result than CT, it does avoid radiation exposure. Given the minimal risk of harmful effects from low-dose stone CT and the support of ACOG, abdominal/pelvic CT can be used if medically necessary in cases of uncertainty of the cause of renal colic, including during the first trimester [8]. In the acute clinical setting, such as if the patient has intractable pain or signs of sepsis, a low-dose non-contrast CT should be obtained. However, in a non-acute setting where MRI is easily accessible, MRI can be used as second-line imaging study when renal ultrasound is non-diagnostic [7].

Initial management of nephrolithiasis in pregnancy focuses on pain and nausea relief, hydration, and prevention of complications. Acetaminophen can be tried as first-line therapy, although opioids such as oral oxycodone or IV morphine are often needed in the acute setting [6]. If a patient's symptoms can be effectively controlled with analgesic medication and no additional complicating factors are present, it is recommended to initiate a trial of passage by hydration [7]. Adjunctive treatment can include the addition of alpha-

blockers such as tamsulosin. While FDA-approved for men, it has been used successfully in women and considered safe in pregnancy. Additionally, urine straining, urine output monitoring, and serial Cr monitoring can be employed [1]. It is important to provide the patient with counseling regarding potential complications that can arise. The most frequent complication is UTIs, which can progress to pyelonephritis or sepsis, posing additional risks. Approximately 17% of women who are hospitalized for nephrolithiasis and renal colic also experience concomitant pyelonephritis [1]. Nephrolithiasis itself has also been reported to be a risk factor for preterm labor and low birth weight [9].

In cases of unrelenting pain, suspected infection, or obstructive symptoms, consultation with urology or interventional radiology is recommended. Urgent decompression of the urinary tract with procedures such as ureteral stent placement or percutaneous nephrostomy tube insertion may need to be performed [2,7]. These procedures entail specific risks of their own [2,7,10]. During insertion, there is a slightly elevated risk of trauma or injury compared to nonpregnant individuals. In certain instances, these procedures can be related to preterm labor, with preterm delivery risks increasing from 9.1% for patients with a stone to 11.2% in those that undergo urologic intervention and 19.6% in those with percutaneous nephrostomy placement in one study [6]. Another risk associated with these interventions is the presence of pain and discomfort at the site of the stent or percutaneous nephrostomy. Moreover, the use of indwelling catheters increases the patient's susceptibility to infections. Lastly, complications related to placement, such as migration and obstruction, may arise [2]. Systematic review of the literature on ureteroscopic stone removal during pregnancy supports its consideration. The pooled operative success rate was 97% for stenting procedures and 99% for ureteroscopy [11].

Early identification, proper treatment, and close monitoring are crucial in managing nephrolithiasis in pregnancy and the associated risks. The majority of pregnant women with kidney stones experience symptom resolution after delivery [1,2]. However, the potential for stone recurrence in future pregnancies or later stages of life highlights the importance of long-term follow-up. Lifestyle modifications to prevent future stone formation include nonpharmacological interventions such as maintaining adequate fluid intake and dietary changes [6]. In conclusion, nephrolithiasis can present significant challenges during pregnancy. A comprehensive approach that addresses the unique considerations necessary to ensure the best possible outcomes for both the mother and the fetus should be undertaken.

Key Teaching Points

- Physiological and anatomical changes during pregnancy, such as increased urinary calcium excretion and ureteral dilation, can contribute to stone formation.
- The most common presenting symptom for symptomatic nephrolithiasis is flank pain, which can be associated with nausea, restlessness, and urinary symptoms.

- Ultrasonography is the recommended imaging method for suspected nephrolithiasis during pregnancy due to its safety and effectiveness in detecting size, location, and potential obstruction.
- If complicating factors are not present, initial management of nephrolithiasis in pregnancy primarily focuses on pain relief, hydration, and prevention of complications.
- In cases of suspected obstruction, infection, or severe pain, consultation with a multidisciplinary team and intervention with ureteral stents or percutaneous nephrostomy may be warranted.

References

- 1 Dai JC, Nicholson TM, Chang HC, et al. Nephrolithiasis in Pregnancy: Treating for Two. *Urology*. 2021;151:44–53. <http://dx.doi.org/10.1016/j.urology.2020.06.097> (accessed September 26, 2024).
- 2 Juliebø-Jones P, Somani BK, Baug S, et al. Management of Kidney Stone Disease in Pregnancy: A Practical and Evidence-Based Approach. *Curr Urol Rep*. 2022;23(11):263–270. <http://dx.doi.org/10.1007/s11934-022-01112-x> (accessed September 26, 2024).
- 3 Morton A, Teasdale S. Physiological Changes in Pregnancy and Their Influence on the Endocrine Investigation. *Clin Endocrinol (Oxf)*. 2022;96(1):3–11. <http://dx.doi.org/10.1111/cen.14624> (accessed September 26, 2024).
- 4 FitzGerald MP, Graziano S. Anatomic and Functional Changes of the Lower Urinary Tract during Pregnancy. *Urol Clin North Am*. 2007;34(1):7–12. <http://dx.doi.org/10.1016/j.ucl.2006.10.007> (accessed September 26, 2024).
- 5 Jeyabalan A, Lain KY. Anatomic and Functional Changes of the Upper Urinary Tract during Pregnancy. *Urologic Clinics of North America*. 2007;34(1):1–6. <http://dx.doi.org/10.1016/j.ucl.2006.10.008> (accessed September 26, 2024).
- 6 Meher S, Gibbons N, DasGupta R. Renal Stones in Pregnancy. *Obstet Med*. 2014;7(3):103–110. <http://dx.doi.org/10.1177/1753495X14538422> (accessed September 26, 2024).
- 7 Lee MS, Fenstermaker MA, Naoum EE, et al. Management of Nephrolithiasis in Pregnancy: Multidisciplinary Guidelines from an Academic Medical Center. *Front Surg*. 2021;8:796876. <http://dx.doi.org/10.3389/fsurg.2021.796876> (accessed September 26, 2024).
- 8 American College of Obstetricians and Gynecologists. Committee Opinion No. 656: Guidelines for Diagnostic Imaging during Pregnancy and Lactation. *Obstet Gynecol*. 2016;127(2):e75–e80. <http://dx.doi.org/10.1097/AOG.0000000000001316> (accessed September 26, 2024).
- 9 Kirubarajan A, Taheri C, Yau M, et al. Incidence of Kidney Stones in Pregnancy and Associations with Adverse Obstetrical Outcomes: A Systematic Review and Meta-analysis of 4.7 Million Pregnancies. *J Matern Fetal Neonatal Med*. 2022;35(25):5282–5290. <http://dx.doi.org/10.1080/14767058.2021.1878141> (accessed September 26, 2024).
- 10 N'gamba M, Lebdaï S, Hasting C, et al. Acute Renal Colic during Pregnancy: Management and Predictive Factors. *Can J Urol*. 2015;22(2):7732–7738.
- 11 Jin X, Liu B, Xiong Y, et al. Outcomes of Ureteroscopy and Internal Ureteral Stent for Pregnancy with Urolithiasis: A Systematic Review and Meta-analysis. *BMC Urol*. 2022;22(1):150. <http://dx.doi.org/10.1186/s12894-022-01100-w> (accessed September 26, 2024).

CASE 26

A 30-Year-Old at 18 Weeks' Gestation with Fever, Dysuria, Worsening Flank Pain, and Hydronephrosis

Esther Fuchs

History of Present Illness

A 30-year-old gravida 3 para 1 with dichorionic, diamniotic twin gestation presented 2 weeks ago for a midtrimester ultrasound at 18 weeks and experienced some right-sided flank pain. The ultrasound showed moderate maternal hydronephrosis on the right side. She returns with burning with urination, increased frequency and urgency, worsening right flank pain, fever, chills, nausea, and vomiting. She denies any significant medical and surgical history and has no drug allergies.

Physical Examination

General appearance: Appears uncomfortable

Vital signs:

Temperature: 38.1°C

Pulse: 110 beats per minute

Blood pressure: 100/70 mmHg

Respiratory rate: 20 breaths per minute

Oxygen saturation: 98% on room air

Chest: Equal respirations bilaterally, lungs clear to auscultation

CV: Tachycardia with regular rhythm, no murmurs

Abdomen: Gravid with fundus at umbilicus, abdomen soft, mild suprapubic tenderness. Right-sided costovertebral angle tenderness

Pelvic: Normal vagina. Cervix closed, long, and high

Extremities: No calf tenderness or edema

Neurologic/psychologic: Alert and oriented × 3, normal gait and movements

Laboratory studies:

WBC: 14,000 /μL

Hgb: 11.5 g/dL

Plt: 250,000/μL

Complete metabolic panel (electrolytes, liver function tests, bilirubin) within normal limits:

Lactate: 1.9 mmol/L

Procalcitonin: 0.6 ng/mL

CRP: 35 mg/L

Urinalysis: WBC present, nitrate positive, bacteriuria

Urine culture: >100,000 cfu/mL *Escherichia coli*

Blood cultures: no growth

Imaging (Figure 26.1):



Figure 26.1 Right moderate hydroureter and hydronephrosis above pelvic brim

How Would You Manage This Patient?

The diagnosis of pyelonephritis was made given worsening flank pain, urinary tract infection (UTI) symptoms, nausea and vomiting, fever, costovertebral angle tenderness, bacteriuria, and moderate hydroureter/hydronephrosis. A CBC, complete metabolic panel, and CRP were drawn. Lactate and procalcitonin levels were used in the evaluation of sepsis. Before initiating antibiotic treatment, urine and blood cultures were collected. She required hospital admission for parenteral antibiotic therapy for pyelonephritis. Fluid resuscitation was administered cautiously, as endotoxin release increases the alveolar capillary membrane permeability and raises the risk of pulmonary edema. Parenteral broad spectrum antibiotics, Beta-lactam or gentamicin should be given until afebrile for 24–48 hours with symptomatic improvement. At that point, oral therapy was initiated to complete a 10–14-day treatment course. The choice of oral antibiotic were based on culture and susceptibility results. Antibiotic prophylaxis and serial urine cultures were recommended for the remainder of the pregnancy to prevent recurrence of pyelonephritis. Additionally, a treatment approach of hydroureter/hydronephrosis could involve conservative measures like positional adjustments with a leftward tilt to alleviate pressure on the ureter at the pelvic brim, hydration, and pain medication. Furthermore, when moderate hydroureter/hydronephrosis was discovered during the midtrimester ultrasound, a urinalysis could have been considered to assess for concomitant infection.

Hydronephrosis/Hydroureter

Hydronephrosis refers to the enlargement of the renal collecting system, while hydroureter is the abnormal distention of

the ureter. These conditions are observed in approximately 80% of pregnant patients, with a higher prevalence on the right side. Typically, these changes can be visualized through ultrasound examination by the second trimester, often after 20 weeks' gestation, and resolve within 6 weeks postpartum [1]. Defining hydronephrosis in pregnancy and distinguishing between physiological and pathological degrees of dilation is still a topic of debate in the medical literature [2]. Some researchers measured the calyces, while others focus on the anteroposterior renal pelvis diameter (APD). Caliceal dilatation ranging from 6 to 10 mm is found in 90% of gravidas and pelvic-calyceal complexes measuring <10 mm could be considered as physiologic. Hydronephrosis is often classified mild if the renal pelvis is dilated, moderate if the calyces are dilated, and severe if the renal parenchyma is affected and shows thinning. Nonsevere hydronephrosis in asymptomatic pregnant patients may be considered a normal finding [3]. Severe hydronephrosis rarely occurs in the absence of obstruction. Hydroureter and hydronephrosis during pregnancy are primarily attributed to external compression from the uterus against the pelvic brim and the ureters are usually dilated above the level of the pelvic brim (linea terminalis) and of normal caliber below this level. Although hormonal effects from progesterone can reduce ureteral tone, peristalsis, and contraction pressure, they are considered less significant. Risk factors for hydroureter include carrying twins, having polyhydramnios, and being a primigravida with taught fascia, which increases the pressure of the uterus against the pelvic brim.

The right kidney often exhibits greater dilatation compared to the contralateral side. The increased involvement of the right ureter can be attributed to the dextrorotation of the uterus by the sigmoid colon, kinking of the ureter as it crosses the right iliac artery, and its proximity to the right ovarian vein. On the other hand, the left ureter may be relatively protected by the presence of the sigmoid colon.

The clinical significance of hydronephrosis lies in its connection to ureteral obstruction and the increased frequency of ascending UTIs during pregnancy, which are associated with preterm delivery. The dilated collecting system can hold 200–300 mL of urine [4]. The urinary stasis resulting from hydronephrosis can serve as a reservoir for bacteria, contributing to the heightened risk of pyelonephritis. Pregnant patients have a 40% higher risk of developing pyelonephritis compared to nonpregnant individuals.

Compression of the ureters causes pain and true urinary obstruction in rare cases. The possibility of acute hydronephrosis or worsening of existing hydronephrosis as a cause of uncertain abdominal pain during pregnancy has been somewhat overlooked, however, previous studies have not shown a general correlation between hydronephrosis and flank pain [5]. The rate of symptomatic maternal renal hydronephrosis ranges from 0.2 to 4.7%. However, the rate of cases requiring surgical intervention is only 1.2% [3].

Pathologic obstruction, such as nephrolithiasis or stricture, can also cause ureteral dilation. Distinguishing between pathologic hydronephrosis caused by obstruction and physiologic

hydronephrosis is usually possible by the presence of flank pain or radiographic or sonographic imaging. The estimated incidence of symptomatic nephrolithiasis during pregnancy is up to 1:2,000 pregnancies [6], and is significantly associated with UTIs, pyelonephritis, hydronephrosis, and hydroureter [6]. Maternal urinoma, peri-pelvic extravasation of urine, is an important consideration when evaluating flank pain during pregnancy and can occur with obstruction.

Treatment approach of symptomatic hydronephrosis/hydroureter primarily focuses on conservative measures aimed at improving drainage by lateral positioning, hydration, and pain medication. However, it is crucial to assess for and treat existing bacteriuria for prevention of pyelonephritis [7]. In case of persistent and uncontrolled pain or impaired renal function, a urethral catheter could be an option but is rarely necessary. Nephrostomy is almost never required [8].

Pyelonephritis in Pregnancy

Pyelonephritis complicates 0.5–2% of pregnancies and is most commonly observed in the second and third trimester. In more than half of the cases, it is unilateral, right-sided, and hydronephrosis/hydroureter is a risk factor. Not only does ureteral dilatation combined with pressure on the bladder from the gravid uterus enhance the progression of bacteriuria to pyelonephritis, there may also be a relative immunosuppression evidenced by mucosal interleukin-6 levels and serum antibody responses to *E. coli* antigen that appear to be lower.

Up to 40% of pregnant individuals with asymptomatic bacteriuria develop pyelonephritis. Therefore, it is recommended to screen all gravidas for asymptomatic bacteriuria through urine culture. In clinical practice, treatment is advised when the bacterial count reaches or exceeds 10^5 cfu/mL. For patients exhibiting acute symptoms of a UTI, a urine culture is considered positive at a bacterial count as low as 10^2 cfu/mL on a clean midstream urine. In-hospital parenteral treatment is generally recommended, as 1 in 5 pregnant patients with pyelonephritis develop multisystem effects from endotoxin release and sepsis.

In pregnant patients, severe pyelonephritis is associated with serious complications in up to 20% of cases, including bacteremia, acute respiratory distress syndrome, renal dysfunction, and increased risk of preterm birth [9]. Acute respiratory distress syndrome is the most common serious complication, occurring in up to 10% of pregnant individuals.

The choice of antibiotic treatment is typically guided by local microbiology and susceptibility data, which may change over time. Initially, parenteral broad spectrum antibiotics, Beta-lactam or gentamicin, are administered until the patient has been afebrile for 24–48 hours with symptomatic improvement. Subsequently, oral therapy depending on culture results, can be initiated to complete 10–14 days of treatment.

The recurrence rate of pyelonephritis during pregnancy is 6–8%. To prevent recurrence, low-dose antimicrobial prophylaxis is prescribed, often with 50–100 mg oral nitrofurantoin taken at bedtime. The evidence regarding an association between sulfonamides and nitrofurantoin and birth defects is

mixed but it is still considered safe in the second and third trimester, while use during the first trimester is still appropriate if no suitable alternatives are available. Both medications are avoided in patients at risk for glucose-6-phosphate-dehydrogenase deficiency [10].

Key Teaching Points

- About 80% of gravidas show hydronephrosis/hydroureter in the second/third trimester and the majority of cases are asymptomatic.
- Hydronephrosis is more frequently observed on the right side, above pelvic brim. The risk is correlated with increased uterine size and less rigid abdominal wall.
- If presenting with flank pain, assess for renal stones and UTI and risk factors for pyelonephritis.
- Diagnostic approach for hydronephrosis/hydroureter is imaging with ultrasound (exclude urinary calculi), urinalysis, and urine culture to exclude pyelonephritis.
- The management options of hydronephrosis are based on the coexisting renal pathological conditions such as stone, pyelonephritis, and intrinsic renal disease but there is rarely a need for intervention as ureteral stent or nephrostomy.
- Up to 40% of pregnant individuals with asymptomatic bacteriuria develop pyelonephritis, especially in the presence of dilated kidney/ureter.

References

- 1 Rasmussen PE, Nielsen FR. Hydronephrosis during Pregnancy: A Literature Survey. *Eur J Obstet Gynecol Reprod Biol.* 1988;27(3):249–259.
- 2 Watson WJ, Brost BC. Maternal Hydronephrosis in Pregnancy: Poor Association with Symptoms of Flank Pain. *Am J Perinatol.* 2006;23(8):463–466.
- 3 Bayraktar Z, Kahraman ŞT, Alaç ES, et al. Maternal Hydronephrosis in Pregnant Women without Ureteral Stones and Characteristics of Symptomatic Cases Who Need Treatment: A Single-Center Prospective Study with 1026 Pregnant Women. *Arch Ital Urol Androl.* 2021;93(1):35–41.
- 4 White J, Ory J, Lantz Powers AG, et al. Urological Issues in Pregnancy: A Review for Urologists. *Can Urol Assoc J.* 2020;14(10):352–357.
- 5 Farr A, Ott J, Kueronya V, et al. The Association between Maternal Hydronephrosis and Acute Flank Pain during Pregnancy: A Prospective Pilot-Study. *J Matern Fetal Neonatal Med.* 2017;30(20):2417–2421.
- 6 Rosenberg E, Sergienko R, Abu-Ghanem S, et al. Nephrolithiasis during Pregnancy: Characteristics, Complications, and Pregnancy Outcome. *World J Urol.* 2011;29(6):743–747.
- 7 Glaser AP, Schaeffer AJ. Urinary Tract Infection and Bacteriuria in Pregnancy. *Urol Clin North Am.* 2015;42(4):547–560.
- 8 Fainaru O, Almog B, Gamzu R, et al. The Management of Symptomatic Hydronephrosis in Pregnancy. *BJOG.* 2002;109(12):1385–1387.
- 9 Wing DA, Fassett MJ, Getahun D. Acute Pyelonephritis in Pregnancy: An 18-Year Retrospective Analysis. *Am J Obstet Gynecol.* 2014;210(3):219.e1–219.e6.
- 10 Committee Opinion No. 717: Sulfonamides, Nitrofurantoin, and Risk of Birth Defects. *Obstet Gynecol.* 2017;130(3):e150–e152.

A 35-Year-Old with Abdominal Wall Bulge at 24 Weeks' Gestation

Denise De Los Santos

History of Present Illness

A 35-year-old gravida 5 para 4004 at 24 weeks' gestation presents for her routine antenatal care visit. To date, her prenatal care has been uncomplicated. Her medical history is significant for class 1 obesity, gestational diabetes in her previous pregnancy, and gastrointestinal reflux disease (GERD). She has a history of four uncomplicated vaginal deliveries.

Experiencing normal fetal movement, she denies any leakage of fluid, vaginal bleeding, contractions, or abdominal pain. However, she does describe noticing a bulge on her abdomen in the last week. It is in her mid-abdominal area and worsens when moving from a supine to sitting motion or vice versa. There is no pain associated with the bulge. She is concerned as she has never noticed this before.

Physical Examination

General appearance: No acute distress

Vital signs:

Temperature: 36.8°C

Pulse: 82 beats per minute

Blood pressure: 116/76 mmHg

Respiratory rate: 18 breaths per minute

BMI: 32 kg/m²

Abdomen: Soft, gravid, non-tender, non-distended. Fundal height 4 cm above umbilicus. No rebound, guarding, or rigidity. A protrusion in the midline abdominal wall at the level of the umbilicus. Increases in size with movement to the dorsal supine position from sitting and when performing a crunch motion. It is soft, non-tender, non-fluctuant, there is no palpable fascial defect

Fetal assessment: Fetal heart tones are 150 beats per minute by handheld Doppler

Anterior abdominal wall ultrasound: The inter-rectus distance (IRD) was 3.4 cm just above the level of the umbilicus. The linea alba is thinned and domed in this area with no abdominal contents present.

How Would You Manage This Patient?

This patient's presenting complaint along with her examination and ultrasound findings are consistent with a diagnosis of diastasis recti abdominis (DRA). Reassurance and use of light abdominal binding was recommended.

Abdominal Wall Defects in Pregnancy

In routine prenatal care, abdominal wall defects are encountered either incidentally during routine examination or as a complaint from the patient. Specifically, abdominal wall defects that occur or noted most in pregnancy are either primary ventral hernias or DRA.

DRA Incidence

During pregnancy, the incidence of DRA is higher than primary ventral hernias (as high as 66 vs. 0.08%) [1,2]. Diastasis recti abdominis is defined as an acquired weakening or widening of the linea alba, which connects the rectus abdominis muscles in the midline. It can also be comprise overall laxity of the abdominal wall muscles [3]. More commonly discovered in the second and third trimesters of pregnancy, it is rarely found in the first trimester and can remain or partially resolve during the postpartum period [1]. Moreover, the majority of diastasis in pregnant or postpartum women are found above or at the level of the umbilicus [1,4].

Risk Factors

Pregnancy along with obesity is a risk factor for developing DRA. The proposed mechanism is increased abdominal pressure in both conditions, and the effects of relaxin, estrogen, and progesterone on collagen degradation in pregnancy [5]. Other risk factors include ethnicity, history of fetal macrosomia, multiparity, multiple birth, and increased age [5]. Studies have reported no association between rectus diastasis and pre-pregnancy BMI, weight gain during pregnancy, baby's birth weight, regular exercise during pregnancy, and lifting/carrying heavy objects or children [5,6].

Diagnosis

Diagnosis can be based on a physical exam. The finding is elicited when the patient is asked to flex the rectus abdominis from a supine position. The amount of separation present is measured as the inter-rectus distance (IRD), which is used for various classification systems. Commonly, an IRD of greater than two fingerbreadths is used to clinically diagnose DRA [6].

Imaging is not usually required for diagnosis, but does help rule out other concomitant conditions, like ventral hernias, that may be present. Ultrasound is the imaging modality of choice in the initial assessment, although plastic surgeons usually require a CT or an MRI study in patients scheduled for surgical repair with concomitant hernia or abdominoplasty [7].

Unlike diastasis recti, ventral hernias are characterized by a true defect in the rectus fascia. The clinical presentation may be very similar to diastasis; however, the fascial defect may have palpable bowel or other peritoneal contents in a discrete fascial defect.

Treatment

During pregnancy, observation of DRA is recommended. After delivery, conservative management with exercise is the first-line treatment. Abdominal exercises are focused on activating the core muscles (transversus abdominus muscles) that indirectly help to decrease the IRD, but this has been inconsistently proven. There is support for abdominal wall exercises and the addition of deep core stability exercise may further decrease the IRD [8]. Some studies suggest that physical therapy may improve body image and trunk flexion strength, but additional formative work and randomized trials are recommended [9]. Abdominal binders have also been used in the early postpartum period to provide support but may not be feasible for use during pregnancy. It may help to have the patient come into the office with her abdominal binder at the next visit, so that guidance can be given on fit.

Surgical repair is usually performed postpartum by plastic surgery in the form of an abdominoplasty. Plication alone can be performed by a general surgeon as well. Indications for surgical repair are based on the patient's symptoms rather than the IRD measured [5].

Ventral Hernias

Ventral hernias can be congenital and acquired and are more commonly located at the umbilicus or semilunar line [10]. The first is located midline and the latter is laterally displaced at the junction of the rectus sheath and aponeurosis of the transversus and oblique muscles. Risk factors include pregnancy (due to increased intra-abdominal pressure and volume), repetitive straining, prior surgery, and trauma. Hernias can be differentiated by palpation with and without Valsalva.

Ventral Hernias and Pregnancy

In a single-institution retrospective study, which included 20,714 Danish pregnant women, only 17 (0.08%), were

registered with a primary ventral hernia [2]. Although the incidence is low in pregnancy, ventral hernias should be considered in the differential diagnosis, as they may become a surgical emergency if incarceration should occur. An incarcerated hernia may present with nausea, vomiting, tenderness, bloating, and/or intestinal obstruction. However, in this Danish retrospective cohort, none of the women with a ventral hernia required surgery in pregnancy.

Most surgeons recommend delaying treatment of an unincarcerated ventral hernia until the patient is postpartum and/or when childbearing is complete. However, it has been suggested that hernia repair in conjunction with CD could be a feasible treatment of a pregnant patient with a symptomatic abdominal wall hernia. This systematic review revealed no major complications in 102 patients undergoing a hernia repair at the time of elective cesarean, however, none of the studies were randomized controlled trials and two of the studies reported at 13% surgical site infection rate [11]. The surgical approach to repair were performed with or without mesh. Abdominal wall hernia repair with suture or mesh may cause pain in the last trimester of a subsequent pregnancy.

Key Teaching Points

- Diastasis recti abdominis is a weakening or widening of the linea alba of the rectus abdominis muscles, more commonly in the second or third trimesters of pregnancy.
- Presenting symptoms are usually a “bulge” when the patient performs an abdominal crunch motion associated with lower back pain or can be incidentally found.
- Diagnosis is clinical rather than based on imaging, although imaging can help rule out other diagnoses that may be present, like primary ventral hernias.
- In pregnancy, treatment consists of reassurance and use of light abdominal binding, if feasible for the patient.
- The incidence of ventral hernias in pregnancy are rare, and treatment is usually delayed until the postpartum period.
- Emergency surgery of incarcerated hernias in pregnant women, as well as combined hernia repair and cesarean section, appears as feasible procedures.

References

- 1 Boissonnault JS, Blaschak MJ. Incidence of Diastasis Recti Abdominis during the Childbearing Year. *Phys Ther.* 1988;68(7):1082–1086. <https://doi.org/10.1093/ptj/68.7.1082> (accessed June 13, 2023).
- 2 Oma E, Bay-Nielsen M, Jensen KK, et al. Primary Ventral or Groin Hernia in Pregnancy: A Cohort Study of 20,714 Women. *Hernia.* 2017;21(3):335–339.
- 3 Cavalli M, Aiolfi A, Bruni PG, et al. Prevalence and Risk Factors for Diastasis Recti Abdominis: A Review and Proposal of a New Anatomical Variation. *Hernia.* 2021;25:883–890.
- 4 Corvino A, Rosa DD, Sbordone C, et al. Diastasis of Rectus Abdominis Muscles: Patterns of Anatomical Variation as Demonstrated by Ultrasound. *Pol J Radiol.* 2019;84:e542–e548.
- 5 Mughal M, Ross D. Management of the Post-pregnancy Abdomen: The Plastic Surgical Perspective. *Hernia.* 2021;25(4):929–938.
- 6 Sperstad JB, Tennfjord MK, Hilde G, et al. Diastasis Recti Abdominis during Pregnancy and 12 Months after Childbirth: Prevalence, Risk Factors and Report of Lumbopelvic Pain. *Br J Sports Med.* 2016;50(17):1092–1096.
- 7 Tung RC, Towfigh S. Diagnostic Techniques for Diastasis Recti. *Hernia.* 2021;25(4):915–919.
- 8 Thabet AA, Alshehri MA. Efficacy of Deep Core Stability Exercise Program in Postpartum Women with Diastasis Recti Abdominis: A Randomised

- Controlled Trial. *J Musculoskelet Neuronal Interact.* 2019;19(1):62–68.
- 9 Keshwani N, Mathur S, McLean L. The Impact of Exercise Therapy and Abdominal Binding in the Management of Diastasis Recti Abdominis in the Early Post-partum Period: A Pilot Randomized Controlled Trial. *Physiother Theory Pract.* 2021;37(9): 1018–1033.
- 10 Smith J, Parmely JD. Ventral Hernia. In: StatPearls. Treasure Island, FL: StatPearls Publishing; 2023. www.ncbi.nlm.nih.gov/books/NBK499927/ (accessed September 26, 2024).
- 11 Jensen KK, Henriksen NA, Jorgensen LN. Abdominal Wall Hernia and Pregnancy: A Systematic Review. *Hernia.* 2015;19(5): 689–696.

CASE 28

A 30-Year-Old Presents for a Prenatal Visit at 41 Weeks' Gestation

Michelle Tang

History of Present Illness

A 30-year-old primigravida presents to the office at 41 0/7 weeks for a routine prenatal visit. She is dated by her last menstrual period, which is consistent with an 8-week ultrasound. Her pregnancy is complicated by a Rh-negative blood type and mild, intermittent asthma. She has intermittent abdominopelvic discomfort and pelvic pressure but denies consistent contractions, leakage of fluid, or vaginal bleeding. Her fetus is very active. She denies preeclampsia symptoms. She is hoping to go into spontaneous labor. She had declined membrane sweeping at her prior office visits but is open to a cervical exam and membrane sweeping in the office today.

Physical Examination

General appearance: Well-appearing in no apparent distress

Vital signs:

Temperature: 37.1°C

Pulse: 86 beats per minute

Blood pressure: 124/78 mmHg

Respiratory rate: 18 breaths per minute

Pre-gravid BMI: 23.8 kg/m²

Abdomen: Soft, gravid, non-tender, non-distended, fundal height is 38 cm

Pelvic: Cervix is 1 cm dilated, 20% effaced, -3 station, posterior position, and firm consistency

Extremities: No swelling, non-tender

Fetal assessment: 145 beats per minute

How Would You Manage This Patient?

This patient has a late-term pregnancy. She was offered a cervical exam and membrane sweeping in the office and accepted. She was also offered an induction of labor between 41 0/7 weeks and 41 6/7 weeks, which she declined. She was, therefore, recommended initiation of antenatal fetal surveillance until delivery and labor induction between 42 0/7 weeks and 42 6/7 weeks in the absence of spontaneous labor. She was amenable to antenatal fetal surveillance and scheduling an induction at 42 0/7 weeks. She presented to Labor and Delivery at 42 0/7 weeks for her induction. Her cervical exam on admission was 2 cm dilation, 60% effacement, -3 station, mid position, and medium consistency. She underwent cervical ripening with vaginal misoprostol and a transcervical balloon. Her contractions were subsequently augmented with IV oxytocin followed by an artificial amniotomy. She reached

complete dilation after 18 hours and pushed for 1.5 hours before undergoing an spontaneous vaginal delivery.

Post-dates Pregnancy

Post-dates or postterm pregnancy refers to a pregnancy that has reached or extended beyond 42 0/7 weeks' gestation. The overall incidence of post-dates pregnancies in the United States was 5.5% in 2011. There are several known risk factors for post-dates pregnancies, including a prior post-dates pregnancy, nulliparity, maternal obesity, carrying a male fetus, and certain fetal disorders such as anencephaly [1].

Post-dates pregnancies are associated with an increased risk of perinatal morbidity and mortality. For instance, there is a twofold increase in the risk of macrosomia, as well as a higher likelihood of operative vaginal delivery, CD, and shoulder dystocia in these gestations [2]. Oligohydramnios is also seen more frequently in post-dates pregnancies and can be associated with fetal heart rate (FHR) abnormalities, umbilical cord compression, meconium-stained amniotic fluid, umbilical cord arterial blood pH of <7.0, and lower Apgar scores [3].

Studies also demonstrate an increase in neonatal mortality and stillbirth amongst post-dates pregnancies compared with term pregnancies. In one large retrospective study, fetal and neonatal mortality rates were evaluated in 181,524 late-term and post-dates pregnancies. The study found a significant increase in fetal demise after 41 weeks' gestation compared with 40 weeks' gestation (odds ratio [OR]: 1.5, 1.8, and 2.9 at 41, 42, and 43 weeks' gestation, respectively) [4]. Post-dates neonates were more likely to have 5-minute Apgar scores of <4, convulsions, and meconium aspiration syndrome. Delivery after 42 weeks' gestation was also associated with a significant increase in the rate of NICU admission [5].

Additionally, 10–20% of post-dates pregnancies are complicated by postmaturity syndrome, which is characterized by decreased subcutaneous fat and minimal to no vernix or lanugo. Meconium staining of the neonate, amniotic fluid, membranes, and cord is also commonly seen [6].

Maternal risks are also present in the setting of post-dates pregnancies. Third- and fourth-degree perineal laceration, infection, postpartum hemorrhage, and CD are all increased in women who carry to this gestation [7].

Observational data suggest an increased risk of stillbirth in late-term and post-dates pregnancies, and therefore initiation of antenatal fetal surveillance should be considered at or beyond 41 0/7 weeks' gestation. Options for antenatal fetal surveillance include nonstress test, contraction stress test, biophysical profile, and modified biophysical profile. The optimal

type or frequency of testing has not been determined due to insufficient data. However, amniotic fluid evaluation is important to consider during surveillance given the increased risk of oligohydramnios in late-term and post-dates pregnancies. Twice-weekly antenatal fetal surveillance via a modified or full biophysical profile starting at or beyond 41 0/7 weeks is common across many institutions. This surveillance frequency is supported over once-weekly surveillance by several small studies [1].

Induction of labor should be recommended between 42 0/7 and 42 6/7 weeks' gestation given an increase in perinatal morbidity and mortality at this gestation. In a Cochrane review of 22 randomized control trials comparing expectant management with induction of labor in post-dates pregnancies, induction of labor was associated with a decreased risk of perinatal death, CD, and meconium aspiration syndrome [8]. Neonatal intensive care unit admissions were similar between the two groups. One large clinical trial compared expectant management with induction of labor in late-term pregnancies and found that induction of labor was associated with a decreased rate of CD. However, there were no differences in the rate of perinatal mortality and neonatal morbidity [9]. Such data suggest that induction of labor between 41 0/7 and 41 6/7 weeks' gestation can be considered.

The incidence of post-dates pregnancies is decreased by accurate gestational age determination with firm clinical criteria or early ultrasonography. One Cochrane review also demonstrated that membrane sweeping, which involves digital separation of the amniotic membranes from the lower uterine segment during a digital cervical exam, was associated with a significant reduction in the number of late-term and

post-dates pregnancies [10]. Women who have contraindications to labor and vaginal delivery should not undergo membrane sweeping. In women who are colonized with GBS, there are insufficient data on the risks of membrane sweeping, and performance of a sweep should be based on clinical judgment.

A trial of labor after CD (TOLAC) remains a reasonable option in women with uncomplicated post-dates pregnancies and no contraindications to a vaginal delivery. There is no increase in uterine rupture risk when a TOLAC is attempted at or beyond 40 0/7 weeks' gestation. However, uterine rupture risk is higher in the setting of labor induction, as opposed to awaiting spontaneous labor. Additionally, the TOLAC failure rate increases with advancing gestational age. Individual risks of TOLAC failure and uterine rupture should therefore be reviewed with all patients who are considering a post-dates TOLAC [1].

Key Teaching Points

- Post-dates pregnancies are associated with an increased risk of perinatal morbidity and mortality.
- Patients without medical indications for term delivery and without contraindications to vaginal delivery should be recommended for labor induction between 42 0/7 and 42 6/7 weeks' gestation.
- These patients can also be offered an induction of labor between 41 0/7 and 41 6/7 weeks' gestation.
- For patients who elect to continue expectant management until 42 weeks' gestation, antenatal fetal surveillance at or beyond 41 0/7 weeks' gestation should be recommended.

References

- 1 American College of Obstetricians and Gynecologists. Management of Late-Term and Postterm Pregnancies: Practice Bulletin No. 146. *Obstet Gynecol.* 2014;124:390–396.
- 2 Alexander JM, McIntire DD, Leveno KJ. Forty Weeks and Beyond: Pregnancy Outcomes by Week of Gestation. *Obstet Gynecol.* 2000;96:291–294.
- 3 Morris JM, Thompson K, Smithy J, et al. The Usefulness of Ultrasound Assessment of Amniotic Fluid in Predicting Adverse Outcome in Prolonged Pregnancy: A Prospective Blinded Observational Study. *BJOG.* 2003;110:989–994.
- 4 Divon MY, Haglund B, Nisell H, et al. Fetal and Neonatal Mortality in the Postterm Pregnancy: The Impact of Gestational Age and Fetal Growth Restriction. *Am J Obstet Gynecol.* 1998;178:726–731.
- 5 Clausson B, Cnattingius S, Axelsson O. Outcomes of Post-term Births: The Role of Fetal Growth Restriction and Malformations. *Obstet Gynecol.* 1999;94:758–762.
- 6 Mannino F. Neonatal Complications of Postterm Gestation. *J Reprod Med.* 1988;33:271–276.
- 7 Caughey AB, Musci TJ. Complications of Term Pregnancies beyond 37 Weeks of Gestation. *Obstet Gynecol.* 2004;103:57–62.
- 8 Gülmezoglu AM, Crowther CA, Middleton P, et al. Induction of Labour for Improving Birth Outcomes for Women at or beyond Term. *Cochrane Database Syst Rev.* 2012;(6):CD004945.
- 9 Hannah ME, Hannah WJ, Hellmann J, et al. Induction of Labor as Compared with Serial Antenatal Monitoring in Post-term Pregnancy: A Randomized Controlled Trial. The Canadian Multicenter Post-term Pregnancy Trial Group. *N Engl J Med.* 1992;326:1587–1592.
- 10 Boulvain M, Stan CM, Irion O. Membrane Sweeping for Induction of Labor. *Cochrane Database Syst Rev.* 2005;(1):CD000451.

A 40-Year-Old Presents at 34 Weeks' Gestation with Absent Fetal Movement

Taylor Gilmore

History of Present Illness

A 40-year-old gravida 3 para 0 at 34 weeks' gestation presents with her second episode of perceived absent fetal movement. She last felt fetal movement about 5 hours ago and this was at rest. Since that time, she has tried drinking cold fluids with no fetal movement noted. She denies abdominal trauma. She denies vaginal bleeding, abdominal pain, contractions, vaginal discharge, or leakage of fluid. She is currently taking prenatal vitamins daily, but she is not taking any other medications. She denies any drug allergies. She denies tobacco use, alcohol use, or other substance use. Her obstetric history is notable for two early pregnancy losses prior to 10 weeks. She denies any other significant past medical history or surgical history.

Physical Examination

General appearance: No acute distress and well-nourished. Conversing but tearful when discussing symptoms

Vital signs:

Temperature: 36.4°C

Pulse: 105 beats per minute

Blood pressure: 110/70 mmHg

Respiratory rate: 18 breaths per minute

BMI: 25 kg/m²

Oxygen saturation: 99% on room air

Cardiopulmonary: Lungs clear to auscultation bilaterally.

No wheezes, rales or rhonchi. Heart rate slightly tachycardic but regular rhythm. No murmurs, rubs, or gallops

Abdomen: Soft, non-tender to palpation, gravid.

No guarding or rebound. Fundal height 33 cm

Pelvic: Normal external genitalia. Vaginal rugae are pink

and moist. Cervix with no lesions, discharge, or bleeding.

Cervix appears closed. On bimanual exam, cervix is closed, long, and thick with enlarged gravid uterus

Neurologic/psychologic: Alert and oriented × 3.

Appears anxious

Fetal assessment: Unable to detect FHR on external FHR monitor; absent. Tocometer: No uterine activity

Laboratory studies:

WBC: 10,000/μL

Hgb: 11.5 g/dL

Plt: 201,000/μL

Fibrinogen, PTT, INR: Within normal limits

Urinalysis: Trace leukocytes but otherwise within normal limits

Liver function tests, Cr, and electrolytes: Within normal limits

Urine protein: creatinine ratio: 0.03

Imaging:

Bedside transabdominal obstetrical ultrasound. Single intrauterine pregnancy with no fetal cardiac activity or movement on visualization of fetal heart. No FHR detected on attempt with M-Mode or Doppler color flow. Fetus in cephalic presentation with posterior placenta with MVP of 1 cm. Fetal anatomical measurements consistent with stated gestational age of 34 weeks.

How Would You Manage This Patient?

This patient presents with perceived absence of fetal movement without any other significant symptoms. She denied any events prior to this sensation or changes in activity. The fetal heart rate (FHR) monitor did not detect a FHR. When the FHR cannot be detected with a external fetal monitor, the next step is to perform an obstetrical ultrasound to check for fetal cardiac activity. In this case, the bedside ultrasound showed absent fetal cardiac activity, which is diagnostic of an intrauterine fetal demise.

This patient was counseled about the diagnosis, additional testing options, and management options for delivery of the fetus. Given the gestational age was >28 weeks, she was counseled and elected to undergo an induction of labor. She delivered the fetus 24 hours later in an uncomplicated vaginal delivery. She was discharged home on postpartum day 1. She elected for a fetal autopsy, placental examination, and genetic testing on the fetus. Results showed that all the testing was normal. She was seen by her obstetrical provider 1 week following delivery to follow her physical recovery from delivery as well as her mood. In subsequent visits she was diagnosed with postpartum depression and started on medication as well as counseling sessions with a therapist.

Intrauterine Fetal Demise

The definition of an intrauterine fetal demise (IUFD) is “the delivery of a fetus showing no signs of life as indicated by the absence of breathing, heartbeat, pulsation of the umbilical cord or definite movements of voluntary muscles” [1]. Fetal deaths are generally reported at gestational ages of 20 weeks or greater. The rate of IUFD in 2020 was 5.74 per 1,000 live births [2]. The rate of IUFD at 28 weeks or greater was lower in 2020 at 2.78 per 1,000 live births (see Figure 29.1) [2]. Risk factors for IUFD include non-Hispanic black race, nulliparity,

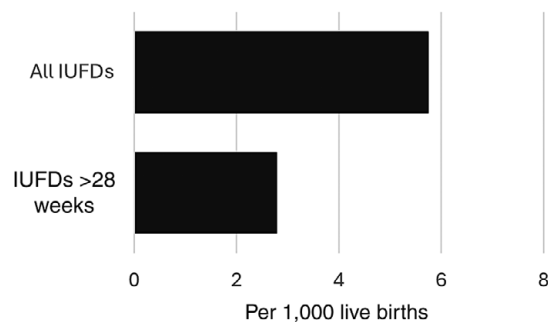


Figure 29.1 Fetal mortality rate: United States, 1990–2020 [2]

advanced maternal age, smoking, alcohol use, having a pregnancy using ART, multiple gestation, male fetal sex, unmarried status, preexisting diabetes, chronic hypertension, substance use, antiphospholipid antibody syndrome, maternal obesity, late and post-term pregnancy, and past obstetric history, such as prior IUFD [3]. In this case, the patient's main risk factor was advanced maternal age. She has a history of two early pregnancy losses, but there is no information regarding prior genetic testing in these cases. Causes of IUFD include placental insufficiency, placental abruption, plurality, smoking, substance use chromosomal and genetic abnormalities, infection (GBS, *E. Coli*, syphilis, cytomegalovirus, parvovirus, etc.), and umbilical cord events [2,4,5]. The National Vital Statistics Report list the most to least frequent causes as unspecified, placental/cord and membrane causes, maternal complications of pregnancy, maternal complications not related to pregnancy, and chromosomal abnormalities.

The clinical presentation for an IUFD can vary and is often dependent on the cause. The most common presenting symptom is the sensation of decreased or absent fetal movement. In cases of a placental abruption, for example, a patient may present with vaginal bleeding, contractions, and at times a firm abdomen that does not relax between contractions. Given high blood pressure can cause a placental abruption, a patient could also present with headaches and increased swelling. A patient with an infectious cause may present with fevers, chills, nausea, vomiting, and/or abnormal vaginal discharge.

In general, evaluation of an IUFD should include fetal autopsy, genetic evaluation (fetal karyotype, chromosomal microarray), and gross and histologic examination of the placenta, umbilical cord and membranes [4,5]. Additional testing may be indicated when other clinical factors are present, such as fetal growth restriction, maternal hypertensive disorder, a suspected fetal anomaly, or an intrapartum IUFD. As an example, in a case where placental abruption is suspected with vaginal bleeding, testing coagulation factors (fibrinogen, PT, PTT, INR) may be recommended for maternal care to rule out disseminated intravascular coagulation (DIC) (see Figure 29.2). In the current case, genetic testing, antiphospholipid antibody testing, and fetal-maternal hemorrhage testing would all be reasonable. Syphilis testing is also recommended as part of the routine maternal evaluation in addition to a detailed past medical history, obstetric history,

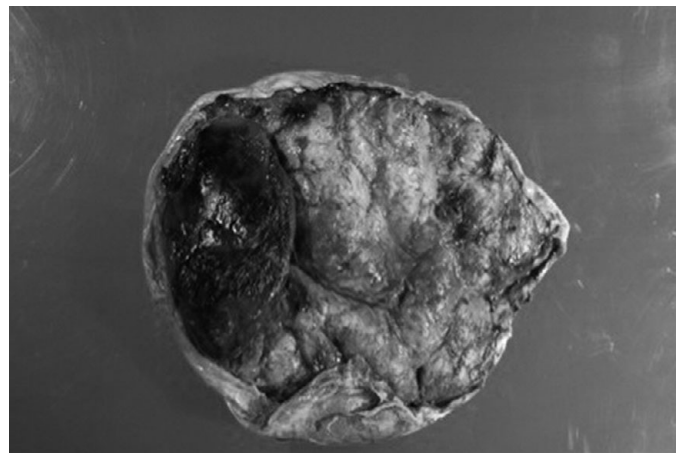


Figure 29.2 Placental evaluation showing evidence of a placental abruption on the left side (reader view) of specimen (A black and white version of this figure will appear in some formats. For the color version, please refer to the plate section.)

family history, and exposure history (medications, viruses, substances, etc.) [4,5].

After diagnosis, the delivery mode is dependent on gestational age, maternal history, and maternal preference [4,5]. Dilation and evacuation as well as induction of labor are options for delivery. Immediate delivery is not required as overall maternal risk is low. Dilation and evacuation (with cervical preparation with dilators as needed) can limit fetal autopsy or prevent holding of an intact fetus after delivery. However, induction of labor can be less effective and have higher complication rates (infection, retained products of conception) than D&E between 13 and 24 weeks [6].

Prior to 28 weeks, induction of labor can be obtained most effectively with vaginal misoprostol 400–600 µg every 3–6 hours. Pre-treatment with oral mifepristone 200 mg can make the misoprostol more efficient in fetal delivery prior to 20 weeks' gestation [7]. There is less data on its use between 24 and 28 weeks. When used, it should be given 24–48 hours before starting misoprostol. Vaginal or oral misoprostol alone typically leads to delivery within 48 hours. This method has also been shown to be safe prior to 24 weeks in patients with prior low transverse hysterotomy with limited data on gestations between 24 and 28 weeks [8]. After 28 weeks, as in the current case, usual obstetric protocols should be used for induction of labor with or without history of cesarean [4]. Avoiding CD for an IUFD is recommended.

The management of IUFD also encompasses the management of bereavement. The bereavement process is individualized for each patient and includes shared decision-making, communication, acknowledging the grief of partners and family members, understanding and acknowledging that grief is individualized, emotional support, access to mental health professionals, and awareness of burial, cremation, and funeral options [4,5]. Communication of results as soon as possible is very important for the grieving process and planning for future pregnancies.

Many patients desire counseling about reducing the risk of future IUFD. Improving certain modifiable risk factors, such as

improved blood sugar control in diabetes, blood pressure control in hypertensive disease, and decreasing substance use, can help reduce this risk. However, when there are no identifiable risk factors, there is insufficient data for decreasing recurrence risk [4,5]. Antepartum surveillance in future pregnancies may help improve anxiety about fetal status as well as providing opportunities to intervene when needed. Antepartum surveillance frequency should follow recommendations for conditions that are modifiable risk factors for IUFD, such as diabetes and chronic hypertension. For other cases of history of IUFD at 32 weeks or greater, antepartum surveillance should begin at 32 weeks with once to twice weekly testing or 1–2 weeks prior to the gestational age of the prior IUFD. For IUFDs prior to 32 weeks, individualized antepartum surveillance is recommended [4,5]. Surveillance may include growth scans, particularly with a history of placental insufficiency as diagnosed by FGR or placental examination.

Timing of delivery is a joint decision between the patient and their health care provider in future pregnancies. Delivery prior to 39 weeks has an increased risk of NICU admission for fetal lung immaturity and other issues, but early term delivery (37–38 6/7 weeks) may be considered in cases where maternal and fetal risks are evaluated and the mother is aware of the fetal risks [4,5].

Key Teaching Points

- The rate of IUFD is 5.74 per 1,000 live births and decreases to 2.78 per 1,000 live births after 28 weeks.
- Risk factors for IUFD include non-Hispanic black race, nulliparity, advanced maternal age, smoking, alcohol use, having a pregnancy using ART, multiple gestation, male fetal sex, unmarried status, preexisting diabetes, chronic hypertension, substance use, antiphospholipid syndrome, maternal obesity, late and post-term pregnancy, and past obstetric history, such as a prior IUFD.
- Decreased or absent fetal movement is the most common presentation/symptom of IUFD. Additional symptoms are dependent on the potential cause.
- All patients with IUFD should be offered fetal autopsy, genetic evaluation, and examination of the placenta, umbilical cord, and membranes. Other testing is individualized by case. Together, SMFM and ACOG have proposed an algorithm to assist clinicians (www.acog.org/clinical/clinical-guidance/obstetric-care-consensus/articles/2020/03/management-of-stillbirth).
- Dilation and evacuation and induction of labor are delivery options prior to 28 weeks and depend on patient preference and history. After 28 weeks, general obstetrical protocols for induction of labor are recommended.
- Antepartum surveillance is recommended starting at 32 weeks and is individualized in patients with a history of IUFD prior to 32 weeks. Consideration can be made for fetal growth scan. Delivery timing is determined by a discussion of the fetal and maternal risks of delivery at 39 or before 39 weeks.

References

- 1 MacDorman MF, Gregory EC. Fetal and Perinatal Mortality: United States, 2013. *Natl Vital Stat Rep*. 2015;64:1–24.
- 2 Gregory ECW, Valenzuela CP, Hoyert DL. *Fetal Mortality: United States, 2020. National Vital Statistics Reports*. Hyattsville, MD: National Center for Health Statistics. 2022. <https://dx.doi.org/10.15620/cdc.118420> (accessed September 26, 2024).
- 3 Reddy UM, Laughon SK, Sun L, et al. Pre-pregnancy Risk Factors for Antepartum Stillbirth in the United States. *Obstet Gynecol*. 2010;116:1119–1126.
- 4 Management of Stillbirth: Obstetric Care Consensus No. 10. *Obstet Gynecol*. 2020;135:e110–e132.
- 5 American College of Obstetricians and Gynecologists; Society for Maternal-Fetal Medicine; Metz TD, Snipe Berry R, Fretts RC, Reddy UM, Turrentine MA. Obstetric Care Consensus #10: Management of Stillbirth: (Replaces Practice Bulletin Number 102, March 2009). *Am J Obstet Gynecol*. 2020;222:B2–B20.
- 6 Bryant AG, Grimes DA, Garrett JM, et al. Second Trimester Abortion for Fetal Anomalies or Fetal Death: Labor Induction Compared with Dilation and Evacuation. *Obstet Gynecol*. 2011;117:788–792.
- 7 ACOG Practice Bulletin No. 135: Second-Trimester Abortion. *Obstet Gynecol*. 2013;121:1394–1406.
- 8 Lemmers M, Verschoor MA, Kim BV, et al. Medical Treatment for Early Fetal Death (Less Than 24 Weeks). *Cochrane Database Syst Rev*. 2019;(6): CD002253.

CASE 30

A 25-Year-Old at 36 Weeks' Gestation Presents with Severe Bilateral Wrist Pain

Vanessa H. Gregg

History of Present Illness

A 25-year-old gravida 3 para 2 at 36 weeks' gestation presents to the clinic with a complaint of severe bilateral wrist pain. She reports the symptoms began recently. She has been waking in the night with frequent tingling and intermittent pain in her fingers on both hands, in particular her thumbs, index, and middle fingers. Symptoms are worse at night and improve during the day. She reports she is otherwise feeling well. She denies fever, chills, headaches, vision changes, rashes, or any other new symptoms. Her pregnancy has otherwise been uncomplicated. She has no major medical problems and no prior surgeries. She has never had these symptoms before.

Physical Examination

General appearance: Well-appearing, no acute distress

Vital signs:

Temperature: 37.0°C

Pulse: 80 beats per minute

Blood pressure: 110/70 mmHg

Respiratory rate: 16 breaths per minute

BMI: 30 kg/m²

Abdomen: Gravid, non-tender to palpation. Fundal height 36 cm

Extremities: Trace pedal edema bilaterally; hands are well perfused, no lesions or rashes. Strength and range of motion of extremities is normal; range of motion of the neck is normal with no neck tenderness. Tinel sign: Positive. Phalen test: Positive

Neurologic/psychologic: Alert and oriented × 3 with no focal neurologic deficits

Fetal assessment: Fetal heart tones are 150 beats per minute

How Would You Manage This Patient?

This patient has carpal tunnel syndrome (CTS) presenting in the third trimester of pregnancy. The Boston Carpal Tunnel Questionnaire (BCTQ) was utilized to assess the severity of her symptoms and the impact on her quality of life [1]. Her symptoms were significantly impacting her sleep and her sense of well-being. Her symptoms were initially managed conservatively with physical therapy and wrist splints worn at night to immobilize her wrists in a neutral position [2]. She did experience some improvement in her symptoms with splinting, however, she subsequently reported increased numbness and tingling, particularly in her dominant hand. Given the severity of her symptoms, she received local steroid injections in both of her wrists. Her symptoms

improved significantly after steroid injections. She went on to have an uncomplicated term vaginal delivery. Her CTS symptoms resolved within weeks after delivery.

CTS of Pregnancy

Carpal tunnel syndrome is a neuropathy of the median nerve that occurs due to compression of the nerve in the carpal tunnel [3]. The prevalence in the general population is about 4%, with more frequent occurrence in women than men [4]. Pregnancy is a risk factor for the development of CTS [5]. Reported prevalence in pregnancy varies widely depending on the diagnostic criteria utilized, with prevalence ranging from 2 to 62%. The most common time for presentation in pregnancy is during the third trimester, though symptoms may commence during all trimesters. Most pregnant patients with CTS will present with mild symptoms and minimal functional impairment [3]. Some patients with CTS in pregnancy may not report their symptoms to a health care provider. Carpal tunnel syndrome in pregnancy has been shown to negatively impact sleeping patterns, therefore, identifying and treating the syndrome in pregnancy can improve quality of life.

Carpal tunnel syndrome with onset during pregnancy will often improve significantly soon after delivery. However, some patients report persistent symptoms for a prolonged period of time. In one study of CTS during pregnancy, 40% of patients had continued CTS symptoms at 1 month, 24% had persistence at 3 months, 11% at 6 months, and 4% at 1 year [6]. A review of studies of CTS during pregnancy found that symptoms resolved in half of cases after 1 year, and in two-thirds of cases after 3 years [1]. If symptom-onset occurs earlier in pregnancy, the CTS is more likely to persist after delivery and may recur in subsequent pregnancies. Some patients will have first onset of CTS during lactation, which resolves after weaning. Women who develop lactational CTS are more likely to be older and primiparous. Risk factors for the development of CTS during pregnancy are inconsistently described across research studies, but include increasing maternal age, self-reported fluid retention, left-hand dominance, and gestational diabetes [5].

Common symptoms of CTS include tingling, numbness, and pain in the thumb, index, and middle fingers. The radial side of the ring finger can also be involved because of the distribution of the median nerve. Patients may develop weakness of the thenar muscles, pain, and burning in the fist, and decreased grip strength and hand dexterity [5]. Symptoms are typically worse at night and can impact sleep patterns. Symptoms can occur in both hands or in only one, and the symptoms may be more prominent in the dominant hand.

Table 30.1 Clinical diagnostic tests for CTS [5]

	How to perform	Positive result
Tinel sign	• Patient is seated • Patient's forearm is supported on a table, hand supine • Patient fist is stabilized and palmar surface of the fist is tapped with a neurological hammer	Patient feels tingling or pain radiating to the thumb, index finger, and/or middle finger
Phalen test	• Patient is seated • Patient's fist is hyperflexed and stationary for 1 minute	Patient reports numbness in the distribution of the median nerve

While CTS is common, it is important to consider other etiologies of wrist or hand pain. A differential diagnosis based on location of pain includes: *volar pain* – CTS, Dupuytren's disease, arthritis; *dorsal pain* – tendinitis, arthritis; *ulnar pain* – ulnar nerve entrapment, tenosynovitis of the flexor carpi ulnaris; *radial pain* – De Quervain's tenosynovitis, tenosynovitis of extensor carpi radialis, and arthritis [7].

Assessment for CTS during pregnancy is similar to that outside of pregnancy. The BCTQ and other similar instruments are validated to characterize signs and symptoms of CTS. The BCTQ has two scales: one for symptom severity and another for functional status. Clinical diagnostic testing includes simple diagnostic tools such as the Tinel sign and Phalen test, which can be performed easily in a clinic setting (Table 30.1).

For more severe cases, electrodiagnostic studies including nerve conduction studies and electromyography can be used to assess the health of the median nerve and determine severity of disease. The American Academy of Orthopedic Surgeons states that there is not sufficient evidence to provide specific treatment recommendations for CTS in pregnancy [8]. In general, electrodiagnostic studies are deferred during pregnancy unless there is concern for median nerve denervation or significant symptoms refractory to splinting and steroid injections [4].

First-line treatment is conservative management with physical therapy and splinting. There is limited evidence to support a therapeutic benefit of splinting for management of CTS in

general, but a recent Cochrane review suggests that there is low-certainty evidence that people may have a greater chance of overall improvement in their CTS symptoms with nighttime splinting than with no treatment [2]. A significant percentage of pregnant patients with CTS will have improvement of symptoms with splinting alone, reported in one study to be as high as 82% of patients experiencing symptom relief [4].

For those patients who do not achieve symptom improvement with splinting, local corticosteroid injections can be considered. One study showed up to 80% improvement in symptoms with local corticosteroid injections among pregnant patients with CTS who had not improved with splinting. In another randomized-controlled trial of steroid injection compared to wrist-splinting alone, BCTQ scores were significantly lower at 6-weeks of treatment among the steroid-treated patients than those who did only splinting. There are no known significant adverse effects of the use of local corticosteroid injections in the management of CTS during pregnancy [9].

Key Teaching Points

- Pregnancy is a risk factor for the development of CTS, a neuropathy of the median nerve that occurs due to compression of the nerve in the carpal tunnel.
- The most common timing of onset of CTS in pregnancy is during the third trimester, and symptoms may persist in some patients for months after delivery. Some patients will develop onset during lactation.
- Carpal tunnel syndrome in pregnancy has been shown to negatively impact sleep patterns, which can have other consequences for physical and mental health in pregnancy. Therefore, identification and treatment of CTS can be important for quality of life.
- Most patients will present with mild symptoms and can be managed conservatively with physical therapy and wrist splinting. Some may require steroid injections for greater symptomatic improvement.
- In severe cases, electrodiagnostic testing may be required to identify more significant neuropathy that may necessitate surgical intervention.

References

- 1 Padua L, Di Pasquale A, Pazzaglia C, et al. Systematic Review of Pregnancy-Related Carpal Tunnel Syndrome. *Muscle Nerve*. 2010;42(5):697–702.
- 2 Karjalainen TV, Lusa V, Page MJ, et al. Splinting for Carpal Tunnel Syndrome. *Cochrane Database Syst Rev*. 2023;(2):CD010003.
- 3 Meems M, Truijens S, Spek V, et al. Prevalence, Course and Determinants of Carpal Tunnel Syndrome Symptoms during Pregnancy: A Prospective Study. *BJOG*. 2015;122(8):1112.
- 4 Osterman M, Ilyas AM, Matzon JL. Carpal Tunnel Syndrome in Pregnancy. *Orthop Clin North Am*. 2012;43(4):515–520.
- 5 Oliveira GAD, Bernardes JM, Santos ES, et al. Carpal Tunnel Syndrome during the Third Trimester of Pregnancy: Prevalence and Risk Factors. *Arch Gynecol Obstet*. 2019;300(3):623–631.
- 6 Sax TW, Rosenbaum RB. Neuromuscular Disorders in Pregnancy. *Muscle Nerve*. 2006;34(5):559–571.
- 7 Almoallim H, Kalantan D, Alharbi L, et al. Approach to Musculoskeletal Examination. In: Almoallim H, Cheikh M (eds.). *Skills in Rheumatology*. Singapore: Springer; 2021. http://dx.doi.org/10.1007/978-981-15-8323-0_2 (accessed September 27, 2024).
- 8 Keith M, Masear V, Chung K, et al. American Academy of Orthopaedic Surgeons Clinical Practice Guideline on the Treatment of Carpal Tunnel Syndrome. *J Bone Joint Surg Am*. 2010;92(1):218–219.
- 9 Filippini C, Saran S, Chari B. Musculoskeletal Steroid Injections in Pregnancy: A Review. *Skeletal Radiol*. 2023;52:1465–1473. <http://dx.doi.org/10.1007/s00256-023-04320-9> (accessed September 27, 2024).

A 20-Year-Old Presents at 31 Weeks' Gestation with Severe Abdominal Pain and Constipation

Paris N. Stowers

History of Present Illness

A 20-year-old gravida 3 para 1011 at 31 weeks' gestation by a first-trimester ultrasound with a singleton intrauterine pregnancy presents to the Labor and Delivery Unit with a three-day history of progressively worsening abdominal pain. She rates her pain intensity as 6 out of 10. Her last bowel movement was 5 days ago. Prior to pregnancy, she had bowel movements daily, but over the past 3 months she has noticed a decrease in stool frequency. When she does have bowel movements, the stools are very firm and painful. Using the Bristol Stool Scale, she reports having type 1 stools for the past two months. She has taken psyllium daily for the past month. She does not feel the sensation of incomplete emptying of her bowels. She denies having to change positions to pass stool. She denies engaging in manual evacuation of stool or splinting her posterior vaginal wall in order to empty bowels. She denies nausea, vomiting, weight loss, or rectal bleeding. Her pregnancy is complicated by mild anemia for which she takes an iron supplement. She also takes a prenatal vitamin. She denies leakage of fluid, vaginal bleeding, or contractions. She feels regular fetal movement throughout the day. She denies, dysuria, hematuria, fevers, chills, or back pain. She has no other medical conditions. She has never had abdominal surgery. She denies a family history of colon cancer.

Physical Examination

General appearance: No acute distress

Vital signs:

Temperature: 36.7°C

Pulse: 80 beats per minute

Blood pressure: 108/75 mmHg

Respiratory rate: 18 breaths per minute

BMI: 29 kg/m²

Cardiopulmonary: Breathing comfortably on room air, clear to auscultation, regular rate and rhythm

Abdomen: Soft. No guarding. No rebound. Gravid uterus. Fundal height 31 cm

Pelvic: No pelvic organ prolapse. Cervix is closed. Firm stool palpated through the posterior vaginal wall. No visible hemorrhoids

Fetal assessment: Nonstress test – Baseline 148 beats per minute; moderate variability, accelerations present, no decelerations. Tocometer: No contractions

Laboratory studies:

WBC: 9,500/μL

Hgb: 10.1 g/dL

Sodium: 140 mEq/L

Potassium: 3.7 mEq/L

Glucose: 97 mg/dL

Calcium: 9.2 mg/dL

TSH: 2.0 mIU/L

How Would You Manage This Patient?

This patient is diagnosed with constipation. Her history, exam, and laboratory findings do not suggest other pathology. Both her pregnancy and iron supplement use likely contribute to her constipation. After reviewing treatment options and engaging in shared decision-making, a bisacodyl suppository is administered. An hour later, she passes a large volume of firm stool and reports significant relief of her abdominal pain. She is counseled to increase oral hydration, eat fiber-rich food, and engage in light physical activity each day. She is discharged with a prescription for polyethylene glycol to be taken daily. At her next prenatal visit, she reports significant improvement of her symptoms. She is now stooling three times per week, producing type 4 stools.

Constipation in Pregnancy

A common condition of pregnancy, constipation impacts up to 40% of all pregnant people with the highest prevalence in the first and second trimesters [1,2]. Constipation is characterized by infrequent stools (fewer than three per week), hard stools, and difficulty passing stools [3]. Untreated, this condition may negatively affect quality of life and impact pelvic floor function [4,5]. Pregnancy-induced hormonal and structural changes contribute to constipation [3,4]. Increased progesterone relaxes the intestinal smooth muscle and reduces colonic motility. Both estrogen and progesterone activate the renin–angiotensin–aldosterone pathway, leading to increased water absorption by the colon and resulting in harder stool consistency. Additionally, the growing gravid uterus can mechanically compress the bowel and impact pelvic floor function. These physiologic changes, combined with altered prenatal diet and physical activity levels, can result in painful, infrequent defecation [3,4].

When evaluating a pregnant person with constipation, etiologies besides pregnancy must be considered. The differential diagnoses include hypothyroidism, hypercalcemia, irritable bowel syndrome, pelvic floor dysfunction or prolapse, medication side effects, gastrointestinal malignancies, and structural abnormalities of the colon. A detailed history including timing of constipation onset, comorbidities, and associated symptoms is essential to assessing for non-obstetric

Table 31.1 Dietary sources of fiber

Food	Serving size	Fiber (g)
Avocado	1 fruit	9.3
Almonds	½ cup	8.9
Black beans	½ cup	8.3
Lentils	½ cup	7.8
Blackberries	1 cup	7.6
Chickpeas	½ cup	6.3
Lima beans	½ cup	5.8
Whole grain pasta (cooked)	½ cup	2.7
Kiwi	1 fruit	2.3

Data source: United States Department of Agriculture, Agricultural Research Service. FoodData Central, 2019 (<https://fdc.nal.usda.gov>)

causes of constipation [3]. For most people without signs or symptoms of other pathology, lifestyle changes and pharmacotherapy can be implemented to alleviate pregnancy-related constipation. Patients with severe constipation and those who do not respond to these therapies may warrant a more extensive work-up including imaging or testing of colorectal function [4].

Despite the prevalence of pregnancy-related constipation, there are limited research studies with pregnant participants to guide clinical management of this condition [6]. Initial interventions consist of lifestyle changes. Boosting consumption of fiber-rich foods (adult target 20–35 g/day) increases intraluminal water retention and fecal volume to improve constipation [6]. Table 31.1 includes examples of dietary sources of fiber. These dietary fibers should be combined with adequate oral hydration [7]. Thirty minutes of light exertion per day can also stimulate bowel function for constipated individuals [3,6]. Additionally, when stooling, using a posture modification device such as a Squatty Potty (Squatty Potty, LLC) can reduce straining and bowel emptying duration for nonpregnant people. Pregnant people were not included in this study [8]. These devices elevate the user's feet to simulate a squatting position, resulting in a straighter anorectal angle. Given the low likelihood of maternal and fetal risks of using a posture modification device, it may be a reasonable intervention to discuss with constipated pregnant patients.

For patients who do not respond to lifestyle changes or those who desire additional interventions, bulking laxatives, such as psyllium, are first-line therapies [3,6]. These fiber-containing laxatives increase stool water content and weight, stimulating bowel motility and producing softer, bulkier stools [6,9]. Although generally well tolerated, bulking laxatives can induce bloating and cramping in some patients and requires several days to take effect [3,9].

If bulking laxatives do not sufficiently alleviate constipation symptoms, osmotic laxatives should be considered [6]. Osmotic laxatives are the most commonly prescribed therapy for pregnant people with constipation [10]. These hyperosmolar agents are poorly absorbed by the intestines and have not

been associated with teratogenic effects in animal studies [4,6,7]. Osmotic laxatives, such as polyethylene glycol, draw fluid and electrolytes into the intestinal lumen, resulting in softer stools and increased colonic peristalsis with rare side effects of bloating and cramping [4,9].

For pregnant patients with persistent or severe constipation, stimulant laxatives can be used as an intermittent single dose therapy [6]. Commonly used stimulant laxatives include bisacodyl and senna. These medications stimulate the nerve plexus of smooth muscle, producing increased colonic motility within 8 hours of oral administration [6,9]. For patients who cannot tolerate oral intake or those who need more rapid therapy, bisacodyl suppositories stimulate the nerves of the large colon, producing a bowel movement within 30 minutes to 3 hours [6]. Compared to bulking and osmotic laxatives, stimulant laxatives are more effective and faster-acting [6,7]. However, these agents are not well studied in pregnant people and commonly cause side effects of diarrhea and abdominal pain [7,9]. These adverse symptoms can lead to dehydration, hypokalemia, and hyponatremia in some patients [6]. Because of these potential adverse effects, stimulant laxatives are not recommended for recurrent daily therapy [6].

Other options for treating constipation include emollient laxatives and lubricant laxatives. Docusate is an emollient laxative that lowers the surface tension in the oil–water stool interphase, leading to softer stools [6,9]. Despite widespread use, there is minimal evidence supporting the benefit of this medication [9]. Lubricant laxatives, such as orally consumed mineral oil, should also be avoided due to the risk of vitamin malabsorption [6]. Enemas and manual disimpaction can be considered if other remedies are unsuccessful.

Pregnancy-related constipation will worsen in the immediate postpartum period, affecting half of all postpartum people. However, these symptoms rapidly improve, with <15% of people reporting constipation at 1-month postpartum [1].

Patient-facing health information is available online. The National Institute of Diabetes and Digestive and Kidney Diseases hosts a section on constipation that includes diagnosis, treatment, and lifestyle modification (www.niddk.nih.gov/health-information/digestive-diseases/constipation).

Key Teaching Points

- Hormonal and structural changes of pregnancy contribute to constipation.
- Changes in diet, fluid intake, and physical activity may improve constipation symptoms.
- Bulking laxatives are the first-line pharmacotherapy for pregnant patients with constipation.
- Osmotic laxatives are the second-line pharmacotherapy for pregnant patients.
- Stimulant laxatives are an effective, fast-acting treatment for severe constipation in pregnancy, but are not recommended for daily use due to potential adverse effects.

References

- 1 Kuronen M, Hantunen S, Alanne L, et al. Pregnancy, Puerperium and Perinatal Constipation: An Observational Hybrid Survey on Pregnant and Postpartum Women and Their Age-Matched Non-pregnant Controls. *BJOG*. 2021;128:1057–1064.
- 2 Derbyshire E, Davies J, Costarelli V, et al. Diet, Physical Inactivity and the Prevalence of Constipation throughout and after Pregnancy. *Mater Child Nut*. 2006;2:127–134.
- 3 Cullen G, O'Donoghue D. Constipation and Pregnancy. *Best Pract Res Clin Gastroenterol*. 2007;21:807–818.
- 4 Rao SS, Qureshi WA, Yan Y, et al. Constipation, Hemorrhoids, and Anorectal Disorders in Pregnancy. *Am J Gastroenterol*. 2022;117:16–25.
- 5 Hage-Fransen MAH, Wiezer M, Otto A, et al. Pregnancy- and Obstetric-Related Risk Factors for Urinary Incontinence, Fecal Incontinence, or Pelvic Organ Prolapse Later in Life: A Systematic Review and Meta-analysis. *Acta Obstet Gynecol Scandinavica*. 2021;100:373–382.
- 6 Rungsiprakarn P, Laopaiboon M, Sangkomkamhang US, et al. Interventions for Treating Constipation in Pregnancy. *Cochrane Database Syst Rev*. 2015;(9):CD011448.
- 7 Vazquez JC. Constipation, Haemorrhoids, and Heartburn in Pregnancy. *BMJ Clin Evid*. 2010;8:1411.
- 8 Modi RM, Hinton A, Pinkhas D, et al. Implementation of a Defecation Posture Modification Device: Impact on Bowel Movement Patterns in Healthy Subjects. *J Clin Gastroenterol*. 2019;53:216–219.
- 9 Rao SSC, Brenner DM. Efficacy and Safety of Over-the-Counter Therapies for Chronic Constipation: An Updated Systematic Review. *Am J Gastroenterol*. 2021;116:1156–1181.
- 10 Shafe ACE, Lee S, Dalrymple JSO, et al. The LUCK Study: Laxative Usage in Patients with GP-Diagnosed Constipation in the UK, within the General Population and in Pregnancy: An Epidemiological Study Using the General Practice Research Database (GPRD). *Therap Adv Gastroenterol*. 2011;4:343–363.

A 35-Year-Old Presents at 25 Weeks' Gestation with Abnormal Glucose Tolerance Testing

Sneha Subhash

History of Present Illness

A 35-year-old gravida 2 para 0 woman at 25 weeks' gestation presents to the office for routine prenatal care. She reports good fetal movement. She denies any contractions, vaginal bleeding, or leakage of fluid. Her review of systems is negative. Her only medications are prenatal vitamins. She denies any significant past medical, surgical, or family history.

Physical Examination

General appearance: Alert and oriented, well-developed female in no acute distress

Vital signs:

Temperature: 36.7°C

Pulse: 77 beats per minute

Blood pressure: 120/70 mmHg

Respiratory rate: 18 breaths per minute

Body mass index (BMI): 30 kg/m²

Oxygen saturation: 99% on room air

Cardiopulmonary: Heart regular rate and rhythm. Lungs clear to auscultation bilaterally

Abdomen: Gravid, soft, non-tender, non-distended

Fetal assessment: Fundal height 26 cm. Fetal heart tones 144 beats per minute

Laboratory studies:

Normal prenatal labs

1-hour glucose tolerance test: 155 mg/dL

Weekly antenatal testing was scheduled beginning at 32 weeks' gestation. Given adequate control, induction of labor was scheduled at 39 weeks' gestation. Glucose monitoring was discontinued following delivery; however, she was advised regarding her future increased risk of developing type 2 diabetes. At her 6-week postpartum visit, she will be scheduled to complete a 2-hour 75 g OGTT.

Gestational Diabetes

Gestational diabetes mellitus is defined as hyperglycemia first detected during the second or third trimester of pregnancy [1]. It develops when there is underlying pancreatic beta-cell dysfunction that cannot overcome the physiological state of insulin resistance in pregnancy [1]. The prevalence of GDM is directly proportional to that of type 2 diabetes and increased in Hispanic, African American, Native American, and Asian or Pacific Islander women [2]. It directly impacts the mother and fetus (increased risk of preeclampsia, cesarean delivery, future development of type 2 diabetes, preterm birth, macrosomia, shoulder dystocia, birth trauma, neonatal hypoglycemia, admission to neonatal intensive care unit [NICU], and stillbirth). The Hyperglycemia and Adverse Pregnancy Outcome (HAPO) study, a large-scale multinational cohort study, demonstrated that the risk of adverse outcomes, such as cesarean delivery, neonatal hypoglycemia, and birth weight greater than the 90th percentile, increased as a function of maternal glycemia. These findings guide the diagnostic criteria for GDM [3].

Gestational diabetes mellitus is diagnosed with an OGTT administered at 24–28 weeks' gestation, and universal screening for all pregnant women is recommended [2]. Early testing in the first trimester is encouraged for women with risk factors for diabetes (Box 32.1), although studies show conflicting results [4]. Elevated BMI has been one of the several risk factors, but is now a prerequisite of the early screening algorithm proposed by the American College of Obstetricians and Gynecologists (ACOG) [2]. There are two leading recommendations – one-step or two-step testing – both approaches have vocal proponents. A systematic review from the US Preventive Services Task Force (USPSTF) concluded that there is no superior screening method, and neither is associated with improved health outcomes [5].

The one-step approach is derived from the International Association of the Diabetes and Pregnancy Study Groups (IADPSG) 75 g OGTT criteria. A 75 g OGTT is administered after a minimum of an 8-hour fasting period and blood

How Would You Manage This Patient?

This patient presents with an elevated glucose tolerance test. Since this patient's screening test was abnormal, she was instructed to complete the diagnostic 3-hour oral glucose tolerance test (OGTT) after an overnight fast.

This patient had two abnormal values on the 3-hour OGTT, diagnosing her with gestational diabetes mellitus (GDM). She was advised to initiate home glucose monitoring four times a day – fasting and 1-hour postprandially – and to log her measurements. She was also referred for nutritional counseling. At each of her subsequent visits, her home glucose log was reviewed. More than half of her values were elevated, fastings were greater than 95 mg/dL and postprandial values were greater than 140 mg/dL. She was initiated on weight-based insulin to manage her elevated glucose levels. Her insulin dose required periodic titration to maintain her glucose levels at goal.

Box 32.1 For obese or overweight patients with one or more of these risk factors, screening for GDM should occur at initiation of prenatal care**Early screening for GDM: Risk factors**

Overweight or obese and one or more additional risk factors:

- Physical inactivity
- First-degree relative with diabetes
- High-risk race or ethnicity
- Previous infant with birth weight of 4,000 g or more
- History of GDM
- Hypertension
- High-density lipoprotein cholesterol <35 mg/dL or a triglyceride level >250 mg/dL
- Polycystic ovary syndrome
- Hemoglobin A1c (glycosylated haemoglobin) $\geq 5.7\%$ or any history of impaired glucose tolerance
- History of cardiovascular disease
- Any clinical conditions associated with insulin resistance

Box 32.2 If a patient has a negative early GDM screening test, two-step testing should be used again after 24 weeks' gestation. If the patient has a positive early 50 g OGTT, but a negative 100 g OGTT, one can proceed with performing solely the 100 g OGTT at 24–28 weeks [2]**Two-step screening approach for diagnosis of GDM**

Step 1

- Administer a 50 g OGTT (nonfasting) and measure blood glucose at 1-hour
- If test result exceeds institutional cut-off of 130, 135, or 140 mg/dL, administer 100 g OGTT

Step 2

- Administer 100 g OGTT fasting
- Measure blood glucose at fasting, 1-hour, 2-hour, and 3-hour
- GDM diagnosed if at least two out of four glucose levels exceed either of the intuitively selected cut-offs

glucose values are checked at the fasting, 1-hour, and 2-hour marks. A diagnosis of GDM is given if any single measurement exceeds the cut-off (fasting value: 92 mg/dL, 1-hour value: 180 mg/dL, or 2-hour value: 153 mg/dL) [6].

Implementation of the IADPSG criteria would increase the prevalence of GDM from 5–6% to 15–20%. Without evidence to support improvement in health outcomes, this would lead to unnecessary increased health care expenditure [1,7]. Therefore, ACOG supports the two-step approach. The two-step approach starts with a 50 g nonfasting screening test followed by a 100 g OGTT only if the screening test is positive (Box 32.2 and Table 32.1).

Once GDM is diagnosed, women should receive nutritional and exercise education and begin glucose monitoring. Fingerstick glucose should be checked four times a day – fasting and 1–2 hours postprandially. Similar outcomes are reported testing 1-hour versus 2 hours after meals. The American Diabetic Association (ADA) and ACOG recommend targeting fasting glucose levels <95 mg/dL and

Table 32.1 Blood glucose at fasting cut-offs

Carpenter–Coustan criteria (mg/dL)	National diabetes data group criteria (mg/dL)
Fasting: 95	Fasting: 105
1-hour: 180	1-hour: 190
2-hour: 155	2-hour: 165
3-hour: 140	3-hour: 145

postprandial values <140 mg/dL at 1 hour or 120 mg/dL at 2 hours [2,8]. Women should be encouraged to keep a log of their measurements, to be reviewed at 1–2-week intervals during prenatal visits.

Treatment of GDM reduces the risk of preeclampsia, shoulder dystocia, large-for-gestational-age neonates, macrosomia, and decreased neonatal fat mass [2]. Initial management of GDM begins with lifestyle modifications. If glucose levels are not at target, medical management is recommended. The two pharmacologic options are subcutaneous insulin and an oral antidiabetic medication, metformin. Glyburide, another oral agent, is no longer recommended because it has been shown to carry inferior outcomes compared to metformin [2]. A large, randomized trial showed perinatal outcomes were similar in women that received metformin alone or in combination with insulin compared to insulin alone. However, there is a lack of evidence to show superiority of metformin±insulin compared to insulin alone and limited evidence for metformin±insulin insulin long-term safety data in fetuses exposed to metformin [8]. The recommendation of both ACOG and ADA is insulin therapy as the first-line therapy for treatment of GDM [2,9].

Insulin, unlike oral medications, does not cross the placenta and achieves tighter glycemic control. A starting dose of 0.7–1.0 units/kg/day (based on trimester) should be divided into one dose of long-acting insulin (e.g. glargine) and short-acting insulin (e.g. lispro) prior to meals. Calculators are available to aid clinicians (e.g. <https://perinatology.com/calculators/GDM.htm>). According to ACOG, metformin remains a viable alternative in woman who decline insulin, are not able to safely administer it, or cannot afford insulin [2]. Patients should be counseled that they may require step-up therapy to insulin when on metformin alone.

Women with GDM successfully managed with lifestyle modifications alone are not at risk for stillbirth, and therefore, do not require antepartum fetal testing and can be managed expectantly until 40 6/7 weeks. Antepartum fetal surveillance should be initiated at 32 weeks' gestation in women with poorly controlled GDM or GDM well-controlled on pharmacologic therapy. Women with well-controlled GDM on medications should also undergo induction of labor between 39 0/7 and 39 6/7 weeks' gestation to reduce perinatal mortality. For poorly controlled GDM, delivery between 37 0/7 and 38 6/7 weeks' gestation can be recommended after weighing the risks of prematurity with the risks of stillbirth [10]. Patients should be counseled on the risks and benefits of a scheduled cesarean

delivery in GDM if the estimated fetal weight is 4,500 g or more [2].

The insulin resistance associated with GDM typically resolves after delivery, immediate postpartum finger sticks are not necessary. However, GDM remains an antecedent to type 2 diabetes. Therefore, screening for type 2 diabetes at 4–12 weeks postpartum is recommended for all women with GDM with a fasting, 2-hour 75 g OGTT. Women who screen positive on their postpartum test should be referred to a primary care provider for continued management of glucose intolerance [2].

Key Teaching Points

- Gestational diabetes mellitus is the most common complication during pregnancy.
- All women should be screened for GDM between 24 and 28 weeks. If they have underlying risk factors for diabetes, they should be screened at the initiation of prenatal care.
- The two-step approach to screening starts with a 1-hour 50 g nonfasting OGTT, followed by a 3-hour 100 g fasting OGTT if the first test is positive.
- Insulin is the preferred first-line pharmacologic agent for treatment of GDM if lifestyle modifications are not sufficient to control glucose levels, but metformin can be considered in certain cases.
- For patients with diabetes managed on medications, induction of labor is indicated in 39 weeks' gestation.
- All women with GDM should be tested for underlying diabetes with a 2-hour 75 g OGTT at 4–12 weeks postpartum.

References

- 1 ElSayed NA, Aleppo G, Aroda VR, et al. 2. Classification and Diagnosis of Diabetes: Standards of Care in Diabetes–2023. *Diabetes Care*. 2023;46:s19.
- 2 ACOG Practice Bulletin No. 190: Gestational Diabetes Mellitus. *Obstet Gynecol*. 2018;131:e49–e64.
- 3 Metzger BE, Lowe LP, Dyer AR, et al.; HAPO Study Cooperative Research Group. Hyperglycemia and Adverse Pregnancy Outcomes. *N Engl J Med*. 2008;358:1991–2002.
- 4 Raets L, Beunen K, Benhalima K. Screening for Gestational Diabetes Mellitus in Early Pregnancy: What Is the Evidence? *J Clin Med*. 2021;10(6):1257. <http://dx.doi.org/10.3390/jcm10061257> (accessed September 20, 2024).
- 5 Pillay J, Donovan L, Guitard S, et al. *Screening for Gestational Diabetes Mellitus: A Systematic Review to Update the 2014 US Preventive Services Task Force Recommendation*. Rockville, MD, Agency for Healthcare Research and Quality (US Preventive Services Task Force Evidence Syntheses, formerly Systematic Evidence Reviews), 2021.
- 6 International Association of Diabetes and Pregnancy Study Group Consensus Panel. International Association of Diabetes and Pregnancy Study Groups Recommendations on the Diagnosis and Classification of Hyperglycemia in Pregnancy. *Diabetes Care*. 2010;33:676–682.
- 7 Landon MB, Spong CY, Thom E, et al.; Eunice Kennedy Shriver National Institute of Child Health and Human Development Maternal-Fetal Medicine Units Network. A Multicenter, Randomized Trial of Treatment for Mild Gestational Diabetes. *N Engl J Med*. 2009;361:1339–1348.
- 8 Rowan JA, Hague WM, Gao W, et al. Metformin versus Insulin for the Treatment of Gestational Diabetes. *N Engl J Med*. 2008;358:2003–2015.
- 9 American Diabetes Association. Management of Diabetes in Pregnancy. *Diabetes Care*. 2017;40:S114–S119.
- 10 ACOG Practice Bulletin No. 145: Antepartum Fetal Surveillance. *Obstet Gynecol*. 2014;124:182–192.

A 35-Year-Old Presents at 25 Weeks' Gestation with Abnormal Glucose Tolerance Testing

Sneha Subhash

History of Present Illness

A 35-year-old gravida 2 para 0 woman at 25 weeks' gestation presents to the office for routine prenatal care. She reports good fetal movement. She denies any contractions, vaginal bleeding, or leakage of fluid. Her review of systems is negative. Her only medications are prenatal vitamins. She denies any significant past medical, surgical, or family history.

Physical Examination

General appearance: Alert and oriented, well-developed female in no acute distress

Vital signs:

Temperature: 36.7°C

Pulse: 77 beats per minute

Blood pressure: 120/70 mmHg

Respiratory rate: 18 breaths per minute

Body mass index (BMI): 30 kg/m²

Oxygen saturation: 99% on room air

Cardiopulmonary: Heart regular rate and rhythm. Lungs clear to auscultation bilaterally

Abdomen: Gravid, soft, non-tender, non-distended

Fetal assessment: Fundal height 26 cm. Fetal heart tones 144 beats per minute

Laboratory studies:

Normal prenatal labs

1-hour glucose tolerance test: 155 mg/dL

Weekly antenatal testing was scheduled beginning at 32 weeks' gestation. Given adequate control, induction of labor was scheduled at 39 weeks' gestation. Glucose monitoring was discontinued following delivery; however, she was advised regarding her future increased risk of developing type 2 diabetes. At her 6-week postpartum visit, she will be scheduled to complete a 2-hour 75 g OGTT.

Gestational Diabetes

Gestational diabetes mellitus is defined as hyperglycemia first detected during the second or third trimester of pregnancy [1]. It develops when there is underlying pancreatic beta-cell dysfunction that cannot overcome the physiological state of insulin resistance in pregnancy [1]. The prevalence of GDM is directly proportional to that of type 2 diabetes and increased in Hispanic, African American, Native American, and Asian or Pacific Islander women [2]. It directly impacts the mother and fetus (increased risk of preeclampsia, cesarean delivery, future development of type 2 diabetes, preterm birth, macrosomia, shoulder dystocia, birth trauma, neonatal hypoglycemia, admission to neonatal intensive care unit [NICU], and stillbirth). The Hyperglycemia and Adverse Pregnancy Outcome (HAPO) study, a large-scale multinational cohort study, demonstrated that the risk of adverse outcomes, such as cesarean delivery, neonatal hypoglycemia, and birth weight greater than the 90th percentile, increased as a function of maternal glycemia. These findings guide the diagnostic criteria for GDM [3].

Gestational diabetes mellitus is diagnosed with an OGTT administered at 24–28 weeks' gestation, and universal screening for all pregnant women is recommended [2]. Early testing in the first trimester is encouraged for women with risk factors for diabetes (Box 32.1), although studies show conflicting results [4]. Elevated BMI has been one of the several risk factors, but is now a prerequisite of the early screening algorithm proposed by the American College of Obstetricians and Gynecologists (ACOG) [2]. There are two leading recommendations – one-step or two-step testing – both approaches have vocal proponents. A systematic review from the US Preventive Services Task Force (USPSTF) concluded that there is no superior screening method, and neither is associated with improved health outcomes [5].

The one-step approach is derived from the International Association of the Diabetes and Pregnancy Study Groups (IADPSG) 75 g OGTT criteria. A 75 g OGTT is administered after a minimum of an 8-hour fasting period and blood

How Would You Manage This Patient?

This patient presents with an elevated glucose tolerance test. Since this patient's screening test was abnormal, she was instructed to complete the diagnostic 3-hour oral glucose tolerance test (OGTT) after an overnight fast.

This patient had two abnormal values on the 3-hour OGTT, diagnosing her with gestational diabetes mellitus (GDM). She was advised to initiate home glucose monitoring four times a day – fasting and 1-hour postprandially – and to log her measurements. She was also referred for nutritional counseling. At each of her subsequent visits, her home glucose log was reviewed. More than half of her values were elevated, fastings were greater than 95 mg/dL and postprandial values were greater than 140 mg/dL. She was initiated on weight-based insulin to manage her elevated glucose levels. Her insulin dose required periodic titration to maintain her glucose levels at goal.

Box 32.1 For obese or overweight patients with one or more of these risk factors, screening for GDM should occur at initiation of prenatal care**Early screening for GDM: Risk factors**

Overweight or obese and one or more additional risk factors:

- Physical inactivity
- First-degree relative with diabetes
- High-risk race or ethnicity
- Previous infant with birth weight of 4,000 g or more
- History of GDM
- Hypertension
- High-density lipoprotein cholesterol <35 mg/dL or a triglyceride level >250 mg/dL
- Polycystic ovary syndrome
- Hemoglobin A1c (glycosylated haemoglobin) $\geq 5.7\%$ or any history of impaired glucose tolerance
- History of cardiovascular disease
- Any clinical conditions associated with insulin resistance

Box 32.2 If a patient has a negative early GDM screening test, two-step testing should be used again after 24 weeks' gestation. If the patient has a positive early 50 g OGTT, but a negative 100 g OGTT, one can proceed with performing solely the 100 g OGTT at 24–28 weeks [2]**Two-step screening approach for diagnosis of GDM**

Step 1

- Administer a 50 g OGTT (nonfasting) and measure blood glucose at 1-hour
- If test result exceeds institutional cut-off of 130, 135, or 140 mg/dL, administer 100 g OGTT

Step 2

- Administer 100 g OGTT fasting
- Measure blood glucose at fasting, 1-hour, 2-hour, and 3-hour
- GDM diagnosed if at least two out of four glucose levels exceed either of the intuitively selected cut-offs

glucose values are checked at the fasting, 1-hour, and 2-hour marks. A diagnosis of GDM is given if any single measurement exceeds the cut-off (fasting value: 92 mg/dL, 1-hour value: 180 mg/dL, or 2-hour value: 153 mg/dL) [6].

Implementation of the IADPSG criteria would increase the prevalence of GDM from 5–6% to 15–20%. Without evidence to support improvement in health outcomes, this would lead to unnecessary increased health care expenditure [1,7]. Therefore, ACOG supports the two-step approach. The two-step approach starts with a 50 g nonfasting screening test followed by a 100 g OGTT only if the screening test is positive (Box 32.2 and Table 32.1).

Once GDM is diagnosed, women should receive nutritional and exercise education and begin glucose monitoring. Fingerstick glucose should be checked four times a day – fasting and 1–2 hours postprandially. Similar outcomes are reported testing 1-hour versus 2 hours after meals. The American Diabetic Association (ADA) and ACOG recommend targeting fasting glucose levels <95 mg/dL and

Table 32.1 Blood glucose at fasting cut-offs

Carpenter–Coustan criteria (mg/dL)	National diabetes data group criteria (mg/dL)
Fasting: 95	Fasting: 105
1-hour: 180	1-hour: 190
2-hour: 155	2-hour: 165
3-hour: 140	3-hour: 145

postprandial values <140 mg/dL at 1 hour or 120 mg/dL at 2 hours [2,8]. Women should be encouraged to keep a log of their measurements, to be reviewed at 1–2-week intervals during prenatal visits.

Treatment of GDM reduces the risk of preeclampsia, shoulder dystocia, large-for-gestational-age neonates, macrosomia, and decreased neonatal fat mass [2]. Initial management of GDM begins with lifestyle modifications. If glucose levels are not at target, medical management is recommended. The two pharmacologic options are subcutaneous insulin and an oral antidiabetic medication, metformin. Glyburide, another oral agent, is no longer recommended because it has been shown to carry inferior outcomes compared to metformin [2]. A large, randomized trial showed perinatal outcomes were similar in women that received metformin alone or in combination with insulin compared to insulin alone. However, there is a lack of evidence to show superiority of metformin±insulin compared to insulin alone and limited evidence for metformin±insulin insulin long-term safety data in fetuses exposed to metformin [8]. The recommendation of both ACOG and ADA is insulin therapy as the first-line therapy for treatment of GDM [2,9].

Insulin, unlike oral medications, does not cross the placenta and achieves tighter glycemic control. A starting dose of 0.7–1.0 units/kg/day (based on trimester) should be divided into one dose of long-acting insulin (e.g. glargine) and short-acting insulin (e.g. lispro) prior to meals. Calculators are available to aid clinicians (e.g. <https://perinatology.com/calculators/GDM.htm>). According to ACOG, metformin remains a viable alternative in woman who decline insulin, are not able to safely administer it, or cannot afford insulin [2]. Patients should be counseled that they may require step-up therapy to insulin when on metformin alone.

Women with GDM successfully managed with lifestyle modifications alone are not at risk for stillbirth, and therefore, do not require antepartum fetal testing and can be managed expectantly until 40 6/7 weeks. Antepartum fetal surveillance should be initiated at 32 weeks' gestation in women with poorly controlled GDM or GDM well-controlled on pharmacologic therapy. Women with well-controlled GDM on medications should also undergo induction of labor between 39 0/7 and 39 6/7 weeks' gestation to reduce perinatal mortality. For poorly controlled GDM, delivery between 37 0/7 and 38 6/7 weeks' gestation can be recommended after weighing the risks of prematurity with the risks of stillbirth [10]. Patients should be counseled on the risks and benefits of a scheduled cesarean

delivery in GDM if the estimated fetal weight is 4,500 g or more [2].

The insulin resistance associated with GDM typically resolves after delivery, immediate postpartum finger sticks are not necessary. However, GDM remains an antecedent to type 2 diabetes. Therefore, screening for type 2 diabetes at 4–12 weeks postpartum is recommended for all women with GDM with a fasting, 2-hour 75 g OGTT. Women who screen positive on their postpartum test should be referred to a primary care provider for continued management of glucose intolerance [2].

Key Teaching Points

- Gestational diabetes mellitus is the most common complication during pregnancy.

- All women should be screened for GDM between 24 and 28 weeks. If they have underlying risk factors for diabetes, they should be screened at the initiation of prenatal care.
- The two-step approach to screening starts with a 1-hour 50 g nonfasting OGTT, followed by a 3-hour 100 g fasting OGTT if the first test is positive.
- Insulin is the preferred first-line pharmacologic agent for treatment of GDM if lifestyle modifications are not sufficient to control glucose levels, but metformin can be considered in certain cases.
- For patients with diabetes managed on medications, induction of labor is indicated in 39 weeks' gestation.
- All women with GDM should be tested for underlying diabetes with a 2-hour 75 g OGTT at 4–12 weeks postpartum.

References

- 1 ElSayed NA, Aleppo G, Aroda VR, et al. 2. Classification and Diagnosis of Diabetes: Standards of Care in Diabetes–2023. *Diabetes Care*. 2023;46:s19.
- 2 ACOG Practice Bulletin No. 190: Gestational Diabetes Mellitus. *Obstet Gynecol*. 2018;131:e49–e64.
- 3 Metzger BE, Lowe LP, Dyer AR, et al.; HAPO Study Cooperative Research Group. Hyperglycemia and Adverse Pregnancy Outcomes. *N Engl J Med*. 2008;358:1991–2002.
- 4 Raets L, Beunen K, Benhalima K. Screening for Gestational Diabetes Mellitus in Early Pregnancy: What Is the Evidence? *J Clin Med*. 2021;10(6):1257. <http://dx.doi.org/10.3390/jcm10061257> (accessed September 20, 2024).
- 5 Pillay J, Donovan L, Guitard S, et al. *Screening for Gestational Diabetes Mellitus: A Systematic Review to Update the 2014 US Preventive Services Task Force Recommendation*. Rockville, MD, Agency for Healthcare Research and Quality (US Preventive Services Task Force Evidence Syntheses, formerly Systematic Evidence Reviews), 2021.
- 6 International Association of Diabetes and Pregnancy Study Group Consensus Panel. International Association of Diabetes and Pregnancy Study Groups Recommendations on the Diagnosis and Classification of Hyperglycemia in Pregnancy. *Diabetes Care*. 2010;33:676–682.
- 7 Landon MB, Spong CY, Thom E, et al.; Eunice Kennedy Shriver National Institute of Child Health and Human Development Maternal-Fetal Medicine Units Network. A Multicenter, Randomized Trial of Treatment for Mild Gestational Diabetes. *N Engl J Med*. 2009;361:1339–1348.
- 8 Rowan JA, Hague WM, Gao W, et al. Metformin versus Insulin for the Treatment of Gestational Diabetes. *N Engl J Med*. 2008;358:2003–2015.
- 9 American Diabetes Association. Management of Diabetes in Pregnancy. *Diabetes Care*. 2017;40:S114–S119.
- 10 ACOG Practice Bulletin No. 145: Antepartum Fetal Surveillance. *Obstet Gynecol*. 2014;124:182–192.

A 25-Year-Old Presents at 35 Weeks' Gestation with Hypertension, Proteinuria, and Seizure

Omari J. Young

History of Present Illness

A 25-year-old gravida 3 para 0 at 35 weeks' gestation presents to Labor and Delivery triage after a complaint of headache and elevated blood pressure at her routine prenatal care visit that day. This is the patient's first elevated blood pressure. Her frontal headache is 7 out of 10 in severity. She denies visual disturbances, chest pain, shortness of breath, right upper quadrant (RUQ) pain, or epigastric pain. On arrival, her blood pressure was 165/95 mmHg. Her obstetric history is notable for one missed abortion and one therapeutic abortion. Her medical, surgical, and family history are unremarkable. The patient has been placed on the external fetal monitor and her labs were collected, which were notable for proteinuria. After completing the physical examination, her repeat blood pressure was 170/110 mmHg and she developed a tonic-clonic seizure.

Physical Examination

General appearance: Mildly distressed and disoriented

Vital signs:

Temperature: 36.5°C

Pulse: 80 beats per minute

Blood pressure: 165/95 mmHg; repeat: 170/110 mmHg

Respiratory rate: 16 breaths per minute

BMI: 24 kg/m²

Cardiopulmonary: Regular rate and rhythm without murmur, rub, or gallop. Lungs clear to auscultation bilaterally

Abdomen: Gravid uterus with size appropriate for dates. Soft, non-tender to palpation

Pelvic: Normal external genitalia; vagina normal with no lesions, fluid, discharge, or blood; cervix is closed, no effacement, -3 station, posterior, and firm

Neurologic/psychologic: 3+ deep tendon reflexes, sustained clonus

Fetal assessment:

Baseline: 140 beats per minute. Variability: moderate with periods of minimal. Accelerations: present. Decelerations: occasional variable. Tocometer: irritability

Laboratory studies:

Hgb: 11.3 g/dL

Plt: 110,000/ μ L

AST/ALT: 20/10 U/L

Cr: 0.9 mg/dL

Lactate dehydrogenase (LDH): 850 IU/L

Protein: creatinine ratio: 0.6 (normal less than 0.3)

Imaging:

Fetal ultrasound: cephalic presentation, fetal cardiac activity – present, posterior placenta, amniotic fluid index 10 cm

How Would You Manage This Patient?

This patient has developed eclampsia. While in triage, additional nursing and anesthesia personnel were called. The patient was stabilized by protecting the airway, administering supplemental oxygen, and placing the patient in left lateral decubitus position. Vital signs were monitored closely including oxygen saturation. Intravenous (IV) access was obtained with collection of labs. Six grams loading dose of magnesium was administered intravenously. Once the seizure resolved, the concurrent fetal deceleration resolved. She was transferred to a labor and delivery room where a foley catheter was inserted. The patient also had persistent severe range blood pressures, which were lowered promptly with IV labetalol. Initially, consideration was made to induce labor. During her management, the fetal heart tracing was noted to worsen with tachycardia, minimal variability, and occasional late decelerations. Given fetal status and unfavorable cervix, the patient was counseled for cesarean delivery. Following the delivery, the patient was continued on magnesium sulfate intravenously for 24 hours. During the postpartum course, she received routine postoperative care, monitored for signs and symptoms of magnesium toxicity, and began an oral antihypertensive regimen. She met her milestones and discharged home on postoperative day 4 with a blood pressure check in 3 days.

Gestational Hypertension and Preeclampsia

Gestational hypertension is defined as new onset systolic blood pressure of 140 mmHg or diastolic blood pressure of ≥ 90 mmHg on two occasions at least 4 hours apart after 20 weeks' gestation. Preeclampsia is defined as gestational hypertension with associated proteinuria. Hypertension disorders of pregnancy are a leading cause of morbidity and mortality [1]. Risks factors for preeclampsia include but are not limited to previous history of preeclampsia, nulliparity, chronic hypertension, multifetal gestation, diabetes, maternal age > 35 years old, and assisted reproductive technology. There has not been commercially available screening methods, however, the FDA just approved immunoassay measuring the ratio of serum soluble fms-like tyrosine kinase 1 (sFlt-1) and placental growth factor (PlGF) [2]. It purports a 96% negative predictive value. Additionally, low-dose aspirin (81 mg) can reduce the risk of developing preeclampsia. After an assessment of high and

moderate risk factors, the decision can be made to initiate low-dose aspirin ideally between 12 and 16 weeks' gestation or up to 28 weeks' gestation and continued until delivery [3].

Proteinuria is defined as urine protein of ≥ 300 mg from a 24-hour collection, protein: creatinine ratio of ≥ 0.3 , or 2+ urine dipstick. Preeclampsia can be diagnosed in the absence of proteinuria if new onset hypertension is associated with thrombocytopenia ($\text{Plt} < 100 \times 10^9/\text{L}$), renal insufficiency (serum Cr of 1.1 mg/dL or doubling of serum Cr), impaired liver function (liver transaminases double the normal limit), pulmonary edema, or new onset refractory headache. Once, the diagnosis of preeclampsia has been made, it should be further defined as being with or without severe features. Severe features include a persistent systolic blood pressure of ≥ 160 mmHg or diastolic blood pressure of ≥ 110 mmHg at least 4 hours apart (unless antihypertensive therapy has been initiated), thrombocytopenia, impaired liver function, persistent severe RUQ or epigastric pain, renal insufficiency, pulmonary edema, new onset refractory headache, or visual disturbances. The absence or presence of severe features will influence maternal management, antenatal fetal surveillance, and timing of delivery [1].

Preeclampsia without severe features can be appropriately managed expectantly in the outpatient setting until 37 0/7 weeks' gestation. An initial inpatient observation period is warranted to confirm maternal and fetal stability and the absence of severe features. If deemed appropriate for discharge, outpatient management will require frequent maternal evaluations and fetal monitoring. Maternal evaluation may include daily symptom and home blood pressure checks, weekly clinic monitoring of signs and symptoms, blood pressure measurement, and laboratory testing of complete blood count (CBC), liver enzymes, and serum Cr to assess for progression to preeclampsia with severe features. Initiation of oral antihypertensives can be considered. Antenatal fetal surveillance for preeclampsia without severe features should commence at the time of diagnosis. Monitoring should include fetal ultrasound every 3–4 weeks to assess for growth and amniotic fluid volume. Twice weekly testing with nonstress test (NST) should also be performed [4]. Preeclampsia with severe features should be managed expectantly in the inpatient setting until 34 0/7 weeks' gestation. Daily maternal and fetal evaluations should assess for progression of disease and contraindications for expectant management. Maternal conditions that preclude expectant management are uncontrolled severe range blood pressures nonresponsive to medications, persistent headache nonresponsive to medication, epigastric pain, or RUQ pain nonresponsive to medication, visual disturbances, HELLP syndrome, worsening renal dysfunction, eclampsia, pulmonary edema, stroke, myocardial infarction, or suspected placental abruption. Additional consideration should be paid to a patient's ability to comply with treatment and access medical services. Fetal conditions include abnormal testing, fetal demise, and persistent reverse end-diastolic flow in the umbilical artery [1,5,6].

Intrapartum management and mode of delivery should follow routine obstetric indications while initiating seizure

prophylaxis, maintaining blood pressure control, and monitoring disease progression. Magnesium sulfate is administered for seizure prophylaxis in patients with preeclampsia with severe features. Routine seizure prophylaxis is not uniformly indicated for patients with preeclampsia without severe features. In the Magpie study, the seizure rate was reduced by more than half with treatment but the absolute frequency is low [7]. The preferred regimen is a loading dose of 4–6 g of magnesium sulfate administered intravenously over 20–30 minutes followed by continuous infusion of 1–2 g per hour. The suggested therapeutic range is 4.8–8.4 mg/dL. The patient should be monitored closely for signs and symptoms of magnesium toxicity, which includes loss of deep tendon reflexes (>9 mg/dL), respiratory depression (>10 mg/dL), and respiratory paralysis (>12 mg/dL and cardiac arrest) [8]. Following delivery, the patient should be continued on magnesium sulfate for 24 hours in the postpartum period. The goal of antihypertensive management is to lower the blood pressure out of the severe range to reduce the risk of morbidity and mortality related to stroke, myocardial infarction, or renal failure. This can be achieved with IV labetalol, hydralazine, or oral nifedipine [1,5,6].

Eclampsia

Eclampsia is the progression to seizures and is the most severe outcome along the spectrum of hypertension disorders of pregnancy. It is defined as new onset tonic-clonic, focal, or multifocal seizures in the absence of other conditions such as epilepsy. Eclampsia can lead to maternal death secondary to maternal hypoxia, trauma, and aspiration pneumonia. Seizures are commonly preceded by neurologic signs and symptoms such as persistent severe frontal or orbital headache, visual disturbances, photophobia, or altered mental status. However, patients can develop eclampsia in the absence of symptoms or severe range blood pressures. Posterior reversible encephalopathy syndrome (PRES) is a constellation of symptoms including seizure, vision loss, altered mental status, and headache. The diagnosis of PRES is confirmed on magnetic resonance imaging with findings of cerebral edema and hyperintensities in the posterior portion of the brain [1,5,9].

The management of eclampsia encompasses maternal stabilization, seizure prophylaxis, blood pressure control, fetal assessment, and timely delivery. Once eclampsia is diagnosed, immediate help should be requested from anesthesia, emergency doctor or intensivist to assist with protecting the maternal airway, positioning the patient in the left lateral decubitus, providing supplemental oxygen, and monitoring vital signs including oxygen saturation. Appropriate IV access should be obtained, foley catheter inserted, and preeclampsia labs drawn if they were not previously collected. The patient should be placed on continuous external fetal heart rate monitoring. Magnesium sulfate should be administered as described earlier for seizure prophylaxis. If IV access is unavailable, then magnesium sulfate can be administered intramuscularly at a dose of 10 g, with half (5 g) given in the upper outer quadrant of each buttock. If recurrent seizure occurs, it is recommended to

administer an additional bolus of 2–4 g of magnesium sulfate intravenously; alternatively, second agents such as phenytoin, diazepam, or keppra can be used if seizures continue or magnesium is contraindicated. Avoid magnesium in those with myasthenia gravis and heart block. Persistent severe range blood pressures should be treated with IV labetalol, hydralazine, or oral nifedipine. Initially administer labetalol 20 mg IV. If pressures do not decrease, serially double the dose to 40 mg and then 80 mg every 10-minute intervals until blood pressure is <160/110 mmHg. Intravenous hydralazine is administered in either 5–10 mg doses over 2-minute (may re-administer 10 mg IV after 20 minutes) interval. Oral immediate release nifedipine is given administered at an initial dose of 10 mg (may re-administer 20 mg dose after 30 minutes, can repeat 20 mg once). During an eclamptic seizure, the fetus will often experience a prolonged deceleration and the postictal phase may have an abnormal fetal heart rate tracing with late decelerations, tachycardia, and reduced variability. Eclampsia is an indication for prompt delivery. The mode of delivery should consider maternal status, fetal status, gestational age, and cervical examination. Magnesium sulfate should be continued

for 24 hours after delivery with continued blood pressure control and frequent evaluations. Head imaging can be considered in the setting of recurrent seizures or persistent neurologic symptoms [1,5,9].

Key Teaching Points

- Gestational hypertension and preeclampsia without severe features can be managed expectantly in the outpatient setting until 37 0/7 weeks' gestation.
- Preeclampsia with severe feature should be managed expectantly in the inpatient setting until 34 0/7 weeks' gestation. Contraindications exist.
- Magnesium sulfate should be administered in the setting of preeclampsia with severe features for seizure prophylaxis and prevention of recurrent seizures.
- Antihypertensive management should be initiated for treatment of persistent severe range blood pressure.
- Eclampsia should be managed with maternal stabilization, seizure prophylaxis, antihypertensive treatment, and prompt delivery.

References

- 1 ACOG Practice Bulletin No. 222: Gestational Hypertension and Preeclampsia. *Obstet Gynecol.* 2020;135:237–260.
- 2 Tanne JH. Pre-eclampsia: FDA Approves Blood Test to Identify Pregnant Women at Risk. *BMJ.* 2023;382:1594. <http://dx.doi.org/10.1136/bmj.p1594> (accessed September 30, 2024).
- 3 Committee Opinion No. 743: Low-Dose Aspirin Use during Pregnancy. *Obstet Gynecol.* 2018;132:44–52.
- 4 Committee Opinion No. 888: Indications for Outpatient Antenatal Fetal Surveillance. *Obstet Gynecol.* 2021;137:177–197.
- 5 Cunningham GF, Leveno KJ, Dashe JS, et al. Preeclampsia Syndrome. In: *Williams Obstetrics*, 26th ed. New York: McGraw-Hill; 2022. 3415–3542.
- 6 Cunningham GF, Leveno KJ, Dashe JS, et al. Clinical Management of the Preeclampsia Syndrome. In: *Williams Obstetrics*, 26th ed. New York: McGraw-Hill; 2022. 3543–3647.
- 7 Altman D, Carroli G, Duley L, et al.; Magpie Trail Collaboration Group. Do Women with Preeclampsia, and Their Babies, Benefit from Magnesium Sulfate? The Magpie Trial: A Randomised Placebo-Controlled Trial. *Lancet.* 2002;350:1877–1890.
- 8 Taylor RN, Roberts JM, Cunningham GF, et al. *Chesley's Hypertensive Disorders in Pregnancy*, fourth ed. Cambridge, MA: Academic Press; 2015.
- 9 Duley L, Henderson-Smart DJ, Walker GJA, et al. Magnesium Sulphate versus Diazepam for Eclampsia. *Cochrane Database Syst Rev.* 2010;12: CD000127. <https://doi.org/10.1002%2F14651858.CD000127.pub2> (accessed September 30, 2024).

CASE 34

A 25-Year-Old at 32 Weeks' Gestation with Hypertension and Right Upper Quadrant Pain

Amy M. Burkett

History of Present Illness

A 25-year-old gravida 1 para 0 at 32 weeks' gestation presents with RUQ pain and a blood pressure of 154/92 mmHg. She reports she has not been feeling well over the last few days. Initially she had nausea but started vomiting this morning. The pregnancy is uncomplicated, routine prenatal serologic testing was within normal limits, and the patient has no significant past medical or surgical history. The patient takes a prenatal vitamin and denies use of other vitamins, herbal supplements, or medications. The patient denies vaginal bleeding, loss of fluid, or contractions. Fetal movement is present.

Physical Examination

General appearance: Gravid female who is ill appearing and in mild distress

Vital signs:

Temperature: 37.0°C

Pulse: 92 beats per minute

Blood pressure: 154/92 mmHg

Respiratory rate: 18 breaths per minute

Cardiopulmonary: Regular rate and rhythm, lungs clear to auscultation bilaterally but diminished respiratory effort is noted secondary to pain with inspiration

Abdomen: Gravid abdomen, soft with tenderness to palpation in the RUQ. Bowel sounds are present

Integumentary: There is no evidence of jaundice, excessive bruising, or rash. 2+ pitting edema is noted in the lower extremities bilaterally

Neurologic/psychologic: Deep tender reflexes are 3+ with no clonus bilaterally. No photophobia elicited

Fetal assessment: Fetal heart rate is 140 beats per minute with moderate variability and accelerations. There are no decelerations. Tocometer: No contractions

Laboratory studies:

Hgb: 8.2 g/dL

Plt: 75,000/ μ L

LDH: 676 IU/L

AST: 250 U/L

ALT: 185 U/L

Total bilirubin: 0.3 mg/dL

BUN: 20 mg/dL

Cr: 1.0 mg/dL

Glucose: 92 mg/dL

Protein: creatinine ratio: 0.6

Imaging:

Transabdominal ultrasound: Single live intrauterine pregnancy in the vertex position with a fundal placenta. Estimated fetal weight is 1,750 g. Amniotic fluid index 9. Biophysical profile (BPP) 8/8.

How Would You Manage This Patient?

This patient has hemolysis, elevated liver enzymes, low platelets (HELLP) syndrome based on laboratory findings. Acute blood pressure management, seizure prophylaxis with magnesium sulfate, and serial laboratories studies were ordered. The fetus remained on continuous monitoring until delivery and an NICU consultation was obtained. Betamethasone was given in anticipation of early delivery. Labor induction was initiated. Regional anesthesia was employed and is preferred for pain control. It is generally considered safe if the Plt is >70 . Magnesium sulfate was continued to 24 hours postpartum. Close postpartum monitoring of vital signs and laboratory studies were necessary as they may worsen. She was discharged when blood pressures were controlled and laboratory abnormalities began to trend toward normal. At discharge, return precautions and a blood pressure cuff for daily surveillance were provided. She returned for a blood pressure check 2–4 days after discharge.

HELLP Syndrome

HELLP syndrome is generally considered a variant of preeclampsia and is considered a life-threatening obstetric condition with a mortality rate as high as 24%. First described in 1982, most cases are diagnosed during the third trimester of pregnancy. Up to 15% do not present with hypertension or proteinuria and about one-third may not be recognized until the postpartum period [1,2]. Hypertensive disorder of pregnancy including HELLP syndrome are thought to be the result of abnormal placentation, chronic placental ischemia, vascular endothelial damage, and activation of pro-inflammatory cytokines [1,3,4].

The typical presentation of a patient with HELLP is RUQ pain and malaise. Nausea and vomiting are also often present. Complaints of headache, visual changes, rashes, yellowing of the skin, dark urine, decreased urine output, vaginal bleeding, and shortness of breath may also be present. These additional complaints can point to both increased disease severity and complications of HELLP syndrome.

Initial evaluation includes vital signs, a detailed review of systems and a thorough physical exam including assessment of fetal status to evaluate for potential complications of HELLP

syndrome as well as to eliminate other diagnoses. Initial recommended laboratory studies include CBC, comprehensive metabolic panel (CMP) and urine protein: creatinine ratio. The CMP provides the necessary evaluation of the liver and kidneys while also providing glucose and electrolyte assessment, which can help delineate HELLP syndrome from acute fatty liver of pregnancy (AFLP), given their clinical manifestations are similar. AFLP more commonly is associated with leukocytosis, hypoglycemia, elevated ammonia, significant hyperbilirubinemia, and coagulopathy [2]. When readily available, a peripheral smear can assist in the diagnosis of hemolysis versus anemia of other etiologies. Consider adding LDH to assess for hemolysis when highly suspicious of the diagnosis and coagulation studies such as PT, PTT, and fibrinogen if vaginal bleeding, placental abruption, or any other signs of coagulopathy are present. Alternatively, these tests can be added once preliminary studies are noted to be abnormal. Right upper quadrant ultrasound should be performed to evaluate for liver hematoma, rupture, or fulminant failure when pain is not easily controlled [3,4].

The fetus should also undergo assessment with an low-stress test (NST). Continuous fetal monitoring is recommended if blood pressures are severe at presentation and once the diagnosis of HELLP syndrome has been made. Further testing with BPP and ultrasonography for fetal position and growth assessment can be performed once the patient is stabilized. Although fetal growth restriction is no longer a diagnostic criterion for preeclampsia with severe features, it can assist the neonatal team in counseling the patient and preparing to care for the neonate.

Differentiating preeclampsia with severe features, HELLP syndrome, and AFLP is often challenging. All three diagnoses can be complicated by placental abruption and postpartum hemorrhage, which may lead to disseminated intravascular coagulation (DIC). It is often only through serial laboratory studies that the diagnosis becomes apparent. Other conditions to consider are thrombotic thrombocytopenic purpura (TTP), which presents with fever, hematuria, and altered mental status, and hemolytic uremic syndrome (HUS), which may mimic TTP in clinical picture and by having increased von Willebrand's factor (vWF) multimers but has normal a disintegrin and metalloproteinase with thrombospondin motifs (ADAMTS) 13. Systemic lupus erythematosus (SLE) flare can present with hypertension and proteinuria, but patients may complain of joint pain, rash, and pleuritic symptoms. Antiphospholipid antibody syndrome (APLS) classically presents with arterial or venous thrombosis in the setting of recurrent pregnancy loss but can present later in pregnancy with lab abnormalities and hypertension similar to HELLP syndrome. It can be diagnosed by assessing for anticardiolipin antibodies IgG or IgM (ELISA), anti-beta-2-glycoprotein-I antibodies IgG or IgM (ELISA), and lupus anticoagulants (functional assays). Fulminant viral hepatitis from infection, drug toxicity, medication overdose, and excessive use of herbal supplements should be considered in patients with jaundice and altered mental status but normal blood pressures.

A detailed history of potential exposures in the preceding months is necessary as the liver insult may have occurred remote from symptom onset [2].

Due to the risk of rapid deterioration of the patient with HELLP and the fetus, inpatient management in a medical facility equipped with adult and neonatal intensive care units, a blood bank capable of massive transfusion protocol, and the availability of maternal fetal medicine, surgical, and other consultative services is recommended. Pulmonary edema can develop rapidly, necessitating intubation while rarely acute renal or hepatic failure can be severe enough to require dialysis and organ transplantation.

Adequate neonatal collaboration and support is crucial. After 34 weeks' gestation, the patient should be started on magnesium sulfate for seizure prophylaxis, treated with IV antihypertensives if needed, and counseled to proceed with delivery due to the risks of worsening HELLP syndrome to both the patient and fetus. Betamethasone can be administered if delivery is not imminent, but should not delay delivery. Prior to 34 weeks, a delay to allow for administration of corticosteroids for fetal lung maturity may be attempted if the patient's clinical and laboratory status remain stable. When there are significant lab abnormalities between 32 and 34 weeks, the risk of worsening maternal deterioration generally outweighs the benefits of delaying delivery for steroid administration. Between 28 and 32 weeks, it is a nuance decision and warrants a multidisciplinary approach, and prior to 28 weeks, there may be more fetal benefit to delay. Again, any delay is contingent upon maternal stabilization. Obstetric and neonatal teams should consider the fetal status, maternal laboratory values, and other maternal factors to decide whether to delay delivery until the steroid window is achieved.

Dexamethasone for the treatment of HELLP syndrome is no longer recommended as large trials show no proven benefit to the patient or fetus [3]. Labor induction and vaginal delivery is preferred but counseling on success rates based on gestational age and shared decision-making to perform a cesarean section without labor is acceptable.

Magnesium sulfate is continued in the postpartum period and should not be stopped during the perioperative period should a cesarean section be performed. Close monitoring of postpartum blood pressures is warranted as oral antihypertensive therapy may be indicated. Serial laboratory studies are generally performed as frequently as every 6 hours as worsening thrombocytopenia and liver function tests are often seen both intra- and post-partum. Platelet transfusion should be done if <20 to avoid risk of intracranial bleeding, in the setting of abruption or in anticipation of operative delivery. Red blood cell (RBC), fresh frozen plasma, or cryoprecipitate transfusions may be necessary in the setting of hemolysis or abruption. Further liver imaging and consultation to subspecialists may be warranted.

Prevention of HELLP syndrome should be directed at modifiable risk factors including hypertension, obesity, and diabetes. Should the patient desire further pregnancies,

ACOG, Society for Maternal-Fetal Medicine (SMFM), and USPSTF recommend starting 81 mg of aspirin at 12 weeks. Pravastatin and metformin have been studied in the prevention of preeclampsia due to evidence that they decrease inflammation and have positive effects on endothelial health, but the data are not conclusive enough to recommend them in general obstetric practice. Bed rest and a low sodium diet do not reduce the risks of developing HELLP or other hypertensive disorders in pregnancy. Vitamins, garlic, and fish oil supplements also do not have enough data to recommend their use to prevent hypertensive disorders of pregnancy [5].

There is ongoing research aimed at identifying a serologic biomarker or early pregnancy ultrasound findings to predict development of preeclampsia. Previous studies that looked at uterine artery Dopplers alone and with serum PlGF and sFlt-1 did not show definitive usefulness. The FDA recently approved sFlt-1:PlGF ratio testing for the assessment of preeclampsia. However, the study inclusion criteria was new or worsening hypertension and new or worsening proteinuria, both being variable in HELLP syndrome, so no conclusions can be drawn about the predictive value for HELLP syndrome at this time [4,6].

Key Teaching Points

- The cure for HELLP syndrome is delivery.
- When a diagnosis is made at 34 weeks and beyond, delivery is recommended at the time of diagnosis. Prior to 34 weeks, a delay to allow for administration of corticosteroids for fetal lung maturity may be attempted if the patient's clinical and laboratory status remain stable.
- Patients with AFLP and HELLP syndrome are best managed in tertiary care centers to ensure access to critical support measures that enable the best maternal and fetal outcomes.
- HELLP syndrome and AFLP can be differentiated by serum glucose and ammonia levels. Both can be complicated by DIC.
- Regardless of gestational age, labor induction and vaginal delivery are preferred in the absence of other clinical indications for cesarean delivery [2].
- Low-dose aspirin beginning at 12 weeks' gestation may lessen the chance of developing HELLP and other hypertensive disorders in future pregnancies [7].

References

- 1 Erez O, Romero R, Jung E, et al. Preeclampsia and Eclampsia: The Conceptual Evolution of a Syndrome. *Am J Obstet Gynecol*. 2022;226:S786–S803.
- 2 Hadi Y, Kupec J. Fatty Liver in Pregnancy. In: *StatPearls*. Treasure Island, FL: StatPearls Publishing; 2023. www.ncbi.nlm.nih.gov/books/NBK545315/ (accessed September 30, 2024).
- 3 Khalid F, Mahendraker N, Tonismae T. HELLP Syndrome. *StatPearls*. Treasure Island, FL: StatPearls Publishing; 2023. www.ncbi.nlm.nih.gov/books/NBK560615/ (accessed September 30, 2024).
- 4 Zeisler H, Llorba E, Chantraine F, et al. Predictive Value of the sFlt-1:PlGF Ratio in Women with Suspected Preeclampsia. *N Engl J Med*. 2016;374:13–22. <http://dx.doi.org/10.1056/NEJMoa1414838> (accessed September 30, 2024).
- 5 Louis JM, Parchem J, Vaught A, et al.; Society for Maternal-Fetal Medicine (SMFM). Preeclampsia: A Report and Recommendations of the Workshop of the Society for Maternal-Fetal Medicine and the Preeclampsia Foundation. *AJOG*. 2022;227:B2–B24.
- 6 Gestational Hypertension and Preeclampsia: ACOG Practice Bulletin, Number 222. *Obstet Gynecol*. 2020;135:e237–e260.
- 7 US Preventive Services Task Force; Davidson KW, Barry MJ, et al. Aspirin Use to Prevent Preeclampsia and Related Morbidity and Mortality: US Preventive Services Task Force Recommendation Statement. *JAMA*. 2021;326:1186–1191.

A 35-Year-Old Presents at 8 Weeks' Gestation with Tremor and Exophthalmos

Lindsey Pflugner

History of Present Illness

A 35-year-old nonbinary pregnant person presents at 8 weeks' gestation by last menstrual period for their first prenatal visit, endorsing minimal nausea, no vomiting, and losing weight while their appetite has been normal. They frequently feel their heart racing at rest and have trouble with heat intolerance. Their biggest concern is a new tremor in their hands. They deny any other pregnancy complaints. Their pregnancy history is significant for two prior first-trimester losses. They report no significant personal or family history. Their only medication includes prenatal vitamins.

Physical Examination

General appearance: Anxious-appearing adult, well-developed

Vital signs:

Temperature: 37.1°C

Pulse: 107 beats per minute

Blood pressure: 140/90 mmHg

Respiratory rate: 18 breaths per minute

BMI: 21 kg/m²

Head and neck: Bilateral exophthalmos. Enlarged thyroid with no nodules

Cardiopulmonary: Tachycardic, otherwise unremarkable

Abdomen: Soft, non-distended. Uterus is below the pubic symphysis

Imaging:

Pelvic ultrasound: A viable intrauterine gestation measuring 8 0/7 weeks, crown rump length consistent with last menstrual period. Fetal heart rate is 160 beats per minute. Normal bilateral adnexa

How Would You Manage This Patient?

This patient is presenting to care for the first time in several years with classic signs and symptoms of hyperthyroidism: nervousness, tremor, weight loss, palpitations, heat intolerance, tachycardia, and hypertension. You are suspicious for Graves' disease given the findings of goiter and evidence of exophthalmos. Thyroid studies were added to routine initial prenatal labs order. These labs were significant for an undetectable thyroid-stimulating hormone (TSH) and a markedly elevated free thyroxine (T4), which confirmed your diagnosis of hyperthyroidism in pregnancy. The patient was counseled regarding the maternal and fetal risks of hyperthyroidism in pregnancy and initiated a thioamide with a plan to repeat thyroid studies throughout the pregnancy.

Hyperthyroidism in Pregnancy

Hyperthyroidism occurs in 0.2–0.7% of pregnancies, with the large majority due to Graves' disease [1]. Graves' disease is an autoimmune condition where TSH-receptor antibodies (TRAb) stimulate the thyroid gland, leading to increased thyroid hormone and decreased TSH via negative feedback loop (Figure 35.1). Inadequately treated hyperthyroidism can lead to maternal and fetal adverse outcomes, as listed in Table 35.1. The risks of immune-mediated fetal hypo- or hyper-thyroidism due to circulating autoantibodies persist even in pregnant people with well-controlled and previously surgically treated Graves' disease [1,2]. Conversely, the second most common cause of hyperthyroidism in pregnancy, physiologic human chorionic gonadotropin (hCG)-mediated thyrotoxicosis,

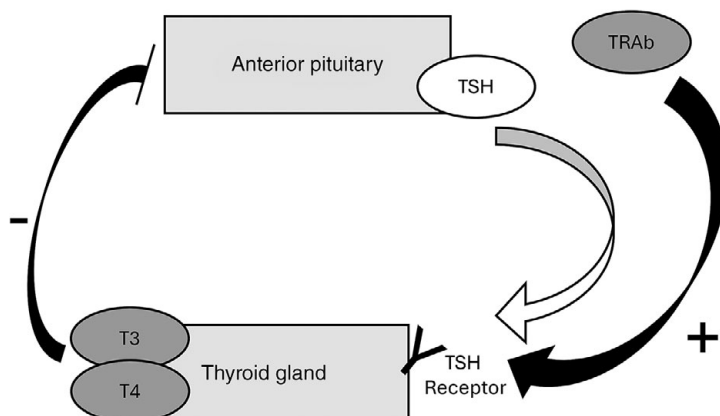


Figure 35.1 Pituitary–thyroid axis in Graves' disease. Thyroid-stimulating hormone receptor antibodies stimulate the TSH receptor, leading to increased production of triiodothyronine (T3) and T4. This leads to negative feedback loop to anterior pituitary, causing a decrease in TSH

Table 35.1 Risks of hyperthyroidism in pregnancy

Maternal	Fetal
Preeclampsia	Spontaneous abortion
Heart failure	Intrauterine fetal demise
Thyroid storm	Fetal growth restriction
	Fetal hyperthyroidism
	Fetal hypothyroidism
	Fetal hydrops

is usually self-limited without significant maternal or fetal risks.

Screening and Diagnosis

Screening for thyroid disease in pregnancy is not universal. It should only be assessed in patients with a personal or family history of thyroid disease, type 1 diabetes, or clinical suspicion of thyroid disease [1]. Initial screening for suspected hyperthyroidism is with evaluation of TSH. Normal TSH levels are population-based and trimester-specific due to hCG stimulation of the TSH receptor leading to increased thyroid hormone and decreased TSH. If these reference ranges are not available, first-trimester TSH reference ranges can be reduced by 0.4 milliunits/L of the lower limit and 0.5 milliunits/L of the upper limit. Non-pregnant TSH reference ranges can be used in the second and third trimesters [1,3].

Findings of a suppressed TSH should then reflex to evaluation of free T4 (fT4) and total triiodothyronine (T3) levels. These values are also pregnancy-specific to account for the increase in thyroid binding globulin in pregnancy. The upper reference range for T4 and T3 can be increased by approximately 50% beyond the first trimester [1]. The diagnosis of hyperthyroidism in pregnancy is then confirmed with a low TSH and high free or total T4 (TT4) or total T3.

Graves' disease is typically differentiated from hCG-mediated thyrotoxicosis based on history and physical examination, including presence or absence of emesis, goiter, and orbitopathy, but measurement of thyroid receptor antibodies may be useful for further clarification of etiology [2]. Some suggest antibody testing in all pregnant persons with hyperthyroidism as a diagnosis of Graves' disease confers additional fetal and neonatal risks. The presence of antibodies may guide additional antenatal surveillance whereas others universally perform antenatal surveillance for all patients with hyperthyroidism in pregnancy. This is a variable practice with insufficient evidence to recommend for or against universal antibody screening and maternal-fetal medicine or endocrinology subspecialty consultation should be considered [3,4,5].

Initial Management

The mainstay of treatment for moderate to severe hyperthyroidism in pregnancy is the thioamide class of medications, namely propylthiouracil (PTU) and methimazole. These medications inhibit the synthesis of thyroid hormones by interfering with thyroid peroxidase within the thyroid gland. While both have been associated with birth defects, PTU is

routinely prescribed in the first trimester when needed, secondary to the twice elevated risk of embryopathy associated with methimazole [4]. Propylthiouracil may be continued throughout the remainder of pregnancy but there is an increased risk of maternal hepatotoxicity, which directs many clinicians to switch to methimazole at the start of the second trimester. Shifting medications may lead to a period of less tight control, thus this decision is individualized [3]. Additional consideration should be given to prior response to therapy and whether the hyperthyroidism is predominantly T3 or T4, as PTU additionally blocks the conversion of T4 to T3 in peripheral tissues.

Initial dosing is empiric with the goal to give the lowest dose necessary whereby reducing the risks of medication exposure and optimizing maternal-fetal outcomes. Suggested starting doses of PTU range from 50 to 100 mg three times a day and methimazole 5–10 mg daily [1]. Dosing is then adjusted based on serial monitoring of fT4, or T3 in T3-predominant hyperthyroidism, every 2–4 weeks. The goal is to keep thyroid hormone levels slightly above or at the high-end of normal range, regardless of TSH [3,5]. Monitoring and dose management is frequently carried out in conjunction with endocrinology and/or maternal-fetal medicine subspecialists. Patients may also benefit from treatment of palpitations, tachycardia, and hypertension with secondary medications as the thioamide medications take effect. Beta-blockade may control symptoms more quickly and can be weaned.

Gradual titration of thioamides is appropriate in all cases of hyperthyroidism in pregnancy except in the presence of thyroid storm. Thyroid storm is a rare and potentially life-threatening complication that requires immediate recognition and management. Frequently following an acute precipitating event such as infection, trauma, or delivery, thyroid storm manifests as a significant exaggeration of typical biochemical hyperthyroidism. These symptoms include fever, cardiovascular dysfunction such as heart failure and arrhythmia, central nervous system decline such as psychosis and coma, multi-organ failure, and maternal death if untreated. Initial management includes supportive measures within the intensive care unit, reducing the synthesis and release of thyroid hormone, and treating the precipitating event. This can be achieved with the use of IV fluids, oxygen, acetaminophen, beta-blockers, steroids, PTU, and iodine supplementation. For the best outcome, these patients should be managed in a hospital capable of a high level of care with availability of a multidisciplinary team [6].

Key Teaching Points

- Screening for thyroid disease is indicated in pregnant persons with personal or family history of thyroid disease, history of type 1 diabetes, or clinical features suspicious for thyroid disease.
- Hyperthyroidism in pregnancy is diagnosed by a low TSH and a high T4 or T3, based on trimester-specific and population-based reference ranges.

- Treatment is traditionally with PTU given in the first trimester to reduce risk of embryopathy, and methimazole in the second and third trimesters to reduce the risk of hepatotoxicity, but variation in practice exists.
- Thyroid hormone, not TSH, should be monitored every 2–4 weeks with the goal to keep T4 or T3 slightly above or within the high-normal reference range.
- Thyroid storm is a rare, potentially life-threatening condition requiring immediate recognition and management in a tertiary care setting.

References

- 1 Thyroid Disease in Pregnancy: ACOG Practice Bulletin, Number 223. *Obstet Gynecol.* 2020;135:e261–e274.
- 2 Cooper D, Laurberg P. Hyperthyroidism in Pregnancy. *Lancet Diabetes Endocrinol.* 2013;3(1):238–249.
- 3 Alexander EK, Pearce EN, Brent GA, et al. 2017 Guidelines of the American Thyroid Association for the Diagnosis and Management of Thyroid Disease during Pregnancy and the Postpartum. *Thyroid.* 2017;27:315.
- 4 Ross DS, Burch HB, Cooper DS, et al. 2016 American Thyroid Association Guidelines for Diagnosis and Management of Hyperthyroidism and Other Causes of Thyrotoxicosis. *Thyroid.* 2016;26:1343.
- 5 De Groot L, Abalovich M, Alexander EK, et al. Management of Thyroid Dysfunction during Pregnancy and Postpartum: An Endocrine Society Clinical Practice Guideline. *J Clin Endocrinol Metab.* 2012;97:2543.
- 6 Pokhrel B, Aiman W, Bhusal K. Thyroid Storm. *StatPearls.* Treasure Island, FL: StatPearls Publishing; 2022. www.ncbi.nlm.nih.gov/books/NBK448095/ (accessed October 3, 2024).

A 23-Year-Old Primigravida at 8 Weeks' Gestation with Fatigue, Constipation, and Cold Intolerance

Jorge Luis Casquero Leon

History of Present Illness

A 23-year-old primigravida at 8 weeks' gestation presents at your office for her initial prenatal visit. She reports experiencing fatigue, muscle cramps, and constipation since the onset of her pregnancy, with these symptoms having recently worsened. Despite wearing layered clothing, she frequently feels cold while at home. Her medical history is unremarkable, with no prior surgeries or allergies. She is currently taking prenatal vitamins, and her last primary-care physician visit, including normal routine blood work and cervical cytology, occurred 6 months ago.

Physical Examination

Vital signs:

Temperature: 36.6°C

Pulse: 65 beats per minute

Blood pressure: 110/70 mmHg

Respiratory rate: 14 breaths per minute

BMI: 32 kg/m²

General appearance: Well-developed, well-nourished, in no apparent distress

Neck: Thyroid gland enlarged, firm, and non-tender

Integumentary: Cold and dry

Abdomen: Soft, non-tender

Pelvic: Normal external genitalia; vagina with normal rugae, no discharge or lesions seen; normal cervix without lesions; uterus enlarged consistent with dates, adnexa without enlargement or tenderness

Extremities: Prolonged relaxation phase of deep tendon reflexes

Laboratory studies:

TSH: 6 mU/L

fT4: 0.1 ng/dL

Antithyroid peroxidase antibodies (TPOAb): Positive

Hgb: 9.3 g/dL

Imaging:

A transvaginal ultrasound examination reveals a single viable intrauterine pregnancy at 8 weeks' gestation, with fetal heart tones of 170 beats per minute. A right 3 cm ovarian cyst is present, consistent with the corpus luteum

was educated on the importance of maintaining adequate thyroid function to avoid complications. We also reviewed a set of evidence-based recommendations to assist the patient in making informed decisions.

The patient was advised to take 100 µg/day of levothyroxine (LT4) medication. To address the anemia, the patient has been prescribed ferrous sulfate once daily and an osmotic laxative to manage constipation. It is important to note that ferrous sulfate can impact T4 absorption and should be taken at least 4 hours apart from LT4. At the patient's 4-week checkup for routine prenatal care, she reported significant improvement in her symptoms. Her repeat TSH level was 5 mU/L, and her Hgb increased to 10.1 g/dL. An additional increase in her LT4 was made to normalize her TSH. By the mid second trimester, her TSH level was within normal limits. The remainder of the pregnancy was uncomplicated. The patient was not on LT4 before pregnancy, so her dose was maintained, and performed a thyroid function test at her 6-week postpartum visit. We advised her to continue managing her thyroid disease with her primary care provider.

How Pregnancy Affects Thyroid Function

During pregnancy, the thyroid gland undergoes alterations in size and function. This is attributed to various factors such as increased excretion of iodine by the kidneys, enhanced production of thyroid hormones, higher levels of proteins that bind to T4, and the stimulation of the thyroid gland by hCG. In regions with an adequate supply of iodine, the thyroid gland enlarges by approximately 10%. However, in areas with iodine deficiency, the gland can grow up to 20–40% [1,2].

Following conception, there is a rise in estrogen production, leading to an increase in T4-binding globulin (TBG) levels. Thyroxine-binding globulin is responsible for binding more thyroid hormone, significantly increasing TBG and TT4 concentrations by week 7 of pregnancy. These levels peak at approximately week 16 and remain elevated until delivery [3].

In the first trimester of pregnancy, maternal hCG stimulates the TSH receptor, causing an increase in T4 production and a temporary decrease in serum thyrotropin-releasing hormone (TRH) and TSH levels. As many as 15% of healthy women may experience a TSH below the nonpregnant lower limit of 0.4 mIU/L within the first 12 weeks' gestation. During the third trimester, TSH levels gradually increase and return to baseline values due to placental growth and the production of placental deiodinase [1,2].

The upper reference limit for serum TSH concentration during pregnancy was previously defined as 2.5 mU/L in the

How Would You Manage This Patient?

The patient has untreated hypothyroidism, causing fatigue, muscle cramps, constipation, and cold intolerance. The patient

first trimester and 3.0 mU/L in the second and third trimesters based on six pregnancy studies from 2011. However, a more extensive cohort study revealed significant variations in the upper reference limit due to factors such as iodine status, TSH assay methods used for analysis, BMI, geography, and ethnicity. In addition, during pregnancy, the TSH reference range experiences a downward shift, resulting in a decrease in the lower and upper limits of maternal TSH compared to the typical nonpregnant TSH reference range [1].

As there are notable differences in maternal TSH levels among healthy, TPOAb-negative, and iodine-sufficient women, the American Thyroid Association recommends that practitioners and hospitals establish their trimester-specific reference ranges based on these factors. This approach ensures more accurate and reliable results. If not possible, the Task Force of the American Thyroid Association recommends using an upper reference limit of 4.0 mU/L (which represents a reduction in the nonpregnant TSH upper reference limit of 0.5 mU/L) [1,4].

How Thyroid Disease Affects Pregnancy

Overt hypothyroidism is defined as an elevated TSH and low fT4. Etiologies can include autoimmune (Hashimoto's), congenital, removal or destruction of the thyroid (surgical or radiation), iodine insufficiency, or pituitary damage. Hashimoto's thyroiditis is the primary cause of hypothyroidism during pregnancy. This autoimmune condition is characterized by anti-thyroid peroxidase antibodies, which destroy the thyroid gland. Therefore, TPOAb is present in 30–60% of pregnant women with elevated TSH [1,2].

Overt hypothyroidism can manifest with nonspecific symptoms similar to those experienced during pregnancy, such as fatigue, constipation, cold intolerance, muscle cramps, and weight gain. Other clinical manifestations include edema, dry skin, hair loss, and prolonged relaxation phase of deep tendon reflexes. The presence of goiter is not a definitive indicator, but it is more likely to occur in women with Hashimoto's thyroiditis or areas with insufficient iodine levels. If left untreated, maternal hypothyroidism can result in adverse outcomes for both the pregnancy and fetal development, such as premature birth, low birth weight, pregnancy loss, and reduced cognitive abilities in offspring. In addition, there is a 22% increased risk of developing gestational hypertension. Addressing maternal hypothyroidism is crucial to prevent such complications [5,6,7].

In contrast, subclinical hypothyroidism is characterized by an elevated serum TSH level with a normal fT4 level. Although this condition is prevalent during pregnancy, insufficient evidence supports identifying and treating it. Further research is needed to establish the potential benefits and risks of intervention for this condition [8].

Up to 20% of women of reproductive age have been found to have autoantibodies to thyroid peroxidase. Those with TPOAb are at a higher risk for worsening thyroid disease and developing postpartum thyroiditis. For women with normal thyroid function tests and without a history of

thyroid disease, routine testing for TPOAb is not recommended. This is because thyroid hormone replacement therapy for these antibodies alone has yet to improve pregnancy outcomes significantly. However, women with mild elevations of TSH (>2.5 mU/L) and positive TPOAb are at increased risk for pregnancy complications, including pregnancy loss [1,4].

Treatment

Administering oral LT4 is the recommended treatment for maternal hypothyroidism, as it is crucial for fetal brain development. Desiccated thyroid preparations have a T4:T3 ratio of 4.2:1, significantly lower than the 14:1 ratio of secretion by the human thyroid gland. This results in supraphysiologic maternal levels of T3 and relatively low levels of T4 due to the relative excess of T3. Patients using either desiccated thyroid or a treatment regimen combining T3 and T4 likely have insufficient transfer of maternal T4 to the fetal brain, putting the baby at risk. Therefore, preparations like T3 or desiccated thyroid should be avoided during pregnancy [1,2].

Inadequate adjustment of exogenous LT4 can lead to maternal hypothyroidism as the demand for pregnancy exceeds supply. Studies have revealed that the need for T4 (or exogenous LT4) increases as early as 4–6 weeks' gestation, gradually escalating through 16–20 weeks and stabilizing until delivery. Therefore, it is advisable for patients receiving LT4 treatment with a suspected or confirmed pregnancy (e.g. positive home pregnancy test) to increase their LT4 dose by 20–30% and promptly inform their provider for testing and evaluation. One way to achieve this is by administering two additional tablets per week of the patient's current daily LT4 dosage [1,3].

The recommended daily dose of LT4 for replacement therapy is approximately 1–2 $\mu\text{g}/\text{kg}$ of body weight, or about 100 $\mu\text{g}/\text{day}$. Pregnant patients with thyroid surgery or radioiodine therapy and no thyroid function may need a higher dosage. Adjustments should be made every 4 weeks to ensure optimal thyroid functioning. Maintaining maternal TSH concentrations ≤ 2.5 mU/L is advisable [1,2]. For women who have adequately treated hypothyroidism, there is no need for any additional maternal or fetal testing, except for measuring maternal thyroid function, unless there are other unique circumstances during pregnancy. Serial fetal ultrasounds, antenatal testing, and umbilical blood sampling are not recommended [2,3].

Following delivery, lowering LT4 to the patient's preconception dose is recommended. It is advisable to conduct additional thyroid function tests around 6 weeks after delivery. Some who start on LT4 during pregnancy may not require it postpartum, particularly those prescribed <50 $\mu\text{g}/\text{day}$. These women may consider discontinuing LT4, although the decision is subjective and should be cautiously made. However, those with thyroid peroxidase antibodies have a higher chance of experiencing postpartum thyroiditis and the progression of thyroid disease. Furthermore, not treating overt hypothyroidism could affect milk production [1,3].

Key Teaching Points

- Hashimoto's thyroiditis is the primary cause of hypothyroidism during pregnancy.
- Hypothyroidism that goes untreated during pregnancy can lead to spontaneous abortion, preterm birth, preeclampsia, abruptio placentae, stillbirth, low birth weight, and impaired neuropsychological development of the baby.
- Thyroid disease evaluation is recommended for pregnant women with a history of thyroid disease, type 1 diabetes, or presenting symptoms.
- Population- and trimester-specific reference ranges for serum TSH during pregnancy should be defined by a provider's institute or laboratory and represent the typical population for whom care is provided. If this is not feasible, an upper reference limit of 4.0 mU/L may be used.
- When initiating replacement therapy, LT4 is administered at a daily dose of 1–2 µg/kg of body weight or approximately 100 µg/day.
- Target the TSH level between the lower limit of the reference range and 2.5 mU/L. Adjustments should be made every 4 weeks to ensure optimal thyroid functioning.
- If the patient is undergoing treatment for hypothyroidism, consider a 25% increase in LT4 replacement at pregnancy confirmation.
- After delivery, decrease the dosage of LT4 to the patient's pre-pregnancy level. If LT4 was started during pregnancy, maintain the exact dosage to prevent the disease progression and support lactation.

References

- 1 Alexander EK, Pearce EN, Brent GA, et al. 2017 Guidelines of the American Thyroid Association for the Diagnosis and Management of Thyroid Disease during Pregnancy and the Postpartum. *Thyroid*. 2017;27(3):315–389.
- 2 Thyroid Disease in Pregnancy: ACOG Practice Bulletin, Number 223. *Obstet Gynecol*. 2020;135:e261–e274.
- 3 Zhong Y, Peng S, Chen Q, et al. Preconceptional Thyroid Stimulating Hormone Level and Fecundity: A Community-Based Cohort Study of Time to Pregnancy. *Fertil Steril*. 2023;119(2):313–321.
- 4 Plowden TC, Schisterman EF, Sjaarda LA, et al. Thyroid-Stimulating Hormone, Anti-thyroid Antibodies, and Pregnancy Outcomes. *Am J Obstet Gynecol*. 2017;217(6):697.e1–697.e7.
- 5 Consortium on Thyroid and Pregnancy – Study Group on Preterm Birth; Korevaar TIM, Derakhshan A, Taylor PN, et al. Association of Thyroid Function Test Abnormalities and Thyroid Autoimmunity with Preterm Birth: A Systematic Review and Meta-analysis. *JAMA*. 2019;322(7):632–641.
- 6 Frank AS, Lupattelli A, Brandlistuen RE, et al. Maternal Thyroid Hormone Replacement Therapy Exposure and Language and Communication Skills of Offspring at 8 Years of Age. *JAMA Netw Open*. 2019;2(10):e1912424.
- 7 Jansen TA, Korevaar TIM, Mulder TA, et al. Maternal Thyroid Function during Pregnancy and Child Brain Morphology: A Time Window-Specific Analysis of a Prospective Cohort. *Lancet Diabetes Endocrinol*. 2019;7(8):629–637.
- 8 Feller M, Snel M, Moutzouri E, et al. Association of Thyroid Hormone Therapy with Quality of Life and Thyroid-Related Symptoms in Patients with Subclinical Hypothyroidism: A Systematic Review and Meta-analysis. *JAMA*. 2018;320(13):1349–1359.

A 25-Year-Old with Elevated Hemoglobin A2 on Initial Prenatal Labs

Logan C. Peterson*

History of Present Illness

A 25-year-old gravida 1 at 10 weeks' gestation presents for her initial prenatal appointment. She reports feeling well overall but notes persistent mild nausea and a few episodes of vomiting. She denies cramping, abdominal pain, or vaginal bleeding. She has no significant medical or surgical history. She is married and denies any alcohol or tobacco use. Her family history is unremarkable. On review of her prenatal labs, she is found to have a mild microcytic anemia and an elevated Hgb A2 on prenatal screen.

Physical Examination

General appearance: Well-appearing young woman, sitting comfortably on the exam table, no distress

Vital signs:

Temperature: 37.2°C

Pulse: 78 beats per minute

Blood pressure: 109/72 mmHg

Respiratory rate: 14 breaths per minute

BMI: 23.1 kg/m²

Cardiopulmonary: Regular rate and rhythm

Abdomen: Soft, non-tender, no guarding or rebound, no masses

Pelvic: Unremarkable

Laboratory studies:

WBC: $9.1 \times 10^3/\mu\text{L}$

Hgb: 10.6 g/dL

Hct: 32%

Plt: $196 \times 10^3/\mu\text{L}$

Mean corpuscular volume: 71

Ferritin: 90 µg/L

Hgb electrophoresis:

Hgb A: 93%

Hgb A₂: 5%

Hgb F: 2%

Hgb S: 0%

Hgb C: 0%

Imaging:

Bedside ultrasound: Single intrauterine pregnancy with fetal cardiac activity present at 164 beats per minute. Size consistent with 10 weeks.

How Would You Manage This Patient?

This patient presents with findings concerning for a hemoglobinopathy, specifically beta-thalassemia minor, given her abnormal CBC and Hgb electrophoresis. The patient should be evaluated for any symptoms of anemia, though most patients with beta-thalassemia minor will be asymptomatic. A detailed history should be obtained, including family history of any individuals affected by genetic disorders, and the patient should be offered screening for other genetic diseases. Hemoglobinopathy testing for the other parent should be recommended to assess the risk of hemoglobinopathy in the fetus. If her partner has no hemoglobinopathy, then there is little risk to the fetus; however, should the partner also have a thalassemia, the risk of having an affected fetus ranges from 25 to 50% depending on the mutation. She should also be counseled regarding this diagnosis. Patients with beta-thalassemia minor have similar pregnancy risks and outcomes as those in the general population. Ensure the patient is taking folic acid supplementation, as folate stores may be lower due to increased erythropoiesis. The patient should be monitored at routine intervals for development of worsening anemia and treated as appropriate. Importantly, supplementing iron in the absence of iron deficiency will not improve maternal anemia and may lead to iron-related side effects. Timing of delivery will depend on obstetric indications, as beta-thalassemia minor is not an indication for early delivery. Route of delivery should also be based on obstetric considerations. Breast-feeding is not contraindicated and should be encouraged in all patients with hemoglobinopathy [1].

Hemoglobinopathy

One in 66 people in the United States have a hemoglobinopathy trait and over 270 million people are heterozygous carriers of hemoglobinopathies worldwide. Hemoglobin consists of four protein chains (two α-chains and two β-, γ-, δ-, ε-, or ζ-chains), each joined with a heme molecule. In adult Hgb, Hgb A (two α-chains and two β-chains) is the predominant type; however, Hgb F (α- and γ-chains) and Hgb A₂ (α- and δ-chains) can also be seen in small amounts [2]. Alterations in the amount or quality of the Hgb proteins can adversely impact RBC production, function, shape, oxygen delivering capacity, and increase RBC destruction. The most common

* Note: The opinions and assertions expressed herein are those of the author(s) and do not reflect the official policy or position of the Uniformed Services University of the Health Sciences or the Department of Defense.

hemoglobinopathies include sickle cell, and alpha- and beta-thalassemia, which are disorders involving decreased production of Hgb chains. This is due to deletion or mutation of the α -globin or β -globin genes, which are located on chromosome 16 and on chromosome 11, respectively [3]. Hemoglobinopathies represent the most common single-gene disorders found worldwide, thus the burden of disease, and importance of screening and appropriately managing these patients, cannot be overemphasized. Universal screening of all pregnant patients or patients that desire to become pregnant should be offered; ethnicity- or geographically-based screening is not recommended given the disease prevalence is over 1% [4,5].

Evaluation of Anemia in Early Pregnancy

All pregnant patients should have a CBC completed early in pregnancy. When anemia is observed, evaluation of the MCV should follow. A microcytic anemia should prompt iron studies such as a ferritin level to rule out iron deficiency anemia (IDA). If IDA is diagnosed, then iron supplementation should be started and the patient monitored for improvement. If iron studies are normal, then additional testing via Hgb electrophoresis or other modality to detect abnormal Hgb variants should be completed. Diagnosis of many of the common hemoglobinopathies to include sickle cell and beta-thalassemia disorders can be made via electrophoresis. Alpha-thalassemia disorders require molecular genetic testing for diagnosis [5]. If testing returns positive for a hemoglobinopathy, the patient should be counseled regarding this diagnosis, and testing should be recommended for the other parent so that fetal risk for inheriting a hemoglobinopathy can be assessed. Importantly, ACOG now recommends that Hgb electrophoresis or molecular genetic testing be offered to *all* patients [4].

Alpha-thalassemia

Alpha-thalassemia is a group of disorders related to decreased or absent α -globin chain production. There are no substitutes for the α -globin chain in adult Hgb as there are for β -globin chain, and thus chains are either present or not. Four major states have been described based on the number of nonfunctional or, more commonly, deleted genes. The silent carrier state is the absence of one α -globin gene and is clinically undetectable except under DNA analysis. Absence of two α -globin genes leads to alpha-thalassemia trait, which usually presents as a mild anemia. Importantly, individuals with deletion of both genes from the same chromosome (heterozygous *cis* α -thalassemia-1) are at risk of having a fetus with more severe alpha-thalassemia. Hemoglobin H disease is the absence of three α -globin genes and has a wide clinical presentation from a mild, asymptomatic anemia to profound anemia complicated by hepatosplenomegaly and hemolysis. Finally, Hgb Bart's disease is the complete absence of α -globin genes. This condition generally leads to fetal hydrops and fetal or neonatal death; however, intrauterine transfusion has been employed successfully. Diagnosis is made via molecular genetic testing. Pregnancy outcomes are generally favorable in the carrier and

trait states and many patients have gone undiagnosed until pregnancy screening. Those with Hgb Bart's have been found to have higher rates of obstetric complications, including polyhydramnios and preeclampsia, and will need multidisciplinary care [2].

Beta-thalassemia

Beta-thalassemia disorders are related to decreased or absent production of the β -globin protein. As with alpha-thalassemia, the phenotype is variable based on the number of globin genes present. Unlike alpha-thalassemia, however, compensation can occur for the lack of β -globin chains via increases in γ - and δ -chain production, leading to the formation of Hgb F and Hgb A₂. Three major conditions have been described in relation to beta-thalassemia:

- Beta-thalassemia minor, in which the patient is heterozygous for a mutation, presents with very mild or no anemia. The MCV will generally be notably small and elevated levels of Hgb A₂ and Hgb F are seen on electrophoresis.
- Beta-thalassemia intermedia is notable for two gene mutations and is characterized by a mild anemia and symptoms presenting later in life secondary to iron overload due to increased intestinal absorption.
- Beta-thalassemia major (Cooley's anemia) is caused by homozygous or double heterozygous mutations. This state is characterized by severe anemia presenting very early in life and patients are transfusion dependent. Hgb electrophoresis is notable for only Hgb A₂ and Hgb F [2].

Diagnosis of beta-thalassemia made via Hgb electrophoresis with elevated Hgb A₂ and a concomitant decrease in Hgb A. Hgb F may also be seen in a slightly elevated range. Pregnancy outcomes are good in those with beta-thalassemia minor. Pregnancies complicated by beta-thalassemia intermedia and major are at increased risk for fetal growth restriction, diabetes, thyroid disorders, and rates of cesarean delivery approach 80% in those with more severe forms [1].

Sickle Cell

In sickle cell disease, the Hgb has a single nucleotide substitution that leads to an amino acid change and thus an alteration in the shape of the globin chain and eventually the RBC [6]. There are several phenotypes that have been described to include sickle cell trait, sickle cell anemia, and concomitant β -globin disorders such as Hgb sickle cell disease and Hgb S/beta-thalassemia. Depending on the inherited genotype, clinical presentation may vary from the asymptomatic carrier state (sickle cell trait) to a profound hemolytic anemia with significant vasoocclusive crises. Diagnosis is made via Hgb electrophoresis with Hgb S bands observed. Solubility testing alone is not recommended as it cannot distinguish carrier versus disease state nor can it detect other pathologic variations [3]. Pregnancy outcomes vary with phenotype and are generally good in patients with sickle cell trait. In those with sickle cell anemia or mixed disorders, a range of

complications have been attributed to the disease, including: anemia necessitating transfusion, hypertensive disorders, venous thromboembolism, urinary tract infection, fetal growth restriction, and stillbirth, among others [6].

Pregnancy Management

Management strategies for hemoglobinopathies will vary depending on disease and severity. Generally, patients will need additional folic acid supplementation given the increased turnover in RBCs. Additionally, treatment with 81 mg daily aspirin should be considered, especially in patients with vasoocclusive disease states. Additional anticoagulation may be warranted, depending on the patient's history and the disease severity. An early and careful review of medications is necessary. Several commonly used medications including hydroxyurea, angiotensin-converting enzyme inhibitors, bisphosphonates, and oral iron chelators have limited data or are directly contraindicated in pregnancy [6]. The patient should take a prenatal vitamin, but those at risk for iron overload should take one without iron. Further, a careful evaluation for signs and symptoms of end organ damage related to the hemoglobinopathy should be completed. This may include cardiac disease and arrhythmia related to iron overload, splenectomy related to

infarction or surgical removal, and pulmonary arterial hypertension. Patients should undergo electrocardiography, echocardiography, and early screening for diabetes and thyroid disorders [1]. Patients with clinically significant disease are best managed by a multidisciplinary team that has demonstrated improved maternal and fetal outcomes [6].

Key Teaching Points

- All patients desiring pregnancy or that are pregnant should be screened for hemoglobinopathy via CBC and Hgb electrophoresis or molecular genetic testing.
- Evaluate gestational anemia and supplement iron only in cases of iron deficiency.
- Patients with hemoglobinopathy should be referred for genetic counseling and should be counseled regarding pregnancy-specific risks.
- Most patients found to have a hemoglobinopathy on prenatal screening will likely be asymptomatic and have a normal pregnancy.
- Care for patients with clinically significant hemoglobinopathies should involve a multidisciplinary team.

References

- 1 Naik RP, Lanzkron S. Baby on Board: What You Need to Know about Pregnancy in the Hemoglobinopathies. *Hematology Am Soc Hematol Educ Program*. 2012;2012(1):208–214.
- 2 Rappaport VJ, Velazquez M, Williams K. Hemoglobinopathies in Pregnancy. *Obstet Gynecol Clin North Am*. 2004;31(2):287–317, vi.
- 3 ACOG Practice Bulletin No. 78: Hemoglobinopathies in Pregnancy. *Obstet Gynecol*. 2007;109(1):229–237. <http://dx.doi.org/10.1097/00006250-200701000-00055> (accessed September 30, 2024).
- 4 American College of Obstetricians and Gynecologists. Hemoglobinopathies in Pregnancy. Practice Advisory August 2022. www.acog.org/clinical/clinical-guidance/practice-advisory/articles/2022/08/hemoglobinopathies-in-pregnancy (accessed October 3, 2024).
- 5 Barrett AN, Saminathan R, Choolani M. Thalassaemia Screening and Confirmation of Carriers in Parents. *Best Pract Res Clin Obstet Gynaecol*. 2017;39:27–40.
- 6 Jackson LA, Hill QA, Ciantar E. The Management of Haemoglobinopathies in Pregnancy and Childbirth. *The Obstetrician & Gynaecologist*. 2022;24:109–118.

CASE 38

A 30-Year-Old at 10 Weeks' Gestation with a New Positive HIV Test

Denise M. S. Willers

History of Present Illness

A 30-year-old patient is presenting for follow-up after her recent labs revealed a positive HIV 1/2 Ab+ p24 antigen and confirmatory HIV 1 antibodies on immunoblot differentiation assay. The patient has no medical conditions and ultrasound confirms a 10-week viable intrauterine pregnancy. The patient presents with her fiancé and is crying. On further history, the patient is unsure how she could be infected. She has had three sexual partners in the last 10 years, including her ex-husband, who is the father of her 7-year-old son, another man during a 1-year relationship, and her fiancé, who she has dated for 18 months. She tested negative for HIV during her last pregnancy. She is a nurse but does not remember any possible exposures and denies any intravenous (IV) drug use. After your phone call yesterday disclosing the positive HIV test, she disclosed this to her fiancé and he got tested and is negative. Review of systems is negative for fevers, cough, and skin changes and positive for nausea and breast tenderness.

Physical Examination

General appearance: Healthy-appearing female, tearful with good eye contact

Vital signs:

Temperature: 37°C

Pulse: 78 beats per minute

Blood pressure: 108/64 mmHg

Respiratory rate: 20 breaths per minute

Oropharynx: Normal dentition, no thrush

Thyroid: Normal, no thyromegaly or nodules, no palpable cervical lymphadenopathy

Abdomen: Soft and non-tender to palpation with no masses

Genitourinary: Normal external genitalia, no lesions, no abnormal discharge, speculum exam with normal cervix. Bimanual exam is normal with a 10-week-sized uterus and no adnexal masses

Laboratory studies:

WBC: $12.7 \times 10^9/L$

Hgb: 11.2 g/dL

Plt: 423,000/ μL

HIV 1/2 Ab+ p24 antigen: Positive

Immunoblot HIV differentiation assay: Positive for HIV 1 antibodies

HIV 1 RNA polymerase chain reaction (viral load): 47,321 copies/mL

HIV genotype: No relevant mutations

CD4: 543 cells/ mm^3

Hepatitis C Ab: Negative

Rapid plasma reagin: Negative

Hepatitis B surface antigen: Negative

Gonorrhea: Negative

Chlamydia: Negative

Trichomonas: Negative

How Would You Manage This Patient?

This patient and her partner were supportively counseled and educated about the importance of antiviral therapy to reduce circulating HIV, and the respective risk of transmission to the fetus. She was counseled that with good antiviral therapy compliance, the HIV RNA (often referred to as viral load) can be reduced to a level so low it becomes “undetectable” with standard labs (<50 copies/mL in most labs). She was reassured that with use of antiviral medication, an undetectable HIV RNA, and oral zidovudine (ZDV) given to the newborn for 2–6 weeks, the risk of maternal-to-child transmission of HIV is <1%. A transmission rate is 0.09% if viral load was <50 copies/mL [1]. She was also counseled that taking medications and having an undetectable HIV RNA will reduce the risk of transmission of HIV to her partner and that use of condoms is indicated to further reduce the risk. She was counseled on the good long-term prognosis of HIV infection. A referral to infectious disease was expedited by clinic staff.

HIV Testing

Testing for HIV is highly acceptable to patients during pregnancy and should be completed at first presentation for prenatal care. Opt-out testing in pregnancy is preferred. Testing for HIV based on risk-factor assessment is not recommended in pregnancy as this approach has been proven to miss diagnoses in pregnant patients [2]. Repeat testing is recommended in the third trimester for patients with recent sexually transmitted infections or who have a new sexual partner or a partner with HIV infection. The Centers for Disease Control and Prevention (CDC) and ACOG recommend facilities with an HIV incidence of ≥ 1 per 1,000 pregnant women to routinely repeat HIV testing in the third trimester (before 36 weeks). All patients who present in labor without HIV testing during pregnancy should have a rapid test for HIV that results within 1 hour [3,4]. State mandates vary from those with no HIV testing mandate to mandates for universal third-trimester HIV testing. Many states mandate HIV antibody testing in newborns with unknown maternal status. Positive HIV

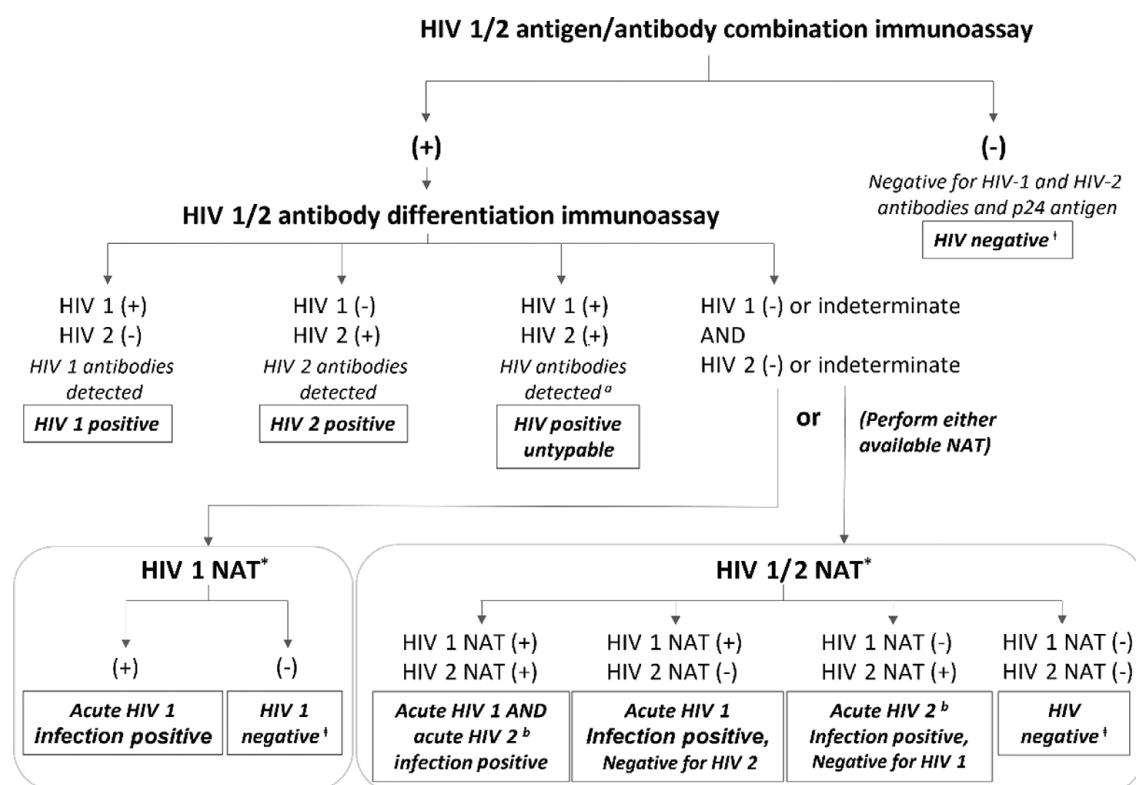


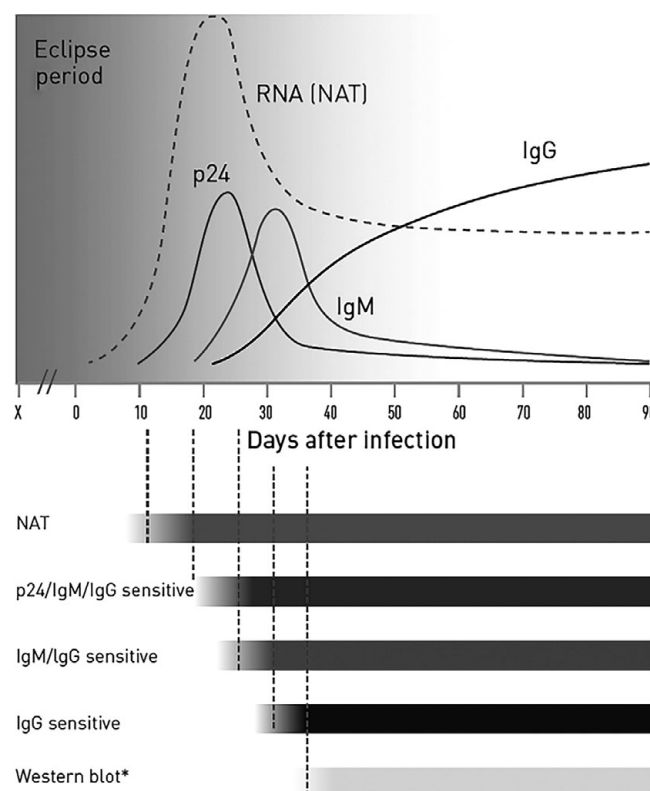
Figure 38.1 Algorithm for HIV screening in pregnancy. NAT, nucleic acid test

antibodies in the newborn indicate maternal HIV infection regardless of newborn HIV status [5]. Figure 38.1 summarizes the algorithm for HIV screening in pregnancy.

Screening for HIV should be performed with combined HIV 1/2 antibody and P24 antigen testing (fourth-generation test). All positive tests are confirmed with an HIV 1/2 differentiation assay. The fourth-generation test detects HIV infection as early as 18 and as late as 45 days post-infection, so if more recent exposure or acute HIV is suspected (fever, headache, lymphadenopathy, rash, myalgia, leukopenia, and thrombocytopenia), an HIV RNA can also be sent. This converts to positive approximately 12 days after exposure (see Figure 38.2 for timing of infection to detection) [3]. Urgent consultation with infectious disease specialists should be obtained for acute HIV infection. Patients with high-risk exposures within the last 72 hours should be considered for HIV postexposure prophylaxis. The CDC maintains a site that provides updated recommendations on HIV screening tests (www.cdc.gov/hiv/clinicians/screening/tests.html).

Pregnancy Management

A new diagnosis of HIV in pregnancy can be devastating for a patient, and adequate time for counseling and support is paramount. This patient appears to have a supportive partner who is negative for HIV, but often patients have concerns about rejection, blame, or their safety when they disclose to a partner. Patients may desire to delay this disclosure until



* Western blot is no longer used for HIV.

Figure 38.2 Timing of infection to detection

they feel safe. Assistance with disclosure to a partner and referrals for partner testing can be offered if desired by the patient.

Consultation with an infectious disease specialist for medication management of HIV is available in most centers in the United States. If any delays are anticipated, antiretroviral therapy can be started by the obstetrician. The Perinatal HIV Clinical Guidelines are regularly updated and can give insight into currently recommended medications, including different patient scenarios such as prior antiretroviral use or coexisting hepatitis [3]. The patient should be counseled to take every dose of medication throughout her pregnancy. Clinicians should assess and address any potential barriers such as pharmacy issues, cost, or tolerance. Testing for HIV RNA, genotype resistance testing, and CD4 count should be drawn prior to medication initiation, but for late diagnoses, the medication should not be held for results. Retesting for HIV RNA should be performed 2–4 weeks after antiviral initiation and every 4 weeks until HIV RNA is undetectable. In stable patients with undetectable HIV RNA, the test can be repeated in the second and third trimesters and at 36 weeks – at least every 3 months. Liver enzymes and CD4 count should be repeated at least every 3 months. Counts of CD4 are a measure of immune function and patients with CD4 counts ≤ 200 $\mu\text{L/mL}$ require daily antibiotic prophylaxis against opportunistic infections [3]. It is also important to make sure health care maintenance, such as vaccinations and cervical cancer screening, are up to date.

Delivery Planning

The HIV RNA level at 36 weeks is the key driver to delivery recommendations. If HIV RNA is $>1,000$ copies/mL, cesarean delivery prior to labor reduces the risk of transmission and is performed at 38 weeks to decrease the chance of spontaneous labor or rupture of membranes. An HIV RNA that is detectable but $<1,000$ copies/mL should raise concern that there are issues with compliance and patient counseling and possible repeat testing before 38 weeks should be considered. In patients who have achieved or maintained an undetectable HIV RNA by 36 weeks and are compliant with medications, the risk of transmission of HIV during vaginal delivery is extremely low and cesarean delivery has not been shown to further reduce the risk. Delivery timing for patients with HIV and an undetectable HIV RNA should be per usual obstetric indications and a 38-week delivery is not indicated.

There are several obstetric considerations in patients with HIV. Length of rupture of membranes is not a transmission risk factor when the HIV RNA is $<1,000$ copies/mL. As such in this subgroup, rupture of membranes can be performed as indicated. However, in all groups, scalp electrode should be avoided. Other procedures such as operative delivery and first- or second-trimester genetic chorionic villous sampling and amniocentesis are low risk in patients with an undetectable HIV RNA, and shared decision-making with attention to risks and benefits should be employed.

Oral antiviral medications are continued throughout labor and delivery, regardless of per oral status. The addition of IV ZDV at least 3 hours prior to delivery (2 mg/kg load over first hour, then 1mg/kg/hour until delivery) for patients with HIV RNA $>1,000$ copies/mL further reduces the risk of transmission. The recommendation of ACOG is to use IV ZDV during labor or prior to cesarean delivery for patients with HIV RNA that is at a detectable level but $<1,000$ copies/mL, although benefit is less clear. Maternal-to-child transmission is unlikely to be further reduced with IV ZDV in patients with an undetectable HIV RNA [6].

Infants born to HIV-positive mothers receive weight-based dosing of oral ZDV as a postexposure prophylaxis to reduce mother-to-child transmission. This medication is managed by the pediatricians, and the length of treatment between 2 and 6 weeks is based on risk factors for transmission. Oral ZDV should be initiated as soon as possible, by 6 hours of life at the latest. Newborns can be briefly separated from their mothers shortly after birth to get weighed on a scale in the delivery/recovery room. Infants born to mothers with a high HIV RNA at delivery may receive additional antivirals to further reduce risk [3].

Infant feeding recommendations for newborns with HIV-positive mothers is evolving. Historically, formula feeding was recommended for all HIV-positive newborns to reduce ongoing infection risk. Breast-feeding is supported for the lowest-risk mother/infant dyads, with shared decision-making and ongoing monitoring. Best practices are updated regularly on CDC and National Institutes of Health websites [3].

Patients with HIV-Positive Partners

Women who are HIV-negative with HIV-infected sexual partners are counseled that protecting themselves from HIV transmission during pregnancy and breast-feeding will eliminate risk to their child. The primary risk factor for sexual transmission is the infected partner's medication compliance and HIV RNA level. A 2023 World Health Organization systematic review of over 7,700 couples confirmed that the risk of HIV transmission is zero when the infected partner's HIV RNA is <200 copies/mL and very low when the HIV RNA is $<1,000$ copies/mL [7]. In pregnancy, condoms are recommended to protect in the case of an increase in the partner's HIV RNA due to suboptimal compliance or development of resistance. If viral suppression is unable to be achieved and maintained, partner's HIV status is unknown, or condoms are not able to be negotiated, the addition of preexposure prophylaxis (PrEP) with tenofovir/emtricitabine should be considered [8]. Tenofovir/emtricitabine is well tolerated and safe in pregnancy. Cabotegravir injection is not approved for use in pregnancy at the time of publication, but the CDC website will provide updated guidance.

Key Teaching Points

- The vertical HIV transmission rate is 0.09% if the viral load was <50 copies/mL.

- If HIV RNA is >1,000 copies/mL, cesarean delivery prior to labor is performed at 38 weeks
- Detectable HIV RNA, but <1,000 copies/mL should raise concern that there are issues with compliance, repeat testing before 38 weeks should be considered. With an undetectable HIV RNA by 36 weeks, cesarean delivery has not been shown to further reduce the vertical transmission risk. Delivery timing and mode for patients with HIV and an undetectable HIV RNA should be per usual obstetric indications.
- Length of rupture of membranes is not a transmission risk factor when the HIV RNA is <1,000 copies/mL. Scalp electrode should be avoided.
- Oral antiviral medications are continued throughout labor and delivery. Adding IV ZDV at least 3 hours prior to delivery for patients with HIV RNA >1,000 copies/mL is recommended.
- In HIV discordant couples, condoms are recommended during pregnancy. If viral suppression is unable to be maintained, partner's HIV status is unknown, or condoms are not able to be negotiated, consider the addition of PrEP.

References

- 1 Townsend CL, Byrne L, Cortina-Borja M, et al. Earlier Initiation of ART and Further Decline in Mother-to-Child HIV Transmission Rates, 2000–2011. *AIDS*. 2014;28(7):1049–1057. www.ncbi.nlm.nih.gov/pubmed/24566097 (accessed October 3, 2024).
- 2 US Department of Health and Human Services, Centers for Disease Control and Prevention. An Opt-out Approach to HIV Screening. 2019. www.cdc.gov/hivnexus/hcp/diagnosis-testing/index.html (accessed October 30, 2024).
- 3 US Department of Health and Human Services. Panel on Treatment of HIV during Pregnancy and Prevention of Perinatal Transmission. Recommendations for the Use of Antiretroviral Drugs during Pregnancy and Interventions to Reduce Perinatal HIV Transmission in the United States. 2023. <https://clinicalinfo.hiv.gov/en/guidelines/perinatal> (accessed November 16, 2023).
- 4 Pollock L, Cohan D, Chang Pecci C, et al. American College of Obstetricians and Gynecologists. *Obstet Gynecol*. 2019;133:187.
- 5 US Department of Health and Human Services, Centers for Disease Control and Prevention. Perinatal HIV Testing Laws. 2021. www.cdc.gov/hiv/policies/law/states/perinatal.html (accessed November 16, 2023).
- 6 ACOG Committee Opinion No. 751 Summary: Labor and Delivery Management of Women with Human Immunodeficiency Virus Infection. *Obstet Gynecol*. 2018;132:803–804.
- 7 Broyles L, Luo R, Boeras D, et al. The Risk of Sexual Transmission of HIV in Individuals with Low-Level HIV Viraemia: A Systematic Review. *Lancet*. 2023;402:464–471.
- 8 US Department of Health and Human Services, Centers for Disease Control and Prevention. How Do I Prescribe preEP? 2023. www.cdc.gov/hivnexus/hcp/prep/index.html (accessed October 30, 2024).

CASE 39

A 30-Year-Old at 14 Weeks' Gestation Presents after Exposure to a Child with CMV

Rita Tsai

History of Present Illness

A 30-year-old gravida 4 para 2012 at 14 weeks' gestation presents for routine prenatal care. The patient works at a day care center, and she reports that a child she cares for complained of not feeling well in the past week. The child had a fever and sore throat, and the mom called recently to let the center know that her child had been diagnosed with a cytomegalovirus (CMV) infection. The patient is wondering if she needs testing for CMV since she was exposed and whether this infection can affect her baby. She has been feeling well; she denies any complaints today – neither fever, malaise, myalgias, upper respiratory infection symptoms, nor rash. The patient's obstetric history is unremarkable; she has a history of two prior pregnancies that were uncomplicated. She has no significant past medical history, and she is taking only a prenatal vitamin.

Physical Examination

General appearance: Well-developed, well-nourished, in no apparent distress

Vital signs:

Temperature: 37.1°C

Pulse: 77 beats per minute

Blood pressure: 116/63 mmHg

Respiratory rate: 18 breaths per minute

Body mass index (BMI): 28.6 kg/m²

Abdomen: Soft, non-tender, non-distended

Fetal assessment: Fetal heart rate is 150 beats per minute

How Would You Manage This Patient?

Baseline CMV serology including IgM and IgG with an avidity assay is obtained from the patient. The serology returns as IgM negative and IgG positive with high avidity. The patient is counseled that she appears to have evidence of a past infection, which is not surprising given seroprevalence is increased with increasing parity and contact with children under 3 years of age, particularly in day care. However, there remains a risk of reactivation of latent virus or reinfection with a different viral strain. She is informed that the frequency of fetal infection is low in patients with non-primary infection, with a vertical transmission rate of 0.15–2%. However, infected fetuses can still be at risk for symptomatic and asymptomatic newborn disease and associated long-term sequelae. Serology is repeated several weeks later, and no rise is noted with serial IgG titers. It is discussed with the patient that there does not appear to be evidence of a secondary infection. The patient goes on to have

a normal anatomy ultrasound in the second trimester. No further testing is recommended, although the patient is cautioned to notify the office to be evaluated if she develops any influenza-like illness during the rest of the pregnancy.

CMV in Pregnancy

Cytomegalovirus, a double-stranded DNA herpesvirus, is the most common viral cause of congenital infection, affecting 0.2–2.2% of all neonates [1,2,3,4,5]. It is the leading nongenetic cause of congenital deafness and a major cause of neurologic disability in children [3,4,5]. Transmission of the virus can occur through direct contact with bodily fluids, including blood, urine, saliva, cervicovaginal secretions, and breast milk; it can also be transmitted through sexual contact [1,2,3,4,5]. Cytomegalovirus can be acquired for the first time during pregnancy, with resulting viremia noted 2–3 weeks after a primary infection [2]. Of previously seronegative women, 1–4% will become infected during pregnancy [4], and while most are asymptomatic, some patients may experience a mononucleosis-like syndrome, which can include fever, chills, myalgias, and malaise [2,3]. Pregnant patients may also experience secondary CMV infection, which can occur either due to reactivation of latent CMV or infection with a different exogenous strain [2,3,4]. Prevalence of CMV immunity varies by geography, socioeconomic status, and ethnicity [2,4]. The majority of congenitally infected infants are born to women with preexisting immunity [3].

Vertical transmission of CMV across the placenta carries the most significant risk of developing clinical sequelae in neonates; CMV infection from breast milk or cervical secretions is typically asymptomatic and not associated with severe sequelae [2]. The likelihood of congenital infection is highest following primary infection, with an overall risk of transmission to the fetus of 30–50% cited [4]. There is an increased frequency of congenital infection with greater gestational age, with the greatest risk of transmission in the third trimester [2,4]. However, earlier infection in the first trimester is associated with more serious fetal sequelae [2,4]. In women with primary infection with fetuses infected in utero, approximately 10–15% of infants will be symptomatic at birth, with 25% of the asymptomatic infants experiencing sequelae by age 2. Compare this to patients with secondary infections, where <1% of infant are symptomatic at birth, but 8% of children can still go on to develop sequelae by age 2 [4]. Congenital hearing loss is typically the most severe sequelae after a recurrent infection, with multiple sequelae much less likely overall [2].

Maternal CMV infection is typically established by serologic testing. Serial samples collected 3–4 weeks apart that

demonstrate seroconversion from negative to positive or that demonstrate a greater than fourfold increase in anti-CMV IgG titers is evidence of infection. Unlike with other viral infections like rubella, IgM is not diagnostic for recent CMV primary infection. This is due to multiple reasons, including IgM persisting for many months after primary infection, IgM being present during reactivation or reinfection, IgM cross-reactivity with another viral infection like Epstein–Barr virus, and IgM being present as a result of a nonspecific polyclonal stimulation of the immune system [2,3,4,5]. Thus, a positive IgM status alone should not be used for diagnosis of acute CMV infection. IgG avidity assays, which measure the maturity of the IgG, allow for better identification of the timing of infection in conjunction with IgM titers. A high avidity index, generally >60%, suggests a past infection more than 3 months ago or a secondary infection, while a low avidity IgG <30% in combination with a positive IgM antibody (Ab) is indicative of an infection within the preceding 3 months [2,3,4,5].

Routine serologic testing for CMV for screening of pregnant women is not recommended, as it is not an effective screening test [1,2,3,4,5]. Besides IgM testing being limited in being able to differentiate primary from recurrent infection, maternal immunity does not eliminate the possibility of fetal infection, and no effective treatment to prevent congenital transmission exists at this time [1,2,3]. Testing is thus typically limited to pregnant patients who have developed influenza-like symptoms with negative testing for other viral etiologies, patients who have hepatitis with negative hepatitis A, B, and C testing, or in patients with ultrasound findings suggestive of CMV [3].

Referral to maternal-fetal medicine is warranted in known cases of maternal CMV infection. Serial ultrasound surveillance that includes fetal anatomy and growth is typically performed [2]. The most common ultrasound findings seen in CMV congenital infection are cerebral calcifications, microcephaly, and echogenic bowel [4]. Other findings can include growth restriction, cerebral ventriculomegaly, ascites, pericardial effusion, echogenic kidneys, hepatomegaly, and fetal hydrops [2,3,4,5]. However, these ultrasound findings can be associated with other abnormalities, and ultrasound imaging alone cannot diagnose a fetal infection [2,3,4,5]. Amniocentesis is considered the best option to diagnose fetal congenital CMV infection, and ideally it is performed after 21 weeks' gestation and >6 weeks from the time of maternal infection [4]. Cytomegalovirus can be detected

in the amniotic fluid by either polymerase chain reaction (PCR) or culture [2]. It is important to note for patients that the severity of infection cannot be determined by amniocentesis. Patients should also be aware that normal brain imaging does not necessarily predict normal neurodevelopmental outcomes [4].

There are no current therapies to treat maternal or fetal CMV infection. Small studies have evaluated antiviral therapy with ganciclovir and valganciclovir, but they have not been proven to be effective [2,3,4,5,6]. CMV-specific hyperimmune globulin (HIG) has also been under investigation for potential prevention and treatment, but has also not shown a clear benefit [2,3,4,5]. Thus, antenatal therapy either with antivirals or CMV HIG should be reserved for the research setting and should not be used in routine clinical care [2,3,4,5,6]. In addition, no licensed vaccine exists for CMV, and candidate vaccines still remain in the research and development phase [1,3,5,6].

It has been recommended that pregnant patients be educated to reduce contact with saliva and urine from babies and young children for general CMV prevention, particularly if they are at higher risk for CMV infection. This includes the use of gloves and handwashing after potentially infected articles (e.g. diapers or respiratory secretions), avoidance of sharing food, utensils, or cups with young children, and avoidance of kissing young children if saliva is present [1,2]. Counseling on personal hygiene measures has been shown to decrease rates of maternal seroconversion [4], but no good-quality randomized controlled trials exist that demonstrate the success of such patient instruction in reducing the risk of congenital CMV infection [6]. However, in the absence of other antenatal interventions, patient education may be the best method available to providers for CMV prevention at this time, particularly given its low cost and simplicity to implement.

Key Teaching Points

- The diagnosis of primary CMV infection in pregnancy can be made by IgG seroconversion or detection of CMV IgM and IgG Abs and low IgG avidity.
- Routine serologic screening of pregnant women for CMV is not recommended.
- Pregnant patients, particularly those who care for young children, should be counseled about behavioral measures to reduce the risk of CMV infection.

References

- Centers for Disease Control and Prevention. Cytomegalovirus (CMV) and Congenital CMV Infection: Clinical Diagnosis and Treatment. www.cdc.gov/cmvm/clinical/diagnosis-treatment.html (accessed June 4, 2023).
- American College of Obstetricians and Gynecologists. Cytomegalovirus, Parvovirus B19, Varicella Zoster, and Toxoplasmosis in Pregnancy: Practice Bulletin No 151. *Obstet Gynecol.* 2014;125:1510–1525.
- Congenital Cytomegalovirus Infection: Update on Treatment: Scientific Impact Paper No. 56. *BJOG.* 2018;125:e1–e11.
- Society for Maternal-Fetal Medicine (SMFM); Hughes BL, Gyamfi-Bannerman C. Diagnosis and Antenatal Management of Congenital Cytomegalovirus Infection. *Am J Obstet Gynecol.* 2016;214(6):B5–B11.
- Boucoiran I, Yudin M, Poliquin V, et al. Guideline No. 420: Cytomegalovirus Infection in Pregnancy. *J Obstet Gynaecol Can.* 2021;43(7):893–908.
- McCarthy FP, Giles ML, Rowlands S, et al. Antenatal Interventions for Preventing the Transmission of Cytomegalovirus (CMV) from the Mother to Fetus during Pregnancy and Adverse Outcomes in the Congenitally Infected Infant. *Cochrane Database Syst Rev.* 2011;(3):CD008371.

CASE 39

A 30-Year-Old at 14 Weeks' Gestation Presents after Exposure to a Child with CMV

Rita Tsai

History of Present Illness

A 30-year-old gravida 4 para 2012 at 14 weeks' gestation presents for routine prenatal care. The patient works at a day care center, and she reports that a child she cares for complained of not feeling well in the past week. The child had a fever and sore throat, and the mom called recently to let the center know that her child had been diagnosed with a cytomegalovirus (CMV) infection. The patient is wondering if she needs testing for CMV since she was exposed and whether this infection can affect her baby. She has been feeling well; she denies any complaints today – neither fever, malaise, myalgias, upper respiratory infection symptoms, nor rash. The patient's obstetric history is unremarkable; she has a history of two prior pregnancies that were uncomplicated. She has no significant past medical history, and she is taking only a prenatal vitamin.

Physical Examination

General appearance: Well-developed, well-nourished, in no apparent distress

Vital signs:

Temperature: 37.1°C

Pulse: 77 beats per minute

Blood pressure: 116/63 mmHg

Respiratory rate: 18 breaths per minute

Body mass index (BMI): 28.6 kg/m²

Abdomen: Soft, non-tender, non-distended

Fetal assessment: Fetal heart rate is 150 beats per minute

How Would You Manage This Patient?

Baseline CMV serology including IgM and IgG with an avidity assay is obtained from the patient. The serology returns as IgM negative and IgG positive with high avidity. The patient is counseled that she appears to have evidence of a past infection, which is not surprising given seroprevalence is increased with increasing parity and contact with children under 3 years of age, particularly in day care. However, there remains a risk of reactivation of latent virus or reinfection with a different viral strain. She is informed that the frequency of fetal infection is low in patients with non-primary infection, with a vertical transmission rate of 0.15–2%. However, infected fetuses can still be at risk for symptomatic and asymptomatic newborn disease and associated long-term sequelae. Serology is repeated several weeks later, and no rise is noted with serial IgG titers. It is discussed with the patient that there does not appear to be evidence of a secondary infection. The patient goes on to have

a normal anatomy ultrasound in the second trimester. No further testing is recommended, although the patient is cautioned to notify the office to be evaluated if she develops any influenza-like illness during the rest of the pregnancy.

CMV in Pregnancy

Cytomegalovirus, a double-stranded DNA herpesvirus, is the most common viral cause of congenital infection, affecting 0.2–2.2% of all neonates [1,2,3,4,5]. It is the leading nongenetic cause of congenital deafness and a major cause of neurologic disability in children [3,4,5]. Transmission of the virus can occur through direct contact with bodily fluids, including blood, urine, saliva, cervicovaginal secretions, and breast milk; it can also be transmitted through sexual contact [1,2,3,4,5]. Cytomegalovirus can be acquired for the first time during pregnancy, with resulting viremia noted 2–3 weeks after a primary infection [2]. Of previously seronegative women, 1–4% will become infected during pregnancy [4], and while most are asymptomatic, some patients may experience a mononucleosis-like syndrome, which can include fever, chills, myalgias, and malaise [2,3]. Pregnant patients may also experience secondary CMV infection, which can occur either due to reactivation of latent CMV or infection with a different exogenous strain [2,3,4]. Prevalence of CMV immunity varies by geography, socioeconomic status, and ethnicity [2,4]. The majority of congenitally infected infants are born to women with preexisting immunity [3].

Vertical transmission of CMV across the placenta carries the most significant risk of developing clinical sequelae in neonates; CMV infection from breast milk or cervical secretions is typically asymptomatic and not associated with severe sequelae [2]. The likelihood of congenital infection is highest following primary infection, with an overall risk of transmission to the fetus of 30–50% cited [4]. There is an increased frequency of congenital infection with greater gestational age, with the greatest risk of transmission in the third trimester [2,4]. However, earlier infection in the first trimester is associated with more serious fetal sequelae [2,4]. In women with primary infection with fetuses infected in utero, approximately 10–15% of infants will be symptomatic at birth, with 25% of the asymptomatic infants experiencing sequelae by age 2. Compare this to patients with secondary infections, where <1% of infant are symptomatic at birth, but 8% of children can still go on to develop sequelae by age 2 [4]. Congenital hearing loss is typically the most severe sequelae after a recurrent infection, with multiple sequelae much less likely overall [2].

Maternal CMV infection is typically established by serologic testing. Serial samples collected 3–4 weeks apart that

demonstrate seroconversion from negative to positive or that demonstrate a greater than fourfold increase in anti-CMV IgG titers is evidence of infection. Unlike with other viral infections like rubella, IgM is not diagnostic for recent CMV primary infection. This is due to multiple reasons, including IgM persisting for many months after primary infection, IgM being present during reactivation or reinfection, IgM cross-reactivity with another viral infection like Epstein–Barr virus, and IgM being present as a result of a nonspecific polyclonal stimulation of the immune system [2,3,4,5]. Thus, a positive IgM status alone should not be used for diagnosis of acute CMV infection. IgG avidity assays, which measure the maturity of the IgG, allow for better identification of the timing of infection in conjunction with IgM titers. A high avidity index, generally >60%, suggests a past infection more than 3 months ago or a secondary infection, while a low avidity IgG <30% in combination with a positive IgM antibody (Ab) is indicative of an infection within the preceding 3 months [2,3,4,5].

Routine serologic testing for CMV for screening of pregnant women is not recommended, as it is not an effective screening test [1,2,3,4,5]. Besides IgM testing being limited in being able to differentiate primary from recurrent infection, maternal immunity does not eliminate the possibility of fetal infection, and no effective treatment to prevent congenital transmission exists at this time [1,2,3]. Testing is thus typically limited to pregnant patients who have developed influenza-like symptoms with negative testing for other viral etiologies, patients who have hepatitis with negative hepatitis A, B, and C testing, or in patients with ultrasound findings suggestive of CMV [3].

Referral to maternal-fetal medicine is warranted in known cases of maternal CMV infection. Serial ultrasound surveillance that includes fetal anatomy and growth is typically performed [2]. The most common ultrasound findings seen in CMV congenital infection are cerebral calcifications, microcephaly, and echogenic bowel [4]. Other findings can include growth restriction, cerebral ventriculomegaly, ascites, pericardial effusion, echogenic kidneys, hepatomegaly, and fetal hydrops [2,3,4,5]. However, these ultrasound findings can be associated with other abnormalities, and ultrasound imaging alone cannot diagnose a fetal infection [2,3,4,5]. Amniocentesis is considered the best option to diagnose fetal congenital CMV infection, and ideally it is performed after 21 weeks' gestation and >6 weeks from the time of maternal infection [4]. Cytomegalovirus can be detected

in the amniotic fluid by either polymerase chain reaction (PCR) or culture [2]. It is important to note for patients that the severity of infection cannot be determined by amniocentesis. Patients should also be aware that normal brain imaging does not necessarily predict normal neurodevelopmental outcomes [4].

There are no current therapies to treat maternal or fetal CMV infection. Small studies have evaluated antiviral therapy with ganciclovir and valganciclovir, but they have not been proven to be effective [2,3,4,5,6]. CMV-specific hyperimmune globulin (HIG) has also been under investigation for potential prevention and treatment, but has also not shown a clear benefit [2,3,4,5]. Thus, antenatal therapy either with antivirals or CMV HIG should be reserved for the research setting and should not be used in routine clinical care [2,3,4,5,6]. In addition, no licensed vaccine exists for CMV, and candidate vaccines still remain in the research and development phase [1,3,5,6].

It has been recommended that pregnant patients be educated to reduce contact with saliva and urine from babies and young children for general CMV prevention, particularly if they are at higher risk for CMV infection. This includes the use of gloves and handwashing after potentially infected articles (e.g. diapers or respiratory secretions), avoidance of sharing food, utensils, or cups with young children, and avoidance of kissing young children if saliva is present [1,2]. Counseling on personal hygiene measures has been shown to decrease rates of maternal seroconversion [4], but no good-quality randomized controlled trials exist that demonstrate the success of such patient instruction in reducing the risk of congenital CMV infection [6]. However, in the absence of other antenatal interventions, patient education may be the best method available to providers for CMV prevention at this time, particularly given its low cost and simplicity to implement.

Key Teaching Points

- The diagnosis of primary CMV infection in pregnancy can be made by IgG seroconversion or detection of CMV IgM and IgG Abs and low IgG avidity.
- Routine serologic screening of pregnant women for CMV is not recommended.
- Pregnant patients, particularly those who care for young children, should be counseled about behavioral measures to reduce the risk of CMV infection.

References

- Centers for Disease Control and Prevention. Cytomegalovirus (CMV) and Congenital CMV Infection: Clinical Diagnosis and Treatment. www.cdc.gov/cmv/clinical/diagnosis-treatment.html (accessed June 4, 2023).
- American College of Obstetricians and Gynecologists. Cytomegalovirus, Parvovirus B19, Varicella Zoster, and Toxoplasmosis in Pregnancy: Practice Bulletin No 151. *Obstet Gynecol.* 2014;125:1510–1525.
- Congenital Cytomegalovirus Infection: Update on Treatment: Scientific Impact Paper No. 56. *BJOG.* 2018;125:e1–e11.
- Society for Maternal-Fetal Medicine (SMFM); Hughes BL, Gyamfi-Bannerman C. Diagnosis and Antenatal Management of Congenital Cytomegalovirus Infection. *Am J Obstet Gynecol.* 2016;214(6):B5–B11.
- Boucoiran I, Yudin M, Poliquin V, et al. Guideline No. 420: Cytomegalovirus Infection in Pregnancy. *J Obstet Gynaecol Can.* 2021;43(7):893–908.
- McCarthy FP, Giles ML, Rowlands S, et al. Antenatal Interventions for Preventing the Transmission of Cytomegalovirus (CMV) from the Mother to Fetus during Pregnancy and Adverse Outcomes in the Congenitally Infected Infant. *Cochrane Database Syst Rev.* 2011;(3):CD008371.

CASE 40

A 20-Year-Old with Positive Rapid Plasma Reagin on Initial Prenatal Labs

Katherine Strafford

History of Present Illness

A 20-year-old nulliparous patient with a history of asthma and chlamydia presents for prenatal care. She is on no medications other than prenatal vitamins. Her social history is significant for tobacco and cannabis as well as unstable housing. She reports a current monogamous heterosexual relationship and four prior sexual partners.

Physical Examination

General appearance: Well-appearing, alert, oriented

Vital signs:

Temperature: 38.2°C

Pulse: 97 beats per minute

Blood pressure: 122/78 mmHg

Respiratory rate: 16 breaths per minute

BMI: 24 kg/m²

Abdomen: Soft, non-tender, without masses

Pelvic: Normal genitalia without lesions. Uterus non-tender, 10-week sized

Fetal assessment: Fetal heart rate is 155 beats per minute

Laboratory studies:

Rapid plasma reagin (RPR): Reactive

Hepatitis B surface antigen and hepatitis C Ab: Negative

HIV-1/HIV-2: Non-reactive

Chlamydia/gonorrhea: Not detected

Urine culture: No growth

Transvaginal ultrasound: Singleton intrauterine pregnancy, crown-rump measurement consistent with last menstrual period dating

How Would You Manage This Patient?

Prenatal testing is significant for a reactive RPR, a potential indicator of infection with the spirochete *Treponema pallidum* and maternal syphilis. A provider must understand the methodology of syphilis screening used by their laboratory to distinguish true from false-positive results and to evaluate active from previously treated disease. Inform public health officials of positive results and ascertain any known prior syphilis exposure, testing, or treatment. Additional testing and treatment, as indicated, will mitigate maternal and fetal risks.

Additional testing confirmed the diagnosis of late latent syphilis. The patient was counselled regarding the risks to maternal and fetal health. Her case was reported to the health department and treatment was provided for patient, partner,

and infant. The patient had an appropriate response to treatment and her child was delivered without evidence of congenital syphilis.

Syphilis Diagnosis

The United States saw 176,713 maternal cases of syphilis in 2021, up 74%, and 2,855 newborn cases, up 203%, since 2017 [1]. Risk factors for syphilis include young age, a prior sexually transmitted infection (STI), substance use disorder, unstable housing, incarceration, and multiple sexual partners [2,3,4].

Syphilis is divided into primary, secondary, tertiary, and latent disease. Primary syphilis develops 10–90 days from transmission; painless ulcer(s) or chancre(s) may be present for several weeks. Testing is reactive within 1–4 weeks of chancre formation. Sexual transmission occurs when mucosal lesions are present in primary and secondary disease with a 30% transmission risk. Secondary syphilis manifests between 6 weeks and 6 months from transmission and may present with a maculopapular rash, lymphadenopathy, alopecia, and mucocutaneous lesions. Secondary syphilis symptoms may resolve in a few months, leaving patients with asymptomatic latent disease [1,2,4].

Latent syphilis is often diagnosed through screening. When previous negative testing or history identifies transmission within the past year, this is considered early latent syphilis. A new diagnosis of syphilis should prompt a thorough evaluation of all mucosal surfaces for lesions that would indicate primary or secondary disease. Latent syphilis has low rates of transmission to partners but remains a congenital infection risk. Tertiary syphilis may develop at distant intervals in untreated individuals as an inflammatory process involving multiple organs, gummatous lesions, and cardiac involvement can be seen [1,2,4].

Neurosyphilis may develop during any stage. Patients with neurologic symptoms and tertiary, high titer latent syphilis or HIV coinfection should be evaluated for neurosyphilis with venereal disease research laboratory (VDRL) testing of the cerebrospinal fluid (CSF). Patients with a new diagnosis of syphilis should be tested for HIV and offered HIV pre-exposure prophylaxis (PrEP) and repeat testing in 3 months when results are negative [1,2].

Most state health departments in the United States mandate testing for syphilis in pregnancy on varying schedules. In addition to joining the US Preventive Services Task Force (USPSTF) recommendation for screening at the initiation of prenatal care, the Centers for Disease Control and Prevention (CDC), American Academy of Pediatrics, and the

American College of Obstetricians and Gynecologists (ACOG) recommend re-screening during the third trimester of pregnancy, at both 28 weeks and at delivery in high-risk communities [2,5,6].

Evaluation of Syphilis Testing

Definitive testing for syphilis can be performed by darkfield microscopy or direct fluorescent antibody testing, although rarely used. Point of care testing and nucleic acid amplification tests (NAATs) involving PCR are not widely and commercially available [7,8]. Serologic treponemal tests (TTs) and nontreponemal tests (NTTs) are the mainstay of clinical practice. Testing is initiated with either a TT or NTT, depending on laboratory protocol. Reactive (positive) results are followed by testing from the alternate category to confirm diagnosis. Nonreactive results for TTs and NTTs are possible in early disease (false-negative). With high clinical suspicion and non-reactive results, repeat testing should be performed in 4 weeks [2,3,7].

Treponemal tests (TTs) including fluorescent treponemal Ab absorption (FTA-ABS) and *T. pallidum* particle agglutination (TPPA) assays detect IgG and/or IgM Abs to *T. pallidum*. Newer TTs, including enzyme immunoassays (EIAs) and chemiluminescence immunoassay (CIA), are automated for rapid convenience but have potentially high false-positive rates (46.5–88.2%). Results for TTs do not have quantitative titers. They cannot distinguish active from previously treated disease and typically remain reactive following treatment [5,6,8].

Nontreponemal tests, including VDRL and RPR, identify IgG Abs to cardiolipin, lecithin, and cholesterol released by infection-mediated cell damage and are less specific than TTs. Reactive results are followed by a titer (1:×) reflective of disease activity and treatment response. High titers are seen in early disease. False-positive NTTs can be seen in many conditions, including pregnancy, autoimmune diseases, viral infections, injection drug use, HIV, and older age [1,3,8].

Reverse sequence testing utilizes convenient automated TT (e.g. EIA). Reactive automated TTs require NTTs (e.g. RPR) for confirmation and provision of titer. If nonreactive NTTs follow reactive TTs, traditional TTs (e.g. TPPA) are run. When both forms of TTs are reactive, this confirms current or past syphilis and need for treatment is based on clinical evaluation. If both the NTT and the second TT are nonreactive, the initial TT can be considered false-positive (Figure 40.1) [1,2].

In traditional testing, reactive NTTs (e.g. RPR) are followed by TTs (e.g. TPPA). When confirmatory TTs are reactive, treatment is based on clinical assessment and titer. If the TTs are nonreactive, NTTs can be considered false-positive (Figure 40.1) [1,2,8].

Treatment is indicated when there is no history of prior treatment, if NTT titers increase, or with new symptoms or exposures. Following treatment, NTTs may revert to nonreactive, or low titers ($\leq 1:8$) can persist. When following titers post-treatment, it is important to utilize the same test (RPR vs VDRL), and if possible, the same laboratory as results are not interchangeable [1,3,8].

Management of Syphilis in Pregnancy

Timely diagnosis and treatment of syphilis in pregnancy is 98% effective at preventing congenital syphilis. Without adequate early treatment, the risk of maternal–fetal transmission is 50–80% with primary, 40–60% with secondary, and 10–20% with latent syphilis. The risk increases the later in pregnancy that treatment occurs. Congenital syphilis sequelae can include spontaneous abortion, fetal demise, fetal malformations, preterm birth, low birth weight, and systemic disorders of hematologic, dermatologic, hepatobiliary, orthopedic, and neurologic function. A detailed ultrasound should be considered for all pregnant patients receiving syphilis treatment [1,2,3,9].

Treatment with benzathine penicillin G (BPG) is required during pregnancy. The appropriate dose for primary,

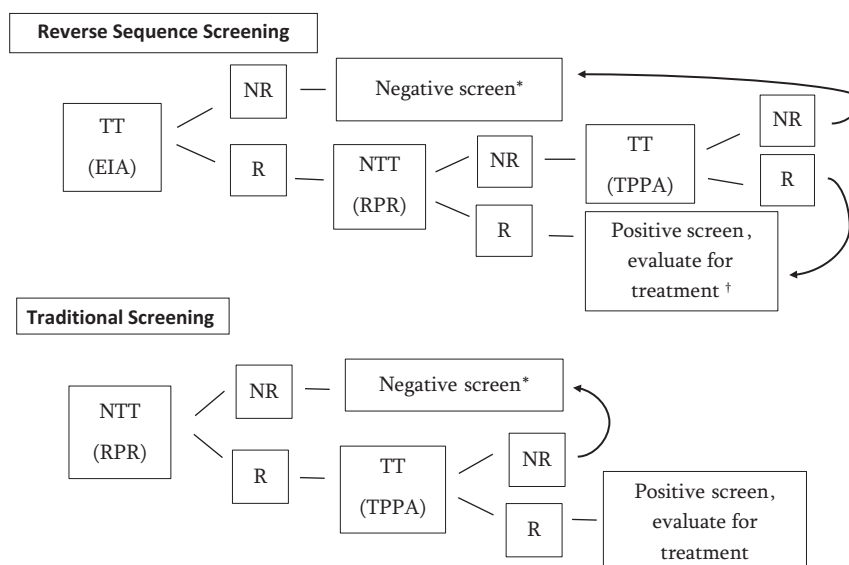


Figure 40.1 Syphilis screening algorithms. NR, nonreactive; R, reactive
 *False negative possible in high-risk populations, consider re-testing in 4 weeks
 †NTT Abs may persist post successful treatment, clinical assessment determines when treatment is indicated

secondary, and early latent syphilis is 2.4 million units intramuscular. In pregnancy, some experts recommend a second dose of BPG after 1 week, particularly for any case with ultrasound evidence of congenital syphilis [1,9]. For tertiary, latent syphilis of late or unknown duration, and retreatments, three weekly doses of BPG are required. If more than 9 days elapse between doses, the series must start again. Treatment of neurosyphilis should be undertaken with an infectious disease provider with extended intravenous (IV) administration of aqueous crystalline penicillin G [1,2].

The Jarisch–Herxheimer (JH) treatment reaction is an acute systemic inflammatory response to spirochete death, resulting in fever, headache, tachycardia, and myalgia. In pregnancy, preterm contractions and nonreassuring fetal monitoring may also manifest. Risk is greatest after treatment for primary syphilis and may occur in as high as 45% of pregnant cases. The reaction is seen within 2–8 hours of treatment and abates by 24 hours. For viable pregnancies receiving initial BPG treatment, fetal monitoring for 24 hours should be considered. Treatment for JH is supportive therapy [1,2,4].

For patients with a penicillin allergy, collaborate with allergy and infectious disease to assess the nature of the allergy and treat following penicillin desensitization. Benzathine penicillin G crosses the placenta, allowing for treatment of the fetus. Alternative treatments for syphilis in pregnancy have been associated with higher rates of congenital syphilis and should not be used [1,2].

Congenital syphilis testing requires comparing maternal–infant serum NTT (e.g. RPR) titers. Infant testing may be positive due to maternal IgG for the first several months of life. With adequate treatment in early pregnancy, successful maternal response, and low infant titers, a single dose of BPG is recommended at birth. A fourfold higher infant titer in comparison to maternal is concerning for congenital syphilis. For these infants, or those born to suboptimal/untreated patients, a 10-day treatment course is indicated [1,3,9].

In the case of primary and secondary syphilis, a successful syphilis treatment response manifests a fourfold drop in titer,

or a decrease of two dilutions (e.g. 1:32 to 1:8) over 6–12 months, and 24 months for late latent syphilis or in cases of HIV coinfection. When initial titers are low ($\leq 1:8$), a fourfold drop may not be seen. Pregnant patients should undergo clinical assessment and serologic testing of NTT titers 8 weeks after BPG treatment and at delivery. If symptoms of disease present or a significant increase in titer is seen, retreat. For pregnant patients with an adequate pre-pregnancy treatment history who lack signs of active disease or reinfection, serial NTTs should be performed, as frequently as every 4 weeks until delivery [1,2].

Outside of pregnancy, evaluation is recommended post-treatment at 6 and 12 months in primary and secondary disease; and at 24 months post-treatment for other forms. If symptoms persist/recur or a fourfold increase in titer is seen for >2 weeks, retreat and assess for neurosyphilis and HIV [1,2].

Treat all sexual partners from within 90 days of a diagnosis of primary, secondary, or early latent syphilis, even individuals with negative serologic testing. Partner testing, and resulting treatment, is recommended for late latent syphilis within 3–12 months of diagnosis. Presumptive treatment is also appropriate for any partner unable to be tested or in cases of latent syphilis of unknown duration and a high titer. Tertiary syphilis is not generally considered a risk for sexual transmission [1,2].

Key Teaching Points

- Syphilis prevalence is increasing.
- Prenatal patients should be screened at intake, at 28 weeks, and at delivery.
- Positive results require confirmatory testing.
- Consider detailed fetal ultrasound assessment.
- Benzathine penicillin G is the treatment of choice during pregnancy, even if requiring desensitization.
- Syphilis cases must be reported to public health departments and partner therapy is critical.

References

- Centers for Disease Control and Prevention. Sexually Transmitted Diseases Treatment Guidelines. *MMWR Morb Mortal Wkly Rep*. 2021;70(4):39–59. www.cdc.gov/std/treatment-guidelines/toc.htm (accessed May 18, 2023.)
- Eppes C, Stafford I, Rac M. Syphilis in Pregnancy: An Ongoing Public Health Threat. *Am J Obstet Gynecol*. 2022;227:822–838.
- Easterlin MC, Ramanathan R, De Beritto T. Maternal-to-Fetal Transmission of Syphilis and Congenital Syphilis. *NeoReviews*. 2021;22(9):e585–e597.
- Uku A, Albujaasim Z, Dwivedi T, et al. Syphilis in Pregnancy: The Impact of “the Great Imitator.” *Eur J Obstet Gynecol*. 2021;259:207–210.
- USPSTF. Screening for Syphilis Infection in Pregnant Women US Preventive Services Task Force Reaffirmation Recommendation Statement. *JAMA*. 2018;320(9):911–917.
- Lin J, Eder M, Bean S. Screening for Syphilis Infection in Pregnant Women Updated Evidence Report and Systematic Review for the US Preventive Services Task Force. *JAMA*. 2018;320(9):918–925.
- Zhou C, Zhang X, Zhang W, et al. PCR Detection for Syphilis Diagnosis: Status and Prospects. *J Clin Lab Anal*. 2019;33:e22890.
- Satyaputra F, Hendry S, Braddick M, et al. The Laboratory Diagnosis of Syphilis. *J Clin Microbiol*. 2021;59:e00100–e00121. <https://doi.org/10.1128/JCM.00100-21> (accessed October 8, 2024).
- Freyne B, Nourse C, Walls T. Congenital Syphilis: Controversies and Questions. *Pediatr Infect Dis J*. 2023;42(5):e166–e169.

A 35-Year-Old at 26 Weeks' Gestation Presents with Fever and Diarrhea after Shopping at a Farmer's Market

Brandi N. Ring

History of Present Illness

A 35-year-old gravida 4 para 3 at 26 weeks' gestation presents to the office with complaints of fever and diarrhea. The fever started last evening and was as high as 38.4°C at home. The diarrhea started 2 days ago, occurs four to six times per day, and is watery. The patient is weak, nauseous, and dizzy upon standing. The patient reports mild abdominal cramping without contractions, vaginal bleeding, and loss of fluid. Fetal movement is decreased. Review of systems is positive for lower extremity and large joint discomfort. Past history is only significant for three uncomplicated term vaginal deliveries without preterm labor. The patient is taking prenatal vitamins and has no known drug allergies. There is no history of drug or alcohol use. There is no recent travel, but reports shopping at the local farmers market, along with purchasing raw vegetables, nonpasteurized cheese, and deli meat.

Physical Examination

General: No distress, well-appearing but flushed, skin appears dry

Vital signs:

Temperature: 38.3°C

Pulse: 101 beats per minute

Blood pressure: 120/76 mmHg

Respiratory rate: 16 breaths per minute

BMI: 32.1 kg/m²

Abdomen: Gravid with fundal height of 26 cm, soft, mild tenderness, non-distended, hyperactive bowel sounds, and no rebound, guarding, masses, hernias, or hepatosplenomegaly

Pelvic: Normal internal and external genitalia. The cervix was closed, long, and high.

Fetal assessment: Fetal heart rate is 145 beats per minute, reactive with moderate variability without decelerations or contractions. The amniotic fluid index was 10.7 and the biophysical profile was 8/8.

Laboratory studies:

Potassium: 2.5 mmol/L

Sodium: 137 mmol/L

Chloride: 95 mmol/L

Bicarbonate: 24 mmol/L

BUN: 5 mg/dL

Cr: 0.7 mg/dL

Urine: Ketones present with a specific gravity of 1.035

How Would You Manage This Patient?

This patient presents with a fever and diarrhea in the setting of exposure to raw and unpasteurized foods. The history of term deliveries, cervical evaluation, and absence of contractions on nonstress testing make preterm labor unlikely. The symptoms of diarrhea for >24 hours with fever indicate an infectious process. Use of the CDC Foodborne Outbreaks website identified a local outbreak of *Listeria monocytogenes*. Due to the fever of >38.3°C, duration of symptoms, orthostatic changes, and lab abnormalities, the patient warranted inpatient evaluation and IV hydration. Simultaneous testing and empiric antibiotic treatment was initiated, with bacterial blood cultures identifying *L. monocytogenes* [1]. Fetal monitoring and supportive care, including electrolyte repletion and ongoing IV hydration, was continued until symptoms resolved. A 2-week course of IV amoxicillin was completed.

Foodborne Illnesses

US-acquired foodborne illnesses from 31 pathogens are responsible for an estimated 9.4 million infections a year, causing 56,000 hospitalizations and 1,350 deaths annually. The most impactful pathogens are listed in Table 41.1 [2]. *L. monocytogenes*, while only causing 1,600 cases of listeriosis annually, has a 94% hospitalization rate and a 15.9% death rate. *Listeria* infections were responsible for 30% of food borne bacterial illness fatalities from 1996 to 2005, and are 10–13 times more likely to sicken pregnant women [1,3]. *Listeria* infections can have serious detrimental effects on pregnancy outcomes and transplacental transmission can affect the newborn [3]. When acquired in the early first trimester, listeriosis is associated with spontaneous abortion about 65% of the time. In the second and third trimesters, listeriosis can cause preterm delivery or stillbirth [4].

Listeria Infections

L. monocytogenes is an intracellular, aerobic, and facultative anaerobic, gram-positive bacteria. It can be found in soil, water, and animal sources (poultry and cattle). While 13 subtypes have been identified, only four cause clinical disease (1/2a, 1/2b, 1/2c, and 4b). Serotype 4b has a higher likelihood of infection in pregnant women [3]. *L. monocytogenes* causes the

Table 41.1 Top pathogens that cause US foodborne illness, hospitalizations, and deaths [2]

Pathogen	Foodborne illnesses (%; N = 9.4 million)	Hospitalizations (%; N = 55,961)	Deaths (%; N = 1,351)	Death rate (%)
<i>Norovirus</i>	58	26	11	<0.1
<i>Salmonella</i> spp (nontyphoidal)	11	35	28	0.5
<i>Clostridium perferingens</i>	10	0.7	1.9	<0.1
<i>Campylobacter</i> spp.	9	15	5.6	0.1
<i>Toxoplasma gondii</i>	0.9	8	24	0.2
<i>L. monocytogenes</i>	0.01	2.6	19	15.9

clinical disease listeriosis and about 16% of cases occur in pregnant women. Increased susceptibility to listeriosis is partly due to reduced T cell immunity, and the *Listeria* bacterium invades the placenta both through direct invasion and through cellular infection. Placental evaluation can identify bacteria in both extravillous trophoblastic cells and in syncytiotrophoblasts. Placental infection can then spread disease to other parts of the body.

Outbreaks have been linked to raw and unpasteurized foods and unsafe food preparation. *Listeria* is killed by pasteurization and cooking, but grows at refrigerated temperatures (4.5°C). In healthy individuals, many cases result in mild gastrointestinal illness. In pregnant women, isolated fever or generalized symptoms including chills, muscle pain, and joint aches are not uncommon. Gastrointestinal symptoms include nausea, vomiting, and diarrhea. Severe disease can cause neurological symptoms: headache, stiff neck, confusion, and lack of balance [1]. Symptoms present days to weeks after ingestion and can occur with only 10^4 – 10^6 organisms per gram of food.

Transplacental infection can occur, neonatal *Listeria* infection is a critical illness with high mortality. Fetal transmission can occur in the setting of asymptomatic maternal disease [3]. A 2013 French prospective cohort study found 80% of infected mothers experienced major fetal or neonatal complications, with 45% preterm deliveries, 25% fetal loss, and 22% with other complications [5]. When transmission occurs placentally, infants can develop listeriosis after birth, which can result in both neurological and physical impairments. Neurological affects can range from seizures and blindness, to brain impairments or intellectual disability. Physical impairments such as paralysis, along with heart or kidney problems, can develop. Infant blood infections and meningitis can also occur [4]. Newborn symptoms of listeriosis can manifest subtly as irritability, vomiting, or little interest in feeding, however, fever or difficulty breathing can also occur and should prompt immediate evaluation.

Testing for *L. monocytogenes* can be done by bacterial culture of the serum or CSF as well as placental samples after delivery. Communicating specific clinical concern for listeriosis to the laboratory team can aid diagnosis. Testing asymptomatic individuals with possible exposure is not indicated [1]. Amniocentesis can aid diagnosis when infection is uncertain, but stool cultures are not beneficial.

Treatment in pregnancy includes inpatient management with IV hydration, antibiotics, and supportive care. Dehydration is common and can be life threatening. A treatment course of at least 2 weeks of high-dose IV amoxicillin (more than 6 g/day) is recommended in pregnancy. In cases of penicillin allergy, sulfamethoxazole is a second-line option, but is limited in the first trimester due to fetal development concerns. In these cases, erythromycin can be a safe alternative [1,3].

Shared Decision-Making

Despite the increased risks of listeriosis in pregnancy, the absolute risk with any single food exposure is low. Overly restrictive food recommendations, therefore, can cause undue stress and focus on food avoidance can exacerbate preexisting eating disorders. A risk assessment performed by the US Food and Drug Administration (FDA) estimated the risk of listeriosis to be 1 case in 83,000 servings of deli meat and 1 in 5 million servings of soft cheese (Table 41.2) [6]. Shared decision-making regarding diet restriction should be undertaken and women should be counseled on the risks, recommendations for safer food preparation, and safest alternatives to avoid *Listeria* infection.

Prevention

Food Avoidance

Avoidance of exposure to *Listeria* bacteria is the best strategy to prevent infection [7]. Foods to avoid or limit and proper preparation are included in Table 41.2. Setting refrigerator temperatures to $\leq 4.5^\circ\text{C}$ and freezer temperatures to -17°C can help limit bacterial growth, as can discarding any food after 2 hours of room temperature exposure (or 1 hour of ambient temperature $>32.2^\circ\text{C}$).

Food Preparation

Washing hands for 30 seconds before and after touching raw food, washing produce before cutting or preparation, and washing all utensils, cutting boards, and surfaces decreases contamination risk. Separate cutting boards and serving plates limit cross-contamination. Thawing frozen food in the refrigerator or microwave and cooking immediately using a food thermometer ensures foods are cooked adequately.

Table 41.2 Foods to avoid, limit, or modify preparation of in order to reduce *Listeria* infection risk [6]

Food	Risk ^a per serving	Modifications for safety ■ Proper cooking temperatures
Meats		
Deli meat	High risk 7.7×10^{-8}	Reheat until steaming
Hot dogs	High risk 6.5×10^{-8}	Reheat until steaming
Meat/poultry	n/a	Avoid undercooked preparations ■ Chicken/turkey: 74–82°C ■ Ground meat: 71–74°C ■ Beef, medium well: 71°C ■ Pork: 71–77°C ■ Ham (raw): 71°C ■ Ham (precooked): 60–71°C
Seafood (sushi, sashimi, raw oysters, raw clams, raw scallops, ceviche)	Low risk 2.0×10^{-11}	Cook clams, oysters, and mussels until the shell opens ■ Seafood: 63°C
Refrigerated		
Pâté or meat spreads, meat salads	High risk 3.2×10^{-8}	Use pâtés in jars, cans, sealed pouches
Smoked seafood (nova-style, lox, kippered, smoked, jerky, etc.)	High risk 6.2×10^{-9}	Avoid unless in a cooked dish like casserole
Cheese		
Cottage and cream cheese	Moderate risk 1.8×10^{-9}	Check label for “made with pasteurized milk”
Fresh soft cheese, queso blanco/queso fresco	Low risk 1.7×10^{-10}	Check label for “made with pasteurized milk”
Soft ripened cheese, feta/brie/camembert	Low risk 5.1×10^{-12}	Check label for “made with pasteurized milk”
Raw foods		
Unpasteurized or raw milk	High risk 7.1×10^{-9}	Use pasteurized products
Fruit	Low risk 1.9×10^{-11}	Wash thoroughly
Sprouts	Unavailable	Cook thoroughly
Produce	Low risk 2.8×10^{-12}	Wash, purchase only precut if refrigerated or surrounded by ice
Freshly squeezed juices	n/a	Avoid unless pasteurized

^a Risk categorized as high risk (>5 cases per billion servings), moderate risk (<5 but >1 case per billion servings), and low risk (<1 case per billion servings)

Key Teaching Points

- A complete ingestion history of raw or unpasteurized foods is warranted for any concern of diarrheal illness or unexplained fever.
- Education on the avoidance of certain foods, proper preparation, and storage of foods can help prevent *Listeria* infection.
- While listeriosis only causes 0.01% of foodborne illnesses, it causes 19% of the deaths related to foodborne infections, with a death rate of 15.9%.
- The absolute risk of *Listeria* infection with any single food exposure is low, however, the risk of poor pregnancy and fetal outcomes with listeriosis is high and shared decision-making and risk-reduction discussions should occur with patients.

References

- 1 Committee Opinion No. 614: Management of pregnant women with presumptive exposure to *Listeria monocytogenes*. *Obstet Gynecol*. 2014;124:1241–1244.
- 2 Scallan E, Hoekstra R, Angulo F, et al. Foodborne Illness Acquired in the United States: Major Pathogens. *Emerg Infect Dis*. 2011;17(1):7–15.
- 3 Wang Z, Tao X, Liu S, et al. An Update Review on *Listeria* Infection in Pregnancy. *Infect Drug Resist*. 2021;14:1967–1978.
- 4 Centers for Disease Control and Prevention (CDC). Vital Signs: *Listeria* Illnesses, Deaths, and Outbreaks: United States, 2009–2011. *MMWR Morb Mortal Wkly Rep*. 2013;62

- (22):448–452. www.ncbi.nlm.nih.gov/pmc/articles/PMC4604984/ (accessed June 14, 2023).
- 5 Charlier C, Perrodeau E, Leclercq A, et al. Clinical Features and Prognostic Factors of Listeriosis: The MONALISA National Prospective Cohort Study. *Lancet Infect Dis.* 2017;17(5):510–519.
- 6 US Food and Drug Administration/USDA Food Safety and Inspection Agency. Quantitative Assessment of the Relative Risk to Public Health from Food-borne *Listeria monocytogenes* among Selected Categories of Ready-to-Eat Foods. www.fda.gov/media/124721/download (accessed June 4, 2023).
- 7 US Department of Health and Human Services. Food Safety Website. www.foodsafety.gov (accessed July 12, 2023).

A 20-Year-Old with a History of Herpes Presents for a New Obstetrical Visit

Eduardo F. Estrella

History of Present Illness

A 20-year-old gravida 2 para 0 at 14 weeks' gestation presents for her initial prenatal care evaluation. This planned pregnancy follows the patient's previous pregnancy, which ended with a spontaneous first-trimester miscarriage. The patient is currently asymptomatic without any complaints. Her past medical history is remarkable for documented genital herpes infections. The patient states that she averages about three infections per year since she was 15 years old. She denies any history of additional STIs. The patient states that she has been married for the past two years and that she is in a stable and monogamous relationship.

During the initial prenatal visit, the patient expresses concern about her genital herpes condition and how it can affect her pregnancy. The patient wishes to know what treatment options are available and how she can prevent infecting her baby.

Physical Examination

General appearance: Well-developed and well-nourished, in no apparent distress

Vital signs:

Temperature: 36.9° C

Pulse: 82 beats per minute

Blood pressure: 112/68 mmHg

Respiratory rate: 16 breaths per minute

BMI: 26.8 kg/m²

Fetal assessment: Fetal heart rate is 150 beats per minute

Abdomen: Soft, non-tender, no distention, with normoactive bowel sounds

Pelvic: Normal external genitalia, vagina, and cervical mucosa. No ulcerated lesions nor vaginal discharge noted. Uterus of about 14 weeks' size, non-tender. Normal adnexa

Laboratory studies:

Hgb: 12.6 g/dl

Blood type and group: A positive

HSV-1 IgG type specific Ab: <0.90 (<0.90 Ab index (AI) negative/0.91–1.08 AI equivocal/>1.09 positive)

HSV-2 IgG type specific Ab: 2.62 (<0.90 AI negative/0.91–1.08 AI equivocal/>1.09 positive)

Gonorrhea/chlamydia transcription mediated amplification: Negative/negative

HIV Ag/Ab fourth generation: Nonreactive

Syphilis IgG EIA: Negative

How Would You Manage This Patient?

Managing a 20-year-old with a history of genital herpes during pregnancy requires a comprehensive approach that involves medical and emotional support. Routine prenatal care, including regular prenatal checkups, ultrasounds, and blood tests, is essential. Antiviral medications such as acyclovir and valacyclovir can reduce the severity and frequency of herpes outbreaks. Medical prophylaxis can be offered starting at 36 weeks' gestation in order to avoid an active infection or viral shedding at the time of delivery. The mother should be informed about the risks of herpes transmission to the baby and how to reduce the risk of transmission. The partner should be evaluated for herpes and encouraged to participate in the management of the infection.

Herpes In Pregnancy

Epidemiology

The prevalence of herpes simplex virus (HSV) genital infection has been on the rise [1]. A large, national study found that about 21% of women have positive serologic evidence of HSV-2 infection [2]. About 2% of women are infected with the HSV virus during pregnancy [3]. The prevalence of genital herpes is sometimes underestimated using serologic studies because HSV-1 can also cause genital infections [2]. The primary goal of diagnosis and treatment of HSV infections in pregnancy is to prevent neonatal herpes. This is accomplished by preventing primary as well as recurrent genital herpes infections during late pregnancy and preventing the neonatal exposure to herpetic lesions and viral shedding during delivery [1]. The risk for transmission to the neonate from an infected mother is as high as 30–50% among women who acquire genital herpes near the time of delivery, while it is <1% among women with prenatal histories of recurrent herpes or who acquire recurrent genital herpes during the first half of pregnancy [4]. Despite this apparent lower likelihood of transmission in recurrent cases, the ramifications of neonatal herpes can be devastating, making it still paramount to exercise extreme caution. It is estimated that between 1,200 and 1,500 cases of neonatal herpes occur in the United States on an annual basis [2].

Disease Manifestations

Neonatal and Congenital HSV

There are several types of disease manifestation. It can be congenital, neonatal (intrapartum or postpartum), or maternal infection. About 90% of the infections are due to HSV-2 [3]. Neonatal (intrapartum) and congenital types occur when

the infection occurs through the exposure of the virus from the maternal genital tract [1]. In 85–90% of neonatal HSV infections, the virus is acquired at the time of delivery (intrapartum) and 5–10% of neonatal infections occur with postpartum exposure [3]. Neonatal herpes infections are diagnosed when the HSV infection symptoms occur more than 48 hours (about 2 days) after delivery [1]. Neonatal and congenital HSV infections are classified as disseminated (25%); central nervous system disease (30%); and disease limited to the skin, eyes, or mouth (45%). Central nervous system disease carries a mortality rate of >90% if left untreated [2]. The type of maternal infection dictates the likelihood of neonatal disease. Neonatal HSV infection is more frequent (50%) if the mother has a primary infection versus a recurrent HSV infection (<3%) [3]. But almost 70% of HSV infections are due to exposure to an asymptomatic genital HSV infection in the mother during the third trimester [3].

In cases with documented maternal HSV genital lesions during the delivery, or if there is any clinical suspicion that the neonate is presenting symptoms 48 hours (about 2 days) post-delivery, an immediate consultation to a pediatric infectious disease specialist should be considered. Cultures or PCR of mucosal surfaces of the neonate to detect HSV should be considered [4]. Intravenous acyclovir should also be initiated as soon as possible. Use of IV acyclovir has been shown to reduce mortality rates from 58 to 16% [1].

Maternal HSV

Both HSV-1 and HSV-2 can cause genital infections. HSV-2 is more common than HSV-1, but infections with HSV-1 are on the rise [1]. It is of the utmost importance to be able to recognize as a clinician the different clinical manifestations of HSV in pregnancy in order to manage HSV properly. There are several clinical manifestations of an HSV infection.

1. Primary first episode
2. Non-primary first episode (previous immunity but no previous active infection)
3. Recurrent infection

Being able to know which type of clinical manifestation the patient has will help the provider in counseling during pregnancy [1]. The clinical implications for the mother and the fetus/neonate are different depending on the manifestation. On physical examination, an infection will present as vesicular tender lesions on the genital area. These vesicles will evolve into pustules, then ulcerations, and finally into crusted lesion [1]. There may be

atypical presentations like minor erythema, fissures, pruritus, and pain [1]. In some cases, it may not be possible to distinguish primary from non-primary infections based on signs and symptoms alone. To diagnose an HSV infection, type-specific methods are recommended. These include viral detection HSV culture methods as well as HSV antigen detection methods using PCR [2]. If genital lesions are present, the diagnosis of HSV should be confirmed by type-specific virologic testing from the lesion by nucleic acid amplification test (NAAT) or culture [4]. The most sensitive tests available are HSV NAATs because they detect the virus from genital lesions as well as from other lesions throughout the body [4]. For patients with a previous history of herpes infections that do not have an active infection or lesion, or when the culture taken from the lesion was negative, type-specific serologic tests can be used [2]. These type-specific methods help distinguish between HSV-1 and HSV-2. A primary first infection is diagnosed with a positive culture and a negative antibody response. For a primary infection, antibodies to HSV develop a few weeks after the infection and persist indefinitely [2]. If testing is done early post exposure, the result may be falsely negative. If clinical suspicion is high, repeat testing is warranted [2]. In a patient with previous documented HSV infections, or positive antibody testing, there is no need to repeat testing during pregnancy [4].

According to the 2023 United States Preventive Services Task Force (USPSTF) recommendations, the routine serologic screening for genital HSV infection in asymptomatic adolescents and adults, including pregnant patients, is not recommended [5]. Also, according to American College of Obstetricians and Gynecologists (ACOG), genital cultures at term in asymptomatic patients with a history of recurrent disease is not cost-effective, so they are not recommended [2].

Treatment

There are two oral antiretroviral agents available for HSV infections during pregnancy (Table 42.1). Dosage, quantity, and duration will depend on the type of HSV episode the patient has. They are acyclovir and valacyclovir. No clinical benefit has been noted with the use of topical agents during pregnancy [2]. Acyclovir is a nucleoside analog that enters cells that have been infected by the virus and inhibits viral DNA replication. Valacyclovir is converted to acyclovir once it is metabolized in the liver [2]. Both medications have been found to be safe for use during pregnancy [5]. The increased

Table 42.1 CDC-recommended antiretroviral medications for herpes in pregnancy [4]

Indication	Acyclovir	Valacyclovir
Primary infection – first episode	400 mg orally, three-times daily for 7–10 days	1 g orally, twice daily, for 7–10 days
Symptomatic recurrent episode	400 mg orally, three-times daily, for 5 days or 800 mg orally, twice daily, for 5 days	500 mg orally, twice daily, for 3 days or 1 g orally, daily, for 5 days
Daily suppression	400 mg orally, three-times daily, from 36 weeks' estimated gestation until delivery	500 mg orally, twice daily, from 36 weeks' estimated gestation until delivery
Severe or disseminated disease	5–10 mg/kg, IV, every 8 hours for 2–7 days, then oral therapy for primary infection to complete 10 days	

bioavailability of valacyclovir and the fact that it can be taken less often favors patient compliance. However, valacyclovir tends to be more expensive than acyclovir [2].

Treatment from 36 weeks' gestation until delivery with prophylactic doses of either acyclovir or valacyclovir reduces the frequency of viral shedding, active infection, vertical transmission, and reduces the rate of delivery via cesarean section during the birthing process [3]. In cases of primary infections that occur during the third trimester of pregnancy, continuous antiretroviral therapy until delivery should be considered [2].

Delivery

According to ACOG [2], cesarean delivery is indicated for patients with an active genital infection or prodromal symptoms of HSV (burning, pain). Prodromal symptoms may indicate active viral shedding. Cesarean delivery is not recommended in cases of no active genital lesions nor prodromal symptoms. Also, cesarean delivery is not recommended for patients with non-genital lesions (e.g. back, thigh, buttock). Lesions such as these can be covered with an occlusive dressing for added precaution. Finally, in patients with premature rupture of membranes, there is no consensus on the timing of delivery if the fetus is less than 37 weeks' gestation.

Intravenous retroviral suppression is recommended if expectant management is chosen.

Postpartum

All infections that occur in the postpartum period should be managed with adequate handwashing and contact precautions [2]. This is to prevent infecting the infant by persons in close contact. Breast-feeding is contraindicated if the patient has active HSV lesions on the breast [2,3]. Both acyclovir and valacyclovir are considered safe if the mother is breast-feeding.

Key Teaching Points

- During pregnancy, HSV infections can have deleterious effects on the developing fetus and newborn.
- The diagnosis of HSV should be confirmed by type-specific virologic testing from the lesion by NAAT or culture.
- Prevention and early detection of HSV infections will help to decrease the incidence of neonatal herpes.
- In patients with a history of recurrent herpes infections, antiretroviral suppression starting around 36 weeks' gestation has been proven to reduce viral shedding and therefore infection spread to the neonate.

References

- 1 Money D. SOGC No. 208: Guidelines for the Management of Herpes Simplex Virus in Pregnancy. *Obstet Gynaecol Can.* 2017;39(8): e199–e205.
- 2 Management of Genital Herpes in Pregnancy: ACOG Practice Bulletin No. 220. *Obstet Gynecol.* 2020;135(5): e193–e202.
- 3 Straface G, Selmin A, Zanardo V, et al. Herpes Simplex Virus Infection in Pregnancy. *Infect Dis Obstet Gynecol.* <https://doi.org/10.1155/2012/385697> (accessed October 8, 2024).
- 4 Center for Disease Control and Prevention. Genital Herpes. In: Sexually Transmitted Infections Treatment Guidelines. Atlanta, GA: CDC, 2021, 29–36.
- 5 USPSTF Recommendation Statement: Serologic Screening for Genital Herpes Infection. *JAMA.* 2023;329(6):502–507.

CASE 43

A 40-Year-Old at 16 Weeks' Gestation Whose Toddler Has Chicken Pox

Stephanie Marshall Lee

History of Present Illness

A 40-year-old gravida 3 para 1 at 16 weeks' gestation presents to the office for routine prenatal care. During her visit, she divulges that her toddler had a fever for 2 days and started to develop an itchy rash all over his body last night. She received a message from his daycare that there has been an outbreak of chicken pox in the classroom. Her toddler has not been vaccinated for varicella. She is unsure if she had chicken pox as a child. She is currently asymptomatic and denies any rashes or skin lesions. Her past medical history is notable for asthma. Her surgical history is notable for a tonsillectomy. She does not take any medications and has no drug allergies.

Physical Examination

General appearance: Well-developed, well-nourished female sitting comfortably in no distress

Vital signs:

Temperature: 37.1°C

Pulse: 88 beats per minute

Blood pressure: 114/64 mmHg

Respiratory rate: 16 breaths per minute

BMI: 27.5 kg/m²

Cardiopulmonary: Nonlabored respirations, lungs clear to auscultation bilaterally. Normal heart rate and rhythm

Abdomen: Normal bowel sounds, soft, non-distended, no guarding or rebound. Fundal height appropriate, below the umbilicus

Fetal assessment: Fetal heart rate is 140 beats per minute

Laboratory studies:

WBCs: 8,500/μL

Plt: 220,000/μL

Hgb: 12.6 g/dL

Varicella zoster virus (VZV) IgG: Negative

Imaging:

Transabdominal ultrasound reveals a singleton intrauterine pregnancy in cephalic presentation.

How Would You Manage This Patient?

This patient presented with concerns for exposure to varicella (chicken pox) from her child. She is asymptomatic at presentation. Review of the patient's prenatal records indicate that her immune status to varicella was checked at her initial obstetrics visit, and she had a negative varicella IgG, indicating a lack of immunity from previous infection or immunization

(see section titled "Maternal Varicella" about testing and ways to confirm immunity).

The patient was immediately started on Varicella-Zoster Immune Globulin (VZIG). She developed a fever, body aches, and a vesicular rash 1 day later and was started on oral acyclovir. She did not develop any respiratory symptoms and her rash dissipated within 2 weeks. Her anatomy scan at 20 weeks' gestation showed normal anatomy of the fetus, without concern for embryopathy or malformations. The patient delivered an appropriate for gestational age fetus at 39 weeks' gestation.

Varicella Zoster Virus

Varicella zoster virus (VZV) is a DNA virus in the herpesvirus family that is highly infectious [1]. Primary infection with VZV causes chickenpox, a vesicular exanthem that is most commonly seen in the pediatric population. Following primary infection, the virus lies dormant in the sensory root ganglia and may cause secondary infection, often decades later, called herpes zoster or shingles [1]. The antibody to VZV develops within days of infection, conferring lifelong immunity to primary infection [2].

Varicella is transmitted by both respiratory droplets and direct contact with lesions [2,3]. The incubation period is 14 days on average, with a range of 10–21 days after exposure [3]. The period of infectivity begins 1–2 days prior to the onset of the rash and lasts until vesicles crust over, generally 6–10 days after onset [2,3].

Primary varicella is one of the most contagious diseases documented, with an infection rate among susceptible contacts of over 90% [1,2]. Prior to 2000, approximately four million people per year were infected with VZV. However, following the widespread availability of the varicella vaccine in 1995, the incidence decreased 82% from 2000 to 2010 [2]. Varicella remains most common in childhood and is rare in pregnancy. The estimated prevalence is <0.4–0.7 per 1,000 pregnant women [2,4].

Varicella is classically characterized by a viral prodrome of fever, malaise, and headache [4]. Next, an intensely pruritic maculopapular rash develops that transforms quickly to a vesicular rash [2,4]. Vesicles then dry and crust over. Lesions initially appear on the face and trunk and spread to limbs over 4–7 days. Infection is generally self-limited in children with supportive care and recommended hydration, as well as avoidance of secondary infection of lesions. Rare complications can include hepatitis, arthritis, pericarditis, and nephritis [1]. Adults experience higher morbidity, with an increased risk of pneumonia and encephalitis [2].

Pneumonia may develop several days after the onset of a rash and varies from mild illness to hypoxic respiratory failure [1]. Approximately 16% of adults with primary varicella infection have pulmonary involvement compared to only 1% in the pediatric population [1].

Diagnosis of varicella is generally a clinical diagnosis, based on pathognomonic exanthems. A laboratory diagnosis can be made through PCR assay from a sample of an unroofed vesicle [2].

Varicella Embryopathy

The first description of congenital varicella syndrome was made in 1947 by Laforet and Lynch [1,4]. The classic anomalies attributed to congenital varicella are: cutaneous scarring, limb hypoplasia, digital malformations, microcephaly, chorioretinitis, microphthalmia, cataracts, and psychomotor retardation [1]. Incidence of varicella embryopathy is dependent upon the trimester in which infection occurs. The incidence of congenital varicella with exposure in the first trimester is 0.4%, whereas it is as high as 2% in the second trimester [3]. Exposure to varicella in the third trimester of pregnancy does not appear to confer a risk of embryopathy. Intrauterine infection does not directly correlate with the severity of maternal infection. Congenital infection occurs primarily through transplacental (hematogenous) dissemination [1].

There is no definitive diagnostic method to confirm the presence of fetal varicella infection prior to birth [1]. Targeted ultrasound remains the primary method of detecting the presence and severity of an infection. Ultrasound findings suggestive of congenital infection include hydrops fetalis, polyhydramnios, limb deformities, soft tissue calcification, microcephaly, growth restriction, and an echogenic focus in the liver or bowel [2,3,4].

Maternal Varicella

Varicella immunity status should be documented at the beginning of pregnancy for all women. A history of previous chickenpox infection is nearly 99% predictive of lifelong immunity [2,3]. While the sensitivity of viral serology is not ideal for a history of vaccination, if a woman is unsure of a past infection with varicella or prior vaccination, varicella IgG serology should be obtained [1,2]. While a patient's year of birth should not be used as a criterion for immunity, a diagnosis or confirmation of a varicella history can be made by a healthcare provider [5]. Box 43.1 reviews the acceptable approach to confirming a patient has immunity to varicella.

Exposure of a seronegative pregnant woman to varicella necessitates immediate treatment with VZIG, ideally within 72 hours [3,6]. However, there are data to support use of VZIG up to 10 days post exposure. Following exposure, VZIG should also be given empirically to exposed women with unclear immunity until serology is ascertained [1]. Early use of VZIG has been shown to be up to 70%

Box 43.1 Ways to elicit a history of varicella immunity [5]

- Confirm the patient has had an age-appropriate varicella vaccination.
- Carry out laboratory testing to confirm varicella immunity.
- Source a diagnosis or verification, by a healthcare provider, of a history of herpes zoster or varicella.

effective in preventing primary varicella infection in pregnant women [1].

Treatment of primary varicella in the pregnant woman includes supportive care, fluid administration, and analgesia. Patients should be treated with oral acyclovir 800 mg five-times daily or valacyclovir 1 g three-times daily, both for 7 days [4,6]. Treatment with acyclovir within 24 hours of a rash appearing reduces the duration of new lesion formation and the total number of lesions [2,3]. Known complications of varicella in pregnancy include severe mucocutaneous infections, hepatitis, encephalitis, and pneumonia. Of the 16% who develop pneumonia [1,2], approximately 40% will require intubation and ventilation [4]. Pregnant women with complications of varicella should be managed as inpatients and treated with IV acyclovir (10–15 mg/kg every 8 hours) [6].

Pregnant women who are seronegative should avoid individuals infected with varicella until the rash has completely crusted over [2]. Additionally, pregnant women should not receive vaccination with the varicella vaccine as it is a live, attenuated virus. Harmful effects of inadvertent vaccination have not been reported in newborns of mothers who received this vaccine, however, the risk to the fetus cannot be definitively excluded. For more detail on varicella vaccination and the use of live vaccines in pregnancy, see Chapter 11.

Neonatal Varicella

Neonatal varicella infection can occur if maternal infection occurs within 3 weeks prior to delivery [1]. It is associated with a high rate of neonatal demise and severe infection when maternal varicella occurs between 5 days prior to delivery and 48 hours postpartum. This is likely due to the lack of neonatal antibodies and immaturity of the neonatal immune system as a whole [2,3]. The most common complications of neonatal varicella are pneumonia, encephalitis, and hepatitis. The mortality rate with neonatal varicella infection has been reported to be as high as 30%. However, with the advent of immunoglobulin treatment in the intensive care setting, the estimated mortality rate has been reduced to about 7%, according to Centers for Disease Control and Prevention (CDC) data [5].

If possible, attempts should be made to delay delivery for at least 5–7 days following development of maternal rash to allow for passive transfer of maternal antibodies [1]. If delivery is not delayed, the infant should receive VZIG immediately upon delivery [1]. Efforts should be made to avoid any direct contact between the infant and maternal lesions until all lesions have crusted. Breast-feeding may be initiated if there are no lesions present on the breast [1].

Despite treatment with VZIG, approximately 50% of infants will develop primary varicella [3]. Supportive care should be given and the infant should be placed in isolation until all lesions have crusted. Consideration should be given to treating the neonate with IV acyclovir to reduce varicella morbidity [1,3].

Prevention of Varicella

All women of reproductive age should be asked about their varicella immune status prior to conceiving. If varicella naïve or unvaccinated, women should be vaccinated prior to pregnancy with the two-dose VARIVAX series. The varicella vaccine can be safely given to anyone over 12 months of age as injections 4–8 weeks apart [6]. Given that VARIVAX is a live, attenuated viral vaccine, conception should be delayed for at least 4 weeks following completion of the vaccine series [2,4]. Vaccination is especially important for those at high risk of severe disease, such as those who are immunocompromised,

or those at high risk of transmission (e.g. childcare employees and residents of institutional settings) [2].

Key Teaching Points

- Primary varicella infection in a pregnant mother poses a risk of fetal transmission of congenital varicella syndrome, with the highest risk of transmission in the second trimester.
- Pregnant people with primary varicella infection should be treated with supportive care and acyclovir. The most morbid sequelae of primary varicella infection in pregnancy is varicella pneumonia, which may require intubation and ventilation.
- Neonatal varicella infection can occur if maternal infection occurs within 3 weeks prior to delivery. Delivery should be delayed, if possible, for at least 5 days following maternal symptom onset. Neonates should be treated with VZIG, supportive care, and consideration for IV acyclovir.

References

- 1 Chapman SJ. Varicella in Pregnancy. *Semin Perinatol.* 1998;22(4): 339–346.
- 2 Practice Bulletin No. 151: Cytomegalovirus, Parvovirus B19, Varicella Zoster, and Toxoplasmosis in Pregnancy. *Obstet Gynecol.* 2015;125 (6):1510–1525.
- 3 Tan MP, Koren G. Chickenpox in Pregnancy: Revisited. *Reprod Toxicol.* 2006;21(4):410–420.
- 4 Lamont RF, Sobel JD, Carrington D, et al. Varicella-zoster Virus (Chickenpox) Infection in Pregnancy. *BJOG.* 2011;118(10):1155–1162.
- 5 Centers for Disease Control and Prevention. Chickenpox (Varicella): For Healthcare Professionals. www.cdc.gov/chickenpox/hcp/index.html (accessed October 8, 2024).
- 6 Gardella C, Brown ZA. Managing Varicella Zoster Infection in Pregnancy. *Cleve Clin J Med.* 2007;74 (4):290–296.

A 35-Year-Old at 19 Weeks' Gestation Whose Toddler Was Diagnosed with Parvovirus

Tara Harris

History of Present Illness

A 35-year-old gravida 3 para 2 presents to the office at 19 3/7 weeks' gestation and reports that her 2-year-old son was diagnosed with fifth disease. The previous week, he came home from daycare fussier than usual, with a low-grade fever and runny nose. He stayed home for a few days and improved. Three days ago, she noticed that his cheeks seemed unusually flushed. Yesterday, he developed a lace-like rash on his trunk and arms, prompting a visit to the pediatrician. After diagnosing fifth disease, the pediatrician suggested notifying her obstetrician as this "could affect the current pregnancy." She does not recall any previous exposures to parvovirus B19. Though she is quite anxious about what affect her son's illness may have on her current pregnancy, she has no complaints. She reports positive fetal movement and denies fevers or flu-like symptoms, nausea, pain, or bleeding. This pregnancy has been uncomplicated, as were her two prior pregnancies, with subsequent normal spontaneous vaginal deliveries (SVDs) at term. She has no significant past medical or surgical history, is taking only prenatal vitamins, and she has no known drug allergies.

Physical Examination

General appearance: Well-developed, anxious appearing

Vital signs:

Temperature: 37.1° C

Pulse: 92 beats per minute

Respiratory rate: 18 breaths per minute

Blood pressure: 116/63 mmHg

BMI: 26.4 kg/m²

Abdomen: Soft, gravid, non-tender, fundus at the umbilicus

Skin: Warm and dry, no rashes

Fetal assessment: Fetal heart rate is 145 beats per minute

How Would You Manage This Patient?

This patient presents at 19 3/7 weeks' gestation with a household exposure to parvovirus B19. Though she has not had signs or symptoms of acute infection, many patients infected with parvovirus B19 are asymptomatic; thus, serologic screening is necessary to determine if she needs to be monitored for seroconversion [1]. This patient's parvovirus B19-specific IgM was negative and her IgG positive, indicating that she had a previous exposure to parvovirus B19 and presumed lifelong immunity. After receiving the test results, the patient

was reassured that there was no risk of transplacental transmission to her developing fetus and that she did not need further testing for this issue. She continued receiving routine prenatal care and the remainder of her pregnancy was uneventful. She went into labor at 38 2/7 weeks' gestation and had a normal SVD of a healthy 3,104 g female infant.

Clinical Features of Fifth Disease

Fifth disease is the colloquial name for the childhood exanthema erythema infectiosum, named such as it was the fifth identified of the six common skin rash illnesses in childhood. It is caused by the single-stranded DNA virus named parvovirus B19. It is typically transmitted through respiratory secretions and hand-to-mouth contact. Infected persons are most contagious during the periods of active viral replication and shedding, which occurs approximately 5–10 days following exposure and usually lasts 5 days. Approximately 20–25% of patients are asymptomatic during this time [1,2], while others exhibit nonspecific symptoms such as fever, headache, sore throat, myalgias, or gastrointestinal distress. As parvovirus B19 is cytotoxic for erythroid progenitor cells, commonly there is a significant decrease in the reticulocyte count in infected individuals. Since erythrocytes last in circulation for approximately 4 months, this usually does not have significant clinical sequela for the patient unless they have an underlying hemoglobinopathy. In patients with a hematologic abnormality such as sickle cell disease or hereditary spherocytosis, infection with parvovirus B19 can trigger a transient aplastic crisis.

Parvovirus-specific IgM and IgG Abs are produced in response to the viremia. Although many individuals remain asymptomatic, approximately 1 week following antibody development, patients may present with signs or symptoms more specific to fifth disease, such as a rash and/or joint pain. The rash is classically an erythematous malar rash (the "slapped cheek rash"), which may be followed days later by a lace-like rash on the trunk, arms, and legs. The joint symptoms associated with fifth disease are characterized as acute, symmetric, and may involve the joints of the hands, wrists, knees, and feet [3]. Though either symptom can present regardless of age, children more commonly exhibit the rash, while adults (particularly women), typically present with joint pain. By the time these more specific symptoms develop, the patient is no longer contagious. Symptoms usually resolve within a few weeks and rarely become a chronic issue. Most infections are mild and require only supportive care for symptoms. The risk of infection with parvovirus B19 varies

depending on the level of exposure to an infected individual. Household contacts are associated with a 50% risk of seroconversion, while work-related exposure for daycare workers or teachers ranges from 20 to 50% [1].

Serologic Screening for Parvovirus B19 Infection

The prevalence of seropositivity to parvovirus B19 in reproductive-age women is 50–65% [1]. Pregnant women with a suspected or established exposure to parvovirus B19 need to have serologic testing done as soon as possible in order to determine their immune status, the potential risk to the fetus, and need for follow-up. Parvovirus B19-specific IgM Abs are typically detectable within 7–10 days following exposure and may remain present for several months. The IgG Abs arise approximately 2 weeks following infection and persist indefinitely. When serologic testing for IgM is negative, but IgG is positive, the patient has presumed lifelong immunity to parvovirus B19 and thus there is no risk of transmission to the fetus. The presence of IgM is highly suggestive of a recent infection, but not confirmatory as there are reasons for false-positive IgM testing (e.g. rheumatoid factor). False-negative IgM results are also possible if testing is performed before there are detectable levels of IgM. When both IgM and IgG are negative, the patient is at risk to develop acute infection with parvovirus B19 and serologic testing needs to be repeated in 4 weeks. If the repeat test is positive for IgM and/or IgG, the patient should undergo monitoring for potential fetal transmission. Given that the IgG response develops shortly after the IgM, commonly when the IgM is detectable, the IgG is also positive. When IgM and IgG are both positive, the patient needs to be monitored for potential fetal infection [1].

Assessment and Management of Fetal Complications from Parvovirus B19 Infection

Rates of transplacental fetal transmission of parvovirus B19 range from 17 to 33% [1]. While most resolve without complications, some cases can result in nonimmune hydrops fetalis (9.3%) or fetal loss (7.6%) [4]. Parvovirus B19 does not appear to cause congenital anomalies, but the long-term neurodevelopmental outcomes for children born with congenital parvovirus infection are unclear.

Hydrops fetalis is the term for a pathological fluid accumulation in fetal soft tissues and serous cavities as detected by ultrasound (Figure 44.1). It is diagnosed when there are two or more abnormal fluid collections in the fetus, including pleural effusions, pericardial effusions, ascites, or generalized skin edema. Hydrops fetalis and fetal anemia can develop in response to the cytotoxic effect of parvovirus B19 on fetal erythroid precursors. This is of specific concern in the second trimester, when rapid changes in fetal hematopoiesis occurs [1]. Most poor fetal outcomes happen when patients are infected prior to 20 weeks' gestation. Rates of fetal loss range from 8 to 17% when parvovirus B19 infection occurs on or



Figure 44.1 Fetal ultrasound showing the abdominal circumference, stomach, and ascites

before 20 weeks versus 2–6% when the infection occurs after 20 weeks [1,5].

When serologies are concerning for acute maternal infection with parvovirus B19, serial ultrasounds are performed to assess the fetus for signs of hydrops fetalis. The peak systolic velocity of the fetal middle cerebral artery is used as a predictor of fetal anemia and is a noninvasive alternative to fetal cord blood sampling. Ultrasounds are performed every 1–2 weeks for 8–12 weeks following exposure; if no fetal complications have been detected by that time, it is highly unlikely and thus monitoring may be discontinued. If hydrops fetalis is detected via ultrasound, fetal parvovirus B19 infection may be confirmed via PCR testing of the amniotic fluid. Fetal blood sampling should be done when severe fetal anemia is suspected to confirm the hematocrit and prepare for potential intrauterine fetal transfusion. While mild to moderate anemia may be tolerated, severe fetal anemia can lead to demise. Though the risk of fetal loss is higher when hydrops fetalis is detected, intrauterine transfusion can improve survival rates (82 vs 55% without transfusion) [6]. Intrauterine transfusion is typically limited to gestational ages of 18–34 weeks given the technical considerations before 18 weeks and the risks to the infant versus delivery after 34 weeks. When a pregnancy shows signs of hydrops fetalis, the pregnancy and delivery should be managed at a tertiary-care facility with experience in managing hydropic neonates as their resuscitation is often substantially complicated [7].

Prevention of Parvovirus B19 Infection

Given the typical transmission of parvovirus B19 via respiratory secretions and hand-to-mouth contact, the best methods of prevention are the personal practices recommended to control most infections: frequent handwashing, avoiding the sharing of utensils, food, or beverages, and avoiding close contact with sick individuals whenever possible. This last practice can be specifically challenging whenever patients must be near children either at work or at home, especially given the nonspecific

symptoms and sometimes lack of symptoms occurring during the viremic phase. During outbreaks of parvovirus B19, questions often arise as to whether pregnant women should avoid settings such as daycares or schools. The Centers for Disease Control and Prevention (CDC) currently recommends that pregnant women be able to continue working but to discuss the risks with their healthcare providers to make the choice that works best for them [3]. Routine or targeted serologic screening for parvovirus B19 is not currently recommended given the low incidence of seroconversion as well as the variable risk of transplacental transmission and complications [1].

Key Teaching Points

- Fifth disease may be asymptomatic or have nonspecific symptoms during the infectious period. When signs and symptoms specific to parvovirus B19 appear, the patient is no longer contagious.
- Many reproductive-age women have lifelong immunity to parvovirus B19, and most women who are acutely infected during pregnancy will not have any fetal sequela.
- Serologic testing of parvovirus B19-specific IgM and IgG should be performed as soon as a patient reports concern of an exposure; the serologic testing will inform the patient's risk and need for further testing.
- IgM most often represents an acute infection, although false-positive results are possible. IgG is positive slightly later and remains positive for life.
- For patients with a risk of acute infection with parvovirus B19, serial ultrasounds are performed to assess for hydrops fetalis and fetal anemia every 1–2 weeks for 8–12 weeks following exposure.
- Personal infection control strategies, such as frequent handwashing, are the main method to prevent infection with parvovirus B19.

References

- 1 American College of Obstetricians and Gynecologists. Cytomegalovirus, Parvovirus B19, Varicella Zoster, and Toxoplasmosis in Pregnancy: Practice Bulletin 151. *Obstet Gynecol.* 2015; 125(6):1510–1525.
- 2 Woolf AD, Campion GV, Chishick A, et al. Clinical Manifestations of Human Parvovirus B19 Infection. *Arch Intern Med.* 1989;149(5):1153–1156.
- 3 Center for Disease Control and Prevention. Parvovirus B19 and Fifth Disease. Reviewed 2019. www.cdc.gov/parvovirusb19/index.html (accessed July 14, 2023).
- 4 Xiong YQ, Tan J, Liu YM, et al. The Risk of Maternal Parvovirus B19 Infection during Pregnancy on Fetal Loss and Fetal Hydrops: A Systematic Review and Meta-analysis. *J Clin Virol.* 2019;114:12–20.
- 5 Enders M, Weidner A, Zoellner I, et al. Fetal Morbidity and Mortality after Acute Human Parvovirus B19 Infection in Pregnancy: Prospective Evaluation of 1018 Cases. *Prenat Diagn.* 2004;24(7): 513–518.
- 6 von Kaisenberg CS, Jonat W. Fetal Parvovirus B19 Infection. *Ultrasound Obstet Gynecol.* 2001; 18(3):280–288.
- 7 Society for Maternal-Fetal Medicine (SMFM). Society for Maternal-Fetal Medicine (SMFM) Clinical Guideline #7: Nonimmune Hydrops Fetalis. *Am J Obstet Gynecol.* 2015;212(2): 127–139.

CASE 45

A 20-Year-Old Presents at 12 Weeks' Gestation with Septic Arthritis and Petechial Skin Rash

Maria Shaker

History of Present Illness

A 20-year-old gravida 1 para 0 at 12 weeks' gestation presents with a concern for septic arthritis and a petechial skin rash. Two days prior to presentation, she noted right fourth finger pain, right ankle swelling, and "insect-like bites" on her legs. Her left knee started swelling the day prior to presentation. Her pregnancy is notable for a remote history of pelvic inflammatory disease, for which she was treated. She has no other medical history. She is sexually active with her ex-boyfriend, but she is concerned that he has recently had other partners.

Physical Examination

Vital signs:

Temperature: 37°C

Pulse: 112 beats per minute

Blood pressure: 133/76 mmHg

BMI: 34.1 kg/m²

General: Alert, oriented, in no apparent distress

Cardiopulmonary: Clear breath sounds with no wheezes, rhonchi, or rales

Abdomen: Soft, non-tender throughout. No rebound, guarding, or rigidity

Pelvic: Friable cervix with mucopurulent discharge and a 12-week-sized uterus, which is non-tender. Bilateral adnexa are non-tender with no palpable masses

Integumentary: Small pustular lesions located on bilateral lower extremities

Musculoskeletal: Erythema and swelling of the right fourth finger, left thumb, and knees. The left knee is swollen and warm to the touch

Neurological: Cranial nerves II–XII grossly intact

Fetal assessment: Fetal heart rate is 155 beats per minute

Laboratory studies:

Hgb: 10.9 g/dL

WBC: $18.7 \times 10^9/\mu\text{L}$

Liver function tests: Within normal limits

Cr: 0.52 mg/dL

Urinalysis: 1+ protein, 2+ leukocyte esterase, negative nitrites

Gonorrhea, amplified: Positive pharyngeal and urine specimens

Chlamydia, amplified: Negative

HIV: Nonreactive

Syphilis IgG: Nonreactive

Synovial fluid: Straw color, cloudy; WBCs 95,184/ μL ; neutrophils 79%, no growth aerobically or anaerobically
Blood cultures: No growth

Imaging:

X-ray, hand: No fractures or evidence of osteomyelitis

How Would You Manage This Patient

A young, sexually active patient with skin manifestations, arthralgia, and findings consistent with a septic joint has disseminated gonococcal infection (DGI) until proven otherwise. A rapid response and assistance from orthopedics and infectious disease are prudent steps in adequately caring for this patient.

Clinical evaluation requires collection of specimens from potentially exposed urogenital and extra-genital mucosal sites, as well as disseminated sites of infection. Further workup of a septic joint includes arthrocentesis to obtain a cell count, culture, and Nucleic Acid Amplification Test (NAAT). Bacterial cultures, if positive, confirm the etiology and enable antibiotic susceptibilities. It is important to alert laboratory services of your clinical suspicion of DGI as *Neisseria gonorrhoeae* is a fastidious bacterium to isolate in the laboratory.

The patient should be hospitalized to initiate parenteral therapy with ceftriaxone, typically 1 g IV every 24 hours. Intravenous antibiotics usually continue for at least 24–48 hours beyond resolution of clinical symptoms. Antibiotics are then tailored based on susceptibilities. Recent sexual contact(s) should be offered testing and treatment.

Prenatal care proceeds normally. A test of cure is not required if the patient is treated appropriately, but reinfection is common [1]. A test of cure should be obtained for those affected by pharyngeal gonorrhea 7–14 days after treatment. Otherwise, retesting at 3 months is prudent to identify those potentially reinfected [1].

DGI in Pregnancy

According to the Centers for Disease Control and Prevention (CDC), there are over 1.5 million new *N. gonorrhoeae* infections diagnosed every year, the second most commonly reported bacterial infection behind chlamydia [1]. Gonorrhea infection may be on the rise [2]; coincident with this increase in *N. gonorrhoeae* prevalence are changes in antibiotic susceptibility, prompting the CDC to update its management guidelines in 2020 [1].

Frequently, gonococcal infections in women are asymptomatic, delaying diagnosis and increasing the risk for significant reproductive sequelae. In contrast, men with a gonococcal infection experience the symptom of urethritis, prompting

Box 45.1 Recommended screening for *N. gonorrhoeae* [1]

Screen annually:

- Sexually active individuals <25-years old
- Individuals ≥25-years old with a new sex partner, more than one sex partner, a sex partner with other partners, or sex partner with reported STI
- Inconsistent condom use
- Previous or coexisting STIs
- Exchanging sex for money or drugs

them to seek treatment sooner, but not before transmission has likely occurred. A delay in treatment likely facilitates a bacteremic phase of infection, and thus, enables dissemination of gonorrhea to extra-mucosal sites [3].

Prevalence of DGI was previously reported at 0.5–3% of untreated infections. While DGI seems rare, *N. gonorrhoeae* is the most common cause of septic arthritis in sexually active young adults without a prior history of rheumatologic/joint disease [4]. Annual screening for those at highest risk of infection and obtaining a detailed sexual history serves to reduce prevalence and the associated consequences of infection (Box 45.1).

Disseminated infection is dependent upon a complex interplay of the host, bacterial virulence, and other immune factors. Some host factors include female sex, pregnancy, complement deficiencies, and monoclonal antibody administration. Women may be affected three to four times more frequently than men [3,5], although this trend may be changing. This predilection for women may be due to a temporal relationship between infection and menstruation, with the associated increased pH and available iron during menses, a nutrient needed for gonococcal growth and proliferation [6].

Known to be facultative parasites, *N. gonorrhoeae* infects cells by attaching to their epithelial receptors via pili and Opa (opacity-related proteins). Through the process of endocytosis, the bacteria enter the cell, evade the usual host cell responses, and replicate, thereby leading to host cell death. Bacterial porins and lipooligosaccharide bind complement factors to facilitate suppression of neutrophil apoptosis and oxidative burst [7].

An alteration in immune-host responses, specifically a reduction in cell-mediated immunity [5] and increased mucosal vascularity, may be reasons why pregnancy is another risk factor for DGI. Symptoms can manifest at any gestational age of pregnancy [3]; usually, symptoms occur 2–3 weeks after mucosal infection [5].

Clinically, DGI can present as a triad of dermatitis, tenosynovitis, and migratory polyarthritis, which is also known as the “arthritis-dermatitis syndrome.” Constitutional symptoms such as fever, chills, and general malaise may precede the skin and joint manifestations, but patients may defervesce spontaneously (Table 45.1). Furthermore, as many as 40% of patients may be afebrile [8]. Interestingly, it is common for patients to be asymptomatic at the mucosal sites of infection, but 70–80% of infections are identified at these anatomic locations [8].

Table 45.1 Common symptoms of DGI [5,8]

Organ system	Sign/symptom	Prevalence
Asymptomatic mucosal infection		70–80%
Constitutional	Fever Chills Malaise	60%
Dermatitis	Transient, acral Oligolesional (5–40) Papules, hemorrhagic pustules, sometimes vesicular	75%
Tenosynovitis	Flexor tendons, slightly flexed at rest Upper extremities Tenderness along flexor sheath Erythema Pain with passive extension	68%
Migratory polyarthritis	Asymmetrical, small and large joints	70–85%
Septic/suppurative arthritis	Oligoarticular Asymmetrical Distal joints (wrists, knees, ankles)	None reported

Asymmetrical small and large joint involvement is typical of the associated migratory polyarthritis and is a common presenting complaint, reported in 70–86% of patients [5]. Skin manifestations, also common in approximately 75% of cases, can go unnoticed. The lesions are typically acral in location, oligolesional, transiently present, and resolve spontaneously [9]. Initial eruption appears papular, with progression to hemorrhagic pustules [5]. Sometimes, the skin lesions are vesicular in appearance. Infectious tenosynovitis usually involves the flexor tendons of the upper extremities, with affected tendons slightly flexed at rest. There is associated tenderness and erythema along the flexor sheath. Pain is elicited with passive extension.

A less common clinical symptom is suppurative arthritis, which can present in isolation or with other associated symptoms. Hematogenous spread is the most likely route of infection [4]. Onset is abrupt, usually without a prodrome, and oligoarticular in nature, with the knee being the most commonly affected joint [8]. Acute joint pain, swelling, warmth, erythema, and decreased range of motion are some of the features of septic arthritis [4].

Although rare, physical exam should assess whether DGI has progressed to endocarditis, meningitis, or osteomyelitis [3]. Dermatologic involvement warrants careful skin examination. Similarly, close visual inspection and palpation of large and small joints should be mainstays of the physical exam.

Importantly, collection of several specimens further elucidates *N. gonorrhoeae* as the definitive etiologic agent (Figure 45.1). These specimens should be collected before initiating antibiotic therapy. The laboratory should be aware of the working diagnosis of DGI. Obtain two sets of blood cultures, and request antibiotic susceptibilities when cultures are ordered. When positive for *N. gonorrhoeae*, blood cultures confirm the diagnosis of DGI.

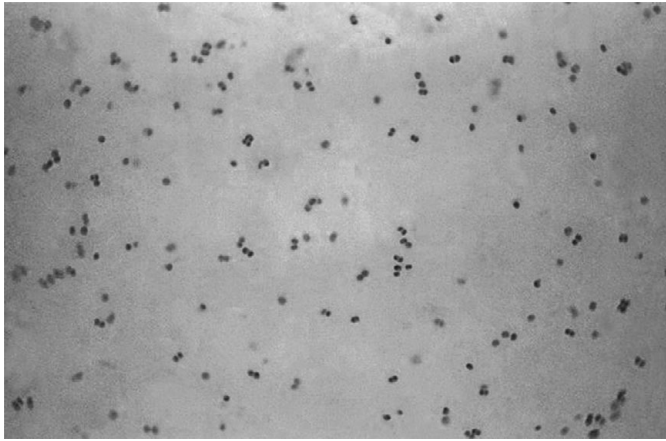


Figure 45.1 The Gram-negative diplococci of *N. gonorrhoeae* demonstrated on Gram stain. CDC/Joe Miller (A black and white version of this figure will appear in some formats. For the color version, please refer to the plate section.)

Joint aspirates should be evaluated with cell count and differential, Gram stain, and bacterial culture. In suppurative arthritis, WBCs are likely to be 40,000–60,000 cells/mm³, and neutrophils dominate the differential. This finding, however, only identifies the presence of inflammation and not the etiologic agent [8]. Cultures from joint aspirates are usually negative unless frank pus is present. Additionally, synovial fluid should undergo nucleic acid amplification when available. These results can help to differentiate an infectious cause from crystal-induced arthritis [8]. When DGI is suspected, laboratory workup should also include comprehensive screening for other STIs to exclude concurrent infections.

The differential diagnosis of DGI includes other arthritides such as reactive arthritis, acute rheumatoid arthritis, sarcoidosis, and erythema nodosum, along with drug- and crystal-induced arthritis. Infectious causes to consider include STIs like hepatitis B, human immunodeficiency virus, secondary syphilis, and other viral infections. While endocarditis could be a manifestation of DGI, infective endocarditis from another etiologic agent is possible.

Treatment commences with hospitalization in order to initiate parenteral antibiotic administration, especially if the diagnosis is unclear, a patient has a septic joint, or if the patient may have difficulties adhering with the recommended treatment. The CDC-recommended regimen is ceftriaxone 1 g IV every 24 hours. Monotherapy is appropriate as long as

concurrent infection with chlamydia has been excluded. Transition to an oral regimen can occur 24–48 hours after clinical improvement, as guided by antibiotic susceptibility testing, for a total course of at least 7 days [1].

Penicillin allergy cross-reactivity is lowest (<1%) with third-generation cephalosporins [1]. If a concern for severe allergic reaction exists, the aforementioned infectious disease consult may be beneficial in selecting an alternative regimen.

Conduct contact tracing to identify partners potentially exposed within the past 60 days [1]. Testing and treatment should be offered to these individuals. Instruct the affected and treated individuals to avoid sexual intercourse for at least 7 days after treatment to prevent reinfection.

Neonatal conjunctivitis contracted during birth, or ophthalmia neonatorum, is one potential consequence of undiagnosed and untreated gonococcal infection during the antenatal period. While *N. gonorrhoeae* accounts for <1% of cases of neonatal ophthalmia, the severity of disease is significant [9]. Prenatal screening in the first trimester, with repeat screening for those at higher risk are important prevention tactics. Neonates with possible exposure should be treated with one dose of ceftriaxone (25–50 mg/kg) IV or intramuscularly. Current practice dictates universal prophylactic 0.5% erythromycin ointment administration in regions where gonorrhea is a public health issue, to those with insufficient prenatal care, or as required by law [9].

It was previously thought that DGI contributed to other potential adverse outcomes including miscarriage, preterm labor, and premature rupture of membranes. However, in a retrospective study that spanned decades, pregnancy outcomes did not corroborate this hypothesis [3].

Key Teaching Points

- Suspect DGI in any sexually active woman (pregnant or otherwise) with septic arthritis.
- After obtaining a thorough history and physical examination, collect blood cultures, specimens from potentially exposed mucosal surfaces, and synovial fluid aspirates to help confirm the diagnosis.
- Hospitalization to initiate parenteral ceftriaxone is the mainstay of treatment.
- With adequate antibiotic treatment, the clinical picture usually resolves without adverse maternal or neonatal outcomes.

References

- 1 Workowski KA, Bachmann LH, Chan PA, et al. Sexually Transmitted Infections Treatment Guidelines, 2021. *MMWR Morb Mortal Wkly Rep.* 2021;70(4):1–187. <http://dx.doi.org/10.15585/mmwr.r7004a1> (accessed October 8, 2024).
- 2 Blank JA, Thapa N, Mansoor AM. Arthritis-Dermatitis Syndrome: A Case of Disseminated Gonococcal Infection with Petechial Skin Rash. *J Gen Intern Med.* 2021;36(9):2836–2838.
- 3 Bleich AT, Sheffield JS, Wendel GD, et al. Disseminated Gonococcal Infection in Women. *Obstet Gynecol.* 2012;119(3):597–602.
- 4 Wang DA, Tambyah PA. Septic Arthritis in Immunocompetent and Immunosuppressed Hosts. *Best Pract Res Clin Rheumatol.* 2015;29(2):275.
- 5 Khoo CL, Davies AJ, Dobson AJ, et al. Disseminated Gonococcal Infection in Pregnancy. *J Obstet Gynaecol.* 2010;29(6):550–551.
- 6 McLaughlin S, Ghanem K, Zenilman JM, McLeod Griffiss J. Risk of Gonococcal Infection during Vaginal Exposure Is Associated with High

- Vaginal pH and Active Menstruation. *Sex Transm Dis.* 2019;46(2):86–90.
- 7 Quillin S, Seifert H. *Neisseria gonorrhoeae* Host Adaptation and Pathogenesis. *Nat Rev Microbiol.* 2018;16:226–240.
- 8 Rice PA. Gonococcal Arthritis (Disseminated Gonococcal Infection). *Infect Dis Clin North Am.* 2005;19:853–861.
- 9 Kimberlin DW, Barnett ED, Lynfield R, et al. Neonatal Ophthalmia. In: *Red Book*, 32nd ed. Report of the Committee on Infectious Diseases, Committee on Infectious Diseases. Itasca, IL: American Academy of Pediatrics; 2021–2024.

CASE 46

A 40-Year-Old at 41 Weeks with a Closed Cervix after 12 Hours of Induction

Jessica Kline

History of Present Illness

A 40-year-old gravida 2 para 0 at 41 0/7 weeks' gestation, based on last menstrual period and consistent with an 8-week ultrasound, presents to the Labor and Delivery unit for a scheduled late-term induction of labor (IOL). She denies any vaginal bleeding, leakage of fluid, or contractions. Her fetus is active. Her pregnancy is complicated only by advanced maternal age. Her group B streptococcus test is negative and the fetus is confirmed to be in cephalic presentation by bedside ultrasound. The patient's cervical examination on admission is 1 cm dilated, 25% effaced, and at -3 station. Clinical pelvimetry is assessed to be adequate for vaginal delivery. Estimated fetal weight (EFW) on a recent ultrasound is 3,950 g. A fetal nonstress test (NST) is reactive. Induction of labor is initiated with a double-balloon cervical ripening catheter that is removed after 12 hours of use.

Physical Examination

General appearance: Well-developed, in no acute distress

Vital signs:

Temperature: 37°C

Pulse: 98 beats per minute

Blood pressure: 115/79 mmHg

Respiratory rate: 19 breaths per minute

Body mass index (BMI): 27 kg/m²

Cardiopulmonary: Well-perfused, unlabored respirations

Abdomen: Soft, gravid, non-tender, contractions palpate mild

Sterile vaginal examination: After removal of the balloon catheter, the cervix is 3 cm dilated, 50% effaced, and the fetus is at -2 station. The cervix is mid-position and soft

Fetal assessment: Fetal heart rate is 145 beats per minute, moderate variability, accelerations present, no decelerations, and contractions every 6-7 minutes

How Would You Manage This Patient?

This patient is undergoing IOL and, after 12 hours of cervical ripening, remains in the latent phase. Her cervix remains unfavorable, with a Bishop score of 5. The patient is stable, and the fetus has a category 1 heart tracing. The decision is made to proceed with administration of intravenous (IV) oxytocin. After 4 hours, the cervix is 4 cm, 90% effaced, and the fetus is at -1 station. The patient is counseled and offered artificial rupture of membranes, which she accepts. Membrane rupture yields clear fluid and is tolerated well by the patient

and fetus. After 8 additional hours of oxytocin titration, the cervical exam is 6 cm, 90% effaced, and the fetus is at 0 station. The active phase of labor progresses appropriately with ongoing augmentation, and the patient has a spontaneous vaginal delivery (SVD) of a vigorous infant after 1 hour of pushing.

Failed IOL

Induction of labor is common, with data between 2016 and 2019 showing that as many as 1 in 3 patients require a labor induction [1]. If labor does not begin spontaneously prior to 41 weeks' gestation, IOL should be recommended to reduce the risks of cesarean delivery (CD) and perinatal morbidity and mortality. Historically, prior to 41 weeks, IOL was reserved for maternal or fetal indications, with the concern that IOL compared with spontaneous labor increased the risk of CD [2]. Recent evidence has shown that IOL at 39 weeks, compared with the appropriate alternative of expectant management, yields no difference or decreased risk of CD among patients who are induced, even among patients with an unfavorable cervix. This is in the absence of an increase in neonatal or other maternal morbidity [3]. Considering this evidence, practice has shifted and IOL can now reasonably be offered for all pregnant patients without medical indication at 39 weeks' gestation if resources allow and the patient prefers [4].

The alternative to successful labor that results in a vaginal delivery is unsuccessful labor that results in a CD. While a CD is the safest route of delivery in some circumstances, it does increase the risk of overall severe maternal morbidity and mortality such as hemorrhage, uterine rupture, anesthetic complications, shock, cardiac arrest, acute renal failure, assisted ventilation, venous thromboembolism, major infection, surgical wound complications, and placental abnormalities in future pregnancies [2]. Pre-labor CDs increase the risk of respiratory morbidity in the neonate [2]. A primary CD also has downstream risks for subsequent pregnancies. Reserving CD for medical indications and individualized patient factors is prudent and labor arrest is documented to be the indication for ≤34% of CDs (see Cases 47 and 48 for protracted latent and active phases of labor, respectively) [2].

It is important to note that the alternative to a successful IOL is failure to enter the active stage of labor. The few published studies aimed at defining a failed IOL utilize CD as a primary outcome. The studies are observational in nature, largely limited to low-risk populations, and looked primarily at the length of the latent phase of induced labor. The length of

the latent phase is defined as the time after cervical ripening and before the onset of active labor, which is variably defined from a cervical exam that is 4 cm dilated and 90% effaced or ≥ 6 cm dilated regardless of effacement. Latent phase interventions, if indicated, mainly included oxytocin administration with ruptured fetal membranes. At durations ranging from 12 to 24 hours of oxytocin with ruptured membranes, only 2–4% of patients did not enter the active phase of labor. Evaluated adverse outcomes were rates of infection, hemorrhage, and neonatal outcomes. There was some increase in risk of hemorrhage and infection corresponding with increased duration of the latent phase. There was also some demonstration of increased neonatal intensive care unit (NICU) admission but no significant difference in overall neonatal outcomes [1].

The most robust data were a secondary analysis of a multicenter observational cohort study looking at maternal and neonatal morbidity based on the length of the latent phase of induced labor [5]. It included over 10,000 nulliparous patients and found that at 15 hours, only 3.6% of patients remained in the latent phase. It redemonstrated that the rate of infectious sequelae increased with increasing duration of the latent phase and found no difference in neonatal outcomes.

Prevention of a failed IOL involves attentive and tailored management of the induction process from the start. Patients with an unfavorable cervix, defined as a Bishop score of ≤ 6 , should undergo cervical ripening with pharmacologic or mechanical methods prior to augmentation with oxytocin to reduce the rate of failed induction and decrease induction to delivery time [6]. Expected durations of the latent phase of spontaneous labor cannot be applied to induced labor, and most patients with a prolonged latent phase of induced labor

will eventually progress to the active phase. Criteria for a prolonged latent phase of spontaneous labor (>20 hours in primiparas or >14 hours in multiparas) should not be an indication for CD in a labor induction. Nor should standards for active phase arrest be applied prior to patients progressing to active labor (6 cm dilation) [6]. For clinically stable patients with intact amniotic membranes who do not respond well to cervical ripening or experience an extended latent phase, consideration may also be given to allowing the induction to pause for hours to days, as induction may be more successful when attempts are restarted at a later time [7].

Cesarean delivery for failed IOL can be avoided by allowing >24 hours to enter active labor and should require that oxytocin be administered for at least 12–18 hours after membrane rupture prior to deeming the induction a failure [6]. Randomized controlled trials (RCTs) in this area are needed to help better define a failed IOL.

Key Teaching Points

- Patients undergoing IOL with an unfavorable cervix should receive cervical ripening with mechanical and/or pharmacologic agents prior to oxytocin administration.
- Twenty-four hours or longer should be allowed for entry into the active phase of labor before diagnosing a failed induction if maternal and fetal statuses allow.
- Patients should have oxytocin administration with ruptured amniotic membranes and a minimum of 12–18 hours allowed to enter the active phase of labor before diagnosing a failed induction.
- Further studies are needed to establish criteria for diagnosing a failed IOL.

References

- 1 American College of Obstetricians and Gynecologists. Clinical Guidance for Integration of the Findings of the ARRIVE Trial: Labor Induction versus Expectant Management in Low-Risk Nulliparous Women. Practice Advisory August 2018. www.acog.org/clinical/clinical-guidance/practice-advisory/articles/2018/08/clinical-guidance-for-integration-of-the-findings-of-the-arrive-trial (accessed October 11, 2024).
- 2 Ayala NK, Rouse DJ. Failed Induction of Labor. *Am J Obstet Gynecol*. 2024;230(3S):S769–S774. <http://dx.doi.org/10.1016/j.ajog.2021.06.103> (accessed October 11, 2024).
- 3 Cohen WR, Friedman EA. The Latent Phase of Labor. *Am J Obstet Gynecol*. 2023;228(5):S1017–S1024. <https://doi.org/10.1016/j.ajog.2022.04.029> (accessed October 11, 2024).
- 4 Grobman WA, Rice MM, Reddy UM, et al.; Eunice Kennedy Shriver National Institute of Child Health and Human Development Maternal–Fetal Medicine Units Network. Labor Induction versus Expectant Management in Low-Risk Nulliparous Women. *N Engl J Med*. 2018;379:513–523.
- 5 Grobman WA, Bailit J, Lai Y, et al.; Eunice Kennedy Shriver National Institute of Child Health and Human Development Maternal–Fetal Medicine Units Network. Defining Failed Induction of Labor. *Am J Obstet Gynecol*. 2018;218(1):122.e1–122.e8. <http://dx.doi.org/10.1016/j.ajog.2017.11.556> (accessed October 11, 2024).
- 6 Obstetric Care Consensus No. 1: Safe Prevention of the Primary Cesarean Delivery. *Obstet Gynecol*. 2014;123(3):693–711.
- 7 ACOG Practice Bulletin No. 107: Induction of Labor. *Obstet Gynecol*. 2009;114:386–397.

CASE 46

A 40-Year-Old at 41 Weeks with a Closed Cervix after 12 Hours of Induction

Jessica Kline

History of Present Illness

A 40-year-old gravida 2 para 0 at 41 0/7 weeks' gestation, based on last menstrual period and consistent with an 8-week ultrasound, presents to the Labor and Delivery unit for a scheduled late-term induction of labor (IOL). She denies any vaginal bleeding, leakage of fluid, or contractions. Her fetus is active. Her pregnancy is complicated only by advanced maternal age. Her group B streptococcus test is negative and the fetus is confirmed to be in cephalic presentation by bedside ultrasound. The patient's cervical examination on admission is 1 cm dilated, 25% effaced, and at -3 station. Clinical pelvimetry is assessed to be adequate for vaginal delivery. Estimated fetal weight (EFW) on a recent ultrasound is 3,950 g. A fetal nonstress test (NST) is reactive. Induction of labor is initiated with a double-balloon cervical ripening catheter that is removed after 12 hours of use.

Physical Examination

General appearance: Well-developed, in no acute distress

Vital signs:

Temperature: 37°C

Pulse: 98 beats per minute

Blood pressure: 115/79 mmHg

Respiratory rate: 19 breaths per minute

Body mass index (BMI): 27 kg/m²

Cardiopulmonary: Well-perfused, unlabored respirations

Abdomen: Soft, gravid, non-tender, contractions palpate mild

Sterile vaginal examination: After removal of the balloon catheter, the cervix is 3 cm dilated, 50% effaced, and the fetus is at -2 station. The cervix is mid-position and soft

Fetal assessment: Fetal heart rate is 145 beats per minute, moderate variability, accelerations present, no decelerations, and contractions every 6-7 minutes

How Would You Manage This Patient?

This patient is undergoing IOL and, after 12 hours of cervical ripening, remains in the latent phase. Her cervix remains unfavorable, with a Bishop score of 5. The patient is stable, and the fetus has a category 1 heart tracing. The decision is made to proceed with administration of intravenous (IV) oxytocin. After 4 hours, the cervix is 4 cm, 90% effaced, and the fetus is at -1 station. The patient is counseled and offered artificial rupture of membranes, which she accepts. Membrane rupture yields clear fluid and is tolerated well by the patient

and fetus. After 8 additional hours of oxytocin titration, the cervical exam is 6 cm, 90% effaced, and the fetus is at 0 station. The active phase of labor progresses appropriately with ongoing augmentation, and the patient has a spontaneous vaginal delivery (SVD) of a vigorous infant after 1 hour of pushing.

Failed IOL

Induction of labor is common, with data between 2016 and 2019 showing that as many as 1 in 3 patients require a labor induction [1]. If labor does not begin spontaneously prior to 41 weeks' gestation, IOL should be recommended to reduce the risks of cesarean delivery (CD) and perinatal morbidity and mortality. Historically, prior to 41 weeks, IOL was reserved for maternal or fetal indications, with the concern that IOL compared with spontaneous labor increased the risk of CD [2]. Recent evidence has shown that IOL at 39 weeks, compared with the appropriate alternative of expectant management, yields no difference or decreased risk of CD among patients who are induced, even among patients with an unfavorable cervix. This is in the absence of an increase in neonatal or other maternal morbidity [3]. Considering this evidence, practice has shifted and IOL can now reasonably be offered for all pregnant patients without medical indication at 39 weeks' gestation if resources allow and the patient prefers [4].

The alternative to successful labor that results in a vaginal delivery is unsuccessful labor that results in a CD. While a CD is the safest route of delivery in some circumstances, it does increase the risk of overall severe maternal morbidity and mortality such as hemorrhage, uterine rupture, anesthetic complications, shock, cardiac arrest, acute renal failure, assisted ventilation, venous thromboembolism, major infection, surgical wound complications, and placental abnormalities in future pregnancies [2]. Pre-labor CDs increase the risk of respiratory morbidity in the neonate [2]. A primary CD also has downstream risks for subsequent pregnancies. Reserving CD for medical indications and individualized patient factors is prudent and labor arrest is documented to be the indication for $\leq 34\%$ of CDs (see Cases 47 and 48 for protracted latent and active phases of labor, respectively) [2].

It is important to note that the alternative to a successful IOL is failure to enter the active stage of labor. The few published studies aimed at defining a failed IOL utilize CD as a primary outcome. The studies are observational in nature, largely limited to low-risk populations, and looked primarily at the length of the latent phase of induced labor. The length of

the latent phase is defined as the time after cervical ripening and before the onset of active labor, which is variably defined from a cervical exam that is 4 cm dilated and 90% effaced or ≥ 6 cm dilated regardless of effacement. Latent phase interventions, if indicated, mainly included oxytocin administration with ruptured fetal membranes. At durations ranging from 12 to 24 hours of oxytocin with ruptured membranes, only 2–4% of patients did not enter the active phase of labor. Evaluated adverse outcomes were rates of infection, hemorrhage, and neonatal outcomes. There was some increase in risk of hemorrhage and infection corresponding with increased duration of the latent phase. There was also some demonstration of increased neonatal intensive care unit (NICU) admission but no significant difference in overall neonatal outcomes [1].

The most robust data were a secondary analysis of a multicenter observational cohort study looking at maternal and neonatal morbidity based on the length of the latent phase of induced labor [5]. It included over 10,000 nulliparous patients and found that at 15 hours, only 3.6% of patients remained in the latent phase. It redemonstrated that the rate of infectious sequelae increased with increasing duration of the latent phase and found no difference in neonatal outcomes.

Prevention of a failed IOL involves attentive and tailored management of the induction process from the start. Patients with an unfavorable cervix, defined as a Bishop score of ≤ 6 , should undergo cervical ripening with pharmacologic or mechanical methods prior to augmentation with oxytocin to reduce the rate of failed induction and decrease induction to delivery time [6]. Expected durations of the latent phase of spontaneous labor cannot be applied to induced labor, and most patients with a prolonged latent phase of induced labor

will eventually progress to the active phase. Criteria for a prolonged latent phase of spontaneous labor (>20 hours in primiparas or >14 hours in multiparas) should not be an indication for CD in a labor induction. Nor should standards for active phase arrest be applied prior to patients progressing to active labor (6 cm dilation) [6]. For clinically stable patients with intact amniotic membranes who do not respond well to cervical ripening or experience an extended latent phase, consideration may also be given to allowing the induction to pause for hours to days, as induction may be more successful when attempts are restarted at a later time [7].

Cesarean delivery for failed IOL can be avoided by allowing >24 hours to enter active labor and should require that oxytocin be administered for at least 12–18 hours after membrane rupture prior to deeming the induction a failure [6]. Randomized controlled trials (RCTs) in this area are needed to help better define a failed IOL.

Key Teaching Points

- Patients undergoing IOL with an unfavorable cervix should receive cervical ripening with mechanical and/or pharmacologic agents prior to oxytocin administration.
- Twenty-four hours or longer should be allowed for entry into the active phase of labor before diagnosing a failed induction if maternal and fetal statuses allow.
- Patients should have oxytocin administration with ruptured amniotic membranes and a minimum of 12–18 hours allowed to enter the active phase of labor before diagnosing a failed induction.
- Further studies are needed to establish criteria for diagnosing a failed IOL.

References

- 1 American College of Obstetricians and Gynecologists. Clinical Guidance for Integration of the Findings of the ARRIVE Trial: Labor Induction versus Expectant Management in Low-Risk Nulliparous Women. Practice Advisory August 2018. www.acog.org/clinical/clinical-guidance/practice-advisory/articles/2018/08/clinical-guidance-for-integration-of-the-findings-of-the-arrive-trial (accessed October 11, 2024).
- 2 Ayala NK, Rouse DJ. Failed Induction of Labor. *Am J Obstet Gynecol*. 2024;230(3S):S769–S774. <http://dx.doi.org/10.1016/j.ajog.2021.06.103> (accessed October 11, 2024).
- 3 Cohen WR, Friedman EA. The Latent Phase of Labor. *Am J Obstet Gynecol*. 2023;228(5):S1017–S1024. <https://doi.org/10.1016/j.ajog.2022.04.029> (accessed October 11, 2024).
- 4 Grobman WA, Rice MM, Reddy UM, et al.; Eunice Kennedy Shriver National Institute of Child Health and Human Development Maternal–Fetal Medicine Units Network. Labor Induction versus Expectant Management in Low-Risk Nulliparous Women. *N Engl J Med*. 2018;379:513–523.
- 5 Grobman WA, Bailit J, Lai Y, et al.; Eunice Kennedy Shriver National Institute of Child Health and Human Development Maternal–Fetal Medicine Units Network. Defining Failed Induction of Labor. *Am J Obstet Gynecol*. 2018;218(1):122.e1–122.e8. <http://dx.doi.org/10.1016/j.ajog.2017.11.556> (accessed October 11, 2024).
- 6 Obstetric Care Consensus No. 1: Safe Prevention of the Primary Cesarean Delivery. *Obstet Gynecol*. 2014;123(3):693–711.
- 7 ACOG Practice Bulletin No. 107: Induction of Labor. *Obstet Gynecol*. 2009;114:386–397.

A 25-Year-Old at 39 Weeks' Gestation Presents with Regular Contractions and Minimal Cervical Change

Jonathan D. Emery and Peter F. Schnatz

History of Present Illness

A 25-year-old gravida 1 para 0 at 39 2/7 weeks' gestation presents to Labor and Delivery with complaints of regular, painful contractions and fatigue. She reports her contractions started 21 hours prior to admission and increased in intensity and frequency over the past 6 hours. The contractions are now every 5 minutes. She denies vaginal bleeding or leakage of fluid. She notes passing her mucous plug 10 hours ago. She reports ample and regular fetal movement between contractions. Her most recent prenatal appointment was 4 days ago. At that time, her cervical examination was 2.5 cm dilated, 60% effaced, and -2 station.

Her prenatal course was uncomplicated and included 10 prenatal visits. She had a negative aneuploidy evaluation. Ultrasound evaluation at 18 weeks revealed normal anatomy.

Her past medical and surgical histories are unremarkable. Medications include a prenatal vitamin and cetirizine as needed for allergic rhinitis. She denies any allergies. Social history is unremarkable. She denies cigarette or alcohol use during pregnancy. Her family history is negative for congenital or genetic abnormalities.

Physical Examination

General appearance: Well-developed, well-nourished female, appears fatigued but in no acute distress

Vital signs:

Temperature: 36.9°C

Pulse: 95 beats per minute

Blood pressure: 128/72 mmHg

Respiratory rate: 20 breaths per minute

BMI: 31.6 kg/m²

Cardiopulmonary: Unremarkable

Abdomen: Gravid, non-tender uterus with a fundal height of 41 cm, no hepatosplenomegaly

Pelvic: Normal external genitalia. Cervical examination on admission was 3 cm dilated, 80% effaced, -2 station

Neurologic/psychologic: Alert and oriented × 3, fatigued but conversing easily

Fetal assessment: Fetal heart rate is 140 beats per minute. Category 1 fetal heart rate tracing. Contractions every 3–5 minutes, lasting 45–60 seconds. Normal amniotic fluid index (AFI)

Laboratory studies:

Hgb: 11.1 g/dL

Type and screen on admission: B positive. Antibody screen negative

1-hour glucose screen: 114 mg/dL

Group B beta streptococcus culture: Negative

Imaging:

Limited transabdominal ultrasound confirmed cephalic presentation

How Would You Manage This Patient?

This patient presented in labor with minimal cervical change after 21 hours of contractions. This combination is consistent with prolonged (or protracted) latent phase of labor since she has made little cervical change despite having regular painful contractions at home and in the triage unit for more than 20 hours. Discussion with the patient revealed significant maternal fatigue with request for hospital admission. Options for management were discussed including expectant management, therapeutic rest, and oxytocin augmentation. Due to her fatigue, she opted for therapeutic rest.

The patient was admitted to the Labor and Delivery unit and an IV line was placed. Fetal monitoring was instituted and 15 mg morphine sulfate (5 mg IV and 10 mg intramuscular) was administered. The patient was allowed to sleep with intermittent fetal monitoring. After 6.5 hours, the patient awoke with increasingly painful contractions. Cervical examination was 6 cm dilated with 90% effacement at 0 station. She requested epidural anesthesia and was observed while she progressed through active labor. Approximately 7 hours later she was completely dilated. She pushed for 90 minutes and had a vaginal delivery of a vigorous female infant weighing 3,685 g.

Prolonged Latent Phase of Labor

The definition of prolonged latent labor was established by Friedman over 50 years ago [1]. He divided the first stage of labor into latent and active phases. According to his definition, the latent phase begins with the onset of contractions and continues to 4 cm cervical dilation. The active phase starts at 4 cm and continues until full dilation. Prolonged latent phase was defined as >20 hours in nulliparas and >14 hours in multiparas. These lengths were determined by calculating statistical limits of studied labors. The initiation of labor is subjective, typically noted by the patient as the onset of painful contractions. An estimated 5–7% of women meet the diagnostic criteria for prolonged latent phase of labor [2]. Prolonged latent phase is associated with a higher risk of adverse outcomes including active phase of labor abnormalities, cesarean delivery (CD), neonatal depression, and Neonatal Intensive Care Unit (NICU) admission, with risk increasing with greater prolongation [3].

More recent studies suggest that latent labor may progress until 6 cm dilation. The Consortium on Safe Labor noted that active labor often started at a dilation of at least 6 cm, with a likely slower course of dilation between 4 and 6 cm [4]. These differences are important because admission to Labor and Delivery in the latent phase of labor is associated with more labor interventions such as oxytocin administration, internal monitoring, and CD [5]. Admission during the latent phase may be necessary for maternal or fetal indications. Maternal reasons include fatigue (as in this patient), impaired maternal coping, pain management, or when ambulatory/outpatient measures have failed to meet the patient's needs. Fetal indications may include fetal heart rate abnormalities, requiring admission for further evaluation or management.

When women require admission in latent labor, care should be directed at supporting the patient's needs as well as promoting continued support and education with the aim of avoiding CD and adverse maternal or fetal outcomes. Friedman noted that most patients who are diagnosed with a protracted latent phase of labor and managed with conservative or expectant measures will eventually enter active phase. Thus, "a prolonged latent phase should not be an indication for cesarean delivery" [6]. The American College of Obstetricians and Gynecologists (ACOG) recommends that support measures include ongoing education along with continuous emotional support from nursing, family, or a doula. Nonpharmacologic techniques for pain include hypnosis, massage, and water immersion therapy [5].

Management Approaches

Despite a prolonged latent phase of labor being recognized over 50 years ago, there is no clear consensus on optimal management. Active labor arrest criteria should not be used for patients at less than 6 cm as they are unlikely to be in active labor. The literature search for this case study found no adequate quality and sized studies validating approaches to prolonged latent phase or comparative effectiveness studies between approaches. The three generally accepted approaches to a prolonged latent phase of labor include expectant management, therapeutic rest, and labor augmentation (Figure 47.1).

Expectant management of labor can be considered for patients in the latent phase when maternal and fetal status are reassuring. Expectant management includes clinical monitoring and supportive care while awaiting natural labor progress. Expectant management may occur in the hospital or at home. Therapeutic rest includes the use of medications to help control pain while allowing sleep and rest prior to reassessing the next steps in management. In many instances, patients will progress to active labor during therapeutic rest. Labor augmentation typically uses oxytocin. It is indicated when time to delivery should be minimized including indications like gestational hypertension, intraamniotic infection (IAI), or ruptured membranes [3].

Determining when these approaches have failed and a CD is indicated needs to be individualized as there is little guidance from studies. The upper limit of normal for the latent phase of labor has not been precisely defined [7]. The Consortium on Safe Labor revised the transition point from latent to active

phase of labor to 6 cm [4], emphasizing the need for patience. It is frequently unclear which prolonged labors are only abnormal by statistical standards and which are pathologic processes. Given the limitations of statistical norms in this situation, decisions about proceeding with cesarean should not be made based on the length of latent labor, but instead on failure of appropriately applied interventions. As long as fetal well-being is confirmed, patients failing expectant management or therapeutic rest should undergo a trial of augmentation. CD is indicated for failure to respond to the augmentation or lack of transition to active phase despite extended augmentation. Maternal emotional tolerance after failed expectant management and therapeutic rest is another important consideration.

The current case was successfully managed with therapeutic rest. Labor augmentation with oxytocin also would have been appropriate. Compelling data to support one approach over the other does not exist. Oxytocin administration should be chosen over therapeutic rest or expectant management if there are contraindications to delaying delivery. This approach would have been initiated had the trial of therapeutic rest failed.

Conclusion

The three usual approaches to prolonged latent phase include expectant management, therapeutic rest (which was the approach taken in this case), and labor augmentation. As latent labor is highly variable, no matter how it is defined, some women require more time to achieve progression in labor [5,6].

Once a patient is admitted to the hospital in latent labor, management decisions should be made in a patient-centered manner. If therapeutic rest is chosen, this is typically done in a hospital setting to monitor both maternal and fetal well-being [2,6]. In patients with a prolonged latent phase, most will enter active labor over time with or without oxytocin [5]. Prolonged latent labor should not be an independent indication for CD and the decision to proceed with a CD should be individualized and restricted to maternal or fetal indications or failure of interventions to successfully transition the patient to active labor.

Key Teaching Points

- Prolonged latent labor is defined as >20 hours of painful contractions in nulliparas and >14 hours in multiparas without progress to active labor.
- Supportive measures in the latent phase of labor include education, emotional and physical support, and nonpharmacologic pain relief such as massage, water immersion, or hypnosis.
- The typical management options for prolonged latent labor include expectant management, therapeutic rest, and augmentation.
- Prolonged latent labor should not be an independent indication for CD.
- Augmentation is appropriate if expectant management or therapeutic rest alone are not adequate.

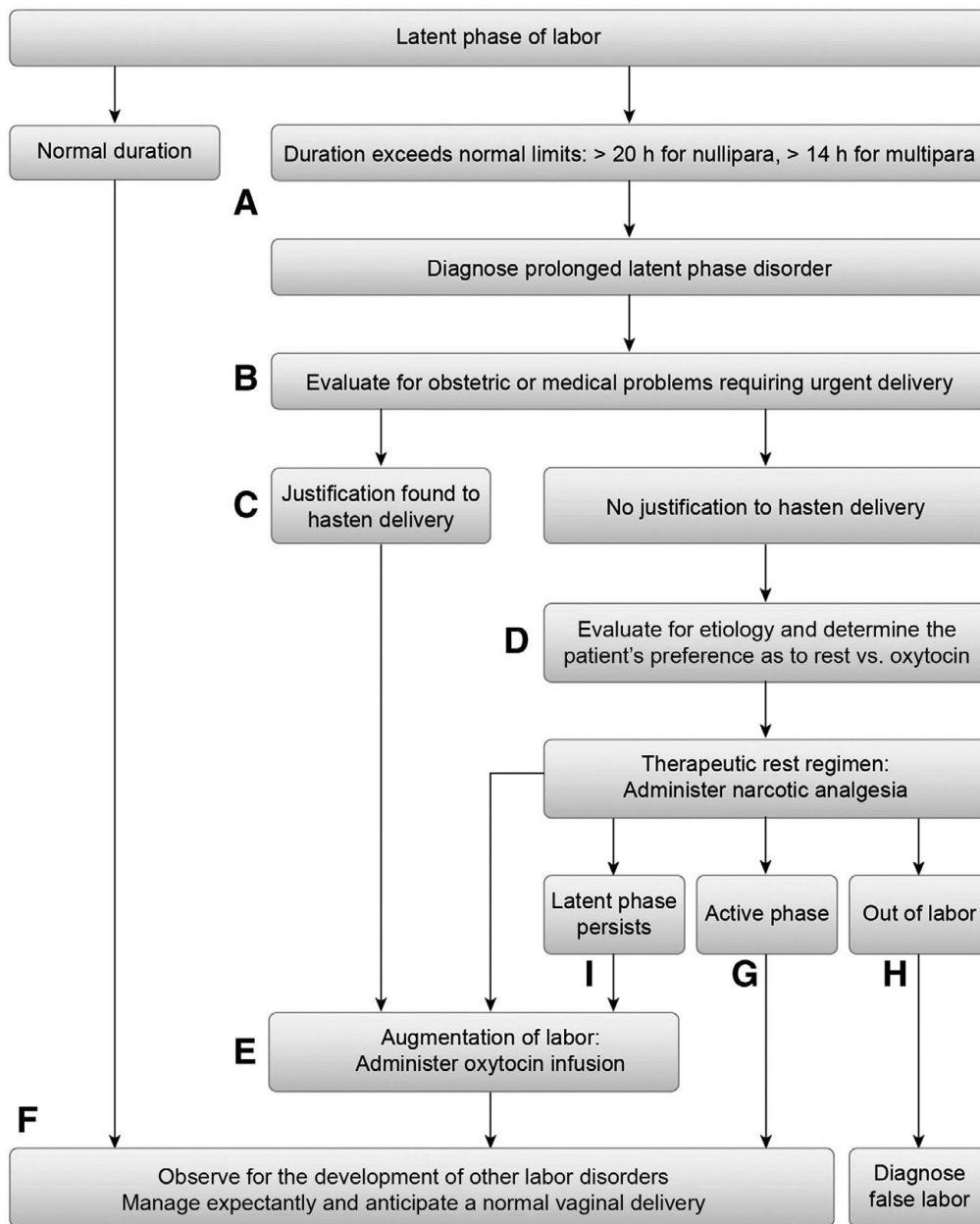


Figure 47.1 Management algorithm for prolonged latent phase of labor. Reprinted from Cohen WR, Friedman EA. The Latent Phase of Labor, *Am J Obstet Gynecol.* 2023;228(5):S1017–S1024, Copyright Elsevier (2023)

References

- Friedman EA, Sachtleben MR. Dysfunctional Labor: I. Prolonged Latent Phase in the Nullipara. *Obstet Gynecol.* 1961;17:135–148.
- Greulich B, Tarrant B. The Latent Phase of Labor: Diagnosis and Management. *J Midwifery Womens Health.* 2007;52:190–198.
- Friedman EA, Cohen WR. Dysfunctional Labor and Delivery: Adverse Effects on Offspring. *Am J Obstet Gynecol.* 2023;228: S1104–S1109.
- Zhang J, Landy HJ, Branch DW, et al.; Consortium on Safe Labor. Contemporary Patterns of Spontaneous Labor with Normal Neonatal Outcomes. *Obstet Gynecol.* 2010;116:1281–1287.
- ACOG Committee Opinion No. 766: Approaches to Limit Intervention during Labor and Birth. *Obstet Gynecol.* 2019;133: e164–e173.
- Obstetric Care Consensus No. 1: Safe Prevention of the Primary Cesarean Delivery. *Obstet Gynecol.* 2014;123:693–711.
- Spong CY, Berghella V, Wenstrom KD, et al. Preventing the First Cesarean Delivery. *Obstet Gynecol.* 2012;120:1181–1193.

A 35-Year-Old at 40 Weeks with Ruptured Membranes and Arrest of Cervical Dilation at 7 cm for 3 Hours

Jennifer R. Hamm

History of Present Illness

A 35-year-old gravida 1 para 0 at 39 weeks' gestation with an uncomplicated prenatal course presents to triage accompanied by her partner and doula. She complains of increasing contraction frequency and intensity over the last 6 hours and notes loss of clear fluid approximately 2 hours prior to arrival. She reports active fetal movement and denies vaginal bleeding. On evaluation, her vital signs are within normal limits and fetal monitoring is reassuring. Fetal heart rate of 120 beats per minute is noted with moderate variability and accelerations. She is spontaneously contracting every 2–3 minutes. Rupture of membranes is confirmed on examination and her cervix is found to be 5 cm dilated and 50% effaced with the fetal head at –1 station. She is admitted to the Labor and Delivery unit for labor management. She requests and receives an epidural for pain control. On reevaluation 2 hours later, maternal and fetal status remains reassuring with a category 1 fetal tracing. She continues to spontaneously contract every 3–5 minutes and her cervical exam is now 7 cm dilated, 80% effaced, and the fetal head has descended to 0 station. You continue to expectantly manage her labor progress and reevaluate in 3 hours with the following findings.

Physical Examination

General appearance: Comfortable and in no apparent distress. Resting in the supine position

Vital signs:

Temperature: 37.1°C

Pulse: 78 beats per minute

Blood pressure: 128/78 mmHg

Respiratory rate: 16 breaths per minute

BMI: 28.6 kg/m²

Abdomen: Soft, gravid, non-tender, with an estimated fetal weight (EFW) of 8 lbs (3,700 g) by Leopold's

Pelvic: The cervix is 7 cm dilated and 80% effaced. The fetal head is at 0 station in left occiput posterior (OP) position. No caput is appreciated. The diagonal conjugate is 13 cm. On palpation, the ischial spines are not prominent, the pubic angle accommodates two fingerbreadths, and the intertuberous diameter is >8 cm

Fetal assessment: Baseline fetal heart rate is 120 beats per minute, category 1 with contractions every 3–5 minutes, lasting 60 seconds

How Would You Manage This Patient?

This patient is experiencing labor dystocia in the active phase. While maternal and fetal status is otherwise reassuring, an evaluation for factors that may be impeding labor progression should be performed (Figure 48.1). There are both fixed and potentially modifiable elements of this patient's history and evaluation that put her at an increased risk for abnormal labor progression. While her age and parity are fixed, modifiable factors in this case include maternal laboring position, fetal position, inadequate contraction pattern, and the potential level of regional anesthesia.

In your discussion of labor progress with your patient, you recommend changing maternal position to one that is more upright, starting oxytocin augmentation, and placing an intra-uterine pressure catheter. You consider decreasing the epidural infusion rate and increasing intravenous (IV) hydration with a solution containing dextrose (e.g. D5LR) to 250 mL/hour.

After initiating your interventions, you continue serial assessments of the patient's labor progress. At your next check, her cervix is 10 cm dilated, completely effaced, and the fetal head is at +1 station. She begins pushing and has a spontaneous vaginal delivery (SVD) of a viable female infant.

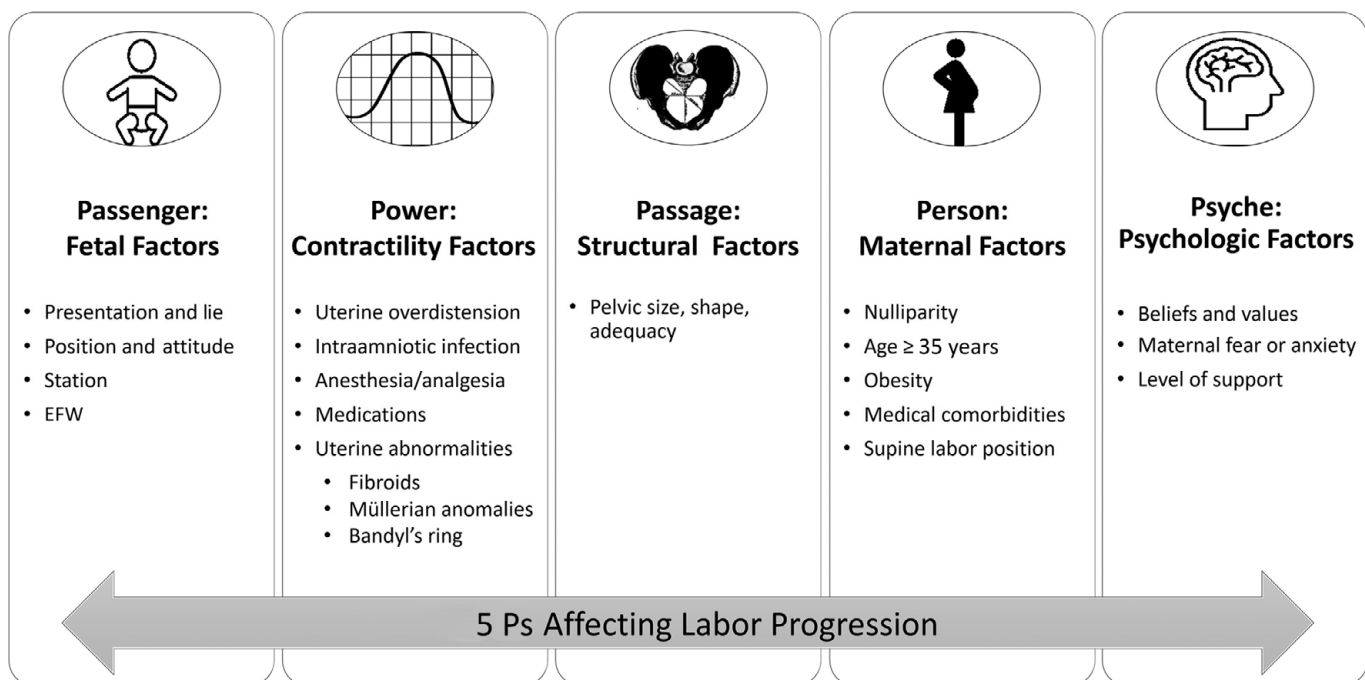
Abnormal Active Phase

The active phase of the first stage of labor corresponds to the point at which the rate of change of cervical dilation significantly increases [1,2,3,4]. As referenced in the latent labor case (Case 47), the pioneering work of Freidman was the first to depict the "normal" labor curve (partogram) and further define both a protracted and arrested active phase [1,2,3,4]. However, the last 50 years has seen significant changes in our obstetric populations and practices, raising concerns that current labor processes may differ from those described by Freidman. In response, Zhang and colleagues, as part of the Consortium on Safe Labor, developed a new model using contemporary labor data and several substantial differences from Freidman's work were identified (Table 48.1) [1,2]. Most notably, 6 cm appears to be a more accurate landmark for the onset of active labor and dilation in the active phase appears to occur more slowly than traditionally defined by Friedman [1,2]. Additionally, an optimal duration of time to diagnose protracted labor in the active phase is not defined [1,2].

Once an abnormal labor pattern has been identified, evaluation of inhibiting factors is warranted. These are classified into several broad categories and comprise the 5 Ps: Passenger,

Table 48.1 Traditional versus consensus guideline definitions for the active phase of labor

The active phase of labor	Traditional	Current guidelines obstetric care consensus ACOG and Society for Maternal-Fetal Medicine (SMFM)
Definition	The point at which the rate of change of cervical dilation significantly increases	
Based on the work of	Friedman	Zhang
Beginning cervical dilation	≥ 4 cm	≥ 6 cm
Protracted dilation	Nulliparous: <1.2 cm/hour Multiparous: <1.5 cm/hour	Dilation occurs more slowly than traditionally defined (no optimal duration of time addressed)
Arrest of dilation	No cervical change in the presence of: - cervical dilation of ≥ 4 cm - rupture of membranes ≥ 2 hours of adequate uterine contractions (≥ 200 Montevideo [MvU] units)	No cervical change in the presence of: - cervical dilation of ≥ 6 cm - rupture of membranes ≥ 4 hours of adequate uterine contractions (≥ 200 MvU) ≥ 6 hours of inadequate uterine contractions


Figure 48.1 The 5 Ps that can affect labor progression

Power, Passage, Person, and Psyche (Figure 48.1). Frequent and more upright maternal positioning (walking, sitting, standing, kneeling) in labor can help with optimal fetal positioning (passenger), with a recent meta-analysis citing a reduction of the first stage of labor by 1 hour and 22 minutes [5]. In the setting of poor uterine contractility (power), adding oxytocin augmentation is recommended [1,4]. The size, shape, and adequacy of the pelvis (passage) should always be assessed, as cephalopelvic disproportion can be identified in 15–30% of labor arrests [4]. While most maternal (person) factors affecting successful labor progress are fixed (age, parity, weight, medical comorbidities), maternal hydration status is modifiable and has been shown to play a role in labor progress. Current data suggest a decrease in the first stage of labor by approximately 1 hour when IV fluids containing dextrose are given at a rate of 250 mL/hour [6].

The psychologic state of the patient (psyche) can also influence labor progress. Women who have continuous one-on-one emotional support (a doula or nonmedical support person) have a modest decrease in the length of labor, with decreased rates of cesarean delivery (CD) and increased rates of personal satisfaction [1,5,6].

Obstetric Care Consensus Guidelines

One of the most common indications for a primary CD is arrest of labor [1,2,7]. Utilizing evidence-based practices to define abnormal labor patterns and guide labor management has the potential to aid in the reduction of the primary cesarean rate. To that end, American College of Obstetricians and Gynecologists (ACOG) and Society for Maternal-Fetal Medicine (SMFM) jointly published the Obstetric Care Consensus: Safe Prevention of the

Primary Cesarean Delivery in March 2014. These guidelines incorporate the findings from the Consortium on Safe Labor study (versus those traditionally proposed by Friedman) and support that with continued progression of labor, even if slow, observation is appropriate and will promote higher rates of vaginal delivery. Additionally, arrest of dilation is not diagnosed until 4 hours of adequate or 6 hours of inadequate contractions without cervical change at or after 6 cm dilation [1,2,7].

Since their publication, studies have evaluated the subsequent effect on the primary CD rate and resultant maternal and neonatal outcomes in patients with prolonged active phase. Conflicting results have been reported for CD rates, with some showing mild reductions since adoption, while others had no observable change, and one reported an increase in the cesarean rate [4,8]. Similarly, data on maternal and neonatal risks are mixed, with some studies reporting no change in maternal or neonatal outcomes and other literature suggesting both increased maternal (fever, infection, blood loss, and operative vaginal delivery [OVD] rate) and neonatal (increased Neonatal Intensive Care Unit [NICU] admission and length of stay) morbidity with increasing length of active phase [4,8,9,10]. The variability of these results could be at least in part secondary to varying levels of adoption of the care guidelines, and point to the need for additional well-designed prospective studies. It also highlights the need for adequate counseling and shared decision-making with patients experiencing labor dystocia in the active phase regarding the potential risks and benefits of additional time to labor versus CD.

Key Teaching Points

- The active phase of labor is defined as the point at which the rate of change of cervical dilation significantly increases. Recent analysis of contemporary labor patterns recommends a threshold of ≥ 6 cm to reach the active phase and notes that the rate of dilation in the active phase occurs more slowly than traditionally proposed for both nulliparous and multiparous patients.
- Slow but continued progress in the first stage of labor is not an indication for cesarean.
- Protracted labor patterns should be evaluated for contributing factors (Passenger, Power, Passage, Person, Psyche).
- Medical interventions shown to improve labor progression and decrease cesarean section rates include oxytocin augmentation and IV hydration with dextrose-containing solutions at 250 mL/hour. Similarly, successful nonmedical strategies include ambulation, upright maternal positioning, and the use of a labor support person or doula.
- To diagnose arrest of dilation in the active phase, the cervix must be ≥ 6 cm dilated with rupture of membranes and ≥ 4 hours of adequate contractions (≥ 200 MvU) or ≥ 6 hours of inadequate contractions.

References

1. Obstetric Care Consensus No. 1: Safe Prevention of the Primary Cesarean Delivery. *Obstet Gynecol.* 2014;123:693–711.
2. Zhang J, Landy HJ, Ware Branch D, et al. Contemporary Patterns of Spontaneous Labor with Normal Neonatal Outcomes. *Obstet Gynecol.* 2010;116(6):1281–1287.
3. Ashwal E, Livne MY, Benichou JIC, et al. Contemporary Patterns of Labor in Nulliparous and Multiparous Women [published correction appears in *Am J Obstet Gynecol.* 2020;223(6):918]. *Am J Obstet Gynecol.* 2020;222(3):267.e1–267.e9.
4. Friedman EA, Cohen WR. The Active Phase of Labor. *Am J Obstet Gynecol.* 2023;228(5S):S1037–S1049.
5. ACOG Committee Opinion No. 766 Summary: Approaches to Limit Intervention during Labor and Birth. *Obstet Gynecol.* 2019;133(2):406–408.
6. Kilpatrick, SJ, Garrison E, Fairbrother E. Normal Labor and Delivery. In: *Gabbe's Obstetrics: Normal and Problem Pregnancies*, 8th ed. Philadelphia: Elsevier; 2021, 204–225.e4.
7. Spong CY, Berghella V, Wenstrom KD, Mercer BM, Saade GR. Preventing the First Cesarean Delivery: Summary of a Joint Eunice Kennedy Shriver National Institute of Child Health and Human Development, Society for Maternal–Fetal Medicine, and American College of Obstetricians and Gynecologists Workshop. *Obstet Gynecol.* 2012;120(5):1181–1193.
8. Rouse DJ, Owen J, Hauth JC. Active-Phase Labor Arrest: Oxytocin Augmentation for at Least 4 Hours. *Obstet Gynecol.* 1999;93(3):323–328.
9. Wood S, Skiffington J, Brant R, et al. The REDUCED Trial: A Cluster Randomized Trial for REDucing the Utilization of CEsaean Delivery for Dystocia. *Am J Obstet Gynecol.* 2023;228(5S):S1095–S1103.
10. Govindappagari S, Greene N, Burwick R, Wong M, Gregory K. Maternal and Neonatal Morbidity after 4 and 6 Hours of Protracted Active Labor in Nulliparous Term Pregnancies. *Obstet Gynecol.* 2020;135(1):185–193.

CASE 49

A 30-Year-Old at 36 Weeks' Gestation with Breech Presentation

Kelly L. Ferroni

History of Present Illness

A 30-year-old nulliparous patient presents for a 36-week routine obstetric visit. Today, she reports positive fetal movement and intermittent Braxton-Hicks contractions. She denies loss of fluid or vaginal bleeding.

Her pregnancy has been complicated by nausea and vomiting in early pregnancy, which has resolved, as well as Rhesus (Rh)-negative status. Her obstetric history is notable for two spontaneous abortions around 6 weeks' gestation. Her past medical history is otherwise unremarkable. She has had no prior surgery.

Physical Examination

General appearance: 25-year-old pregnant female in no apparent distress

Vital signs:

Temperature: 36.8°C

Pulse: 98 beats per minute

Blood pressure: 129/79 mmHg

Respiratory rate: 20 breaths per minute

BMI: 28.3 kg/m²

Cardiopulmonary: Regular rate and rhythm without murmur, rub or gallop. Lungs clear to auscultation bilaterally

Abdomen: Soft, gravid, with Leopold's maneuvers suggesting the fetal head is at the fundus of the uterus, with the breech presenting to the pelvic inlet. The fundal height is 37 cm

Pelvic: Normal external genitalia. Cervix is 0.5 cm dilated and 25% effaced. Fetal station is at -4 and ballotable. Fetal head is not palpable

Fetal assessment: Fetal heart rate is 147 beats per minute noted in the right upper quadrant. The amniotic fluid index (AFI) is 18.6 cm

Imaging:

Ultrasound demonstrates a 36-week fetus measuring appropriate for gestational age in a frank breech position. Placental location: Fundal, anterior

How Would You Manage This Patient?

This nulliparous patient presents with a breech fetus at 36 weeks of pregnancy. The patient was counseled that singleton pregnancies complicated by a breech presentation at term can be offered the option of an external cephalic version (ECV) versus cesarean delivery (CD) in the 37th to 39th weeks of pregnancy

or at the time of presenting in labor. The patient was counseled that ECV decreases her risk of having a CD and has a low risk of placental abruption, rupture of membranes, cord prolapse, reversion to breech, feto-maternal hemorrhage, or fetal demise (Table 49.1). After counseling, the patient opted for an ECV. This was performed at 37 0/7 weeks on the Labor and Delivery floor after a reactive nonstress test (NST) and a repeat ultrasound that confirmed breech presentation. She was given subcutaneous terbutaline prior to the procedure. Two attempts at rotating the fetus were made. The fetal heart rate was evaluated with ultrasound after each attempt. Ultrasound confirmed the fetus had been rotated to vertex on the second attempt. The fetus was monitored for 30 minutes after the procedure. The patient received RhoGAM prior to discharge. She went on to deliver a liveborn 3,600 g male fetus at 40 6/7 weeks after presenting in spontaneous labor.

Term Breech Presentation

Breech presentation is present in 3–4% of pregnancies at term [1]. Risk factors include previous term breech presentation, uterine anomalies, high parity, fundal placenta, placenta previa, polyhydramnios, prematurity, fetal growth restriction, multiple gestations, maternal anti-convulsant use, fetal malformations (including Potter's syndrome, anencephaly, and hydrocephalus) and genetic disorders (including aneuploidies and myotonic dystrophy) [3].

The Term Breech Trial was a randomized, multi-center study that demonstrated that neonatal mortality and severe neonatal morbidity were significantly less among those who had a planned CD for breech presentation compared to those who had a planned vaginal breech delivery, with a relative risk of 0.33 [4]. Severe neonatal morbidity included Neonatal Intensive Care Unit (NICU) admission, intracranial hemorrhage, fractured bones, hyperbilirubinemia, seizures, and neonatal depression [4]. The study determined that for every

Table 49.1 Complication and mode of delivery rates after ECV

Rate of individual serious adverse events after ECV* [1]	<1%
Pooled complication rate after ECV [1]	6%
Pooled success rate of ECV [1]	58%
Operative vaginal delivery (OVD) rate after ECV [2]	14%
Cesarean rate after successful ECV [2]	21%
Overall vaginal delivery rate after successful ECV [2]	79%

* Placental abruption, umbilical cord prolapse, rupture of membranes, stillbirth and fetomaternal hemorrhage

14 planned CDs for breech presentation, one baby would be spared from serious morbidity or mortality with no significant difference in maternal complications [4]. Because of this landmark study and the associated diminishing experience of term vaginal breech deliveries among obstetricians, CD has become the typical mode of delivery for a breech fetus [5].

ECV has gained favor in an effort to reduce cesarean section rates due to fetal malpresentation. It is a procedure that involves applying pressure on the gravid abdomen to lift the fetus from the pelvic inlet and turn it from breech to cephalic. The rotation can be applied in either a clockwise or counterclockwise rotation. Success rates for ECV are reported around 60% and are associated with a reduction in CD by 43–65%, with an estimated number needed to treat of three [2,5]. However, it should be noted that the overall cesarean rate (for fetal distress and labor dystocia) is higher in those patients with successful ECV, compared to patients who present with spontaneous cephalic presentation [2]. Patients with successful ECV are also at increased risk for operative vaginal delivery (OVD), compared to the same controls [2]. Though not completely understood, these findings are thought to be due to fetal factors that may make breech babies less tolerant to labor, uterine or pelvic factors that may increase labor dystocia, as well as diminished engagement of the fetal head in the pelvis [2].

External Cephalic Version

ECV is associated with higher success rates in parous patients, posterior placental location, amniotic fluid index (AFI) greater than 7 cm, gestation between 37 and 39 weeks, and oblique or transverse presentations [1]. Tocolytic use prior to ECV also improves success [1]. Neuraxial anesthesia (spinal, epidural, or combined spinal-epidural) has also been demonstrated to not only increase ECV success rates but is also associated with a higher incidence of cephalic presentation in labor, higher vaginal delivery rates, and improved patient perception of pain without significant side effects [6]. Risk factors associated with failure of ECV include maternal obesity, oligohydramnios, anterior placenta, posterior fetal back, advanced cervical dilation, and deep engagement of the breech into the pelvis [1]. Absolute contraindications to ECV include contraindications to vaginal delivery [1]. An ECV may be attempted by one or two clinicians and should only be done in settings where a CD can be immediately performed [1]. The ECV should be stopped if there is prolonged fetal bradycardia or if the patient is unable to tolerate the procedure due to discomfort [1]. Given the risk of feto-maternal hemorrhage, all unsensitized Rh-negative patients should receive anti-D immune globulin after an ECV attempt. The fetus should be monitored for at least 30 minutes after both successful and unsuccessful ECV attempts [1]. Although data are limited, an ECV may also be offered in patients with a prior CD. Overall, ECV success rates in patients with a prior cesarean birth are similar to those without, and available trials have demonstrated no cases of uterine rupture during ECV [1].

Breech Vaginal Birth

There have been renewed discussions regarding planned singleton vaginal breech deliveries using specific guidelines. A recent large cohort study out of Norway suggests that while the risk of neonatal mortality is higher in planned vaginal breech delivery (0.9 per 1,000 births) compared with planned cesarean (0.8 per 1,000 births) and vertex controls (0.3 per 1,000 births), the absolute risk of adverse outcomes is overall low [7]. These findings are supported in a recent meta-analysis, which reveal overall low perinatal mortality and trauma rates of 0.6 and 0.41%, respectively, in the planned vaginal delivery group, compared to 0.14 and 0.18% in the planned cesarean group [8]. Additionally, this same meta-analysis shows a significant decrease in severe maternal morbidity (obstetric hemorrhage, sepsis, or neurologic, lung, kidney and cardiac complications) with planned breech vaginal delivery compared to CD, by a relative risk of 0.30, which was not previously demonstrated by the Term Breech Trial [8]. There is also a suggested increase in long-term adverse maternal outcomes, especially in future pregnancies (including placenta accreta spectrum [PAS] disorders, uterine rupture, and abdominal scar tissue complicating future cesareans); however, the overall contribution of planned CD for breech presentation to these outcomes has been under studied [3]. These findings pertaining to severe maternal morbidity are likely to disenfranchise pregnant patients in resource-poor settings [3]. Additionally, planned CDs for nearly every term breech neonate has led to an atrophy of term vaginal delivery skills among clinicians. This can pose hazardous for the unexpected breech delivery, breech delivery where cesarean services are not readily available, and breech second twins [9]. Because of these concerns, consideration can be made for offering a planned vaginal breech delivery to specific patients under controlled circumstances with an appropriately trained team (for a description of vaginal breech maneuvers, see Case 76).

A planned vaginal birth should be agreed upon by both the patient and physician after informed consent that details the risks of vaginal breech delivery as well as short- and long-term risks of CD [3]. The obstetrician that offers a trial of labor to a patient with a breech fetus should have training and experience in term breech vaginal deliveries [5]. It is recommended that these labors not be induced, be augmented only with caution, that gestational age be >37 weeks, and estimated fetal weight (EFW) should be between 2,500 and 4,000 g. The maternal pelvis should be deemed adequate by pelvimetry, the fetus should be in a frank or complete breech position, and the fetal head should be flexed [5]. Casteels et al. have outlined a robust breech program for obstetrical teams in Belgium, which outlines a coordinated plan of ECV, counseling for those with a persistent breech fetus, optimal vaginal delivery candidate selection, breech training simulation, and labor and delivery protocols for planned breech vaginal delivery [9]. General recommendations for labor and delivery protocols include immediate availability of obstetric anesthesia, continuous fetal heart rate monitoring, and attendance by a team that could perform an immediate CD if needed [5].

Key Teaching Points

- Singleton vaginal breech delivery at term is associated with higher neonatal morbidity and mortality than CD.
- Cesarean delivery has become the typical mode of delivery as a consequence of the associated risks, along with diminished obstetric training and experience, with vaginal breech deliveries.
- ECV is a low-risk obstetric procedure that can decrease the rate of breech positioning prior to labor and decrease the overall CD rate.
- An ECV should be offered to all patients with a term breech presentation, unless contraindicated.
- Planned CD for breech is associated with an increased risk of short-term maternal morbidity and likely associated with long-term risks relating to future pregnancies.
- A planned singleton vaginal breech delivery can be considered with an appropriately trained team of providers, a strong labor and delivery protocol, and thorough shared decision-making with the patient.

References

- 1 Practice Bulletin No. 221: External Cephalic Version. *Obstet Gynecol.* 2020;135:e203–e212.
- 2 De Hundt M, Velzel J, de Groot C, et al. Mode of Delivery after Successful External Cephalic Version: A Systemic Review and Meta-analysis. *Obstet Gynecol.* 2014;123:1327–1334.
- 3 Hofmeyr GJ, Hannah M, Lawrie TA. Planned Caesarean Section for Term Breech Delivery. *Cochrane Database Syst Rev.* 2015;7:CD000166.
- 4 Hannah ME, Hannah WJ, Hewson SA, et al.; Term Breech Trial Collaborative Group. Planned Caesarean Section versus Planned Vaginal Birth for Breech Presentation at Term: A Randomized Multicentre Trial. *Lancet.* 2000;356:1375–1383.
- 5 Committee Opinion No. 745: Mode of Term Singleton Breech Delivery. *Obstet Gynecol.* 2018;132:e60–e63.
- 6 Magro-Malosso ER, Saccone G, Tommasco MD, et al. Neuraxial Analgesia to Increase the Success Rate of External Cephalic Version: A Systematic Review and Meta-analysis of Randomized Controlled Trials. *Am J Obstet Gynecol.* 2016;215:276–286.
- 7 Bjellmo S, Andersen GL, Martinussen MP. Is Vaginal Breech Delivery Associated with Higher Risk for Perinatal Death and Cerebral Palsy Compared with Vaginal Cephalic Birth? Registry-Based Cohort Study in Norway. *BMJ Open.* 2017;7:e014979.
- 8 Fernández-Carrasco FJ, Cristóbal-Cañadas D, Gómez-Salgado J, et al. Maternal and Fetal Risks of Planned Vaginal Breech Delivery vs Planned Caesarean Section for Term Breech Birth: A Systematic Review and Meta-analysis. *J Glob Health.* 2022;12:04055.
- 9 Casteels M, Podevyn K, Vanoverschelde H, et al. Implementation of a Breech Program in a Belgian Obstetric Team. *Int J Gynaecol Obstet.* 2022;158:432–438.

A 25-Year-Old at 39 Weeks' Gestation with Brow Presentation at 9 cm Dilation

Jordan Hylton

History of Present Illness

A 25-year-old gravida 3 para 2 at 39 weeks' gestation presents to the Labor and Delivery unit in active labor. Upon admission, she undergoes cervical examination notable for 9 cm dilation and a fetus with brow presentation, anterior fontanelle posterior. The patient notes onset of her contractions 10 hours prior and spontaneous rupture of membranes just prior to presentation. She reports an uncomplicated pregnancy course and notes a history of two prior vaginal births.

Physical Examination

General appearance: Well-appearing gravid patient, grimacing with contractions and otherwise well-appearing in between

Vital signs:

Temperature: 37.2°C

Pulse: 106 beats per minute

Blood pressure: 126/78 mmHg

Respiratory rate: 22 breaths per minute

BMI: 31 kg/m²

Cardiopulmonary: Regular rate and rhythm without murmur, rub, or gallop

Abdomen: Gravid, palpable contraction every 3 minutes, otherwise soft and non-tender to palpation

Pelvic: No lesions, pooling with gross clear rupture of membranes, 9 cm dilation, 100% effaced, at 0 station with fontanelle posterior

Fetal assessment: Fetal heart rate is 140 beats per minute, moderate variability, occasional variable decelerations, absent accelerations. Tocometer: Demonstrating contractions every 3 minutes

Laboratory studies:

Hgb: 10.6 g/dL

Imaging:

Limited bedside ultrasound confirming cephalic presentation with no amniotic fluid present

How Would You Manage This Patient?

This patient is admitted with a brow presentation at 9 cm dilation. In this case, the patient's prior vaginal birth and lack of complications with the pregnancy made her a good candidate for expectant management. The decision was made to proceed with placement of epidural analgesia, which was well tolerated by the patient. She was counseled regarding the risks of a vaginal delivery and the potential of an emergent cesarean

delivery (CD). She was also counseled on risks to the fetus including facial edema and bruising. The patient was rechecked 1 hour after presentation with an urge to begin pushing. Upon repeat cervical examination, the fetus was found to be mentum anterior and now +2 station. She pushed for 20 minutes until the delivery of a healthy newborn. The neonate was assessed by the pediatric team with notable bruising and edema of the face. There were no vaginal lacerations (Figure 50.1).

Brow and Face Presentation

During presentation to a Labor and Delivery unit, one of the first and most important findings, aside from maternal and fetal well-being, is the presentation of the fetus. The most common presentation is cephalic; however, with this designation includes malpresentations such as brow, face, and chin presentations. These rare malpresentations occur <5% of the time and in less than 1/1,500 births and 1/600–800 births, respectively, for brow and face presentations [1,2]. They occur due to extension of the neck during descent rather than flexion. Risk factors for this include anencephaly, hydrocephalus, fetal head and neck masses, nuchal cord, and polyhydramnios [2].



Figure 50.1 Face presentation with mentum anterior at the introitus

Further risk factors can also influence the possibility of a vaginal birth and include prematurity, low birth weight, and parity [1]. Considering the dimensions of the pelvis, a woman who is delivering a smaller fetus likely has higher chances of a successful vaginal birth. If the presentation is related to a neck mass, however, the ability for resolution and vaginal delivery diminish, with resolution relying on a CD. This is secondary to increased presenting diameters based on presentation. The occipito-mental diameter of a brow presentation is 13.5 cm from the midpoint of the fontanelles to the chin. If the brow presentation evolves into a face presentation with the mentum anterior, the diameter decreases to 9.5 cm equivalent to vertex presentation. The diameter of a face presentation, submento-bregmatic, is calculated from the center of the bregma to the angle of the mandible.

The ability to assess and accurately describe the presentation is helpful in communication as this determines the possibility of vaginal birth and allows for appropriate parental counseling. The presenting part is used to describe the presentation. In vertex presentations, the occiput is hard and firm while a brow presentation is based on the palpation of the anterior fontanelle and is softer than the occiput. Brow presentations are described based on the orientation of the anterior fontanelle to the maternal pelvis and are further distinguished by the inability to palpate the mouth and chin. For face presentation, it is possible to palpate the mouth, nose, and chin. The description is based on the orientation of the mentum to the pelvis [1,3].

Given the mechanism of fetal malpresentation, patients are more likely to present with contracted or prolonged phases of labor. Such protraction can lead to fetal compromise, as evidenced by fetal heart rate abnormalities as well as facial edema or bruising upon delivery [3]. It is important to consider presentation when assessing fetal compromise as fetal scalp electrodes are not advised given the risks to fetal facial structures [2]. External monitoring should be continued. Patients and their birthing support should be informed of these potential risks when deciding how to proceed with their birth.

For patients that desire a vaginal birth, multiparity status can have a positive impact on their success rate. As the brow-presenting fetus rotates, 20% will result in vertex presentation and 30% in face presentation that leave vaginal birth as a possibility [1,3]. Fetuses who are persistently mentum

posterior or with continued brow presentation, a CD is warranted as flexion of the fetal neck is not possible. When a fetus is mentum anterior, flexion can occur as contractions descend the fetus under the pubic symphysis, causing natural flexion of the neck [2]. Decisions to proceed with cesarean birth should include fetal compromise, as noted by external monitoring, as well as active or second-stage arrest parameters, as used in vertex presentations. The maternal risks of inappropriate management are the same as any obstructed labor. For the newborn, the risks are associated with hypoxia or trauma.

In the absence of abnormal fetal heart tracings and desiring a vaginal birth after informed consent, it is reasonable to perform expectant management for face presentations [2]. For mentum anterior, oxytocin can be used for augmentation. Manual attempts to alter face and brow presentations, including the use of manual rotation, forceps, or version with breech extraction, are not recommended and increase the risk of maternal and neonatal morbidity [1,3]. In the setting of a face presentation, operative delivery is not absolutely contraindicated when the mentum is anterior, but an abundance of caution should be taken, and consideration of presentation is key. The landmarks are mouth and mentum rather than occiput and posterior fontanelle. The direction of traction should be downward until the mentum transcends the pubic symphysis. Once past the symphysis, traction should slowly be changed to upward to deliver by flexion. Given a risk of edema and airway compromise, consideration of NICU presence at the time of delivery should be made [2].

Key Teaching Points

- Persistent mentum posterior and brow presentations require a CD.
- Vaginal deliveries are possible and expectant management in the absence of neonatal or maternal compromise can result in vertex or mentum anterior presentations, which may result in vaginal birth in >60% of patients.
- There are significant differences in the fetal skull diameters, with persistent brow presentation resulting in a higher risk of fetal trauma or hypoxic injury.
- Informed consent should be obtained, and parents should be aware of the risks of fetal compromise, based on malpresentation.

References

- 1 Kesavan M. Management of Brow, Face, and Compound Malpresentations. SASGOG Pearls of Excellence. [www.excellence.org/list-of-pearls/management-of-brow-face-and-compound-malpresentations/?categoryName=&searchTerms=&](http://www.excellence.org/list-of-pearls/management-of-brow-face-and-compound-malpresentations/?categoryName=&searchTerms=&featured=False) (accessed June 13, 2023).
- 2 Makajeva J, Ashraf M. Delivery, Face and Brow Presentation. In: *StatPearls*. Treasure Island, FL: StatPearls Publishing; 2023. www.ncbi.nlm.nih.gov/books/NBK567727/ (accessed June 13, 2023).
- 3 Pilliod RA, Caughey AB. Fetal Malpresentation and Malposition: Diagnosis and Management. *Obstet Gynecol Clin North Am*. 2017;44(4): 631–643. <http://dx.doi.org/10.1016/j.ogc.2017.08.003> (accessed October 13, 2024).

A 30-Year-Old at 39 Weeks' Gestation with Fever in Labor

Elizabeth A. Deckers

History of Present Illness

A 30-year-old gravida 1 para 0 patient at 39 0/7 weeks' gestation, presents to the Labor and Delivery unit reporting contractions beginning 8 hours ago, which have become progressively stronger and more painful. For the last 4 hours, the contractions have been occurring every 3–5 minutes. She also notes leakage of green fluid per vagina, which started 4 hours ago. She reports fetal movement and denies vaginal bleeding. She has received regular prenatal care since the first trimester. Prenatal testing was normal, including a 20-week anatomy survey. She has no significant medical or surgical history, is taking prenatal vitamins, and has no known drug allergies.

Physical Examination

General appearance: Gravid, well-developed and well-nourished, and appears uncomfortable with uterine contractions

Vital signs:

Temperature: 39.1°C (102.4°F)

Pulse: 120 beats per minute

Blood pressure: 120/68 mmHg

Respiratory rate: 18 breaths per minute

Oxygen saturation: 98% on room air

BMI: 28.6 kg/m²

Cardiopulmonary: Tachycardic, no murmurs, rubs, or gallops. Lungs clear bilaterally

Abdomen: Gravid, fundal height 39 cm, uterine contractions palpate strong, estimated fetal weight (EFW) by Leopold's maneuver of 3,400 g

Pelvic: Speculum examination reveals light green fluid in the vault, positive nitrazine, positive ferning. The cervix is 6 cm dilated, 80% effaced, at 0 station in the cephalic position

Fetal assessment: Fetal heart rate is 170 beats per minute, minimal variability, no decelerations, no accelerations present. Four uterine contractions in 10 minutes

Laboratory studies:

WBC: 17,300 μ L

Group B streptococcus (collected at 36 weeks): Positive

Imaging:

Limited abdominal ultrasound demonstrates a single intrauterine pregnancy in cephalic presentation.

Posterior placenta. The amniotic fluid index (AFI) is 2.0

How Would You Manage This Patient?

This term patient with group B streptococcus colonization and ruptured membranes is in active labor with a fever of 39.1°C. Based on her fever, she meets the American College of Obstetricians and Gynecologists (ACOG) criteria for suspected intra-amniotic infection (IAI). This patient has several risk factors for developing IAI, including low parity, meconium-stained fluid, and group B streptococcus infection. To prevent adverse maternal and neonatal sequelae, ampicillin 2 g IV every 6 hours and gentamicin 400 mg IV every 24 hours were started, and she received acetaminophen 650 mg to reduce her fever [1].

The initial fetal heart rate tracing responded to intrauterine resuscitative measures and became category 1. The patient requested an epidural, which was placed. Maternal vital signs after epidural placement revealed a temperature of 38.0°C and pulse of 105 beats per minute; all other vital signs were normal. After placement of the epidural, uterine contractions spaced out, and labor was augmented with oxytocin.

The patient progressed to full dilation over 4 hours. She pushed for 2 hours and had an spontaneous vaginal delivery (SVD). The diagnosis of suspected IAI was communicated to the neonatal providers. Uterine atony and heavy bleeding occurred after placental delivery and required treatment with oxytocin and methergine. A second-degree laceration was repaired. Quantitative blood loss was 850 cc.

The patient's vital signs were normal after delivery. Mother and infant recovered together for the first hour, and then the infant was transferred to the nursery for evaluation and treatment. The patient was transferred to the postpartum floor, and intrapartum antibiotics were discontinued.

Management of Clinical Chorioamnionitis/Suspected IAI

Clinical chorioamnionitis is a commonly encountered infection in Labor and Delivery units and complicates up to 13% of term labors [2]. Traditionally, clinical chorioamnionitis is diagnosed in the presence of maternal fever ($>38^{\circ}\text{C}$ or 100.4°F), with clinical signs such as maternal and fetal tachycardia, maternal leukocytosis, malodorous vaginal discharge, or uterine tenderness. A confirmed diagnosis of IAI requires sampling the amniotic fluid via amniocentesis and analysis with culture, gram-stain, and biochemical markers of inflammation. Current microbiologic and diagnostic amniotic fluid tests for inflammation and infection may take hours to days to return. Therefore, they are of little use for clinical decision-making during labor. Using clinical criteria to predict IAI is also

challenging because studies have demonstrated that the diagnostic accuracy of clinical criteria ranges between 40 and 58% [2]. This is problematic because IAI is associated with significant maternal and neonatal morbidity and clinicians may tend to overtreat with antibiotics to avoid adverse outcomes.

Recent studies of IAI using amniocentesis to identify the presence or absence of microbial infection and markers of maternal and fetal inflammation have identified that clinical chorioamnionitis is a heterogeneous condition encompassing the following categories: 1. Confirmed IAI – characterized by the presence of microbial infection and inflammation of the amniotic cavity; 2. sterile inflammation of the amniotic cavity without microbial infection; and 3. maternal signs of systemic inflammatory response without evidence of IAI or inflammation. Epidural-related fever is a commonly encountered example of the third category [2]. The challenge for clinicians is distinguishing between infectious and noninfectious causes of clinical chorioamnionitis in order to individualize treatment. Further research and development are needed to improve the ability to identify infection and inflammation in the amniotic fluid rapidly.

Given the challenges of making a diagnosis of clinical chorioamnionitis, American College of Obstetricians and Gynecologists (ACOG), in a 2017 Committee Opinion, recommended the following definitions:

1. **Suspected IAI:** Maternal temperature of $\geq 39.0^{\circ}\text{C}$ or when the maternal temperature is $38.0\text{--}38.9^{\circ}\text{C}$, and one additional clinical risk factor is present:
 - a. Baseline fetal tachycardia: >160 beats per minute for 10 minutes or longer.
 - b. Maternal leukocytosis: white blood cell (WBC) count $>15,000$ in the absence of corticosteroids.
 - c. Purulent fluid from the cervical os.
2. **Absent maternal fever:** While fever is often associated with suspected IAI, ACOG acknowledges that if associated clinical signs and symptoms are present, a maternal fever is not necessary to make the diagnosis of suspected IAI.

The recommendation of ACOG is that intrapartum antibiotics be administered whenever IAI is suspected or confirmed and that antibiotics should be considered in isolated maternal fever unless another source is documented.

Most cases of IAI arise from a polymicrobial ascending infection of the vaginal flora. Common microorganisms cultured include *Ureaplasma urealyticum*, *Gardnerella vaginalis*, *Mycoplasma hominis*, *Streptococcus agalactiae*, *Lactobacillus*, and *Bacteroides* [3]. Intrapartum antibiotic therapy for IAI has been shown in a randomized controlled trial (RCT) to decrease neonatal and maternal morbidity. This trial of intrapartum versus postpartum (immediately after cord clamping) treatment demonstrated a significant reduction in neonatal pneumonia, sepsis, and maternal length of stay [4]. The recommendations of ACOG for treatment are in Table 51.1. Consultation with infection control is recommended to understand local antibiotic resistance patterns. Most experts also recommend using antipyretics to treat intrapartum fever.

Both maternal fever and clinical chorioamnionitis confer risk of neonatal and maternal morbidity. Adverse neonatal outcomes associated with maternal fever include an increased risk for neonatal encephalopathy (adjusted odds ratio 3.8–4.7) and an

increased risk of all-cause early neonatal mortality at term (odds ratio [OR] 1.7; 95% confidence interval [CI] 1.2–2.45) [5]. A maternal diagnosis of clinical chorioamnionitis at term has been associated with worsening neonatal outcomes such as 5-minute Apgar ≤ 3 (relative risk [RR] 2.09; 95% CI 1.26–3.46) seizures (RR 2.76; 95% CI 1.50–5.09), and sepsis (RR 1.93; 95% CI 1.25–2.99) [6]. There is also risk of long-term disability, including cerebral palsy (OR 9.3; 95% CI 2.7–31) [2]. Maternal risks associated with intrapartum fever include a two- to three-fold increase in rates of cesarean section and an OR between 1.6 and 2.1 for operative vaginal delivery (OVD) [5]. Common adverse maternal outcomes associated with chorioamnionitis are found in Table 51.2.

Labor progress must be monitored closely due to the association of chorioamnionitis and maternal fever with reduced uterine contractility and dysfunctional labor. The decision to proceed

Table 51.1 Recommended antibiotic regimes for treatment of IAI. Reproduced from Committee Opinion No. 712: Intrapartum Management of Intraamniotic Infection. *Obstet Gynecol.* 2017;130(2):e95–e101

Primary regimen	
- Ampicillin - and - Gentamicin	2 g IV every 6 hours 2 mg/kg IV load followed by 1.5 mg/kg every 8 hours or 5 mg/kg IV every 24 hours
Recommended antibiotics (mild penicillin allergy)	Dosage
- Cefazolin - and - Gentamicin	2 g IV every 8 hours 2 mg/kg IV load followed by 1.5 mg/kg every 8 hours or 5 mg/kg IV every 24 hours
Recommended antibiotics (severe penicillin allergy)	Dosage
- Clindamycin - or - Vancomycin* - and - Gentamicin	900 mg IV every 8 hours 1 g IV every 12 hours 2 mg/kg IV load followed by 1.5 mg/kg every 8 hours or 5 mg/kg IV every 24 hours
<i>Postcesarean delivery:</i> One additional dose of the chosen regimen is indicated. Add clindamycin 900 mg IV or metronidazole 500 mg IV for at least one additional dose. <i>Postvaginal delivery:</i> No additional doses required; but if given, clindamycin is not indicated.	
Alternative regimens	
- Ampicillin-sulbactam - Piperacillin-tazobactam - Cefotetan - Cefoxitin - Ertapenem	3 g IV every 6 hours 3.375 g IV every 6 hours or 4.5 g IV every 8 hours 2 g IV every 12 hours 2 g IV every 8 hours 1 g IV every 24 hours
<i>Postcesarean delivery:</i> One additional dose of the chosen regimen is indicated. Additional clindamycin is not required. <i>Postvaginal delivery:</i> No additional doses required; but if given, clindamycin is not indicated.	

*Vancomycin should be used if the woman is colonized with group B streptococci resistant to either clindamycin or erythromycin (unless clindamycin-inducible resistance testing is available and is negative) or if the woman is colonized with group B streptococci and antibiotic sensitivities are not available.

Table 51.2 Chorioamnionitis at term and its duration: relationship to outcomes. Adapted from Rouse, DJ, Landon M, Leveno KJ, et al. The Maternal-Fetal Medicine Units Cesarean Registry: Chorioamnionitis at Term and Its Duration-Relationship to Outcomes. *Am J Obstet Gynecol.* 2004;191(1):211–216

Outcome	Chorioamnionitis (%; N = 1,965)	No chorioamnionitis (%; N = 14,685)	RR (95% CI)
Atony	14.2	5.7	2.50 (2.20–2.84)
Blood transfusion	4.5	2.0	2.25 (1.78–2.83)
Septic pelvic thrombophlebitis	0.6	0.2	2.74 (1.38–5.46)

with cesarean delivery (CD) should be based on standard obstetric indications, as the duration of clinical chorioamnionitis has not been shown to significantly impact most adverse maternal or neonatal outcomes [6]. After vaginal delivery, antibiotics are discontinued unless risk factors such as bacteremia, unexplained fever, or sepsis are present. It is recommended that post-CD, one additional dose of intrapartum antibiotics be given along with either clindamycin or metronidazole [1]. Clear communication with the neonatal care team is imperative to ensure the neonate receives appropriate treatment after delivery.

Key Teaching Points

- IAI refers to microbial infection and inflammation of the amniotic cavity and is associated with significant maternal and neonatal morbidity.
- The diagnosis of IAI may be made in the absence of maternal fever if associated clinical signs and symptoms are present.
- Suspected IAI is diagnosed when the maternal temperature is $\geq 39^{\circ}\text{C}$ or when the maternal temperature is $38.0\text{--}38.9^{\circ}\text{C}$ with at least one additional clinical risk factor.
- Administration of antibiotics is recommended as soon as IAI is diagnosed. Antibiotics should be considered for isolated maternal fever unless another source is identified and documented.
- IAI alone is not an indication for CD. Standard obstetric indications for cesarean section should be followed.

References

- 1 Committee Opinion No. 712: Intrapartum Management of Intraamniotic Infection. *Obstet Gynecol.* 2017;130(2):e95–e101.
- 2 Jung E, Romero R, Manaphat S, et al. Clinical Chorioamnionitis due to Intraamniotic Infection in Term Gestations: The Definition, Microbiology, Pathogenesis, Differential Diagnosis and Treatment. *Am J Obstet Gynecol.* 2024;230(3):S807–S840.
- 3 Conde-Agudelo A, Romero R, Jung EJ, Garcia Sánchez ÁJ. Management of Clinical Chorioamnionitis: An Evidence-Based Approach. *Am J Obstet Gynecol.* 2020;223(6):848–869.
- 4 Gibbs R, Dinsmoor M, Newton E, Ramamurthy R. A Randomized Trial of Intrapartum versus Immediate Postpartum Treatment of Women with Intra-amniotic Infection. *Obstet Gynecol.* 1988;72(6):823–828.
- 5 Goetzl L. Maternal Fever in Labor: Etiologies, Consequences, and Clinical Management. *Am J Obstet Gynecol.* 2023;228(5S):S1274–S1282.
- 6 Rouse, DJ, Landon M, Leveno KJ, et al. The Maternal-Fetal Medicine Units Cesarean Registry: Chorioamnionitis at Term and Its Duration-Relationship to Outcomes. *Am J Obstet Gynecol.* 2004;191(1):211–216.

A 20-Year-Old at 39 Weeks' Gestation with Persistent Occiput Posterior Presentation, Arrest of Descent, and Worsening Fetal Heart Rate Tracing

Michael L. Galloway

History of Present Illness

A 20-year-old primigravid patient at 39 weeks' gestation was admitted for scheduled induction of labor (IOL). Her prenatal care had been uncomplicated. She has no significant medical conditions. She does not smoke and exercises regularly. Her family history is noncontributory.

Her induction started 24 hours ago with an initial cervical exam of 1–2 cm dilation, 70% effacement, and –2 station. She initially received a Foley bulb and low-dose oxytocin infusion for her induction. Her labor progressed uneventfully, with a transition to active phase after 12 hours, at which time she received epidural anesthesia. She has now been completely dilated and pushing for 3 hours. She initially brought the vertex from +1/5 to +4/5 station, but she is becoming tired with little progress in the last hour. The fetal head is in an occiput posterior (OP) position and attempts to manually rotate the head have been unsuccessful.

Physical Examination

General appearance: Well-developed, 20-year-old adult female, fatigued, anxious, no acute distress

Vital signs:

Temperature: 37.2°C

Pulse: 94 beats per minute

Blood pressure: 144/81 mmHg

Respiratory rate: 18 breaths per minute

BMI: 28.8 kg/m²

Cardiopulmonary: Regular heart rate and rhythm, no murmurs. Lungs clear bilaterally with no wheezes

Abdomen: Gravid full-term size, estimated fetal weight (EFW) by Leopold's 3,500 g

Extremities: Trace lower extremity edema bilaterally

Neurologic/psychologic: alert, intact, good insight

Pelvic: The cervix is completely dilated and effaced with membranes ruptured. The vertex is at +4 station in direct OP position. Clinical pelvimetry is adequate.

Laboratory studies:

Hgb: 10.1 g/dl

Plt: 175,000/μL

WBC: 14.3 × 10³/μL

Fetal assessment: Fetal heart rate tracing demonstrates baseline is in 150 beats per minute with moderate variability. Repetitive late decelerations have appeared in the final hour with pushing.

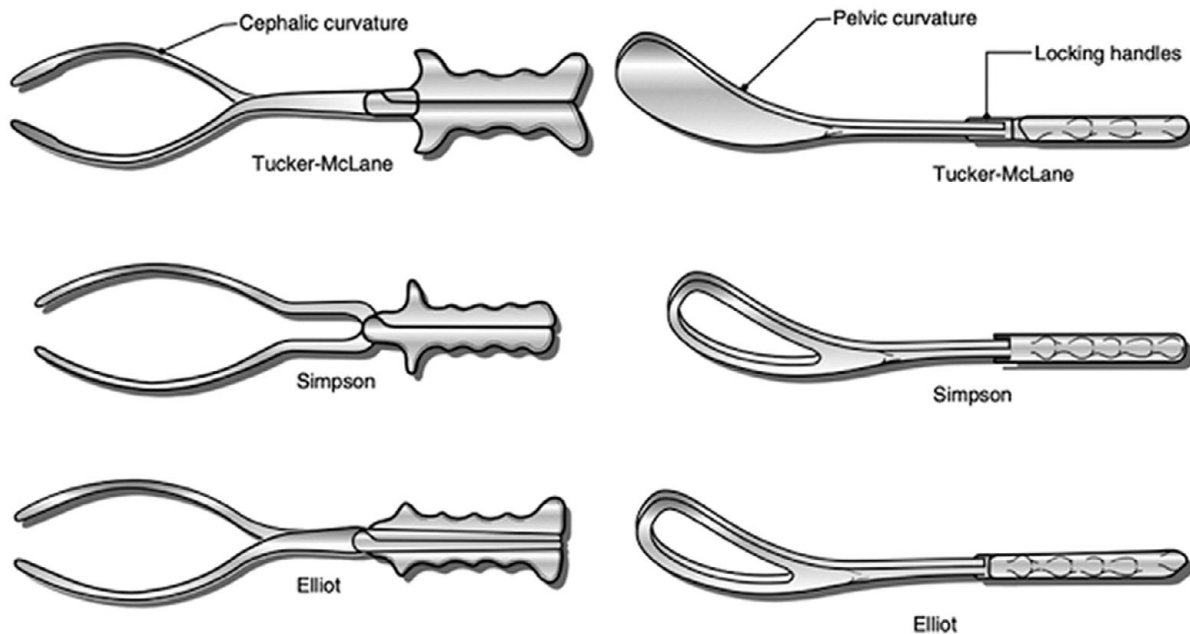
How Would Manage This Patient?

While the patient has progressed well in the second stage, the fetal tracing indicates a concern for fetal compromise. The delivery of the baby needs to be accomplished more quickly than the patient is likely to achieve in her exhausted state. Prerequisites for operative vaginal delivery (OVD) are met with complete dilation, ruptured membranes, and fetal head engaged at +4/5 station. The patient has adequate anesthesia with an epidural. Risks related to OVD are discussed with the patient, including the risks of maternal trauma (obstetric anal sphincter injury [OASI], extension of vaginal lacerations) and neonatal morbidity (cephalohe-matoma, facial nerve injury, skull fracture, peripheral nerve injury). Cesarean section is also discussed as an option, though she is informed of increased risks for both maternal and neonatal morbidity in this setting. Given that the benefit of OVD outweighs the risks in this case, the patient provides verbal consent to OVD. The obstetrician is comfortable using forceps and selects Simpson's forceps to expedite delivery. A successful outlet forceps vaginal delivery is achieved over a mediolateral episiotomy.

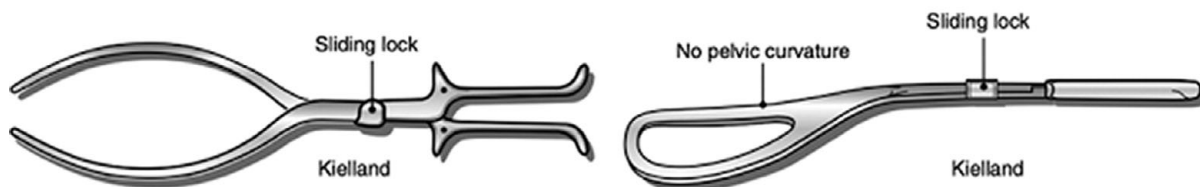
Operative Vaginal Delivery

The use of forceps or vacuum is a useful skill to expedite delivery in the proper setting. Forceps have been in use since the seventeenth century and the vacuum in late eighteenth century [1]. Indications for OVD are nonreassuring fetal status, maternal exhaustion, need for shortened second stage of labor, and prolonged second stage of labor with reassuring fetal status. Prerequisites for OVD include engaged fetal head, complete dilation of the cervix, ruptured membranes, assessment of adequate pelvic size for fetal weight, known fetal head position, adequate anesthesia, empty bladder, and risks/benefits explained to patient. When these prerequisites are met, OVD is usually a faster means of delivery in the setting of nonreassuring fetal heart tracing than emergency cesarean delivery (CD). Operative vaginal delivery confers a 97% efficacy in delivery [2]. Classification of OVD is defined by the station and position of the fetal head. In an outlet delivery, the fetal scalp is visible without separating the labia. In this situation, the fetal skull has reached the pelvic floor, and the sagittal suture is in the anteroposterior diameter and does not exceed 45° rotation. In a low delivery, the leading point of the fetal skull (not caput) is at or beyond +2/5 station but

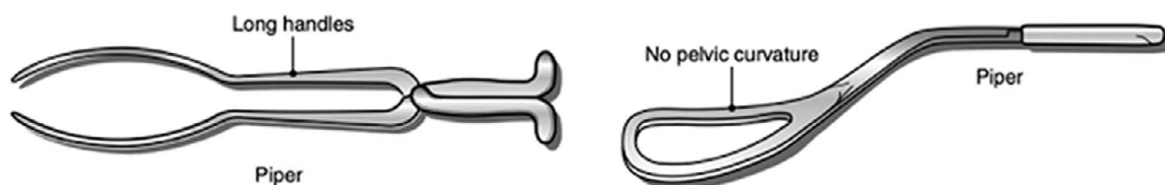
Classical forceps



Rotational forceps



Forceps for delivery of aftercoming head of the breech



JWKOI/McLary

Figure 52.1 Classification of forceps. Used with permission from Landon M (ed.). *Obstetrics: Normal and Problem Pregnancies*. Philadelphia: Elsevier, 2021

has not yet reached the pelvic floor. It is characterized as without rotation if the head is rotated $\leq 45^\circ$, and with rotation if $>45^\circ$. A mid-pelvic delivery is one in which the fetal head is engaged but still above +2/5 station.

The latest US data show the incidence of OVD was 3.0% of vaginal deliveries in 2021 [3]. Vacuum delivery is performed more often than forceps delivery (2.5 and 0.5%, respectively). The decision between forceps and vacuum depends on the

clinical situation and physician experience [4]. Physicians may develop a preference for either instrument with more experience of use. Advantages of forceps include more assured application to effect delivery and the ability to correct asynclitism or rotation. Risks of forceps include a higher risk of OASI compared to vacuum (approximately 1 in 4 forceps deliveries compared with 1 in 8 vacuum deliveries), with a total risk of significant laceration of 25.3% [5]. Neonatal morbidity

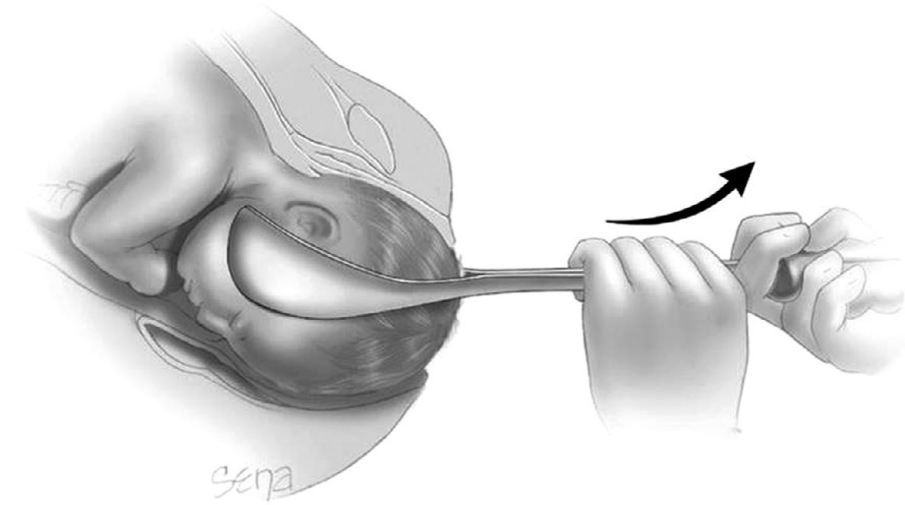


Figure 52.2 Appropriate axis of traction for forceps delivery of OP fetus. Used with permission from Cunningham F, Leveno KJ, Bloom SL, et al. (eds). *Williams Obstetrics*, 24th ed. New York: McGraw Hill; 2014, fig. 29-14

including facial nerve injury or skull fracture is rare. Neonatal morbidity occurs in <1% of births for both forceps and vacuum. The existing data suggest that the use of OVD, in the properly selected patient, minimizes maternal risk without increasing neonatal morbidity. Advantages of vacuum devices include ease of application, particularly in settings of rotated fetal head, and less risk of maternal trauma. Disadvantages of vacuum include increased risk of fetal scalp hematomas or lacerations. Vacuum-assisted delivery has limits on duration of use (usually 20 minutes) and pop-offs (usually 3). The contraindications to vacuum delivery are gestational age of <34 weeks (due to risk of intracranial hemorrhage), face presentation, suspected bleeding disorders, and suspicion of fetal bone demineralization disease. Lack of descent with either forceps or vacuum is reason to proceed to cesarean section. Combining both methods of operative delivery has increased risk of morbidity and is discouraged. Cesarean sections in the setting of deep arrest carry significant risk as well, as they are associated with increased blood loss, maternal wound infection, delay in delivery relative to OVD, and delivery of impacted head that may lead to fetal injury (refer to Case 53).

Fetal position is important to determine, as OP position incurs additional difficulty for OVD due to larger presenting diameter of the fetal head and an increased risk of third- and fourth-degree perineal lacerations [6]. In a situation with recurrent fetal decelerations and OP fetal head position, the provider may prefer a forceps-assisted delivery as a more assured means to effect delivery expeditiously. Episiotomy may be needed to assist with delivery and a mediolateral episiotomy may reduce risk of OASI.

The vacuum device is plastic with a handheld pump to generate suction, with a bell or mushroom-shaped cup. The cup should be applied with its center at the flexion point, located approximately 3 cm anterior to the posterior fontanelle. Checking correct placement and assuring no cervical or vaginal tissue entrapped in the cup is required prior to applying suction. Negative pressure is increased to the desired level

(exact pressure may differ per device instructions), and traction on the vacuum device is applied in coordination with maternal pushing efforts. Suction should be discontinued in between contractions and should not be applied for more than 15–20 minutes. Traction is applied in a vector to maintain flexion and gradually direct the head outward and upward to effect delivery.

Forceps are constructed from stainless steel, with differences in handle, lock, shanks, or blades, depending on the type of forceps. Most forceps have a pelvic curve, though rotational forceps are straight. Shanks may be overlapping or parallel, which allows additional room for molding. Locks may be fixed or sliding, which allows for better correction of asynclitism. Blades are either fenestrated or nonfenestrated. The nonfenestrated forceps tend to leave fewer indentations on the fetal cheeks, but fenestration provides a better grip. Common types of forceps include Simpson, Luikart–Simpson, Tucker–McLean, and Elliot (Figure 52.1).

Prior to application of forceps, a phantom application may be helpful to ensure the correct choice for top and bottom blades. The blades should be applied to each side of the fetal head, taking care to protect the vaginal sidewall from injury with the toe of the blade. Once applied, the sagittal suture should be parallel to and equidistant from the shanks. Once correct application is confirmed, traction is coordinated with maternal pushing efforts, with separation of the handles in between pushes to relieve pressure on the fetal head. The direction of traction should follow the curve of the pelvis, with outward pull followed by gradual extension upward (Figure 52.2). Downward pressure on the handles during traction, or Pajot's maneuver, will create a vector suitable for the curve of the pelvis. Once the vertex has cleared the symphysis pubis, an upward vector will help the fetal head extend when in an occiput anterior position.

Ensuring safe preparation and execution of OVD is crucial. When planning the procedure, a neonatal team should be present and an operating room available in case the attempt

is unsuccessful. Safety checklists may be helpful to ensure that steps are followed appropriately [7]. The checklists confirm that prerequisites have been met, the patient counseled, appropriate setup and necessary teams are present, and the procedure is appropriately documented. Another factor contributing to safety is operator training. The incidence of OVD has significantly decreased over the past 40 years, and many providers have little experience or training [8]. Recent postgraduation reports show the median numbers for resident OVD experience are 13 vacuum and 3 forceps deliveries [9]. Improved training is required to achieve successful outcomes. Use of simulation and increased educational involvement of experienced mentors can improve learner skills and provide the needed experience to achieve success and safety with forceps and vacuum.

Key Teaching Points

- Both vacuum and forceps delivery are safe, effective, and may effect delivery more expeditiously than cesarean in the proper scenario.
- Forceps are more reliable than vacuum for successful vaginal delivery, but may increase the risk of maternal trauma.
- Vacuum may be easier to apply with less risk of vaginal tears.
- A lack of descent with appropriate traction should prompt reconsideration of the approach and possible preparation for CD.
- Attention to training and safety are essential to ensure continued successful use of OVD.

References

- 1 Baskett TF. Operative Vaginal Delivery: An Historical Perspective. *Best Pract Res Clin Obstet Gynaecol.* 2019;56:3–10. <http://dx.doi.org/10.1016/j.bpobgyn.2018.08.002> (accessed October 13, 2024).
- 2 Barth WH Jr. Persistent Occiput Posterior. *Obstet Gynecol.* 2015; 125(3):695–709. <http://dx.doi.org/10.1097/AOG.0000000000000647> (accessed October 13, 2024).
- 3 Osterman MJK, Hamilton BE, Martin JA, Driscoll AK, Valenzuela CP. Births: Final Data for 2021. *Natl Vital Stat Rep.* 2023;72(1):1–53.
- 4 Operative Vaginal Birth: ACOG Practice Bulletin, Number 219. *Obstet Gynecol.* 2020;135(4): e149–e159.
- 5 Muraca GM, Boutin A, Razaz N, et al. Maternal and Neonatal Trauma Following Operative Vaginal Delivery. *CMAJ.* 2022;194(1):E1–E12.
- 6 Panelli DM, Leonard SA, Joudi N, et al. Clinical and Physician Factors Associated with Failed Operative Vaginal Delivery. *Obstet Gynecol.* 2023;141(6):1181.
- 7 Patient Safety and Quality Committee; Society for Maternal-Fetal Medicine; Staat B, Combs CA. SMFM Special Statement: Operative Vaginal Delivery: Checklists for Performance and Documentation. *Am J Obstet Gynecol.* 2020;222(5):B15–B21.
- 8 Merriam AA, Ananth CV, Wright JD, et al. Trends in Operative Vaginal Delivery, 2005–2013: A Population-Based Study. *Br J Obstet Gynaecol.* 2017;124(9):1365–1372.
- 9 Accreditation Council for Graduate Medical Education. Obstetrics and Gynecology Case Logs: National Data Report 2023. <https://apps.acgme-i.org/ads/Public/Reports/Report/25> (accessed October 28, 2023).

A 25-Year-Old at 40 Weeks' Gestation with a Cesarean Delivery after a Failed Vacuum

Vanessa Torbenson

History of Present Illness

A 25-year-old gravida 1 para 0 is undergoing induction of labor (IOL) for premature rupture of membranes at 40 weeks' gestation. Her antepartum course was complicated by obesity and anxiety, not currently on medications. On initial arrival to the labor unit, the fetal heart rate tracing was found to be reassuring and category 1. Rupture of membranes was confirmed by speculum examination and oxytocin was started. During her labor, she opted for epidural anesthesia for pain relief. Her labor course was protracted, and she progressed to complete dilation after a 2-day process. She pushed for 3 hours with descent to +2/5 station. The fetal heart tracing was then category 2, and the patient was counselled for an operative vaginal delivery (OVD). A trial of vacuum extraction was performed and unsuccessful. The patient was consented for cesarean delivery (CD) and the team meets for a huddle.

Physical Examination

General appearance: Well-developed, well-nourished, tired, comfortable with epidura

Vital signs:

Temperature: 37.5°C

Pulse: 98 beats per minute

Blood pressure: 131/81 mmHg

Respiratory rate: 16 breaths per minute

BMI: 32.9 kg/m²

Abdomen: Gravid, non-tender, EFW of 3,900 g

Pelvic: completely dilated at +2/5 station with caput, occiput posterior (OP)

Fetal assessment: Fetal heart rate is 150 beats per minute with moderate variability, intermittent variable and late decelerations are present. Contractions noted every 2–3 minutes

How Would You Manage This Patient?

The team pauses for a surgical time out, noting that this second stage CD may be complicated by an impacted fetal head (IFH). The primary surgeon attempts to dislodge the fetal vertex by a vaginal assisted exam after the patient is in stirrups. As the patient is prepped, a nonscrubbed member of the team prepares to help with a hand from below and anesthesia prepares intravenous (IV) nitroglycerine. After the surgical pause, the case starts, and the operator makes a generous low transverse hysterotomy. An IFH is identified, and nitroglycerine is given. The operator is unable to disengage the fetal

vertex and the staff member on standby places a vaginal hand and attempts to dislodge the fetal head. After 30 seconds, a brief release is noted, and the surgeon receives the fetal vertex abdominally and the infant is delivered. The team identifies and repairs a right inferior uterine extension.

Impacted Fetal Head

An IFH occurs when the fetal head cannot be delivered by usual maneuvers during a CD [1]. Impacted fetal head typically is encountered during CD performed during the second stage but can be seen in late first-stage deliveries. The mechanism is descent of the fetal head deep into the pelvis such that a hand cannot fit between the fetal vertex and the pelvis. In a large observational study in Great Britain, 16% of second-stage CDs were classified as difficult and IFH complicated 1.5% of all births [2,3]. IFH is associated with oxytocin augmentation, full cervical dilation, mid/low station, molding, and caput [3]. The incidence may be increasing with the trend to allow parturients to labor longer to increase vaginal delivery rates.

Complications

Maternal and neonatal outcomes are worse with second-stage delivery compared to first-stage delivery with an increased risk of intraoperative trauma, febrile morbidity, hemorrhage, an Apgar score <3, and asphyxia (see Table 53.1) [4]. The lower uterine segment is often thin and can be easily traumatized during delivery leading to extensions with increased blood loss.

Entry

The lower uterine segment can be quite distended during the second stage and making an incision low on the uterus may lead to inadvertent entry into the cervix. It is best to make an incision in the upper portion of the lower uterine segment, which will leave more tissue between the hysterotomy and the bladder, allowing for easier repair. A higher incision is also helpful if a pull technique will be utilized to relieve IFH. Avoid flexing the wrist during delivery of an IFH as this can act as a fulcrum on the thinned myometrium between the hysterotomy and cause inferior extensions [1].

Uterine Relaxation

As soon as the decision to perform a CD is made, it is important to discontinue contractile agents such as oxytocin. Contractions make it more difficult to deliver the fetal vertex. IV nitroglycerine can be used to provide the quickest relaxation with doses of 50–200 µg [1]. It takes approximately

Table 53.1 Relative risk >1.5 of maternal and neonatal morbidity in CDs performed at second stage versus those performed before second stage [4]

		Cesarean in second stage (%)	Cesarean before second stage (%)	Adjusted risk*	
				RR	CI
Maternal morbidity					
Blood transfusion	0.9	0.5	2.0	0.56–6.8	
Hysterectomy	0.2	0.1	1.9	0.12–31	
Febrile morbidity	1.1	0.3	4.0	0.98–16	
Early postpartum hemorrhage (PPH)	4.7	2.9	1.7	1.0–3.0	
Intraoperative trauma	6.4	1.3	2.6	1.7–3.9	
Neonatal morbidity					
5-minute Apgar ≤3	0.6	0.3	2.2	0.43–11	
Asphyxia	11	8.0	1.5	1.1–2.1	

*Adjusted for maternal age, antibiotic administration, induction or augmentation, regional anesthesia, length of labor and gestation age, when significant

30 seconds for nitroglycerine to be effective. Adequate relaxation will often allow for delivery of the vertex and can allow further techniques to have a greater chance of success. Therefore, continue maneuvers for at least 30 seconds after administration of nitroglycerin.

Push Technique

Abdominovaginal delivery, or vaginal-assisted CD, is the most common technique used to resolve IFH, with approximately 84% of obstetricians in one study using this method [5]. A hand is placed in the vagina and dispersing the pressure across several fingers or the palm of the hand, steady upward pressure is applied to the fetal vertex (Figure 53.1). Simultaneously, the abdominal operator is attempting to place their hand below the fetal vertex or providing upward pressure on the fetal shoulders. It is important to train team members who will provide a hand from below to avoid sharp movements or concentrated pressure points while pushing from below, as this can lead to fetal skull fracture. Placing the patient in yellow fin stirrups prior to delivery allows for better access to allow placement of the vaginal hand. If stirrups are not available, placing the patient in the frog leg or Whitmore position will aid with access [6]. While push techniques are commonly used and often effective, there is some evidence that their use may have higher morbidity than pull techniques. If the push technique is ineffective, the team can transition to a pull technique and evaluate if the hysterotomy needs to be modified. Consider increasing the length of the incision by making a J or T incision if more room is necessary to perform a pull maneuver and avoid an inferior extension.

Pull Techniques

A pull technique for delivery of an IFH avoids manipulation of the fetal vertex and uses the relatively larger space of the upper uterine cavity compared to the lower pelvis for fetal manipulation. The most used pull technique is reverse breech extraction. Reverse breech extraction involves grasping the fetal legs to deliver the body, decreasing the pressure on the fetal head,

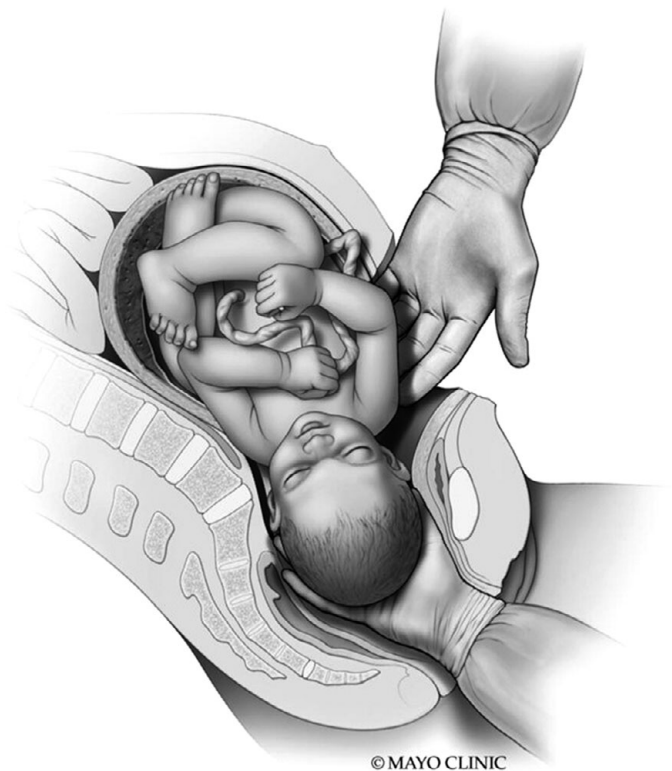


Figure 53.1 Abdominovaginal delivery with push technique. Assistant disengages the fetal head with a vaginal hand dispersing pressure across fingers or palm while surgeon elevates through the hysterotomy. Reproduced from Manning JB, Tolcher MC, Chandharan E, Rose CH. Delivery of an Impacted Fetal Head during Cesarean: A Literature Review and Proposed Management Algorithm. *Obstet Gynecol Surv.* 2015;70(11):719–724. Used with permission of the Mayo Foundation for Medical Education and Research, all rights reserved

which then allows easier delivery of the head (Figure 53.2). Reverse breech extraction is most easily performed when the fetus is in the OP position, although it can be performed in other positions. Another pull technique is called the Patwardhan maneuver or shoulders-first delivery [7]. This technique is less known but involves delivery of the fetal shoulders, trunk, and then legs, followed by the vertex. There



© MAYO CLINIC

Figure 53.2 Reverse breech extraction. Fetus is in OT position and legs are grasped and delivered without manipulation of the fetal vertex. Reproduced from Manning JB, Tolcher MC, Chandraran E, Rose CH. Delivery of an Impacted Fetal Head during Cesarean: A Literature Review and Proposed Management Algorithm. *Obstet Gynecol Surv.* 2015;70(11):719–724. Used with permission of the Mayo Foundation for Medical Education and Research, all rights reserved

are various small studies and systematic reviews of small, randomized studies that compare maternal and neonatal outcomes between push and pull techniques. Based on these small studies, it appears that pull techniques may decrease the risk of hysterotomy extension, postpartum hemorrhage (PPH), and blood transfusions without a difference in neonatal outcomes [8]. However, given the small numbers in these studies, more investigation is needed. During the performance of a pull technique, an upper extension into the contractile portion of the uterus may occur. It is important when considering these techniques to make the initial hysterotomy in the upper portion of the lower uterine segment and to consider a J-incision if there is concern for space during the maneuvers.

References

- 1 Bloch C, Dore S, Hobson S. Committee Opinion No. 415: Impacted Fetal Head, Second-Stage Cesarean Delivery. *J Obstet Gynaecol Can.* 2021;43(3):406–413.
- 2 Wyn Jones N, Mitchell EJ, Wakefield N, et al. Impacted Fetal Head during Second Stage Caesarean Birth: A Prospective Observational Study. *Eur J Obstet Gynecol Reprod Biol.* 2022;272:77–81.
- 3 Cornthwaite K, Draycott T, Bahl R, Hotton E, Winter C, Lenguerrand E. Impacted Fetal Head: A Retrospective Cohort Study of Emergency Caesarean Section. *Eur J Obstet Gynecol Reprod Biol.* 2021;261:85–91.
- 4 Allen VM, O'Connell CM, Baskett TF. Maternal and Perinatal Morbidity of Caesarean Delivery at Full Cervical Dilatation Compared with Caesarean Delivery in the First Stage of Labour. *Br J Obstet Gynaecol.* 2005;112(7):986–990.
- 5 Hanley SJ, Walker KF, Wakefield N, et al. Managing an Impacted Fetal Head at Caesarean Section: A UK Survey of Healthcare Professionals and Parents. *Eur J Obstet Gynecol Reprod Biol.* 2022;271:88–92.
- 6 Landesman R, Graber EA. Abdominovaginal Delivery: Modification of the Cesarean Section Operation to Facilitate Delivery of the Impacted Head. *Am J Obstet Gynecol.* 1984;148(6):707–710.

Devices

There have been several devices developed to aid with IFH. The most common and best studied is a fetal elevation device called the fetal pillow (FP). The FP is placed prior to the surgery and is not for emergent use. The device is placed, and the reservoir is filled with fluid once the maternal legs are placed flat on the table. The objective is for the device to lift the fetal head, break the vacuum, and allow for easier delivery of the fetal vertex. Several studies have shown mixed results on the benefits of its use and a Cochrane review did not show an overall benefit [9].

Preparation

Teams should consider multidisciplinary training to manage an IFH. Having a common language of communication for informing team members and a systematic management plan can improve outcomes. Several algorithms [1,10] have been suggested, including one that contains the mnemonic ALERT [10], where A stands for alerting the team, L for lowering the operating table, E for extend incisions, R for relax the uterus, and T for deciding on push versus pull technique. Whatever algorithm is used, practice and knowledge of how to correctly perform these procedures is vital to optimize outcomes. Additionally, practicing pull technique maneuvers can be done prior to the procedure for “just in time” review if it has been some time since the maneuvers have been used. A systematic plan for management of the IFH will lead to improved outcomes for the mother-baby dyad.

Key Teaching Points

- Anticipate the presence of an IFH at CD during any second-stage cesarean, vertex at low station with caput/molding, and failed OVD.
- Make the hysterotomy incision high on the lower uterine segment to avoid an inferior hysterotomy extension and to facilitate a pull method of delivery.
- Become familiar with push and pull methods of extraction to safely employ if needed.
- Engage in multidisciplinary team training to define a management algorithm, assign roles, and optimize communication when an IFH is encountered.
- Commit to memory a mnemonic, such as ALERT, to assist with a safe delivery during an IFH.

- 7 Saha PK, Gulati R, Goel P, Tandon R, Huria A. Second Stage Caesarean Section: Evaluation of Patwardhan Technique. *J Clin Diagn Res.* 2014;8(1):93–95.
- 8 Gq Peak A, Barwise E, Walker KF. Techniques for managing an Impacted Fetal Head at Caesarean Section: A Systematic Review. *Eur J Obstet Gynecol Reprod Biol.* 2023;281:12–22.
- 9 Waterfall H, Grivell RM, Dodd JM. Techniques for Assisting Difficult Delivery at Caesarean Section. *Cochrane Database Syst Rev.* 2016;(1): CD004944.
- 10 Manning JB, Tolcher MC, Chandraharan E, Rose CH. Delivery of an Impacted Fetal Head during Cesarean: A Literature Review and Proposed Management Algorithm. *Obstet Gynecol Surv.* 2015;70(11): 719–724.

A 25-Year-Old at 40 Weeks' Gestation with Broad Ligament Extension during Cesarean Delivery

Laura Calder Parsons

History of Present Illness

A 25-year-old gravida 3 para 2 patient at 40 weeks is admitted to Labor and Delivery for an elective induction of labor (IOL). Her labor course has been slow. She is fully dilated with an epidural and has been pushing for 3 hours; however, she remains at 0 station and is not a candidate for operative vaginal delivery (OVD). Since she meets criteria for arrest of descent, she has been appropriately counseled on the recommendation for cesarean delivery (CD) and consents to the procedure. During the cesarean, the fetal head is deeply engaged in the pelvis, making extraction difficult. After delivery of the fetus and placenta, an extension of the hysterotomy is noted into the left broad ligament with heavy bleeding. She has had no complications during this pregnancy and has had two prior uncomplicated term vaginal deliveries. She has no significant past medical or surgical history.

Physical Examination

General appearance: Well-developed, obese, in no acute distress

Vital signs:

Temperature: 37.6°C

Pulse: 110 beats per minute

Blood pressure: 120/80 mmHg

Respiratory rate: 18 breaths per minute

Oxygen saturation: 98% on room air

BMI: 39 kg/m²

Abdomen: Uterus with a low transverse hysterotomy and a 3 cm extension into the left broad ligament with involvement of the uterine vessels

Pelvic: Cervical examination prior to cesarean: 10 cm dilation, 100% effaced, at 0 station

Fetal assessment: Fetal heart rate is 135 beats per minute. Prior to her CD, fetal monitoring revealed a category 2 tracing with moderate variability, recurrent variable decelerations, and absent accelerations. Contractions are noted every 3 minutes. Estimated fetal weight (EFW) >95% on last ultrasound assessment

Laboratory studies:

Hgb: 10 g/dL on admission

vessels were clamped. The extension was easily recognized, and a thorough evaluation was performed of the surrounding structures (i.e. cervix, vagina, bladder, ureter) to ensure there were no other injuries. The apex of the extension was grasped and a suture was placed, ensuring the apex was incorporated. A running-locked stitch was performed to close the extension, ensuring any thin or friable tissue was not torn during the repair. An imbricated layer was performed followed by closure of the hysterotomy. Firm uterine tone and hemostasis were confirmed. Due to the proximity of the ureter with the extension, cystoscopy was performed and revealed an intact bladder with good ureteral efflux bilaterally. The complication was communicated with anesthesia, nursing, and the patient during the surgery. The estimated blood loss was >1,500 mL and an intraoperative hemoglobin was 8. The hemoglobin was rechecked 6 hours after surgery and was 6.7. The patient was asymptomatic with normal vital signs, a soft abdomen, and no signs of ongoing bleeding. The patient was transfused one unit of packed red blood cells with appropriate rise on recheck.

Uterine Extension

The rate of uterine extensions during CD has been reported to be approximately 7% [1,2]. Extensions are most often in the lower uterine segment, followed by the cervix and the broad ligament. Extensions can occur during any cesarean, but the rate is significantly higher in cesareans done during the second stage of labor, with studies showing a rate between 14 and 26% [1,2,3]. A prolonged second stage causes thinning of the lower uterine segment, which increases the risk of an extension. One study showed that if a CD is performed >4 hours after the second stage commences, then the risk of an extension was 40% [3].

Many risk factors for extensions have been studied, including gestational age, race/ethnicity, emergency CDs, experience level of the surgeon, tobacco use, obesity, hypertension, diabetes, and chorioamnionitis. Some are thought to be associated with extensions, but there is no consensus as to whether these are independent risk factors [1].

Possible complications from extensions include higher rates of postpartum Hemorrhage (PPH), blood transfusion, and prolonged hospitalization. One retrospective study found that patients with an extension had a significantly increased risk of PPH (53.2 vs. 23.8%, $p < 0.001$) and prolonged length of stay >4 days (29 vs. 17%, $p = 0.04$) than patients without an extension [4]. Another study found that the median estimated blood loss with an extension was significantly higher (1,000 vs. 800 cc, $p < 0.01$) than without an extension [1]. The number of blood transfusions was also significantly increased in both

How Would You Manage This Patient?

This patient had a difficult fetal extraction due to deep arrest of descent, causing a broad ligament extension and significant bleeding. To gain quick control of the hemorrhage, the bleeding

studies; however, other studies have not shown a significant increase in blood transfusions or length of stay [2,3].

Prevention of extensions is critical. One meta-analysis found a lower incidence of extensions when the uterine incision was expanded bluntly versus sharply (RR 0.47, 95% CI 0.28–0.79) [5]. Another meta-analysis found a lower incidence of extensions when the uterine incision was expanded in a cephalad-caudad direction versus a transverse direction (RR 0.62; 95% CI 0.45–0.86), as well as a lower rate of uterine vessel injury (RR 0.55; 95% CI 0.41–0.73) [6]. Therefore, multiple organizations recommend that the uterine incision is expanded with a blunt, cephalad-caudad technique.

Finally, extraction of the fetal head can cause significant uterine extensions, more so with an impacted fetal head or occiput posterior (OP) head than a free floating head. Methods to prevent these extensions are discussed in further detail in Case 53.

Repair of Broad Ligament Extension

Thorough evaluation of an extension is necessary to determine the extent of injury and to ensure adequate repair. The first step is to identify the location of the apex. Visibility can be difficult due to heavy bleeding and depth of the extension. Extra assistance for retraction and suction to improve visualization can often be helpful. A broad ligament extension can be repaired separately, or it can be incorporated into the repair of the hysterotomy. If the extension is too long or if the tissue is very thin, it may be better to repair it separately. The repair begins by finding the most lateral angle of the extension and anchoring your suture there. If the angle is not visible, then suture the most distal visible point and then use that stitch to gently pull the tissue up toward you to elevate the angle into a more visible space. Consider giving tranexamic acid since the primary cause of bleeding is not uterine atony. If uterine atony is also present, then give uterotonics. If the bleeding continues despite suture repair of the extension and uterotonics, then ligation of the uterine vessels (O'Leary stitch) may be necessary to decrease bleeding on that side. An O'Leary stitch is a suture placed both inferiorly and superiorly to the injury in order to ligate both ends of the lacerated vessels. The needle is passed medial to the uterine artery through the anterior uterine wall, around the posterior aspect, back anteriorly through the broad ligament in an avascular space (created by retracting with your nondominant hand), and tied [7]. It is important not to place sutures blindly to avoid injury to the ureter. If the extension is close to the ureter, then you will need to perform a cystoscopy to ensure there is no ureteral injury.

Broad Ligament Hematoma

Occasionally the bleeding can progress into a broad ligament hematoma (Figure 54.1). The reported incidence varies between 1:500 and 1:20,000 deliveries [8]. A small hematoma that is stable in size may be observed. A hematoma that is slowly (venous) or rapidly (arterial) expanding is an obstetric emergency. Expansion can enter the retroperitoneal spaces and lead to significant hemorrhage and hypovolemic shock.

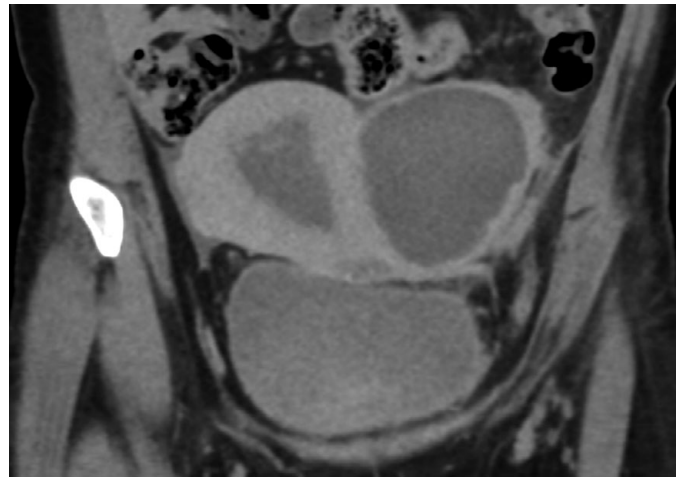


Figure 54.1 Computed tomography (CT) image of a left broad ligament hematoma after a CD

Pressure or pelvic packing can be applied while a management plan is made and resuscitative measures are implemented (i.e. collect complete blood count (CBC)/PT/PTT/fibrinogen, assess blood loss, intravenous (IV) fluid replacement, obtain blood products). If you have not already, perform an O'Leary stitch, as detailed.

First-line treatment is consultation with an interventional radiologist (IR) to perform uterine artery embolization, which is successful in 90% of the cases [8]. If an IR is not available, or the patient is unstable, then evacuation of the hematoma and ligation of the vessels may be necessary. Evacuation is performed by incising the anterior leaf of the broad ligament over the hematoma, and removing the clot, which will make bleeding vessels more visible for suture ligation.

If bleeding continues, an internal iliac artery/hypogastric artery ligation may be considered and is successful in 50% of cases. While gynecologic and obstetrical surgeons should be comfortable in the retroperitoneal space, an experienced surgeon may be of added value in this situation [7]. First, the peritoneum is opened over the common iliac artery and down toward the bifurcation of the external and internal iliac arteries. Follow the internal iliac artery 5 cm distal to this bifurcation in order to identify the anterior division (the posterior division branches off almost immediately from the internal iliac artery – do not ligate above this). Dissect the sheath of the anterior division away from the sidewall in order to pass a right-angle clamp beneath the artery lateral to medial. Pass a suture under the artery with the clamp, and tie to ligate.

When these interventions are not possible and/or there continues to be an expanding hematoma, a hysterectomy is necessary to prevent uncontrolled bleeding into the retroperitoneum [8,9].

Key Teaching Points

- Uterine extensions occur in <10% of CDs, with extensions into the broad ligament being the least common.
- The highest risk of an extension with a CD is during the second stage of labor.

- Patients with broad ligament extensions have a higher rate of PPH and a longer length of stay.
- Prevention of an extension is critical and can be accomplished with a uterine incision that is expanded with a blunt, cephalad-caudad technique, as well as by using several evidence-based methods, as detailed in Case 53.
- Visualization is key during management, and for this you may need additional assistants.
- Small, stable broad ligament hematomas can be monitored, whereas an expanding hematoma is an obstetric emergency, requiring rapid management.
- If a hematoma expands despite an O'Leary stitch and uterotonics, IR consultation for embolization is first line. If unavailable, it may be necessary to evacuate the hematoma and attempt to isolate the bleeding vessels for ligation.
- If the patient is unstable or the hematoma continues to expand, consider internal iliac artery/hypogastric artery ligation and/or hysterectomy.
- Cystoscopy is necessary if the extension is near the ureter or bladder.

References

- 1 Bligard KH, Durst JK, Stout MJ, et al. Risk Factors and Maternal Morbidity Associated with Unintentional Hysterotomy Extension at the Time of Cesarean Delivery. *Am J Perinatol*. 2019;36:1054–1059.
- 2 de la Torre L, González-Quintero VH, Mayor-Lynn K, et al. Significance of Accidental Extensions in the Lower Uterine Segment during Cesarean Delivery. *Am J Obstet Gynecol*. 2006;194:4–6.
- 3 Sung JF, Daniels KI, Brodzinsky L, et al. Cesarean Delivery Outcomes after a Prolonged Second Stage of Labor. *Am J Obstet Gynecol*. 2007;197:e1–5.
- 4 Patel SS, Koelper NC, Srinivas SK, et al. Adverse Maternal Outcomes Associated with Uterine Extensions at the Time of Cesarean Delivery. *Am J Perinatol*. 2019;36:785–789.
- 5 Saad AF, Rahman M, Costantine MM, Saade GR. Blunt versus Sharp Uterine Incision Expansion during Low Transverse Cesarean Delivery: A Meta-analysis. *Am J Obstet Gynecol*. 2014;6:e1–e11.
- 6 Pergialiotis V, Mitsopoulou D, Biliou E, et al. Cephalad-Caudad versus Transverse Blunt Expansion of the Low Transverse Hysterotomy during Cesarean Delivery Decreases Maternal Morbidity: A Meta-analysis. *Am J Obstet Gynecol*. 2021;225:e1–e13.
- 7 Management of Obstetrical Hemorrhage. In: Cunningham F, Leveno KJ, Dashe JS, et al. (eds). *Williams Obstetrics*, 26th ed. New York: McGraw Hill; 2022.
- 8 Broad Ligament Haematoma. In: Sharma A (ed.). *Labour Room Emergencies*. New York: Springer; 2020. 395–402.
- 9 Wendel PJ. Management of Broad Ligament Extension and Hematoma during a Cesarean Delivery. SASGOG Pearls of Excellence. <https://excellence.org/list-of-pearls/management-of-broad-ligament-extension-and-hematoma-during-a-cesarean-delivery/> (accessed October 13, 2024).

A 25-Year-Old at 40 Weeks' Gestation with Urine Noted in Operative Field during Repeat Cesarean

Eric R. Craig

History of Present Illness

A multiparous, 25-year-old gravida 3 para 2 at estimated 40 weeks' gestation was admitted for a trial of labor after cesarean delivery (CD) (TOLAC). She has a history of one vaginal delivery and a CD for breech presentation with her second. Her surgical history is notable for a laparoscopic appendectomy. During labor, she developed a persistent category 2 fetal heart rate tracing. A prolonged deceleration with a nadir to the 70s lead to an emergency CD.

Physical Examination

General appearance: Uncomfortable with contractions

Vital signs:

Temperature 37.0°C

Pulse: 105 beats per minute

Blood pressure: 108/67 mmHg

Respiratory rate: 20 breaths per minute

Oxygen saturation: 98% on room air

BMI: 31.8 kg/m²

Abdomen: Gravid, non-tender, with a prior cesarean scar

Pelvic: Cervical dilation of 5 cm, 75% effaced, at -2 station. There was bloody show with intact membranes

Intraoperative findings: Clear fluid noted in the operative field following closure of the hysterotomy.

There was a thin lower uterine segment along with normal ovaries and fallopian tubes. Dense adhesive disease was noted between the lower uterine segment and the bladder

How Would You Manage This Patient?

This patient attempting a TOLAC ultimately undergoes an unplanned emergent repeat CD, and there is an intraoperative bladder injury. The delivery and uterine closure are completed prior to bladder repair, which is inspected to assess the size and extent of damage. A 3 cm full-thickness injury at the bladder dome is noted. The defect is repaired in two layers using absorbable suture in a running nonlocked fashion, with care to avoid tension at the repair site. Sodium fluorescein is given intravenously and a cystoscopy is performed revealing bilateral efflux of urine from the ureteral orifices (UOs). The cystotomy repair is watertight and no other defects are noted. A urinary catheter will remain in place for 10 days postoperatively. Upon return to the clinic, you back-fill the bladder, and the patient voids spontaneously. At 8-weeks postpartum, she has no complaints.

Urinary Tract Injuries during CD

The urinary tract is the most commonly damaged organ system at the time of CD. A systematic review reported weighted pooled injury rates of 267 bladder and 7 ureteric injuries per 100,000 procedures, with much higher rates (6,279 and 666 per 100,000, respectively) of injury after open peripartum hysterectomy [1]. Risk factors for injury include a prior CD, adhesions, emergent delivery, surgeon inexperience, endometriosis, abnormal placentation, and a CD performed in the second stage of labor [1,2,3]. With more prior CDs comes an increasing risk of a urologic injury [2]. Prevention of injury should be a priority but is often difficult to balance with maternal and fetal indications for expedited delivery in cases of an emergent cesarean. Although no studies specific to CD were identified, data on delayed recognition of ureteral injuries at the time of hysterectomy demonstrate an increased risk of nephrostomy tube placement, sepsis, fistulae formation, acute renal insufficiency, and death [4].

Anatomy

The ureter is a retroperitoneal organ from its origin at the renal pelvis to its eventual insertion into the bladder trigone. The ureters run along the lateral posterior abdominal sidewall and cross over the common iliac vessels at the pelvic brim. The ureter can often be seen trans-peritoneally at this location. The ureter travels near the ovarian vessels and is located posterior and medial to the infundibulopelvic ligament. From here it begins to traverse medially and can be located in the medial leaf of the broad ligament, and courses directly under the uterine artery [5]. Its insertion to the bladder is typically 2 cm lateral to the cervicovaginal junction but can be closer [5]. If not visible tranperitoneally, a retroperitoneal dissection can be performed to identify the ureter at the pelvic brim and follow its course into the deep pelvis. Above the pelvic brim, the blood supply originates medially whereas below the pelvic brim it originates laterally. This should be noted during ureterolysis to avoid devascularization of the ureter. Figure 55.1 depicts the ureteral anatomy and proximity to surgically relevant pelvic structures [5].

The bladder functions as the storage vesicle for urine. It is a muscular, hollow, retroperitoneal organ with several anatomically distinct areas: the dome, body, fundus, and neck. The trigone of the bladder is a triangular region between the UOs extending down toward the bladder neck. Injuries to this area of the bladder are rare in obstetrics, but when they do occur urologic consultation should be strongly considered for repair. The bladder obtains its blood supply from the superior

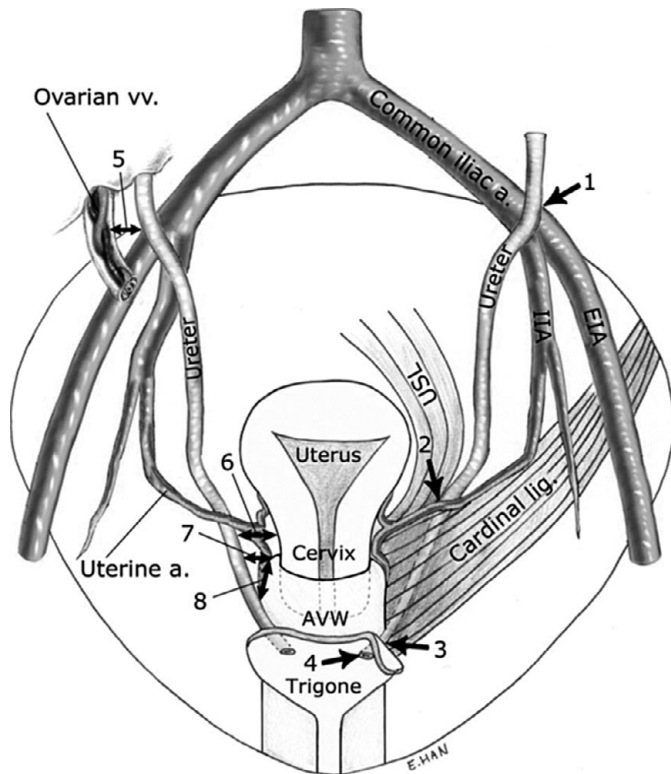


Figure 55.1 Schematic representation of ureteral lengths and relationships examined. Arrows depict specific points along the ureter used to measure ureteral lengths. Double-headed arrows represent closest distances between ureter and clinically relevant pelvic structures. 1. Lateral border of ureter as it crosses over iliac vessels; 2. superomedial point where ureter passes under uterine artery; 3. point at which ureter enters bladder wall; 4. ureteric orifice; 5. lateral ureter to most medial ovarian vessel at pelvic brim; 6. medial ureter to uterine isthmus; 7. medial ureter to anterolateral vaginal fornix (vaginal apex in specimens without uteri); 8. distance from ureter as it passes over anterolateral vaginal wall to anterolateral vaginal fornix–vaginal apex. AVW, anterior vaginal wall; EIA, external iliac artery; IIA, internal iliac artery; USL, uterosacral ligament. Illustration created by Elizabeth Han. Reprinted from Jackson LA, Ramirez DM, Carrick KS, et al. Gross and Histologic Anatomy of the Pelvic Ureter: Clinical Applications to Pelvic Surgery. *Obstet Gynecol.* 2019;133(5):896–904 with permission (A black and white version of this figure will appear in some formats. For the color version, please refer to the plate section.)

and inferior vesical arteries. The bladder wall consists of three distinct tissue layers: the urothelium, a specialized epithelium found inside the bladder, a smooth muscle layer, and the serosa. Knowledge of these layers and their gross appearances are crucial for appropriate repair of injuries.

Prevention and Recognition

Bladder injury at the time of CD most often occurs at the dome during lysis of adhesions to the lower uterine segment. Ureteral injuries are uncommon in routine CDs but can occur with lateral hysterotomy extensions. Ureteral injury more frequently occurs during cesarean-hysterectomy, especially emergent and unplanned surgeries. Best practices to reduce the risk of injury at CD include bladder decompression and sharp rather than blunt dissection to avoid distortion of tissue planes. Prophylactic identification of the anatomy can be helpful, particularly in cases of extensive adhesions, cesarean in the second stage of labor, or a cesarean hysterectomy [6]. Regarding placenta

accreta spectrum (PAS) disorders, a retrospective cohort study demonstrated a reduction in bladder and ureteral injuries with prophylactic ureteral stents, even when controlling for the presence of a gynecologic oncologist, urgency of delivery, and number of prior CDs [7]. The bladder edges can be better visualized by backfilling the bladder via an indwelling urinary catheter. Distention can be accomplished with sterile milk or sterile saline dyed with indigo carmine or methylene blue. These techniques also allow for assessment of bladder integrity after repair.

Some surgeons routinely create a bladder flap during CD intending to decrease bladder injury. While randomized controlled trials (RCTs) have failed to show a benefit with this approach, these studies are underpowered for this outcome. Some have recommended only to perform a bladder flap dissection if needed; there is lack of proven benefit, increased risks of postoperative urinary frequency, and increased intraoperative bleeding [8,9].

Early recognition is crucial to preventing further morbidity and mortality. A retrospective analysis of ureteral injuries at the time of hysterectomy found that up to 62% of injuries were unrecognized at the time of surgery. Intraoperative findings that can suggest bladder injury include extravasation of urine, direct visualization of the foley bulb, new onset hematuria in the foley bag, and a visually apparent laceration [10]. In the case of an open bladder injury, a cystoscope can be introduced via the defect to perform a teloscopy to visualize the UOs and confirm patency. Conversely, the UOs can be visualized directly through larger defects or inspected at the time of traditional cystoscopy following repair. Upon recognition of a bladder injury, the primary surgical procedure should be completed prior to repair in the event additional injuries are sustained, or the repair site is disrupted during the primary surgical procedure. The area can be tagged for easy identification after completion of the delivery and uterine closure. If the ureters or trigone are involved, urologic consultation should be strongly considered intraoperatively [6].

Management

High-quality data regarding the best approach for bladder repair are limited [6]. Small, simple cystotomies may be closed with a single layer. A large, full thickness cystotomy should be repaired with two to three layers, using a delayed absorbable suture. Permanent suture should be avoided as it can act as a nidus for stone formation. Polyglactin or poliglecaprone suture are conventionally used and are prudent choices given minimal tissue reaction and fast absorption, as the bladder heals quickly. First the mucosa should be repaired using a 2-0 or 3-0 absorbable suture in a running nonlocked fashion. The muscularis and submucosa may be closed in the same layer or separately, again using a 2-0 or 3-0 absorbable suture in a running fashion. The serosal layer may be closed using a 4-0 absorbable suture. After completion of the repair, the bladder should be backfilled to confirm integrity of the repair; multiple agents, as described earlier, may be used. Any areas with continued leakage should be further repaired. Following repair, the bladder should be decompressed using an

indwelling catheter for at least 7 days, and up to 14 depending on the extent of the injury. Prophylactic antibiotics are not indicated while the catheter is in place nor do additional antibiotics need to be given at the time of delivery and cystotomy repair beyond standard prophylactic antibiotics given for CDs. A voiding cystourethrogram is not required following catheter removal but can be obtained if extensive or complex repairs were performed, or if there is concern for incomplete healing.

While most injuries are identified and addressed at the time of surgery, incidental cystotomies can be unrecognized. Postoperative signs of a missed injury include hematuria, oliguria, ascites, abdominal pain, ileus, peritonitis, and an elevated blood urea nitrogen:creatinine ratio [2]. Imaging can help assess for undiagnosed urinary tract injuries. Retrograde cystography can be useful to identify bladder injuries but does not assess the ureters. Abdominal CT with

IV pyelography can assess bladder integrity, rule out additional pathology, and visualize the upper urinary tract.

Key Teaching Points

- Strategies for prevention of a urologic injury include improved anatomical knowledge, enhanced surgical technique, and prophylactic identification of the anatomy.
- Repair may be completed by the obstetrician with urologic consultation as needed.
- Delayed absorbable sutures should be used for surgical repair using one or more layers. Injuries of <1 cm may be treated with prolonged catheterization alone.
- Antibiotic prophylaxis is not needed with bladder repair or with a short-term urinary catheter.
- A cystogram is not required prior to catheter removal but may be performed to confirm bladder integrity.

References

- 1 Wei G, Harley F, O'Callaghan M, et al. Systematic Review of Urological Injury during Cesarean Section and Hysterectomy. *Int Urogynecol J*. 2023;34:371–389.
- 2 Tarney CM. Bladder Injury during Cesarean Delivery. *Curr Womens Health Rev*. 2013;9(2):70–76.
- 3 Silver RM, Landon MB, Rouse DJ, et al. Maternal Morbidity Associated with Multiple Repeat Cesarean Deliveries. *Obstet Gynecol*. 2006;107(6):1226–1232.
- 4 Blackwell RH, Kirshenbaum EJ, Shah AS, et al. Complications of Recognized and Unrecognized Iatrogenic Ureteral Injury at Time of Hysterectomy: A Population Based Analysis. *J Urol*. 2018;199(6):1540–1545.
- 5 Jackson LA, Ramirez DM, Carrick KS, et al. Gross and Histologic Anatomy of the Pelvic Ureter: Clinical Applications to Pelvic Surgery. *Obstet Gynecol*. 2019;133(5):896–904.
- 6 Zelivianskaia AS, Bradley SE, Morozov VV. Best Practices for Repair of Iatrogenic Bladder Injury. *Am J Obstet Gynecol Glob Rep*. 2022;2:100062.
- 7 Scaglione MA, Allshouse AA, Canfield DR, et al. Prophylactic Ureteral Stent Placement and Urinary Injury during Hysterectomy for Placenta Accreta Spectrum. *Obstet Gynecol*. 2022;140(5):806–811.
- 8 Dahlke JD, Mendez-Figueroa H, Maggio L, et al. The Case for Standardizing Cesarean Delivery Technique: Seeing the Forest for the Trees. *Obstet Gynecol*. 2020;136(5):972–980.
- 9 Dahlke JD, Mendez-Figueroa H, Rouse DJ, et al. Evidence-Based Surgery for Cesarean Delivery: An Updated Systematic Review. *Am J Obstet Gynecol*. 2013;209(4):294–306.
- 10 Sharp HT, Adelman MD. Prevention, Recognition, and Management of Urologic Injuries during Gynecologic Surgery. *Obstet Gynecol*. 2016;127(6):1085–1096.

A 20-Year-Old with a Fourth-Degree Perineal Laceration

L. David Moore

History of Present Illness

A 20-year-old primigravid patient in the second stage of labor progresses to +2 station after 3 hours of pushing. There is little progress as the patient is near exhaustion from her efforts. The fetus is in the occiput posterior (OP) position, and the pelvis is found to be adequate to attempt an operative vaginal delivery (OVD). After obtaining patient consent, the decision is made to attempt a forceps-assisted vaginal delivery. Simpson's forceps are placed and articulated without difficulty. Traction is applied with the next contraction. With distension seen in the perineum, a midline episiotomy is performed. The infant is delivered shortly afterward. The placenta is delivered without complication. Upon inspection, a fourth-degree perineal laceration is identified.

Physical Examination

General appearance: Fatigued from labor

Vital signs:

Temperature: 37.4°C

Pulse: 101 beats per minute

Blood pressure: 110/85 mmHg

Respiratory rate: 18 breaths per minute

Pelvic: The vaginal portion of the perineal laceration extends 5–6 cm superiorly. The perineal portion of the laceration includes the entire perineum and anal sphincter complex, involving the anal mucosa

How Would You Manage This Patient?

After careful inspection, the full extent of the laceration is noted. The rectal mucosa is reapproximated, followed by the internal anal sphincter (IAS). The external anal sphincter (EAS) is repaired using an end-to-end anastomosis technique. The remaining portion of the perineal laceration is repaired using a single-stitch technique similar to the repair for a second-degree laceration. A single dose of cefoxitin is given for antimicrobial prophylaxis. The patient's pain is controlled with nonsteroidal anti-inflammatory drugs and hydrocodone when needed. The patient is started on a stool softener and counseled for pelvic rest for 6 weeks to allow for proper healing. On the day of discharge, the patient is continent of flatus but has yet to stool. At her 2-week follow-up visit, she reports rectal continence. At her 6-week follow-up visit, the perineum appears well-healed, and no other complications are noted.

Obstetric Anal Sphincter Injuries

Obstetric anal sphincter injuries (OASIs) are severe perineal lacerations with childbirth that extend into or through the anal sphincter complex [1]. A third-degree laceration involves different ranges of damage to the EAS while leaving the rectal mucosa intact. A 3a laceration damages <50% of the external EAS, while a 3b laceration includes >50%. A 3c laceration is a laceration through the entire EAS and includes the IAS without damage to the rectal mucosa. A fourth-degree laceration extends through both the EAS and IAS and involves the rectal mucosa. Risk factors for OASIs include nulliparity, midline episiotomy, advanced maternal age, neonatal weight of >4 kg, OVD, prolonged second stage of labor, and OP position [2]. Third- and fourth-degree lacerations occur in 0.6–8% of births [3]. The incidence of OASIs may be reduced in modern obstetrics due to the decreased use of forceps and midline episiotomy, along with an overall increased rate of cesarean delivery (CD) [3]. However, the incidence tripled from 1.8 to 5.9% between 2000 and 2012 in England [4]. This increase in OASIs is likely secondary to one of the most important principles in managing severe perineal lacerations – increased vigilance in proper inspection and diagnosis in the immediate postpartum period.

Identifying relevant anatomy is crucial for severe perineal lacerations. Efforts to correctly visualize the anatomy are made difficult by the clinical situation: the tissue is edematous, bloody, and irregular borders to the tissue are common with these lacerations [3]. The patient may need to be moved to the operating room to ensure optimal resources for the surgical repair. Efforts to identify the anatomy can be improved by placing a gloved index finger in the rectum. This assists in providing exposure to identify the tissues. From the most inferior portion of the laceration, the practitioner should be able to identify the rectal mucosa and determine if it has been damaged. Just superior to the rectal mucosa is the IAS. It appears as a thin, shiny white layer made of the endpoint of the smooth muscle layer of the bowel. When torn, the IAS is found retracted and lateral to the tear. The smooth muscle of the IAS is under autonomic, involuntary control. Up to 80% of the resting pressure of the anal canal is provided by the IAS. The EAS is found just above the IAS. It is a ring of striated skeletal muscle that can vary in diameter among patients. The striated, skeletal muscle of the EAS provides the voluntary squeeze pressure of the anal canal [1]. As seen in Figure 56.1, many times one side of the muscular ring is found retracted into the body. With the gloved index finger still in the rectum, the practitioner can use the external thumb to

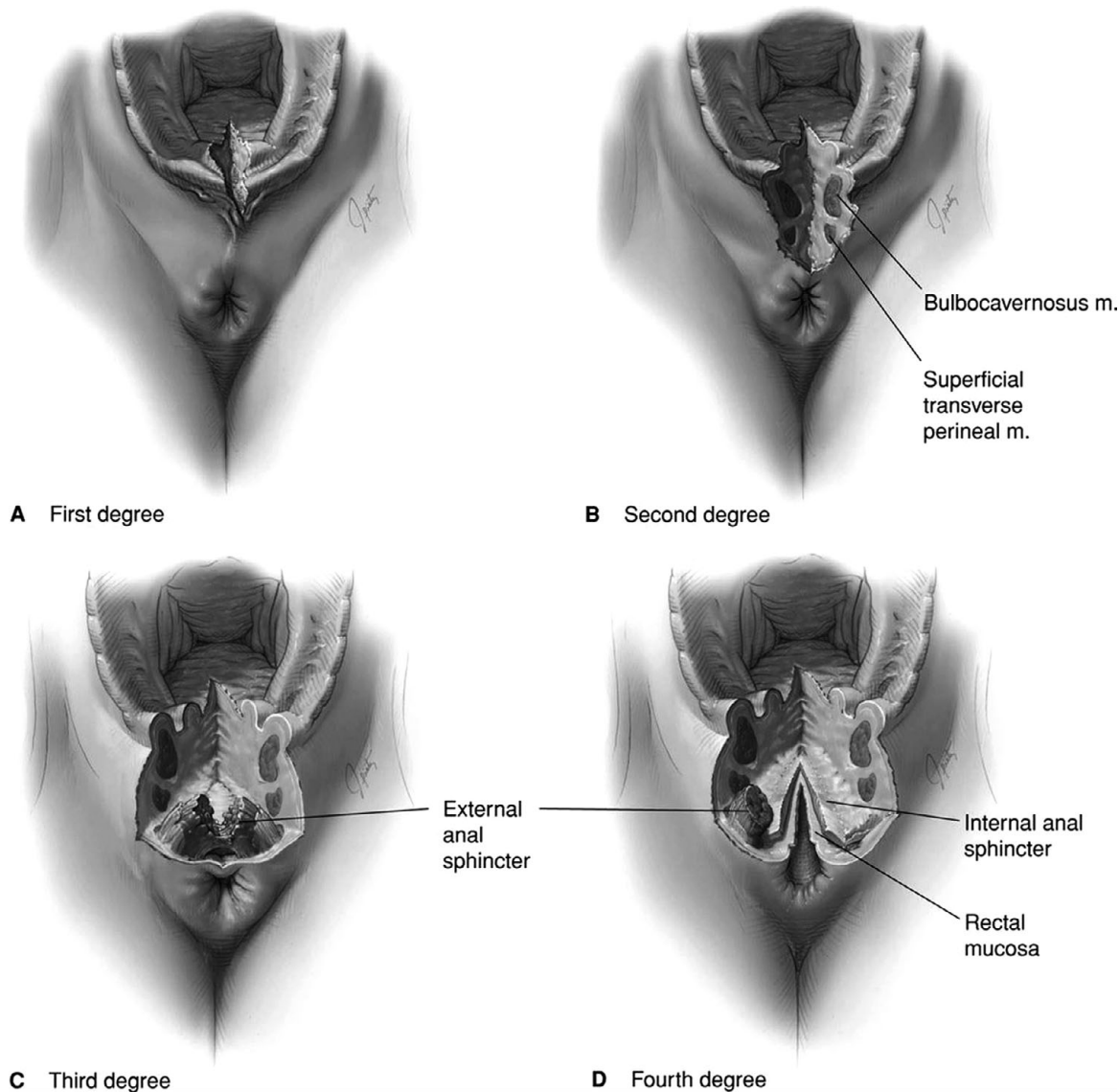


Figure 56.1 Varying degrees of perineal laceration with relevant anatomy. Reprinted with permission from Cunningham F, Leveno KJ, Bloom SL, et al. (eds). *Williams Obstetrics*, 24th ed. New York: McGraw Hill; 2014

palpate the tissue through the skin to assist in its identification. It is important to differentiate the generally thicker, round EAS from the transverse perineal muscle, which is thinner and found more superiorly in the perineum.

For a fourth-degree laceration, repair begins with the rectal mucosa. A rapidly absorbable monofilament suture (e.g. 4-0 poliglecaprone) should be used as it will glide through this delicate tissue easier than a braided suture. Additionally, the rectal mucosa will heal quickly, and a delayed or nonabsorbable suture should be avoided so it does not become a nidus for infection. The repair should be done in either a running, nonlocking manner or as simple interrupted stitches with care taken to suture the submucosa without including the mucosa itself [5]. Attention is then turned to the IAS, which is found in the last 3–4 cm of the canal. A fine suture (3-0 or 4-0) should be used for this portion of the repair with either polydioxanone or polyglactin suture. The IAS can be included

with a portion of the rectal muscularis layer to provide reinforcement for the previous layer [1].

Both ends of the EAS are grasped with Allis clamps to isolate and define the next tissue layer to be repaired. If one side of the EAS is retracted, undermining the skin with Metzenbaum scissors can be worthwhile to free some of the tension on the repair. However, care must be taken not to damage the muscle fibers or skin further and to also not dissect too much of the fascial sheath surrounding the muscle. Including this capsule around the muscle in the repair is essential to ensuring a good outcome. With the cylinders of the muscle ends isolated, an end-to-end anastomosis repair is started with a simple interrupted stitch of 2-0 polyglactin suture to bring the most dorsal aspect of the EAS together. The ends of this suture can be held together with a hemostat while the next stitch is placed in the most cranial aspect of the torn muscle. Then the second stitch is isolated with a hemostat

as well. It is crucial that these two areas are stitched before the rest of the muscle, otherwise, visualization of these areas will be compromised. The repair can be performed with the gloved index finger of the nondominant hand in the rectum. This will provide good visualization and help the surgeon avoid passing the suture through the anal canal. The needle can be repositioned in the needle driver with the still sterile middle finger and thumb of the nondominant hand.

At this point, the surgeon should assess the constitution of the repair. If satisfied with the reapproximation shown by putting gentle tension on the sutures, then it is advisable to tie these stitches. Tying of the sutures should be done either by an assistant or after changing gloves to avoid contamination of the operative field. Next, a simple interrupted suture is placed in the most ventral aspect of the EAS. Again, a hemostat is used to hold the suture ends afterward. Finally, the most caudal portion is sutured. These stitches are again checked by applying gentle traction. If satisfied, these sutures are tied, and the operative field is cleared so the repair can be reviewed. A final check can be made using the gloved index finger in the anal canal and the thumb exteriorly to palpate the repaired EAS in the midline and laterally through the skin to assess continuity and bulk of the repaired tissue. The remaining portions of the repair are performed similarly to a second-degree perineal laceration, taking care that dead space is closed in the remaining portions. Of note, the surgeon can use one or two simple interrupted sutures to reapproximate the skin close to the rectum to make the rest of the subcuticular repair easier and potentially avoid contamination of the needle being used for the more ventral portions of the repair.

With lacerations that include the entire EAS, there is an opportunity to perform an overlapping repair of the EAS instead of an end-to-end anastomosis. In a meta-analysis, the overlapping repair showed some advantages over the end-to-end anastomosis technique at 12 months [6]. However, at 36 months, no difference was found between the two methods regarding quality of life and rectal continence.

Postoperative care for the OASI repair is important in order to limit complications. There is a 4.2% incidence of wound infection and a 6.7% rate for wound dehiscence [7]. It is reasonable to give a one-time dose of a second-generation cephalosporin at the time of the repair. Further research is needed to confirm the benefit of antibiotic administration [1,8]. In the postoperative course, Sitz baths can be used to assist in pain control and hygiene for the affected area. Stool softeners and oral laxatives should be used to avoid constipation and unnecessary pressure exerted on the EAS during healing. Additionally, pelvic rest is advised. These recommendations are important so the wound has the best chance to heal properly. A second surgery on the anal sphincter complex is often difficult given the risk of further infection, scarred postoperative anatomy, and retracted pelvic musculature; referral to a subspecialist is likely needed. Finally, the recurrence rate for OASI is approximately 6%, similar to the rate for primary OASI [9]. While recurrence is low, patients who experienced difficulties from their previous severe perineal laceration (anal incontinence, wound infection, psychological trauma) could benefit from a primary CD rather than attempting another vaginal delivery [1].

Key Teaching Points

- A thorough exam of perineal lacerations in the immediate postpartum period is essential for the proper diagnosis and management of OASI.
- There is no difference in long-term complications regarding the use of an end-to-end anastomosis or overlapping technique to repair the EAS.
- It is reasonable to administer a single dose of a second-generation cephalosporin as antibiotic prophylaxis with third- and fourth-degree perineal lacerations.
- Proper postoperative care, including the avoidance of constipation, pelvic rest, good hygiene, and short-term follow-up visits, are key to avoiding complications.

References

- 1 Committee on Practice Bulletins-Obstetrics. ACOG Practice Bulletin No. 198: Prevention and Management of Obstetric Lacerations at Vaginal Delivery. *Obstet Gynecol.* 2018;132(3):e87–e102.
- 2 Yeomans E, Hoffman B, Gilstrap L, Cunningham G (eds.). *Cunningham and Gilstrap's Operative Obstetrics*, 3rd ed. New York: McGraw-Hill; 2017.
- 3 Groutz A, Hasson J, Wengier A, et al. Third- and Fourth-Degree Perineal Tears: Prevalence and Risk Factors in the Third Millennium. *Am J Obstet Gynecol.* 2011;204:347.e1–347.e4.
- 4 Royal College of Obstetricians and Gynaecologists. *The Management of Third- and Fourth-Degree Perineal Tears: Green-top Guideline No. 29*. London: Royal College of Obstetricians and Gynaecologists; 2015.
- 5 Hale R, Ling F. *Episiotomy: Procedure and Repair Techniques*, 1st ed. Washington, DC: American College of Obstetricians and Gynecologists; 2007.
- 6 Fernando RJ, Sultan AH, Kettle C, Thakar R. Methods of Repair for Obstetric Anal Sphincter Injury. *Cochrane Database Syst Rev.* 2013;(12):CD002866.
- 7 Okeahialam N, Wong K, Thakar R, et al. The Incidence of Wound Complications Following Primary Repair of Obstetric Anal Sphincter Injury: A Systematic Review and Meta-analysis. *Am J Obstet Gynecol.* 2022;227(2):182–191.
- 8 Buppasiri P, Lumbiganon P, Thinkhamrop J, Thinkhamrop B. Antibiotic Prophylaxis for Third- and Fourth-Degree Perineal Tear during Vaginal Birth. *Cochrane Database Syst Rev.* 2014;(10):CD005125.
- 9 Jha S, Parker V. Risk Factors for Recurrent Obstetric Anal Sphincter Injury (rOASI): A Systematic Review and Meta-analysis. *Int Urogynecol J.* 2016;27(6):849–857.

A 25-Year-Old at 39 Weeks' Gestation with Abdominal Pain, Vaginal Bleeding, and Worsening Fetal Heart Rate Tracing during TOLAC

Clodagh Mullen

History of Present Illness

A 25-year-old gravida 3 para 2 at 39 weeks' gestation presents with spontaneous rupture of membranes. The patient had a prior vaginal delivery followed by a term cesarean delivery (CD) for breech presentation. She desires a trial of labor after CD (TOLAC). Approximately 4 hours after admission, the fetal heart rate tracing is noted to have deep variable decelerations and then a prolonged deceleration. The patient has an epidural but is having breakthrough pain.

Physical Examination

General appearance: Uncomfortable

Vital signs:

Temperature: 37°C

Pulse: 120 beats per minute

Blood pressure: 90/60 mmHg

Respiratory rate: 20 breaths per minute

BMI: 31.0 kg/m²

Abdomen: Gravid, tender to palpation, guarding, and rebound

Pelvic: The cervix is 5 cm dilated, 90% effaced, at -3 station, with moderate bleeding

Fetal assessment: Fetal heart rate is 140 beats per minute, minimal variability, recurrent variable decelerations, and no accelerations

How Would You Manage This Patient?

The patient is noted to have abdominal pain that is partially controlled with neuraxial anesthesia, a sudden change in fetal status, and bleeding on examination. A uterine rupture is suspected, and the patient is immediately brought for an emergent CD. Anesthesia quickly prepares for general anesthesia. Although the patient is stable, blood products are ordered for the high risk of disseminated intravascular coagulation and consideration for the massive transfusion protocol if needed intraoperatively. The pediatric team is notified for resuscitation given the high risk of neonatal morbidity and mortality.

Intraoperatively, a uterine rupture is confirmed at the site of the previous low transverse incision with extension into the bladder and right broad ligament. The infant and placenta are found completely extruded into the abdomen. The neonatal team quickly work to correct the fetal acidemia. The bleeding

from the right broad ligament is able to be controlled, and the rest of the hysterotomy is repaired. Urology is consulted to repair the extensive bladder injury.

Risk Factors of Uterine Rupture

For patients with one or two prior CDs, the option of a TOLAC can be considered. The risk of uterine rupture leads to the most significant maternal and fetal morbidity and mortality, hence, the advantages of a TOLAC only occur with a successful vaginal birth. Additionally, repeat CD for a failed attempt at labor is associated with more risk than a scheduled repeat cesarean section. Therefore, the chance of success should be explored for the individual patient. Assessing the patient's indication for their prior cesarean section and likelihood of its recurrence can guide productive discussions. For example, a patient with a prior CD for fetal malpresentation is more likely to have success than a patient with a failed second stage. The Maternal-Fetal Medicine Units Network Vaginal Birth after Cesarean calculator [1] can provide a specific chance of success for the patient; however, it must all be taken in context of the patient's birthing goals and their overall fertility plans.

Outside of common contraindications for a vaginal birth (i.e. placenta previa, malpresentation), there are additional considerations for patients desiring a TOLAC. A patient with a prior uterine rupture or uterine dehiscence (incomplete uterine scar separation) should not undergo a TOLAC. Additionally, patients with uterine incisions that were not low transverse or low vertical have an increased risk of uterine rupture and repeat CD is recommended. The rate of uterine rupture was 10.6% in a study of 1,785 patients with prior classical incisions that experienced labor [2].

The risk of uterine rupture after a prior myomectomy is related to the extent of the myometrial and endometrial defect created during the surgical resection. A recommendation for the future route of delivery should be commented on in the operative report. Entry into the endometrial canal or extensive disruption of the myometrium should lead to recommending a planned CD with subsequent pregnancies. There are also rare cases of spontaneous uterine rupture without a prior scar that occur in approximately 1 in 22,000 labors [3]. Rupture is increased in trauma cases and patients with Ehlers Danlos type IV.

There are additional risk factors that inconsistently increase the risk of uterine rupture. These include advanced

Table 57.1 Risk factors for uterine rupture [4,5]

	Risk of rupture with TOLAC	Evidence/recommendations
TOLAC: Contraindicated		
1. Prior uterine rupture	6–32%	Deliver at 36–37 weeks
2. Uterine dehiscence (incomplete uterine scar separation)	Potentially 6–32%	Deliver at 37–39 weeks
3. Prior classical, “T”, or “J” incision	10.6%	Deliver 36–37 weeks
TOLAC: Relatively contraindicated		
1 Myomectomy (dependent on scar location and depth)	0.6% in appropriate candidates	Individualized delivery planning and route of delivery
Possible increased risk of rupture		
1. Short delivery interval (<6–24 months)	2–3% uterine rupture	Individualized delivery planning
2. Second-trimester cesarean section	1.8% uterine rupture	Individualized delivery planning
3. Lower uterine segment thickness <2.3 mm	Limited data	Individualized delivery planning
4. Two prior low transverse CD	0.9–1.46% uterine rupture	Individualized delivery planning

maternal age, a fetus of >4,000 g, >40 weeks' gestation, short delivery interval (<24 months), a single layer hysterotomy closure, and a previous second-trimester CD [4]. While a delivery interval of <24 months has been identified as a risk factor [4], expert opinion favors shorter intervals, such as <6 months, as being an even greater risk for uterine rupture. There is an increased risk of uterine rupture with more than one prior CD; however, the increase from one cesarean section (0.72%) to two (1.59%) is generally considered an acceptable margin to still consider a TOLAC [4].

The overall rate of uterine rupture is between 0.4 and 1.1%. The varying factors that increase the risk of a uterine rupture can be seen in Table 57.1 and can help inform clinical decision-making, recommendations regarding TOLAC, and timing of a repeat CD. Induction and augmentation during a TOLAC with oxytocin are acceptable, but may increase the risk of rupture by two- to three-fold [4]. Misoprostol increases the risk of rupture by 5–10% and is thus not recommended in patients with a prior uterine scar [4].

Antenatal Ultrasound Screening to Predict Uterine Rupture

Research into ways to evaluate for elevated risk of rupture have focused on antepartum measurement of the lower uterine segment. A multicenter randomized trial counseled patients regarding a repeat cesarean section versus TOLAC based on the lower uterine segment thickness. The control group did not undergo antepartum evaluation of the lower uterine segment. The composite risk outcome was similar between groups. There was a nonsignificantly decreased rate of uterine rupture in those with a lower uterine segment thickness of >3.5 mm compared to those with the thickness of ≤3.5 mm (0.4 vs. 0.9%), but the study was not powered for this outcome [5]. As the results were nonsignificant, routine use of antenatal lower uterine segment thickness is not recommended at this time. However, if during imaging the thickness is found to be <2 mm, expert opinion would suggest considering a scheduled CD, given a higher association with uterine rupture.

Recognition of Uterine Rupture

There are multiple intrapartum signs of uterine rupture. The intrapartum diagnosis of a uterine rupture is typically accompanied by a sudden change in the fetal heart rate pattern or abdominal pain. There is no pathognomonic tracing abnormality associated with uterine rupture; however, the most common is a fetal bradycardia that may have been preceded by significant variable decelerations [4,6]. Continuous fetal monitoring in a patient undergoing a TOLAC may help in the swift diagnosis of a uterine rupture. The contraction pattern is often impacted by a uterine rupture and may lead to uterine atony or increased contractility [6]. Some uterine ruptures are associated with the “staircase sign,” which is a gradual decrease in the amplitude of consecutive contractions.

Abdominal pain in the patient may be masked by neuraxial analgesia; however, if a patient is requesting additional or frequent dosing, they should be assessed for uterine rupture. Additional findings that can occur in a uterine rupture include vaginal bleeding, loss of fetal station, hematuria, and maternal hemodynamic instability [6].

Response and Outcomes of Uterine Rupture

When a uterine rupture is diagnosed, there are a number of considerations while proceeding toward emergent CD. Quickly contacting anesthesia for assistance, while providing guidance regarding the urgency of adequate anesthesia, is important. If the maternal and fetal status is stable, regional anesthesia may be an option. Typically, general anesthesia will be needed to facilitate delivery. If the patient is hemodynamically unstable, immediate attention to fluid resuscitation and blood transfusion should be initiated. The amount of bleeding in a uterine rupture can quickly result in disseminated intravascular coagulation and thus initiating the massive transfusion protocol may be necessary. Lastly, a team capable of neonatal resuscitation should be present at delivery given the high risk of neonatal morbidity and mortality in these cases.

The morbidity and mortality for both the patient and fetus are increased in cases of uterine rupture. The overall maternal mortality rate for uterine ruptures is approximately 1 death

per 500 uterine ruptures based on a report of 1,879 cases of uterine rupture in Canada [7]. Additionally, patients have higher morbidity from uterine rupture including blood transfusion and hysterectomy, with 14–33% of patients undergo hysterectomy at the time of uterine rupture [4].

The risk to the fetus is elevated and is directly related to placental separation and/or fetal extrusion. The overall risk of neonatal demise in uterine rupture ranges from 5 to 26% [4]. An incidence of neonatal hypoxic-ischemic encephalopathy of 6%, of which 28% subsequently died, has been reported [8]. The differences in outcomes for the fetus may be related to the prompt recognition of uterine rupture and ability to undergo emergency CD. Two studies have shown that taking longer than 18 minutes from recognition of fetal heart rate abnormalities to delivery is associated with increased neonatal morbidity [9]. This further supports TOLAC in hospitals capable of emergent delivery and worse outcomes in planned home births including low Apgars, neonatal seizures, and neonatal death [4].

Follow-up after a Uterine Rupture and Subsequent Pregnancies

In a subsequent pregnancy after a uterine rupture, patients are recommended to undergo a repeat CD given the 6–32% risk

of recurrence. The goal is to deliver prior to labor and thus earlier delivery may need to be individualized, but is recommended by 36.0–37.0 weeks. With a prior uterine dehiscence without rupture, the recommendation is to deliver between 37.0 and 39.0 weeks' gestation based on expert opinion (see Table 57.1). Uterine rupture is an uncommon obstetrical complication that requires emergent intervention. Appropriately screened patients should be encouraged to undergo TOLAC in environments that can respond to uterine rupture.

Key Teaching Points

- Patients undergoing a TOLAC should be promptly assessed for sudden changes in their fetal heart rate tracing to evaluate for a possible uterine rupture.
- If a uterine rupture is diagnosed, urgent delivery should be undertaken by the obstetrician while coordinating with anesthesia, pediatrics, and the blood bank.
- Depending on the size and location of the uterine rupture, primary repair may be feasible, but a more complex repair may be required if the rupture extends into the broad ligament or involves surrounding viscera.

References

- 1 The Maternal-Fetal Medicine Units Network Vaginal Birth after Cesarean Calculator. <https://mfmunetwork.bsc.gwu.edu/web/mfmunetwork/vaginal-birth-after-cesarean-calculator> (accessed November 12, 2023).
- 2 Thompson BB, Reddy UM, Burn M, et al. Maternal Outcomes in Pregnancies after Classical Cesarean Delivery. *Obstet Gynecol.* 2022;140:212.
- 3 Gibbins KJ, Weber T, Holmgren CM, et al. Maternal and Fetal Morbidity Associated with Uterine Rupture of the Unscarred Uterus. *Am J Obstet Gynecol.* 2015;213:382.e1.
- 4 ACOG Practice Bulletin No. 205: Vaginal Birth after Cesarean Delivery. *Obstet Gynecol.* 2019;133(2):e110–e127.
- 5 Rozenberg P, Sénat MV, Deruelle P, et al.; Groupe de Recherche en Obstétrique et Gynécologie. Evaluation of the Usefulness of Ultrasound Measurement of the Lower Uterine Segment before Delivery of Women with a Prior Cesarean Delivery: A Randomized Trial. *Am J Obstet Gynecol.* 2022;226(2):253.e1–253.e9.
- 6 Craver Pryor E, Mertz HL, Beaver BW, et al. Intrapartum Predictors of Uterine Rupture. *Am J Perinatol.* 2007;24:317.
- 7 Wen SW, Huang L, Liston R, et al. Severe Maternal Morbidity in Canada, 1991–2001. *CMAJ.* 2005;173:759.
- 8 Bujold E, Gauthier RJ. Neonatal Morbidity Associated with Uterine Rupture: What Are the Risk Factors? *Am J Obstet Gynecol.* 2002;186:311.
- 9 Holmgren C, Scott JR, Porter TF, et al. Uterine Rupture with Attempted Vaginal Birth after Cesarean Delivery: Decision-to-Delivery Time and Neonatal Outcome. *Obstet Gynecol.* 2012;119:725.

CASE 58

A 40-Year-Old at 39 Weeks' Gestation Becomes Unresponsive during the Second Stage of Labor

Sarah M. Page-Ramsey

History of Present Illness

A 40-year-old gravida 6 para 5 at 39 weeks' gestation is admitted in active labor. Her obstetrical history is notable for five uncomplicated term vaginal deliveries. She has more dyspnea on exertion and lower extremity swelling than in her prior pregnancies, but otherwise her pregnancy has been routine. Her vital signs show a heart rate of 118 beats per minute but is otherwise normal. Continuous external fetal monitoring is initiated, and an epidural catheter is placed. The patient progresses to the second stage and begins pushing. She suddenly complains of acute chest pain radiating into her jaw, and rapidly becomes unresponsive with no pulse. The nurse alerts a "Code Blue."

Physical Examination

General appearance: Unresponsive

Vital signs:

Pulse: No carotid pulse

Cardiopulmonary: No respirations

Abdomen: Gravid. Fundal height of 40 cm

Extremities: No pulses palpable with 2+ pitting edema of lower extremities to the mild calf

Pelvic: 10/100%/+2, vertex presentation, left occiput anterior position

Fetal assessment: Fetal heart rate is 110 beats per minute

How Would You Manage This Patient?

This patient experiences acute cardiac arrest and needs immediate intervention of basic life support (Figure 58.1). A chest compression board is placed under her back, and uterine displacement performed as chest compressions and respirations are initiated. External fetal Doppler and tocometer are removed. Obstetric forceps are placed, and the fetus is delivered with a heart rate of 80 beats per minute. Neonatal resuscitation is initiated by the pediatric support team. The patient is quickly transitioned into supine positioning with lateral uterine displacement as chest compressions and respirations are continued. A "crash cart" is brought to the bedside, and automated external defibrillator pads are placed. Asystole is confirmed and epinephrine administered. After 2 minutes of cardiopulmonary

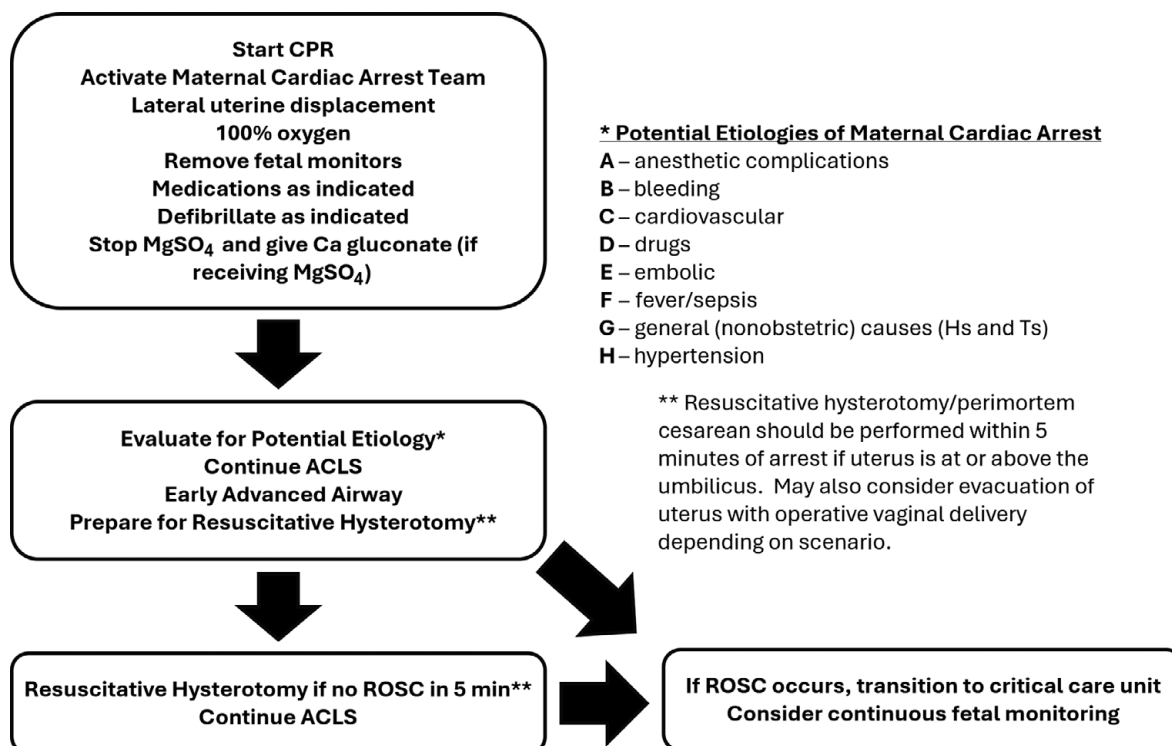


Figure 58.1 Algorithm for advanced cardiac life support in pregnancy. Adapted from American Heart Association "Cardiac Arrest in Pregnancy In-Hospital ACLS" Algorithm, 2020

resuscitation (CPR), the patient experiences return of spontaneous circulation (ROSC). The patient is intubated. The placenta is removed from the vagina. Bimanual uterine massage is performed while oxytocin is infused. Blood pressure support is provided while she is transported in left lateral decubitus positioning to the intensive care unit.

Cardiac Arrest in Pregnancy

Maternal cardiac arrest is a rare event, occurring in 1 per 12,000 deliveries. It is unique in that there are two patients involved and interventions impact outcomes for both. The best maternal and neonatal outcomes occur when prompt recognition and intervention is directed toward maternal resuscitation [1]. In a series of >400 patients with maternal cardiac arrest, survival rates are better in patients with maternal in-hospital cardiac arrest compared to nonmaternal, with a survival rate of 45% and ROSC in 75%. Intact neurologic survival in maternal cardiac arrest is also more favorable [2]. Understanding the maternal physiologic changes, unique aspects of resuscitation in pregnancy, and development of teams prepared to respond appropriately is of vital importance in achieving good outcomes.

Physiologic Changes

During pregnancy, cardiac output is increased up to 50% due to increased stroke volume and heart rate. Systemic vascular resistance decreases because of peripheral vasodilation. The enlarged uterus compresses the aorta and vena cava, leading to increased afterload and reduced cardiac return, most notably in the supine position. Uteroplacental blood flow increases throughout pregnancy and peaks at 20% of the cardiac output by term. The normal compensatory mechanisms for systemic hypotension may be blunted in pregnancy [3].

Pulmonary changes are also important. Functional residual lung capacity decreases by 25% from diaphragmatic elevation. Ventilation increases 40% above baseline by term. Oxygen consumption increases. These respiratory changes can lead to more rapid development of hypoxemia in response to hypoventilation or apnea. A higher partial pressure of oxygen is therefore needed. Airway management may also prove more difficult in pregnant patients due to edema, increased vascularity, and friability from hormonal changes. Furthermore, progesterone leads to relaxation of the gastroesophageal sphincter and slows gastric emptying, increasing the risk for aspiration [3].

In addition to an experienced “code team,” obstetricians, pediatricians, and anesthesiologists with experience in obstetrics should be involved in the patient’s care. Resuscitation efforts are largely similar to the nonpregnant patient, including high-quality chest compressions to a depth of 2 inches and a rate of 100–120 beats per minute. Compressions to respirations are administered at a 30:2 ratio. Defibrillation and medications should be administered as indicated without delay nor change in dosing, including administration of thrombolytics when indicated. The previous practice of placing hands higher on the sternum to administer compressions was removed in the most recent American Heart Association (AHA) guidelines [1].

Unique features in maternal cardiac arrest resuscitation include leftward uterine displacement, resuscitative hysterotomy or evacuation of the uterus in the first 5 minutes, and earlier advanced airway intervention. In the supine position, the gravid uterus compresses the inferior vena cava, impeding venous return and reducing cardiac output. Manual uterine displacement improves venous return, optimizes cardiac output and maternal resuscitation efforts, and is recommended whenever the uterus is at the level of the umbilicus or higher [1]. The AHA recommends against fetal assessment during CPR because it does not improve maternal status and may impede resuscitation efforts. As such, fetal monitors should be removed, and fetal ultrasound is not indicated [1,3,4].

If the uterus is at or above the umbilicus, prompt evacuation of the uterus in the first 5 minutes of ongoing cardiac arrest resuscitation helps to relieve aortocaval compression and improves the likelihood of ROSC [1,3]. In the case of a completely dilated cervix and appropriate fetal station, as in this case, assisted vaginal delivery is an appropriate route for timely evacuation of the uterus, provided it does not interfere with maternal resuscitation [3]. In this unique situation, operative vaginal delivery (OVD) should be considered as a rapid, effective means to evacuate the uterus, while also optimizing neonatal survival [5]. Because the patient is already in lithotomy positioning, this can be facilitated quickly. Chest compressions and respirations should not be delayed.

In cases where assisted vaginal delivery is not possible, resuscitation efforts should be directed to maternal benefit rather than neonatal, as ROSC may occur without evacuation of the uterus. Resuscitative hysterotomy, also called perimortem CD (PMCD) and performed when the uterus is at least 20 weeks’ size, improves outcomes in maternal cardiac arrest in cases where ROSC does not occur immediately. Therefore, resuscitative hysterotomy is recommended within the first 5 minutes of cardiac arrest treatment or immediately if resuscitation is not expected to be successful [1,3]. Additional details on resuscitative hysterotomy can be found in Case 59. In this case, timing of placental delivery should also be considered. If the placenta remains adherent after delivery of the neonate, the focus should be on continued maternal resuscitation. However, upon ROSC, the patient will begin perfusing the uterus, with significant risk for hemorrhage. Hence, as soon as safely possible, the third stage of labor should be managed.

If ROSC occurs without resuscitative hysterotomy, the patient should be placed in full left lateral decubitus position or manual uterine displacement continued, transferred to an intensive care setting, and an advanced airway secured. Principles of post-resuscitation care include hemodynamic support, mechanical ventilation, temperature management, and diagnosis/treatment of the underlying etiology. Patients have a high mortality rate even after ROSC, particularly when neurologic impairment eventually prompts withdrawal of support. In cases of maternal cardiac arrest with ROSC not requiring uterine evacuation, the fetus is also at significant risk from maternal hypothermia, acidosis, hypoxemia, and hypotension, all of which frequently occur in the post-resuscitation period [1]. Consideration of fetal well-being, and potential intervention

on behalf of fetus must be balanced with the care of the maternal patient. Continuous fetal monitoring should be considered as a decline in fetal status may be an indicator of worsening maternal status [1]. Therapeutic hypothermia has been shown to improve neurologic outcomes following cardiac arrest in nonpregnant patients, and may be considered in pregnant patients. Because the impact on the fetus is not known, continuous fetal monitoring is encouraged [4].

Identification of the underlying cause of cardiac arrest is essential. In the pregnant patient, the differential diagnosis should be expanded to include anesthetic complications, bleeding, cardiovascular disease, drugs, embolism, sepsis, general nonobstetric causes, and hypertensive etiologies [1,3]. In developed countries, the most common causes include venous thromboembolism and hypertensive disorders. Hemorrhage, sepsis, and maternal acquired heart disease are also potential underlying causes [4,6]. The most common etiologies for maternal acquired heart disease during pregnancy include myocardial infarction, heart failure, arrhythmia, or dissection. In the obstetric patient, spontaneous coronary artery dissection (SCAD) must be considered, and is further discussed in Case 59. Because some symptoms of heart disease may be similar to physiologic changes in pregnancy, symptoms may be overlooked. Up to 28% of cardiac-related maternal deaths are preventable. Non-Hispanic Black pregnant patients are three-times more likely to die from cardiac causes than their non-Hispanic white counterparts. Patients over 40 years old are 30-times more likely to experience cardiovascular-related death compared to patients under 20. In pregnant patients with hypertension, the risk of myocardial infarction is increased 13-fold, and heart failure eightfold compared to normotensive patients. Obesity is another significant risk factor, particularly if sleep apnea is present [6]. In this case, the patient reported increased dyspnea during exertion and lower extremity edema, and arrived with a baseline heart rate of 118 beats per minute. These changes were likely attributed to pregnancy and labor alone, however, they may have heralded an underlying cardiac condition that predisposed her to cardiac arrest. Early recognition of warning signs and use of a cardiovascular disease

assessment tool is recommended to help prevent cardiovascular death in pregnancy [6].

Long-term sequelae requiring emotional and mental health support should be considered. The impact on the health care team is also important, and team debriefings can help facilitate open discussions [1]. The recommendation of ACOG is to develop emergency response teams, including the incorporation of support staff, with regular training to prepare for emergency obstetric events. Periodic drills help establish, modify, and gain awareness of standard protocols and processes, and improve response during emergencies. Furthermore, they identify systematic issues that require revision [7]. All health care team members caring for pregnant patients should be aware of the most recent AHA guidelines for management of cardiac arrest in pregnancy [1]. Potential resources for continuing education in maternal cardiac arrest include AHA: Advanced Life Support Maternal Cardiac Arrest Module and Obstetric Life Support Manual [8,9]. Courses for further education include the SMFM's "Critical Care in Obstetrics" and the ACOG's "Emergencies in Clinical Obstetrics."

Key Teaching Points

- Cardiac arrest in pregnancy is largely managed like the nonpregnant patient. Chest compressions, ventilations, medications, and defibrillation should be administered as indicated with a focus on maternal resuscitation.
- Unique features of maternal cardiac arrest management include continuous lateral uterine displacement, evacuation of the uterus within 5 minutes when the uterine size is at or beyond the umbilicus, and early advanced airway attempts.
- Fetal monitoring is not recommended during resuscitation.
- Early recognition of cardiac risk factors and formal cardiovascular disease assessment is recommended to reduce the chance of cardiovascular related maternal cardiac arrest.
- Post-resuscitation care should occur in a critical care unit with a multidisciplinary approach.

References

- 1 Panchal AR, Bartos JA, Cabanas JG et al. Part 3: Adult Basic and Advanced Life Support: 2020 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. *Circulation*. 2020;142(16 Suppl. 2): S366–S468.
- 2 Thomas M, Hejjaji V, Tang Y, et al. Survival Outcomes and Resuscitation Process Measures in Maternal In-hospital Cardiac Arrest. *Am J Obstet Gynecol*. 2022;226:401.e1–401.e10.
- 3 Jeejeebhoy FM, Zelop CM, Lipman S, et al. Cardiac Arrest in Pregnancy: A Scientific Statement from the American Heart Association. *Circulation*. 2015;132:1747–1773.
- 4 Kikuchi J, Deering S. Cardiac Arrest in Pregnancy. *Semin Perinatol*. 2018;42:33–38.
- 5 Einav S, Kaufman N, Sela HY. Maternal Cardiac Arrest and Perimortem Caesarean Delivery: Evidence or Expert-Based? *Resuscitation*. 2012;83:1191–1200.
- 6 ACOG Practice Bulletin 212: Pregnancy and Heart Disease. *Obstet Gynecol*. 2019;133:e320–e56.
- 7 Committee Opinion No. 590: Preparing for Clinical Emergencies in Obstetrics and Gynecology. *Obstet Gynecol*. 2014;123(3): 722–725.
- 8 American Heart Association Advanced Life Support (ALS): Maternal Cardiac Arrest Module. <https://shopcpr.heart.org/als-maternal-cardiac-arrest-module> (accessed July 1, 2023).
- 9 Shields A, Vidosh J, Kavanagh L, Nielsen P, Thomson B. *Obstetric Life Support Manual*. Boca Raton, FL: CRC Press; 2024.

A 45-Year-Old at 39 Weeks' Gestation Presents in Ventricular Fibrillation Undergoing CPR

Jody Stonehocker

History of Present Illness

A 45-year-old gravida 5 para 4 patient at 39 weeks' gestation presents to the Emergency Department (ED) via ambulance in ventricular fibrillation. She had been in her usual state of health until 2 hours prior to arrival when she began to experience substernal chest pain, diaphoresis, and nausea. Fifteen minutes prior to arrival she experienced loss of consciousness and her partner called Emergency Medical Services and began CPR. Her obstetrical history includes four prior vaginal deliveries, with her last delivery complicated by preeclampsia without severe features. Her past medical history is significant for type II diabetes, which has been well-controlled during pregnancy, and obesity. She is taking insulin, low-dose aspirin, and prenatal vitamins. She has no prior surgeries and has never smoked tobacco.

Physical Examination

General appearance: Well-developed female currently unconscious, lying supine on stretcher, undergoing CPR

Vital signs:

Temperature: 37.0°C

Pulse: 170 beats per minute

Blood pressure: 58/30 mmHg

Respiratory rate: 30 breaths per minute via bag-mask ventilation

Oxygen saturation: 72% on 100% oxygen

BMI: 40 kg/m²

EKG rhythm: Ventricular fibrillation

Cardiopulmonary: Lungs with no rales or rhonchi; peripheral pulses are not appreciated

Abdomen: Obese with term gravid uterus

Fetal assessment: Fetal heart rate of 140 beats per minute via external Doppler upon arrival to hospital

How Would You Manage This Patient?

A multidisciplinary team is needed to care for this patient including the ED physicians, critical care team, neonatal intensive care resuscitation team, and the obstetrics team. It is imperative that the obstetrician help guide the team as they may not have familiarity with resuscitation of the gravid patient [1]. Preparation for a perimortem cesarean delivery (PMCD) is begun immediately. While gathering the necessary supplies, CPR is continued. The patient should be lying supine on a hard surface with left uterine displacement (Figure 59.1). Advanced cardiac life support (ACLS) guidelines are followed to administer standard medications and defibrillation sequence, but do not result in return of spontaneous circulation (ROSC). At the conclusion of two standard ACLS cycles, a PMCD is performed in the ED via a midline vertical skin incision and a low transverse uterine incision, now 20 minutes since the time of the patient's cardiovascular collapse. A live, female infant is delivered with Apgar scores of 1 at 1 minute and 6 at 5 minutes. Cardiopulmonary resuscitation is continued throughout the delivery. Emptying the uterus does not provide ROSC. The uterus and abdomen are quickly closed while CPR is continued without success. The critical care team concludes the code and the patient is declared dead.



Figure 59.1 Left uterine displacement from the patient's right and left side

Maternal Cardiac Arrest Resulting in Maternal Death

Cardiovascular disease is the leading cause of death in pregnancy and the postpartum period, accounting for 25.6% of all US pregnancy-related deaths [2]. Most morbidity and mortality occur from acquired heart disease including heart failure, myocardial infarction, arrhythmia, or aortic dissection. Risk factors for mortality from maternal cardiovascular disease include pre-pregnancy obesity (especially if associated with obstructive sleep apnea), age >40 years, hypertension, and race and ethnicity. The most common cause of myocardial infarction in pregnancy is spontaneous coronary artery dissection (SCAD), which may affect individuals with no risk factor other than age. Non-Hispanic Black women have a 3.4-times higher risk of dying from cardiovascular disease-related pregnancy complications compared with non-Hispanic White women independent of other variables [2]. This disparity represents the effects of racism, including institutional and systemic barriers to appropriate care prior to pregnancy, during pregnancy and in the postpartum period. Cardiac arrest occurs in 1:12,000 admissions for delivery in the United States and, globally, is the cause of 800 maternal deaths every day. Despite the rarity of cardiac arrest in pregnancy, the rate of survival to hospital discharge after maternal cardiac arrest may be as high as 58.9%, far higher than most arrest populations.

As soon as maternal cardiac arrest occurs, ACLS should be administered. The patient should be placed on a hard backboard in the supine position to facilitate successful chest compressions [3,4,5]. Traditionally, ACLS teams were instructed to perform chest compressions at a 30° tilt to avoid aortocaval compression from the gravid uterus. Yet, this position reduces the quality and effectiveness of chest compressions and current recommendations advocate manual left uterine displacement or pushing/pulling the uterus slightly anteriorly and to the left. If downward force is inadvertently applied, inferior vena cava compression may worsen [3,4,6]. Left uterine displacement can be accomplished with one or two hands from either side of the patient but may be optimal from the patient's left (Figure 59.1). Cardiac arrest in pregnancy is otherwise treated with the same ratio of chest compressions to breaths, respiratory support, drugs, and defibrillation as for any adult in cardiac arrest.

This patient presented in ventricular fibrillation, which is a shockable rhythm, unlike pulseless electrical activity or asystole. According to standard ACLS protocols, a patient should be defibrillated every 2 minutes, and CPR providers should rotate every 2 minutes to ensure continued quality chest compressions. If at the end of two defibrillation cycles, the pregnant patient has not had ROSC, consideration should be given to emptying the uterus, if at or above the level of the umbilicus, to reduce aortocaval compression and increase the effectiveness of CPR [1]. This timing was used to establish the 4–5-minute rule of the PMCD in 1986, which suggests that CD should be initiated 4 minutes after maternal cardiopulmonary collapse (if no response to standard resuscitation) and completed by 5 minutes [7]. The current AHA guidelines

suggest delivery by 5 minutes following cardiovascular collapse *and* by 5 minutes of unsuccessful resuscitative efforts. These two statements may create confusion because, as in the case of the patient described, there is often a delay between the cardiac event and the onset of resuscitative measures. A team is not required to wait 4 minutes prior to performing PMCD, and in some cases, an earlier delivery may be indicated [4,6].

Achieving delivery within 5 minutes of cardiovascular collapse is technically challenging, given the multiple teams assembled and necessary tasks in a maternal code. As such, it is imperative that the obstetrics team begin planning for PMCD immediately upon cardiovascular collapse or responding to a maternal code. The team should gather necessary supplies (scalpel, instruments, suture and cord clamps) and maintain clear communication with the code leader. The NICU team should be present for resuscitation of the neonate. The patient should not be transported to the operating room, and PMCD should be performed at the site of the code. Checking for fetal heart tones is unnecessary and will delay the PMCD. Even if fetal heart tones are no longer present, there may be maternal benefit from delivery [2,4]. Time does not allow a standard surgical skin preparation, but a “splash” with antiseptic solution can be performed if available. Originally, PMCD was described through a midline vertical skin incision, as this is generally thought to be a faster abdominal entry and may allow further abdominal exploration, especially in trauma-related cardiac arrest. However, successful cases of PMCD have been described using the Pfannenstiel skin incision, and the surgeon should use the approach with which they feel most comfortable [4]. Uterine incision should be based upon standard obstetric decision-making. The placenta should be delivered. The surgical incisions will not bleed significantly while the patient is undergoing CPR, but if ROSC occurs, hemostasis will be needed, so closing the uterus and abdomen should be considered. Cardiopulmonary resuscitation should not be interrupted for the PMCD and left uterine displacement should be practiced until delivery of the fetus is accomplished [4]. If maternal resuscitation is successful, consideration should be given to broad spectrum antibiotics during surgical recovery.

Nearly 20 years following the initial recommendations of the 4–5-minute rule, a case series of 38 PMCDs was published, showing only 8 of 38 cases were performed within the recommended 4–5 minute window. Seventeen infants were born without sequelae, and four of these infants, who were 30–38 weeks' gestation, were born more than 15 minutes after the onset of maternal cardiac arrest. Fifty-five percent of the cases showed substantial improvement in maternal hemodynamic status following PMCD [8]. Survival curves have shown 50% injury-free maternal and neonatal survival with PMCD as late as 25 minutes from cardiac arrest, so PMCD should always be considered even outside the ideal 4-to-5-minute window [2].

When the term “perimortem cesarean delivery” was first developed in 1986, it emphasized the importance of the fetus. Intervention was focused on quick delivery for a viable neonate, prioritizing fetal status possibly at the expense of maternal status. In the intervening years, we have gained further

knowledge about the maternal benefits of PMCD and a new name – resuscitative hysterotomy – has been proposed [9]. This term would shift our thinking to consider both patients – mother and fetus – in parallel. It would emphasize that gestational age does not need to be known at the time of PMCD, because maternal benefit is experienced even when a nonviable fetus is delivered if causing aortocaval compression (uterus at or above the umbilicus). It would also remind providers that heart tones should not be verified prior to proceeding with PMCD. While both terms are now seen in the obstetric literature, PMCD is used in major society guidelines [4,6]. This term may provide the clearest communication for multidisciplinary teams participating in the maternal code who may not understand that resuscitative hysterotomy refers to an impending delivery. While language is important, PMCD is still the prevailing term used to prevent delays in care during these rare events.

Maternal cardiac arrest is a rare event that requires multidisciplinary coordination between care providers.

Coordination for such infrequent and complex responses relies upon preparation and clear communication. As such, multidisciplinary maternal cardiac drills are important components of preparedness [4,6].

Key Teaching Points

- While maternal cardiac arrest is a rare event, it is increasing in frequency and disproportionately affects non-Hispanic Black women.
- During a maternal code, ACLS should be performed supine with left uterine displacement.
- Perimortem CD should be considered if the uterus is at or above the umbilicus, causing aortocaval compression.
- While completing PMCD in the 4-to-5-minute window provides the best maternal and fetal outcomes, completion well beyond the ideal timeframe may also provide benefit.

References

- 1 ACOG Practice Bulletin No. 211: Critical Care in Pregnancy. *Obstet Gynecol.* 2019;133(5):e303–e319.
- 2 ACOG Practice Bulletin No. 212: Pregnancy and Heart Disease. *Obstet Gynecol.* 2019;133(5):e320–e356.
- 3 Jeejeebhoy FM, Zelop CM, Windrim R, et al. Management of Cardiac Arrest in Pregnancy: A Systematic Review. *Resuscitation.* 2011;82(7):801–809.
- 4 Jeejeebhoy FM, Zelop CM, Lipman S, et al.; American Heart Association Emergency Cardiovascular Care Committee, Council on Cardiopulmonary, Critical Care, Perioperative and Resuscitation, Council on Cardiovascular Diseases in the Young, and Council on Clinical Cardiology. Cardiac Arrest in Pregnancy: A Scientific Statement From the American Heart Association. *Circulation.* 2015;132(18):1747–1773.
- 5 Enomoto N, Yamashita T, Furuta M, et al.; Japan Resuscitation Council Maternal task Force. Effect of Maternal Positioning during Cardiopulmonary Resuscitation: A Systematic Review and Meta-analyses. *BMC Pregnancy Childbirth.* 2022;22(1):159.
- 6 Lipman S, Cohen S, Einav S, et al. The Society for Obstetric Anesthesia and Perinatology Consensus Statement on the Management of Cardiac Arrest in Pregnancy. *Anesth Analg.* 2014;118(5):1003–1016.
- 7 Katz VL, Dotters DJ, Droegemueller W. Perimortem Cesarean Delivery. *Obstet Gynecol.* 1986;68(4):571–576.
- 8 Katz V, Balderston K, DeFreest M. Perimortem Cesarean Delivery: Were Our Assumptions Correct? *Am J Obstet Gynecol.* 2005;192(6):1916–1920; discussion 1920–1921.
- 9 Rose CH, Faksh A, Traynor KD, et al. Challenging the 4- to 5-Minute Rule: From Perimortem Cesarean to Resuscitative Hysterotomy. *Am J Obstet Gynecol.* 2015;213(5):653–656, 653.e1.

A 35-Year-Old with a Vaginal Mass and Hemorrhage Immediately after Delivery

Rebecca Hunt

History of Present Illness

A 35-year-old gravida 5 para 4 patient with otherwise uncomplicated pregnancy presents in spontaneous labor. Her previous pregnancies were uncomplicated spontaneous vaginal deliveries (SVDs). The cervical exam is 5 cm dilated, 80% effaced, and 0 station. She requests an epidural, which is placed without difficulty and provides good pain control. After 2 hours, she is fully dilated, and complains of pressure and urge to push. Thirty minutes after she begins pushing, she delivers a liveborn neonate.

After 1 minute of delayed cord clamping, oxytocin 20 units in 1,000 mL is administered. The umbilical cord is gently pulled with the clinician's other hand at the fundus. As the placenta descends through the vaginal canal, there is a palpable depression at the fundus. The placenta delivers and is noted to be intact with a normal three-vessel cord and central cord attachment. Simultaneously, a pale mass is noted at the introitus, along with brisk bleeding. Uterine inversion is recognized.

Physical Examination

General appearance: Uncomfortable, pale, anxious

Vital signs:

Temperature: 37.0°C

Pulse: 110 beats per minute

Blood pressure: 110/60 mmHg

Respiratory rate: 12 breaths per minute

BMI: 26.1 kg/m²

Abdomen: Tender, fundus not palpable

Pelvic: There is a pale mass at the introitus. Bleeding is brisk, and the initial quantified blood loss is 500 mL.

No vaginal or perineal lacerations are noted

Laboratory studies:

Hgb: 10.2 g/dL

Plt: 149,000/μL

How Would You Manage This Patient?

The first step is recognition, and the second is immediate action.

The loss of uterine height and pale mass protruding from the introitus were signs that the uterus had inverted. Oxytocin administration was stopped immediately. The obstetrics emergency team was mobilized, and with the assistance of nursing and anesthesiologists, a second large bore IV was inserted. Since the patient's anesthesia was judged to be adequate and the patient remained hemodynamically stable, uterine replacement in the delivery room was attempted first. With the

vaginal hand cupping the fundus, the fundus was pushed cephalad, with care to spread the force across all fingers so as not to perforate the uterus.

Once the uterus was replaced to a normal anatomical position, an oxytocin bolus was restarted, and uterotonics were given to control hemorrhage. Methylergonovine 0.2 mg was administered intramuscularly, and 800 μg misoprostol was administered per rectum. Bimanual pressure was continued for several minutes until uterine tone was satisfactory and bleeding subsided.

The patient was maintained on oral methylergonovine 0.2 mg every 6 hours for the first 24 hours. A follow-up CBC was drawn the morning after delivery, with a hemoglobin of 7.7 g/dL. Anemia was treated with iron sucrose infusion. She remained stable and was discharged the following day.

Uterine Inversion

Uterine inversion is a rare though life-threatening complication of childbirth, accompanied by hemorrhage and hypovolemic shock in up to 41% of cases, with associated morbidity and mortality [1]. Shock may be disproportionate to blood loss, due to stretching of peritoneal tissues. Diagnosis is usually made clinically, with recognition of a palpable divot at the fundus or a mass at the introitus (Figure 60.1). There is

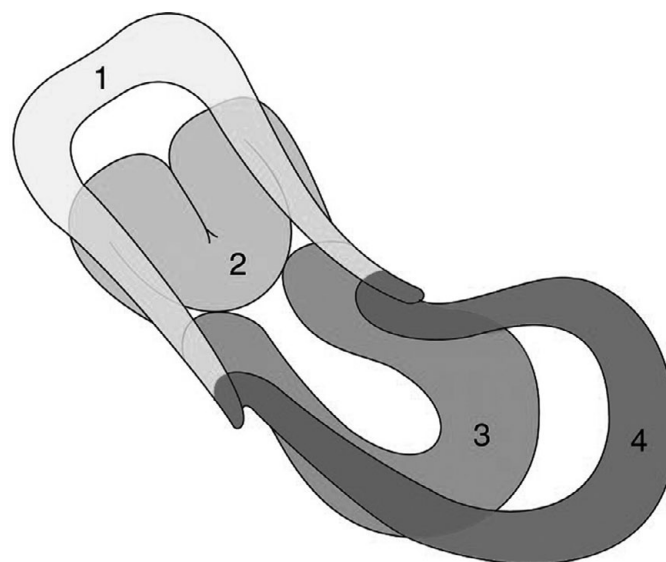


Figure 60.1 Degrees of uterine inversion. 1. Normal anatomic position; 2. fundal inversion; 3. complete uterine inversion; 4. inversion of uterus and vagina. Reprinted from Cunningham F, Leveno KJ, Dashe JS, et al. (eds). *Williams Obstetrics*, 26th ed. New York: McGraw Hill; 2022



Figure 60.2 Replacement of uterine inversion. From Dudley EC. *The Principles and Practice of Gynecology: For Students and Practitioners*. Philadelphia: Lea Brothers & Co; 1904

disagreement as to whether excessive cord traction during the third stage of labor is a causative factor.

Risk factors for uterine inversion include fundal placenta, PAS, short umbilical cord, atony (e.g. due to grand multiparity or prolonged induction of labor [IOL]), connective tissue disorders, uterine tumors or structural abnormalities, and congenital weakness of the uterine wall.

Iatrogenic risks were traditionally thought to include actions that are now routine elements of the active management of the third stage of labor (AMTSL), such as fundal massage and cord traction. Although there has been widespread adoption of AMTSL, uterine inversion remains rare [1,2]. When uterine massage is performed properly, by placing a hand above the symphysis pubis to press the uterus cranially cephalad, and without excessive cord traction or fundal pressure, AMTSL does not carry increased risk.

Uterine inversion can usually be managed at the bedside, though in up to 10% of cases, surgical management is required [1,3].

Manual replacement is the mainstay of treatment and can often be done immediately upon recognition, whether or not the placenta remains attached. A hand is placed at the fundus, cupping it with the fingertips, and taking care to spread the force across all fingers to avoid perforating the uterus. The fundus is then pushed cephalad (Figure 60.2).

At the same time, assistance from nurses, anesthesiologists, and additional obstetrical clinicians should be requested immediately in case conservative measures are not successful and additional intervention is needed. Uterotonics are stopped in order to prevent lower segment constriction from trapping the inverted fundus. A second IV is placed to aid resuscitation, and tocolytics are administered to relax the uterine musculature allowing for manual replacement. Effective tocolytics for this situation include terbutaline 250 µg given subcutaneously or magnesium sulfate 4 g bolus given intravenously. Nitroglycerin has been described; however, it is not supported in the anesthesiology literature [4]. Analgesics may be needed if neuraxial anesthesia is lacking. Ongoing hemorrhage should be treated according to institutional protocols (see Case 63).

Once the uterus is replaced to a normal anatomical position and the placenta has been removed, oxytocin is started. Atony can contribute to hemorrhage and unstable uterine position, so additional uterotonics may become necessary. Bimanual pressure should be continued for up to 5 minutes until uterine position and tone are satisfactory. A Bakri balloon may be placed to aid in maintaining position [5].

The placenta may be removed manually either immediately after the uterus is repositioned, or after position has been maintained. If there is concern for accreta, additional intervention is required; see Case 79 for details on management of PAS.

If manual replacement cannot be performed in the delivery room, whether due to excessive tone, patient discomfort, or worsening hemorrhage, the patient should be moved to the operating room. Halogenated inhalation agents can be given to relax the uterus and provide anesthesia for anticipated interventions. If hemorrhage is present, appropriate measures should be taken, including hemodynamic monitoring and activation of massive transfusion protocol. When manual replacement is not successful, then laparotomy is performed.

Once the abdomen is opened, one operator may push the fundus vaginally while the other grasps the round ligaments with clamps and pulls abdominally. The clamps can be advanced sequentially until the fundus has been replaced. Once the fundus has been restored to a normal position, uterine compression sutures may be necessary to hold the uterus in place, decrease ongoing bleeding, and prevent recurrence of inversion. If there is a tight cervical ring preventing replacement, a vertical hysterotomy can be made in the posterior portion of the uterus to provide room. This would then be closed in three layers, with subsequent risk of uterine rupture. Though the quantity of risk is unknown, cesarean birth for future pregnancies is generally recommended [1,3].

Despite the endometrium being exposed to vaginal flora, there does not seem to be an increased risk of infection, with the use of prophylactic antibiotics lacking any evidence of benefit [1,3].

In future pregnancies, the patient should be counseled that the recurrence risk is unpredictable and that the mode of delivery should be dictated by routine obstetric practice [1,6].

Key Learning Points

- Uterine inversion is rare, but more likely to occur in the presence of risk factors such as placenta accreta or uterine atony, or excessive fundal pressure or cord traction during the third stage of labor.
- Keys to managing inversion are prompt recognition, communication, and quick action toward replacement.
- Hemorrhage and atony should be anticipated and treated according to institutional protocols.
- Laparotomy may be necessary to replace the fundus by traction when pressure from below is insufficient.
- Evidence does not support use of antibiotics following fundal replacement.

References

- 1 Wendel MP, Shnaekel KL, Magann EF. Uterine Inversion: A Review of a Life-Threatening Obstetrical Emergency. *Obstet Gynecol Surv.* 2018;73:411–417.
- 2 Peña-Martí GE, Comunián-Carrasco G. Fundal Pressure versus Controlled Cord Traction as Part of the Active Management of the Third Stage of Labour. *Cochrane Database Syst Rev.* 2007;(4):CD005462.
- 3 You WB, Zahn CM. Postpartum Hemorrhage: Abnormally Adherent Placenta, Uterine Inversion, and Puerperal Hematomas. *Clin Obstet Gynecol.* 2006;49:184–197.
- 4 Sumikura H, Inada E. Uterotonics and Tocolytics for Anesthesiologists. *Curr Opin Anaesthesiol.* 2016;29:282–287.
- 5 Majd HS, Pilsniak A, Reginald P. Recurrent Uterine Inversion: A Novel Treatment Approach Using SOS Bakri Balloon. *Br J Obstet Gynaecol.* 2009;116:999–1001.
- 6 Baskett TF. Acute Uterine Inversion: A Review of 40 Cases. *J Obstet Gynaecol Can.* 2002;24(12):953.

A 30-Year-Old with an Undelivered Placenta 30 Minutes Following Delivery

Sona Jasani

History of Present Illness

A 30-year-old gravida 2 para 1 patient at 40 weeks' gestation presents to the hospital in active labor. Her prenatal course was uncomplicated with a normal anatomy ultrasound showing an anterior placenta without previa. Her first pregnancy resulted in a vaginal delivery complicated by prolonged third stage. Past surgical history is negative for any uterine or abdominal surgeries. Maternal and fetal vital signs remain stable throughout labor, without any signs of chorioamnionitis. After administration of epidural anesthesia, her labor progresses without complication. She pushes for 40 minutes to deliver a healthy vigorous female infant. The umbilical cord is clamped and cut after 60 seconds, and the infant is placed directly on the mother's skin. Oxytocin is administered and intermittent uterine massage is performed alternating with gentle traction on the umbilical cord along with suprapubic pressure. After 30 minutes, the placenta has still not delivered.

Physical Examination

General appearance: Well-appearing, no acute distress, bonding well with infant

Vital signs:

Temperature: 37°C

Pulse: 80 beats per minute

Blood pressure: 107/60 mmHg

Respiratory rate: 18 breaths per minute

BMI: 29.5 kg/m²

Abdomen: Soft, non-tender, fundus at the level of the umbilicus

Pelvic: External genitalia are normal with an intact perineum. The clamped umbilical cord protrudes from a dilated cervix and there is no active bleeding

Laboratory studies:

Hgb: 11 g/dL (normal 12–16 g/dL)

Blood type: O positive

Antibody screen: Negative

How Would You Manage This Patient?

This patient is experiencing prolonged third stage of labor due to a retained placenta. Her history of a prolonged third stage of labor in her prior delivery increases her risk of having a prolonged third stage in her current delivery. Risk for placenta accreta spectrum (PAS) is low in this patient given normal placental imaging (without low-lying location or other abnormal ultrasound findings) and no history of uterine surgery.

Active management of the third stage of labor has failed to achieve placental separation (unchanged cord length and fundal position). As she remains hemodynamically stable with a functional epidural, manual removal of the placenta at bedside is offered to the patient. She consented for the procedure and is informed of the possibility of hemorrhage that would require operative management. The provider's nondominant hand stabilizes the uterine fundus externally by either grasping or exerting downward pressure on the fundus as the dominant hand is inserted through the dilated cervix into the uterine cavity. The fingers are used to separate the plane between the placenta and the uterine wall until the placenta is fully separated. The placenta is then grasped and removed from the uterus while the external nondominant hand places suprapubic counter-traction to prevent uterine inversion. Visual inspection of the placenta shows an intact specimen. Post-procedure ultrasound shows a thin endometrial stripe, and she is given a single dose of cefazolin for prophylaxis. She remains stable with appropriate bleeding and the remainder of her postpartum course is uncomplicated.

Retained Placenta

Retained placenta, the second leading cause of postpartum hemorrhage (PPH) [1], occurs in 0.5–4.8% of vaginal deliveries [2]. Predicting patients who will have retained placenta is a current challenge for a variety of reasons: study heterogeneity complicates risk factor meta-analysis, variations in obstetric practice limits generalizability of results, prediction models currently are only experimental [2], and useful diagnostic or therapeutic biomarkers do not yet exist [3]. Risk factors can include a previous history of retained placenta, high parity, prolonged use of oxytocin, history of uterine surgery, assisted reproductive technology (in vitro fertilization or intracytoplasmic sperm injection), preterm delivery, or uterine anomaly [1]. As with the patient described, a history of a previous retained placenta is a significant risk factor for subsequent development of retained placenta. The overall recurrence rate can be 14% and specifically in women whose first delivery is complicated by retained placenta, 25% will have a recurrence in a subsequent birth [4]. Historically, this condition has been classified into three different subtypes: placenta adherens, PAS, and incarcerated placenta [1]. Though the underlying biologic pathways contributing to these subtypes are poorly understood, proposed mechanisms include abnormal implantation, placental hypoperfusion, and poor contractility [1,2]. Less is known about incarcerated placentas; however, this is thought to result from lower uterine segment constriction. Epidemiologic evidence

does support all three proposed mechanisms; however, further translational research may help elucidate the molecular pathways that give rise to the variety of clinical presentations [2].

Retained placenta is clinically diagnosed when the placenta does not deliver regardless of whether the third stage is managed actively or expectantly. There is no universally accepted time limit for placental delivery. Active management is recommended by the National Institute for Health and Care Excellence (NICE), the World Health Organization (WHO), and ACOG, given the association with reduced PPH rates. Controlled cord traction, immediate administration of a uterotonic agent like oxytocin, uterine massage and early cord clamping are all components of active management. Though active management of third stage reduces PPH risk, it does not prevent retained placenta or decrease rates of manual removal [5]. Despite agreement amongst these three oversight bodies on the implementation of active management of third stage of labor and expeditious care of the unstable patient, variations in retained placenta management in the clinically stable patient exist. These variations include timing (wait time recommendations), modality (manual removal vs. pharmacologic strategies), antibiotic prophylaxis administration, analgesia recommendations and the possible uses of ultrasound.

Waiting up to 30 minutes after the delivery of the infant in the case of a hemodynamically stable patient without PPH is an acceptable obstetric practice. In the setting of PPH, ACOG explicitly recommends manual removal as an immediate first-line treatment when retained placenta is diagnosed. However, ACOG does not specifically note a required wait time prior to manual removal in cases without PPH [6,7]. The NICE guidelines explicitly state that providers can diagnose a prolonged third stage if the placenta has not delivered after 30 minutes of active management or 60 minutes of physiologic management [1,8]. The WHO guidelines also explicitly state that retained placenta can be diagnosed after 30 minutes; however, WHO further recommends waiting an additional 30 minutes prior to performing manual removal in a stable patient regardless of active or physiologic management of third stage [1,9]. The 30 minute timeframe was originally suggested by a study in 1991 by Coombs et al. that demonstrated a mean third-stage duration of 6.8 minutes and an increased risk of PPH, transfusion, and dilation and curettage after 30 minutes in both spontaneously and manually removed placentas [1]. In contrast to older studies, contemporary research demonstrates a shorter mean duration of third stage, likely due to the routine adoption of active management [5]. These new data show an earlier onset of PPH risk (at 20 vs. 30 minutes) but also that certain proposed mechanisms of retained placenta, such as poor contractility or abnormal implantation, better correlate to PPH risk rather than third-stage duration itself [5].

Currently, manual removal of the placenta is the most conventional treatment option; however, the associated risks include infection, genital tract lacerations, uterine perforation, and bleeding [7]. Reducing the risk of infection associated with manual removal through prophylactic antibiotic administration is inconclusive. According to ACOG, the current

evidence neither supports nor rejects this practice, the WHO recommends prophylaxis and NICE does not make explicit mention of this practice [6,8,9].

Pharmacologic interventions for retained placenta management have been proposed in an attempt to reduce the risks associated with manual removal. Various interventions have been proposed that differ by agent, dose, and route of administration. Umbilical vein injection of both oxytocin and prostaglandins have demonstrated moderate improvement in rates of manual placental removal, as has sublingual and orally administered prostaglandin [7]. Recommendations based on the studies regarding pharmacologic options vary. The NICE recommendation is to avoid the routine use of oxytocic agents for the sole purpose of retained placenta and avoid the use of umbilical vein agents [8]. In contrast, WHO encourages oxytocin with controlled cord traction and consideration of intraumbilical vein injection of oxytocin [9]. ACOG does not explicitly mention the role of pharmacologic interventions for retained placenta management [6]. More robust studies are needed to determine the safety and efficacy of medical interventions for retained placenta.

Analgesia recommendations for retained placenta management are also nuanced. The general consensus is to ensure adequate analgesia; however, what to do if a patient does not already have regional analgesia is unclear [6,8,9]. A 2020 Cochrane review found only one RCT comparing paracervical block versus IV pethidine with diazepam and concluded that there is insufficient evidence to evaluate the effectiveness and safety of anesthesia or analgesia during manual removal from this one low-quality study. Given the potential pain involved, providers should consider local, regional, or general anesthesia options as appropriate for their patient and clinical situation.

Ultrasound may be used to diagnose retained placental tissue or to aid in curettage procedures [6]. Real-time ultrasound assessments of the third stage have shown that blood flow between the placenta and uterine wall ceases prior to detachment in normal and non-PAS retained placenta cases but persists in PAS cases [10]. Providers should consider PAS if placental tissue is adherent to the uterine wall, heavy bleeding occurs during attempted manual removal, or if PAS risk factors are present (previous CD, advanced maternal age, prior uterine surgeries, and placenta previa) [3]. The exact role that ultrasound may play in retained placenta management is currently unclear; however, the evidence does suggest that color flow Doppler may be a useful tool for providers to quickly evaluate and prepare for the possibility of PAS during third-stage management.

Practice recommendations for retained placenta remain inconsistent. Providers should be aware of these recommendations but individualize management when caring for patients with retained placenta. Table 61.1 summarizes the current recommendations and considerations of treatment strategies. Though definitive management is manual removal, pharmacologic interventions may be considered in the medically stable patient. Patients should have adequate analgesia prior to manual removal, and clinicians should keep PAS in mind to avoid additional morbidity.

Table 61.1 Retained placenta management considerations in the clinically stable patient

Feature	Description	Recommendation	Considerations
Manual removal of placenta with or without curettage	Physical removal of placenta by provider	Can wait between 30 and 60 minutes prior to performing	Risks include infection, bleeding, genital tract injury, and uterine perforation
Analgesia/anesthesia	Pain management for manual removal	Should administer but no consensus on modality	Balance patient comfort with risks of anesthesia. May be unavailable in low-resource areas or possibly delay manual removal
Antibiotic administration	Prophylaxis for manual removal	Can consider but evidence is inconclusive	Balance benefit of decreased risk of infection from manual removal with risk of antibiotic reaction or resistance
Pharmacologic interventions	Use of medications to induce placental separation	No current consensus	Oxytocin or prostaglandin injected into umbilical vein has shown mixed results. Not shown to significantly reduce PPH
Third-stage labor management	Can be active or expectant	Active management	Reduces PPH rates but does not prevent placental retention or reduce manual removal rates
Ultrasound	Use prior to attempt at manual removal, or as adjunct tool during removal	No current consensus	May identify possible PAS if persistent blood flow is present between uterus and placenta during third stage. May be unavailable in some facilities

Key Teaching Points

- Retained placenta can be diagnosed if the placenta has not delivered within 30–60 minutes of delivery of the neonate.
- Abnormal implantation, placental hypoperfusion, and poor contractility are all possible mechanisms contributing to retained placenta.
- Manual removal of the placenta is the definitive management of retained placenta; however, pharmacologic interventions may be beneficial in the stable patient.
- Waiting up to 30 minutes after delivery of the neonate before proceeding with manual removal is acceptable, however, variations in practice recommendations exist.
- Active management of the third stage of labor is recommended to reduce rates of PPH; however, it may not reduce rates of retained placenta or manual removal.

References

- 1 Perlman N, Carusi DA. Retained Placenta after Vaginal Delivery: Risk Factors and Management. *Int J Womens Health*. 2019;11:527–534.
- 2 Favilli A, Tosto V, Ceccobelli M, et al. Risk Factors for Non-adherent Retained Placenta after Vaginal Delivery: A Systematic Review. *BMC Pregnancy Childbirth*. 2021;21:268.
- 3 American College of Obstetricians and Gynecologists; Society for Maternal-Fetal Medicine. Obstetric Care Consensus No. 7: Placenta Accreta Spectrum. *Obstet Gynecol*. 2018;132:e259–e275.
- 4 Nikolajsen S, Lokkegaard ECL, Bergholt T. Reoccurrence of Retained Placenta at Vaginal Delivery: An Observational Study. *Acta Obstet Gynecol Scand*. 2013;92:421–425.
- 5 Frolova AI, Stout MJ, Tuuli MG, et al. Duration of the Third Stage of Labor and Risk of Postpartum Hemorrhage. *Obstet Gynecol*. 2016;127(5):951–956.
- 6 Committee on Practice Bulletins-Obstetrics. Practice Bulletin No. 183: Postpartum Hemorrhage. *Obstet Gynecol*. 2017;130:e168–e186.
- 7 Patrick H, Mitra A, Rosen T, et al. Pharmacologic Intervention for the Management of Retained Placenta: A Systematic Review and Meta-analysis of Randomized Trials. *Am J Obstet Gynecol*. 2020;223(3):447.e1–447.e19.
- 8 National Institute for Health and Care Excellence. Intrapartum Care for Healthy Women and Babies. Clinical Guideline. CG190. www.nice.org.uk/guidance/cg190/resources/intrapartum-care-for-healthy-women-and-babies-pdf-35109866447557 (accessed June 8, 2023).
- 9 World Health Organization. WHO Guidelines for the Management of Postpartum Hemorrhage and Retained Placenta. <https://apps.who.int/iris/handle/10665/44171> (accessed June 8, 2023).
- 10 Krapp M, Baschat AA, Hankeln M, Gembruch U. Gray Scale and Color Doppler Sonography in the Third Stage of Labor for Early Detection of Failed Placental Separation. *Ultrasound Obstet Gynecol*. 2000;15:138–142.

A 30-Year-Old at 38 Weeks' Gestation with "Turtle Sign" Noted at Delivery

Lauren R. Baker

History of Present Illness

A 30-year-old gravida 2 para 1001 at 38 4/7 weeks' gestation is admitted to the Labor and Delivery unit after spontaneous rupture of membranes. The patient's last delivery was an uncomplicated spontaneous vaginal delivery (SVD) of a term infant weighing 3,430 g. This pregnancy has been complicated by a 45-pound total weight gain and well-controlled A2 gestational diabetes for which the patient is taking insulin. At the time of admission, the patient is in moderate distress with contractions every 3–5 minutes, described as a 7 on a pain scale of 1–10. Fetal heart rate tracing is category 1. The fetus is in cephalic presentation and the cervix is dilated to 6 cm/80% effaced/–2 station. The EFW is approximately 4,000 g. Soon after arrival, epidural anesthesia is administered with improvement in the patient's pain. On repeat exam, the cervix is noted to be complete/0 station and the patient starts to push. After almost 2 hours of pushing, the fetal head delivers in the right occiput anterior position. A turtle sign is immediately noted.

Physical Examination

General appearance: Well-appearing, pregnant patient in lithotomy position

Vital signs:

Temperature: 37°C

Pulse: 90 beats per minute

Blood pressure: 130/76 mmHg

Respiratory rate: 18 breaths per minute

BMI: 32 kg/m²

Cardiopulmonary: Regular rate and rhythm, non-labored breathing

Abdomen: Gravid, soft, non-tender to palpation

Pelvic: Fetal head retracted against the perineum in the ROA position

Neurologic/psychologic: Alert, oriented, normal mood and affect

Fetal assessment: Fetal heart rate is baseline 140 beats per minute, moderate variability, accelerations present, intermittent variable decelerations. Tocometer:

Contractions every 2–3 minutes

Laboratory studies:

Hgb: 10.2 g/L

Plt: 193,000/μL

Blood glucose: 97 mg/dL

Blood type: A positive, antibody screen negative

Imaging:

36-week ultrasound: EFW 3,410 g (95th percentile), deepest vertical pocket 7.5 cm, anterior placenta, cephalic presentation

How Would You Manage This Patient?

The turtle sign was promptly recognized and announced. Gentle downward axial traction was applied to the fetal head, without subsequent delivery of the shoulders. The care team was immediately notified using the phrase "we have a shoulder dystocia" and additional staff were called to the bedside. Documentation and timekeeping roles were assigned. The patient was instructed to stop pushing and was repositioned so that the perineum was at the edge of the bed. The patient's hips were flexed using the McRoberts maneuver while an assistant applied suprapubic pressure. As the shoulders remained stuck, the delivering provider placed a hand in the posterior vagina and slid it along the fetal chest to grasp the posterior wrist. The fetal elbow was flexed and swept across the fetal chest, facilitating delivery. The infant was transitioned to the radiant warmer for evaluation by the pediatric team and cord gases were sent. A thorough vaginal exam was performed demonstrating adequate uterine tone with minimal bleeding. A second-degree perineal laceration was identified and repaired. The complication of shoulder dystocia was explained to the patient and questions answered. Comprehensive documentation was completed in the health record. The care team debriefed, and a patient safety report was submitted.

Discussion

Shoulder dystocia is an obstetric emergency that complicates approximately 1% of vaginal cephalic births [1]. It is defined as failure to deliver the fetal shoulder(s) with routine downward traction on the fetal head, requiring supplemental maneuvers to facilitate delivery. The fetal shoulder is most often impacted anteriorly, by the maternal pubic symphysis, however, impedance may also occur posteriorly at the level of the maternal sacral promontory or due to increased resistance between the fetal body and vaginal walls. A turtle sign (sudden retraction of the delivered fetal head back against the perineum) may also be present [2].

Although risk factors for shoulder dystocia have been identified (Table 62.1), they are insufficiently predictive [3]. Thus, providers should be prepared to manage this potentially catastrophic complication during every vaginal birth. Risk factors for shoulder dystocia include maternal diabetes, fetal macrosomia, maternal obesity or excessive weight gain,

Table 62.1 Shoulder dystocia risk factors

	Maternal	Fetal
Antepartum	• Diabetes • Obesity • Excessive weight gain • Prior shoulder dystocia • Multiparity	• Suspected macrosomia
Intrapartum	• Labor induction • Oxytocin administration • Epidural use • Abnormal labor (precipitous or prolonged) • OVD	• Late-term gestation

prior shoulder dystocia, and multiparity. Intrapartum factors such as late-term gestation, labor induction, oxytocin administration, epidural use, precipitous or prolonged labor, and operative vaginal delivery (OVD) also incur greater risk [1]. The risk of recurrent shoulder dystocia in a subsequent pregnancy is approximately 13% [4].

Shoulder dystocia is unpreventable and most often occurs in nondiabetic patients with normal-weight infants [2]. There is no evidence to support prophylactic maneuvers aimed at prevention [5]. Ultrasound estimation of fetal weight is imprecise ($\leq 20\%$ variability) with decreasing accuracy with fetal weight $>4,000$ g. Further research is needed to determine whether labor induction is beneficial over expectant management in the setting of suspected macrosomia, and at what gestational age. Labor induction should not occur before 39 0/7 weeks' gestation unless otherwise medically indicated. Elective CD should be considered in marked cases of suspected macrosomia, using an estimated fetal weight (EFW) of $>4,500$ g in diabetic patients and $>5,000$ g in nondiabetic patients. This approach provides benefit to the newborn as the incidence of shoulder dystocia when birth weight exceeds 4,500 g may be as high as 50% in diabetics [6].

Appropriate management of shoulder dystocia requires immediate recognition and implementation of systematic maneuvers to relieve the obstruction and effect timely delivery (Figure 62.1). Once recognized, the diagnosis of shoulder dystocia should be clearly communicated to the delivery team. Additional nursing, obstetric, pediatric, and anesthesia support should be mobilized to the bedside [2].

Maternal lithotomy positioning should be adjusted to the end of the bed. The patient should be instructed not to push as doing so may further impact the shoulder. There is no role for fundal pressure. Routine use of episiotomy is discouraged; however, it may be helpful in cases where additional space is required to perform intravaginal maneuvers [3].

The McRoberts maneuver should be employed first. This is a noninvasive intervention in which the maternal hips are flexed, abducted, and brought to the patient's chest to widen the anterior-posterior diameter of the pelvis [2]. Ideally, suprapubic pressure is applied simultaneously from the side of the fetal back in a downward and lateral motion [3]. If necessary, delivery of the posterior arm may be attempted, as this approach has been associated with the highest rate of

delivery when compared with other maneuvers [7]. This three-step approach has a success rate of 95% within 4 minutes [8].

Internal rotational efforts, such as the Rubin and Woods Screw maneuvers, may be utilized in lieu of posterior arm delivery or if this approach fails. The Rubin maneuver is performed by the operator placing a hand on the dorsal aspect of the posterior fetal shoulder followed by anterior rotation toward the fetal face. The Woods Screw maneuver involves the operator placing a hand on the ventral surface of the posterior fetal clavicle to rotate the posterior shoulder until the anterior shoulder emerges. Use of a posterior axillary sling to deliver the posterior shoulder has also been described. The Gaskin "all fours" maneuver can be used in patients without impaired mobility from regional anesthesia. This is done by positioning the patient on hands and knees and applying downward traction on the posterior shoulder or upward traction on the anterior shoulder. If maneuvers are initially unsuccessful, they should be repeated as necessary. An absolute time limit for shoulder dystocia management has not been established, however, rates of hypoxic ischemic encephalopathy are low up to 5 minutes [2,3,9].

In the rare circumstance that standard maneuvers persistently fail, more aggressive efforts may be required. These should be used judiciously due to significant maternal and fetal morbidity and mortality. Such techniques include the Zavanelli maneuver (manual replacement of the fetal head into the vagina followed by CD), abdominal rescue (hysterotomy to dislodge the shoulder from above followed by vaginal delivery), intentional clavicular fracture (using outward directed force), and maternal symphysiotomy [2,3,9].

Associated maternal complications of shoulder dystocia include PPH and third- or fourth-degree perineal lacerations. Even when managed properly, shoulder dystocia is associated with increased perinatal morbidity and mortality. While most shoulder dystocia cases are relieved without fetal injury, sequelae may include brachial plexus injury (transient 3–16.8%, permanent 0.5–1.6%), clavicular fracture (1.7–9.5%), humeral fracture (0.1–4.2%), and rarely hypoxic-ischemic encephalopathy (0.3%) or death (0–0.35%) [3,7].

Following delivery, both the mother and infant should be thoroughly evaluated for injuries. Identified adverse outcomes should be managed as clinically indicated and cord gases sent. The event should be explained to the patient and support personnel using plain language. Debriefing with all members of the care team should also be performed. Documentation in the health record should be detailed, with care exercised to ensure all critical information is notated. Real-time documentation of timing by nursing staff can promote accuracy. Use of standardized documentation forms or checklists has also been proposed. Ongoing simulation-based team training, quality review processes, and institutional shoulder dystocia protocols are recommended to improve outcomes [2]. Shared decision-making should be employed in delivery planning for subsequent pregnancies. Factors to consider include the severity of the shoulder dystocia and sequelae, EFW, and maternal medical and surgical history.

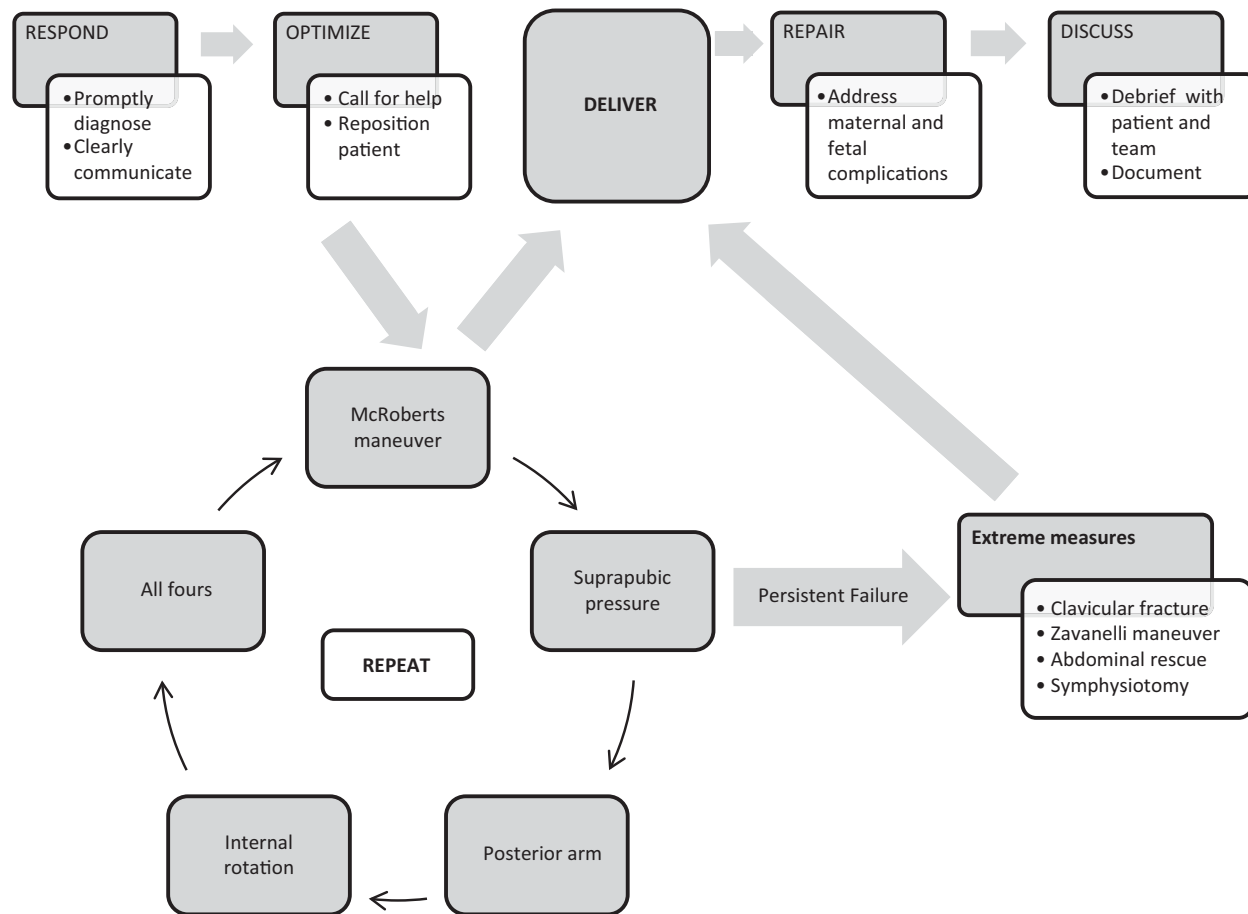


Figure 62.1 Shoulder dystocia management

Key Teaching Points

- Shoulder dystocia is an obstetric emergency that is unpreventable and unpredictable.
- Risk factors include the following: maternal diabetes, fetal macrosomia, obesity or excessive weight gain, prior shoulder dystocia, multiparity, late-term gestation, labor induction, oxytocin administration, epidural use, abnormal labor, and OVD.
- Appropriate management of shoulder dystocia requires immediate recognition and implementation of systematic maneuvers.
- McRoberts, suprapubic pressure, and posterior arm maneuvers will relieve 95% of shoulder dystocia cases in up to 4 minutes.
- Post-delivery management includes treatment of complications, patient counseling, team debriefing, and detailed documentation.

References

- 1 Ouzounian JG. Shoulder Dystocia: Incidence and Risk Factors. *Clin Obstet Gynecol.* 2016;59(4):791–794.
- 2 Practice Bulletin No 178: Shoulder Dystocia. *Obstet Gynecol* 2017;129: e123–e133.
- 3 Royal College of Obstetricians and Gynaecologists. *Shoulder Dystocia: Green-top Guideline No. 42.* London: Royal College of Obstetricians and Gynaecologists; 2012.
- 4 Al-Hawash S, Whitehead CL, Farine D. Risk of Recurrent Shoulder Dystocia: Are We Any Closer to Prediction? *J Matern Fetal Neonatal Med.* 2019;32(17):2928–2934.
- 5 Athukorala C, Middleton P, Crowther CA. Intrapartum Interventions for Preventing Shoulder Dystocia. *Cochrane Database Syst Rev.* 2006;(4): CD005543.
- 6 Macrosomia: ACOG Practice Bulletin, Number 216. *Obstet Gynecol.* 2020;135: e18–e35.
- 7 Hoffman MK, Bailit JL, Ware Branch D, et al. A Comparison of Obstetric Maneuvers for the Acute Management of Shoulder Dystocia. *Obstet Gynecol.* 2011;117(6): 1272–1278.
- 8 Leung TY, Stuart O, Suen SS, et al. Comparison of Perinatal Outcomes of Shoulder Dystocia Alleviated by Different Type and Sequence of Manoeuvres: A Retrospective Review. *Br J Obstet Gynaecol.* 2011;118(8): 985–990.
- 9 Hill DA, Lense J, Roepcke F. Shoulder Dystocia: Managing an Obstetric Emergency. *Am Fam Physician.* 2020;102(2): 84–90.

A 20-Year-Old with Vaginal Bleeding and Enlarging Fundus Following a Cesarean Delivery

Aaron Goldberg

History of Present Illness

A 20-year-old primigravid patient was admitted to Labor and Delivery at 41 1/7 weeks' gestation for labor induction. Her pregnancy and prenatal care were uncomplicated. She had no medical problems and no prior surgery. Her induction lasted more than 36 hours and she received oxytocin for more than 24 hours with no progress beyond 6 cm. During labor, she also developed chorioamnionitis that was treated with antibiotics through the final 12 hours of her labor. A primary low transverse cesarean section was performed for active phase arrest without complication under epidural anesthesia. The estimated blood loss was 900 cc during the surgery.

Approximately 30 minutes after returning to the recovery room, the nurse caring for her performs a routine abdominal exam and identifies the fundus 4 cm above the umbilicus, and the patient has a significant amount of vaginal bleeding.

Physical Examination

General appearance: Patient is awake and oriented, but states she feels somewhat weak and is mildly short of breath.

Vital signs:

Temperature: 37.5°C

Pulse: 115 beats per minute

Blood pressure: 98/62 mmHg

Respiratory rate: 16 breaths per minute

Body mass index (BMI): 26 kg/m²

Cardiopulmonary: Mild tachycardia; lungs are clear to auscultation

Abdomen: Appropriately tender without rebound or guarding, fundus palpable 4 cm superior to umbilicus, feels boggy, bandage is dry

Pelvic: Vaginal exam reveals no evidence of lacerations or other trauma. Approximately 500 cc of both clotted and bright red blood is noted to be pooling under the patient

Laboratory studies:

Hgb: 11.5 g/dL

Plt: 210 × 10⁹/L

WBC: 12.1 × 10⁹/L

Imaging:

Bedside abdominal ultrasound shows no evidence of free fluid in the abdomen. Uterus is enlarged with clot and debris within the endometrial cavity

How Would You Manage This Patient?

This patient is experiencing a postpartum hemorrhage (PPH) due to uterine atony. It is defined as cumulative blood loss >500 mL after a vaginal birth and 1,000 mL after a cesarean section within 24 hours of delivery. Blood loss in conjunction with clinical evidence of hypovolemia regardless of delivery method within 24 hours of delivery is also considered PPH [1].

Her total quantifiable blood loss is 1,400 cc since the start of her cesarean delivery (CD) and she is exhibiting signs of hypovolemia, including tachycardia and hypotension. While repeat labs are collected and blood component transfusion is prepared, she is given uterine massage and an intravenous (IV) infusion of oxytocin. Due to continued atony, she is given IV tranexamic acid (TXA) 1,000 mg and methergine 0.2 mg intramuscularly. After these treatments, the bleeding substantially lessens, and her uterus becomes firm below the level of the umbilicus. Repeat labs include a hemoglobin of 8.9 g/dL, platelets of 175 × 10³/L, and fibrinogen of 275 mg/dL. The patient's bleeding remains minimal and she remains stable with no further complications.

Postpartum Hemorrhage

Postpartum hemorrhage is the most common cause of maternal mortality, accounting for approximately 11% of maternal deaths in the United States and 30% of maternal deaths worldwide [2]. According to the World Health Organization, each year approximately 14 million women experience PPH, leading to 700,000 maternal deaths. In assessing the patient with PPH, it is important to consider various causes of postpartum bleeding including uterine atony, obstetric lacerations or trauma, infection, retained or abnormally adherent placenta, or disorders of coagulation. Uterine atony is the most common cause of PPH, accounting for 70–80% of these cases. A careful clinical assessment including physical exam and laboratory data can quickly rule out the other causes of PPH.

Risk factors for uterine atony include prolonged labor with use of oxytocin, high parity, intrauterine infection, multiple gestation, macrosomia, polyhydramnios, and a history of prior PPH. Fibroids and other uterine abnormalities can also be associated with atony and PPH [1]. A recent systematic review and meta-analysis of risk factors for PPH due to atony

suggests that PPH often occurs in the absence of known risk factors, suggesting vigilance in every delivery is important [3].

Efforts to reduce PPH after delivery include umbilical cord traction following delivery of the baby to expedite placental separation, uterine massage to stimulate uterine contraction after placental delivery, and prophylactic administration of 10 units of IV oxytocin. A meta-analysis of these efforts, collectively known as “active management” of the third stage of labor, demonstrated that they may reduce the risk of severe PPH but do not seem to improve severe maternal morbidity or mortality [4].

Rapid diagnosis and intervention are critical to avoid significant morbidity. Clinical signs of PPH include excessive vaginal bleeding, an enlarged and boggy uterus, hypotension, tachycardia, or low urine output. Patients may not show clinical signs of significant blood loss until they have lost more than 1,500 mL or approximately 25% of their total blood volume. Treatment for PPH should be initiated based on clinical assessment of the patient. Laboratory data can help guide management, but treatment decisions should not be delayed while awaiting this information.

Quantitative measurement techniques improve the accuracy of blood loss estimation compared to traditional visual estimation and may aid clinicians in early detection of PPH and decision regarding blood product replacement. This process of quantitative assessment of blood loss requires a team approach and includes blood loss both during and after delivery, as well as postdelivery. Estimated blood content of soaked surgical sponges, sheets, and towels is combined with blood collected by calibrated suction devices and surgical drapes to calculate the total blood volume lost, though the techniques for collection in vaginal and CDs differ. Compared to visually estimated blood loss, these efforts are less likely to underestimate total blood loss [2].

Blood product replacement should be based on estimates of blood lost in conjunction with clinical signs of hypovolemia. Coagulopathy is common during severe PPH as clotting factors are consumed. Transfusion protocols in the setting of significant PPH should include replacement of red blood cells (RBCs), platelets, and clotting factors. Massive transfusion protocols (MTPs) at each institution help to standardize the

appropriate ratio of blood products in patients requiring large-volume transfusions. Clinical judgement guides initiation of the MTP as no specific threshold of blood loss exists. An unstable patient with anticipated ongoing bleeding or requiring four or more units of RBCs serve should lead to MTP initiation. Obstetric MTP protocols typically describe a 1:1:1 ratio of packed RBCs to platelets and fresh frozen plasma (FFP) to restore circulating blood volume and needed coagulation factors, although these ratios may vary based on institutional protocols [5].

The first line of management for uterine atony includes aggressive uterine massage and medical therapy. Several commonly used uterotonic medications are available to help improve uterine tone. Recognition of relevant contraindications to each medication is critical to safe administration of these medications. No one uterotonic agent is more effective than others, and many patients require the use of multiple agents to resolve their atony. Tranexamic acid, an antifibrinolytic medication, has emerged as an additional medical therapy that can be used in conjunction with uterotonic agents. The WOMAN trial, a large randomized international trial, demonstrated that TXA may reduce death from PPH when used within 3 hours of birth. Medical options for treating PPH due to uterine atony are presented in Table 63.1 [1,5,6].

When initial medical therapies and uterine massage do not achieve an improvement in uterine tone or reduced bleeding, intrauterine compression of endometrial vessels can be helpful. Various techniques of intrauterine tamponade have been described. The commercially available Bakri balloon can be placed transcervically into the uterine cavity following vaginal or CD. The intrauterine portion of the balloon is inflated with 300–500 mL of saline creating uterine compression. The Jada system similarly involves placement of a vacuum tube transcervically into the uterine cavity and uses suction to simulate physiologic uterine contraction. If neither the Bakri balloon or Jada device are available, providers may place one or more large Foley catheters transcervically into the uterine cavity and inflate the balloons with saline. Packing the uterine cavity with gauze remains an option if other methods of intrauterine tamponade are unavailable. This technique involves layered packing of gauze in the uterine cavity with the gauze

Table 63.1 Medical options for treating PPH due to uterine atony

	Dose and route	Frequency	Adverse reactions	Contraindication
Oxytocin	IV: 10–40 units/500–1,000 mL Intramuscular (IM): 10 units (once)	As continuous infusion (IV)	Minimal, but may include nausea, vomiting, or hyponatremia with very high doses	Allergy to drug
Methyl maleate ergonovine (Methergine)	IM: 0.2 mg	Every 2–4 hour	Nausea, vomiting, hypertension	Hypertension, significant cardiovascular disease, allergy to drug
Carboprost tromethamine (Hemabate)	IM: 0.25 mg	Every 15 minutes (max eight doses)	Nausea, vomiting, diarrhea, bronchospasm	Asthma, active liver/hepatic/ cardiac disease
TXA	IV: 1,000 mg	May repeat once after 30 minutes	Rare (possible small increased risk of venous thromboembolism [VTE])	Prior VTE, severe renal impairment
Prostaglandin E1 (Misoprostol)	600–1,000 µg per oral, per rectum, sublingual	Once	Nausea, vomiting	Allergy to drug

protruding through the cervical os for easy removal later. Uterine packing and the use of intrauterine Foley catheters are rarely performed given the wide availability of the Bakri and Jada in most Labor and Delivery units. Intrauterine balloons or uterine packing should be removed within 24 hours with close surveillance for ongoing bleeding.

Uterine artery embolization (UAE) may be considered for those whose bleeding does not improve after medical therapy and uterine compression, provided they are hemodynamically stable. A large series of UAE for uterine atony described a success rate in excess of 80% [7]. Uterine artery embolization requires close coordination with the interventional radiology department to expedite treatment.

When bleeding continues after these less invasive options are exhausted, surgical intervention is necessary. The patient should be taken to an operating room rapidly and an exploratory laparotomy should be performed. Initial surgical options may ligate vessels to reduce pulse pressure and blood flow to the uterus. A commonly performed technique involves bilateral ligation of the uterine arteries, historically known as an "O'Leary suture." Similar sutures may be placed across the utero-ovarian vessels.

Another conservative surgical option is the use of compression sutures to reduce bleeding. While many similar techniques have been described, none have been shown to be superior [1,8]. The B-Lynch method is the most well-known and involves compressing the uterus with a suture anchored in the anterior and posterior cervix and extending around the fundus. A large rapidly absorbed suture should be used, such as #1 chromic [9].

If medical therapy and conservative surgical intervention fail to resolve bleeding, hysterectomy is the definitive treatment. While consideration of the patient's desire for future

fertility is important, this procedure can be lifesaving and should not be delayed even in a primiparous patient. Consultation with an experienced gynecologic surgeon or gynecologic oncologist should be considered given the increased risk of ureteral or bladder injuries in peripartum hysterectomies.

Continued attention to hemodynamic stability by replacing blood products and maintaining perfusion should continue while interventions are utilized to achieve hemostasis. A multidisciplinary team involving obstetricians, anesthesiologists, nursing staff, and critical care providers is needed to optimize care.

Standardized approaches to PPH are essential for organizations to optimize care and equity in obstetric emergencies. Interdisciplinary and interprofessional team-based drills using simulated patient scenarios can help improve team performance and should be integrated into institutional preparation and education efforts. The Alliance for Innovation on Maternal Health is a program created to improve maternal safety and outcomes that has created evidence-based safety bundles that standardize the management of PPH and other obstetric emergencies. Resources can be found online [5].

Key Teaching Points

- Prompt recognition of PPH and initiation of treatment is critical to reducing maternal morbidity and mortality.
- Treatment should start with less invasive medical options. Progression to procedural or surgical treatments should proceed rapidly if initial therapy is not successful.
- A multidisciplinary approach using evidence-based safety bundles for managing PPH can optimize maternal outcomes.

References

- 1 Committee on Practice Bulletins-Obstetrics. Practice Bulletin No. 183: Postpartum Hemorrhage. *Obstet Gynecol.* 2017;130:e168–e186.
- 2 Quantitative Blood Loss in Obstetric Hemorrhage: ACOG Committee Opinion, Number 794. *Obstet Gynecol.* 2019;134:e150–156.
- 3 Ende HB, Lozada MJ, Chestnut DH, et al. Risk Factors for Atonic Postpartum Hemorrhage: A Systematic Review and Meta-analysis. *Obstet Gynecol.* 2021;137:305–323.
- 4 Begley CM, Gyte GM, Devane D, et al. Active versus Expectant Management for Women in the Third Stage of Labour. *Cochrane Database Syst Rev.* 2019;(2):CD007412.
- 5 Alliance for Innovation on Maternal Health. Obstetric Hemorrhage Patient Safety Bundle. https://saferbirth.org/wp-content/uploads/U2-FINAL_AIM_Bundle_ObstetricHemorrhage.pdf (accessed June 10, 2023).
- 6 WOMAN Trial Collaborators. Effect of Early Tranexamic Acid Administration on Mortality, Hysterectomy, and Other Morbidities in Women with Postpartum Haemorrhage (WOMAN): An International, Randomised, Double-Blind, Placebo Controlled Trial. *Lancet.* 2017;389:2105–2116.
- 7 Zwart JJ, Dijk PD, van Roosmalen J. Peripartum Hysterectomy and Arterial Embolization for Major Obstetric Hemorrhage: A 2-Year Nationwide Cohort Study in the Netherlands. *Am J Obstet Gynecol.* 2010;202:150.e1–150.e7.
- 8 Hayman RG, Arulkumaran S, Steer PJ. Uterine Compression Sutures: Surgical Management of Postpartum Hemorrhage. *Obstet Gynecol.* 2002;99:502–506.
- 9 B-Lynch C, Coker A, Lawal AH, Abu J, Cowen MJ. The B-Lynch Surgical Technique for the Control of Massive Postpartum Hemorrhage: An Alternative to Hysterectomy? Five Cases Reported. *Br J Obstet Gynaecol.* 1997;104:372–375.

A 20-Year-Old with Vaginal Bleeding and Enlarging Fundus Following a Cesarean Delivery

Aaron Goldberg

History of Present Illness

A 20-year-old primigravid patient was admitted to Labor and Delivery at 41 1/7 weeks' gestation for labor induction. Her pregnancy and prenatal care were uncomplicated. She had no medical problems and no prior surgery. Her induction lasted more than 36 hours and she received oxytocin for more than 24 hours with no progress beyond 6 cm. During labor, she also developed chorioamnionitis that was treated with antibiotics through the final 12 hours of her labor. A primary low transverse cesarean section was performed for active phase arrest without complication under epidural anesthesia. The estimated blood loss was 900 cc during the surgery.

Approximately 30 minutes after returning to the recovery room, the nurse caring for her performs a routine abdominal exam and identifies the fundus 4 cm above the umbilicus, and the patient has a significant amount of vaginal bleeding.

Physical Examination

General appearance: Patient is awake and oriented, but states she feels somewhat weak and is mildly short of breath.

Vital signs:

Temperature: 37.5°C

Pulse: 115 beats per minute

Blood pressure: 98/62 mmHg

Respiratory rate: 16 breaths per minute

Body mass index (BMI): 26 kg/m²

Cardiopulmonary: Mild tachycardia; lungs are clear to auscultation

Abdomen: Appropriately tender without rebound or guarding, fundus palpable 4 cm superior to umbilicus, feels boggy, bandage is dry

Pelvic: Vaginal exam reveals no evidence of lacerations or other trauma. Approximately 500 cc of both clotted and bright red blood is noted to be pooling under the patient

Laboratory studies:

Hgb: 11.5 g/dL

Plt: 210 × 10⁹/L

WBC: 12.1 × 10⁹/L

Imaging:

Bedside abdominal ultrasound shows no evidence of free fluid in the abdomen. Uterus is enlarged with clot and debris within the endometrial cavity

How Would You Manage This Patient?

This patient is experiencing a postpartum hemorrhage (PPH) due to uterine atony. It is defined as cumulative blood loss >500 mL after a vaginal birth and 1,000 mL after a cesarean section within 24 hours of delivery. Blood loss in conjunction with clinical evidence of hypovolemia regardless of delivery method within 24 hours of delivery is also considered PPH [1].

Her total quantifiable blood loss is 1,400 cc since the start of her cesarean delivery (CD) and she is exhibiting signs of hypovolemia, including tachycardia and hypotension. While repeat labs are collected and blood component transfusion is prepared, she is given uterine massage and an intravenous (IV) infusion of oxytocin. Due to continued atony, she is given IV tranexamic acid (TXA) 1,000 mg and methergine 0.2 mg intramuscularly. After these treatments, the bleeding substantially lessens, and her uterus becomes firm below the level of the umbilicus. Repeat labs include a hemoglobin of 8.9 g/dL, platelets of 175 × 10³/L, and fibrinogen of 275 mg/dL. The patient's bleeding remains minimal and she remains stable with no further complications.

Postpartum Hemorrhage

Postpartum hemorrhage is the most common cause of maternal mortality, accounting for approximately 11% of maternal deaths in the United States and 30% of maternal deaths worldwide [2]. According to the World Health Organization, each year approximately 14 million women experience PPH, leading to 700,000 maternal deaths. In assessing the patient with PPH, it is important to consider various causes of postpartum bleeding including uterine atony, obstetric lacerations or trauma, infection, retained or abnormally adherent placenta, or disorders of coagulation. Uterine atony is the most common cause of PPH, accounting for 70–80% of these cases. A careful clinical assessment including physical exam and laboratory data can quickly rule out the other causes of PPH.

Risk factors for uterine atony include prolonged labor with use of oxytocin, high parity, intrauterine infection, multiple gestation, macrosomia, polyhydramnios, and a history of prior PPH. Fibroids and other uterine abnormalities can also be associated with atony and PPH [1]. A recent systematic review and meta-analysis of risk factors for PPH due to atony

suggests that PPH often occurs in the absence of known risk factors, suggesting vigilance in every delivery is important [3].

Efforts to reduce PPH after delivery include umbilical cord traction following delivery of the baby to expedite placental separation, uterine massage to stimulate uterine contraction after placental delivery, and prophylactic administration of 10 units of IV oxytocin. A meta-analysis of these efforts, collectively known as “active management” of the third stage of labor, demonstrated that they may reduce the risk of severe PPH but do not seem to improve severe maternal morbidity or mortality [4].

Rapid diagnosis and intervention are critical to avoid significant morbidity. Clinical signs of PPH include excessive vaginal bleeding, an enlarged and boggy uterus, hypotension, tachycardia, or low urine output. Patients may not show clinical signs of significant blood loss until they have lost more than 1,500 mL or approximately 25% of their total blood volume. Treatment for PPH should be initiated based on clinical assessment of the patient. Laboratory data can help guide management, but treatment decisions should not be delayed while awaiting this information.

Quantitative measurement techniques improve the accuracy of blood loss estimation compared to traditional visual estimation and may aid clinicians in early detection of PPH and decision regarding blood product replacement. This process of quantitative assessment of blood loss requires a team approach and includes blood loss both during and after delivery, as well as postdelivery. Estimated blood content of soaked surgical sponges, sheets, and towels is combined with blood collected by calibrated suction devices and surgical drapes to calculate the total blood volume lost, though the techniques for collection in vaginal and CDs differ. Compared to visually estimated blood loss, these efforts are less likely to underestimate total blood loss [2].

Blood product replacement should be based on estimates of blood lost in conjunction with clinical signs of hypovolemia. Coagulopathy is common during severe PPH as clotting factors are consumed. Transfusion protocols in the setting of significant PPH should include replacement of red blood cells (RBCs), platelets, and clotting factors. Massive transfusion protocols (MTPs) at each institution help to standardize the

appropriate ratio of blood products in patients requiring large-volume transfusions. Clinical judgement guides initiation of the MTP as no specific threshold of blood loss exists. An unstable patient with anticipated ongoing bleeding or requiring four or more units of RBCs serve should lead to MTP initiation. Obstetric MTP protocols typically describe a 1:1:1 ratio of packed RBCs to platelets and fresh frozen plasma (FFP) to restore circulating blood volume and needed coagulation factors, although these ratios may vary based on institutional protocols [5].

The first line of management for uterine atony includes aggressive uterine massage and medical therapy. Several commonly used uterotonic medications are available to help improve uterine tone. Recognition of relevant contraindications to each medication is critical to safe administration of these medications. No one uterotonic agent is more effective than others, and many patients require the use of multiple agents to resolve their atony. Tranexamic acid, an antifibrinolytic medication, has emerged as an additional medical therapy that can be used in conjunction with uterotonic agents. The WOMAN trial, a large randomized international trial, demonstrated that TXA may reduce death from PPH when used within 3 hours of birth. Medical options for treating PPH due to uterine atony are presented in Table 63.1 [1,5,6].

When initial medical therapies and uterine massage do not achieve an improvement in uterine tone or reduced bleeding, intrauterine compression of endometrial vessels can be helpful. Various techniques of intrauterine tamponade have been described. The commercially available Bakri balloon can be placed transcervically into the uterine cavity following vaginal or CD. The intrauterine portion of the balloon is inflated with 300–500 mL of saline creating uterine compression. The Jada system similarly involves placement of a vacuum tube transcervically into the uterine cavity and uses suction to simulate physiologic uterine contraction. If neither the Bakri balloon or Jada device are available, providers may place one or more large Foley catheters transcervically into the uterine cavity and inflate the balloons with saline. Packing the uterine cavity with gauze remains an option if other methods of intrauterine tamponade are unavailable. This technique involves layered packing of gauze in the uterine cavity with the gauze

Table 63.1 Medical options for treating PPH due to uterine atony

	Dose and route	Frequency	Adverse reactions	Contraindication
Oxytocin	IV: 10–40 units/500–1,000 mL Intramuscular (IM): 10 units (once)	As continuous infusion (IV)	Minimal, but may include nausea, vomiting, or hyponatremia with very high doses	Allergy to drug
Methyl maleate ergonovine (Methergine)	IM: 0.2 mg	Every 2–4 hour	Nausea, vomiting, hypertension	Hypertension, significant cardiovascular disease, allergy to drug
Carboprost tromethamine (Hemabate)	IM: 0.25 mg	Every 15 minutes (max eight doses)	Nausea, vomiting, diarrhea, bronchospasm	Asthma, active liver/hepatic/ cardiac disease
TXA	IV: 1,000 mg	May repeat once after 30 minutes	Rare (possible small increased risk of venous thromboembolism [VTE])	Prior VTE, severe renal impairment
Prostaglandin E1 (Misoprostol)	600–1,000 µg per oral, per rectum, sublingual	Once	Nausea, vomiting	Allergy to drug

protruding through the cervical os for easy removal later. Uterine packing and the use of intrauterine Foley catheters are rarely performed given the wide availability of the Bakri and Jada in most Labor and Delivery units. Intrauterine balloons or uterine packing should be removed within 24 hours with close surveillance for ongoing bleeding.

Uterine artery embolization (UAE) may be considered for those whose bleeding does not improve after medical therapy and uterine compression, provided they are hemodynamically stable. A large series of UAE for uterine atony described a success rate in excess of 80% [7]. Uterine artery embolization requires close coordination with the interventional radiology department to expedite treatment.

When bleeding continues after these less invasive options are exhausted, surgical intervention is necessary. The patient should be taken to an operating room rapidly and an exploratory laparotomy should be performed. Initial surgical options may ligate vessels to reduce pulse pressure and blood flow to the uterus. A commonly performed technique involves bilateral ligation of the uterine arteries, historically known as an "O'Leary suture." Similar sutures may be placed across the utero-ovarian vessels.

Another conservative surgical option is the use of compression sutures to reduce bleeding. While many similar techniques have been described, none have been shown to be superior [1,8]. The B-Lynch method is the most well-known and involves compressing the uterus with a suture anchored in the anterior and posterior cervix and extending around the fundus. A large rapidly absorbed suture should be used, such as #1 chromic [9].

If medical therapy and conservative surgical intervention fail to resolve bleeding, hysterectomy is the definitive treatment. While consideration of the patient's desire for future

fertility is important, this procedure can be lifesaving and should not be delayed even in a primiparous patient. Consultation with an experienced gynecologic surgeon or gynecologic oncologist should be considered given the increased risk of ureteral or bladder injuries in peripartum hysterectomies.

Continued attention to hemodynamic stability by replacing blood products and maintaining perfusion should continue while interventions are utilized to achieve hemostasis. A multidisciplinary team involving obstetricians, anesthesiologists, nursing staff, and critical care providers is needed to optimize care.

Standardized approaches to PPH are essential for organizations to optimize care and equity in obstetric emergencies. Interdisciplinary and interprofessional team-based drills using simulated patient scenarios can help improve team performance and should be integrated into institutional preparation and education efforts. The Alliance for Innovation on Maternal Health is a program created to improve maternal safety and outcomes that has created evidence-based safety bundles that standardize the management of PPH and other obstetric emergencies. Resources can be found online [5].

Key Teaching Points

- Prompt recognition of PPH and initiation of treatment is critical to reducing maternal morbidity and mortality.
- Treatment should start with less invasive medical options. Progression to procedural or surgical treatments should proceed rapidly if initial therapy is not successful.
- A multidisciplinary approach using evidence-based safety bundles for managing PPH can optimize maternal outcomes.

References

- 1 Committee on Practice Bulletins-Obstetrics. Practice Bulletin No. 183: Postpartum Hemorrhage. *Obstet Gynecol.* 2017;130:e168–e186.
- 2 Quantitative Blood Loss in Obstetric Hemorrhage: ACOG Committee Opinion, Number 794. *Obstet Gynecol.* 2019;134:e150–156.
- 3 Ende HB, Lozada MJ, Chestnut DH, et al. Risk Factors for Atonic Postpartum Hemorrhage: A Systematic Review and Meta-analysis. *Obstet Gynecol.* 2021;137:305–323.
- 4 Begley CM, Gyte GM, Devane D, et al. Active versus Expectant Management for Women in the Third Stage of Labour. *Cochrane Database Syst Rev.* 2019;(2):CD007412.
- 5 Alliance for Innovation on Maternal Health. Obstetric Hemorrhage Patient Safety Bundle. https://saferbirth.org/wp-content/uploads/U2-FINAL_AIM_Bundle_ObstetricHemorrhage.pdf (accessed June 10, 2023).
- 6 WOMAN Trial Collaborators. Effect of Early Tranexamic Acid Administration on Mortality, Hysterectomy, and Other Morbidities in Women with Postpartum Haemorrhage (WOMAN): An International, Randomised, Double-Blind, Placebo Controlled Trial. *Lancet.* 2017;389:2105–2116.
- 7 Zwart JJ, Dijk PD, van Roosmalen J. Peripartum Hysterectomy and Arterial Embolization for Major Obstetric Hemorrhage: A 2-Year Nationwide Cohort Study in the Netherlands. *Am J Obstet Gynecol.* 2010;202:150.e1–150.e7.
- 8 Hayman RG, Arulkumaran S, Steer PJ. Uterine Compression Sutures: Surgical Management of Postpartum Hemorrhage. *Obstet Gynecol.* 2002;99:502–506.
- 9 B-Lynch C, Coker A, Lawal AH, Abu J, Cowen MJ. The B-Lynch Surgical Technique for the Control of Massive Postpartum Hemorrhage: An Alternative to Hysterectomy? Five Cases Reported. *Br J Obstet Gynaecol.* 1997;104:372–375.

CASE 64

A 25-Year-Old with Post-cesarean Endometritis and Fever Unresponsive to Antibiotics

Enid Rivera-Chiauzzi

History of Present Illness

A 25-year-old gravida 1 para 1 patient presented to triage due to abdominal pain and fever 5 days after a cesarean delivery (CD). In her earlier admission, she had presented in spontaneous labor and was augmented with artificial rupture of membranes at 8 cm. Six hours later, she underwent CD for arrest of descent at 0 station. She had been adequately treated with penicillin for group B streptococcus (GBS) positive status, and also received cefazolin and azithromycin preoperatively. Both her surgery and her postpartum course were uncomplicated, and she was discharged on postoperative day 3. Prenatal care had been uncomplicated except for gestational diabetes managed with diet. She had no other medical or surgical history.

She reported feeling well until postoperative day 4, when she started to have increased abdominal pain. She awoke in the middle of the night with chills, a fever of 38.9°C and new foul-smelling discharge. After presenting to the hospital, she was diagnosed with endometritis based on fever, fundal tenderness, and foul-smelling discharge. She was admitted and started on clindamycin 900 mg every 8 hours, gentamicin 5 mg/kg every 24 hours, and ampicillin 2 g every 6 hours. She remained intermittently febrile after 48 hours of antibiotics.

Physical Examination

Postoperative Day 7

General appearance: 25-year-old postpartum adult, ill-appearing, well-developed, well-nourished, and in no apparent distress

Vital signs:

Temperature: 38.9°C

Pulse: 110 beats per minute

Blood pressure: 121/75 mmHg

Respiratory rate: 18 breaths per minute

BMI: 27.5 kg/m²

Cardiopulmonary: Unremarkable

Abdomen: Soft, non-distended, with normal active bowel sounds. No rebound or guarding. Incision is clean, dry, and intact with no erythema or redness. Moderately tender fundus palpable 3 cm below the umbilicus

Lower extremities: 2+ pitting edema bilaterally; no calf tenderness, redness, or discoloration present

Pelvic: External genitalia are normal. On speculum exam, there is foul-smelling, purulent discharge noted from the cervix, but no cervical motion tenderness. Bimanual exam reveals no adnexal tenderness but positive fundal tenderness

Laboratory studies:

Hgb: 11.9 g/dL

Plt: $215 \times 10^3/\mu\text{L}$

Leukocytes: $35.2 \times 10^3/\mu\text{L}$

Bilirubin: 1.1 mg/dL

Cr: 0.6 mg/dL

Lactate: 1.7 mmol/L

Imaging:

Pelvic ultrasound demonstrates endometrial measurement of 25 mm and no evident retained placental tissue, with some fluid in the endometrial cavity consistent with recent CD. The adnexa appear normal with no abscesses.

Abdominal/pelvic computed tomography (CT) scan demonstrates normal postoperative changes, with a small amount of fluid in the uterine cavity, but no pelvic abscess, ascites, venous thrombus, or other abnormal abdominal findings.

How Would You Manage This Patient?

This patient has persistent postpartum endomyometritis based on clinical presentation with continued fevers after 48 hours of appropriate broad-spectrum antibiotic treatment. A repeat physical exam did not reveal any other source of infection. Pelvic ultrasound was performed to assess for retained products of conception (RPOCs) but showed a normal endometrial cavity with small amount of fluid. CT scan of the abdomen and pelvis was ordered to evaluate for nonobstetric sources of infection, but no thrombus, ascites, abscess, or gastrointestinal lesions were seen.

Lactate, platelets, bilirubin, and creatinine were ordered to assess for sepsis. She remained normotensive without signs of sepsis, and labs were stable. Blood and urine cultures were obtained to help guide treatment. The initial antibiotics were discontinued and switched to ampicillin-sulbactam 3 g IV every 6 hours to cover enterococci or GBS resistant to clindamycin.

The patient continued to receive supportive care with acetaminophen, ibuprofen, and IV fluids. After 24 hours on ampicillin-sulbactam, the patient no longer had a fever. The patient's fundal tenderness resolved. The blood and urine cultures resulted as negative. The ampicillin-sulbactam was discontinued after the patient remained afebrile for 24 hours. She was discharged home on postoperative day 10 with no need for additional antibiotics.

Postpartum Endomyometritis

Endometritis is the infection of the uterine endometrium following delivery, which may spread to the myometrium (endomyometritis) or parametrium (endoparametritis) [1]. Mode of delivery is a significant factor associated with uterine infection [2]. The frequency of infection after vaginal delivery is 0.2–2.0% [2]. For CDs with preoperative antibiotics given, the infection frequency is 7% after the onset of labor versus 1.5% for scheduled cases. Without preoperative antibiotics, those frequencies increase to 18.4 and 3.9%, respectively [3]. As shown in Table 64.1, there are several risk factors for endometritis [2,1]. When left untreated, mortality rates can reach alarming levels, with estimates as high as 17% [4]. Early recognition and active management are essential to decrease morbidity and mortality associated with these infections.

The diagnosis of endometritis is primarily clinical, based on fever ($>38.0^{\circ}\text{C}$), uterine pain and tenderness, and purulent uterine drainage [1]. Laboratory findings are not useful in making the diagnosis, but an upward trend in WBC count suggests infection. On initial evaluation, an ultrasound can be considered if there is a suspicion for RPOCs. The initial treatment is IV clindamycin 900 mg every 8 hours, and gentamicin 5 mg/kg every 24 hours. The use of ampicillin 2 g IV every 6 hours is indicated if the patient is known to have GBS colonization. The antibiotics should be continued for a minimum of 24 hours without fevers [5]. There is insufficient evidence to support the effectiveness of continuing oral antibiotics after clinical improvement [6].

There should be a strong clinical concern for sepsis in patients who appear toxic, have worsening vital signs, develop lab abnormalities, or note worsening symptoms despite first-line antibiotics. Sepsis is a medical emergency and requires

rapid management to improve outcomes. Sepsis is characterized by a range of signs and symptoms that may include fever, tachycardia, hypotension, hypothermia, altered mental status, and indications of end organ dysfunction. Using a scoring system is recommended to identify patients at greatest risk of morbidity and to decrease sepsis-related mortality. The Sequential Organ Failure Assessment scoring system assesses organ damage using respiratory function ($\text{PaO}_2/\text{FiO}_2$), platelet count, bilirubin level, mean arterial pressure, Glasgow Coma Scale, and creatinine level [7]. If sepsis is diagnosed, the patient should be closely monitored in an intensive care unit (ICU).

Severe and life-threatening infections can be caused by group A streptococcus (*Streptococcus pyogenes*, or GAS), Staphylococcus, or Clostridium species, which may cause tissue necrosis, rapid progression to sepsis, toxic shock syndrome, necrotizing fasciitis, and maternal death (Table 64.2) [5]. Some distinguishing features that suggest GAS include fever of $>38.8^{\circ}\text{C}$, chills, nausea, vomiting, myalgia, dyspnea, rash, pharyngitis, headache, and confusion. Staphylococcal toxic shock syndrome typically presents within the first 24 hours after birth, with high fevers, hypotension, erythroderma, and desquamation [8]. Unique features of *Clostridium sordellii* include late onset >1 week postpartum, shock with refractory hypotension, marked leukemoid reaction, and no rash or fever. *Clostridium perfringens*' distinct features include rapid progression to severe illness with intravascular hemolysis. Distinguishing between GAS, Staphylococcal, and Clostridium infections are quite difficult without confirmation on laboratory cultures. However, to improve outcomes for these patients, it is crucial to start broad-spectrum antibiotics within 1 hour of evaluation to effectively manage sepsis and septic shock. The initial recommended broad-spectrum antibiotics are vancomycin, clindamycin, and

Table 64.1 Risk factors for endometritis

Maternal:	Pregnancy:	Iatrogenic:
Heavy vaginal colonization with <i>Escherichia coli</i> or GBS	Chorioamnionitis	Internal fetal monitoring
HIV infection	Meconium in amniotic fluid	Internal uterine monitoring
Immunosuppression	Preterm delivery	Manual removal of the placenta
Low socioeconomic status	Post-term delivery	Multiple cervical exams
Maternal diabetes mellitus	Prolonged labor	Operative vaginal delivery
Maternal severe anemia	Prolonged rupture of membranes	
Nasal carriage of <i>Staphylococcus aureus</i>		
Obesity		
Sexually transmitted infections		
Smoking		

Table 64.2 Features of persistent endometritis

	Resistant endometritis	Group A strep infection	Clostridial infection
Timing	Continued fever after 48 hours of broad-spectrum antibiotics	Within 48 hours of birth	Late onset >1 week postpartum
General appearance	Mildly ill	Toxic	Toxic
Associated symptoms	Pain confined to uterine area	Chills, myalgia, vomiting, pharyngitis, macular rash, hypotension, confusion, renal impairment	Little to no fever, refractory hypotension, marked leukemoid reaction, no rash

piperacillin-tazobactam. In addition to antibiotic therapy, providing comprehensive supportive care is of paramount importance, with a particular focus on aggressive fluid resuscitation and other resuscitative measures. In instances of necrotizing soft tissue infection, timely surgical intervention is imperative. Source control measures may include wound debridement, hysterectomy, or a combination of these approaches. Hysterectomy can be lifesaving in these infections, leading to sepsis due to their associated high mortality rate and should be performed expeditiously if the clinical situation does not rapidly improve [9].

Fevers that persist despite standard antibiotics in patients who do not appear toxic may be due to insufficient coverage either for resistant bacteria or for a different infection. Evaluation for alternative sources of infection is essential. A complete physical exam should include any system that may harbor an occult infection. Imaging studies such as ultrasound and CT scan may be considered to evaluate for RPOCs, other infections (pelvic abscess, infected hematoma), injury to bowel or bladder, non-obstetric infections (pyelonephritis, appendicitis, pancreatitis, or cholecystitis), and septic pelvic thrombophlebitis [6].

In cases where resistance is suspected, obtaining blood and urine cultures may identify the underlying organism and its susceptibilities. Endometritis is a polymicrobial infection involving aerobic and anaerobic organisms from the lower genital tract. The most common causative agents include gram-positive cocci (e.g. groups A and B streptococci, staphylococcus, and enterococcus), gram-negative bacilli (e.g. *E. coli*, *Klebsiella*, and *Proteus*), anaerobes (e.g. *bacteroides*, *peptostreptococcus*, *peptococcus*, *Prevotella*, and *clostridium*), and others like *mycoplasma* and *chlamydia*. It is important to note that endometrial cultures are not recommended due to potential contamination from the vaginal canal. If standard clindamycin and gentamicin do not induce clinical improvement, initiation of IV ampicillin-sulbactam at a dose of 3 g every 6 hours is typically recommended to provide coverage against enterococci.

Prevention strategies for endometritis include reducing intrapartum infection by minimizing vaginal exams and delaying rupture of membranes when possible. Antibiotic treatment should be promptly initiated for chorioamnionitis, and maintaining glycemic control may reduce infection rates in diabetic patients. Protocols to reduce surgical site infections that include standard surgical preparation and antibiotic prophylaxis are recommended for CDs. Routine antibiotics for vaginal deliveries are not recommended to prevent endometritis [10]. Avoiding manual removal of placenta in CD reduces postpartum infection. Prophylactic antibiotics can be considered for patients with third- or fourth-degree perineal lacerations and manual removal of placenta [10].

Despite preventive measures, endometritis can still occur. Timely treatment with antibiotics is usually effective, but persistent fever should prompt consideration of other sources that may contribute to morbidity and mortality.

Key Teaching Points

- Endometritis is diagnosed clinically based on fever, uterine pain/tenderness, or purulent uterine drainage.
- If symptoms do not improve within 24–48 hours, further evaluation is necessary to rule out other sources of infection and assess for signs of sepsis.
- In cases of suspected sepsis, prompt attention to source control including consideration of hysterectomy is warranted.
- If fevers persist despite initial treatment, additional coverage for gram-positive cocci should be considered.
- Perioperative protocols implemented for CDs reduce rates of postpartum infection.
- In cases of suspected sepsis, antibiotics should be started within 1 hour and prompt attention to source control including consideration of hysterectomy is warranted.

References

- 1 Taylor M, Jenkins SM, Pillarisetty LS. Endometritis. In: *StatPearls*. Treasure Island, FL: StatPearls Publishing; 2023. www.ncbi.nlm.nih.gov/books/NBK553124/ (accessed October 15, 2024).
- 2 Burrows LJ, Meyn LA, Weber AM. Maternal Morbidity Associated with Vaginal versus Cesarean Delivery. *Obstet Gynecol*. 2004;103(5 Pt. 1): 907–912.
- 3 Smaill FM, Grivell RM. Antibiotic Prophylaxis versus No Prophylaxis for Preventing Infection after Cesarean Section. *Cochrane Database Syst Rev*. 2014;(10):CD007482.
- 4 Meaney-Delman D, Bartlett LA, Gravett MG, Jamieson DJ. Oral and Intramuscular Treatment Options for Early Postpartum Endometritis in Low-Resource Settings: A Systematic Review. *Obstet Gynecol*. 2015;125(4):789–800.
- 5 Mackeen AD, Packard RE, Ota E, Speer L. Antibiotic Regimens for Postpartum Endometritis. *Cochrane Database Syst Rev*. 2015;(2):CD001067.
- 6 DeNoble AE, Kuller JA, Heine RP, Dotters-Katz S. Antibiotics for the Prevention and Treatment of Postsurgical Obstetric Infections. *Obstet Gynecol Surv*. 2018;73(8): 475–485.
- 7 Society for Maternal-Fetal Medicine (SMFM); Plante LA, Pacheco LD, Louis JM. SMFM Consult Series #47: Sepsis during Pregnancy and the Puerperium. *Am J Obstet Gynecol*. 2019;220(4):B2–B10. Erratum in: *Am J Obstet Gynecol*. 2021;224(2):224.
- 8 Deguchi Y, Horiuchi Y, Shojima K, et al. Postpartum Methicillin-Resistant *Staphylococcus aureus* Toxic Shock Syndrome Caused by a Perineal Infection. *Case Rep Obstet Gynecol*. 2018; 2018:2670179.
- 9 Harris K, Proctor LK, Shinar S, et al. Outcomes and Management of Pregnancy and Puerperal Group A Streptococcal Infections: A Systematic Review. *Acta Obstet Gynecol Scand*. 2023;102(2):138.
- 10 Committee on Practice Bulletins-Obstetrics. ACOG Practice Bulletin No. 199: Use of Prophylactic Antibiotics in Labor and Delivery. *Obstet Gynecol*. 2018;132: e103–e119.

A 40-Year-Old with Severe Obesity and Painful Right Pedal Edema

Michelle Larzelere

History of Present Illness

A 40-year-old gravida 3 para 3 patient with class III obesity presents 5 days after a repeat cesarean delivery (CD) with lower extremity swelling and pain. She reports pain in the right calf that is not present in the left. She states both of her legs have been swollen since delivery but her right calf seems more swollen than the left. These symptoms have progressed over the past 2 days. She denies any shortness of breath, chest pain, or palpitations. She states her incision is healing well. She is currently breast-feeding her infant without issues. Her medical history is otherwise unremarkable. Her surgical history is only significant for two previous CDs. She denies history of alcohol, tobacco, or drug use. She has a family history of diabetes and obesity in her mother, but no family members with clotting disorders.

Physical Examination

General appearance: 40-year-old, well-developed and well-nourished female, in no apparent distress

Vital signs:

Temperature: 39.1°C

Pulse: 80 beats per minute

Blood pressure: 130/80 mmHg

Respiratory rate: 14 breaths per minute

Oxygen saturation: 97% on room air

BMI: 45.0 kg/m²

Cardiopulmonary: Regular rate and rhythm

Abdomen: Soft, appropriately tender, non-distended, normoactive bowel sounds. Pfannenstiel incision healing well without erythema, induration, or tenderness

Extremities: 3+ nonpitting edema noted in the right lower extremity to the mid-thigh with positive Homan's sign. There is noticeable redness, and it is warm to the touch. 1+ pitting edema in the left lower extremity to the knee with negative Homan's sign

Laboratory studies:

Hgb: 10.4 g/dL

Imaging:

Lower extremity compression ultrasonography: Normal venous compressibility of the left lower extremity.

Abnormal compressibility of the right iliofemoral vein consistent with deep vein thrombosis (DVT)

How Would You Manage This Patient?

This patient presents with a clinical picture consistent with acute right lower extremity DVT. She is counseled on her options of low molecular weight heparin (LMWH), warfarin, direct thrombin inhibitors, and anti-Xa inhibitors. Given her desire to breast-feed, she elects to begin warfarin. She is started on an LMWH bridge with plans to continue until her INR is at goal of 2.0–3.0. Given that she is hemodynamically stable with reliable follow-up and normal kidney function, she elects to have outpatient surveillance. She is counseled on symptoms of pulmonary embolism (PE) and encouraged to present for evaluation with symptoms. She is also counseled to use reliable contraception while on warfarin.

Additionally, the patient undergoes testing for Factor V Leiden and prothrombin gene G2021A mutations, antithrombin deficiency, and antiphospholipid antibodies. Testing for protein S deficiency is deferred because she is in the early postpartum stage. Over the next 2 weeks, her swelling improves. She is continued on warfarin for a total of 6 months. She chooses a levonorgestrel intrauterine device for contraception.

Venous Thromboembolism

Pregnancy and the postpartum period are times of increased risk of venous thromboembolism (VTE), with 0.5–2.0/1,000 pregnancies affected, accounting for 9.2% of pregnancy-related deaths [1,2]. This risk is mediated by several factors, including hypercoagulability, venous stasis of the lower extremities, and decreased venous outflow. Coagulation factors are also altered during pregnancy and the immediate postpartum period, leading to an overall thrombotic state. Risk factors for VTE include prior history of VTE, presence of an inherited or acquired thrombophilia, CD (fourfold increase compared to vaginal delivery), PPH, peripartum infection, obesity, hypertension, autoimmune disease, multifetal gestation, sickle cell disease, heart disease, and preeclampsia [1]. Half of pregnancy-related VTE events occur in the postpartum period, making this time overall higher risk per day compared to the antepartum period [2].

All pregnant patients should be screened for risk factors for VTE at their initial prenatal visit. This should include assessing for a personal or family history of VTE. Repeat assessment should be performed on admission to the hospital to identify low-, medium-, and high-risk patients. There are risk assessment tools available, but none have been validated in the obstetric population. Therefore, limited evidence is available

Table 65.1 Dosing regimens for LMWH and UFH in pregnancy

Anticoagulant	Prophylactic dose	Intermediate dose	Adjusted-dose (therapeutic dose)
Enoxaparin ^a	40 mg subcutaneous (SC) daily	40 mg SC every 12 hours	1 mg/kg every 12 hours
Dalteparin ^a	5,000 units SC daily	5,000 units SC every 12 hours	200 units/kg daily
Tinzaparin ^a	4,500 units SC daily	-	175 units/kg daily
Nadroparin ^a	2,850 units SC daily	-	100 units/kg every 12 hours
UFH ^b	First trimester: 5,000–7,500 units SC every 12 hours Second trimester: 7,500–10,000 units SC every 12 hours Third trimester: 10,000 units SC every 12 hours	-	10,000+ units SC every 12 hours for a goal activated partial thromboplastin time (aPTT) of 1.5–2.5 that of controls at 6 hours postinjection

Prophylactic, intermediate, and therapeutic dosing regimens for the various LMWH and UFH formulations

^a LMWH: For therapeutic dosing, anti-Xa levels should be measured at 4 hours from last dose with a goal of 0.6–1.0 units/mL

^b UFH: For therapeutic dosing, aPTT levels should be measured at 6 hours from last dose with a goal of 1.5–2.5 X control

for universal recommendations regarding risk stratification and prescribing of thromboprophylaxis [2,3]. At minimum, all patients undergoing CD should have pneumatic compression devices due to the increased risk in this population.

The majority of women with acute DVT will present with pain (86%) and swelling (97%) in their lower extremity. A difference of ≥ 2 cm in calf circumference measured at 10 cm below the tibial tuberosity is also suggestive of a DVT. The left calf is more commonly affected in the pregnant population due to compression of the left iliac vein by the right iliac artery and the vena cava by the gravid uterus. Additionally, clots tend to be more proximal than those seen in nonpregnant patients, involving the iliac and iliofemoral veins [2]. Diagnosis should be made with compression ultrasonography of these vessels. If there is high suspicion of DVT and negative results, Doppler ultrasonography, venography, or magnetic resonance imaging (MRI) may be performed. If these tests are unavailable, empiric treatment with anticoagulation should be started to prevent delays in treatment. A D-dimer test, which has a high negative predictive value, is not recommended secondary to the higher levels seen in pregnancy and postpartum compared to the nonpregnant population [2].

Patients presenting with an acute PE most commonly experience dyspnea with pleuritic chest pain and cough. When suspected, peripheral oximetry should be performed. However, normal oxygenation does not reliably rule out PE. Initial imaging studies should involve a chest x-ray. If normal, a ventilation/perfusion (V/Q) scan can be performed. If the chest x-ray is abnormal, the diagnostic accuracy of the V/Q scan is decreased and a computed tomographic pulmonary angiography (CTPA) should be performed. Despite these recommendations, CTPA is frequently used as first-line imaging, and may assess for other causes of symptoms. Clinicians should always consider other diagnoses that can present with similar symptoms including dyspnea of pregnancy, peripartum cardiomyopathy (PPCM), and underlying lung disease [4]. Outpatient management is appropriate for hemodynamically stable patients who are at low risk for bleeding, have normal renal function, and are able to administer their medication and attend follow-up as needed. If there is a large clot burden, symptomatic PE, high risk of bleeding, or concern about follow-up, inpatient management is warranted.

Treatment for VTE during pregnancy and the postpartum period should last a minimum of 3 months. If the event occurs during pregnancy, therapy should be continued throughout pregnancy and for 6 weeks postpartum. Treatment should be with unfractionated heparin (UFH) or LMWH at therapeutic levels (Table 65.1). Low molecular weight heparin is preferred due to ease of administration, more predictable therapeutic response, decreased number of bleeding episodes, longer half-life, and a lesser impact on bone mineral density. Additionally, studies in nonpregnant patients show fewer adverse effects [2]. Oral Xa-inhibitors and direct thrombin inhibitors should not be used during pregnancy and the postpartum period as there is insufficient safety data regarding their use. Warfarin is not typically used during pregnancy due to risk of warfarin embryopathy with exposure from 6 to 12 weeks' gestation. However, it may be considered after the first trimester in women with mechanical heart valves, due to their higher risk of thrombosis. Patients in this situation may require management by a multidisciplinary team including perinatology, cardiology, and genetics [2].

During labor, anticoagulation therapy can be paused. This allows for safer administration of neuraxial anesthesia by reducing the risk of spinal hematoma and lowers the risk of intrapartum hemorrhage. For patients receiving prophylactic doses of LMWH or UFH, the medication should be stopped 12 hours prior to a planned induction of labor or scheduled CD. Those on therapeutic-dose therapy should have their medication stopped 24 hours prior to any planned procedure. Additionally, with UFH, assessment of aPTT should be performed prior to neuraxial anesthesia. If urgent delivery becomes necessary in a patient on a therapeutic dose of heparin, protamine sulfate can be given to reverse the anticoagulant effect. Protamine sulfate works more reliably in patients on UFH compared to LMWH [2,5].

Resumption of prophylactic dose therapy should begin 4–6 hours after a vaginal delivery and 6–12 hours after CD. If therapeutic dosing is used, resumption should occur no sooner than 24 hours after neuraxial anesthesia and 4 hours after the catheter is removed. Pneumatic compression devices should be used in these high-risk patients. It should remain in place until resumption of anticoagulation and full ambulation [2,5].

Prophylaxis is used in women at high risk for VTE during pregnancy. Pregnant patients with a known low-risk

Box 65.1 Inherited thrombophilias: List of low- and high-risk thrombophilias**Low-risk thrombophilias**

- Factor V Leiden heterozygous
- Prothrombin *G2021A* heterozygous
- Protein C deficiency
- Protein S deficiency

High-risk thrombophilias

- Factor V Leiden homozygous
- Prothrombin gene *G2021A* homozygous
- Factor V Leiden heterozygous AND prothrombin gene *G2021A* heterozygous
- Antithrombin deficiency

thrombophilia without personal history of an unprovoked VTE do not require anticoagulation therapy. If there is a family history in a first-degree relative and a known low-risk thrombophilia, patients can elect for surveillance or prophylactic dosing during pregnancy. However, given the higher risk of VTE in the postpartum period, they should be placed on prophylactic or intermediate dosing postpartum regardless of mode of delivery (Table 65.1). Those with a history of an unprovoked VTE, including in pregnancy or on hormonal contraception, low-risk thrombophilia with history of VTE, high-risk thrombophilias, and those with two or more prior episodes of VTE require therapeutic anticoagulation during pregnancy [1].

Testing for thrombophilia is warranted for any patient that has a personal history of VTE or known familial inheritable

thrombophilia that has not had previous testing. During pregnancy, testing should include workup for known low- and high-risk thrombophilias (Box 65.1) as well as antiphospholipid antibodies. Testing for protein S deficiency is not reliable during pregnancy as levels are normally decreased during this time. Testing can be performed when the patient is remote from a pregnancy episode. Testing for methylenetetrahydrofolate reductase (MTHFR) mutations or homocysteine levels should not be performed [1]. Regardless of thrombophilia status, all patients with a history of VTE should be counseled on risk of recurrence in future pregnancies.

Key Teaching Points

- Venous thromboembolism affects 0.5–2.0/1,000 pregnancies and accounts for 9.2% of pregnancy-related deaths in the United States.
- The risk of VTE is highest in the immediate postpartum period, with one-half of pregnancy-related VTE occurring during this time.
- All patients should be screened at their initial presentation in pregnancy and again on admission to the hospital.
- Anticoagulation with unfractionated or LMWH is the preferred treatment for VTE in pregnancy and the postpartum period.
- Anticoagulation should be held prior to planned induction or CD to decrease the risk of intrapartum hemorrhage and spinal hematoma with neuraxial anesthesia.
- All patients with a history of VTE should be tested for inherited and acquired thrombophilias.

References

- 1 American College of Obstetricians and Gynecologists' Committee on Practice Bulletins–Obstetrics. ACOG Practice Bulletin No. 197: Inherited Thrombophilias in Pregnancy. *Obstet Gynecol.* 2018;132:e18–e34.
- 2 American College of Obstetricians and Gynecologists' Committee on Practice Bulletins–Obstetrics. ACOG Practice Bulletin No. 196: Thromboembolism in Pregnancy. *Obstet Gynecol.* 2018;132:e1–e17.
- 3 Bain E, Wilson A, Tooher R, et al. Prophylaxis for Venous Thromboembolic Disease in Pregnancy and the Early Postnatal Period. *Cochrane Database Syst Rev.* 2014;(2):CD001689.
- 4 Leung AN, Bull TM, Jaeschke R, et al.; ATS/STR Committee on Pulmonary Embolism in Pregnancy. An Official American Thoracic Society/Society of Thoracic Radiology Clinical Practice Guideline: Evaluation of Suspected Pulmonary Embolism in Pregnancy. *Am J Respir Crit Care Med.* 2011;184(10):1200–1208.
- 5 Leffert L, Butwick A, Carvalho B, et al.; the Members of the SOAP VTE Taskforce. The Society for Obstetric Anesthesia and Perinatology Consensus Statement on the Anesthetic Management of Pregnant and Postpartum Women Receiving Thromboprophylaxis or Higher Dose Anticoagulants. *Anesth Analg.* 2018;126(3):928–944.

A 20-Year-Old 3 Weeks' Postpartum Presents with Anhedonia and Insomnia

Szilvia Nagy

History of Present Illness

A 20-year-old gravida 1 para 1 patient presents with anhedonia and insomnia 3 weeks postpartum. Her pregnancy was complicated by hyperemesis gravidarum. She had an uncomplicated vaginal birth, but the infant needed admission to the neonatal ICU (NICU) due to intraamniotic infection. She is exclusively breast-feeding.

During her visit, she describes insomnia, anxiety, decreased appetite, and tearfulness. She is sometimes unable to care for her newborn. She does not have much family support, and her relationship with her partner seems strained since the birth. Her medical history includes anorexia nervosa at age 13. She denies tobacco, alcohol, or drug use. Her mother has depression.

Physical Examination

General appearance: Unkempt, tearful

Vital signs:

Temperature: 37.1°C

Pulse: 78 beats per minute

Blood pressure: 120/68 mmHg

Respiratory rate: 16 breaths per minute

BMI: 28.6 kg/m²

Abdomen: Soft, non-tender, non-distended, uterine fundus below the umbilicus

Pelvic: Normal external genitalia, perineal repair healing well without any signs of infection

Neurologic/psychologic: Edinburgh Postnatal Depression Screen (EPDS) score = 19, negative self-harm question

Laboratory studies:

Hgb: 11.4 g/dL

Hct: 34%

TSH: 1.45 mIU/L

T4: 0.8 ng/dL

How Would You Manage This Patient?

Based on the patient's EPDS score of ≥ 10 and her negative self-harm question, she is at risk for moderate depression. In a structured interview, the patient reveals that she often feels sad, does not laugh quite as much as before, looks forward to things with less enjoyment, sometimes blames herself unnecessarily, often feels anxious for no good reason,

sometimes feels scared or panicky, doesn't cope at all most of the time, has difficulty sleeping, and cries frequently.

This patient has several risk factors that put her at increased risk for postpartum depression. Her history of anorexia nervosa, hyperemesis gravidarum, the NICU admission of her baby, minimal family support, and a strained relationship with her partner all contribute to her risk. She is referred to psychotherapy initially, but due to the severity of her symptoms, she is interested in starting medication as well. After reporting no history of antidepressant use and testing negative on a screen for bipolar disorder, she is started on sertraline 25 mg daily and instructed to increase her dose to 50 mg after 4 days. Warning signs of manic symptoms and medication side effects are reviewed. When she expresses concern about infant exposure through breast milk, she is informed that the relative infant dose for sertraline is $<10\%$, sertraline is considered compatible with breast-feeding, and benefits outweigh the risks in cases of moderate depression.

The patient is scheduled for a follow-up in 2 weeks to reevaluate her depression using the EPDS and assess her response to treatment. She is given information about adjunctive support options such as collaborating with a psychologist and a group therapy program. Additionally, self-care, acupuncture, massage, yoga, bright-light therapy, balanced nutrition, sleep hygiene, and exercise are also discussed.

Furthermore, a social work consultation is made to address social and structural factors that could be a barrier to improvement, such as housing stability, availability of healthy nutrition and safe drinking water, utility needs, violence exposure, transportation, and childcare.

Postpartum Mood and Anxiety Disorders/Postpartum Depression

As obstetricians/gynecologists (Ob/Gyns) are the primary providers for women during the reproductive years when there is increased risk of psychiatric morbidity, they must be familiar with mood disorders [1]. However, there is a wide gap between the training in mood and anxiety disorders that most Ob/Gyns receive and the clinical needs of their patients. Perinatal mental health disorders, which include depression, anxiety, anxiety-related disorders, bipolar disorder, postpartum psychosis, and suicidality, affect more than one in five pregnant and postpartum people [2,3,4]. Those patients

affected by mood and anxiety disorders experience a profound effect on their quality of life.

Despite the availability of effective strategies for detection and treatment, perinatal mental health disorders are under-recognized and undertreated [5]. Undiagnosed mental health issues can have significant detrimental consequences, including poor involvement in medical care, exacerbation of medical conditions, substance use disorders, and severe maternal morbidity and mortality [6,7]. Adverse obstetric, fetal, neonatal, and infant outcomes include stillbirth, preterm birth, fetal growth restriction, low birth weight, impaired bonding, adverse infant neurodevelopment, and increased mental health concerns for the offspring in the long term [7]. In the most severe circumstances, perinatal mental health conditions lead to suicidality, a leading and preventable cause of maternal mortality [8,9].

Screening with validated tools, such as the EPDS, the Patient Health Questionnaire (PHQ-9), and the Generalized Anxiety Scale-7 (GAD-7) [5], are recommended by several colleges, professional societies, and governmental agencies, and recommended at multiple points during prenatal care. Over the past decade, screening (especially for depression) has increased. Screening alone has been shown to reduce the risk of depression, as it normalizes mental health disorders, decreases stigma, and increases knowledge and awareness.

After screening positive on a routine questionnaire, the diagnosis of depression is made by a structured interview that confirms depressed mood or loss of interest, along with at least five criteria specified in the Diagnostic and Statistical Manual of Mental Disorders (DSM-5-TR) list of associated symptoms. Specifically, perinatal mood and anxiety disorders (PMADs) are diagnosed during or within 1 year of pregnancy. Depression, anxiety, and anxiety-related disorders are associated with intrusive thoughts that are unwanted, disturbing, and even distressing. These thoughts can occur repetitively and without warning or instigation. They may be quite variable in their content, including harm to self or infant. Mild symptoms may not need immediate care, but evidence of psychosis or suicidality warrants immediate hospitalization. Psychotherapy is the first-line treatment for mild-to-moderate perinatal depression [10]. Cognitive behavioral therapy and dialectical behavior therapy have proven to be effective in treating depression. Cognitive behavioral therapy works by changing unhelpful thoughts and behaviors. Dialectical behavior therapy uses skills-based training including mindfulness, interpersonal effectiveness, emotional regulation, and distress tolerance to help improve well-being. Interpersonal therapy, psychodynamic approaches, or group therapy modalities are also effective nonpharmacological treatments. Ensuring adequate sleep is also a valuable adjunct.

When symptoms are moderate to severe or initial therapy is ineffective, pharmacotherapy may be considered. Before initiating treatment, it is also important to screen for bipolar disorder to prevent inadvertent initiation of a manic episode in someone with undiagnosed bipolar disorder. Selective serotonin reuptake inhibitors are first line for perinatal depression

and anxiety. Serotonin-norepinephrine reuptake inhibitors are reasonable alternatives. Benzodiazepines should be avoided or prescribed sparingly due to the potential for dependence. Mood stabilizers may be continued if already prescribed to prevent the risk of recurrent mood symptoms, except for valproate due to potential teratogenicity [10].

Pharmacotherapy should be individualized based on prior response to therapy. If clinically indicated, the pharmacotherapy dosage should be titrated upward, with the goal of remission of symptoms [10]. If there is no pharmacotherapy history, sertraline or escitalopram are reasonable first-line medications because of their safety profile and compatibility with breast-feeding. A new class of medications is now approved specifically for the treatment of postpartum depression, which are neuroactive steroid gamma-aminobutyric acid A receptor modulators. Brexanolone is indicated for the treatment of severe depression, but its clinical use is limited by a mandatory 60-hour in-hospital IV infusion [10]. Zuranolone was more recently approved as the first oral medication in this class, with an indication for use in depression that has an onset within the third trimester of pregnancy or within 4 weeks postpartum. It is administered for 14 days.

Addressing patients' long-term follow-up needs a systems-based approach, such as in the collaborative care model or perinatal psychiatric access programs. The collaborative care model includes a care manager (typically a licensed clinical social worker), and weekly care meetings to coordinate delivery of patient-centered care, including psychotherapy and medications, between a mental health professional and the primary care provider [10]. Perinatal psychiatric access programs are usually state-based and connect clinicians with perinatal psychiatrists or other specialists who can guide clinicians in management and treatment [10]. Additional information about perinatal psychiatric access programs may be found through Lifeline for Moms (www.umassmed.edu/lifeline4moms/Access-Programs/).

Ob/Gyns must be prepared to counsel patients on the benefits and risks of psycho-pharmacotherapy for perinatal mental health conditions when clinically indicated. Although complicated or refractory cases may need input from a psychiatrist, initiation of antidepressant therapy should be within the Ob/Gyn's wheelhouse. Response to treatment should be monitored with a validated screening tool. Clinicians may learn more about treatment and resources helpful to patients through the websites listed in Table 66.1.

Treatment is recommended for at least 6–12 months following symptom remission [10]. If effective pharmacotherapy is discontinued before complete resolution of symptoms, there is a high likelihood of recurrence and an increase in the number of lifetime depressive episodes. Ob/gyns can refer to a primary care clinician or mental health professional for long-term management following symptom resolution. Having a history of perinatal mood or anxiety disorder places a patient at increased risk of recurrence in a subsequent pregnancy. A patient with such a history should be screened early and included in shared decision-making about management of symptoms through the pregnancy.

A 40-Year-Old 1 Week after Vaginal Delivery Presents with Shortness of Breath and Orthopnea

Soha S. Patel

History of Present Illness

A 40-year-old gravida 2 para 1 patient presents 1 week after a full-term vaginal delivery with fatigue, shortness of breath, palpitations, orthopnea, and bilateral lower extremity edema. Her pregnancy was complicated by preeclampsia with severe features based on blood pressure criteria. She received magnesium sulfate for seizure prophylaxis until 24 hours following delivery, and she was started on an anti-hypertensive medication prior to discharge. She reports no other significant past medical, surgical, and family history. She is currently taking prenatal vitamins and labetalol 200 mg twice daily and has no known drug allergies. She is breast-feeding her newborn baby without difficulty.

Physical Examination

General appearance: Well-developed but appears agitated and anxious

Vital signs:

Temperature: 37.1°C

Pulse: 143 beats per minute

Blood pressure: 159/115 mmHg

Respiratory rate: 29 breaths per minute

Oxygen saturation: 88% on room air

BMI: 53 kg/m²

Cardiopulmonary: Tachycardic, regular rhythm with S3 heart sounds; tachypneic, bilateral crackles noted at the bases of the lungs

Abdomen: Soft, non-tender, non-distended, normoactive bowel sounds, no guarding, no rebound, no masses or hernias

Extremities: Bilateral 2+ lower extremity edema

Laboratory studies:

BNP: 2,779 pg/mL

Troponin level: <0.04 ng/ml

Imaging:

Electrocardiogram (ECG): Sinus tachycardia with nonspecific ST and T-wave abnormalities

Chest x-ray: Enlarged cardiac silhouette with pulmonary venous congestion

Transthoracic echocardiogram (TTE): Dilated left ventricle without hypertrophy. Left atrial enlargement. Left ventricular ejection fraction (LVEF) is severely reduced at 29%. Severe global hypokinesis is present

How Would You Manage This Patient?

This patient presented to the Emergency Department (ED) with the classic clinical findings of peripartum cardiomyopathy (PPCM). After a thorough history and physical examination, a BNP, troponin, ECG, and TTE were ordered, with results that were consistent with this diagnosis. A multidisciplinary approach to management was of critical importance and included immediate consultations with maternal-fetal medicine and cardiology. The patient was subsequently admitted to the Cardiac Care unit for cardiac monitoring that included telemetry as well as guideline-directed medical therapy for PPCM. The patient was initially given supplemental oxygen via nasal cannula followed by loop diuretics for volume reduction, hydralazine and enalapril for afterload reduction, digoxin to improve contractility, metoprolol to control blood pressure and heart rate, and low molecular weight heparin (LMWH) to prevent blood clot formation. The patient was monitored with serial physical examinations and BNP, as well as repeat TTE. After significant symptomatic improvement in addition to improvement on repeat TTE, the patient was discharged home and scheduled for outpatient follow-up appointments with her cardiologist and obstetrician.

Peripartum Cardiomyopathy

Peripartum cardiomyopathy is a rare cause of heart failure and is defined as:

- developing heart failure in the last month of pregnancy or within 5 months postpartum;
- absence of another etiology for the heart failure;
- LVEF of <45% [1].

The mean age of PPCM diagnosis is 31 years, and the mean parity is 3 [2]. In the United States, Black women have a higher prevalence of PPCM compared to white women [3]. Risk factors include African descent, age of >30 years, multiple gestation, hypertensive disorders of pregnancy (preeclampsia, eclampsia, or postpartum hypertension), and increased parity [3]. Despite the identification of established risk factors, the cause of PPCM has not been identified [4]. Patients typically present with PPCM during the first month of the postpartum period [4].

Signs and symptoms of PPCM can vary, but patients most commonly present with dyspnea, cough, orthopnea, paroxysmal nocturnal dyspnea, and lower extremity edema. However, it is important to note that these symptoms can often be mistaken for normal pregnancy symptoms, and therefore, the diagnosis of PPCM could often be delayed. Physical signs

can include a third heart sound, jugular venous distension, and/or displaced apical impulse. Signs and symptoms of thromboembolism can also be present since patients with PPCM and a LVEF of <30% are at risk of developing a thrombus in the left ventricle [4].

Peripartum cardiomyopathy is a diagnosis of exclusion. Other diagnoses that should be considered and ruled out include hypertensive disease leading to diastolic heart failure, hypertensive disease of pregnancy, myocardial infarction, and/or PE. Additionally, patients with preexisting cardiomyopathy and/or valvular disease may have an acute exacerbation during pregnancy that can mimic PPCM.

When evaluating a patient with concern for PPCM, several diagnostic tests should be considered. An ECG is an important initial step to guide further testing for other conditions in the differential diagnosis. Typical ECG findings in PPCM patients are nonspecific and usually include sinus tachycardia and nonspecific ST- and T-wave abnormalities. Of note, a normal ECG does not exclude the diagnosis of PPCM [4].

Additionally, a TTE should be ordered in any patient in which the diagnosis of PPCM is suspected. Typical findings include global hypokinesis in the left ventricle with an ejection fraction of <45% [1]. The left ventricle can also be dilated. Other potential findings may include left atrial enlargement, thrombus in the left ventricle or left atria, right ventricular hypokinesis with possible dysfunction, dilated right ventricle, and/or mitral and/or tricuspid regurgitation [4].

A chest x-ray is not necessary to confirm the diagnosis of PPCM. However, it may be useful to assess for signs and symptoms of pulmonary edema. In patients with PPCM, findings on chest radiograph may include enlargement of the cardiac silhouette and/or pulmonary venous congestion with possible pleural effusions.

Lastly, a plasma B-type natriuretic peptide (BNP) is recommended in the initial evaluation of patients suspected of having PPCM. Levels are often markedly elevated in the setting of PPCM [4].

Pregnant patients with PPCM should be cared for at hospitals with cardiologists who have expertise in advanced heart

failure. A multidisciplinary approach to care is essential and should include maternal-fetal medicine, cardiology, anesthesiology, and neonatology, if applicable. There are limited data regarding the timing and mode of delivery for patients with PPCM [3]. If possible, stabilizing the patient is of utmost importance prior to delivery, since normal postpartum physiologic changes may worsen clinical status. Early delivery is not indicated in the setting of PPCM, especially if the patient and fetus are clinically stable.

There are two goals for the treatment and management of PPCM – managing signs and symptoms of volume overload and/or reduced cardiac output, and initiating guideline-directed medical therapy for improvement of systolic function. The treatment for PPCM is similar to that in other forms of cardiomyopathy (Table 67.1). The American College of Cardiology and the American Heart Association provide goals for guideline-directed medical therapy of PPCM.

Supplemental oxygenation and/or assisted ventilation should be used as clinically necessary. Loop diuretics can assist with volume overload. Digoxin is used to improve contractility, and beta blockers optimize blood pressure and heart rate. Hydralazine and ACE inhibitors are used for afterload reduction. Of note, ACE inhibitors and ARBs are contraindicated in pregnancy. They are also contraindicated in breast-feeding, except for enalapril and captopril. Anticoagulants should be considered in patients with PPCM with severe left ventricular dysfunction (LVEF of <30%) as these patients are at higher risk of thrombus formation given the hypercoagulable state of pregnancy and the postpartum periods [4].

Some experts suggest that avoidance of lactation should be considered in patients with severe heart failure due to the increased metabolic demands of breast-feeding [5]. In patients that are clinically stable, breast-feeding should be encouraged, and cardiac medications should be chosen that are compatible with breast-feeding [6].

Mortality rates from PPCM are 1.4–3.4% within the first 30 days of diagnosis [2]. Decreased LVEF, dilated left ventricle, Black race, and delayed diagnosis are all associated with a

Table 67.1 Medical treatment for PPCM

Medication	Medical indications	Safety in pregnancy	Safety during breast-feeding	Adverse effects
Beta blockers	Treatment of heart failure and tachycardia	Yes	Yes	Potential for fetal growth restriction
Loop diuretics	Management of signs/symptoms of fluid overload	Yes	Yes	Avoid hypotension or excessive volume depletion
Hydralazine	Afterload reduction	Yes	Yes	Avoid hypotension
Angiotensin-converting enzyme (ACE) inhibitor/ angiotensin-receptor blockers (ARBs)	Afterload reduction and left ventricular remodeling	No	Only enalapril and captopril	Oligohydramnios, decreased fetal renal function, fetal lung hypoplasia, fetal skeletal malformations
Digoxin	Improving contractility	Yes	Yes	None
Aldosterone receptor antagonists (spironolactone)	Management of signs/symptoms of fluid overload	No	Yes	Feminization of a male fetus, fetal growth restriction
LMWH	Prevention and treatment of thromboembolism, specifically for left ventricular thrombus	Yes	Yes	Bleeding

worse prognosis [7]. Contraceptive counseling is imperative, with a particular focus on avoiding estrogen-containing contraceptives, especially in patients with a severely depressed LVEF. Patients with a history of PPCM should be seen and evaluated by maternal-fetal medicine and cardiology for pre-conception consultation to discuss the risks of recurrence in a subsequent pregnancy. The risk of cardiac complications in a subsequent pregnancy is higher if the patient's LVEF has not recovered after the index pregnancy [4]. There are limited data available regarding the appropriate interval timing of a subsequent pregnancy.

Key Teaching Points

- Peripartum cardiomyopathy is a rare cause of heart failure and is defined as:
 - developing heart failure in the last month of pregnancy or within 5 months postpartum;
- a diagnosis of exclusion with absence of another etiology for the heart failure;
- LVEF of <45% [1].
- Symptoms of PPCM can often be mistaken for normal pregnancy symptoms and, therefore, the diagnosis of PPCM could be delayed.
- Peripartum cardiomyopathy is a diagnosis of exclusion.
- A multidisciplinary approach to care is essential and should include maternal-fetal medicine, cardiology, anesthesia, and neonatology, if applicable.
- Treatment and management are usually supportive and directed toward immediately managing heart failure, improving blood flow to vital organs, and reducing fluid overload.
- Contraceptive counseling and preconception consultation with maternal-fetal medicine and cardiology are essential following recovery.

References

- 1 Bauersachs J, König T, Van der Meer P, et al. Pathophysiology, Diagnosis and Management of Peripartum Cardiomyopathy: A Position Statement from the Heart Failure Association of the European Society of Cardiology Study Group on Peripartum Cardiomyopathy. *Eur J Heart Fail.* 2019;21: 827–843.
- 2 Sliwa K, Mebazaa A, Hilfiker-Kleiner D, et al. Clinical Characteristics of Patients from the Worldwide Registry on Peripartum Cardiomyopathy (PPCM): EURObservational Research Programme in Conjunction with the Heart Failure Association of the European Society of Cardiology Study Group on PPCM. *Eur J Heart Fail.* 2017;19:1131–1141.
- 3 Arany Z, Elkayam U. Peripartum Cardiomyopathy. *Circulation.* 2016;133:1397–1409.
- 4 Davis MB, Arany Z, McNamara DM, et al. Peripartum Cardiomyopathy: JACC State-of-the Art Review. *J Am Coll Cardiol.* 2020;75: 207–221.
- 5 Regitz-Zagrosek V, Roos-Hesselink JW, Bauersachs J, et al. 2018 ESC Guidelines for the Management of Cardiovascular Diseases during Pregnancy. *Eur Heart J.* 2018;39: 3165–3241.
- 6 Elkayam U. Clinical Characteristics of Peripartum Cardiomyopathy in the United States: Diagnosis, Prognosis, and Management. *J Am Coll Cardiol.* 2011;58:659–670.
- 7 McNamara DM, Elkayam U, Alharethi R, et al. Clinical Outcomes for Peripartum Cardiomyopathy in North America: Results of the IPAC Study (Investigations of Pregnancy-Associated Cardiomyopathy). *J Am Coll Cardiol.* 2015;66: 905–914.

A 30-Year-Old with Postural Headache 12 Hours after a Vaginal Delivery with Use of an Epidural

Ann Williford

History of Present Illness

A 30-year-old gravida 3 para 3 patient presented to the hospital in active labor at 39 2/7 weeks' gestation. Upon admission, she requested an epidural for pain control. During the epidural placement, there was an unintentional dural puncture. After her delivery, the patient was taken to the postpartum unit and noticed a worsening frontal headache when she was sitting or standing. Her headache improved when she was lying flat. She reported associated neck stiffness and nausea. Despite taking 600 mg of ibuprofen and 1,000 mg of acetaminophen, her headache has persisted, and she has been unable to take care of her baby due to the severity of the pain.

Her prenatal care was uncomplicated. She has had two prior uncomplicated vaginal deliveries at term without similar symptoms. She has a history of tension headaches but has not had a headache in over a year. She has no other past medical or surgical history.

Physical Examination

General appearance: Well-developed 30-year-old female, lying flat in the bed in no apparent distress, but tearful

Vital signs:

Temperature: 37.1°C

Pulse: 98 beats per minute

Blood pressure: 121/76 mmHg

Respiratory rate: 14 breaths per minute

BMI: 20 kg/m²

Cardiopulmonary: Regular rate and rhythm without murmur, rub, or gallop; lungs clear to auscultation bilaterally

Abdomen: Normoactive bowel sounds, soft, non-tender; fundus is firm and two fingerbreadths below the umbilicus

Neurologic/psychologic: Alert and oriented with normal speech; affect and mood are appropriate to situation. No motor deficits are noted, with muscle strength 5/5 in bilateral upper and lower extremities. Sensation is intact bilaterally. Cranial nerves are grossly intact

Skin: Normal skin on back without lesion, tenderness, or erythema

Laboratory studies:

Hgb: 11.5 g/dL

How Would You Manage This Patient?

This patient has a post-dural puncture headache (PDPH) given her clinical presentation of a positional headache within 72 hours of an unintentional dural puncture during her epidural placement. She also has no abnormal neurologic finding on her physical exam. Her symptoms remain debilitating despite the administration of simple analgesics and she is unable to care for her newborn baby. An anesthesiologist is consulted to obtain an epidural blood patch. After counseling, the patient agrees to the procedure. An epidural needle is inserted in a sterile fashion into the epidural space at the level of the same spinal interspace of her previous dural puncture. Twenty milliliters of autologous blood drawn from the patient's median cubital vein are injected slowly through the epidural needle. The patient has immediate resolution of her headache. After the blood patch is completed, the patient lies flat for 2 hours and is then able to resume normal activities. She has mild back pain following the blood patch, which is controlled with simple analgesia. She is discharged home on the second day postpartum without issue with a plan for routine follow-up.

Post-dural Puncture Headache

More than 60% of pregnant patients in the United States select neuraxial anesthesia for pain control during delivery, with the most common forms being epidural, spinal, and combined spinal-epidural anesthesia [1]. Anatomically, the epidural space is the potential space between the periosteum lining the vertebral canal and the dura mater, which encases the subarachnoid space, cauda equina of the spinal cord, and the cerebrospinal fluid (CSF). During spinal or combined spinal-epidural anesthesia, the dura mater is punctured and anesthetic agents are injected into the subarachnoid space. With epidural anesthesia, the anesthetic agents are administered through a catheter that has been threaded into the epidural space. An unintentional dural puncture can complicate 1.5% of epidural placements [2]. Leakage of CSF from a puncture in the dura mater can lead to a PDPH. The incidence of these headaches is 0.2–1% following spinal anesthesia and 81–88% after epidural placement complicated by an unintentional dural puncture [3]. The overall incidence of a PDPH is 1% when neuraxial anesthesia is used, and it is the most common complication of this type of anesthesia [2].

Table 68.1 Common causes of postpartum headaches

	Tension	Migraine	Cluster	PDPH	Preeclampsia
Location	Bilateral frontal	Unilateral frontal	Unilateral periorbital	Frontal or occipital	Generalized
Severity	Mild-moderate	Severe	Severe	Moderate-severe	Moderate-severe
Quality	Non-throbbing	Throbbing	Sharp/stabbing	Sharp/positional	Throbbing
Associated symptoms	Neck stiffness	Nausea, photophobia, phonophobia	Ptosis, miosis, lacrimation, nasal congestion	Nausea, neck stiffness, vertigo, visual changes	Visual changes, RUQ pain, hypertension, shortness of breath

To decrease the risk of a PDPH, it is recommended to use smaller-gauge needles and to avoid multiple punctures during epidural placement. Using an atraumatic needle and having the bevel oriented parallel to the long axis of the spine decreases the risk following spinal anesthesia [4]. If an unintentional dural puncture occurs during an epidural placement, there is no treatment that has been proven effective at preventing headaches.

It is unclear why leakage of CSF leads to headache. One theory is that CSF hypotension results in compensatory blood volume expansion due to meningeal vasodilation. Another etiology of the headache may be from intracranial hypotension related to the CSF leak, possibly causing intracranial structures to sag and stretch sensory intracranial nerves [3].

Headaches in the postpartum period are common, with women reporting an incidence of 39% in the first week postpartum [5]. Post-dural puncture headache should be distinguished from other potential causes of severe postpartum headache including migraine, tension headache, preeclampsia, cluster headache, and central venous sinus thrombosis (Table 68.1). Classically, a PDPH will be a frontal or occipital headache that is positional, exacerbated by sitting or standing, and relieved by lying flat. It will generally occur within 72 hours of a dural puncture and tends to be more severe if it occurs within the first 24 hours. Nausea, neck stiffness, vertigo, diplopia, blurred vision, photophobia, low back pain, or auditory disturbances may also accompany the headache. The diagnosis of PDPH is clinical, and additional testing is reserved for headaches that fail to respond to epidural blood patch treatment, are prolonged beyond 5–7 days, become non-positional, or are associated with focal neurologic symptoms. Additionally, if the patient is immunocompromised, has signs of infection, or has signs or symptoms of preeclampsia, laboratory testing and/or neuroimaging should be considered.

For patients with mild PDPH symptoms, an initial trial of conservative measures including aggressive rehydration and analgesia is recommended. Although drug therapy has not been found to be universally beneficial for PDPH, caffeine and simple analgesics like acetaminophen and nonsteroidal anti-inflammatory drugs (NSAIDs) are low-risk medications that may be chosen as treatment. Caffeine may also decrease

the risk of PDPH persistence [3]. While these simple measures can help relieve symptoms, they are supportive and not curative. Additionally, gabapentin, hydrocortisone, and theophylline were shown to decrease pain severity scoring in several small randomized controlled trials and can be considered for treatment [3].

The gold-standard treatment for PDPH is an epidural blood patch. This treatment is the most effective option for those with severe or debilitating symptoms. A second epidural procedure is performed and 20 mL of autologous blood is injected into the epidural space at, or just below, the site of the dural puncture. With the epidural blood patch, the CSF leak is sealed by the mass effect of clot formation by the blood patch. Relief is almost immediate following treatment, and the success rate of symptom improvement following an epidural blood patch is 65–98% [5]. Epidural blood patches can be placed with fluoroscopic guidance if the neuraxial anesthesia placement was previously challenging, and outcomes are also improved if the blood patch is placed by an experienced provider [6]. Contraindications to an epidural blood patch are current coagulopathy, systemic infection, anticoagulation use, and infection at the epidural site. If left untreated, PDPH generally remits spontaneously within 2 weeks. A prior history of a PDPH is a risk factor for recurrence, as it may denote a more difficult epidural placement. Epidural placement prior to advanced cervical dilation by an experienced provider decreases the risk of unintentional dural puncture and is a strategy to decrease the risk of recurrence [2].

Key Teaching Points

- Post-dural puncture headache is the most common complication of neuraxial anesthesia.
- It presents as a postural headache that develops within 72 hours of an intentional or unintentional dural puncture.
- Occurrence is lowest when neuraxial anesthesia is placed by an experienced provider, puncture attempts are minimized, and atraumatic spinal needles are used.
- Epidural blood patch achieves high rates of successful resolution when conservative measures fail.

References

- 1 American College of Obstetricians and Gynecologists' Committee on Practice Bulletins-Obstetrics. ACOG Practice Bulletin No. 209: Obstetric Analgesia and Anesthesia. *Obstet Gynecol.* 2019;133:e208–e225.
- 2 Buddeberg BS, Bandschapp O, Girard T. Post-dural Puncture Headache. *Minerva Anesthesiol.* 2019;85:543–553.
- 3 Basurto Ona X, Osorio D, Bonfill Cosp X. Drug Therapy for Treating Post-dural Puncture Headache. *Cochrane Database Syst Rev.* 2015;(7):CD007887.
- 4 Vallejo MC, Zakowski MI. Post-dural Puncture Headache Diagnosis and Management. *Best Pract Res Clin Anaesthesiol.* 2022;36(1):179–189.
- 5 Banks S, Paech M, Gurrin L. An Audit of Epidural Blood Patch after Accidental Dural Puncture with a Tuohy Needle in Obstetric Patients. *Int J Obstet Anesth.* 2001;10:172.
- 6 Kawaguchi M, Hashizume K, Watanabe K, et al. Fluoroscopically Guided Epidural Blood Patch in Patients with Postdural Puncture Headaches after Spinal and Epidural Anesthesia. *J Anesth.* 2011;25:450.

A 35-Year-Old Develops Agitation, Dyspnea, Hypotension, and Cardiovascular Collapse Immediately Postpartum

Amy R. Harrington

History of Present Illness

A 35-year-old gravida 2 para 1 presented in active labor. Her pregnancy was uncomplicated. She quickly progressed to full dilation and had an unmedicated spontaneous vaginal delivery (SVD) of a 3,250 g baby. Intravenous oxytocin was started for postpartum hemorrhage (PPH) prevention. The placenta delivered spontaneously with excellent uterine tone noted. Shortly after delivery, the patient appeared agitated and reported difficulty catching her breath. Vital signs were checked, and she was hypotensive with hypoxia. Brisk vaginal bleeding was noted. She rapidly became unresponsive, and pulses were undetectable.

Physical Examination

General appearance: Appropriate for age, pale and anxious

Vital signs prior to loss of pulses:

Temperature: 37.1°C

Pulse: 174 beats per minute

Blood pressure: 53/40 mmHg

Respiratory rate: 32 breaths per minute

Oxygen saturation: 89%

BMI: 32.9 kg/m²

Cardiopulmonary: Shallow breaths with decreased breath sound bilaterally

Abdomen: Soft, non-distended, gravid postpartum atonic uterus at 4 cm above the umbilicus

Pelvic: Intact perineum, no vaginal or cervical lacerations, profuse bleeding from the uterus

Neurologic/psychologic: Unresponsive, no posturing

Laboratory studies:

On admission:

Hgb: 10.2 g/dL (normal 12.1–14.4 g/dL)

Plt: $182 \times 10^3/\mu\text{L}$ (normal 150×10^3 – $400 \times 10^3/\mu\text{L}$)

Blood type: A positive

During resuscitation:

Hgb: 6.2 g/dL

Plt: $56 \times 10^3/\mu\text{L}$

PT: 15.4 seconds (normal 10–12.9 seconds)

INR: 1.4 (normal 0.9–1.1)

PTT: 36 seconds (25.8–37.9 seconds)

Fibrinogen: 110 mg/dL (normal 172–409 mg/dL nonpregnant)

How Would You Manage This Patient

This patient's sudden, unanticipated cardiovascular collapse immediately postpartum raises the concern for amniotic fluid embolism (AFE). An adult code to assemble a multidisciplinary team (anesthesiologists, intensive care specialists, pharmacists, nursing, respiratory therapy) was called overhead as chest compressions were started. Cardiac rhythm demonstrated pulseless ventricular tachycardia, which returned to sinus tachycardia after two defibrillating shocks. During the resuscitation, endotracheal intubation for airway support was obtained. Due to profuse uterine bleeding and an atonic uterus, massive transfusion protocol (MTP) was initiated. Echocardiography demonstrated a dilated hypokinetic right ventricle. Dobutamine IV drip was initiated. Norepinephrine was started for treatment of hypotension. Atony was managed with IV oxytocin and uterine massage. Additional uterotonics were given. As disseminated intravascular coagulation (DIC) was immediately suspected, tranexamic acid (TXA) and blood products were also infused. The patient received 8 units of packed RBCs, 4 units of packed platelets, 2 units of fresh frozen plasma (FFP), and 3 units of cryoprecipitate. An intrauterine balloon was placed, and bleeding stabilized. Quantitative blood loss for the delivery and resuscitation was 7,034 cc. The patient was transferred to the surgical ICU where she received supportive care. Pulmonary edema was treated with diuretics. The intrauterine balloon was deflated and removed on postpartum day 1. Patient was weaned off vasopressors. She was extubated on postpartum day 2 and transferred to the floor. She was discharged home on postpartum day 5.

Amniotic Fluid Embolus

Amniotic fluid embolism is a rare but potentially devastating obstetric condition. While this condition typically occurs during labor or postpartum, it can be seen following trauma, abortion, and even amniocentesis. The diagnosis remains largely clinical despite efforts for identification of better biochemical markers. As such, the exact incidence of AFE is unknown, but estimated to be 1.9–6.1 per 100,000 deliveries with patient mortality of $\leq 50\%$ [1]. The pathophysiology of AFE appears to be the result of fetal antigens and amniotic fluid that enter the maternal circulation, initiating a complex and abnormal activation of proinflammatory mediator systems. These include the release of vasoactive and

procoagulant substances (like endothelin) that, along with complement activation, result in the triad of hypoxia, hypotension, and coagulopathy that are the hallmarks of AFE. Historically, AFE was thought to be the result of actual physical obstruction of the pulmonary circulation by fetal material present in amniotic fluid due to the findings of fetal squamous cells in the maternal pulmonary arteries, hence the name AFE. Current understanding holds that this phenomenon is an immunologic process rather than an obstructive one. Attempts at renaming the condition anaphylactoid syndrome of pregnancy to better reflect the etiology have been relatively unsuccessful, thus the continued use of the misnomer AFE [2,3,4]. Despite efforts to identify a laboratory marker for AFE, none have yet been found to be useful. Markers that have been investigated include tryptase, urinary histamine, insulin-like growth factor-binding protein-1, markers of complement activation, and postmortem immunohistologic staining for evidence of pulmonary mast cell degranulation. Amniotic fluid embolism should not be diagnosed based on the postmortem presence of fetal squamous cells in the pulmonary circulation as these are now considered nonspecific and found via pulmonary artery catheterization blood specimens in patients with severe preeclampsia, cardiac disease, and septic shock [1].

Clinical signs and symptoms of AFE include a variety of cardiovascular, respiratory, hematologic, neurologic, and obstetric findings. These can be subtle, or severe with acute cardiac arrest. Patients may report restlessness, agitation, chest pain, lightheadedness, feelings of distress or doom, dyspnea, or shortness of breath. Fetal heart rate monitoring may demonstrate fetal distress with decelerations or bradycardia. The timing of symptoms, which occur during labor or within the first 30 minutes postpartum, is another hallmark of the process. Amniotic fluid embolism should be part of the differential diagnosis in any laboring or immediate postpartum person who has a sudden cardiovascular collapse, arrest, seizures, severe respiratory difficulty, or hypoxia. The differential diagnosis of such events includes PE, myocardial infarction, air embolism, anesthetic complications, anaphylaxis, and sepsis. The clinical finding that confirms the diagnosis of AFE is the rapid development of DIC [4,5]. Regardless of cause, the initial management of any of these diagnoses remains the same – the ABCs of resuscitation: cardiopulmonary stabilization, treatment of hypoxia, and maintenance of vascular perfusion. Endotracheal intubation to maintain oxygen saturation is commonly performed. Cardiac arrest in a pregnant patient is addressed elsewhere in this book (Cases 58 and 59), but if the fetus is viable and not yet delivered, expediting delivery either via an assisted vaginal delivery or CD is recommended to optimize maternal resuscitation [5].

The phases of AFE can be divided into early and late and are based on ventricular dysfunction. Once fetal material has breached the maternal circulatory system, massive amounts of pulmonary vasoconstrictors are released (Figure 69.1). This results in the early phase of AFE: acute right ventricle

failure and acute respiratory failure, which we see as hypotension, hypoxia, and the start of cardiovascular collapse. If echocardiography were to be performed, a large dilated and hypokinetic right ventricle would be seen. Interventions during this early stage include recognition and the use of vasopressors (norepinephrine/vasopressin) to maintain blood pressure, inotropes (dobutamine/milrinone) to improve right ventricular function and cardiac output, and inhaled nitric oxide or prostacyclin to decrease pulmonary afterload by decreasing pulmonary vascular resistance. Avoiding excessive volume overload with fluid resuscitation is another goal as flooding a hypokinetic right ventricle continues to overdilate the heart and infarction can occur. Unfortunately, the early stage of AFE rapidly progresses, and these medications may not be readily available. As the right ventricle fails, the left ventricle can become compressed, resulting in decreased left-sided cardiac output. Left ventricular failure, cardiogenic pulmonary edema, and hypotension are the result of the late phase of AFE. Once left heart failure has developed, key interventions include maintaining cardiovascular hemodynamics to optimize cardiac preload, use of norepinephrine to keep coronary vessels open, and using inotropes to increase left ventricular contractility. Avoidance of excessive fluids is recommended as severe pulmonary congestion can occur [4,5].

The coagulopathy that accompanies cardiovascular collapse throws another dynamic into the resuscitation mix. The activation of factor VII and platelets that occurs after fetal material/amniotic fluid enters the maternal circulation results in DIC with further inflammatory responses activating the coagulation cascade. Active treatment of atony or any other areas of bleeding is critical. Massive transfusion protocols should be initiated immediately as hemorrhage can contribute to and worsen hemodynamic instability while DIC leads to ischemic organ dysfunction and multiorgan failure. Another benefit of MTP is that using blood products (colloid) can help decrease the amount of fluid (crystalloid) that is given and may help prevent excessive fluid overload from resuscitation. While recombinant activated factor VII was once thought to be a promising adjunctive treatment for AFE-induced DIC, the risk of diffuse thrombosis and multiorgan failure makes this a treatment of last resort. Newer research has demonstrated hyperfibrinolysis in AFE-induced DIC, making the administration of antifibrinolytics such as TXA a valuable treatment option when available [3,4,5].

More recently, an adjunctive therapy has been suggested: the administration of atropine, ondansetron, and ketorolac (AOK). Data supporting its use are limited to case studies of patients who received AOK early in the acute event and survived. As formal trials have not been conducted, the clinical benefit is still in question, but it has plausibility based on mechanism of action of these medications. These medications provide an additional reduction in pulmonary vascular resistance and, if given early when AFE is suspected, could mitigate the inflammatory response. During an AFE, serotonin and

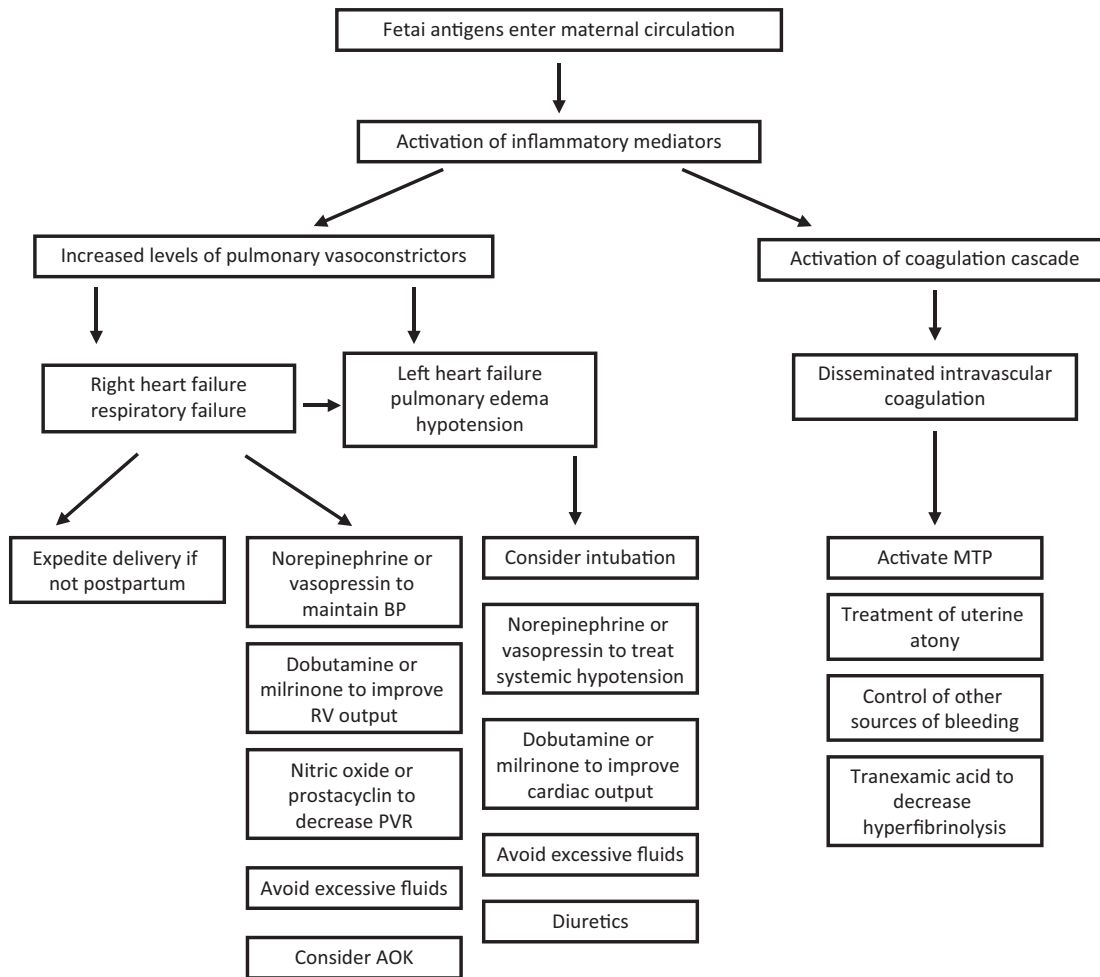


Figure 69.1 Pathophysiology and treatment of AFE. AOK, atropine, ondansetron, and ketorolac; BP, blood pressure; PVR, peripheral vascular resistance; RV, right ventricle

thromboxane are seen in increased levels in maternal circulation. Serotonin activates receptors in pulmonary vessels, causing vasoconstriction and platelet entrapment. Platelets are activated by thromboxane to recruit more platelets, increasing pulmonary hypertension. Serotonin is also thought to reduce peripheral vascular tone via a centrally mediated process that can lead to cardiovascular collapse. The addition of ondansetron may modulate the serotonin effect, preventing worsening of the inflammatory response, while ketorolac can reduce the production of thromboxane through its NSAID effect. Finally, the addition of atropine can counteract the parasympathetic effects that lead to bradycardia [6,7].

Outcomes will vary depending on the severity of the AFE and immune response, the occurrence of cardiac arrest, the availability of critical care, and the location of the event. In studies restricted to patients who had all the classic signs and symptoms of AFE, mortality rates were >60%. In cases that included in-hospital cardiac arrest, <25% survived to discharge. Recurrence rates are very difficult to estimate as AFE itself is so rare [4,5]. Having a high suspicion for an AFE, quickly assembling a multidisciplinary team and intervening

immediately will improve survival from this rare event. As it is such a rare event and many providers have limited to no experience in managing AFE, the Society for Maternal-Fetal Medicine recommends having a readily available checklist for these events. Obstetric emergencies have been shown to have better outcomes when protocols with standardized interventions, identified team roles, and in situ drills are utilized [8,9].

Key Teaching Points

- Amniotic fluid embolism is a clinical diagnosis with the classic triad of sudden onset hypoxia, hypotension, and coagulopathy.
- It is rare, but often lethal. Prompt suspicion and expert critical care management improves outcomes.
- Treatment is supportive, but rapid initiation of treatment is essential. Management focuses on treating right heart failure and the cardiogenic shock that follows with left heart failure.
- Multimodal therapy with the addition of AOK may provide benefit.

References

- 1 Clark SL. Amniotic Fluid Embolism. *Obstet Gynecol.* 2014;123:337–348.
- 2 Sultan P, Seligman K, Carvalho B. Amniotic Fluid Embolism: Update and Review. *Curr Opin Anaesthesiol.* 2016;29(3):288–296.
- 3 Conde-Agudelo A, Romero R. Amniotic Fluid Embolism: An Evidence-Based Review. *Am J Obstet Gynecol.* 2009;201(5):445.e1–445.e13.
- 4 Shamshirsaz AA, Clark SL. Amniotic Fluid Embolism. *Obstet Gynecol Clin North Am.* 2016;43(4):779–790.
- 5 Pacheco LD, Saade G, Hankins GD, Clark SL. Amniotic Fluid Embolism: Diagnosis and Management. *Am J Obstet Gynecol.* 2016;215(2):B16–B24.
- 6 Long M, Martin J, Biggio J. Atropine, Ondansetron, and Ketorolac: Supplemental Management of Amniotic Fluid Embolism. *Ochsner J.* 2022;22(3):253–257.
- 7 Rezai S, Hughes AC, Larsen TB, Fuller PN, Henderson CE. Atypical Amniotic Fluid Embolism Managed with a Novel Therapeutic Regimen. *Case Rep Obstet Gynecol.* 2017;2017:8458375.
- 8 Combs CA, Montgomery DM, Toner LE, Dildy GA. Society for Maternal-Fetal Medicine Special Statement: Checklist for Initial Management of Amniotic Fluid Embolism. *Am J Obstet Gynecol.* 2021;224(4):B29–B32.
- 9 ACOG Committee Opinion No. 487: Preparing for Clinical Emergencies in Obstetrics and Gynecology. *Obstet Gynecol.* 2011;117(4):1032–1034.

CASE 70

A 25-Year-Old Presents with Bright Red Vaginal Bleeding 3 Weeks' Postpartum

Cynthia Abraham

History of Present Illness

A 25-year-old gravida 1 para 1 patient presents to the emergency department (ED) with bright red vaginal bleeding 3 weeks' postpartum. She had an uncomplicated normal spontaneous vaginal delivery (SVD) without lacerations. She did not receive any uterotonics other than oxytocin. She was discharged from the hospital 2 days later. She reports that vaginal bleeding has progressively increased since delivery. For the past 1–2 days, she has been soaking 8–9 pads per day and passing golf-ball-sized blood clots. She also reports abdominal cramping that has not improved with ibuprofen use. She further reports experiencing lightheadedness, dizziness, and weakness. She has no significant past medical or surgical history. She is taking only prenatal vitamins and has no known drug allergies.

Physical Examination

General appearance: Well-developed, no acute distress, pale
Vital signs:

Temperature: 37.1°C

Pulse: 122 beats per minute

Blood pressure: 82/53 mmHg

Respiratory rate: 18 breaths per minute

BMI: 27.2 kg/m²

Cardiopulmonary: Lungs are clear to auscultation bilaterally, with no wheezes or rales. Heart sounds are normal, with a systolic ejection murmur 2/6 auscultated at the left sternal border, but no rubs or gallops

Abdomen: Soft, suprapubic tenderness present, non-distended, no masses palpated

Pelvic: External genitalia appear normal with no masses, lesions, or erythema. The cervix is dilated 1–2 cm with bleeding from the os. Pooled in the vaginal vault are 100 mL of blood. No lesions or cervical motion tenderness is noted. The uterus is 12 weeks in size and mobile with no masses but mild fundal tenderness is present. Adnexa are not palpable, with no tenderness elicited

Laboratory studies:

Urine pregnancy test: Positive

Hgb: 8.4 g/dL (normal 10.6–14.5 g/dL)

Type and antibody screen: O positive, negative antibody screen

Imaging:

Transvaginal ultrasound shows uterus measuring 11.4 cm in length. Endometrial measurement is thickened to

2.6 cm (Figure 70.1) with extensive vascularity (Figure 70.2). Bilateral ovaries are unremarkable in appearance

How Would You Manage This Patient

This patient's clinical presentation is consistent with retained products of conception (RPOCs). Given the extent of bleeding along with hypotension and tachycardia, urgent suction curettage was recommended. The patient was consented and taken to



Figure 70.1 Ultrasound of thickened endometrium (sagittal view of uterus)



Figure 70.2 Ultrasound of thickened endometrium with vascularity (transverse view of uterus) (A black and white version of this figure will appear in some formats. For the color version, please refer to the plate section.)

the operating room for the procedure to be performed under general anesthesia due to hemodynamic instability. Prior to the start of the procedure, the patient's blood loss in the ED was approximately 600 mL. Due to excess blood loss, the patient received 2 units of packed RBCs in the ED prior to being brought to the operating room. Antibiotic administration was deferred due to absence of fever and/or malodorous discharge. The procedure was performed under sonographic guidance in order to identify location of RPOCs and minimize the risk of uterine perforation with instrumentation. A ring forceps was used to apply gentle traction to the anterior lip of the cervix. Suction curettage was performed initially to expedite uterine evacuation given concern for ongoing blood loss. A gritty texture was noted on sharp curettage after the uterine cavity was emptied. However, intermittent bleeding persisted. Tranexamic acid was administered to prevent further bleeding due to its antifibrinolytic properties. The patient was closely observed in the recovery room to assess for recurrence of bleeding from denuded endometrium. The patient was then discharged to home once confirmed to be hemodynamically stable. She was doing well at the time of the postoperative visit 2 weeks later.

Retained Products of Conception

The reported incidence of postpartum RPOCs varies across the literature. Retained products of conception are more likely to occur after a vaginal than a CD. Additional risk factors for RPOCs include presence of succenturiate lobe, history of uterine surgery, and performance of manual extraction at time of delivery. The classic presentation of RPOCs consists of heavy vaginal bleeding and pelvic pain and can occur up to 12 weeks postpartum. Bleeding that should be concerning involves passage of large blood clots, changing of a sanitary pad every hour, and/or bleeding that persists over weeks. Pain beyond the first postpartum week that is uncontrolled by NSAIDs suggests a pathologic process.

Patients may present with hypotension, tachycardia, and/or orthostatic changes stemming from heavy vaginal bleeding. Fever may occur in the setting of endometritis when retained tissue is infected by vaginal flora. On speculum exam, the cervix may be dilated and active bleeding or extrusion of tissue may be seen from the cervical os. Fundal tenderness may be appreciated on bimanual exam. Uterine size may be larger than expected [1].

Laboratory values may be significant for a low hemoglobin after heavy or prolonged bleeding. An elevated WBC count supports the presence of an intrauterine infection but may be a normal finding up to 4 weeks postpartum due to the physiologic leukocytosis of pregnancy. The detection of human chorionic gonadotropin in serum many weeks after a delivery is suggestive of RPOCs [1].

Ultrasonography is the imaging modality of choice to assess uterine contents and to ultimately diagnose RPOCs [1]. Sonographic findings include presence of enhanced myometrial vascularity, an echogenic mass within the endometrium, and thickened endometrium. At time of performance of ultrasonography, color Doppler should be applied. Retained

products of conception are suspected when there is significant low-resistance flow within the myometrium or just beneath the endometrium. However, this sonographic finding may also be due to the presence of an arterio-venous malformation. The detection of an echogenic intracavitary mass has a positive predictive value of 80% for RPOCs [2]. Detectable vascularity within the mass is suggestive of RPOCs while absence of vascularity suggests necrotic decidua or blood clots. Endometrial thickness varies considerably in the postpartum period, and consequently, does not reliably predict the presence of RPOCs. Although a cut-off endometrial measurement of 10 mm has a reported sensitivity of approximately 80%, it is associated with a specificity as low as 20%. Even thinner endometrial measurements may still be present with RPOCs [3].

Sonohysterography and hysteroscopy are additional imaging modalities that can be used to evaluate for RPOCs. Sonohysterography is superior to conventional sonography in delineating irregularities in the uterine cavity but there is inadequate evidence to support more frequent utilization of this tool over conventional sonography in this setting. Hysteroscopy, unlike sonohysterography, allows for diagnosis and treatment of intracavity abnormalities at the same time. However, neither should be performed in the setting of intrauterine infection nor in a patient who is hemodynamically unstable.

In the setting of hemodynamic instability, patients should be stabilized with fluid and blood products prior to urgent surgical intervention. Surgical intervention (either sharp or suction curettage) is directed at evacuation of RPOCs. Patients with RPOCs will not need to undergo further cervical dilation with dilators if presenting with an open cervix. Suction should be utilized when blood loss exceeds 500 mL or if the bleeding is uncontrolled. If dilation is necessary, one should dilate sufficiently to accommodate insertion of the suction cannula. Choosing a cannula of an appropriate size will allow for expeditious uterine evacuation. Curettage should be performed under sonographic guidance in order to decrease the risk of uterine perforation and to confirm that the uterus has been evacuated. Abdominal exploration is warranted if perforation occurs at time of suction curettage if the patient's clinical status worsens or if there is concern for vascular or visceral injury [4]. If bleeding persists after uterine evacuation, uterotonics or tranexamic acid (TXA) may be administered. Ongoing bleeding should raise the suspicion for presence of placenta accreta. Uterine tamponade can be attempted, which can be performed via placement of an intrauterine balloon. If this intervention does not improve bleeding, uterine artery embolization (UAE) is an option if the patient is stable. However, if the patient is unstable, hysterectomy should be considered as an option of last resort [5,6,7].

Although there are data from several high-quality studies that suggest a reduced risk of postoperative endometritis in those undergoing surgical termination of pregnancy in the first trimester, there are no data on prophylactic administration of antibiotics to reduce the risk of endometritis after curettage for RPOC postpartum [8,9]. Broad-spectrum antibiotic administration would be indicated in the setting of fever and/or malodorous discharge for presumed endometritis.

Key Teaching Points

- Treatment of RPOCs in the postpartum period should be performed by curettage.
- Hemodynamically unstable patients should undergo volume resuscitation and proceed to surgical intervention urgently.
- Ultrasound is the imaging modality of choice in the diagnosis of RPOCs. Sonographic findings include presence of enhanced myometrial vascularity, an echogenic mass within the endometrium, and thickened endometrial measurement. Thickened endometrium is the most variable finding.
- There are limited data to support the administration of perioperative antibiotics to reduce risk of postoperative endometritis.
- If bleeding persists after uterine evacuation, uterotonics or antifibrinolytics should be administered. Uterine tamponade may also be attempted. Ongoing bleeding should raise the suspicion for placenta accreta.

References

- 1 Wolman I, Altman E, Faith G, et al. Combined Clinical and Ultrasonographic Work-up for the Diagnosis of Retained Products of Conception. *Fertil Steril*. 2009;92:1162.
- 2 Kamaya A, Petrovitch I, Chen B, et al. Retained Products of Conception: Spectrum of Color Doppler Findings. *J Ultrasound Med*. 2009;28:1031.
- 3 Sellmyer MA, Desser TS, Maturen KE, et al. Physiologic, Histologic, and Imaging Features of Retained Products of Conception. *Radiographics*. 2013;33:781.
- 4 Richards EG, Rehmer JM, Falcone T. Perforation during Gynecological Procedures. *JAMA*. 2023;329(11):933–934.
- 5 American College of Obstetricians and Gynecologists. ACOG Practice Bulletin: Clinical Management Guidelines for Obstetrician-Gynecologists Number 76, October 2006: Postpartum Hemorrhage. *Obstet Gynecol*. 2006;108(4):1039–1047.
- 6 Fox R, Aitken G, Mooney SS. Management of Secondary Postpartum Haemorrhage: A Systematic Review. *Eur J Obstet Gynecol Reprod Biol*. 2023;282:116–123.
- 7 Ahonen J, Stefanovic V, Lassila R. Management of Post-partum Haemorrhage. *Acta Anaesthesiol Scand*. 2010;54(10):1164–1178.
- 8 Lissauer D, Wilson A, Hewitt CA, et al. A Randomized Trial of Prophylactic Antibiotics for Miscarriage Surgery. *N Engl J Med*. 2019;380(11):1012–1021.
- 9 Low N, Mueller M, Van Vliet HA, et al. Perioperative Antibiotics to Prevent Infection after First-Trimester Abortion. *Cochrane Database Syst Rev*. 2012;(3):CD005217.

A 25-Year-Old Presents Immediately Postpartum with Severe Pubic Pain Limiting Ambulation

Cristina Wallace Huff

History of Present Illness

A 25-year-old gravida 3 para 2 patient had an uncomplicated spontaneous vaginal delivery (SVD) at 39 2/7 weeks. She delivered a healthy male weighing 3,800 g and had no lacerations at the time of delivery. Before the pregnancy, she was active and regularly exercised two to three times a week by running and biking. The day after delivery, she reports severe pubic pain. She is having difficulty with ambulation and can barely stand. She can only place limited weight on her legs without pain, and a physical therapist is consulted to provide a walker. She denies having difficulty with voiding or having difficulty with defecation.

She has no medical problems or previous surgeries. She denies a history of trauma or sexually transmitted diseases. She is not on any additional medications and has no food or drug allergies. She is only taking ibuprofen for pain as needed. She reports that the ibuprofen provides moderate relief with rest but does not help her pain when she moves.

Physical Examination

General appearance: Awake, uncomfortable

Vital signs: Temperature: 37.0°C

Pulse: 85 beats per minute

Respiratory rate: 20 breaths per minute

Oxygen saturation: 100% on room air

BMI: 26.6 kg/m²

Abdomen: Soft, fundus firm at the umbilicus, exquisite tenderness at pubic symphysis with palpable separation about 1.5 cm in size; the remainder of abdomen is nontender with no guarding or rebound

Extremities: No cyanosis or edema

Pelvic: Normal external female genitalia with moderate lochia on perineal pad

Neurologic/psychologic: Cranial nerves 2–12 are intact. Sensation is intact and equal in bilateral lower extremities. There is 5/5 strength in both quadriceps and hamstrings, but raising either leg evokes pain that radiates to the pubic region. Gait is limited, requiring assistance with walker

Laboratory studies:

Hgb: 11.5 g/dL (normal 12.1–14.4 g/dL)

Urinalysis: Negative for leukocytes, nitrites

Imaging:

Pelvic x-ray: 1.1 cm separation of pubic symphysis noted (Figure 71.1)

How Would You Manage This Patient?

This patient's symptoms and radiologic findings are consistent with pubic symphyseal separation postpartum. Physical therapy was consulted. The therapist fitted the patient with a pelvic belt and brought a walker to aid the patient with ambulation. Additionally, the physical therapist taught the patient pelvic exercises that would improve the patient's pelvic muscle strength. The patient's pain was also treated with a non-steroidal anti-inflammatory drug (NSAID) analgesic. By postpartum day 3, she could ambulate with a walker on level surfaces and complete basic mobility tasks such as getting out of bed and bearing weight on each leg one at a time. She was subsequently discharged home with instructions for strict pelvic rest and was instructed to take frequent breaks and limit household chores. It was emphasized that she should continue infant care and seek assistance lifting the infant as needed. Outpatient physical therapy was continued upon discharge, and a physical therapist also came to her house for a safety evaluation. She was counseled that she is at increased risk of recurrence of pubic symphyseal separation in a future pregnancy, but this condition does not preclude attempting vaginal delivery for her next pregnancy.

Pubic Symphyseal Separation

Pubic symphyseal separation, or diastasis, is a rare complication, with incidence reported between 1 in 300 and 1 in 30,000 pregnancies [1]. Risk factors for pubic symphysis



Figure 71.1 Anterior/posterior x-ray of pelvis demonstrating pubic symphyseal separation of 11 mm

diastasis include fetal macrosomia, a small pelvic outlet, previous pelvic trauma, precipitous labor, forceps delivery, epidural anesthesia, shoulder dystocia, and rapid second stage of labor [2,3,4]. The etiology of pubic symphyseal separation is not fully understood, but it is associated with pathological joint loosening with increased force placed on the pelvic ring [5].

During pregnancy, the influence of estrogens and relaxin leads to the remodeling of collagen fibers throughout the body. The pubic symphysis is composed of thick type I collagen fibers and chondrocytes. In adults, the average width of the pubic symphysis is 3–6 mm. There is physiologic dilation of the pubic symphysis by 3–4 mm, and usually, by 5 months postpartum, the pubic symphysis returns to its original size [6].

Pubic symphysis diastasis can occur during pregnancy and at the time of delivery. Among antepartum cases, 12% are in the first trimester, 34% are in the second trimester, 52% are in the third trimester, and 2% are unsure of timing [6,7].

At delivery, positioning patients with McRoberts maneuver in the setting of epidural anesthesia may increase the risk of symphysis diastasis [4]. There have been cases of symphysis diastasis documented where an audible crack or “pop” is noted at the time of delivery before the diagnosis [1]. Patients commonly demonstrate symptoms after delivery, and the diagnosis is made in the first 48 hours postpartum [3]. Spinal or epidural anesthesia can potentially mask the symptoms [5].

Patients typically present with acute pain in the suprapubic region with significant tenderness that radiates to the lower back or posterior pelvic girdle. Symptoms typically are worse with ambulating and performing activities of daily living like bending and climbing stairs. Many patients report that the pain is worst with transitioning from sitting to standing, and the pain may make standing on one leg impossible [2]. Patients can significantly change their gait to a waddling gait due to pain on active hip flexion [1,2,6]. Patients often experience dyspareunia, and occasional bladder dysfunction has been noted [5,7]. Patients report that pain improves with rest.

On examination, there is tenderness over the pubic symphysis and occasionally over the sacroiliac joint [7]. In some cases, there is a palpable gap at the pubic symphysis [2]. In addition, there can be swelling, edema, and bruising in the suprapubic region with a possible positive FABER test on one or both sides [7]. FABER stands for flexion, abduction, and external rotation. The test is done by flexing the leg and abducting the thigh with external rotation. The test is positive if pain is elicited when the examiner places pressure on the ipsilateral anterior superior iliac spine [8].

The differential diagnosis for symphyseal pain is broad, including sciatica, urinary tract infection, low back pain, deep pelvic/leg vein thrombosis, inflammation of the pubic symphysis, osteomyelitis, malignant osteolysis, septic arthritis, and multiple myeloma [2,6]. Assessing the patient’s urine with a urinalysis and complete blood count may be considered to rule out other potential etiologies.

Diagnosis is made by an x-ray of the pelvis with inlet, outlet, and anterior/posterior views [2]. A gap in the pubic symphysis of >10 mm is diagnostic. Ultrasound can also be performed to confirm the diagnosis and is more commonly

used during pregnancy to avoid radiation [5]. A CT scan and MRI can also be used to make the diagnosis [2,6]. The degree of separation does not always correspond to the severity of the symptoms. Postpartum patients often have pain, and the diagnosis is often delayed or missed [1]. It is important for clinicians to suspect symphyseal diastasis and to assess patients for this disorder if the pain is refractory and does not improve.

Treatment is aimed at restoring pelvic stability. Initially, conservative therapy is recommended. Conservative therapy includes ice packs, acetaminophen, and short stints of NSAID drugs. Circular compression of the pelvis is also recommended with a pelvic binder or fitted brace. Patients benefit from consultation with a physical therapist, who may instruct in the use of mobilization aids such as crutches or walkers [2,5]. Prolonged bed rest should be avoided due to potential complications like decubitus ulcers and deep venous thrombosis [6]. Local injections with hydrocortisone and ropivacaine have also been successfully used [2,6]. Improvement typically occurs within 6 weeks but can take up to 6 months [2,6]. Nearly complete closure of the pubic symphysis is usually noted on x-ray or ultrasound at 3 months [6]. Some patients may have persistent pain for 12 months or longer. Repeating pelvic x-rays 6–10 weeks after injury to assess proper healing is reasonable [9].

Surgery is typically reserved for patients who do not respond to conservative management. Indications for immediate surgery would be hemorrhage or a lesion impacting the urogenital tract [1]. Surgery can also be considered if there is evidence of severe diastasis of >25 mm or when conservative management fails with evidence of persistent pain or separation noted on x-ray [6,9]. The first-line surgical treatment is an open reduction with an internal fixation procedure performed by an orthopedic surgeon [1,6].

It is difficult to predict the recurrence of symphyseal separation. However, reports suggest that it can be as high as 68–85% in subsequent pregnancies [10]. Occurrence does not necessarily alter the management of subsequent pregnancies and is not a contraindication to trial of labor [5,6]. There are some reports that pubic symphysis separation of >15 mm may predict recurrence and is a possible indication for cesarean section. Physicians should counsel patients about recommended delivery route on a case-by-case basis, as there are no precise data guiding the management [6].

Key Teaching Points

- Pubic symphyseal separation is defined as the separation of pubic symphysis of >10 mm.
- Treatment is initially conservative with a pelvic brace, physical therapy, walking aids, analgesics, and ice packs.
- Surgical management by orthopedic surgery is generally reserved for severe cases with diastasis of >25 mm or for cases where conservative management failed.
- Previous pubic symphyseal separation is not necessarily an indication for cesarean section in future pregnancies, and planned delivery route should be individualized through shared decision-making.

References

- 1 Chawla JJ, Arora D, Sandhu N, Jain M, Kumari A. Pubic Symphysis Diastasis: A Case Series and Literature Review. *Oman Med J*. 2017;32(6): 510–514.
- 2 Herren C, Sobottke R, Dadgar A, et al. Peripartum Pubic Symphysis Separation: Current Strategies in Diagnosis and Therapy and Presentation of Two Cases. *Injury*. 2015;46(6): 1074–1080.
- 3 Anastasio MK, Anastasio AT, Kuller JA. Peripartum Pubic Symphysis Diastasis. *Obstet Gynecol Surv*. 2023; 78(6):369–375.
- 4 Seidman AJ, Siccardi MA. Postpartum Pubic Symphysis Diastasis. In: *StatPearls*. Treasure Island, FL: StatPearls Publishing; 2023. www.ncbi.nlm.nih.gov/books/NBK537043/ (accessed October 15, 2024).
- 5 Snow RE, Neubert AG. Peripartum Pubic Symphysis Separation. *Obstet Gynecol Surv*. 1997;52(7): 438–443.
- 6 Stolarczyk A, Stępiński P, Sasinowski L, et al. Peripartum Pubic Symphysis Diastasis: Practical Guidelines. *J Clin Med*. 2021;10(11):2443.
- 7 Howell ER. Pregnancy-Related Symphysis Pubis Dysfunction Management and Postpartum Rehabilitation: Two Case Reports. *J Can Chiropr Assoc*. 2012;56(2): 102–111.
- 8 Bickley LS, Szilagyi PG, Bates B. *Bates' Guide to Physical Examination and History-taking*, 13th ed. Philadelphia: Wolters Kluwer Health/Lippincott Williams & Wilkins; 2021.
- 9 Palvia V, Kim S, Warholc H, Anasti J. Severe Pubic Symphysis Diastasis Managed Conservatively: A Case Report and Review. *Case Rep Clin Med*. 2017;6(4):120–126.
- 10 Khorashadi L, Petscavage JM, Richardson ML. Postpartum Symphysis Pubis Diastasis. *Radiol Case Rep*. 2011;6(3):542.

A 20-Year-Old with Right Breast Pain and Fever while Breast-Feeding

Shannon DeGroff

History of Present Illness

A 20-year-old gravida 1 para 1 patient presents to the office with right breast pain and fever. She is 7 weeks' postpartum and recently returned to work. She is now pumping while at work and direct breast-feeding when home with her child.

Five days ago she noticed a red, swollen, tender area on her inner right breast. Two days ago she began to experience fever, chills, and overall body aches. The redness and pain of her breast has gotten worse and her temperature at home this morning was 38.5°C. She is having sharp shooting pain from the nipple to deep in her breast with both direct breast-feeding and pump use. She has tried acetaminophen for the fever and pain and is emptying her breast frequently. Her milk output from the right breast has decreased in the past few days, and she is pumping more frequently to try to improve her supply. She denies other symptoms and states her infant is in good health.

Her pregnancy was uncomplicated and resulted in a term spontaneous vaginal delivery (SVD). She has no significant past medical or surgical history. She is taking prenatal vitamins and acetaminophen and has no known drug allergies.

Physical Examination

General appearance: Well-developed, no acute distress

Vital signs:

Temperature: 38.1°C

Pulse: 92 beats per minute

Blood pressure: 128/72 mmHg

Respiratory rate: 18 breaths per minute

BMI: 29.2 kg/m²

Cardiopulmonary: Heart with regular rate and rhythm

Lungs: Clear to auscultation bilaterally, with no rales or rhonchi

Breasts: Right breast with erythema and induration of upper and lower inner quadrants, tender to palpation and warm to touch. There is no fluctuant or solid mass. Bilateral nipples and areolas are normal without fissures or cracking. Left breast is normal on appearance and palpation, and there is no lymphadenopathy in either axilla

Abdomen: Non-tender to palpation

Neurologic/psychologic: Normal affect

How Would You Manage This Patient?

This patient presents with bacterial mastitis, given local signs of inflammation of the breast and systemic symptoms that

have worsened over the past 48 hours. A breast exam showed no nipple trauma or blebs and there were no masses concerning for phlegmon or abscess. She was prescribed dicloxacillin for treatment of bacterial mastitis in the outpatient setting. Conservative measures were recommended, including the use of ice and non-steroidal anti-inflammatory drug (NSAID) medications to help with local erythema and inflammation, and acetaminophen for pain and fever management. She was reassured that her baby could safely continue to drink her breast milk. To help prevent recurrence of mastitis, she was advised to decrease hyperlactation and mammary dysbiosis, including titrating pump usage to obtain just the amount her baby usually consumes each feed. She was also encouraged to avoid deep tissue massage or aggressive hands-on pumping to prevent further trauma to the mammary tissue.

With these interventions, her symptoms began to improve within 24 hours. Her milk supply from the affected breast returned to normal within a week. She completed her antibiotic course as prescribed and did not have any further episodes of mastitis.

Mastitis

Mastitis is an inflammatory condition of the breast resulting from ductal inflammation and stromal edema, and may be associated with infection [1]. Lactational mastitis occurs in 2–25% of breastfeeding patients, most commonly in the first 12 weeks after delivery, and involves a spectrum of disorders ranging from ductal narrowing to inflammatory mastitis to abscess formation [2]. When present, it can contribute to early cessation of breast-feeding. Mastitis is a clinical diagnosis, presenting with unilateral breast pain, swelling, and erythema that can be accompanied by fever, chills, myalgia, and flu-like symptoms. Blood work and imaging are not required for the diagnosis but may be indicated in cases of severe illness, resistance to treatment, or if a palpable mass is noted on exam.

The mammary gland consists of alveoli (small sacs of milk-secreting cells and the ducts that transport the milk) suspended in a network of connective tissue. Coagulase-negative staphylococci and viridans group streptococci form the normal mammary microbiome and create thin biofilms that line the epithelium of the mammary ducts to allow for normal milk flow and protection against pathogenic bacteria [3]. Local and systemic hormonal feedback work together to regulate milk production within the gland [4]. Nipple stimulation with newborn suckling or pumping increases prolactin and

oxytocin levels, leading to increased milk production and milk ejection, respectively. Alternatively, decreased milk removal results in increased pressure and increased concentration of feedback inhibitor of lactation (FIL), leading to a decrease in milk production through negative feedback. Under physiologic conditions this leads to a production of milk volume that reflects the exact needs of the child.

The spectrum of mastitis disorders is understood to begin with inflammation and stromal edema of the ducts, alveoli, and surrounding connective tissue within a segment of the mammary gland. This inflammation compresses the milk ducts and obstructs milk flow. Patients experience unilateral pain, swelling, and erythema of the breast. Milk production is often diminished from the affected breast due to milk stasis and higher resistance to milk flow through narrowed ducts. These initial symptoms are often described as a “plugged” duct. Often these symptoms resolve spontaneously, but if increased stimulation and extraction occurs, this leads to decreased levels of FIL, increased milk production, and worsening inflammation. Fever, chills, myalgia, malaise, and flu-like symptoms result from a systemic inflammatory response and represent inflammatory mastitis. These symptoms can occur in the absence of infection but if inflammation occurs in combination with shifts in the normal mammary microbiome (dysbiosis), this leads to a bacterial mastitis with worsening of systemic symptoms over the next few days. Other diagnoses of the mastitis spectrum include phlegmon, galactocele (obstructed milk causing a cyst within the breast), and subacute mastitis (chronic mammary dysbiosis). *Candida* as a source of symptoms is a consideration, but emerging scientific evidence questions whether yeast is a causative agent for breast and nipple pain, and suggests that other etiologies should be investigated [5].

Risk factors for mastitis are not entirely understood. Evidence suggests a prior history of mastitis, antibiotic use, and ineffective or nonphysiologic milk extraction methods (breast pumps or nipple shields) increase the risk of mastitis. Nipple trauma was previously thought to be a major cause but recent studies show inconclusive evidence as normal skin flora of the lactating breast is also found in healthy human milk [5].

New knowledge has shifted the management of lactational mastitis to a focus on conservative treatment options and

decrease unnecessary antibiotic use. Most cases of mastitis resolve with treatment of the underlying inflammation and the inciting cause (hyperlactation, microbiome changes, or poor extraction). Conservative treatments include the use of cold compresses, over-the-counter nonsteroidal medications, and a supportive bra to reduce dependent edema. Acetaminophen can treat pain and fevers. If available, therapeutic ultrasound may be used to reduce inflammation and relieve edema. The most significant recommendation is to continue to empty the breasts of appropriate physiologic volumes and to avoid overstimulation. Breast pumps and nipple shields should be avoided if possible as they lead to nonphysiologic stimulation and extraction of milk. Patients should be counseled to avoid aggressive massage as any trauma to tissue can lead to necrosis and subsequent phlegmon or abscess formation. If hyperlactation persists despite these interventions, then pharmacologic treatment with dopamine agonists such as cabergoline may be required to decrease milk supply. Patients should be instructed that they can safely continue to breast-feed or express milk without risk of infection for their child.

If symptoms worsen or no improvement is seen within 24–48 hours of initiating conservative care, then patients should be evaluated and antibiotics given for bacterial mastitis [5]. Organisms isolated from bacterial mastitis include *Staphylococcus* (especially *S. aureus*) and *Streptococcus* [5]. Methicillin-resistant *S. aureus* (MRSA) is becoming a common isolated pathogen and patients should be screened for risk factors, such as recent hospitalization or surgery, personal history of MRSA infection, or working in health care areas with a high prevalence of MRSA. Table 72.1 outlines antibiotic options for bacterial mastitis [6]. Laboratory testing is reserved for cases of recurrent mastitis or persistent symptoms despite antibiotics, in which case, a milk culture should be obtained to target treatment. Severe infections are rare but possible and can lead to sepsis, which requires inpatient admission, IV antibiotics, and supportive measures.

Approximately 3–11% of acute mastitis cases will progress to an abscess [7]. Fluctuant or solid masses noted on exam should warrant imaging with ultrasound. Inflammatory breast cancer can mimic lactational mastitis and should always be considered, especially in refractory or recurrent cases. Lesions such as galactocele, phlegmon, or abscess often

Table 72.1 Empiric antibiotic management for bacterial mastitis

Antibiotic	Dose	Comments
First line		
Dicloxacillin or flucloxacillin	500 mg four times daily × 10–14 days	May use cloxacillin if others not available, but more variability in bioavailability
Cephalexin	500 mg four times daily × 10–14 days	Broader coverage (includes gram-negative rods)
Second line		
Clindamycin	300 mg four times daily × 10–14 days	
Trimethoprim-sulfamethoxazole	160 mg/800 mg twice daily × 10–14 days	Avoid if patient's child has G6PD deficiency Use with caution in patients with premature infants or infants with hyperbilirubinemia, especially if <30 days old

require drainage to completely treat. Aspiration is recommended, but drain placement can be considered as the initial treatment to reduce need for repeat sessions. Breast-feeding may continue and patients should be informed that risk of permanent milk fistula formation in these cases is low (<2%) [8].

There is also increasing evidence that a close correlation exists between perinatal mood and anxiety disorders (PMADs) and mastitis [9]. Patients with PMAD are more likely to have symptoms of mastitis, and patients with mastitis are more likely to have a history of PMAD. It is important to have an awareness of this correlation and to counsel and screen patients appropriately and provide necessary education and support.

Key Teaching Points

- Mastitis spectrum disorders involve a range of clinical presentations due to underlying inflammation of the mammary gland causing narrowing of the ductal lumina.
- Prevention and treatment should stress simple management principles (ice, NSAIDs, physiologic milk extraction, and avoidance of underlying risk factors).
- Previous recommendations to treat mastitis with aggressive massage/milk removal are out of date, worsen symptoms, and increase risk for abscess formation.
- Antibiotics are not required in all cases of mastitis, but if symptoms are worsening after 48 hours of conservative treatment then antibiotics should be started.
- Recurrent mastitis or incomplete resolution of symptoms should prompt further evaluation, including a milk culture.
- Any firm masses of the breast should undergo imaging for further evaluation.
- Given association of PMAD and mastitis, it is important to counsel and screen for both and have resources available for support.

References

- 1 World Health Organization. *Mastitis: Causes and Management*. Geneva: World Health Organization; 2000. <https://apps.who.int/iris/handle/10665/66230> (accessed April 22, 2023).
- 2 Wilson E, Woodd SL, Benova L. Incidence of and Risk Factors for Lactational Mastitis: A Systematic Review. *J Hum Lact*. 2020;36(4): 673–686.
- 3 Lawrence RA, Lawrence RM. *Breastfeeding: A Guide for the Medical Professional*, 9th ed. New York: Elsevier; 2021.
- 4 Weaver SR, Hernandez LL. Autocrine-Paracrine Regulation of the Mammary Gland. *J Dairy Sci*. 2016;99:842–853.
- 5 Mitchell KB, Johnson HM, Rodriguez JM, et al. Academy of Breastfeeding Medicine Clinical Protocol #36: The Mastitis Spectrum, Revised 2022. *Breastfeeding Med*. 2022;17(5):360–376.
- 6 Jahanfar S, Ng CJ, Teng CL. Antibiotics for Mastitis in Breastfeeding Women. *Cochrane Database Syst Rev*. 2013;(2):CD005458.
- 7 Amir LH, Forster D, McLachlan H, et al. Incidence of Breast Abscess in Lactating Women: Report from an Australian Cohort. *Br J Obstet Gynaecol*. 2004;111:1378–1381.
- 8 Johnson HM, Mitchell KB. Low Incidence of Milk Fistula with Continued Breastfeeding Following Radiologic and Surgical Interventions on the Lactating Breast. *Breast Dis*. 2021;40:183–189.
- 9 Dagla M, Dagla C, Mrvoljak-Theodoropoulou I, et al. Do Maternal Stress and Depressive Symptoms in Perinatal Period Predict the Lactation Mastitis Occurrence? A Retrospective Longitudinal Study in Greek Women. *Diagnostics (Basel)*. 2021;11:1524.

CASE 73

A 25-Year-Old 6 Hours' Postpartum with Severe Hypertension, Seizures, and Confusion*

Mokerrum Fatima Malik

History of Present Illness

A 25-year-old gravida 1 para 0 patient presents to obstetrics triage at 38 2/7 weeks' gestation with contractions. While in triage, elevated blood pressures are noted, and lab work is obtained. The patient's obstetric and medical history are otherwise unremarkable. She had one elevated blood pressure noted in clinic in the third trimester. She takes prenatal vitamins and an antacid for reflux. She is diagnosed with gestational hypertension and the decision is made to induce labor. Her labor course is uncomplicated, and she has a spontaneous vaginal delivery (SVD) the next day. Two days later, while awaiting discharge, she develops a headache for which Tylenol is given. The headache is refractory to medication and worsens over time. She complains of blurry vision and becomes confused and disoriented. Her blood pressure is noted to be 172/110 mmHg. She is immediately given IV labetalol, however, she starts to have a witnessed generalized tonic-clonic seizure. Her seizure resolves after approximately 1 minute. The patient continues to appear stuporous.

Physical Examination

General appearance: 25-year-old adult, non-responsive except to painful stimuli

Vital signs:

Temperature: 37.8°C

Blood pressure: 172/110 mmHg

Pulse: 116 beats per minute

Respiratory rate: 16 breaths per minute

Height: 65 inches

Weight: 182 lb

BMI: 30.3 kg/m²

Cardiopulmonary: Tachycardia noted, clear to auscultation bilaterally

Abdomen: Soft, non-distended, fundus of uterus firm and palpable at the level of the umbilicus

Neurologic/psychologic: Somnolent and nonresponsive except to painful stimuli, generalized weakness

Extremities: Brisk tendon reflexes bilaterally; 3+ pitting edema in bilateral lower extremities

Laboratory studies:

A lab panel was normal except for the following abnormalities:

White blood count (WBC): $17.6 \times 10^9/L$

AST: 54 U/L

Lactate dehydrogenase: 389 U/L

Proteinuria: 3+

Imaging:

See Figure 73.1.

How Would You Manage This Patient?

The patient is immediately started on magnesium sulfate for further seizure prophylaxis. Based on the patient's presentation of acute onset elevated blood pressures, confusion, headache,

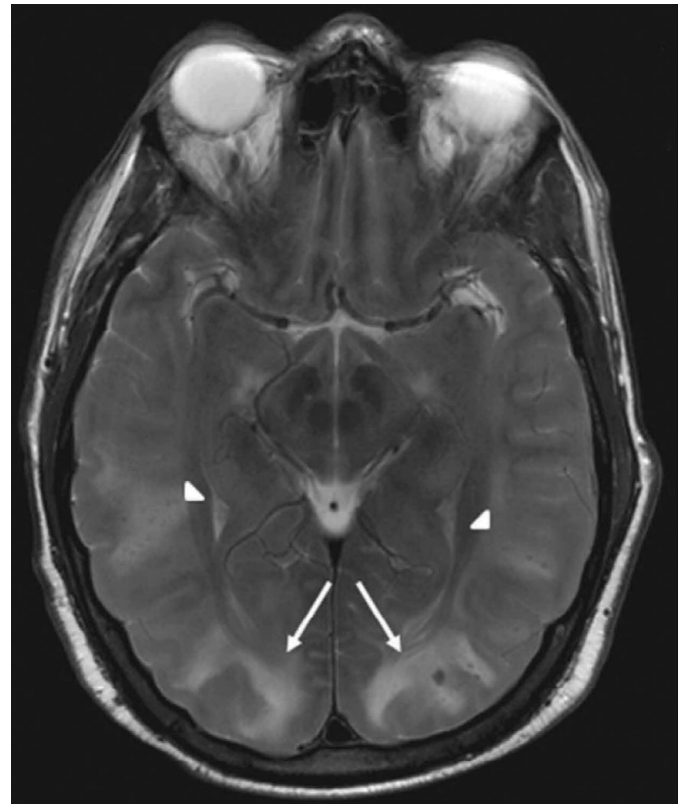


Figure 73.1 Axial T2-weighted MRI revealing bilateral subcortical white matter temporooccipital edema. Hyperintense areas noted in occipital lobe bilaterally, demonstrated by arrows and parietal lobes bilaterally demonstrated by arrowheads. Reproduced from Fisher N, Saraf S, Egbert N, et al. Clinical Correlates of Posterior Reversible Encephalopathy Syndrome in Pregnancy. *J Clin Hypertens (Greenwich)*. 2016;18(6):522–527 with permission from Joseph Varon, M

* I thank Dr. Bilal Butt, neurointensivist and Assistant Professor at the University of Maryland Medical Center for assisting in collecting data and clarifying the radiological implications of PRES.

blurry vision, and seizure, along with the neuro-imaging findings, the patient is diagnosed with posterior reversible encephalopathy syndrome (PRES). The patient was transferred to the intensive care unit (ICU) for closer monitoring. Her blood pressures were controlled with a continuous infusion of nicardipine, a calcium channel blocker. No further seizures were observed. The magnesium sulfate and nicardipine infusion were both discontinued after 24 hours. The patient was started on oral labetalol, a beta blocker to maintain blood pressure stability. Over the course of the next few days, her neurological symptoms improved, and she started breast-feeding her son. A physical therapist was consulted to help with her mobility and on postpartum day 6, she was stable for discharge.

Posterior Reversible Encephalopathy Syndrome

Posterior reversible encephalopathy syndrome (Figure 73.2) was first described by Hinchey et al. in 1996 through a case series studying fifteen unrelated patients both male and female ages 15–62 that were admitted for acute illnesses [1]. The disorder was described as an acute or subacute syndrome with a clinical presentation of headache, altered mental status, seizures, and vision changes, as well as radiographic findings of posterior encephalopathy. The syndrome was found to usually be reversible and, when treated promptly, most symptoms resolved within weeks [1,2].

Amongst those 15 patients described, seven were receiving immunosuppressive therapy, one patient was receiving interferon- α for melanoma, three patients were diagnosed with eclampsia, and four patients had hypertensive encephalopathy [1,3]. Since then, PRES has been linked to a multitude of medical conditions that may cause hypertensive encephalopathy such as acute and chronic kidney disease, endocrine disorders, autoimmune disease, and vasculitis. Pregnancy-

related conditions such as preeclampsia, eclampsia, and Hemolysis, elevated liver enzymes, low platelet count (HELLP) syndrome are all linked. The use of medications such as immunosuppressive drugs post transplantation, chemotherapeutic agents, and antiretroviral therapy, as well as illicit drug use including cocaine, amphetamines, and stimulants are also highly correlated with the syndrome [2,3].

The differential diagnosis of PRES may include a multitude of neurological diseases including different types of strokes, central nervous system infections, demyelinating disease, vasculitis, malignancy or tumors in the brain, toxic encephalopathy, or mitochondrial disorders [2]. The common presenting features of PRES include severe headache, nausea, and vomiting, altered mental status, seizures, and vision changes [1,2].

The mental status changes are due to encephalopathy and may range from mild somnolence to coma [2,3]. Memory impairment, difficulty with concentration, and amnesia were reported as well. Most patients present with seizures that can be generalized tonic-clonic or partial in nature [2]. The headache associated with PRES is usually dull and diffuse, but at times, the sudden onset “thunderclap” headache has also been reported [3]. Patients have often noted visual abnormalities including blurred vision, hemianopia, visual neglect, visual hallucinations, and blindness. Papilledema may often be present on exam [2,3]. Other symptoms and findings may include hyperreflexia, weakness and incoordination, or focal paresis [2,3].

There have been two main theories to explain the pathophysiology of PRES:

1. Acute hypertension causes endothelial dysfunction leading to vasoconstriction in the brain, which in turn causes decreased cerebral blood flow and encephalopathy.
2. Hypertension leading to a breakthrough of autoregulation causes forced vasodilation of cerebral vessels, leading to vasogenic edema [2].

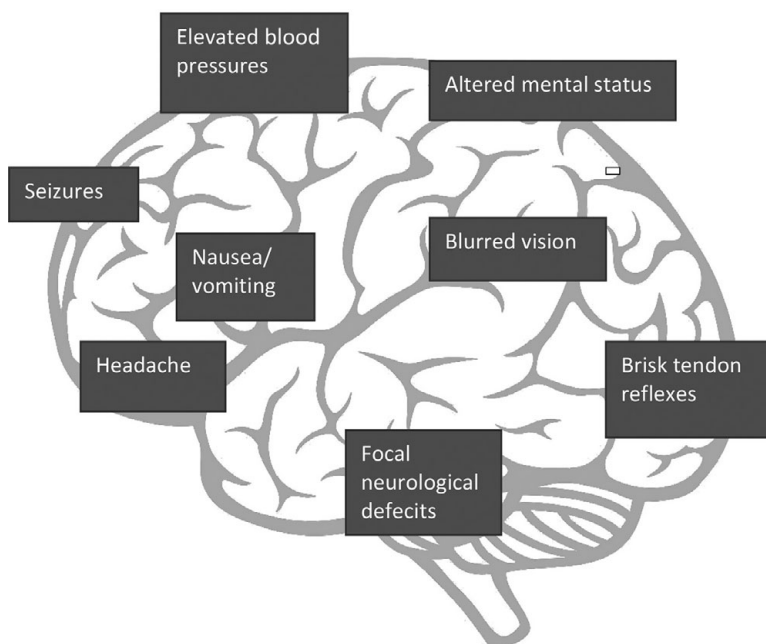


Figure 73.2 Clinical features of PRES [2]

Most commonly, the imaging pattern of PRES has the presence of edema that involves the white matter of both cerebral hemispheres in a symmetric pattern (Figure 73.1) [1,4]. Findings of PRES are often visible on CT but are best shown on brain MRI. These changes are especially common in the parieto-occipital region of the brain in the subcortical white matter but are not limited to this area. Other affected locations of the brain such as frontal lobes, inferior temporal lobes, and cerebellar hemispheres, basal ganglia, brainstem, and deep-white matter have all been reported to be involved in various cases [3].

Other features of PRES on MRI include cortical lesions, predominant watershed distribution, and sometimes predominantly posterior fossa lesions. In several cases, PRES has presented as asymmetric and unilateral. Mild or large hemorrhage and subarachnoid hemorrhage have also been described [3,5]. A trend involving basal ganglia in eclamptic patients has been suggested [5].

Fortunately, the findings on imaging resolve after treatment of the underlying cause of PRES, which suggests that the findings of PRES are short-term edema and not infarction, although infarction can rarely happen [3]. On follow-up imaging studies, the findings of PRES abnormalities were found to have resolved in days to weeks after presentation [1,2]. In extreme cases, the brain edema can be so severe that it can lead to herniation [2].

PRES and Eclampsia

Eclampsia, and to some extent, preeclampsia, are pregnancy-related diseases that are commonly associated with PRES. Both preeclampsia and eclampsia are multisystem disorders that are described to have components of hypertensive encephalopathy [6]. There seems to be an abnormal vascular response to placentation as placental antiangiogenic factors are released into maternal circulation. This in turn can disrupt maternal endothelium, which can lead to elevated blood pressures, proteinuria, and systemic changes in the mother. Often, increased fluid collection in pregnancy may also lead to increased cerebral edema due to increased hydraulic conductivity [3]. In a large case series of 47 eclamptic patients who were radiographically studied, 46 out of 47, or 98%, were diagnosed with PRES. The one patient who did not exhibit PRES on imaging was later found to have an underlying epileptic disorder [6]. The study concluded that “PRES is the primary central nervous system injury in patients with eclampsia” [6].

In another study by Fisher et al., clinical correlations of PRES in patients with preeclampsia and eclampsia were reviewed. The authors found few clinical correlates, except for decreased platelet counts, the diagnosis of eclampsia rather than preeclampsia, a younger age, higher systolic, and diastolic blood pressure [5]. This study also showed that since PRES was in fact found in a subset of preeclamptic patients, PRES development may be precursor, rather than a result of, eclampsia [5,6]. The most common symptom in patients with

preeclampsia/eclampsia and PRES was a headache, however, this was a nonspecific finding [5,6].

Posterior reversible encephalopathy syndrome has been described as a reversible disorder if the patient is treated as soon as the diagnosis is made. Treatment of the underlying cause and eliminating noxious stimuli are key to obtaining good outcomes [2,4]. In a study assessing outcomes of 70 patients admitted to ICUs with PRES, “time to causative factor control was the best predictor of outcome.” Patients with an underlying obstetric cause also had a better outcome than those with a nonobstetric cause [7]. In the case of preeclampsia and eclampsia, treatment includes prompt delivery, blood pressure and seizure control, and ICU management [5].

Magnesium sulfate is given to patients to help prevent and treat eclamptic seizures. The drug has multifactorial effects, as it acts as a vasodilator to decrease peripheral resistance in the peripheral vasculature, while protecting the blood–brain barrier in the central nervous system and thus limiting cerebral edema formation and acting as an anticonvulsant [6]. In certain cases of recurrent convulsions or worsening cerebral edema symptoms such as increased irritability or prolonged coma, additional anti-edema agents such as mannitol or IV dexamethasone may have additive recovery effects [6,8].

Hypertension management is an essential treatment component for PRES in the setting of preeclampsia/eclampsia. Intravenous labetalol, hydralazine, and nicardipine are often used to treat severe hypertension as they can act rapidly [2,6]. Gradual correction rather than a rapid decline in blood pressure is favored to prevent cerebral ischemia and to avert uteroplacental blood flow [6,8].

While PRES is generally associated with a good prognosis, poor outcomes and death have been reported in patients with prolonged admission to the ICU, hemorrhages in the brain, and irreversible cytotoxic edema on brain studies. Favorable outcomes of PRES were generally associated with preeclamptic and eclamptic patients [2]. While MRI images have been seen to show resolution of PRES days to weeks after disease onset, it is not necessary to obtain multiple imaging studies to diagnose and/or follow disease progression unless there is a concern for another differential diagnosis or no resolution of symptoms [8].

Key Teaching Points

- Posterior reversible encephalopathy syndrome is an acute or subacute clinical and radiologic syndrome that consists of headache, altered mental status, seizures, vision changes, and posterior white matter changes on MRI.
- Imaging is not always needed; however, MRI may be recommended in cases where patients are not improving with their current treatment regimen, or other differential diagnoses may need to be considered.
- The syndrome is reversible if it is managed promptly by controlling blood pressures and/or discontinuing the underlying offensive agent.

References

- 1 Hinchey J, Chaves C, Appignani B, et al. A Reversible Posterior Leukoencephalopathy Syndrome. *N Engl J Med*. 1996;334(8):494–500.
- 2 Geocadin RG. Posterior Reversible Encephalopathy Syndrome. *N Engl J Med*. 2023;388(23):2171–2178.
- 3 Lamy C, Oppenheim C, Mas JL. Posterior Reversible Encephalopathy Syndrome. *Handb Clin Neurol*. 2014;121:1687–1701.
- 4 Pedraza R, Marik PE, Varon J. Posterior Reversible Encephalopathy Syndrome: A Review. *Crit Care & Shock*. 2009;12(4):135–143.
- 5 Fisher N, Saraf S, Egbert N, et al. Clinical Correlates of Posterior Reversible Encephalopathy Syndrome in Pregnancy. *J Clin Hypertens (Greenwich)*. 2016;18(6):522–527.
- 6 Brewer J, Owens MY, Wallace K, et al. Posterior Reversible Encephalopathy Syndrome in 46 of 47 Patients with Eclampsia. *Am J Obstet Gynecol*. 2013;208(6):468.e1–468.e6.
- 7 Legriel S, Schraub O, Azoulay E, et al. Determinants of Recovery from Severe Posterior Reversible Encephalopathy Syndrome. *PLoS ONE*. 2012;7(9):e44534.
- 8 Sardesai S, Dabade R, Deshmukh S, et al. Posterior Reversible Encephalopathy Syndrome (PRES): Evolving the Mystery of Eclampsia! *J Obstet Gynaecol India*. 2019;69(4):334–338.

CASE 74

A 40-Year-Old at 28 Weeks' Gestation with a Well Dated Pregnancy and a Fundal Height Measuring 24 cm

Sarah Smithson

History of Present Illness

A 40-year-old gravida 2 para 1 patient presents for a prenatal visit at 28 0/7 weeks. Her due date was confirmed by a 12-week nuchal translucency screening ultrasound that was consistent with her last menstrual period. She has attended regular prenatal appointments since 8 weeks. She had a detailed anatomy scan at 20 weeks, which was notable only for an echogenic focus in the left ventricle. She had a low-risk cell-free fetal DNA aneuploidy screen. She has a history of chronic hypertension, which has been well controlled on oral labetalol. She has been taking low-dose aspirin since 12 3/7 weeks. Her first pregnancy was an uncomplicated term vaginal delivery of a 5 pound, 2 ounce neonate 10 years ago. At her visit today, she states she feels well and has been feeling fetal movement. She denies contractions or loss of fluid. She denies headache, changes in vision, right upper quadrant pain, or epigastric pain. She has not had any recent fevers, flu-like symptoms, or sick contacts.

Physical Examination

General appearance: Well appearing, no acute distress. Appropriately concerned

Vital signs:

Temperature: 98.0°F (36.6°C)

Pulse: 93 beats per minute

Blood pressure: 128/84 mmHg

Respiratory rate: 16 breaths per minute

Body mass index (BMI): 28 kg/m²

Cardiopulmonary: Heart is regular in rate and rhythm. Lungs are clear to auscultation bilaterally

Abdomen: Soft, non-tender, gravid. Fundal height measures 24 cm

Neurologic/psychologic: No focal neurologic deficits. Affect and demeanor appropriate

Fetal assessment: Nonstress test (NST) reactive for gestational age

Laboratory studies:

1-hour diabetes screen: 115 mg/dL

Hgb: 10.2 g/dL

AST: 42 IU/L

ALT: 45 IU/L

Imaging:

On ultrasound, fetus is cephalic in presentation. Estimated fetal weight (EFW) is 950 g (5th percentile). Amniotic fluid volume appears normal (deepest vertical pocket 5.2 cm). Umbilical artery Doppler studies are normal.

How Would You Manage This Patient?

Fetal growth restriction (FGR), first suspected in this case at 28 weeks by the lagging fundal height, was ultimately confirmed by ultrasound findings. Upon diagnosis of FGR, serial growth scans with amniotic fluid measurements and umbilical artery Doppler studies were performed every 2–4 weeks [1]. She also underwent weekly antenatal testing. She was referred for genetic counseling and opted for amniocentesis. Fetal microarray and cytomegalovirus PCR were performed on the amniotic fluid (resulted normal and negative, respectively). Her blood pressure was monitored closely, and she was counseled on the signs and symptoms of superimposed preeclampsia. Serial scans continued to demonstrate reassuring interval growth and normal Dopplers. At 38 weeks, oligohydramnios was diagnosed, and the recommendation was made to proceed with delivery. She was admitted and underwent induction of labor with continuous fetal monitoring and delivered vaginally. She had an uncomplicated postpartum course and was discharged on postpartum day number 2. Placental pathology was unremarkable.

Fetal Growth Restriction

Fetal growth restriction is defined by an EFW <10th percentile or an abdominal circumference <10th percentile for a given gestational age [1]. Etiologies are generally divided into three categories: maternal factors, fetal factors, and placental factors. Maternal factors include conditions such as autoimmune disease, hypertensive disorders, cardiac disease, history of substance use/abuse, or infectious disease. Fetal factors include genetic or structural abnormalities and multifetal gestation. Placental factors such as abnormal placentation or umbilical cord abnormalities may also contribute to risk for FGR [1]. Approximately 20% of fetuses diagnosed with FGR are constitutionally small and have a normal outcome [2].

Fetal Surveillance and Delivery Planning

Fetal growth restriction is associated with an increased risk for stillbirth (1.5% for EFW of <10th percentile, higher for more

severe cases described by an EFW of <5th percentile) [2]. Managing FGR involves balancing this risk with the risk of prematurity if early delivery is considered. The goal for delivery in the setting of uncomplicated growth restriction (EFW of >3rd percentile, normal amniotic fluid and umbilical artery Doppler

studies) is 38 0/7–39 0/7 weeks [3]. Changes in amniotic fluid levels or umbilical artery Doppler studies guide timing of delivery [1,2,3]. Serial growth ultrasounds with umbilical artery Dopplers (every 2–4 weeks) and antenatal testing (once or twice weekly) should be initiated at the time of diagnosis [4]. The

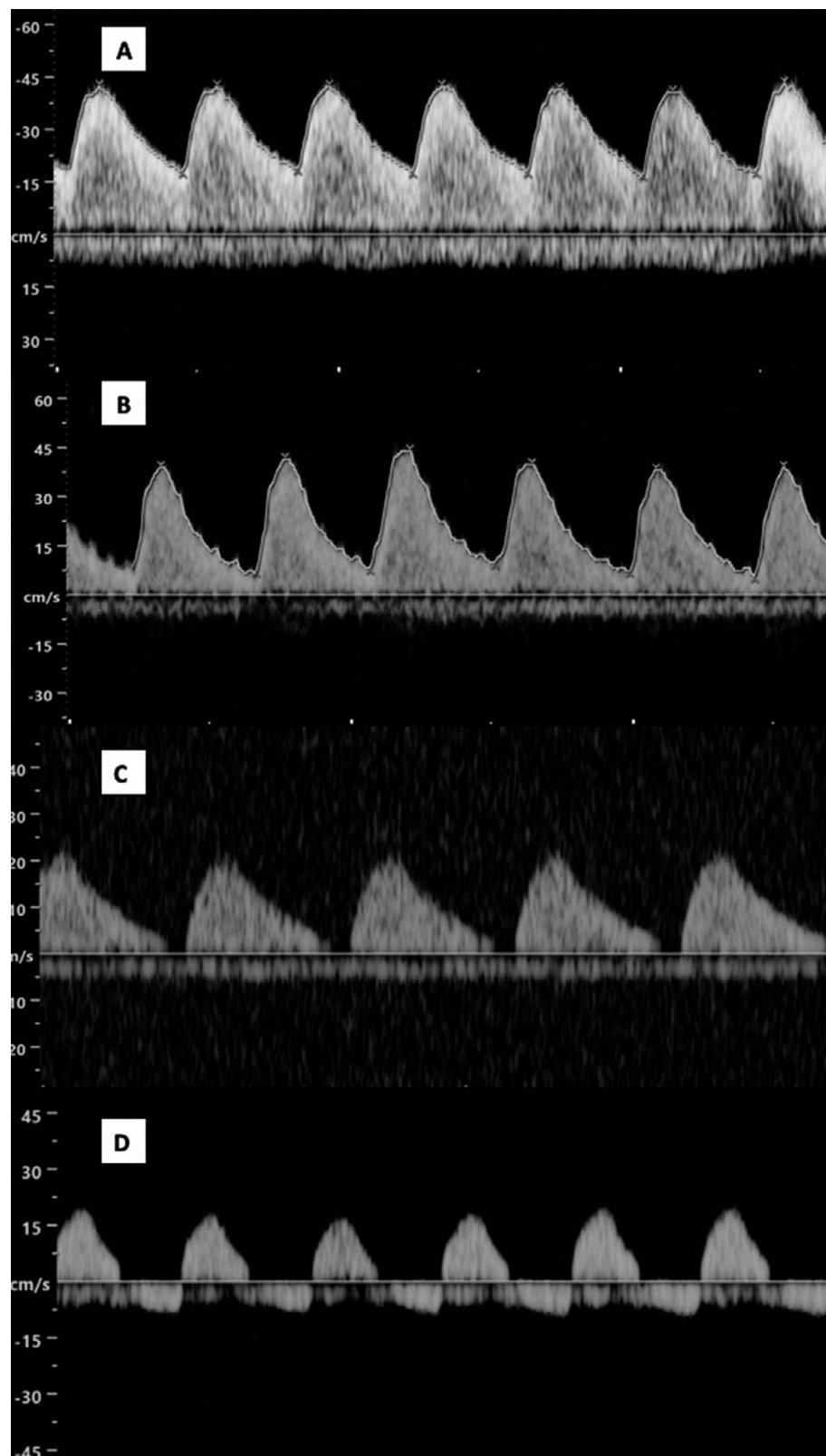


Figure 74.1 Umbilical artery doppler studies. A, normal; B, elevated systolic to diastolic ratio; C, absent end diastolic flow; D, reversed end diastolic flow. (A black and white version of this figure will appear in some formats. For the color version, please refer to the plate section.)

degree of growth restriction and interval changes in ultrasound parameters will determine the precise frequency of testing.

Umbilical artery Doppler is a measure of resistance in the placenta to flow from the fetal side. Abnormal Doppler waveforms indicate placental insufficiency and correlate with increased risk for perinatal mortality [2]. Progression to elevated systolic to diastolic ratio, absent end diastolic flow, or, most ominously, reversed end diastolic flow (Figure 74.1) would alter management and require earlier delivery because abnormal umbilical artery Doppler studies are associated with an even greater risk for neonatal mortality and morbidity [1]. An elevated systolic to diastolic ratio would prompt consideration for delivery at 37 weeks. Absent and reversed end diastolic flow may be associated with risk of stillbirth as high as 6.8 and 19%, respectively [2]. Therefore, absent or reversed end diastolic flow may warrant consideration for antenatal corticosteroids for fetal lung maturity, inpatient admission for prolonged monitoring, and preterm delivery [1,2,3]. The goal for delivery timing in the setting of absent end diastolic flow is 33 0/7–34 0/7 weeks (or at the time of diagnosis if diagnosed later). Earlier delivery (30 0/7–32 0/7 weeks) is recommended in the setting of reversed end diastolic flow [3]. In these more severe cases, consultation with specialists in maternal fetal medicine and neonatology is warranted [1].

Amniotic fluid levels are also closely monitored in the setting of FGR. Oligohydramnios (deepest vertical pocket of <2 cm) should prompt consideration for delivery at 36 0/7–37 6/7, or at the time of diagnosis if diagnosed later [3].

After delivery, small for gestational age neonates are at increased risk for morbidities including respiratory distress syndrome, hypoglycemia, necrotizing enterocolitis, and hyperbilirubinemia [1]. There is no consensus on placental pathology recommendations, but it may be considered in cases of growth restriction, especially if severe enough to warrant preterm delivery.

Maternal Medical Management Considerations

In addition to fetal surveillance, maternal blood pressures should be monitored closely and patients should be counseled on the signs and symptoms of preeclampsia. Over 50% of cases of early onset FGR are associated with development of maternal hypertensive disease [2]. With regards to preexisting or chronic hypertension management, recent data support

treatment of blood pressures in pregnancy with a target goal of blood pressures of <140/90 mmHg to reduce the risk of maternal and perinatal morbidity; antihypertensive treatment does not increase the risk of small for gestational age infants [5]. Daily low-dose aspirin for prevention of preeclampsia should also be continued [6]. There is insufficient evidence to recommend any additional nutritional supplements or dietary modifications (apart from general nutrition recommendations in pregnancy), activity modifications or bed rest, or use of low-dose aspirin to prevent or treat FGR [1].

In the absence of additional risk factors, routine maternal serum screening for cytomegalovirus, toxoplasmosis, rubella, or herpes in the setting of FGR is likely to be low yield and not recommended. However, early onset FGR (diagnosed <32 weeks) should prompt genetic counseling and consideration for genetic amniocentesis [2]. If amniocentesis is performed, the patient should be offered cytomegalovirus PCR testing on amniotic fluid [2].

Other maternal medical conditions associated with FGR such as lupus, symptomatic mood and anxiety disorders, and substance use disorders, are ideally optimized in the preconception period and throughout pregnancy to minimize adverse perinatal outcomes.

With regards to future pregnancy management, the patient with pregnancy complicated by FGR should be counseled on the high recurrence risk if the neonate is confirmed to be small for gestational age. The risk for recurrence of having a small for gestational age neonate is approximately 20% [1]. In a future pregnancy, a third-trimester growth scan should be performed, if not otherwise already indicated. Pre-pregnancy optimization of comorbidities, such as hypertension, obesity, and malnourishment, is most ideal.

Key Teaching Points

- Fetal growth restriction is defined as an EFW of <10th percentile or an abdominal circumference of <10th percentile for a given gestational age.
- Fetal growth restriction warrants close follow-up with serial ultrasound examination (including umbilical artery Doppler studies) as well as antenatal testing.
- Risk of fetal and neonatal morbidity is high, and management is guided largely by maternal and fetal status, with the goal of avoiding fetal demise while also minimizing risks of prematurity.

References

- 1 Fetal Growth Restriction: ACOG Practice Bulletin, Number 227. *Obstet Gynecol.* 2021;137:e16–e28.
- 2 Martins JG, Biggio JR, Abuhamad A. Society for Maternal-Fetal Medicine Consult Series #52: Diagnosis and Management of Fetal Growth Restriction: (Replaces Clinical Guideline Number 3, April 2012). *Am J Obstet Gynecol.* 2020;223:B2–B17.
- 3 American College of Obstetricians and Gynecologists' Committee on Obstetric Practice; Society for Maternal-Fetal Medicine. Medically Indicated Late-Preterm And Early-Term Deliveries: ACOG Committee Opinion, Number 831. *Obstet Gynecol.* 2021;138:e35–e39.
- 4 Antepartum Fetal Surveillance: ACOG Practice Bulletin, Number 229. *Obstet Gynecol.* 2021;137(6):e116–e127.
- 5 Society for Maternal-Fetal Medicine; Publications Committee. Society for Maternal-Fetal Medicine Statement: Antihypertensive Therapy for Mild Chronic Hypertension in Pregnancy—The Chronic Hypertension and Pregnancy Trial. *Am J Obstet Gynecol.* 2022;227(2):B24–B27.
- 6 ACOG Committee Opinion No. 743: Low-Dose Aspirin Use during Pregnancy. *Obstet Gynecol.* 2018;132:e44–e52.

CASE 74

A 40-Year-Old at 28 Weeks' Gestation with a Well Dated Pregnancy and a Fundal Height Measuring 24 cm

Sarah Smithson

History of Present Illness

A 40-year-old gravida 2 para 1 patient presents for a prenatal visit at 28 0/7 weeks. Her due date was confirmed by a 12-week nuchal translucency screening ultrasound that was consistent with her last menstrual period. She has attended regular prenatal appointments since 8 weeks. She had a detailed anatomy scan at 20 weeks, which was notable only for an echogenic focus in the left ventricle. She had a low-risk cell-free fetal DNA aneuploidy screen. She has a history of chronic hypertension, which has been well controlled on oral labetalol. She has been taking low-dose aspirin since 12 3/7 weeks. Her first pregnancy was an uncomplicated term vaginal delivery of a 5 pound, 2 ounce neonate 10 years ago. At her visit today, she states she feels well and has been feeling fetal movement. She denies contractions or loss of fluid. She denies headache, changes in vision, right upper quadrant pain, or epigastric pain. She has not had any recent fevers, flu-like symptoms, or sick contacts.

Physical Examination

General appearance: Well appearing, no acute distress. Appropriately concerned

Vital signs:

Temperature: 98.0°F (36.6°C)

Pulse: 93 beats per minute

Blood pressure: 128/84 mmHg

Respiratory rate: 16 breaths per minute

Body mass index (BMI): 28 kg/m²

Cardiopulmonary: Heart is regular in rate and rhythm. Lungs are clear to auscultation bilaterally

Abdomen: Soft, non-tender, gravid. Fundal height measures 24 cm

Neurologic/psychologic: No focal neurologic deficits. Affect and demeanor appropriate

Fetal assessment: Nonstress test (NST) reactive for gestational age

Laboratory studies:

1-hour diabetes screen: 115 mg/dL

Hgb: 10.2 g/dL

AST: 42 IU/L

ALT: 45 IU/L

Imaging:

On ultrasound, fetus is cephalic in presentation. Estimated fetal weight (EFW) is 950 g (5th percentile). Amniotic fluid volume appears normal (deepest vertical pocket 5.2 cm). Umbilical artery Doppler studies are normal.

How Would You Manage This Patient?

Fetal growth restriction (FGR), first suspected in this case at 28 weeks by the lagging fundal height, was ultimately confirmed by ultrasound findings. Upon diagnosis of FGR, serial growth scans with amniotic fluid measurements and umbilical artery Doppler studies were performed every 2–4 weeks [1]. She also underwent weekly antenatal testing. She was referred for genetic counseling and opted for amniocentesis. Fetal microarray and cytomegalovirus PCR were performed on the amniotic fluid (resulted normal and negative, respectively). Her blood pressure was monitored closely, and she was counseled on the signs and symptoms of superimposed preeclampsia. Serial scans continued to demonstrate reassuring interval growth and normal Dopplers. At 38 weeks, oligohydramnios was diagnosed, and the recommendation was made to proceed with delivery. She was admitted and underwent induction of labor with continuous fetal monitoring and delivered vaginally. She had an uncomplicated postpartum course and was discharged on postpartum day number 2. Placental pathology was unremarkable.

Fetal Growth Restriction

Fetal growth restriction is defined by an EFW <10th percentile or an abdominal circumference <10th percentile for a given gestational age [1]. Etiologies are generally divided into three categories: maternal factors, fetal factors, and placental factors. Maternal factors include conditions such as autoimmune disease, hypertensive disorders, cardiac disease, history of substance use/abuse, or infectious disease. Fetal factors include genetic or structural abnormalities and multifetal gestation. Placental factors such as abnormal placentation or umbilical cord abnormalities may also contribute to risk for FGR [1]. Approximately 20% of fetuses diagnosed with FGR are constitutionally small and have a normal outcome [2].

Fetal Surveillance and Delivery Planning

Fetal growth restriction is associated with an increased risk for stillbirth (1.5% for EFW of <10th percentile, higher for more

severe cases described by an EFW of <5th percentile) [2]. Managing FGR involves balancing this risk with the risk of prematurity if early delivery is considered. The goal for delivery in the setting of uncomplicated growth restriction (EFW of >3rd percentile, normal amniotic fluid and umbilical artery Doppler

studies) is 38 0/7–39 0/7 weeks [3]. Changes in amniotic fluid levels or umbilical artery Doppler studies guide timing of delivery [1,2,3]. Serial growth ultrasounds with umbilical artery Dopplers (every 2–4 weeks) and antenatal testing (once or twice weekly) should be initiated at the time of diagnosis [4]. The

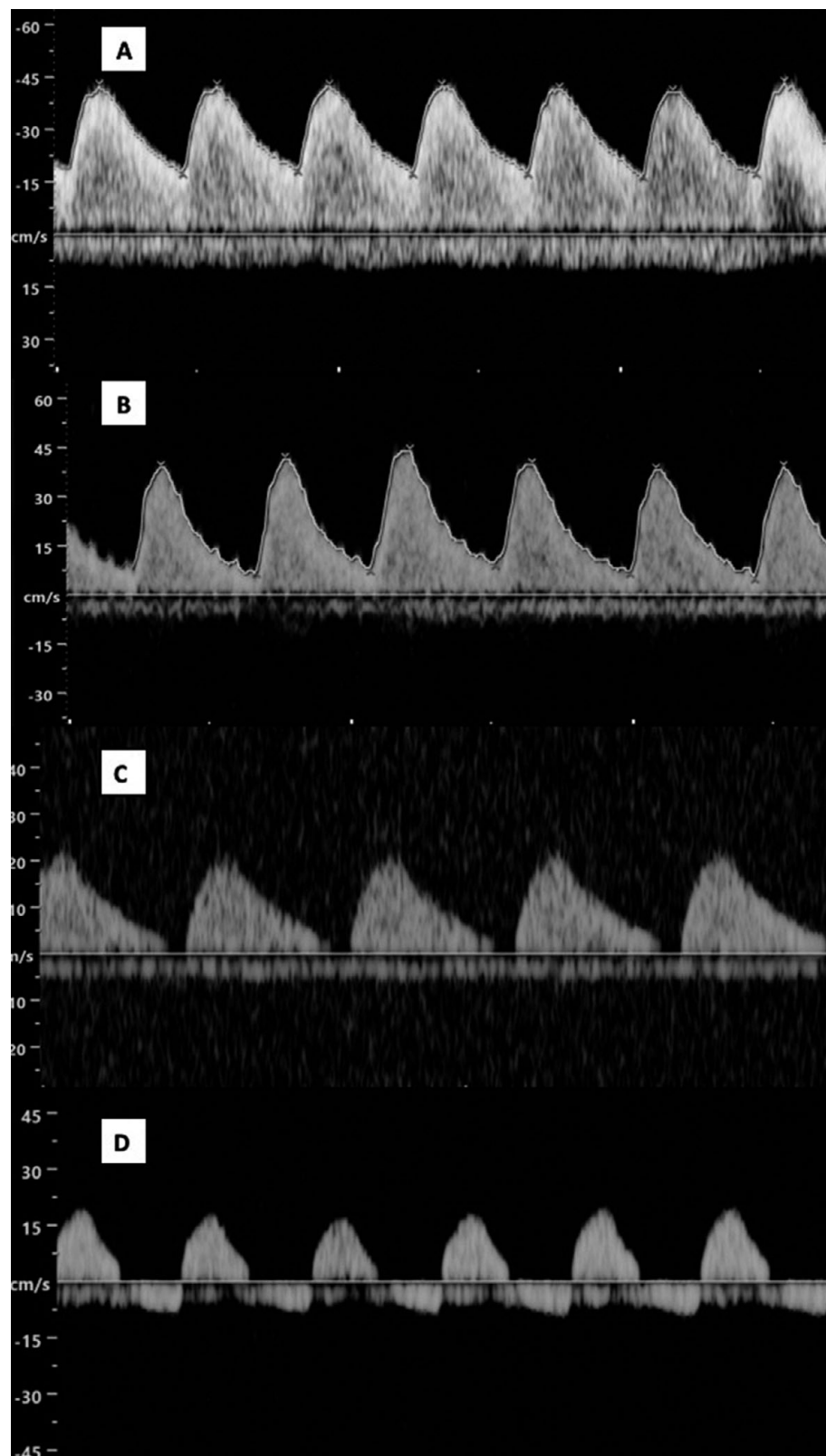


Figure 74.1 Umbilical artery doppler studies. A, normal; B, elevated systolic to diastolic ratio; C, absent end diastolic flow; D, reversed end diastolic flow. (A black and white version of this figure will appear in some formats. For the color version, please refer to the plate section.)

degree of growth restriction and interval changes in ultrasound parameters will determine the precise frequency of testing.

Umbilical artery Doppler is a measure of resistance in the placenta to flow from the fetal side. Abnormal Doppler waveforms indicate placental insufficiency and correlate with increased risk for perinatal mortality [2]. Progression to elevated systolic to diastolic ratio, absent end diastolic flow, or, most ominously, reversed end diastolic flow (Figure 74.1) would alter management and require earlier delivery because abnormal umbilical artery Doppler studies are associated with an even greater risk for neonatal mortality and morbidity [1]. An elevated systolic to diastolic ratio would prompt consideration for delivery at 37 weeks. Absent and reversed end diastolic flow may be associated with risk of stillbirth as high as 6.8 and 19%, respectively [2]. Therefore, absent or reversed end diastolic flow may warrant consideration for antenatal corticosteroids for fetal lung maturity, inpatient admission for prolonged monitoring, and preterm delivery [1,2,3]. The goal for delivery timing in the setting of absent end diastolic flow is 33 0/7–34 0/7 weeks (or at the time of diagnosis if diagnosed later). Earlier delivery (30 0/7–32 0/7 weeks) is recommended in the setting of reversed end diastolic flow [3]. In these more severe cases, consultation with specialists in maternal fetal medicine and neonatology is warranted [1].

Amniotic fluid levels are also closely monitored in the setting of FGR. Oligohydramnios (deepest vertical pocket of <2 cm) should prompt consideration for delivery at 36 0/7–37 6/7, or at the time of diagnosis if diagnosed later [3].

After delivery, small for gestational age neonates are at increased risk for morbidities including respiratory distress syndrome, hypoglycemia, necrotizing enterocolitis, and hyperbilirubinemia [1]. There is no consensus on placental pathology recommendations, but it may be considered in cases of growth restriction, especially if severe enough to warrant preterm delivery.

Maternal Medical Management Considerations

In addition to fetal surveillance, maternal blood pressures should be monitored closely and patients should be counseled on the signs and symptoms of preeclampsia. Over 50% of cases of early onset FGR are associated with development of maternal hypertensive disease [2]. With regards to preexisting or chronic hypertension management, recent data support

treatment of blood pressures in pregnancy with a target goal of blood pressures of <140/90 mmHg to reduce the risk of maternal and perinatal morbidity; antihypertensive treatment does not increase the risk of small for gestational age infants [5]. Daily low-dose aspirin for prevention of preeclampsia should also be continued [6]. There is insufficient evidence to recommend any additional nutritional supplements or dietary modifications (apart from general nutrition recommendations in pregnancy), activity modifications or bed rest, or use of low-dose aspirin to prevent or treat FGR [1].

In the absence of additional risk factors, routine maternal serum screening for cytomegalovirus, toxoplasmosis, rubella, or herpes in the setting of FGR is likely to be low yield and not recommended. However, early onset FGR (diagnosed <32 weeks) should prompt genetic counseling and consideration for genetic amniocentesis [2]. If amniocentesis is performed, the patient should be offered cytomegalovirus PCR testing on amniotic fluid [2].

Other maternal medical conditions associated with FGR such as lupus, symptomatic mood and anxiety disorders, and substance use disorders, are ideally optimized in the preconception period and throughout pregnancy to minimize adverse perinatal outcomes.

With regards to future pregnancy management, the patient with pregnancy complicated by FGR should be counseled on the high recurrence risk if the neonate is confirmed to be small for gestational age. The risk for recurrence of having a small for gestational age neonate is approximately 20% [1]. In a future pregnancy, a third-trimester growth scan should be performed, if not otherwise already indicated. Pre-pregnancy optimization of comorbidities, such as hypertension, obesity, and malnourishment, is most ideal.

Key Teaching Points

- Fetal growth restriction is defined as an EFW of <10th percentile or an abdominal circumference of <10th percentile for a given gestational age.
- Fetal growth restriction warrants close follow-up with serial ultrasound examination (including umbilical artery Doppler studies) as well as antenatal testing.
- Risk of fetal and neonatal morbidity is high, and management is guided largely by maternal and fetal status, with the goal of avoiding fetal demise while also minimizing risks of prematurity.

References

- 1 Fetal Growth Restriction: ACOG Practice Bulletin, Number 227. *Obstet Gynecol.* 2021;137:e16–e28.
- 2 Martins JG, Biggio JR, Abuhamad A. Society for Maternal-Fetal Medicine Consult Series #52: Diagnosis and Management of Fetal Growth Restriction: (Replaces Clinical Guideline Number 3, April 2012). *Am J Obstet Gynecol.* 2020;223:B2–B17.
- 3 American College of Obstetricians and Gynecologists' Committee on Obstetric Practice; Society for Maternal-Fetal Medicine. Medically Indicated Late-Preterm And Early-Term Deliveries: ACOG Committee Opinion, Number 831. *Obstet Gynecol.* 2021;138:e35–e39.
- 4 Antepartum Fetal Surveillance: ACOG Practice Bulletin, Number 229. *Obstet Gynecol.* 2021;137(6):e116–e127.
- 5 Society for Maternal-Fetal Medicine; Publications Committee. Society for Maternal-Fetal Medicine Statement: Antihypertensive Therapy for Mild Chronic Hypertension in Pregnancy—The Chronic Hypertension and Pregnancy Trial. *Am J Obstet Gynecol.* 2022;227(2):B24–B27.
- 6 ACOG Committee Opinion No. 743: Low-Dose Aspirin Use during Pregnancy. *Obstet Gynecol.* 2018;132:e44–e52.

CASE 75

A 45-Year-Old at 37 Weeks' Gestation with Gestational Diabetes and an Estimated Fetal Weight of 4,600 g

Amanda Haines Ritter

History of Present Illness

A 45-year-old gravida 3 para 2 patient at 37 weeks' gestation with pregnancy complicated by gestational diabetes (GDM) presents to Labor and Delivery following a reported large gush of fluid 3 hours prior to arrival. She has not had any significant contractions and denies vaginal bleeding. Her GDM has been well-controlled with diet alone. She has otherwise had an uncomplicated pregnancy. She had a growth ultrasound 7 days prior that showed an estimated fetal weight (EFW) of 4,600 g and normal amniotic fluid index (AFI). Her remaining history is pertinent for two prior uncomplicated vaginal deliveries, the largest of which was a 3,900 g infant. She has no health problems and no prior surgeries. Her only medication is a prenatal vitamin.

Physical Examination

General appearance: Well-developed, obese, no acute distress

Vital signs:

Temperature: 37.2°C

Pulse: 85 beats per minute

Blood pressure: 115/75 mmHg

Respiratory rate: 16 breaths per minute

BMI: 38 kg/m²

Cardiopulmonary: Normal rate, regular rhythm

Abdomen: Soft, gravid, non-tender; clinically EFW of 4,000 g

Pelvic: Speculum examination reveals gross pooling of clear fluid, with positive nitrazine test; her cervix is dilated to 4 cm, with 50% effacement and the vertex at -3 station

Neurologic/psychologic: Alert and oriented × 3, normal judgment

Fetal assessment: Baseline fetal heart rate is in the 140s; there is moderate variability, positive accelerations, and no decelerations. Tocometer: Contractions every 5–7 minutes

Laboratory studies:

Hgb: 12.2 g/dL

Random blood glucose: 110 mg/dL

Imaging:

Bedside transabdominal ultrasound upon admission demonstrates fetus in cephalic presentation, with normal cardiac motion, a maximum vertical pocket (MVP) of 2 cm, and posterior placenta

How Would You Manage This Patient?

In light of this patient's diagnosis of premature rupture of membranes (PROM) at term, admission to Labor and Delivery with the plan for delivery is warranted. Her GDM diagnosis and recent ultrasound findings raise concern for fetal macrosomia with a high risk for shoulder dystocia and subsequent fetal/neonatal complications. Additionally, maternal morbidity in this scenario includes an increased risk of cesarean delivery (CD) in labor, perineal trauma, and postpartum hemorrhage if proceeding with augmentation of labor. After discussion of risks and benefits of vaginal versus CD, CD is recommended based on the risk of shoulder dystocia and fetal injury above 20–50% in this scenario [1]. The patient feels as if her current pregnancy is similar in size to her prior pregnancies, so while she understands the risks of vaginal delivery, she desires augmentation of labor. Augmentation with pitocin is initiated, and she ultimately has an uncomplicated delivery of a live born male infant weighing 4,100 g 12 hours after admission. She has an uneventful postpartum course and is discharged home on postpartum day 2.

Fetal Macrosomia

Macrosomia is defined as an absolute birth weight of >4,000 g irrespective of gestational age. Maternal risk factors that increase the likelihood of a newborn having macrosomia include preexisting diabetes, GDM, maternal pre-pregnancy obesity, a post-term pregnancy, and a prior delivery of a neonate weighing ≥4,000 g. The latter scenario is the strongest risk factor associated with having a newborn with macrosomia [1].

Prevention of fetal macrosomia includes both pre-pregnancy and antenatal interventions. Individuals with class III obesity should receive counseling on weight loss interventions, including bariatric surgery, prior to pregnancy in order to optimize pregnancy outcomes. Bariatric surgery prior to conception can help lower BMI and reduce rates of GDM and large for gestational age newborns. In addition, interventions during pregnancy like aerobic and strength-training exercise and prevention of excessive weight gain can reduce rates of macrosomia regardless of diabetic status. For individuals with GDM, achieving low glycemic environments should be the goal to minimize the likelihood of fetal macrosomia [1].

In order to detect GDM and prevent fetal macrosomia, the American College of Obstetricians and Gynecologists and the

US Preventive Services Task Force recommend that all pregnant individuals undergo glucose screening between 24 and 28 weeks' gestation with a 50 g, 1-hour oral glucose tolerance test unless certain criteria are met that would prompt earlier screening [2]. Criteria that prompt early screening for GDM include having a BMI of ≥ 25 and any of the following: family history of diabetes in a first-degree relative, high-risk race or ethnicity, prior history of GDM or prior delivery of infant weighing $\geq 4,000$ g, polycystic ovarian syndrome, and impaired glucose tolerance. Once a diagnosis of GDM has been determined, frequent blood glucose monitoring, involving fasting and postprandial values, is recommended to ensure tight glucose control. High maternal glucose levels, particularly elevated fasting levels, lead to fetal hyperglycemia and subsequent increased fetal fat accumulation and larger fetal size. If maternal glucose values are elevated despite adherence to a low carbohydrate diet, then medical therapy is recommended, with insulin being the first-line medication used. Since newborns with macrosomia have increased body fat and larger shoulder and upper extremity circumferences, treatment of GDM and monitoring of fetal growth may decrease rates of shoulder dystocia, perinatal death, and potential birth trauma, including clavicular fracture or nerve palsy [3].

While the diagnosis of macrosomia is determined by weighing an infant after delivery, ultrasound is used to formulate an EFW by measuring fetal biometry, including biparietal diameter, head circumference, abdominal circumference, and femur length. However, the accuracy of ultrasonography is poor, especially for fetal weight $>4,000$ g, and the margin of error worsens with increasing fetal weight. Other ways to assess fetal size include physical examination with palpation maneuvers and asking parous women for their prediction of fetal size [1]. No method has been proven to be more accurate than another in regard to estimation of fetal weight. Estimated fetal weight alone may not discriminate macrosomia from risk of shoulder dystocia or fetal neurologic injury. Additional formulas for predicting adverse birth outcomes include calculated differences between the abdominal diameter and biparietal diameter or the abdominal circumference and head circumference, and the ratios of abdominal diameter to biparietal diameter or femur length to abdominal circumference [4]. Among these, the marker most predictive of shoulder dystocia is a measurement of abdominal diameter at least 2.6 cm greater than the biparietal diameter. Abdominal circumference >5 cm greater than head circumference is associated with brachial plexus injury.

As for timing of delivery in pregnancies associated with suspected fetal macrosomia, there is no role for induction of labor <39 weeks' gestation solely to prevent shoulder dystocia or other fetal and/or neonatal morbidity. Induction of labor for suspected fetal macrosomia at 39 weeks may result in neonates with lower birth weight and lower rates of birth trauma and shoulder dystocia compared to awaiting spontaneous labor, but no evidence exists to suggest a reduction of cesarean section or operative delivery in this scenario [5]. Regarding mode of delivery, most vaginal deliveries of pregnancies suspected to be affected by fetal macrosomia are uncomplicated

and do not experience shoulder dystocia. However, scheduled cesarean deliveries may be beneficial for pregnancies with suspected macrosomia and an EFW of $\geq 5,000$ g in women without diabetes or an EFW of $\geq 4,500$ g for individuals with gestational or preexisting diabetes [1]. These guidelines may have reduced the incidence of shoulder dystocia at higher birthweights since they were introduced, but shoulder dystocia may still occur more commonly in diabetics with lower EFW [6]. Counseling about mode of delivery in either scenario should include discussion of the limitations of sonography in antenatal estimation of birth weight and the challenge of predicting shoulder dystocia and other fetal/neonatal morbidity. Also, this counseling should mention that delivery via cesarean section does not completely eliminate the risk of brachial plexus injury, as $>50\%$ of all brachial plexus injuries occur in the setting of uncomplicated vaginal deliveries and can occur with traumatic extraction at the time of cesarean section [7].

During labor, the main risk to mothers of macrosomic fetuses is an increased risk of CD, most often for labor protraction or arrest of labor. Other maternal risks include postpartum hemorrhage, chorioamnionitis, and more severe vaginal lacerations, especially if associated with shoulder dystocia. Fetal risks in deliveries of macrosomic infants include clavicular fracture and brachial plexus palsy, primarily involving nerves C5 and C6, in addition to the major risk of hypoxia/asphyxiation and subsequent morbidity due to a prolonged period of impaired oxygen exchange with severe shoulder dystocia. Furthermore, neonatal morbidity associated with macrosomia involves increased risk of low 5-minute Apgar scores, hypoglycemia, respiratory problems, meconium aspiration, and increased need of admission to a neonatal intensive care unit (NICU) [1]. For further information on management of shoulder dystocia, see Case 62.

Prediction of shoulder dystocia by examining labor curves is inconsistent. However, arrest of descent in the second stage of labor of a macrosomic fetus is an indication for CD. Another consideration in the second stage is the safety of operative vaginal delivery in cases suspected to involve fetal macrosomia. Multiple studies have demonstrated that operative deliveries in the case of suspected macrosomia increase the risk of shoulder dystocia, and the risk rises with increasing numbers of risk factors for macrosomia. Clinicians should counsel patients appropriately regarding this potential risk, and if operative delivery is performed in this setting, preparation for shoulder dystocia is warranted. In the setting of labor after prior CD, suspected macrosomia is not a contraindication, but the risk of uterine rupture may increase in fetuses weighing $>4,000$ g [1]. Given that prediction of actual birth weight is poor, patient counseling and consideration of a patient's prior obstetric history is important in clinical decision-making regarding planned mode of delivery.

Key Teaching Points

- Macrosomia is defined as a newborn having a birth weight of $\geq 4,000$ g; however, prediction of actual birth weight is imprecise based on antenatal ultrasonography.

- Diabetes and obesity increase the risk of fetal macrosomia, so avoidance of maternal hyperglycemia and participation in exercise help reduce potential maternal and fetal morbidity in these clinical scenarios.
- Induction of labor <39 weeks' gestation is not indicated solely for suspected fetal macrosomia, and most deliveries of suspected newborns with macrosomia do not result in shoulder dystocia.
- Counseling regarding mode of delivery for suspected fetal macrosomia should discuss the limitations in prediction of shoulder dystocia or birth trauma, but scheduled CDs may be beneficial for cases of newborns with suspected macrosomia who have an EFW of $\geq 5,000$ g in individuals without diabetes or an EFW of $\geq 4,500$ g for individuals with gestational or preexisting diabetes.

References

- 1 Macrosomia: ACOG Practice Bulletin, Number 216. *Obstet Gynecol.* 2020;135:e18–e35.
- 2 US Preventive Services Task Force. Gestational Diabetes: Screening. www.uspreventiveservicestaskforce.org/uspstf/recommendation/gestational-diabetes-screening (accessed May 28, 2023).
- 3 ACOG Practice Bulletin No. 190: Gestational Diabetes Mellitus. *Obstet Gynecol.* 2018;131:e49–e64.
- 4 Robinson R, Walker KF, White VA, et al. The Test Accuracy of Antenatal Ultrasound Definitions of Fetal Macrosomia to Predict Birth Injury: A Systematic Review. *Eur J Obstet Gynecol Reprod Biol.* 2020;246:79–85.
- 5 Boulvain M, Thornton JG. Induction of Labour at or Near Term for Suspected Fetal Macrosomia. *Cochrane Database Syst Rev.* 2023;(3):CD000938.
- 6 Abdelwahab M, Frey H, Lynch C, et al. Association between Diabetes in Pregnancy and Shoulder Dystocia by Infant Birth Weight in an era of Cesarean Delivery for Suspected Macrosomia. *Am J Perinatol.* 2023;40:929–936.
- 7 Practice Bulletin No 178: Shoulder Dystocia. *Obstet Gynecol.* 2017;129:e123–e133.

CASE 76

A 20-Year-Old at 37 Weeks with a Twin Gestation Presents for Delivery Planning

Eric Strand

History of Present Illness

A 20-year-old primigravida presents for her prenatal visit at 37 weeks. She has a dichorionic/diamniotic twin pregnancy. To date, her pregnancy has been uncomplicated. Prenatal labs have been normal, including first-trimester aneuploidy screening and second-trimester testing for gestational diabetes (GDM). Her prior medical history is unremarkable, and her only medication is a prenatal vitamin. She has had no prior surgery. She does not smoke, drink alcohol, or use illicit drugs. She reports active fetal movement and only very rare contractions. At today's visit, she asks for information regarding the timing and route of her delivery.

Physical Examination

General appearance: 20-year-old healthy-appearing adult, gravid, in no acute distress

Vital signs:

Temperature: 36.8°C

Pulse: 98 beats per minute

Blood pressure: 128/82 mmHg

Respiratory rate: 20 breaths per minute

BMI: 32.0 kg/m²

Cardiopulmonary: Unremarkable

Abdomen: Soft, non-tender; gravid uterus with fundal height 44 cm

Pelvic: The cervix is dilated 1 cm with 50% effacement. A presenting head is palpable at -3 station

Neurologic/psychologic: Affect and mood appropriate

Fetal assessment:

Nonstress test (NST) baby A: Baseline 130s, reactive

NST baby B: Baseline 140s, reactive

Laboratory studies:

Group B streptococcus culture: Negative

Imaging:

Limited ultrasound reveals baby A in vertex presentation, with an EFW of 3,059 g (66th percentile). Baby B is in breech presentation, with an EFW of 2,783 g (38th percentile). Discordance is 9.0%

How Would You Manage This Patient?

This patient has an uncomplicated dichorionic/diamniotic pregnancy. The fetuses are concordant in growth, and the presentations (vertex/breech) allow her to pursue an

attempted vaginal delivery if desired. After reviewing the risks and benefits regarding mode of delivery, the patient consented to an attempted vaginal delivery. She underwent an induction of labor at 38 weeks' gestation. Her induction was uncomplicated and, when the cervix was completely dilated, she was brought to the operating room for delivery in the event an emergent cesarean delivery (CD) would be required. Baby A was delivered without complication, and baby B was successfully delivered via breech extraction. Both the patient and the babies did well.

Management and Delivery of a Twin Gestation

Twin pregnancies may be dichorionic/diamniotic, monochorionic/diamniotic, or monochorionic/monoamniotic. Determination of chorionicity is important as monochorionic twin pregnancies are associated with a higher frequency of certain fetal and neonatal morbidities, including stillbirth, congenital anomalies, twin-to-twin transfusion syndrome (TTTS), prematurity, and fetal growth restriction (FGR). In addition to these risks, monochorionic/monoamniotic twins carry the additional threat of cord entanglement and sudden fetal death. Because of these potential complications, suggested delivery timing varies depending on the type of twins. For otherwise uncomplicated twin gestations, optimal timing of delivery is as follows [1]:

- dichorionic/diamniotic: 38 0/7–38/67 weeks' gestation
- monochorionic/diamniotic: 34 0/7–37 6/7 weeks' gestation
- monochorionic/monoamniotic: 32 0/7–34 0/7 weeks' gestation.

Given the increased risk of fetal and neonatal complications, antenatal surveillance is recommended for all twin pregnancies. For an otherwise uncomplicated dichorionic/diamniotic twin gestation, weekly NSTs starting at 36 weeks are indicated [2].

Route of Delivery

Twin deliveries require a skilled provider. Ultimately, the route of delivery depends on the type of twin gestation, fetal presentations, gestational age, and the experience of the clinician [2]. Given the skill required to safely achieve a vaginal delivery, it is important to continue training residents to perform these procedures [3]. Monochorionic/monoamniotic pregnancies are usually delivered via cesarean to avoid the potential risk of umbilical cord entanglement during labor and attempted vaginal delivery. In addition, CD is recommended for any twin pregnancy in which the presenting twin is non-cephalic.

For diamniotic twin pregnancies, vaginal birth is preferred if the presenting twin is in the cephalic presentation. Multiple studies comparing planned cesarean section to planned vaginal delivery have demonstrated comparable neonatal outcomes with lower maternal morbidity in the patients selected for vaginal delivery [4,5]. These data are consistent for both cephalic and non-cephalic second twins [6]. With a skilled provider, successful vaginal delivery of both twins can be achieved in >80% of deliveries. Although based more on expert opinion than specific data, candidates for attempted vaginal delivery with a non-cephalic second twin should be >28 weeks' gestation and have a second twin with an EFW of >1,500 g and no more than 20% greater than the EFW of the presenting twin [7].

Mechanics of Delivery (Cephalic-Presenting Twin)

Delivering providers should understand that during the course of labor, the presentation of the second twin may change (e.g. from cephalic to non-cephalic). Thus, many twin pairs beginning labor with cephalic/cephalic presentations may not remain so after delivery of the first twin. Combined deliveries – vaginal birth for twin A and cesarean birth for twin B – occur in approximately 5–10% of attempted twin vaginal births. These births are associated with greater maternal and neonatal morbidities compared to successful vaginal births [8]. Given these risks, a patient may request a CD regardless of eligibility for an attempted vaginal delivery – in a model of shared decision-making, this request is reasonable and should be accommodated.

Acknowledging the additional challenges involved in achieving a safe vaginal delivery for twins, it is important for any provider attempting to deliver twin pregnancies to be skilled in both external cephalic version and breech extraction. These skills maximize the odds of achieving a vaginal delivery for twin B. Should a skilled provider not be available, pursuing a planned CD is a reasonable choice for any twin delivery. In addition, complications like cord prolapse, fetal heart rate abnormalities, or a failed attempt at breech extraction exist for all twin deliveries, increasing the potential need for an emergent CD. Understanding these risks, twin deliveries should always be performed in an operating room or a delivery room where a cesarean section could be immediately performed.

After delivery of the first twin, the umbilical cord should be clamped. Ideally, the umbilical cords are clamped in a fashion that allows identification of the respective cords at the time of pathologic examination of the placenta (e.g. one clamp on the cord of twin A, two clamps on the cord of twin B). Both the fetal heart rate and the presentation of the second twin should then be assessed. With the current technologies of fetal monitoring and real-time ultrasound, there does not appear to be a set time interval in which delivery must occur as long as the fetal heart beat remains reassuring [9]. In the case of a cephalic twin B, labor may continue and oxytocin augmentation may be considered if contractions space in frequency. Once engaged, artificial rupture of membranes can be performed to expedite delivery of twin B.

For a non-cephalic second twin, options include attempting an external cephalic version or a breech extraction. If an external cephalic version is preferred, this procedure is performed in the typical fashion, leaving the amniotic membranes of the second twin unruptured (see Case 49 for details of the procedure).

A breech extraction is also a reasonable approach for providers skilled in this procedure. Adequate anesthesia, ideally with an epidural, should be ensured. Breech extraction should be performed soon after delivery of the first twin, in order to reduce the risk of the cervix contracting between deliveries (potentially leading to head entrapment). An ultrasound should be performed to orient the delivering provider to the fetal positioning and the location of the back and feet. The provider then introduces his/her hand into the uterus in order to grasp the fetal feet (Figure 76.1). With firm traction, the feet are brought to the introitus. At this point, the amniotic membranes can be broken and the feet are brought through the introitus. Minimal traction should be provided until the fetal umbilicus has passed the introitus, maintaining the fetus in a back-up position. At this point, the fetal hips may be wrapped in a dry towel to assist with gentle traction as maternal expulsive efforts expel the fetus to the level of the scapula and axilla. It is helpful to have an assistant provide suprapubic pressure to keep the head flexed as the arms are delivered. Once the scapulae are visible, the fetus should be rotated 90°

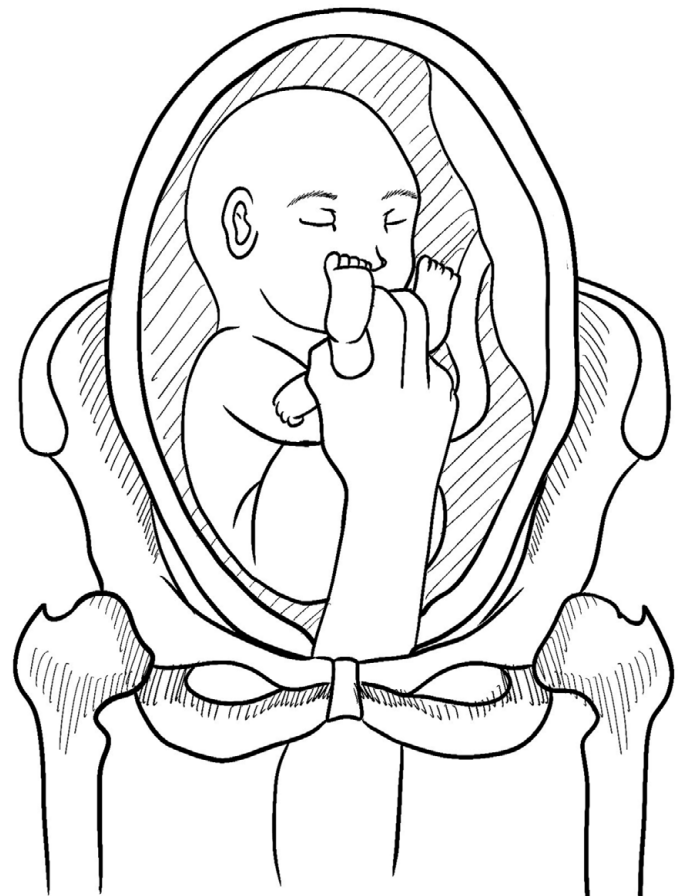


Figure 76.1 Breech extraction of second twin

and the anterior arm can be delivered by gently applying pressure to the inside of the elbow and sweeping the arm across the abdomen. The fetus may then be rotated 180° in the opposite direction to deliver the remaining arm in a similar fashion. Once both arms are delivered, the fetus is rotated back 90° so that the back is again anterior. With the continued application of suprapubic pressure, the head is flexed to facilitate delivery. A flexed position can be accomplished by using the Mauriceau–Smellie–Veit maneuver. In this maneuver, the operator's index and middle fingers apply gentle pressure on the fetal maxillary prominences to keep the head flexed. Care should be taken to avoid severe elevation of the body, as this may lead to hyperextension of the fetal cervical spine. Although not required for delivery, an episiotomy may be performed to facilitate delivery of the second twin if additional space is necessary.

Key Teaching Points

- Twin pregnancies are associated with increased maternal and fetal risks.
- Cesarean delivery is recommended for monochorionic/monoamniotic twin pregnancies as well as any twin pregnancy with a non-cephalic presenting twin.
- An attempted vaginal birth is preferred for diamniotic twin pregnancies with a cephalic-presenting twin; attempted external cephalic version or breech extraction are reasonable options for delivery of a non-cephalic second twin.
- Given the risk for unplanned CD of the second twin, all planned twin vaginal deliveries should occur in an operating room or a delivery room with capacity for emergent CD.

References

- 1 American College of Obstetricians and Gynecologists' Committee on Obstetric Practice; Society for Maternal-Fetal Medicine. Medically Indicated Late-Preterm and Early-Term Deliveries: ACOG Committee Opinion, Number 831. *Obstet Gynecol.* 2021;138(1):e35–e39.
- 2 Multifetal Gestations: Twin, Triplet, and Higher Order Multifetal Pregnancies: ACOG Practice Bulletin, Number 231. *Obstet Gynecol.* 2021;137(6):e145–e162.
- 3 American College of Obstetricians and Gynecologists; Society for Maternal-Fetal Medicine; Caughey AB, Cahill AG, Guise JM, Rouse DJ. Safe Prevention of the Primary Cesarean Delivery. *Am J Obstet Gynecol.* 2014;210(3):179–193.
- 4 Barrett JF, Hannah ME, Hutton EK, et al. A Randomized Trial of Planned Cesarean or Vaginal Delivery for Twin Pregnancy. *N Engl J Med.* 2013; 369(14):1295–1305.
- 5 Hofmeyr GJ, Barrett JF, Crowther CA. Planned Caesarean Section for Women with a Twin Pregnancy. *Cochrane Database Syst Rev.* 2015;(12):CD006553.
- 6 Easter SR, Lieberman E, Carusi D. Fetal Presentation and Successful Twin Vaginal Delivery. *Am J Obstet Gynecol.* 2016;214(1):116.e1–116.e10.
- 7 Fox NS, Silverstein M, Bender S, et al. Active Second-Stage Management in Twin Pregnancies Undergoing Planned Vaginal Delivery in a U.S. Population. *Obstet Gynecol.* 2010; 115(2 Pt. 1):229–233.
- 8 Aviram A, Lipworth H, Asztalos EV, et al. The Worst of Both Worlds-Combined Deliveries in Twin Gestations: A Subanalysis of the Twin Birth Study, a Randomized, Controlled, Prospective Study. *Am J Obstet Gynecol.* 2019;221(4):353.e1–353.e7.
- 9 Rydhström H, Ingemarsson I. Interval between Birth of the First and the Second Twin and Its Impact on Second Twin Perinatal Mortality. *J Perinat Med.* 1990;18(6): 449–453.

A 25-Year-Old at 18 Weeks' Gestation Presents with a Monochorionic/Diamniotic Twin Pregnancy

Shari M. Lawson

History of Present Illness

A 25-year-old primigravid patient presents to the office at 18 weeks for a follow-up obstetrics visit. She has a monochorionic/diamniotic pregnancy that was conceived spontaneously without assisted reproductive technology. Aside from food aversions, nausea, and some episodes of emesis in the first trimester, her pregnancy has been uncomplicated thus far. She denies vaginal bleeding but states that she has had trouble taking deep breaths or catching her breath after taking the stairs. She also reports new onset of acid reflux. Her past medical and surgical history are unremarkable. Her gynecologic history is remarkable for episodic genital herpes simplex, for which she takes valacyclovir for suppression. She denies tobacco, alcohol, and substance use. Her family history is noncontributory. Her only other medication is a prenatal vitamin. She has no drug allergies.

An ultrasound is performed in the prenatal diagnostic center just prior to today's appointment as part of her regular biweekly assessments for amniotic fluid volume (for maximum vertical pocket or MVP), size of the fetal bladder, and umbilical vessel Doppler velocimetry. Prior ultrasound had demonstrated normal fetal anatomy for both twins.

Physical Examination

General appearance: 25-year-old adult, well-developed and in no apparent distress

Vital signs:

Pulse: 88 beats per minute

Blood pressure: 118/66 mmHg

Respiratory rate: 16 breaths per minute

BMI: 27.5 kg/m²

Abdomen: Soft, non-tender, non-distended, gravid with fundal height of 36 cm

Extremities: 1+ edema bilaterally, no calf tenderness

Neurologic/psychologic: Alert and oriented, normal mood and affect

Imaging:

The MVP for twin A is 1.8 cm, and the MVP for twin B is 9.3 cm. The fetal bladder for twin A was visible at the 16-week ultrasound, but it is no longer measurable at this time. Umbilical artery Doppler ultrasounds are normal in both twins

How Would You Manage This Patient?

This patient has stage II twin-to-twin transfusion syndrome (TTTS). The patient was counseled on management options including pregnancy termination, selective reduction of one twin, fetoscopic laser photocoagulation of placental vessels, and amnioreduction for symptomatic polyhydramnios. After counseling, the patient indicated that she would like to proceed with the option that provides the best chance for the survival of both twins – fetoscopic laser photocoagulation. After her procedure, her weekly ultrasound assessments demonstrated appropriate growth and no further discrepancy. She was delivered by primary cesarean delivery (CD) at 34 weeks' gestation due to malpresentation of the presenting twin. Two healthy female infants were discharged home after a 2-week NICU stay.

Twin-to-Twin Transfusion Syndrome

TTTS is a rare complication that occurs in 10–15% of monochorionic/diamniotic twin pregnancies [1,2]. Monochorionic pregnancies are typically diagnosed early in gestation by the presence of a thin intervening membrane where the two amnions meet the chorionic interface (Figure 77.1). This contrasts with the thicker peak seen in dichorionic pregnancies. Accurate diagnosis of monochorionic pregnancies is of utmost importance given the attendant risks of increased incidence of anomalies, TTTS, twin anemia polycythemia sequence (TAPS), and selective FGR (sFGR).

In a monochorionic twin pregnancy, there are placental anastomoses within the shared placenta between the two fetal umbilical circulations. There are three different types of placental anastomoses: superficial artery-to-artery and vein-to-vein anastomoses along the placental surface, and deep artery-to-vein connections within shared cotyledons [1]. In uncomplicated monochorionic/diamniotic pregnancies, the net volume exchanged between the co-twins is balanced. In TTTS, there is unidirectional flow within the deep artery-to-vein anastomoses from the donor twin's artery (high-pressure system) to the recipient twin's vein (low-pressure system), causing the donor twin to transfuse the recipient. As a result, the donor twin develops hypovolemia, which leads to decreased perfusion of kidneys, oliguria, and oligohydramnios. The recipient, in turn, can develop fluid overload, polyuria, and polyhydramnios. In severe cases,

absent/reversed end diastolic flow in the umbilical artery (in the donor), hydrops (in the recipient), or fetal death can occur (in either twin). In all stages of TTTS, there is polyhydramnios in the recipient (MVP >8 cm) and oligohydramnios in the donor (MVP <2 cm). Criteria for staging this condition are shown in Table 77.1, with sample images in Figure 77.2. Without treatment, TTTS can remain stable, regress, or progress.

Stage I TTTS without maternal symptoms of polyhydramnios, cervical shortening, or preterm labor, can be managed expectantly. Treatment is offered in symptomatic stage I or stage II–IV. Management options for TTTS include pregnancy termination, selective reduction of one twin, fetoscopic laser photocoagulation of placental vessels, and amnioreduction for symptomatic polyhydramnios. Pregnancy termination is associated with risks including excessive bleeding, infection, and uterine perforation but eliminates the risks of delivery of severely premature infants and other attendant risks associated with twin pregnancies (i.e. hypertensive disorders of pregnancy, GDM). Pregnancy termination in the second trimester may be limited in states with restrictive abortion laws. While selective fetal reduction decreases the

risks of preterm birth, it was found to have a negligible effect on the risk of hypertensive disorders and GDM and to possibly convey an increased risk of the demise of the fetal co-twin [4,5]. Due to anastomoses between the two fetal umbilical circulations, selective fetal reduction is performed with bipolar coagulation or radiofrequency ablation to prevent profound hypotension and fetal injury/death due to reversed perfusion from the surviving co-twin. Pregnancy termination and selective fetal reduction are safest when performed in the first- or early-second trimesters. Amnioreduction to relieve symptomatic polyhydramnios is reserved for cases diagnosed in the late third trimester or when access to fetal therapy centers of excellence is limited. Amnioreduction is associated with PROM, infection, preterm labor, and fetal death. It can also complicate future fetoscopic laser procedures due to limited visibility.

When TTTS is diagnosed in the second trimester, fetoscopic laser photocoagulation is the preferred option as it can increase the chances of carrying the twin pregnancy to viability and beyond. During fetoscopy, small laparoscopic instruments are inserted through the maternal abdominal and uterine walls and into the recipient's amniotic sac within the uterus. Under direct visualization, placental vessel anastomoses along the vascular equator (location where the two fetal umbilical circulations meet) are ablated with a laser. The goal of fetoscopic laser ablation is to create two functionally separate placentas and separate fetal circulatory systems. This terminates the donor-to-recipient transfusion and also provides protection for a surviving co-twin in the event of fetal demise. In cases of stage V TTTS, sudden reverse perfusion of the demised twin by the surviving co-twin at the time of death places the surviving twin at risk of neurologic impairment from hypoxia-ischemia [2]. Risks associated with fetoscopic laser photocoagulation include

Table 77.1 Stages of twin-to-twin transfusion

Stage I	Fetal bladder in donor twin is visible
Stage II	Fetal bladder in donor twin is no longer visible
Stage III	Critical abnormalities* in Doppler velocimetry develop
Stage IV	Recipient twin develops hydrops
Stage V	Fetal death occurs

* Absent or reversed umbilical artery diastolic flow, and/or reversed ductus venosus a-wave, and/or pulsatile umbilical vein [1,3]

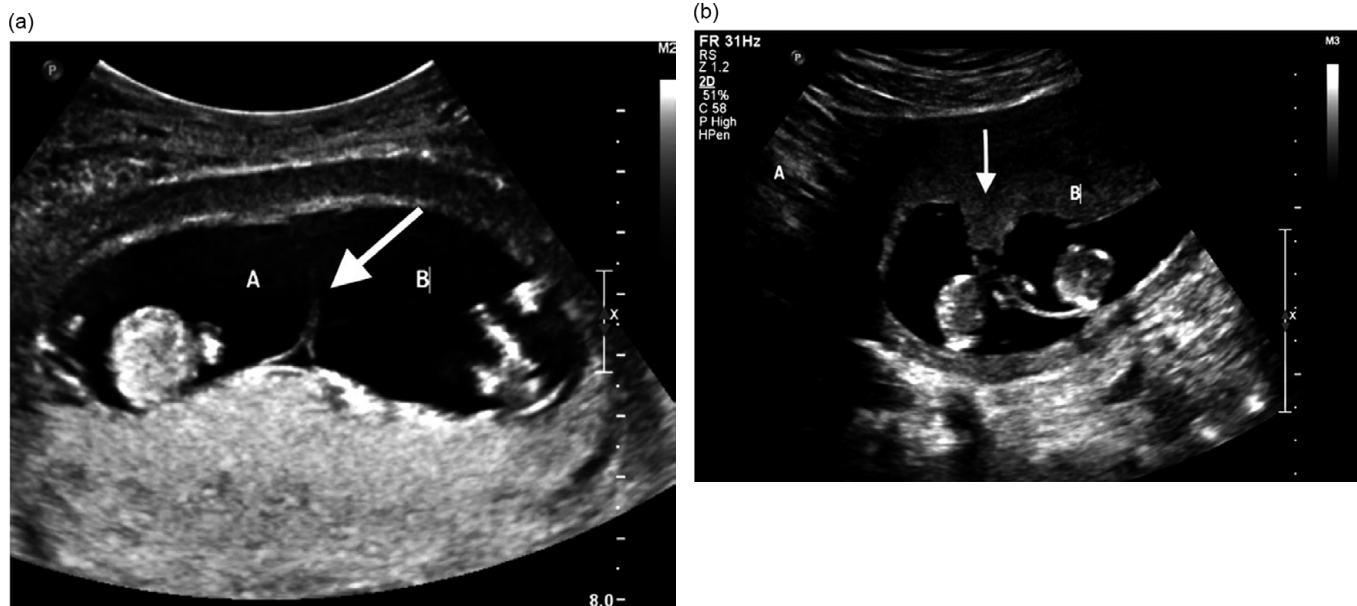


Figure 77.1 Ultrasound diagnosis of monozygotic and dizygotic pregnancies. Reproduced with permission from Smith J, Treadwell MC, Berman DR. Role of Ultrasonography in the Management of Twin Gestation. *Int J Gynaecol Obstet.* 2018;141(3):304–314. a. Monozygotic/diamniotic pregnancy in the first trimester. Arrow indicates the intervening diamniotic membrane separating the two embryos, labeled A and B. b. Twin peak (lambda) sign in a dizygotic pregnancy. Arrow indicates the twin peak, which separates the two embryos labeled A and B. Note the extension of the placenta into the intervening membrane

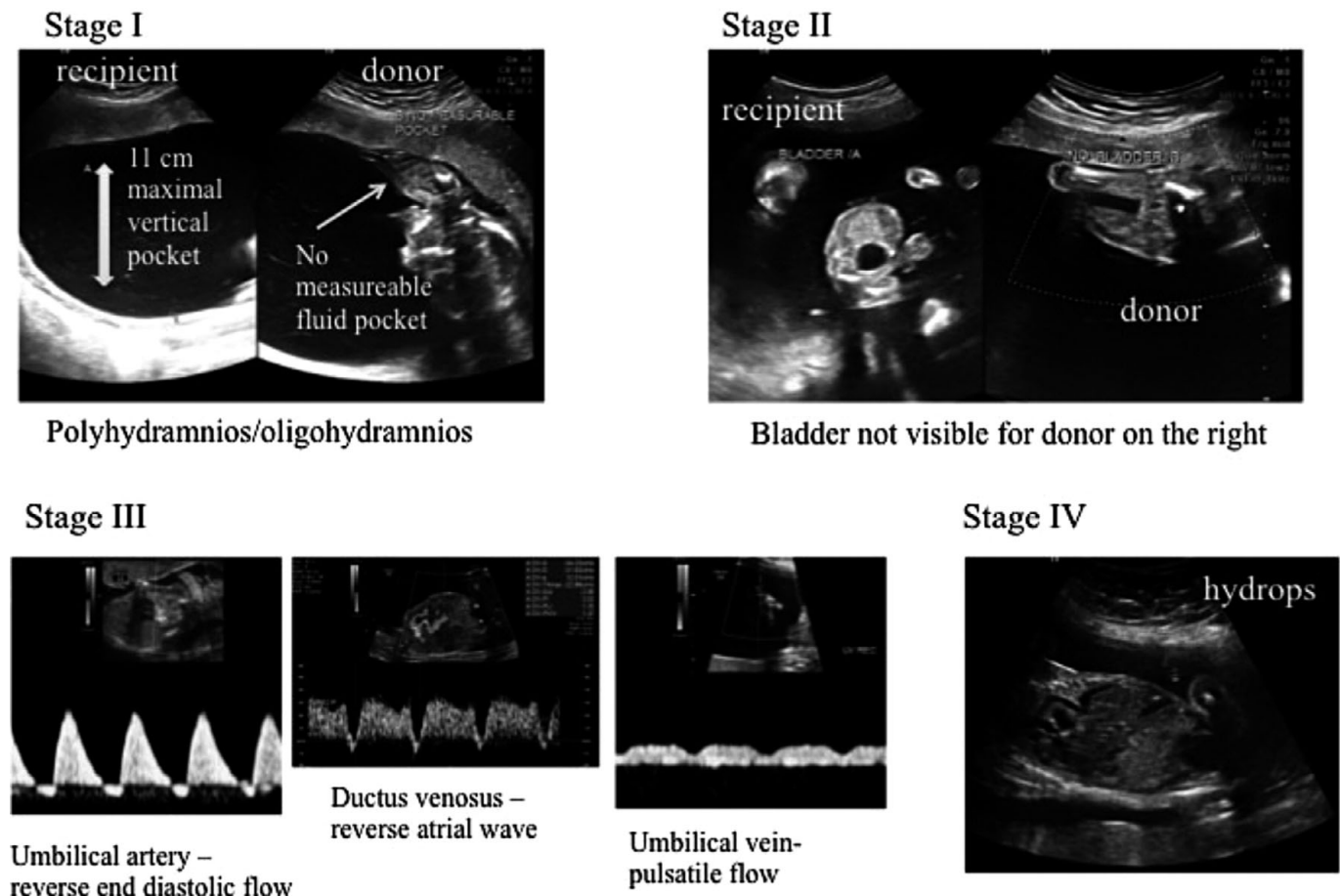


Figure 77.2 Stages of TTTS per the Quintero method. Reproduced with permission from Benoit RM, Baschat AA. Twin-to-Twin Transfusion Syndrome: Prenatal Diagnosis and Treatment. *Am J Perinatol.* 2014;31(7):583–594

premature rupture of membranes (PROM), preterm birth, placental abruption, extravasation of amniotic fluid, and fetal death.

Survival of both twins following laser photocoagulation is as high as 65% and survival of at least one twin is approximately 88%. Following treatment, the patient must continue close surveillance for resolution of TTTS and to monitor for coexistent occurrences of TAPS and sFGR. Twin anemia polycythemia sequence develops when very narrow arteriole-to-vein anastomoses permit the shunting of erythrocytes from the donor twin to the recipient twin without polyhydramnios/oligohydramnios. This results in polycythemia in the recipient and anemia in the donor. It can be detected using peak systolic velocity of the middle cerebral arteries during routine ultrasound assessments of monochorionic/diamniotic twins and confirmed with periumbilical blood sampling. Pregnancies complicated by TAPS are at increased risk of adverse perinatal outcomes, including intrauterine death, and severe neurological morbidity (i.e. intraventricular hemorrhage, periventricular cystic leukomalacia, and ventricular dilation). Monochorionic diamniotic twins are also at risk of experiencing selective growth restriction that occurs when one twin has a significantly smaller share of the placenta than the other. Selective FGR can also have an impact on perinatal outcomes

(e.g. an increased risk of intrauterine death or iatrogenic preterm birth).

Following placental vascular ablation, patients should continue with weekly ultrasound assessments of TTTS and serial ultrasound assessments of fetal growth every 3–4 weeks. These patients should be delivered between 34 0/7 and 37 6/7 weeks' gestation [6], in lieu of any fetal or maternal indications for earlier delivery (e.g. absent or reversed end-diastolic umbilical artery flow or development of maternal hypertensive disorder of pregnancy). Delivery timing for pregnancies complicated by TTTS will also depend on other factors, including progression of TTTS, nursery/NICU level, and availability of trained personnel. Pregnancies complicated by sFGR are typically delivered earlier, between 32 0/7 and 34 6/7 weeks' gestation [6]. Similar to uncomplicated monochorionic/diamniotic twin pregnancies, mode of delivery for pregnancies complicated by TTTS will be determined by the presentation of the presenting twin, gestational age/EFW, and/or presence of discordant growth.

Long-term outcomes in surviving twins are primarily related to neurodevelopment and cardiovascular function. The risk of neurodevelopment impairment is correlated with the gestational age at delivery and does not differ significantly from infants resulting from uncomplicated

monochorionic/diamniotic pregnancy. The recipient co-twin is at increased risk of cardiac dysfunction (e.g. valvular regurgitation, pulmonary stenosis, and diastolic dysfunction). There are no long-term maternal effects due to TTTS.

Key Teaching Points

- Early assessment of chorionicity in twin pregnancies is crucial, as monochorionic pregnancies have unique risks including TTTS, TAPS, and sFGR.
- In TTTS, there is unidirectional flow within the deep artery-to-vein anastomoses from the donor twin's artery (high-pressure system) to the recipient twin's vein (low-pressure system), causing the donor twin to transfuse the recipient.
- In all stages of TTTS, there is polyhydramnios in the recipient (MVP >8 cm) and oligohydramnios in the donor (MVP <2 cm).
- Management options for TTTS include pregnancy termination, selective reduction of one twin, fetoscopic laser photocoagulation of placental vessels, and amnioreduction for symptomatic polyhydramnios.
- When TTTS is diagnosed in the second trimester, fetoscopic laser photocoagulation is the preferred option as it can increase the chances of carrying the twin pregnancy to viability and beyond.

References

- 1 Bamberg C, Hecher K. Twin-to-Twin Transfusion Syndrome: Controversies in the Diagnosis and Management. *Best Pract Res Clin Obstet Gynaecol.* 2022;84:143–154.
- 2 Miller JL. Twin to Twin Transfusion Syndrome. *Transl Pediatr.* 2021;10(5):1518–1529.
- 3 Quintero RA, Morales WJ, Allen MH, et al. Staging of Twin-Twin Transfusion Syndrome. *J Perinatol.* 1999;19(8 Pt. 1):550–555.
- 4 Greenberg G, Bardin R, Danieli-Gruber S, et al. Pregnancy Outcome following Fetal Reduction from Dichorionic Twins to Singleton Gestation. *BMC Pregnancy Childbirth.* 2020;20(1):389.
- 5 Rahimi-Sharbat F, Ghaemi M, Nassr AA, et al. Radiofrequency Ablation for Selective Fetal Reduction in Complicated Monochorionic Twins; Comparing the Outcomes According to the Indications. *BMC Pregnancy Childbirth.* 2021;21:189.
- 6 American College of Obstetricians and Gynecologists' Committee on Obstetric Practice; Society for Maternal-Fetal Medicine. Medically Indicated Late-Preterm and Early-Term Deliveries: ACOG Committee Opinion, Number 831. *Obstet Gynecol.* 2021;138(1):e35–e39.

CASE 78

A 25-Year-Old at 22 Weeks' Gestation with Mild Fetal Renal Pelvis Dilation on an Anatomic Survey Ultrasound

Marcia Little

History of Present Illness

A 25-year-old gravida 1 para 0 at 22 weeks' gestation presents to her routine clinic visit and has concerns regarding a finding on her second-trimester fetal anatomic survey ultrasound. The fetus has isolated mild fetal renal pelvis dilation (pyelectasis or urinary tract dilation [UTD]) and she is anxious about what this may indicate for her baby. This is a planned pregnancy, and other than her Rhesus (Rh)-negative status, there is nothing remarkable about her prenatal course thus far. She started prenatal care in the early second trimester and started to appreciate fetal movement last week. She nor her partner have any family history of congenital abnormalities. She takes prenatal vitamins, an antihistamine for seasonal allergies, and uses acetaminophen for occasional tension headaches. She denies tobacco, alcohol, or nonprescription drug use.

Physical Examination

General appearance: Alert, unlabored respirations although tearful

Vital signs:

Temperature: 37.1°C

Pulse: 102 beats per minute

Blood pressure: 105/72 mmHg

Respiratory rate: 16 breaths per minute

BMI: 31.7 kg/m²

Abdomen: Soft, non-tender with fundal height of 20 cm at the umbilicus

Fetal assessment: Fetal heart tones 154 beats per minute via Doppler

Laboratory studies:

Hgb: 11 g/dL

Rh status: Negative

Noninvasive prenatal serum testing: Declined

Urinalysis: Color – yellow (light/pale), clear; pH – 5.9; specific gravity – 1.010 (normal)

How Would You Manage This Patient?

The patient and her partner were counseled that this finding on ultrasound could indicate an increased risk of fetal aneuploidy, developing urinary tract malformation, or a normal fetus. She previously declined a noninvasive prenatal testing (NIPT) but given the ultrasound findings, NIPT was

recommended to assist with further risk stratification. The cell-free DNA test result was performed and was low-risk, and no further management was advised to evaluate for aneuploidy. If the patient had declined NIPT, another option for evaluation would be amniocentesis, which would not be advised without interval cell-free DNA due to the enhanced risk to the pregnancy of an invasive procedure.

A limited follow-up obstetric ultrasound was performed at 32 weeks' gestation to look for stability, regression, or progression in renal pelvis dilation. Persistent or worsening dilation of the renal pelvis would prompt consideration of a urinary tract structural abnormality not related to chromosome makeup. The fetus in this scenario had persistence of pyelectasis measuring 6 mm on the third-trimester ultrasound and maintained a normal AFI. The patient had a successful vaginal delivery at term after prelabor rupture of membranes. The female neonate had acceptable voiding and stooling patterns in the immediate postnatal period. Neonatal renal ultrasound was performed at 6 days of life, and the results were normal.

Mild Fetal Renal Pelvis Dilation on Ultrasound

Mild fetal renal pelvis dilation is the most common abnormal finding identified with the mid-trimester fetal anatomic assessment. Frequency of this finding is reported in 1–2% of pregnancies [1]. This condition is labeled pyelectasis or UTD if the renal pelvis dilation measured in the anterior-posterior diameter is ≥ 4 mm prior to 32 weeks' gestation or ≥ 7 mm after 32 weeks (Figure 78.1) [1]. These ultrasound measurements should ideally be taken with the fetal spine in the 12 o'clock position. Calipers are placed at the inferior renal parenchymal margin and measured across the widest diameter of the fluid-filled renal pelvis [2].

In practice, the words pyelectasis and hydronephrosis are used interchangeably, however, hydronephrosis is usually reserved for more severe dilation (≥ 10 mm) and with involvement of the renal calyces as well as the renal pelvis. The consensus statement featured in the *Journal of Pediatric Urology* asserts that the term urinary tract dilation should be used to avoid inconsistency with language [1]. The etiology of UTD is multifactorial. Urinary tract filling and evacuation is dynamic and physiologic and ultrasound measurements of dilation can vary in as little as 2 hours. Postnatal pathology was detected in 12% of children with isolated second-trimester UTD but in 40% of children with UTD in the second and third

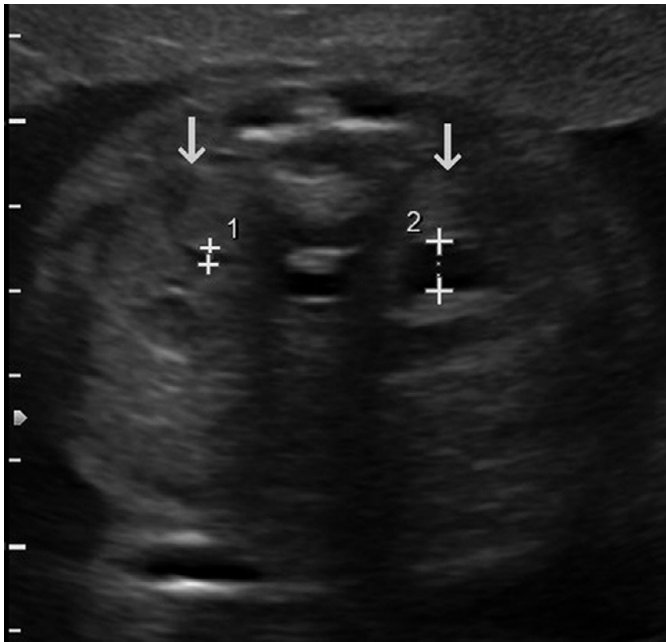


Figure 78.1 Renal cross-section of 24 week fetus. The right renal pelvis is 2 mm in diameter, the left 6 mm in diameter (mildly dilated). Acoustic shadowing is present from the vertebral body

trimesters [1]. The likelihood of resolution is based on the severity of the dilation at the time of diagnosis. Postulates for the physiologic basis of resolution include immaturity of the ureters causing decrease in urine outflow and transient infolding of ureteral tissue [2]. These processes often correct and result in normal urinary tract function of the infant.

UTD and Fetal Aneuploidy

Urinary tract dilation is a soft marker for fetal aneuploidy, specifically trisomy 21 (Downs syndrome). Soft ultrasound markers are findings on ultrasound associated with aneuploidies but also commonly seen in normal fetuses. Monosomy X (60–80%), trisomy 8 (75%), and trisomy 13 (50–60%) can also have hydronephrosis and other renal abnormalities as part of their physical antenatal expression [3]. Enlarged fetal renal pelvis dimensions were identified in the early 1990s as being associated with aneuploidy. The positive predictive value for UTD with additional abnormal ultrasound findings and Down syndrome was 1/90 [4]. This was comparable to other identifiable risk factors and indications for genetic amniocentesis such as maternal age ≥ 35 years or low maternal serum alpha-fetoprotein. However, if there were no other findings on fetal anatomic survey and the patient possessed no other risk factors, the positive predictive value fell to 1/340. In a study published in the *American Journal of Obstetrics and Gynecology*, evaluation of 12,672 ultrasound subjects revealed a positive predictive value of only 0.33% for trisomy 21 when pyelectasis is the sole abnormality seen [5]. Before cell-free DNA testing became commercially available in 2011, less accurate maternal serum screening methods were used to assist with risk stratification. Currently, a low-risk cell-free DNA result reduces the risk of

trisomy 21 by 300-fold. As technology has improved and become more accurate, invasive antenatal testing such as amniocentesis to obtain fetal chromosome array is no longer advised for this solitary soft ultrasound marker finding [5,6].

UTD and Structural Abnormalities

Urinary tract dilation can also be an indicator of structural conditions in the urinary tract such as pelviureteric junction stenosis or vesicoureteral reflux. Obstructive uropathy is the most common cause of pediatric chronic kidney disease. These disorders can obstruct passage of urine from the renal collecting system into the urinary bladder. Maturation of the renal parenchyma can be impeded due to the resulting hydrostatic pressure from the dilated renal pelvis. Renal tubular atrophy and inflammation are more common with an increase in pressure from the collecting system. The number of nephrons, the functional unit of the kidney, can be reduced due to the obstructive process [7]. A fetus with persistent or worsening hydronephrosis can develop low amniotic fluid volumes and postnatal kidney disease. An ultrasound should be repeated in the third trimester (around 32 weeks' gestation) to assess stability or progression of UTD. If the UTD on subsequent ultrasound imaging is classified as mild, no further antenatal ultrasounds are indicated.

UTD Classification

There is a lack of uniformity in grading and reporting antenatal UTD abnormalities. Perinatologists favor using the anterior-posterior renal pelvis dilation (APRPD) reporting system. Pediatric urologists have numerous grading systems but use the APRPD and Society of Fetal Urology (SFU) hydronephrosis grading system to a large degree. The SFU system incorporates more detail in evaluating the renal pelvis and the renal calyces and parenchyma. The APRPD classifies renal pelvis dilation of >10 mm in the second trimester and >15 mm in the third trimester as severe for reference [1].

Postnatal Management

The recommendation for postnatal renal ultrasound to detect structural conditions should be individualized, and there is no standardized guidance for the pediatrician on how often these exams should be performed [1]. Across studies and publications, cut-offs range from 7.5 mm of dilation seen after 24 weeks to >10 mm. The lower the cut-off, the more significant uropathy cases requiring surgical intervention will be captured. However, there will be more unnecessary testing performed and expenditure of health care resources utilizing lower thresholds.

In many instances, the pediatric urologist cannot access antenatal ultrasound reports or images when consulted neonatally. This occurs due to the use of different radiographic storage technology and limitations with flow of information between electronic health records. The parents should be provided with actual antenatal ultrasound images to provide to any consultants. Severe UTD should prompt antenatal consultation with a perinatologist and pediatric urologist.

After delivery, many factors can influence the results of postnatal urologic ultrasound, thereby making the

standardization of timing difficult. Dehydration is a major cause of underestimation of hydronephrosis, with the neonate in a physiologically dehydrated state, especially if exclusively breastmilk fed. The patient position in which the ultrasound is performed as well as the distention of the bladder can influence fluid seen in the renal pelvis. Subsequently, the timing and frequency of postnatal urinary tract ultrasound should be individualized but should be delayed at least 48 hours (about 2 days) post-birth [1]. More severe renal pelvis dilation requires imaging to be performed prior to the neonate's discharge from the hospital [8].

Key Teaching Points

- Mild UTD in the fetal renal pelvis occurs in 1–2% of pregnancies.
- Solitary mild UTD on the fetal anatomic survey ultrasound with low-risk cell-free DNA testing is reassuring. Invasive testing for fetal aneuploidy is not indicated.
- Reassessment of the fetal urinary tract at 32 weeks' gestation should be performed to assess stability, regression, or progression of renal pelvis dilation.
- Structural conditions of the urinary tract can also result in UTD. Antenatal consultation with Maternal Fetal Medicine and Pediatric Urology is warranted for severe dilation of the renal pelvis and every effort should be made to provide consultants with antenatal ultrasound images.
- Postnatal renal ultrasound should be performed but delayed at least 48 hours post-birth. Severe UTD of $\geq 15\text{mm}$ should prompt imaging prior to the neonate's discharge.

References

- 1 Nguyen H, Benson C, Bromley B, et al. Multidisciplinary Consensus on the Classification of Prenatal and Postnatal Urinary Tract Dilation (UTD Classification System). *J Pediatr Urol.* 2014;10:982–999.
- 2 Zuckerwise L. Renal Pelvic Dilation. *Am J Obstet Gynecol.* 2021;225(5):31–33.
- 3 Barakat A, Butler A. Renal and Urinary Tract Abnormalities Associated with Chromosome Aberrations. *Int J Pediatr Nephrol.* 1987;8(4):215–226.
- 4 Corteville J, Dicke J, Crane J. Fetal Pyelectasis and Downs Syndrome: Is Genetic Amniocentesis Warranted? *Obstet Gynecol.* 1992;79(5):770–772.
- 5 Coco C, Jeanty P. Isolated Fetal Pyelectasis and Chromosomal Abnormality. *Am J Obstet Gynecol.* 2005;193(3 Pt. 1):732–738.
- 6 Prabhu M, Kuller J, Biggio J. Society for Maternal Fetal Medicine Consult Series #57: Evaluation and Management of Isolated Soft Ultrasound Markers for Aneuploidy in the Second Trimester. *Am J Obstet Gynecol.* 2021;225(4):B2–B15.
- 7 Jain S, Chen F. Developmental Pathology of Congenital Kidney and Urinary Tract Anomalies. *Clin Kidney J.* 2019;12(3):382–399.
- 8 Lee R, Cendron M, Kinnamon D. Antenatal Hydronephrosis as a Predictor of Postnatal Outcome: A Meta-analysis. *Pediatrics.* 2006;118(2):587–593.

CASE 79

A 35-Year-Old with Three Prior Cesarean Deliveries and a Possible Accreta on Her Anatomy Ultrasound

Priyanka Raju and Peter F. Schnatz

History of Present Illness

A 35-year-old gravida 4 para 3 at 18 0/7 weeks' gestation presents to the office for a scheduled fetal anatomy ultrasound. The current pregnancy has been uncomplicated. The patient's prenatal labs are significant for mild anemia with a second-trimester hemoglobin of 10.0 g/dL. Her prior pregnancies were complicated by chronic hypertension and a primary cesarean delivery (CD) for arrest of dilation followed by two repeat CDs. Her chronic hypertension is well-controlled without medications. She is taking a prenatal vitamin daily and has no known drug allergies.

Physical Examination

General appearance: Well-developed, no apparent distress

Vital signs:

Temperature: 37.2°C

Pulse: 89 beats per minute

Blood pressure: 128/82 mmHg

Respiratory rate: 12 breaths per minute

Body mass index (BMI): 26.3 kg/m²

Cardiopulmonary: Regular rate and rhythm with clear lung sounds

Abdomen: Soft, non-tender, gravid uterus

Pelvic: The external genitalia is normal without lesions. There is scant, clear vaginal discharge. The uterus is 18-weeks size, mobile, and non-tender

Fetal assessment: Fetal heart rate is 154 beats per minute

Imaging:

Transabdominal ultrasound reveals an amniotic fluid index of 15.1 cm with a maximum vertical pocket (MVP)

of 5.3 cm. The estimated fetal weight (EFW) is in the 30th percentile for gestational age. No gross fetal abnormalities are noted. Placental evaluation reveals an anterior placenta with a partial previa, multiple vascular lacunae within the placenta, and loss of the normal hypoechoic zone between the placenta and the myometrium (Figure 79.1).

How Would You Manage This Patient?

Given the high suspicion for placenta accreta, an magnetic resonance image (MRI) was performed revealing abnormal bulging of the placenta into the uterus. The patient received routine prenatal care and was monitored with regular growth scans in the third trimester. The patient was not interested in future pregnancy. She received betamethasone injections for fetal lung maturity and underwent a planned repeat CD at 35 0/7 weeks at a quaternary care center. Her multidisciplinary team consisted of an obstetrician, perinatologist, neonatologist, and an anesthesiologist. A total hysterectomy immediately followed delivery and pathologic evaluation of the uterus confirmed the diagnosis of placenta accreta.

Placenta Accreta Spectrum Disorder

Placenta accreta is defined as abnormal trophoblast invasion through the deeper layers of the decidua and into the myometrium. Placenta accreta spectrum disorder (PAS), previously known as morbidly adherent placenta, includes placenta accreta, placenta increta, and placenta percreta.

PAS is associated with increased maternal and fetal morbidity and mortality. Thus, delivery planning should include appropriate subspecialists consultation and access to a blood

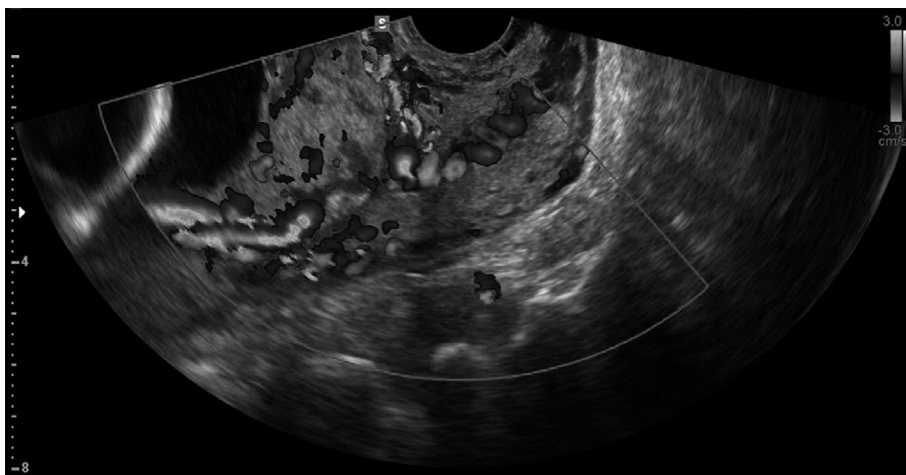


Figure 79.1 Ultrasound findings concerning for placenta accreta spectrum disorder (A black and white version of this figure will appear in some formats. For the color version, please refer to the plate section.)

Table 79.1 Risk of PAS (%) with number of prior cesarean section and placenta previa

Number of CDs	1	2	3	4	5	6+
Risk of PAS (without placenta previa; %)	0.03	0.1	0.8	0.8	4–6	4–6
Risk of PAS (with placenta previa; %)	3.3	11	40	61	67	67

bank with protocols in place for massive transfusion to improve outcomes in the setting of a known or suspected placenta accreta [1].

Risk Factors

The most common risk factor for PAS is a prior CD. Additional risk factors include placenta previa, advanced maternal age, multiparity, prior uterine surgery or curettage, and a history of Asherman syndrome. Table 79.1 demonstrates the additive risk with the combination of prior CDs and the finding of a placenta previa on ultrasound in the current pregnancy. When the diagnosis is in question, specific biomarker testing can indicate a higher risk. These include maternal serum alpha-fetoprotein (AFP), pregnancy-associated plasma protein A, pro B-type natriuretic peptide, troponin, free beta-human chorionic gonadotropin, and human placental lactogen [2].

Evaluation

Evidence of PAS on ultrasound can be detected as early as 6–10 weeks. All patients at risk of PAS are recommended to have a formal ultrasound assessment of placental location at the time of their mid-trimester anatomy scan. Patients found to have a low-lying placenta or placenta previa in the setting of a previous CD should undergo detailed imaging by a specialist with expertise in the diagnosis of PAS. Abnormalities associated with PAS include vascular lacunae within the placenta, loss of the normal hypoechoic zone between the placenta and the myometrium, decreased retroplacental myometrial thickness (<1 mm), abnormalities of the uterine–bladder interface, and extension of the placenta into the myometrium, serosa, or bladder. Doppler findings of turbulent lacunar blood flow, gaps in myometrial blood flow, or vessels bridging the placenta to the uterine margin may be present. Although ultrasound evaluation is important, the absence of ultrasound findings does not preclude a diagnosis of PAS. MRI may be used for antenatal evaluation of PAS; associated findings include dark intra-placental banding, abnormal bulging of the placenta or uterus, and abnormal or disorganized placental blood vessels [2,3].

Counseling

Patients with suspected PAS face a high-risk delivery and recovery. Routine antenatal care should proceed with modifications as needed for comorbidities. Anemia and iron deficiency should be evaluated and optimized accordingly. Repeat ultrasound imaging should be considered each trimester to

evaluate placenta location and features. Regular fetal growth scans should be performed at 28, 32, and 34 weeks due to the risk of fetal growth restriction (FGR). Bed rest is not indicated, and recommendations for pelvic rest should be made on an individualized basis. Antenatal bleeding, preterm labor, and preterm premature rupture of membranes frequently result in an unscheduled delivery, which has an increased risk of maternal and neonatal morbidity. Patients with these complications may benefit from antenatal hospitalization for closer monitoring. In the third trimester, distance from the planned hospital for birth, challenges of childcare, or difficulties with transportation should be considered. Counseling should also include discussing the potential for hemorrhage and the need for transfusion, the various surgical possibilities and complications, and an extended hospital admission. Patients with PAS are at increased risk for anxiety, postpartum depression, and post-traumatic stress disorder and should be counseled regarding warning signs and resources.

Delivery Planning

Maternal and neonatal outcomes are improved when delivery occurs at a tertiary or quaternary maternal care facility before the onset of labor and/or bleeding. Where a multidisciplinary team, as described later, is not available, patients should be referred to an appropriate tertiary care center at the time of diagnosis or if there is a need for further management. Patients should undergo a planned CD in the late preterm period (34 0/7–35 6/7 weeks). Earlier delivery may be indicated in cases of persistent bleeding, preeclampsia with severe features, preterm labor, rupture of membranes, or fetal compromise. Administration of antenatal steroids for fetal lung maturation should be considered in patients with PAS and an anticipated delivery before 37 weeks' gestation. Additionally, patients may benefit from prenatal consultation with a neonatal intensivist for a discussion on the expected infant course following preterm delivery [1,2].

Inclusion of the following team members should be considered: an obstetrician, a perinatologist, a urologist, a general surgeon, a hematologist, a neonatologist, an interventional radiologist, an anesthesiologist, and an advanced pelvic surgeon. Preoperative consultations should be considered on an individualized basis. Involvement of an anesthesiologist accustomed to managing massive obstetric hemorrhage, rapid transfusion, and hemodynamic monitoring is critical for improved maternal and neonatal outcomes in PAS cases [1,2,3].

Due to the frequent need for large-volume blood transfusion, centers handling scheduled PAS deliveries should have an established massive transfusion protocol, including staff trained in the management of postpartum hemorrhage (PPH). At a minimum, patients should have adequate intravenous (IV) access with large-bore catheters. PAS teams should be trained in the use of cell salvage and rapid infusion devices to expedite transfusion of blood products. Because the risk of rapid hemorrhage is hard to predict, surgeons should consider obtaining multiple units of packed red blood cells (pRBCs), fresh frozen plasma (FFP), and platelets before the

procedure in order to be ready for rapid transfusion if needed. Medications for atony and antifibrinolytic agents should be immediately available to avoid delay [4].

Perioperative Considerations

Patient positioning during the procedure should allow for adequate surgical exposure, rapid intubation, sufficient space for vascular access, and access to the perineum. Lithotomy positioning can allow the team to assess vaginal blood loss, allow vaginal access, perform cystoscopy, and stent placement if indicated. Tranexamic acid (TXA) should be administered immediately before, or during, CD for all PAS procedures.

Surgical Methods

The preferred surgical management of PAS remains unclear. The skin incision should optimize visualization while considering the use of a Pfannenstiel, Maylard, Joel-Cohen, Cherney, or vertical skin incisions. A uterine incision should be chosen to avoid the placenta. Data have demonstrated favorable outcomes with transverse fundal incisions, classical vertical incisions, and posterior incisions, among others. Intraoperative ultrasonography is recommended to visualize the placental edge before the incision. Regional versus general anesthesia should be considered factoring in patient preference, body habitus, American Society of Anesthesiologists physical status classification score, anesthesiologist expertise, urgency of the procedure, hemodynamic stability, ability to resuscitate for cases of hypovolemic shock, patient comorbidities, and potential complications. In cases where significant intraoperative hemorrhage is anticipated, general anesthesia with establishment of an endotracheal tube is often the preferred method [5,6].

Total hysterectomy is the recommended surgical method for emergent peripartum hysterectomy due to the risk of morbidity associated with cervical stump remnants. Conversely, subtotal hysterectomy is associated with decreased blood loss, blood transfusions, perioperative complications, and shorter operating time. An attempt at manual separation of placenta and use of uterotonics is not recommended in the setting of a planned hysterectomy for PAS. Other novel surgical techniques include early devascularization and the use of disposable devices such as stapling or vessel sealing devices. Adjunctive techniques such as stepwise devascularization, aortic balloon occlusion catheter, internal iliac or hypogastric artery ligation, or uterine artery embolization (UAE) may be considered to mitigate bleeding [4,5,6].

Planning a delayed or secondary hysterectomy is an alternative surgical management strategy for PAS disorders. Delayed hysterectomy may be undertaken where extensive invasion into

surrounding organs would make immediate cesarean hysterectomy difficult. Delayed hysterectomy may be performed between 3 and 12 weeks' postpartum and typically involves postpartum uterine artery embolization (UAE). Several retrospective studies report up to a 33% decrease in blood loss for patients managed with UAE before hysterectomy [5,6,7].

Conservative surgical management techniques aim to avoid peripartum hysterectomy. One approach is leaving the placenta in situ and waiting for complete spontaneous resorption. Aforementioned adjunctive techniques may accelerate placental resorption. Another technique includes resection of all invaded myometrial tissue along with the entire placenta as one piece with subsequent myometrial reconstruction; this technique may be aided by pelvic devascularization. A novel technique to hasten placenta resolution is the use of methotrexate. As described in several case reports, systemic administration of methotrexate through both oral and IV regimens following delivery may be associated with a reduction in placental size and decreased uteroplacental vascularity resulting in a decrease or resorption of placental tissue. Currently, no protocol exists regarding the dose and duration of methotrexate administration, but case reports have described resolution between 2 and 17 weeks. In cases without appropriate resolution, patients were managed with alternative surgical methods as previously described [5,8].

Key Teaching Points

- All patients with a previous CD should have placental location clearly documented at their fetal anatomy scan. When features suspicious for PAS are identified, assessment by a specialist should be considered.
- Care should ideally be provided by a multidisciplinary team at a tertiary center with expertise in diagnosis and management of PAS disorder.
- Patients are typically stable for outpatient monitoring unless other clinical factors such as bleeding, labor, or rupture of membranes necessitate inpatient management. Patients should receive routine antenatal care with additional consideration for ultrasounds to follow growth at 28, 32, and 34 weeks.
- Delivery for patients with suspected PAS should be considered from 34 0/7 to 35 6/7 weeks' gestation. In select cases, cesarean section <34 weeks may be indicated. Patients with planned delivery before 37 weeks should receive antenatal steroids for fetal lung maturity.
- The preferred surgical management of PAS remains unclear and includes both conservative and nonconservative surgical methods.

References

- 1 Cahill AG, Beigi R, Phillips Heine R, Silver RM, Wax JR. Obstetric Care Consensus: No. 7 Summary: Placenta Accreta Spectrum. *Obstet Gynecol*. 2018;132:1519–1521.
- 2 Klar M, Michels KB. Cesarean Section and Placental Disorders in Subsequent Pregnancies: A Meta-analysis. *J Perinat Med*. 2014;42(5):571–583.
- 3 Hobson SR, Kingdom JC, Murji A, et al. No. 383: Screening, Diagnosis, and Management of Placenta Accreta Spectrum Disorders. *J Obstet Gynaecol Can*. 2019;41(7):1035–1049.
- 4 Epidemiology, Etiology, Diagnosis, and Management of Placenta Accreta. *Obstet Gynecol Int*. 2012;2012:873929.

- 5 Einerson BD, Gilner JB, Zuckerwise LC. Placenta Accreta Spectrum. *Obstet Gynecol.* 2023;142:31–50.
- 6 Jauniaux E, Ayres-de-Campos D, Langhoff-Roos J, Fox KA, Collins S, FIGO Placenta Accreta Diagnosis and Management Expert Consensus Panel: FIGO Classification for the Clinical Diagnosis of Placenta Accreta Spectrum Disorders. *Int J Gynaecol Obstet.* 2019;146:20–24.
- 7 Munoz JL, Blankenship LM, Ramsey PS, McCann GA. Implementation and Outcomes of a Uterine Artery Embolization and Tranexamic Acid Protocol for Placenta Accreta Spectrum. *Am J Obstet Gynecol.* 2023;229(1):61.e1–61.e7.
- 8 Arulkumaran S, Ng CS, Ingemarsson I, Ratnam SS. Medical Treatment of Placenta Accreta with Methotrexate. *Acta Obstet Gynecol Scand.* 1986;65(3):285–286.

CASE 79

A 35-Year-Old with Three Prior Cesarean Deliveries and a Possible Accreta on Her Anatomy Ultrasound

Priyanka Raju and Peter F. Schnatz

History of Present Illness

A 35-year-old gravida 4 para 3 at 18 0/7 weeks' gestation presents to the office for a scheduled fetal anatomy ultrasound. The current pregnancy has been uncomplicated. The patient's prenatal labs are significant for mild anemia with a second-trimester hemoglobin of 10.0 g/dL. Her prior pregnancies were complicated by chronic hypertension and a primary cesarean delivery (CD) for arrest of dilation followed by two repeat CDs. Her chronic hypertension is well-controlled without medications. She is taking a prenatal vitamin daily and has no known drug allergies.

Physical Examination

General appearance: Well-developed, no apparent distress

Vital signs:

Temperature: 37.2°C

Pulse: 89 beats per minute

Blood pressure: 128/82 mmHg

Respiratory rate: 12 breaths per minute

Body mass index (BMI): 26.3 kg/m²

Cardiopulmonary: Regular rate and rhythm with clear lung sounds

Abdomen: Soft, non-tender, gravid uterus

Pelvic: The external genitalia is normal without lesions. There is scant, clear vaginal discharge. The uterus is 18-weeks size, mobile, and non-tender

Fetal assessment: Fetal heart rate is 154 beats per minute

Imaging:

Transabdominal ultrasound reveals an amniotic fluid index of 15.1 cm with a maximum vertical pocket (MVP)

of 5.3 cm. The estimated fetal weight (EFW) is in the 30th percentile for gestational age. No gross fetal abnormalities are noted. Placental evaluation reveals an anterior placenta with a partial previa, multiple vascular lacunae within the placenta, and loss of the normal hypoechoic zone between the placenta and the myometrium (Figure 79.1).

How Would You Manage This Patient?

Given the high suspicion for placenta accreta, an magnetic resonance image (MRI) was performed revealing abnormal bulging of the placenta into the uterus. The patient received routine prenatal care and was monitored with regular growth scans in the third trimester. The patient was not interested in future pregnancy. She received betamethasone injections for fetal lung maturity and underwent a planned repeat CD at 35 0/7 weeks at a quaternary care center. Her multidisciplinary team consisted of an obstetrician, perinatologist, neonatologist, and an anesthesiologist. A total hysterectomy immediately followed delivery and pathologic evaluation of the uterus confirmed the diagnosis of placenta accreta.

Placenta Accreta Spectrum Disorder

Placenta accreta is defined as abnormal trophoblast invasion through the deeper layers of the decidua and into the myometrium. Placenta accreta spectrum disorder (PAS), previously known as morbidly adherent placenta, includes placenta accreta, placenta increta, and placenta percreta.

PAS is associated with increased maternal and fetal morbidity and mortality. Thus, delivery planning should include appropriate subspecialists consultation and access to a blood

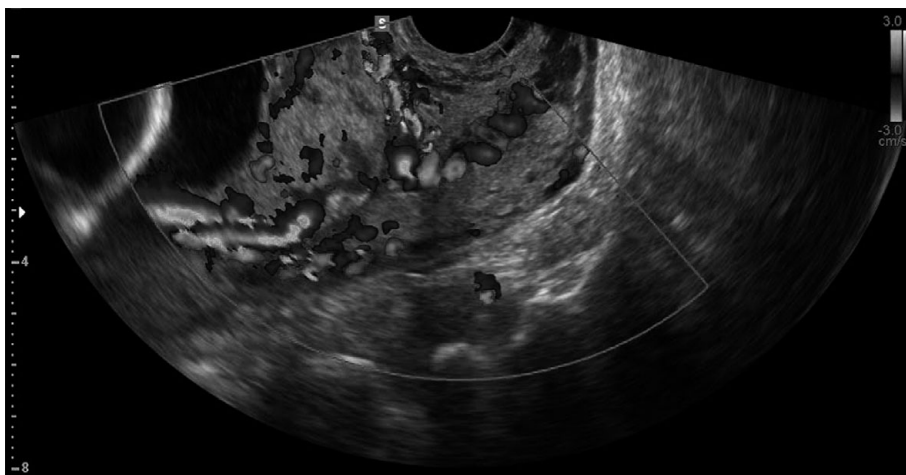


Figure 79.1 Ultrasound findings concerning for placenta accreta spectrum disorder (A black and white version of this figure will appear in some formats. For the color version, please refer to the plate section.)

Table 79.1 Risk of PAS (%) with number of prior cesarean section and placenta previa

Number of CDs	1	2	3	4	5	6+
Risk of PAS (without placenta previa; %)	0.03	0.1	0.8	0.8	4–6	4–6
Risk of PAS (with placenta previa; %)	3.3	11	40	61	67	67

bank with protocols in place for massive transfusion to improve outcomes in the setting of a known or suspected placenta accreta [1].

Risk Factors

The most common risk factor for PAS is a prior CD. Additional risk factors include placenta previa, advanced maternal age, multiparity, prior uterine surgery or curettage, and a history of Asherman syndrome. Table 79.1 demonstrates the additive risk with the combination of prior CDs and the finding of a placenta previa on ultrasound in the current pregnancy. When the diagnosis is in question, specific biomarker testing can indicate a higher risk. These include maternal serum alpha-fetoprotein (AFP), pregnancy-associated plasma protein A, pro B-type natriuretic peptide, troponin, free beta-human chorionic gonadotropin, and human placental lactogen [2].

Evaluation

Evidence of PAS on ultrasound can be detected as early as 6–10 weeks. All patients at risk of PAS are recommended to have a formal ultrasound assessment of placental location at the time of their mid-trimester anatomy scan. Patients found to have a low-lying placenta or placenta previa in the setting of a previous CD should undergo detailed imaging by a specialist with expertise in the diagnosis of PAS. Abnormalities associated with PAS include vascular lacunae within the placenta, loss of the normal hypoechoic zone between the placenta and the myometrium, decreased retroplacental myometrial thickness (<1 mm), abnormalities of the uterine–bladder interface, and extension of the placenta into the myometrium, serosa, or bladder. Doppler findings of turbulent lacunar blood flow, gaps in myometrial blood flow, or vessels bridging the placenta to the uterine margin may be present. Although ultrasound evaluation is important, the absence of ultrasound findings does not preclude a diagnosis of PAS. MRI may be used for antenatal evaluation of PAS; associated findings include dark intra-placental banding, abnormal bulging of the placenta or uterus, and abnormal or disorganized placental blood vessels [2,3].

Counseling

Patients with suspected PAS face a high-risk delivery and recovery. Routine antenatal care should proceed with modifications as needed for comorbidities. Anemia and iron deficiency should be evaluated and optimized accordingly. Repeat ultrasound imaging should be considered each trimester to

evaluate placenta location and features. Regular fetal growth scans should be performed at 28, 32, and 34 weeks due to the risk of fetal growth restriction (FGR). Bed rest is not indicated, and recommendations for pelvic rest should be made on an individualized basis. Antenatal bleeding, preterm labor, and preterm premature rupture of membranes frequently result in an unscheduled delivery, which has an increased risk of maternal and neonatal morbidity. Patients with these complications may benefit from antenatal hospitalization for closer monitoring. In the third trimester, distance from the planned hospital for birth, challenges of childcare, or difficulties with transportation should be considered. Counseling should also include discussing the potential for hemorrhage and the need for transfusion, the various surgical possibilities and complications, and an extended hospital admission. Patients with PAS are at increased risk for anxiety, postpartum depression, and post-traumatic stress disorder and should be counseled regarding warning signs and resources.

Delivery Planning

Maternal and neonatal outcomes are improved when delivery occurs at a tertiary or quaternary maternal care facility before the onset of labor and/or bleeding. Where a multidisciplinary team, as described later, is not available, patients should be referred to an appropriate tertiary care center at the time of diagnosis or if there is a need for further management. Patients should undergo a planned CD in the late preterm period (34 0/7–35 6/7 weeks). Earlier delivery may be indicated in cases of persistent bleeding, preeclampsia with severe features, preterm labor, rupture of membranes, or fetal compromise. Administration of antenatal steroids for fetal lung maturation should be considered in patients with PAS and an anticipated delivery before 37 weeks' gestation. Additionally, patients may benefit from prenatal consultation with a neonatal intensivist for a discussion on the expected infant course following preterm delivery [1,2].

Inclusion of the following team members should be considered: an obstetrician, a perinatologist, a urologist, a general surgeon, a hematologist, a neonatologist, an interventional radiologist, an anesthesiologist, and an advanced pelvic surgeon. Preoperative consultations should be considered on an individualized basis. Involvement of an anesthesiologist accustomed to managing massive obstetric hemorrhage, rapid transfusion, and hemodynamic monitoring is critical for improved maternal and neonatal outcomes in PAS cases [1,2,3].

Due to the frequent need for large-volume blood transfusion, centers handling scheduled PAS deliveries should have an established massive transfusion protocol, including staff trained in the management of postpartum hemorrhage (PPH). At a minimum, patients should have adequate intravenous (IV) access with large-bore catheters. PAS teams should be trained in the use of cell salvage and rapid infusion devices to expedite transfusion of blood products. Because the risk of rapid hemorrhage is hard to predict, surgeons should consider obtaining multiple units of packed red blood cells (pRBCs), fresh frozen plasma (FFP), and platelets before the

procedure in order to be ready for rapid transfusion if needed. Medications for atony and antifibrinolytic agents should be immediately available to avoid delay [4].

Perioperative Considerations

Patient positioning during the procedure should allow for adequate surgical exposure, rapid intubation, sufficient space for vascular access, and access to the perineum. Lithotomy positioning can allow the team to assess vaginal blood loss, allow vaginal access, perform cystoscopy, and stent placement if indicated. Tranexamic acid (TXA) should be administered immediately before, or during, CD for all PAS procedures.

Surgical Methods

The preferred surgical management of PAS remains unclear. The skin incision should optimize visualization while considering the use of a Pfannenstiel, Maylard, Joel-Cohen, Cherney, or vertical skin incisions. A uterine incision should be chosen to avoid the placenta. Data have demonstrated favorable outcomes with transverse fundal incisions, classical vertical incisions, and posterior incisions, among others. Intraoperative ultrasonography is recommended to visualize the placental edge before the incision. Regional versus general anesthesia should be considered factoring in patient preference, body habitus, American Society of Anesthesiologists physical status classification score, anesthesiologist expertise, urgency of the procedure, hemodynamic stability, ability to resuscitate for cases of hypovolemic shock, patient comorbidities, and potential complications. In cases where significant intraoperative hemorrhage is anticipated, general anesthesia with establishment of an endotracheal tube is often the preferred method [5,6].

Total hysterectomy is the recommended surgical method for emergent peripartum hysterectomy due to the risk of morbidity associated with cervical stump remnants. Conversely, subtotal hysterectomy is associated with decreased blood loss, blood transfusions, perioperative complications, and shorter operating time. An attempt at manual separation of placenta and use of uterotonics is not recommended in the setting of a planned hysterectomy for PAS. Other novel surgical techniques include early devascularization and the use of disposable devices such as stapling or vessel sealing devices. Adjunctive techniques such as stepwise devascularization, aortic balloon occlusion catheter, internal iliac or hypogastric artery ligation, or uterine artery embolization (UAE) may be considered to mitigate bleeding [4,5,6].

Planning a delayed or secondary hysterectomy is an alternative surgical management strategy for PAS disorders. Delayed hysterectomy may be undertaken where extensive invasion into

surrounding organs would make immediate cesarean hysterectomy difficult. Delayed hysterectomy may be performed between 3 and 12 weeks' postpartum and typically involves postpartum uterine artery embolization (UAE). Several retrospective studies report up to a 33% decrease in blood loss for patients managed with UAE before hysterectomy [5,6,7].

Conservative surgical management techniques aim to avoid peripartum hysterectomy. One approach is leaving the placenta in situ and waiting for complete spontaneous resorption. Aforementioned adjunctive techniques may accelerate placental resorption. Another technique includes resection of all invaded myometrial tissue along with the entire placenta as one piece with subsequent myometrial reconstruction; this technique may be aided by pelvic devascularization. A novel technique to hasten placenta resolution is the use of methotrexate. As described in several case reports, systemic administration of methotrexate through both oral and IV regimens following delivery may be associated with a reduction in placental size and decreased uteroplacental vascularity resulting in a decrease or resorption of placental tissue. Currently, no protocol exists regarding the dose and duration of methotrexate administration, but case reports have described resolution between 2 and 17 weeks. In cases without appropriate resolution, patients were managed with alternative surgical methods as previously described [5,8].

Key Teaching Points

- All patients with a previous CD should have placental location clearly documented at their fetal anatomy scan. When features suspicious for PAS are identified, assessment by a specialist should be considered.
- Care should ideally be provided by a multidisciplinary team at a tertiary center with expertise in diagnosis and management of PAS disorder.
- Patients are typically stable for outpatient monitoring unless other clinical factors such as bleeding, labor, or rupture of membranes necessitate inpatient management. Patients should receive routine antenatal care with additional consideration for ultrasounds to follow growth at 28, 32, and 34 weeks.
- Delivery for patients with suspected PAS should be considered from 34 0/7 to 35 6/7 weeks' gestation. In select cases, cesarean section <34 weeks may be indicated. Patients with planned delivery before 37 weeks should receive antenatal steroids for fetal lung maturity.
- The preferred surgical management of PAS remains unclear and includes both conservative and nonconservative surgical methods.

References

- 1 Cahill AG, Beigi R, Phillips Heine R, Silver RM, Wax JR. Obstetric Care Consensus: No. 7 Summary: Placenta Accreta Spectrum. *Obstet Gynecol*. 2018;132:1519–1521.
- 2 Klar M, Michels KB. Cesarean Section and Placental Disorders in Subsequent Pregnancies: A Meta-analysis. *J Perinat Med*. 2014;42(5):571–583.
- 3 Hobson SR, Kingdom JC, Murji A, et al. No. 383: Screening, Diagnosis, and Management of Placenta Accreta Spectrum Disorders. *J Obstet Gynaecol Can*. 2019;41(7):1035–1049.
- 4 Epidemiology, Etiology, Diagnosis, and Management of Placenta Accreta. *Obstet Gynecol Int*. 2012;2012:873929.

- 5 Einerson BD, Gilner JB, Zuckerwise LC. Placenta Accreta Spectrum. *Obstet Gynecol.* 2023;142:31–50.
- 6 Jauniaux E, Ayres-de-Campos D, Langhoff-Roos J, Fox KA, Collins S, FIGO Placenta Accreta Diagnosis and Management Expert Consensus Panel: FIGO Classification for the Clinical Diagnosis of Placenta Accreta Spectrum Disorders. *Int J Gynaecol Obstet.* 2019;146:20–24.
- 7 Munoz JL, Blankenship LM, Ramsey PS, McCann GA. Implementation and Outcomes of a Uterine Artery Embolization and Tranexamic Acid Protocol for Placenta Accreta Spectrum. *Am J Obstet Gynecol.* 2023;229(1):61.e1–61.e7.
- 8 Arulkumaran S, Ng CS, Ingemarsson I, Ratnam SS. Medical Treatment of Placenta Accreta with Methotrexate. *Acta Obstet Gynecol Scand.* 1986;65(3):285–286.

CASE 80

A 30-Year-Old at 20 Weeks' Gestation Presents with Vaginal Bleeding and Placenta Previa

Joseph Chappelle

History of Present Illness

A 30-year-old, gravida 2 para 1 female at 20 weeks' gestation presents to the emergency department with vaginal bleeding. Her bleeding started a few hours ago and was initially heavy but has now slowed to spotting. She has not had any previous bleeding during this pregnancy. She reports mild cramping earlier but has no pain now. She denies dizziness and weakness. She had one previous cesarean delivery (CD) at term for breech presentation. She has no other significant past medical or surgical history and is only taking prenatal vitamins. She has no drug allergies. She reports uncomplicated prenatal care to date, with normal prenatal labs, nuchal translucency, and noninvasive prenatal testing.

Physical Examination

General appearance: Well-developed, well-nourished female in no apparent distress

Vital signs:

Temperature: 37.3°C

Pulse: 85 beats per minute

Blood pressure: 118/72 mmHg

Respiratory rate: 16 breaths per minute

Height: 163 cm

Weight: 66 kg

BMI: 24.9 kg/m²

Cardiopulmonary: Unremarkable

Abdomen: Soft, gravid, non-tender, non-distended, no rebound or guarding

Pelvic: Deferred

Speculum: Moderate amount of blood in the vaginal vault. Cervix is visually closed. No active bleeding is noted from the cervical os

Laboratory studies:

Hgb: 10.5 g/dL

Plt: 226

Blood type: A positive

Screen: Negative

Imaging:

Pelvic ultrasound demonstrates a viable pregnancy, measuring 20 weeks' gestation. Placenta is noted to completely cover cervical os. Adnexa are visualized and within normal limits

How Would You Manage This Patient?

This patient presents with vaginal bleeding associated with a placenta previa. Initial assessment and vital signs were not consistent with hypovolemia, but if they were, hemodynamic stability would be the first goal of management. After maternal stability was confirmed, fetal assessment was performed with ultrasound and found to be reassuring. A complete blood count (CBC) was collected to screen for anemia as well as a blood type and screen. She was then observed for 24 hours and had no further bleeding during that time. She was counseled on pelvic rest, discharged from the hospital, and seen regularly for prenatal care. Due to the previous CD, an accreta scan was performed at 28 weeks, which was negative. She was counseled about the recommendation for CD between 36 0/7 and 37 6/7 weeks' gestation in addition to the risks of prematurity. A shared decision-making model was used to select 37 0/7 as the desired delivery date. She presented to Labor and Delivery again at 35 4/7 weeks' gestation with moderate vaginal bleeding. She was determined to be hemodynamically stable, had intermittent contractions, and no laboratory findings of anemia. She was observed for 4 hours and had no change in the amount of bleeding. She was counseled regarding options and agreed to an urgent delivery. A CD was performed with a quantitative blood loss (QBL) of 1,300 cc but was otherwise uncomplicated. Postoperative blood loss demonstrated mild anemia, and oral iron was recommended for 6 weeks. She and her newborn were discharged in stable condition on postoperative day 2.

Placenta Previa

Placenta previa occurs in 0.4–0.5% of births worldwide [1]. The largest risk factors are history of a previous pregnancy affected by placenta previa, history of a prior cesarean birth, and multiple gestation [2]. Other risk factors include prior uterine surgery, infertility treatment, tobacco use, and increased maternal age. The pathophysiology is unknown but may involve hypovascularity of more suitable areas of implantation, which promotes implantation in the lower uterine segment.

Placenta previa is diagnosed by ultrasound evaluation of the relationship of the cervical os to the placenta site. Although transabdominal ultrasound may be utilized, transvaginal ultrasound is the superior method. The positive predictive value of transabdominal ultrasound is 89 versus 94.5%



Figure 80.1 Transvaginal ultrasound demonstrating placental edge covering internal os

for transvaginal ultrasound [3]. A diagnosis of placenta previa is made when the placenta is shown to completely cover the cervical os (Figure 80.1). If the placental edge is within 20 mm of the cervical os, a diagnosis of a low-lying placenta is made. Placenta previa is noted in approximately 11% of pregnancies at the 20-week fetal anatomic survey. However, roughly 90% of these will resolve by a full-term delivery.

Placenta previa is a risk factor itself for malpresentation and abnormal umbilical cord insertion, such as vasa previa and velamentous cord insertion. The most significant risk, however, is for PAS, with 3–67% of women with a placenta previa having a concomitant accreta [4]. The risk of a placenta accreta is directly tied to the number of previous CDs. Placenta accreta can be screened for with either ultrasound or MRI [5]. It has the most clinical utility in women at high risk for accreta, and ultrasound is the first-line modality due to its lower cost and equivalent sensitivity and specificity when compared to MRI. Placenta previa also carries a risk of Postpartum hemorrhage (PPH), transfusion, and hysterectomy. Although mortality is low in areas with a high level of resources, it remains an issue in low-resource settings.

The most common presentation of placenta previa is bleeding. Almost 90% of women with persistent placenta previa will experience bleeding at some point during their pregnancy. Most women will experience bleeding <36 weeks. Although there are no evidence-based interventions to reduce the risk of bleeding, there are several common-sense recommendations. Physical contact with the cervix should be avoided. This includes digital exams, intercourse, and the insertion of any object into the vagina. Although there are no data to support bed rest for women with a placenta previa, it is recommended that women refrain from strenuous exercise to avoid causing bleeding episodes.

There is limited evidence to inform the timing of delivery in women with a placenta previa. However, the current consensus is that women should be counseled for a CD between 36 0/7 and 37 6/7 weeks' gestation [6]. Vaginal delivery is not recommended due to the substantial risk of hemorrhage, and the cesarean is ideally performed before the onset of labor to reduce the risk of bleeding. Women with a low-lying placenta should be counseled according to their chance of emergency cesarean for intrapartum bleeding. Women with a placenta that is <10 mm from the os have an almost 50% chance of emergency cesarean if they present in labor. When the placenta is 10–20 mm from the os, the chance is only 14% [7]. Successful vaginal delivery in both cohorts is tied directly to the risk of bleeding. Vaginal delivery was successful in 43% of women with a placenta within 10 mm of the os and 85% if between 11 and 20 mm. A trial of labor for women with a low-lying placenta with the placental edge at least 10 mm from the os is reasonable. Women with a closer placental edge should consider CD, given the high risk of intrapartum bleeding.

The management of acute antenatal bleeding prior to delivery focuses on maternal and fetal assessment for hypovolemia and anemia, clinical stabilization, and then an assessment to determine whether delivery is indicated. Maternal vital signs should be assessed for any signs of hypovolemia, followed by an assessment of the fetus for signs of hypovolemia or hypoxia. Blood loss should be quantified, a CBC and type and screen should be obtained. Coagulation studies have only been found useful in women experiencing severe acute blood loss. There is no evidence to support their use in women experiencing mild acute or chronic bleeding.

After the initial evaluation is complete, maternal/fetal resuscitation should begin with IV fluids and blood transfusion as clinically indicated. In cases of severe acute blood loss

or signs of coagulopathy, transfusion of FFP and platelets should be considered. If maternal and fetal stability are achieved and bleeding diminishes, there is a role for expectant management in pregnancies <34–36 weeks. If there is any concern for maternal or fetal status, then CD should be performed as soon as clinically possible.

Whether scheduled or due to acute bleeding, women with a placenta previa are at increased risk for hemorrhage during CD, and adequate blood products should be available. Ultrasound can be utilized to locate the placental edge to aid in surgical planning. It is best to avoid a transplacental delivery as it is associated with increased maternal bleeding as well as significant neonatal anemia. However, making an incision higher on the uterus can increase the risk of uterine rupture in subsequent pregnancies. Each delivery plan should therefore be individualized and appropriate to future reproductive goals. If the uterine incision is made at the location of the placenta, every effort should be made to deliver the fetus and clamp the cord as quickly as possible. Additionally, it is essential to always consider placenta accreta during CD in women with a placenta previa, and appropriate instruments necessary to perform a hysterectomy should be readily available.

PPH is a common complication in women with placenta previa, with up to approximately 25% of women experiencing excess bleeding at the time of delivery. Routine management of PPH should be attempted first, including oxytocin, second-line uterotonics, and tranexamic acid (TXA). In several small studies, prophylactic TXA was found to decrease blood loss in women

undergoing CD [8]. However, the absolute difference was small, and further studies on its use in women with additional risk factors such as placenta previa are needed. Additional procedures that may be beneficial include oversewing the placenta bed with a purse string suture that penetrates the myometrium, uterine artery ligation, intrauterine balloon placement, and B-lynch sutures. In refractory cases, uterine artery embolization and peripartum hysterectomy should be considered. In all cases of PPH, it is important to remain cognizant of maternal hemodynamic status. Good communication between nursing, obstetricians, and anesthesiologists leads to better outcomes.

Key Teaching Points

- Placental location should be evaluated using transvaginal ultrasound and a placenta previa should be diagnosed if the placental edge is shown to completely cover the internal cervical os.
- Placenta previa is a large risk factor for placenta accreta spectrum and should be considered in women with prior uterine surgery and a diagnosis of placenta previa.
- Women with a diagnosis of placenta previa should be recommended for a CD between 36+0 and 37+6 weeks' gestation.
- Women undergoing CD with a placenta previa are at high risk of maternal hemorrhage and all team members should prepare for postpartum hemorrhage prior to starting the delivery process.

References

- 1 Cresswell JA, Ronsmans C, Calvert C, Filippi V. Prevalence of Placenta Praevia by World Region: A Systematic Review and Meta-analysis. *Trop Med Int Health*. 2013;18(6):712–724.
- 2 Jenabi E, Salimi Z, Bashirian S, Khazaei S, Ayubi E. The Risk Factors Associated with Placenta Previa: An Umbrella Review. *Placenta*. 2022;117:21–27.
- 3 Becker RH, Vonk R, Mende BC, Ragosch V, Entezami M. The Relevance of Placental Location at 20–23 Gestational Weeks for Prediction of Placenta Previa at Delivery: Evaluation of 8650 Cases. *Ultrasound Obstet Gynecol*. 2001;17(6):496–501.
- 4 Silver RM, Landon MB, Rouse DJ, et al. Maternal Morbidity Associated with Multiple Repeat Cesarean Deliveries. *Obstet Gynecol*. 2006;107(6):1226–1232.
- 5 Einerson BD, Gilner JB, Zuckerwise LC. Placenta Accreta Spectrum. *Obstet Gynecol*. 2023;142(1):31–50.
- 6 Blackwell SC. Timing of Delivery for Women with Stable Placenta Previa. *Semin Perinatol*. 2011;35:249–251.
- 7 Jansen CH, De Mooij YM, Blomaard CM, et al. Vaginal Delivery in Women with a Low-Lying Placenta: A Systematic Review and Meta-analysis. *BJOG*. 2019;126(9):1118–1126.
- 8 Yang F, Wang H, Shen M. Effect of Preoperative Prophylactic Intravenous Tranexamic Acid on Perioperative Blood Loss Control in Patients Undergoing Cesarean Delivery: A Systematic Review and Meta-analysis. *BMC Pregnancy Childbirth*. 2023;23:420.

A 20-Year-Old at 22 Weeks' Gestation with Circumvallate Placenta on Ultrasound

Courtney Rhoades

History of Present Illness

A 20-year-old gravid 1 para 0 presents for her 22-week prenatal visit 1 week after her second-trimester anatomic survey scan. Her obstetric course has been uncomplicated until recently. She has experienced occasional spotting for the past 2 weeks that concerns her but she is feeling the baby move. The bleeding is seen only with wiping and is red to brown and unpredictable. This has happened four to five times since her last visit. She has no cramping or change in her discharge. The first-trimester nausea has resolved. She is eating well and is starting to gain weight. She is taking her prenatal vitamins.

Gynecologic history is negative for infections and abnormal pap smears. Medical and surgical history is negative. She is in a monogamous relationship and is very excited about the pregnancy.

Physical Examination

General appearance: Alert, cheerful in appearance

Vital signs:

Temperature: 36.8°C

Pulse: 84 beats per minute

Blood pressure 114/68 mmHg

Respiratory rate: 20 breaths per minute

Height: 1.7 m

Weight: 93 kg

BMI: 32.1 kg/m²

Cardiovascular: Regular rate and rhythm, no murmurs rubs or gallop

Lungs: Clear to auscultation bilaterally, no wheezes or rhonchi, normal effort

Abdominal: Soft, uterus gravid, non-tender, no palpable hernias or hepatosplenomegaly, fundal height 22 cm

Pelvic: Normal external female genitalia, urethra without masses, bladder non-tender to palpation, vagina without discharge, no pooling or evidence of amniotic fluid, cervix closed, no blood, non-friable, perineum without lesions

Laboratory studies:

Urine analysis: Negative for glucose, protein and ketones

Blood type: B positive

Hgb: 12.2 g/dl

Hematocrit: 38.0%

Syphilis: Non-reactive

Hepatitis B: Non-reactive

Hepatitis C: Non-reactive

Wet prep: Many epithelial cells, negative for bacterial vaginosis

Chlamydia: Not detected

Trichomonas: Not detected

Mycoplasma genitalium: Not detected

Cell-free DNA: Negative aneuploidy, male fetal sex

Fetal imaging:

Ultrasound: Intrauterine pregnancy with a fetal heart rate of 144 beats per minute. Measurements are consistent with dates with EFW of 489 g (51.7%) and the fluid is normal in volume. No anomalies seen. Fetus is vertex. Placenta is posterior, no previa and circumvallate. Cervix is closed and 3.2 cm

How Would You Manage This Patient?

Other causes of vaginal bleeding were fully investigated with a normal pelvic exam, no cervical dilation, negative cultures for infection, and normal placental location. Therefore, this patient was counseled about circumvallate placenta as the possible cause of her bleeding. For many patients with circumvallate placenta on ultrasound there is no difference in pregnancy outcome, however, some studies show an increased risk for growth restriction, oligohydramnios, placental abruption, and preterm delivery. The patient was counseled about the need for serial ultrasounds with possible umbilical Doppler monitoring to detect abnormal growth and placental insufficiency. The patient was informed that placental abruption is an infrequent but serious complication and if she has painful contractions with or without vaginal bleeding or painless vaginal bleeding in the future, she should return to the hospital for immediate workup. Signs and symptoms of preterm labor and preterm premature rupture of membranes were also reviewed with the patient.

Circumvallate Placenta and Circummarginate Placenta

Circumvallate placenta is a placental anomaly that results in the basal plate (maternal side) of the placenta being larger than the chorionic plate (fetal side). The incidence is somewhere between 0.5 and 1.8% of pregnancies [1]. The chorionic membranes insert and fuse with the amnion some distance inside the placental margin instead of at the villous margin of the placenta. The fusion of the amnion and chorion inside the placental edge causes fibrin deposition and degeneration in the area, which results in a white appearing annular ring on

the placental plate. The villous surface of the basal plate of the placenta that is exposed to the decidua is larger and predisposes the area to tears and bleeding [2]. The circummarginate placenta differs from circumvallate by the fibrin ring and insertion of the chorion being just inside the placental edge as opposed to in a circumvallate placenta where the significant distance inside the placental edge causes changes to both plates of the placenta resulting in tearing and bleeding. Circummarginate placenta pregnancies have not been associated with poor clinical outcomes.

Ultrasound Findings

Ultrasound findings of circumvallate placenta are most often seen at the mid-trimester anomaly ultrasound. Due to the amnion and chorion fusing inside the circumference of the placental plate, the edges of the membranes appear thick, raised, and curled toward the middle on ultrasound (Figure 81.1).

The villous portion of the placenta is seen growing beyond the insertion of the membranes with vessels that track down and away from the sac. These changes can be completely circumferential or only partial – which is more common and less clinically significant. On ultrasound, the curved ridge gives the appearance of a “tire mounted on a wheel,” dubbed the “tire” sign of circumvallate placentas by Arlicot et al. [1]. Celik et al. used prenatal ultrasound to diagnose 93 patients with circumvallate placenta with 13 false positives [3]. Susuki looked at placental thickness and felt the circumvallate placenta was significantly thicker at 18–21 weeks’ gestation. When the placental thickness at this gestation was >3 cm, 19.4% had a circumvallate placenta with a sensitivity of 54.5% and specificity of 96.5% [4]. In a study with 222 partial or complete circumvallate

placentas detected by ultrasound, only 25 were confirmed by pathology [5]. Harris et al. speculated that the reason for the high false-positive rate was that the timing of the ultrasound at mid pregnancy when the placenta is still growing may make the placental edge look more irregular and difficult to accurately diagnose. His study was only able to accurately diagnose circumvallation prospectively 35% of the time [6]. Thus, ultrasound diagnosis for circumvallate placenta is difficult and fraught with over- and under-detecting; however, with new innovations in ultrasound technology, this may improve in the future.

Clinical Findings

The difficulty of diagnosing circumvallate placenta via ultrasound or prenatally makes it difficult to study the clinical significance of this anomaly with consistent results. Clinically, circumvallate placenta is associated with interpregnancy bleeding, abruption, preterm rupture of membranes, preterm labor, and placental insufficiency, leading to oligohydramnios and growth restriction. Early studies in the 1950–1970s also quoted high fetal loss rates of 24%. This was likely due to preterm fetal size at delivery that today might have a better chance of survival [2]. However, their publications are based on placental diagnosis only. They noted vaginal bleeding in the first and second trimester and hydorrhea gravidarum (watery discharge) as common symptoms and PPH and fetal loss as the most common complications [7]. This was confirmed in a 2014 study that found when bleeding in the second trimester and premature chemical rupture of membranes were used as predictors for circumvallate placenta, the sensitivity was 28.8% and specificity was 99.7%. This was much better than their ultrasound detection rate in the same study of 4.3% [8].



Figure 81.1 Ultrasound image of circumvallate placenta

Due to the abnormal growth of the placenta, it is believed that placental insufficiency and decreased fetal perfusion contribute to a higher rate of growth restriction, which has been reported as high as 18% in a study with 77 confirmed patients. A higher growth restriction rate was also observed particularly in patients with uterine artery notching, a marker for impaired perfusion in those being monitored with the diagnosis of circumvallate placenta [3]. This was disputed in a smaller study of 25 confirmed circumvallate placentas with no significant difference in the growth restriction rate [5].

In cases where the placenta was confirmed circumvallate, almost half had some bleeding during pregnancy [7]. Perfusion, fibrin deposition, and vascular anomalies in these placentas is thought to lead to subchorionic hematomas. Taniguchi et al. found that 92 women with circumvallate placentas did have a significantly higher incidence of bleeding in the first and second trimesters (32.6 and 39.1%, respectively) with subchorionic hematomas found in 15%. In those cases, with subchorionic hematoma, preterm birth was noted 80% of the time. Abruptio was found in 10.9% of patients with circumvallate placenta versus 1.3% of the controls [8]. The increased incidence of abruptio was also found in another study with 139 circumvallate placentas with an odds ratio of 13.1 [9].

From the earlier reports of circumvallate placenta and its clinical implications to the more recent studies, all have pointed to a higher incidence of preterm delivery [2,3,7,8]. Many of those same reports show that almost half of the pregnancies with confirmed circumvallate placenta had no symptoms and no complications but when the patient has

symptoms, complications are more likely [2]. Currently, ultrasound is not accurate at predicting this condition but once it is diagnosed, growth ultrasounds can help detect concomitant issues such as growth restriction, especially in patients with symptoms such as bleeding and changes in discharge. A 2023 retrospective study looking at 179 of patients diagnosed with circumvallate placenta showed no difference in outcomes in women prenatally diagnosed with circumvallate placenta and the control patients. This suggests that additional ultrasound monitoring may not be warranted [10]. Thus, the management of this diagnosis is still uncertain, and many providers will opt for monthly growth ultrasounds to monitor these pregnancies due to prior studies concerns but this may change as more information is available.

Key Teaching Points

- Circumvallate placenta is an abnormality of the placenta seen in 0.5–2% of placentas.
- Its clinical significance is disputed but thought to increase risk for preterm vaginal bleeding, growth restriction, abruptio, and preterm delivery.
- Prenatal ultrasound is inconsistent in determining the rate of circumvallate placenta.
- Second-trimester bleeding and loss of fluid may be a symptom of circumvallate placenta.
- Patients diagnosed with circumvallate placenta on ultrasound may be followed by growth ultrasounds due to possible increased risk for growth restriction leading to other complications.

References

- 1 Arlicot C, Herve P, Simon E, Perrotin F. Three-Dimensional Surface Rendering of the Chorionic Placental Plate: The “Tire” Sign for the Diagnosis of a Circumvallate Placenta. *J Ultrasound Med*. 2012;31:340–341.
- 2 Hunt AB, Mussey RD, Faber JE. Circumvallate Placenta. *New Orleans Med Surg J*. 1947;100(5):203–207.
- 3 Celik OY, Obut M, Keles A, et al. Outcomes of Pregnancies Diagnosed with Circumvallate Placenta, and Use of Uterine Artery Pulsatility Index and Maternal Serum Alpha-Fetoprotein for Prediction of Adverse Outcomes. *Eur J Obstet Gynecol Reprod Biol*. 2021;262:57–61.
- 4 Suzuki S. Antenatal Screening for Circumvallate Placenta. *J Med Ultrason* (2001). 2008;35(2):71–73.
- 5 Vadlamudi G, Goyert G, Shaman M. Growth Outcomes Associated with Prenatal Diagnosis of Partial and Complete Circumvallate Placenta. *Am J Obstet Gynecol*. 2022;226(1):S632.
- 6 Harris RD, Wells WA, Black WC, et al. Accuracy of Prenatal Sonography for Detecting Circumvallate Placenta. *AJR Am J Roentgenol*. 1997;168(6):1603–1608.
- 7 Wilson D, Paalman RJ. Clinical Significance of Circumvallate Placenta. *Obstet Gynecol*. 1967;29(6):774–778.
- 8 Taniguchi H, Aoki S, Sakamaki K, et al. Circumvallate Placenta: Associated Clinical Manifestations and Complications: A Retrospective Study. *Obstet Gynecol Int*. 2014;2014:986230.
- 9 Suzuki S. Clinical Significance of Pregnancies with Circumvallate Placenta. *J Obstet Gynaecol Res*. 2008;34(1):51–54.
- 10 Herrera CL, Chu TM, Stanteen SM, et al. Prenatal Ultrasound Findings of Circumvallate Placenta and Pregnancy Outcomes. *Am J Perinatol*. 2024;41(Suppl. 1):e2069–e2072.

A 25-Year-Old at 33 Weeks' Gestation Presents with Abdominal Pain and Vaginal Bleeding

Jaime L. Dickerson

History of Present Illness

A 25-year-old gravid 1 para 0 presents to Labor and Delivery triage with complaints of abdominal pain and vaginal bleeding. She is 33 0/7 weeks by her last menstrual period, confirmed by an ultrasound at 8 weeks. The patient reports her pain started about 2.5 hours ago while she was resting at home. She denies any inciting incident or trauma. She describes contraction-like pain; initially it would come and go, now she still has increasing persistent pain between the stronger contraction pain. She reports some vaginal bleeding on and off since the pain started, similar to menstrual bleeding, and passage of one blood clot. She received regular antenatal care starting at 8 weeks' gestation and reports the pregnancy has been uncomplicated. She has no pertinent past medical or surgical history and takes only prenatal vitamins and occasional TUMS for heartburn. She denies any tobacco, alcohol, or drug use.

Physical Examination

General appearance: Well-nourished, alert female patient in mild distress, who appears in pain during contractions

Vital signs:

Temperature: 37.3°C
Pulse: 109 beats per minute
Blood pressure: 133/92 mmHg
Respiratory rate: 26 breaths per minute
Oxygen saturation: 99% on room air
Height: 63 inches
Weight: 144lbs
BMI: 25.5 kg/m²

Cardiopulmonary: Unremarkable

Abdomen: Soft, uterus is firm between contractions and mildly tender to palpation, no rebound, no guarding

Pelvic: Sterile speculum exam: Frank blood in vaginal vault, approximately 15 cc, with slow trickle from cervical os, visually cervix appears 3 cm dilated

Fetal assessment: Fetal heart tones: baseline 130 beats per minute, moderate variability, accelerations present, decelerations absent. Tocometer: Regular contractions every 3–5 minutes

Laboratory studies:

Hgb: 9.8 g/dL
Blood type and screen: A positive, no antibodies
PT: 14

INR: 1.3

aPTT: 38

Fibrinogen: 210 mg/L

Imaging:

Ultrasound: Fetal heart rate is 136 beats per minute, fetus in cephalic presentation, posterior placenta, difficult to fully visualize, no signs of placenta previa or of abruption, biophysical profile 8/8

Focused Physical Exam 1 Hour Later

The patient now appears more uncomfortable and requests something for pain management. Her bleeding is now active with approximately 250 mL on her pad that she recently changed. The fetal heart tracing shows a baseline of 165 beats per minute, moderate variability, accelerations absent, and non-recurrent late decelerations. Her contractions remain every 3–5 minutes.

How Would You Manage This Patient?

This patient presents with signs of labor as well as vaginal bleeding. Differential diagnosis includes preterm labor, placenta previa, chorioamnionitis, and placental abruption. Tools of the traditional speculum exam such as pooling and measurement of MVP on ultrasound can aid in evaluation of membranes status. Immunoassay testing for rupture of membranes would be misleading because of vaginal bleeding. Given this patient's lack of pooling and normal amniotic fluid levels she was managed as if her membranes were intact, and penicillin was not administered. Given her cervical dilation and signs of labor, she received a first dose of antenatal corticosteroids. Maternal fetal medicine and neonatology were consulted, given the hospitals' resources and protocols. Her blood pressure was in the mild range with diastolic of 92, therefore continued monitoring of vitals as well as additional laboratory studies to evaluate for hypertensive disorders were performed and not supportive. Tocolysis was not administered and would not be indicated at any point. The patient's prior ultrasound showed no abnormalities, however, in the absence of complete records, further evaluation for placenta previa would be indicated. After the reassessment, an emergent cesarean delivery (CD) was performed for maternal and fetal benefit. Intravenous fluids and packed red blood cells were given due to noted intraoperative maternal tachycardia and hypotension. Total quantitative blood loss (QBL) was 1,200 mL and pathology showed a 33% abruption. Both patients recovered well without significant complications.

Placental Abruption

Placental abruption is a serious obstetric emergency that occurs when the placenta detaches from the uterine wall before delivery of the fetus. This condition can lead to significant maternal and fetal morbidity and mortality. It is vital to maintain a high suspicion for placental abruption in the appropriate clinical scenario to expeditiously diagnose and treat and thereby improve maternal and fetal outcomes.

The exact cause of placental abruption remains unclear, but several risk factors have been identified. Hypertensive disorders such as gestational hypertension, chronic hypertension, and preeclampsia are strongly associated with an increased risk of abruption. Other factors include advanced maternal age, trauma to the abdomen, intraamniotic infection, preterm premature rupture of membranes, cigarette smoking, illicit drug use, and history of placental abruption in previous pregnancy [1].

An important emerging therapy to decrease the risk of placental abruption is antepartum low-dose aspirin. A meta-analysis from Nicolaides et al. showed a significant decrease in the incidence of placental abruption in patients who started low-dose aspirin at a dose ≥ 100 mg before 16 weeks' gestation. This suggests low-dose aspirin therapy should be considered in patients with risk factors for, or history of, placental abruption [2].

The pathophysiology of placental abruption involves disruption of the maternal-fetal interface of the placenta. It occurs due to the rupture of maternal spiral arteries, leading to hemorrhage and separation of the placenta from the uterine wall. This could be due to trauma and shearing forces, inflammation from infection, or ongoing vascular disease in settings of hypertensive disorders. This separation can be partial or complete, resulting in varying degrees of blood loss and additional subsequent complications. The release of pro-inflammatory and vasoactive factors from the damaged placenta further exacerbates the condition, leading to increased uterine contractions, hypoxia, and tissue damage [3].

There are currently no tests proven to predict abruption. Several biomarkers have been studied and while some, such as first-trimester pregnancy-associated plasma protein (PAPP-A) and second-trimester maternal serum AFP and inhibin-A, are associated with abruption, none have been found to be predictive of abruption [4].

Prompt diagnosis of placental abruption is crucial for effective management and improved outcomes. However, it can be challenging to differentiate it from other conditions such as placenta previa or preterm labor. Abruption cannot always be recognized with certainty and is a diagnosis of exclusion and one that is made clinically rather than by a specific test or ultrasound finding, though these can be used as supportive data to make the correct diagnosis. Clinical signs of abruption include vaginal bleeding, sudden and severe abdominal pain, uterine tenderness, and contractions, as well as signs of fetal distress. However, these symptoms are non-specific and present in other obstetric emergencies. Additionally, there are instances of concealed abruption,

wherein blood remains trapped within the maternal-fetal interface and no vaginal bleeding is appreciated. Therefore, accurate diagnosis relies on a combination of clinical evaluation, laboratory tests, and at times, imaging studies.

Initial assessment involves a physical exam including vital signs, assessment of severity of bleeding, and evaluation of fetal well-being. Laboratory studies include CBC, coagulation profile, blood type and screen, and aid in evaluating the extent of maternal-fetal compromise and guiding management. Of note, the Kleihauer-Betke test (KB) in some settings, such as obstetrical trauma, has been used to support diagnosis of abruption, and ordered despite maternal Rh status with the thought that its use in calculating fetal-maternal hemorrhage can elucidate the severity of an abruption. However, in many studies, KB has been found positive in the absence of abruption and negative in the presence of confirmed abruption. Therefore, KB should not be used as part of the evaluation of suspected placental abruption apart from dose calculation for rho (D) immune globulin in Rh-negative mothers [5].

Ultrasound is of limited utility given the similarity between placenta and fresh clots on imaging. There are instances when the "jello" sign is seen on ultrasound, wherein sudden pressure with the ultrasound probe causes movement of freed placenta. Other findings differ depending on acuity of the abruption. Typically, in acute and subacute abruption, the hematoma is hyper- or iso-echoic in comparison to the placenta, whereas a chronic abruption appears hypoechoic (Figure 82.1). The placenta may appear thickened, heterogeneous, and rounded, with loss of placental-myometrial interface. Ultrasound fails to detect abruption in 50% of cases or more depending on the user, their comfort level and expertise. However, when ultrasound does show signs of abruption, it is highly likely that abruption is in fact present. Importantly, a negative sonographic finding does not exclude abruption. MRI is highly sensitive for placental abruption but the utility is limited by the time constraints of obtaining such an imaging study [6,7].

The management of placental abruption primarily depends on the severity of the maternal and fetal compromise. In mild cases with minimal signs or symptoms of maternal or fetal distress, conservative management with close monitoring may be appropriate. Indeed, there are cases of chronic placental abruption in preterm pregnancies that are monitored until full term. More commonly, prompt delivery is indicated. The mode and timing depend on gestational age, maternal stability, and fetal well-being, and obstetric indications should guide management.

In any obstetric hemorrhage, an important mainstay of treatment is intravenous (IV) access and resuscitation with fluids and blood products. Obtain early IV access during the initial evaluation, if abruption is suspected, and administer resuscitative IV fluids during evaluation. Type and screen should also be expedited in anticipation of needed blood products.

A common additional complication of placental abruption is maternal disseminated intravascular coagulation (DIC). There is evidence that concealed abruption increases the risk for DIC due to delayed diagnosis and due to increased



Figure 82.1 Placental abruption

pressure caused by the trapped retroplacental hemorrhage forcing more placental thromboplastin into maternal circulation. In the setting of placental abruption coagulation studies should be followed and adequate replacement of blood products including fresh frozen plasma should be prioritized to combat DIC [1,7].

Another interesting finding related to placental abruption is Couvelaire uterus, also called uteroplacental apoplexy. Extravasation of blood into the uterine myometrium and serosa causes a black and blue appearance. This can be associated with, though not predictive of, uterine atony and many times is simply a finding during CD further supporting the diagnosis of a placental abruption [1].

In summary, placental abruption is an obstetric complication with a wide range of presentations, severity, and management options. It is a clinical diagnosis of exclusion and should remain high on the differential of any obstetrical triage workup given its variable presentation and potential severity of maternal and fetal complications.

Key Teaching Points

- Placental abruption is an obstetric emergency with a variable clinical presentation and is a clinical diagnosis of exclusion.
- The KB test should not be used as a diagnostic criterion for placental abruption and should only be ordered to manage maternal Rh-negative status as needed for dosing Rh (D) immune globulin.
- Low-dose aspirin at a dose ≥ 100 mg started before 16 weeks' gestation should be considered in patients with risk factors for, or history of, placental abruption as a preventative measure.
- When placental abruption is suspected, it is vital to prepare early for hemorrhage with early IV access, IV fluid resuscitation, and early type and screen for anticipated products.
- Delivery mode and timing should be individualized to the clinical scenario.

References

- 1 Obstetrical Hemorrhage. In: Cunningham F, Leveno KJ, Bloom SL, et al. eds. *Williams Obstetrics*, 25th ed. New York: McGraw Hill; 2018. 770–817.
- 2 Roberge S, Bujold E, Nicolaides KH. Meta-analysis on the Effect of Aspirin Use for Prevention of Preeclampsia on Placental Abruption and Antepartum Hemorrhage. *Am J Obstet Gynecol*. 2018;218(5):483–489.
- 3 Brandt JS, Ananth CV. Placental Abruption at Near-Term And Term Gestations: Pathophysiology, Epidemiology, Diagnosis, and Management. *Am J Obstet Gynecol*. 2023;228(5):S1313–S1329.
- 4 Ananth CV, Wapner RJ, Ananth S, D'Alton ME, Vintzileos AM. First-Trimester and Second-Trimester Maternal Serum Biomarkers as Predictors of Placental Abruption. *Obstet Gynecol*. 2017;129(3):465–472.
- 5 Pearce C, Martin SR. Trauma and Considerations Unique to Pregnancy. *Obstet Gynecol Clin North Am*. 2016;43(4):791–808.
- 6 Fadl SA, Linnau KF, Dighe MK. Placental Abruption and Hemorrhage—Review of Imaging Appearance. *Emerg Radiol*. 2019;26(1):87–97.
- 7 Oyelese Y, Ananth CV. Placental Abruption. *Obstet Gynecol*. 2006;108(4):1005–1016.

A 35-Year-Old Presents after Fetal Demise at 34 Weeks' Gestation to Discuss the Results of Her Placental Pathology Report

Ryan McDonald

History of Present Illness

A 35-year-old gravida 1 para 1000 presents for follow-up after 34-week intrauterine fetal demise. Her pregnancy had been uncomplicated; she had routine prenatal testing including normal noninvasive prenatal screening. Her past medical history is unremarkable. She avoided tobacco, alcohol, and illicit drugs while pregnant. She has no family history of recurrent miscarriage, hereditary conditions, or congenital anomalies.

At 34 weeks' gestation, she presented to care for evaluation of intermittent watery discharge over the past 2 days. Upon presentation, fetal cardiac activity was undetectable by doppler, and fetal demise was confirmed by ultrasound. She was admitted and underwent induction of labor. She delivered a phenotypically normal female infant. Laboratory testing and placental pathology were performed, but she declined an autopsy or genetic testing.

She presents today with her partner to discuss the results of her workup, including her placental pathology report. She also recalls that her anatomy ultrasound showed "placental lakes," and she wants to know if that contributed to her stillbirth.

Physical Examination

General appearance: 35-year-old adult, well-developed and well-nourished, intermittently tearful

Vital signs:

Temperature: 36.8°C

Pulse: 74 beats per minute

Blood pressure: 118/76 mmHg

Respiratory rate: 14 breaths per minute

Height: 168 cm

Weight: 71 kg

BMI: 25.3 kg/m²

Cardiopulmonary: Unremarkable

Abdomen: Soft, non-tender, normal active bowel sounds, no rebound or guarding, no masses or hernias, no hepatosplenomegaly

Neurologic/psychologic: Alert, affect and mood appropriate to the situation, normal insight and judgment

Laboratory studies:

WBC: $11.65 \times 10^3/\mu\text{L}$ (normal $3.80\text{--}10.0 \times 10^3/\mu\text{L}$)

Hgb: 12.2 g/dL (normal 12.1–15.3 g/dL)

KB stain: Fetal bleed of <5 mL

Treponema pallidum antibody (Ab): Non-reactive

Lupus anticoagulant workup: Negative

Cardiolipin Ab IgG/IgM: <10 (normal ≤ 14 GPL)

Beta-2 glycoprotein IgG/IgM: <10 (normal ≤ 20 SGU)

Pathology: Placental weight: 385 g (normal 300–460 g for 34 weeks)

Findings suggestive of ascending intrauterine infection: Maternal inflammatory response, stage 2, grade 2.

Membranes and chorionic plate with acute subchorionitis and acute chorioamnionitis. Fetal inflammatory response, stage 3, grade 2. Acute chorionic vasculitis. Three-vessel umbilical cord with acute umbilical phlebitis, arteritis, and funisitis.

Findings consistent with high-grade fetal vascular malperfusion (FVM): Vascular lesions including one chorionic plate vessel with intramural fibrin deposition/nonocclusive intraluminal thrombus and few small stem villous vessels with nonocclusive intraluminal thrombi. Villous changes with scattered avascular villi and decidual arteriopathy.

Findings consistent with maternal vascular malperfusion (MVM): Villi with patchy increased syncytial knots and patchy intervillous fibrin deposition.

Other findings: Scattered villous stromal-vascular karyorrhexis and involutional change of stem villous vessels, consistent with intrauterine demise. Basal plate myometrial fibers (BPMF): Stage 1 (decidua present), two foci, <1 mm in greatest dimension

Imaging:

Abdominal ultrasound at 20 weeks showed an appropriately grown fetus with normal-appearing anatomy. The placenta was anterior with "several placental lakes." No previa seen

How Would You Manage This Patient?

In 2020, the American College of Obstetricians and Gynecologists (ACOG) and the Society for Maternal-Fetal Medicine released their Obstetric Care Consensus on the management of stillbirth. The follow-up care for stillbirth should include emotional support and bereavement care, a summary of the workup including laboratory and pathology findings, and a discussion of recurrence risk. This conversation should be individualized using a shared decision-making

Table 83.1 Recurrence risk of common pathology findings

Placental pathology pattern	Consider further testing	Recurrence risk
MVM	Maternal coagulopathy, antiphospholipid syndrome (APS)	10–25%
FVM	Neonatal coagulopathy	Small
Acute chorioamnionitis	Cytomegalovirus (CMV), syphilis, <i>Listeria</i> , severe acute respiratory syndrome coronavirus 2	10–25%
VUE	None	25–50%

model. Many patients receive emotional relief from this follow-up counseling [1].

Although fetal autopsy and gross and histologic examination of the placenta are considered essential components of a stillbirth evaluation, many patients will forgo some portion of the available assessment. Placental pathology alone may identify the cause of death approximately 30% of the time.

During counseling with the patient in this case, it is important to address the abnormal findings from the placental pathology and the presence of placental lakes observed during the anatomical ultrasound.

Abnormal Placental Pathology

Placental pathology and the investigation of its clinical implications are areas of active research. In 2016, the Amsterdam consensus created uniform diagnostic criteria for placental histology [2]. They outlined the four most important patterns of placental injury: MVM, FVM, acute chorioamnionitis, and villitis of unknown etiology (VUE) (Table 83.1) [3].

Maternal Vascular Malperfusion

Maternal vascular malperfusion, formerly known as uteroplacental insufficiency, represents a pattern of placental injury related to reduced maternal perfusion to the intervillous spaces. These placental lesions are primarily caused by defects in trophoblast invasion and maternal spiral arterial remodeling. These deficiencies are believed to involve a combination of decidual, endothelial, and natural killer cell dysfunction; primary trophoblastic defects may also play a role. Maternal vascular malperfusion is associated with maternal hypertension, including preeclampsia, certain autoimmune disorders like APS, maternal thrombophilic states, maternal diabetes, and other underlying maternal chronic illnesses such as heart disease and chronic renal failure.

Gross examination of placentas with MVM may reveal a size smaller than expected for gestational age or an increased fetal/placental weight ratio. The umbilical cord may be thin. Villous infarction is often seen, represented by firm, tan-white to tan-yellow lesions within the placental parenchyma. When villous infarction is evaluated microscopically, decidual vasculopathy is observed. The condition progresses from mural hypertrophy to vasculitis to fibrinoid necrosis of the

arteriolar wall and possible accumulation of lipid-laden macrophages. Maternal vascular malperfusion is also characterized by accelerated villous maturation. This appears as regions of underdeveloped or absent villi alternating with regions of villous crowding. Syncytial knots, perivillous fibrin deposition, and villous agglutination are also seen [4]. Maternal vascular malperfusion recurs in 10–25% of subsequent pregnancies [5]. In cases of massive perivillous fibrin deposition, the pregnant person should be evaluated for coagulopathy, particularly APS.

Fetal Vascular Malperfusion

Fetal vascular malperfusion refers to reduced or absent perfusion between the fetus and the villous parenchyma. This is mostly caused by umbilical cord obstruction, also called “umbilical cord accidents.” Risk factors include a long, hypercoiled, or knotted umbilical cord, cord entanglement, or prolapse. Fetal cardiac insufficiency, increased fetal blood viscosity, and fetal coagulopathy may also contribute to FVM [4].

On gross examination of the placenta, FVM can be seen in abnormalities of the chorionic plate vessels. Intramural thrombi or downstream avascular villi may be visibly enlarged. Microscopic findings include vascular ectasia, defined as a vessel that is at least four times the diameter of its neighbors; fibrin deposition in the walls of large fetal vessels; and small foci of ischemic chorionic villi.

Fetal vascular malformation is associated with neonatal encephalopathy, fetal growth restriction (FGR), and stillbirth. The recurrence risk is generally considered small, except in cases due to inherited coagulopathy [5]. Consider testing for congenital viral infections, such as cytomegalovirus or herpes simplex virus, if chorionic plate thrombi are reported or for maternal coagulopathy if occlusive or nonocclusive thromboemboli are observed.

Acute Chorioamnionitis

Acute chorioamnionitis is the next major category of placental pathology. Ascending intrauterine infection can involve both maternal and fetal placental components. On gross examination of the placenta, the membranes and chorionic plate can be yellow or cream-colored with increased opacity. A severe fetal inflammatory response may also cause yellow discoloration of the umbilical cord. Microscopic findings can have a patchy distribution. The maternal inflammatory response begins with neutrophil aggregation in the subchorion, and, with increasing severity, neutrophils can be found in the chorion and overlying amnion. The fetal inflammatory response generally begins in the chorionic plate vessels with neutrophils and eosinophils, which marginate and then migrate into the overlying stroma. Disease progression is marked by umbilical vein involvement, termed umbilical phlebitis, followed by umbilical artery involvement, or umbilical arteritis. Further progression involves all three vessels (umbilical panvasculitis) or Wharton's jelly (funisitis or perivasculitis).

It should be noted that histologically diagnosed chorioamnionitis does not always correlate with clinically diagnosed

acute chorioamnionitis. Chorioamnionitis is associated with multiple perinatal morbidities, including neonatal sepsis, respiratory complications, necrotizing enterocolitis, and neuro-disability. Acute chorioamnionitis is also associated with placental abruption and maternal sequelae, such as endometritis and sepsis. The recurrence risk is 10–25% [3].

Villitis of Unknown Etiology

Villitis of unknown etiology is another crucial placental histopathology category. Villitis of unknown etiology is thought to be a “host-versus-graft” response where maternal T lymphocytes enter the fetal villous stroma, causing chronic inflammatory injury. Although low-grade VUE is common and has little clinical significance, high-grade VUE can lead to FGR, stillbirth, and central nervous system injury. There is a 25–50% chance of recurrence in subsequent pregnancies [3]. There are no known prevention or surveillance recommendations for subsequent pregnancy.

Patient Case

The placental pathology report in this case indicated the presence of maternal and FVM as well as acute chorioamnionitis. Signs of MVM included the presence of villi with syncytial knots and patchy intervillous fibrin deposition. The patient’s placenta also showed one chorionic plate vessel with intramural fibrin deposition, a nonocclusive intraluminal thrombus, and a few small stem villous vessels with nonocclusive intraluminal thrombi. Avascular villi and decidual arteriopathy were also seen. These findings indicate high-grade FVM.

The pathology report also noted histologic acute chorioamnionitis within the membranes and chorionic plate consistent with stage 2 (intermediate), grade 2 (severe) maternal inflammatory response. The stage of the maternal inflammatory response is thought to be associated with the duration of infection. Within the umbilical cord, there were calcifications, acute umbilical phlebitis, arteritis, and funisitis consistent with stage 3 (advanced), grade 2 (severe) fetal inflammatory response.

The patient also expressed concern about the findings of her anatomy ultrasound. It is normal for placentae to have small, sonolucent spaces called placental lakes. These spaces have a regular shape and a normal underlying myometrial thickness. However, large and irregular sonolucent spaces, known as placental lacunae, found in the center of a lobule or cotyledon adjacent to a thinned myometrium, are associated with PAS disorders [6]. Interestingly, the patient’s placenta pathology showed BPMF, stage 1. Although the increasing stage of BPMF is associated with more severe PAS disorders, neither BPMF stage 1 nor placental lakes would be expected to have contributed to the patient’s stillbirth.

In this patient, the placental pathology showed several significant findings associated with stillbirth, including both fetal and maternal malperfusion and acute chorioamnionitis. Given the presence of placental fetal vessel thromboemboli, maternal testing for coagulopathy should be considered. If a coagulopathy is found, then management of a future pregnancy would be based on that diagnosis, otherwise, there are no specific recommendations for surveillance beyond those recommended by ACOG for a history of stillbirth and preterm prelabor rupture of membranes.

By understanding the placental histology following stillbirth, we can better provide needed answers, support, and preparation for future pregnancy.

Key Teaching Points

- The 2016 Amsterdam consensus guidelines provided a model for consistent placental histopathology.
- Maternal vascular malperfusion, FVM, acute chorioamnionitis, and VUE are the most significant placental pathology findings.
- Placental pathology reports can reveal or suggest the etiology of a stillbirth. Clinicians able to translate this information to their patients can provide emotional relief and recurrence counseling.

References

- 1 Management of Stillbirth: Obstetric Care Consensus No. 10. *Obstet Gynecol.* 2020;135(3):e110–e132.
- 2 Khong TY, Mooney EE, Ariel I, et al. Sampling and Definitions of Placental Lesions: Amsterdam Placental Workshop Group Consensus Statement. *Arch Pathol Lab Med.* 2016;140(7):698–713.
- 3 Redline RW, Roberts DJ, Parast MM, et al. Placental Pathology Is Necessary to Understand Common Pregnancy Complications and Achieve an Improved Taxonomy of Obstetrical Disease. *Am J Obstet Gynecol.* 2023;228(2):187–202.
- 4 Ravishankar S, Redline RW. What Obstetricians Need to Know about Placental Pathology. *Obstet Gynecol Clin North Am.* 2020;47(1):29–48.
- 5 Redline RW, Ravishankar S, Bagby CM, Saab ST, Zarei S. Four Major Patterns of Placental Injury: A Stepwise Guide for Understanding and Implementing the 2016 Amsterdam Consensus. *Mod Pathol.* 2021;34(6):1074–1092.
- 6 Pagani G, Cali G, Acharya G, et al. Diagnostic Accuracy of Ultrasound in Detecting the Severity of Abnormally Invasive Placentation: A Systematic Review and Meta-analysis. *Acta Obstet Gynecol Scand.* 2018;97(1):25–37.

CASE 84

A 30-Year-Old Presents at 34 Weeks' Gestation with Gestational Diabetes and a Fundal Height of 38 cm

Porshia Underwood

History of Present Illness

A 30-year-old gravida 3 para 2 at 34 weeks' gestation presents for a routine prenatal visit. Her pregnancy is complicated by gestational diabetes (GDM), which is well controlled with diet and exercise. She reports good fetal movement, no vaginal bleeding, leakage of fluid, or painful contractions. She has no pregnancy concerns today. Her prenatal care has been up to date. She had low-risk genetic screening, negative carrier screening, and a normal detailed anatomy ultrasound. Her obstetric history is notable for two prior pregnancies also complicated by diet-controlled GDM with subsequent spontaneous vaginal deliveries at term. She has no other significant past medical or surgical history. She is taking prenatal vitamins and has no known drug allergies.

Physical Examination

General appearance: Well-appearing, well-developed, no acute distress

Vital signs:

Temperature: 36.5°C

Pulse: 101 beats per minute

Blood pressure: 118/75 mmHg

Respiratory rate: 16 breaths per minute

Abdomen: Soft, gravid, no fundal tenderness, fundal height 38 cm

Fetal assessment: Nonstress test (NST): Baseline 145 beats per minute, two 15 × 15 accelerations, no decelerations, moderate variability. Tocometry: contraction × 1, not felt by patient

Laboratory studies:

Blood type: A positive, antibody screen negative

RPR: Negative

Fasting glucoses <95 mg/dL, 1-hour postprandial glucoses <140 mg/dL

Imaging:

Bedside ultrasound with singleton fetus in cephalic presentation. Full fetal bladder. Normal posterior placenta. Grossly normal fetal movements. Single deepest vertical pocket (DVP) of 9 cm

How Would You Manage This Patient?

A formal growth ultrasound was ordered and notable for a single DVP of 9.7 cm and an amniotic fluid index (AFI) of 27.3 cm, confirming the diagnosis of mild polyhydramnios.

A detailed fetal assessment was performed that noted a normal posterior placenta, normal craniofacial, cardiac, gastrointestinal (GI), and genitourinary anatomy. Fetal growth was appropriate with an estimated fetal weight (EFW) at the 51st percentile. She continued to follow with her nutritionist and maintained excellent control of the GDM with diet and exercise. Given the concurring diagnoses of GDM and polyhydramnios, she started weekly antenatal testing with NSTs, which were reassuring. She subsequently presented for an induction of labor at 39 weeks followed by a vaginal delivery complicated by a postpartum hemorrhage (PPH), which resolved with routine use of uterotonic medications. Her postpartum course was otherwise uncomplicated.

Polyhydramnios

Polyhydramnios is an abnormal increase in amniotic fluid volume and is estimated to affect 1–2% of singleton pregnancies [1]. In most cases, this is typically diagnosed in the late second or early third trimester, although more severe cases can present earlier. In the first trimester, amniotic fluid is a transudate of plasma either from the fetus or the mother. During the second half of pregnancy, amniotic fluid is made entirely from the fetus, through a combination of fetal urine and respiratory secretions. The fetus swallows the fluid, which gets resorbed within its GI tract. An impairment in resorption or disordered production can lead to polyhydramnios [2].

During second- and third-trimester ultrasounds, the sonographer measures amniotic fluid through either measurement of a single DVP or AFI. The DVP is measured in a sagittal plane while holding the transducer perpendicular to the floor and parallel to the patient. To obtain an adequate DVP, the pocket must measure at least 1 cm wide and be void of both fetal parts and umbilical cord. The AFI is measured by dividing the uterus into four equal quadrants and adding the sum of the single deepest pocket (SDP) from each quadrant [2]. A DVP of ≥8 cm or an AFI of ≥24 cm is consistent with polyhydramnios. Furthermore, polyhydramnios is classified as mild, moderate, or severe based on a DVP of 8–11 cm, 12–15 cm, and >16 cm or an AFI of 24.0–29.9 cm, 30.0–34.9 cm, and >35.0 cm, respectively (Figure 84.1). Higher degrees of polyhydramnios are associated with an increased risk of fetal anomalies, preterm delivery, small for gestational age (SGA) infants, and increased perinatal mortality [1].

Causes of polyhydramnios can be categorized based on impaired resorption or excessive production of amniotic fluid. Neuromuscular conditions such as myotonic dystrophy or

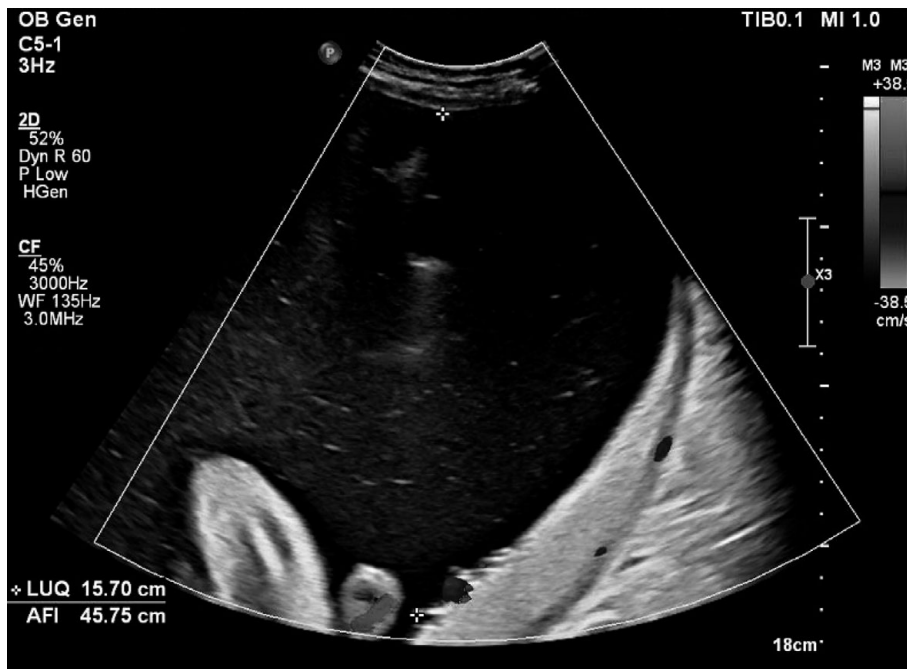


Figure 84.1 Ultrasound depicting a DVP of 15.7 cm and AFI of 45.75 cm, consistent with severe polyhydramnios (A black and white version of this figure will appear in some formats. For the color version, please refer to the plate section.)

intracranial anomalies, GI obstructions resulting from duodenal atresia or diaphragmatic hernias, and craniofacial abnormalities such as a cleft lip and palate can impair fetal swallowing and thus fluid resorption. Excessive urinary production can be related to ureteropelvic junction obstruction, Bartter syndrome, cardiac structural anomalies, sacrococcygeal teratomas, fetal hydrops, and maternal diabetes, among other conditions. Approximately 60–70% of polyhydramnios cases are mild and idiopathic [1].

Currently, the American College of Obstetricians and Gynecologists (ACOG) recommends screening for conditions such as polyhydramnios through routine assessment of fundal height starting at 24 weeks' gestation in low-risk singleton pregnancies. If the discrepancy noted between weeks of gestational age and fundal height is >3 , when taking to account possible limiting factors, further assessment with ultrasound should be performed [3]. A meta-analysis of seven randomized control trials including 23,643 low-risk pregnancies indicated that routine third-trimester ultrasound did not improve perinatal death compared with serial fundal height assessment. It did significantly increase the detection of polyhydramnios and antenatal intervention without a change in preterm birth, mode of delivery, or neonatal outcomes. Thus, performing routine third-trimester ultrasounds as a screening tool is not recommended [3].

If polyhydramnios is suspected, a targeted ultrasound should be performed and include a fluid measurement, fetal growth, placental evaluation for chorioangiomas leading to increased fetal cardiac output, and assessment of fetal structures including the heart, stomach, face, palate, neck, kidneys, spine, and pelvis given association with underlying structural abnormalities. While ultrasound is useful in many cases, if there are no structural abnormalities noted, further evaluation for conditions such as diabetes, alloimmunization, infection,

or genetic syndromes is warranted. The underlying risk that a structural or genetic abnormality will be found within the first year of life in the setting of idiopathic polyhydramnios can be as high as 28% [1].

Most cases of polyhydramnios do not require treatment. In severe cases, which are typically associated with significant maternal discomfort or respiratory difficulty, amnioreduction can be considered for symptomatic relief. The use of indomethacin for symptomatic management of polyhydramnios has been associated with neonatal complications and therefore is not recommended [1].

Polyhydramnios is associated with stillbirth. Previously, the increased risk of fetal mortality was associated with fetal anomalies in the more severe cases. A retrospective cohort study consisting of nonanomalous births complicated by polyhydramnios found that when compared to pregnancies unaffected by polyhydramnios, the risk of stillbirth was 1.14 versus 0.14 per 1,000 at 32 weeks, 1.34 versus 0.16 per 1,000 at 34 weeks, 1.64 versus 0.20 per 1,000 at 36 weeks, and 2.91 versus 0.42 per 1,000 at 39 weeks. This risk persists even when accounting for confounding variables and excluding pregnancies affected by diabetes. A meta-analysis looking at pregnancies complicated by idiopathic polyhydramnios found pregnancies complicated by idiopathic polyhydramnios have an increased likelihood of intrauterine fetal demise and neonatal death when compared with pregnancies with normal DVPs and AFI [4]. Based on this increasing risk, antenatal surveillance may be warranted in pregnancies affected by polyhydramnios. Current recommendations are to begin once or twice weekly surveillance beginning at 32–34 weeks for moderate to severe polyhydramnios [5]. While antenatal surveillance is not required for mild idiopathic polyhydramnios in the absence of concurrent medical conditions, these studies showing increased mortality in this population highlight the

importance of patient counseling and shared decision-making between providers and patients.

Delivery planning in a patient with polyhydramnios requires consideration of several factors. First, in the case of mild idiopathic polyhydramnios, delivery <39 weeks is not recommended. If there is a complicating condition or more severe form of polyhydramnios, this condition takes precedence, and an earlier delivery may be indicated [6]. Given the higher rates of nonvertex presentation, perform an ultrasound on initial presentation to confirm fetal presentation. In addition, higher rates of dysfunctional labor leading to operative delivery have been reported. Discuss risks and benefits of these interventions during antenatal visits to ensure appropriate antenatal counseling. Anecdotally, amniotomy for labor management in patients with polyhydramnios can be cause for concern given the increased risk of cord prolapse seen in some series [7]. For patients with an unengaged fetal head who require an amniotomy, techniques such as fundal pressure and slow release of amniotic fluid by using membrane puncture with a needle using direct visualization with a vaginal speculum or trumpet sheath used for pudendal blockade can be considered [8]. Some studies have reported an increased risk of PPH, even in the setting of mild idiopathic polyhydramnios. Plan adequate access to blood

products and uterotonic agents at the time of delivery, especially in more severe cases. Finally, given the association of structural abnormalities and genetic syndromes with polyhydramnios as well as the risk of neonatal intensive care unit (NICU) admission, having pediatric support at delivery is recommended [1].

Key Teaching Points

- Polyhydramnios is an abnormal increase in amniotic fluid volume quantified by a DVP of ≥ 8 cm or an AFI of ≥ 24 cm.
- A confirmatory ultrasound should be performed when the discrepancy between fundal height and gestational age is >3 to assess for polyhydramnios and include an evaluation of the fluid, placenta, and fetal anatomy.
- Etiologies of polyhydramnios include anomalies related to impaired fetal swallowing, excess urine production, osmotic sources, and idiopathic causes.
- Outpatient antenatal fetal testing is indicated in moderate to severe polyhydramnios once or twice weekly beginning at 32–34 weeks.
- In cases of mild polyhydramnios without other comorbidities, delivery at <39 weeks is not indicated.

References

- 1 Society for Maternal-Fetal Medicine; Dashe JS, Pressman EK, Hibbard JU. SMFM Consult Series #46: Evaluation and Management of Polyhydramnios. *Am J Obstet Gynecol*. 2018;219:B2–B8.
- 2 Obstetrical Imaging. In: Cunningham FG, Leveno KJ, Dashe JS, et al. (eds.). *Williams Obstetrics*, 26th ed. New York: McGraw Hill; 2022. 246–271.
- 3 Al-Hafez L, Chauhan SP, Riegel M, et al. Routine Third-Trimester Ultrasound in Low Risk Pregnancies and Perinatal Death: A Systematic Review and Meta-analysis. *Am J Obstet Gynecol MFM*. 2020;2(4):100242.
- 4 Pagan M, Magann EF, Rabie N, et al. Idiopathic Polyhydramnios and Pregnancy Outcome: Systematic Review and Meta-analysis. *Ultrasound Obstet Gynecol*. 2023;61:302–309.
- 5 ACOG Committee Opinion No. 828: Indications for Outpatient Antenatal Fetal Surveillance. *Obstet Gynecol*. 2021;137(6):e177–e197.
- 6 ACOG Committee Opinion No. 831: Medically Indicated Late-Preterm and Early Term Deliveries. *Obstet Gynecol*. 2021;138(1):e35–e39.
- 7 Tallhage S, Årestedt K, Schildmeijer K, Oscarsson M. Incidence and Risk Factors for Umbilical Cord Prolapse in Labor when Amniotomy Is Used and with Spontaneous Rupture of Membranes: A Swedish Nationwide Register Study. *Acta Obstet Gynecol Scand*. 2024;103(2):304–312.
- 8 Induction and Augmentation of Labor. In: Cunningham FG, Leveno KJ, Dashe JS, et al. (eds.). *Williams Obstetrics*, 26th ed. New York: McGraw Hill; 2022.

CASE 84

A 30-Year-Old Presents at 34 Weeks' Gestation with Gestational Diabetes and a Fundal Height of 38 cm

Porshia Underwood

History of Present Illness

A 30-year-old gravida 3 para 2 at 34 weeks' gestation presents for a routine prenatal visit. Her pregnancy is complicated by gestational diabetes (GDM), which is well controlled with diet and exercise. She reports good fetal movement, no vaginal bleeding, leakage of fluid, or painful contractions. She has no pregnancy concerns today. Her prenatal care has been up to date. She had low-risk genetic screening, negative carrier screening, and a normal detailed anatomy ultrasound. Her obstetric history is notable for two prior pregnancies also complicated by diet-controlled GDM with subsequent spontaneous vaginal deliveries at term. She has no other significant past medical or surgical history. She is taking prenatal vitamins and has no known drug allergies.

Physical Examination

General appearance: Well-appearing, well-developed, no acute distress

Vital signs:

Temperature: 36.5°C

Pulse: 101 beats per minute

Blood pressure: 118/75 mmHg

Respiratory rate: 16 breaths per minute

Abdomen: Soft, gravid, no fundal tenderness, fundal height 38 cm

Fetal assessment: Nonstress test (NST): Baseline 145 beats per minute, two 15 × 15 accelerations, no decelerations, moderate variability. Tocometry: contraction × 1, not felt by patient

Laboratory studies:

Blood type: A positive, antibody screen negative

RPR: Negative

Fasting glucoses <95 mg/dL, 1-hour postprandial glucoses <140 mg/dL

Imaging:

Bedside ultrasound with singleton fetus in cephalic presentation. Full fetal bladder. Normal posterior placenta. Grossly normal fetal movements. Single deepest vertical pocket (DVP) of 9 cm

How Would You Manage This Patient?

A formal growth ultrasound was ordered and notable for a single DVP of 9.7 cm and an amniotic fluid index (AFI) of 27.3 cm, confirming the diagnosis of mild polyhydramnios.

A detailed fetal assessment was performed that noted a normal posterior placenta, normal craniofacial, cardiac, gastrointestinal (GI), and genitourinary anatomy. Fetal growth was appropriate with an estimated fetal weight (EFW) at the 51st percentile. She continued to follow with her nutritionist and maintained excellent control of the GDM with diet and exercise. Given the concurring diagnoses of GDM and polyhydramnios, she started weekly antenatal testing with NSTs, which were reassuring. She subsequently presented for an induction of labor at 39 weeks followed by a vaginal delivery complicated by a postpartum hemorrhage (PPH), which resolved with routine use of uterotonic medications. Her postpartum course was otherwise uncomplicated.

Polyhydramnios

Polyhydramnios is an abnormal increase in amniotic fluid volume and is estimated to affect 1–2% of singleton pregnancies [1]. In most cases, this is typically diagnosed in the late second or early third trimester, although more severe cases can present earlier. In the first trimester, amniotic fluid is a transudate of plasma either from the fetus or the mother. During the second half of pregnancy, amniotic fluid is made entirely from the fetus, through a combination of fetal urine and respiratory secretions. The fetus swallows the fluid, which gets resorbed within its GI tract. An impairment in resorption or disordered production can lead to polyhydramnios [2].

During second- and third-trimester ultrasounds, the sonographer measures amniotic fluid through either measurement of a single DVP or AFI. The DVP is measured in a sagittal plane while holding the transducer perpendicular to the floor and parallel to the patient. To obtain an adequate DVP, the pocket must measure at least 1 cm wide and be void of both fetal parts and umbilical cord. The AFI is measured by dividing the uterus into four equal quadrants and adding the sum of the single deepest pocket (SDP) from each quadrant [2]. A DVP of ≥8 cm or an AFI of ≥24 cm is consistent with polyhydramnios. Furthermore, polyhydramnios is classified as mild, moderate, or severe based on a DVP of 8–11 cm, 12–15 cm, and >16 cm or an AFI of 24.0–29.9 cm, 30.0–34.9 cm, and >35.0 cm, respectively (Figure 84.1). Higher degrees of polyhydramnios are associated with an increased risk of fetal anomalies, preterm delivery, small for gestational age (SGA) infants, and increased perinatal mortality [1].

Causes of polyhydramnios can be categorized based on impaired resorption or excessive production of amniotic fluid. Neuromuscular conditions such as myotonic dystrophy or

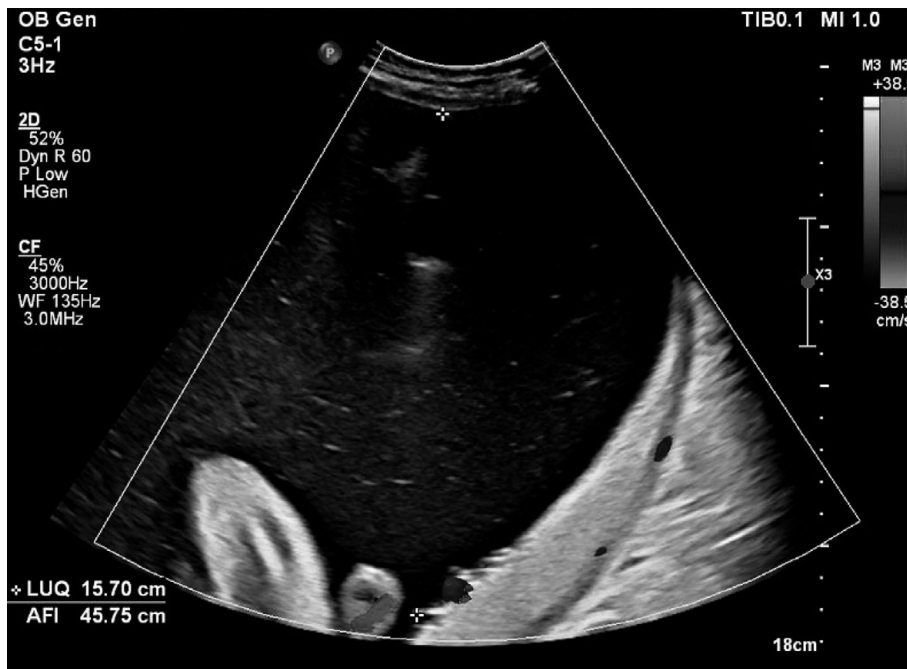


Figure 84.1 Ultrasound depicting a DVP of 15.7 cm and AFI of 45.75 cm, consistent with severe polyhydramnios (A black and white version of this figure will appear in some formats. For the color version, please refer to the plate section.)

intracranial anomalies, GI obstructions resulting from duodenal atresia or diaphragmatic hernias, and craniofacial abnormalities such as a cleft lip and palate can impair fetal swallowing and thus fluid resorption. Excessive urinary production can be related to ureteropelvic junction obstruction, Bartter syndrome, cardiac structural anomalies, sacroccoccygeal teratomas, fetal hydrops, and maternal diabetes, among other conditions. Approximately 60–70% of polyhydramnios cases are mild and idiopathic [1].

Currently, the American College of Obstetricians and Gynecologists (ACOG) recommends screening for conditions such as polyhydramnios through routine assessment of fundal height starting at 24 weeks' gestation in low-risk singleton pregnancies. If the discrepancy noted between weeks of gestational age and fundal height is >3 , when taking to account possible limiting factors, further assessment with ultrasound should be performed [3]. A meta-analysis of seven randomized control trials including 23,643 low-risk pregnancies indicated that routine third-trimester ultrasound did not improve perinatal death compared with serial fundal height assessment. It did significantly increase the detection of polyhydramnios and antenatal intervention without a change in preterm birth, mode of delivery, or neonatal outcomes. Thus, performing routine third-trimester ultrasounds as a screening tool is not recommended [3].

If polyhydramnios is suspected, a targeted ultrasound should be performed and include a fluid measurement, fetal growth, placental evaluation for chorioangiomas leading to increased fetal cardiac output, and assessment of fetal structures including the heart, stomach, face, palate, neck, kidneys, spine, and pelvis given association with underlying structural abnormalities. While ultrasound is useful in many cases, if there are no structural abnormalities noted, further evaluation for conditions such as diabetes, alloimmunization, infection,

or genetic syndromes is warranted. The underlying risk that a structural or genetic abnormality will be found within the first year of life in the setting of idiopathic polyhydramnios can be as high as 28% [1].

Most cases of polyhydramnios do not require treatment. In severe cases, which are typically associated with significant maternal discomfort or respiratory difficulty, amnioreduction can be considered for symptomatic relief. The use of indomethacin for symptomatic management of polyhydramnios has been associated with neonatal complications and therefore is not recommended [1].

Polyhydramnios is associated with stillbirth. Previously, the increased risk of fetal mortality was associated with fetal anomalies in the more severe cases. A retrospective cohort study consisting of nonanomalous births complicated by polyhydramnios found that when compared to pregnancies unaffected by polyhydramnios, the risk of stillbirth was 1.14 versus 0.14 per 1,000 at 32 weeks, 1.34 versus 0.16 per 1,000 at 34 weeks, 1.64 versus 0.20 per 1,000 at 36 weeks, and 2.91 versus 0.42 per 1,000 at 39 weeks. This risk persists even when accounting for confounding variables and excluding pregnancies affected by diabetes. A meta-analysis looking at pregnancies complicated by idiopathic polyhydramnios found pregnancies complicated by idiopathic polyhydramnios have an increased likelihood of intrauterine fetal demise and neonatal death when compared with pregnancies with normal DVPs and AFI [4]. Based on this increasing risk, antenatal surveillance may be warranted in pregnancies affected by polyhydramnios. Current recommendations are to begin once or twice weekly surveillance beginning at 32–34 weeks for moderate to severe polyhydramnios [5]. While antenatal surveillance is not required for mild idiopathic polyhydramnios in the absence of concurrent medical conditions, these studies showing increased mortality in this population highlight the

importance of patient counseling and shared decision-making between providers and patients.

Delivery planning in a patient with polyhydramnios requires consideration of several factors. First, in the case of mild idiopathic polyhydramnios, delivery <39 weeks is not recommended. If there is a complicating condition or more severe form of polyhydramnios, this condition takes precedence, and an earlier delivery may be indicated [6]. Given the higher rates of nonvertex presentation, perform an ultrasound on initial presentation to confirm fetal presentation. In addition, higher rates of dysfunctional labor leading to operative delivery have been reported. Discuss risks and benefits of these interventions during antenatal visits to ensure appropriate antenatal counseling. Anecdotally, amniotomy for labor management in patients with polyhydramnios can be cause for concern given the increased risk of cord prolapse seen in some series [7]. For patients with an unengaged fetal head who require an amniotomy, techniques such as fundal pressure and slow release of amniotic fluid by using membrane puncture with a needle using direct visualization with a vaginal speculum or trumpet sheath used for pudendal blockade can be considered [8]. Some studies have reported an increased risk of PPH, even in the setting of mild idiopathic polyhydramnios. Plan adequate access to blood

products and uterotonic agents at the time of delivery, especially in more severe cases. Finally, given the association of structural abnormalities and genetic syndromes with polyhydramnios as well as the risk of neonatal intensive care unit (NICU) admission, having pediatric support at delivery is recommended [1].

Key Teaching Points

- Polyhydramnios is an abnormal increase in amniotic fluid volume quantified by a DVP of ≥ 8 cm or an AFI of ≥ 24 cm.
- A confirmatory ultrasound should be performed when the discrepancy between fundal height and gestational age is >3 to assess for polyhydramnios and include an evaluation of the fluid, placenta, and fetal anatomy.
- Etiologies of polyhydramnios include anomalies related to impaired fetal swallowing, excess urine production, osmotic sources, and idiopathic causes.
- Outpatient antenatal fetal testing is indicated in moderate to severe polyhydramnios once or twice weekly beginning at 32–34 weeks.
- In cases of mild polyhydramnios without other comorbidities, delivery at <39 weeks is not indicated.

References

- 1 Society for Maternal-Fetal Medicine; Dashe JS, Pressman EK, Hibbard JU. SMFM Consult Series #46: Evaluation and Management of Polyhydramnios. *Am J Obstet Gynecol*. 2018;219:B2–B8.
- 2 Obstetrical Imaging. In: Cunningham FG, Leveno KJ, Dashe JS, et al. (eds.). *Williams Obstetrics*, 26th ed. New York: McGraw Hill; 2022. 246–271.
- 3 Al-Hafez L, Chauhan SP, Riegel M, et al. Routine Third-Trimester Ultrasound in Low Risk Pregnancies and Perinatal Death: A Systematic Review and Meta-analysis. *Am J Obstet Gynecol MFM*. 2020;2(4):100242.
- 4 Pagan M, Magann EF, Rabie N, et al. Idiopathic Polyhydramnios and Pregnancy Outcome: Systematic Review and Meta-analysis. *Ultrasound Obstet Gynecol*. 2023;61:302–309.
- 5 ACOG Committee Opinion No. 828: Indications for Outpatient Antenatal Fetal Surveillance. *Obstet Gynecol*. 2021;137(6):e177–e197.
- 6 ACOG Committee Opinion No. 831: Medically Indicated Late-Preterm and Early Term Deliveries. *Obstet Gynecol*. 2021;138(1):e35–e39.
- 7 Tallhage S, Årestedt K, Schildmeijer K, Oscarsson M. Incidence and Risk Factors for Umbilical Cord Prolapse in Labor when Amniotomy Is Used and with Spontaneous Rupture of Membranes: A Swedish Nationwide Register Study. *Acta Obstet Gynecol Scand*. 2024;103(2):304–312.
- 8 Induction and Augmentation of Labor. In: Cunningham FG, Leveno KJ, Dashe JS, et al. (eds.). *Williams Obstetrics*, 26th ed. New York: McGraw Hill; 2022.

A 30-Year-Old at 31 Weeks' Gestation Presents with Oligohydramnios and Decreased Fetal Movement

Amanda E. Owens

History of Present Illness

A 30-year-old gravida 3 para 1 at 31 weeks' gestation presents to triage complaining of decreased fetal movement over the last several days. She denies vaginal bleeding, contractions, or leakage of fluid, although she endorses increased vaginal discharge. Her pregnancy has been uncomplicated and she has a history of one prior term vaginal delivery and one prior miscarriage. She takes prenatal vitamins and denies prior medical or surgical history. On review of her prenatal record, her routine anatomy sonogram at 20 weeks' gestation reported an anterior placenta, normal amniotic fluid volume, and appropriate growth without evidence of structural anomalies. Her prenatal labs and aneuploidy screening were unremarkable.

Physical Examination

General appearance: Well-developed, well nourished, in no acute distress

Vital signs:

Temperature: 36.8°C

Pulse: 90 beats per minute

Blood pressure: 123/82 mmHg

Respiratory rate: 18 breaths per minute

Body mass index (BMI): 29.1 kg/m²

Abdomen: Soft, gravid, non-tender

Fundus: Non-tender, symphysis-fundus height 29 cm

External genitalia: Normal

Vagina: Thin white discharge, no odor, no pooling, negative Valsalva

Cervix: Parous, closed os

NST: Reactive

Tocometry: No contractions

Laboratory studies:

pH of vaginal discharge: 4.5 (negative nitrazine)

Ferning: Negative

Imaging:

Limited transabdominal ultrasound shows a viable singleton gestation in cephalic presentation, with active fetal movement, and a fetal heart rate of 135. There was a single pocket of amniotic fluid measuring just under 1.8 cm, no other pockets of fluid were visualized

How Would You Manage This Patient?

This patient's evaluation was notable for oligohydramnios with a low amniotic fluid volume measured by a single deepest

vertical pocket (SDP), which in this case was also the cumulative of a four-quadrant assessment, known as amniotic fluid index (AFI). The fetal status was reassuring given the reactive NST and rupture of membranes is ruled out based on the absence of pooling fluid on speculum exam, and negative ferning, nitrazine, and Valsalva test. Review of the 20-week routine anatomic sonogram was normal, noting adequate amniotic fluid as well as bilateral kidneys and a distended urinary bladder; aneuploidy screening was also reviewed and negative. Oral hydration was administered with 1,500 mL of water and a repeat amniotic fluid volume assessment completed 2-hours later. On follow-up, measurements improved with an AFI measurement of 4.8 cm and SDP of 2.1 cm (Figure 85.1).

The patient was advised to continue daily oral hydration. Reassurance was provided, and the patient was discharged home with close interval follow-up for weekly surveillance with NSTs and amniotic fluid measurements. A growth ultrasound was completed, the fetus was measuring appropriate for gestational age (AGA) without concern for growth restriction. She continued to have intermittent isolated oligohydramnios and was scheduled for induction of labor at 37 weeks. She ultimately underwent a successful induction of labor and delivered vaginally at 37 1/7 weeks. Her intrapartum course was notable only for meconium-stained fluid. The mother-infant dyad had an unremarkable course, and the pair was discharged home together on postpartum day 2.

Oligohydramnios

Oligohydramnios, or abnormally low amniotic fluid, is diagnosed using several methods. Transabdominal ultrasound is most common, either utilizing a four-quadrant measurement technique, AFI, or measuring the SDP of fluid [1]. The ultrasound transducer should be held perpendicular to the floor during each measurement, or alternatively can be held perpendicular to the uterine contour. The maximum depth of fluid is measured and must be at least 1 cm in the transverse dimension. Uterine quadrants are delineated by the umbilicus at the cross-section; from above and below, and to the right and left [2]. It is important to avoid fluid pockets with fetal limbs or persistent umbilical cord. Grayscale sonography is preferred; use of color Doppler flow increases the incidence of low fluid without improving outcomes [3]. The gold standard for measuring amniotic fluid involves an invasive dye dilution test, which is not used in the clinical setting, but is reserved for research due to the labor-intensive nature, need for specialized equipment, and staff training [4].



Figure 85.1 Single deepest pocket of amniotic fluid courtesy of Dr. Angela Shaddeau, Walter Reed National Military Medical Center, Bethesda, MD (A black and white version of this figure will appear in some formats. For the color version, please refer to the plate section.)

In earlier gestational ages, only a single quadrant measurement will be feasible. An AFI of ≤ 5 cm, or SDP of < 2 cm are commonly used to diagnose oligohydramnios, although other definitions have been described. In general, SDP is the preferred method for diagnosis as it leads to fewer interventions without higher rates of poor perinatal outcomes, while AFI is more likely to overestimate the condition [5].

Once the diagnosis of oligohydramnios is established, efforts should focus on determining the underlying cause to guide management. Understanding the contributions of amniotic fluid production can help organize and prioritize this assessment. Beyond the first trimester, production of urine by the fetal kidneys plays a significant role in amniotic fluid volume along with fluid from the fetal lungs. To a lesser extent, passive diffusion from maternal circulation influenced by hydration and placental exchange contribute to amniotic fluid production [6].

Ruling out rupture of membranes is an important first step, as it is a common cause of low fluid and should be managed separately. Idiopathic oligohydramnios is the most common cause of low fluid in the third trimester after rupture of membranes, but should be considered a diagnosis of exclusion. After ensuring intact membranes, consider fetal, maternal, and placental causes. Ultrasound assessment of the fetal urinary system is especially important in the setting of low amniotic fluid volumes in mid-pregnancy. Fetal renal abnormalities with or without aneuploidy are a significant cause of oligohydramnios when diagnosed early. Maternal medical comorbidities that impact placental perfusion include chronic hypertension, preeclampsia, chronic abruption, and collagen vascular disorders. A growth ultrasound should be performed assessing for fetal growth restriction (FGR) even in the absence of any other medical history.

After reviewing maternal medical history, ultrasound examination of the fetal urinary system, growth

measurements, and ruling out aneuploidy, consider maternal hydration status. A meta-analysis including 16 studies assessing impact of various maternal hydration strategies on amniotic fluid volume demonstrated benefit of oral compared to intravenous (IV) hydration. Importantly, use of hypotonic oral hydration was more effective at improving amniotic fluid status in patients with isolated oligohydramnios compared to isotonic IV solutions [7]. Therapeutic oral hydration should be considered in cases of idiopathic oligohydramnios in the third trimester as there is some evidence of its utility and it is easy to provide.

Oligohydramnios is associated with increased risk of adverse maternal and neonatal outcomes. Compared to pregnancies with normal amniotic fluid volume, medically complicated pregnancies with oligohydramnios are more likely to be associated with low birth weight at delivery. Another meta-analysis found that otherwise uncomplicated pregnancies with oligohydramnios are at increased risk of delivery via urgent cesarean for fetal distress (relative risk [RR]: 2.16; 95% confidence interval [CI]: 1.64–2.85) as well as NICU admission (RR: 1.71; 95% CI: 1.20–2.42) and meconium aspiration in the neonate (RR: 2.83; 95% CI: 1.38–5.77) [8].

Management of oligohydramnios should be based on the gestational age at diagnosis and any additional comorbid conditions affecting the maternal and fetal status. In the setting of isolated oligohydramnios at term, delivery is indicated. In a preterm patient, a fetal growth assessment and weekly antepartum monitoring with close interval surveillance is most appropriate with delivery scheduled between 36 0/7 weeks and 37 6/7 weeks [9]. Although these guidelines are not stratified by severity of oligohydramnios, some evidence suggests increased incidence of perinatal complications with progressively lower fluid levels [10]. When counseling patients on timing of delivery, severity of oligohydramnios may add to shared decision-making about the timing of delivery.

Key Teaching Points

- Oligohydramnios may be found incidentally during routine ultrasound assessment, during evaluation of fetal well-being in complicated pregnancies, when evaluating decreased fetal movement, or a size to dates discrepancy.
- A single deepest fluid pocket with a width >1 cm, free of umbilical cord or fetal limbs should be measured via transabdominal ultrasound.
- Amniotic fluid index method overestimates oligohydramnios without improving perinatal outcomes, thus SPD is the preferred method of measurement in cases of low fluid.
- Fetal, placental, and maternal conditions can cause derangements in amniotic fluid production leading to oligohydramnios. Gestational age at diagnosis can help to guide evaluation and narrow the possible causes after rupture of membranes is excluded.
- Timing of delivery is based on underlying cause and ongoing fetal assessment with recommended delivery for uncomplicated isolated oligohydramnios by the end of the 37th week.

References

- 1 Chamberlain PF, Manning FA, Morrison I, Harman CR, Lange IR. Ultrasound Evaluation of Amniotic Fluid Volume. I. The Relationship of Marginal and Decreased Amniotic Fluid Volumes to Perinatal Outcome. *Am J Obstet Gynecol.* 1984;150(3):245–249.
- 2 Practice Bulletin No. 175 Summary: Ultrasound in Pregnancy. *Obstet Gynecol.* 2016;128(6):1459–1460.
- 3 Odibo IN, Whittemore BS, Hughes DS, et al. Addition of Color Doppler Sonography for Detection of Amniotic Fluid Disturbances and Its Implications on Perinatal Outcomes. *J Ultrasound Med.* 2017;36(9):1875–1881.
- 4 Dildy GA 3rd, Lira N, Moise KJ Jr., Riddle GD, Deter RL. Amniotic Fluid Volume Assessment: Comparison of Ultrasonographic Estimates versus Direct Measurements with a Dye-Dilution Technique in Human Pregnancy. *Am J Obstet Gynecol.* 1992;167(4 Pt. 1):986–994.
- 5 Kehl S, Schelkle A, Thomas A, et al. Single Deepest Vertical Pocket or Amniotic Fluid Index as Evaluation Test for Predicting Adverse Pregnancy Outcome (SAFE trial): A Multicenter, Open-Label, Randomized Controlled Trial. *Ultrasound Obstet Gynecol.* 2016;47(6):674–679.
- 6 Brace RA. Physiology of Amniotic Fluid Volume Regulation. *Clin Obstet Gynecol.* 1997;40(2):280–289.
- 7 Gizzo S, Noventa M, Vitagliano A, et al. An Update on Maternal Hydration Strategies for Amniotic Fluid Improvement in Isolated Oligohydramnios and Normohydramnios: Evidence from a Systematic Review of Literature and Meta-analysis. *PLoS ONE.* 2015;0(12):e0144334.
- 8 Rabie N, Magann E, Steelman S, Ounpraseuth S. Oligohydramnios in Complicated and Uncomplicated Pregnancy: A Systematic Review and Meta-analysis. *Ultrasound Obstet Gynecol.* 2017;49(4):442–449.
- 9 American College of Obstetricians and Gynecologists' Committee on Obstetric Practice; Society for Maternal-Fetal Medicine. Medically Indicated Late-Preterm and Early-Term Deliveries: ACOG Committee Opinion, Number 831. *Obstet Gynecol.* 2021;138:e35–e39.
- 10 Zilberman Sharon N, Pekar-Zlotin M, Kugler N, et al. Oligohydramnios: How Severe Is Severe? *J Matern Fetal Neonatal Med.* 2022;35(25):5754–5760.

CASE 86

A 35-Year-Old at 36 Weeks' Gestation with a Unicornuate Uterus Desires an External Cephalic Version for Breech Presentation

Allison A. C. Eubanks

History of Present Illness

A 35-year-old gravida 1 para 0 presents at 36 0/7 weeks' gestation for routine visit and delivery counseling. She has a prenatal course complicated by advanced maternal age and a history of infertility. This pregnancy was spontaneously conceived during her infertility workup. During this workup, it was found on 3D ultrasound and confirmed with magnetic resonance imaging (MRI) that she has a unicornuate uterus with ipsilateral renal agenesis. Baseline testing of her present kidney is without evidence of impairment. No other medical or surgical history. Fetal growth at 34 weeks was estimated at the 47th percentile without known anomalies. She has a posterior placenta clear of the cervical os. She is taking 81 mg of acetylsalicylic acid and a prenatal vitamin and has no known drug allergies.

She has no concerns today, but she desires to discuss the possibility of an external cephalic version (ECV) for persistent breech presentation.

Physical Examination

General appearance: Well-developed, well-nourished, gravid female in no acute distress

Vital signs:

Temperature: 37.1°C

Pulse: 89 beats per minute

Blood pressure: 116/74 mmHg

Respiratory rate: 16 breaths per minute

Height: 66 inches (167.6 cm)

Weight: 154 lbs (69.9 kg)

BMI: 24.9 kg/m²

Cardiopulmonary: Unremarkable

Abdomen: Gravid, non-tender, nondistended

Neurologic/psychologic: Alert, affect and mood appropriate to situation, good insight and judgement

Extremities: Equal, bilateral, mild lower extremity edema

Laboratory studies:

Hgb: 12.2 g/dL

Vaginal culture: No growth of group B streptococcus

Imaging:

Transabdominal ultrasound demonstrates singleton fetus with heart rate at 145 beats per minute in frank breech presentation. Single deepest pocket 4.23 cm.

How Would You Manage This Patient?

At the 36-week visit, routine pregnancy counseling is performed to discuss signs and symptoms of preeclampsia, preterm premature rupture of membranes (PPROM), and preterm labor. Her chart was reviewed to confirm she had participated in the labor, breast-feeding, and newborn classes, as she desired. This patient's pregnancy is relatively uncomplicated, but given uterine unification defect, she was screened with a growth scan at 34 weeks, which showed normal growth and normal placentation. Her vitals are reviewed and within normal limits. This patient has already completed her group B streptococcus screening, and this result was discussed with the patient. Transabdominal ultrasound is performed to confirm fetal presentation.

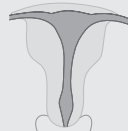
The patient requests an ECV for persistent breech presentation with known Müllerian anomaly of a unicornuate uterus. She has no absolute contraindications to ECV or vaginal delivery. She was counseled on the risks and benefits of the ECV and consented for this procedure, as well as possible emergent cesarean to be performed at 37 weeks' gestation.

Müllerian Anomalies in Pregnancy

Müllerian anomalies are rare outcomes of a failure of the development and migration of the Müllerian, or paramesonephric ducts resulting in structural abnormalities in the uterus, fallopian tubes, and/or the upper part of the vagina [1]. These defects vary significantly from a vaginal septum to two separate uterine cavities to complete Müllerian agenesis (Table 86.1). There is not a universal classification of these anomalies, though several societies have attempted to clarify [2]. The most common classifications of Müllerian anomalies used in studies are septum reabsorption and canalization defects, including arcuate and septate uteri, and unification defects, particularly unicornuate, bicornuate, and didelphic uteri [2]. The most common Müllerian anomaly is bicornuate, accounting for >50% in one large retrospective cohort study. Unicornuate uterus, with an incidence rate of 13% in the same retrospective study, is generally the least common in reviews of pregnancy outcomes [3].

Müllerian anomalies are associated with infertility and first- and second-trimester losses [2]. Diagnosis of these structural anomalies is often found during infertility workup. Imaging modalities that capture these anomalies include

Table 86.1 Müllerian anomaly classification

Classification system										
ESHRE [1]	U0: Normal uterus	U1: Dysmorphic uterus	U2: Septate uterus		U3: Bicorporeal			U4: Hemi-uterus	U5: Aplastic uterus	
ESHRE subcategory		T-shaped	Partial	Complete		Partial	Complete	Bicorporeal septate	With or without rudimentary horn	With or without rudimentary horn
ASRM Müllerian anomalies classification 2021 [2]	Normal uterus		Arcuate (subclassification of uterine septum)	Vaginal septum	Uterine septum		Bicornuate uterus	Uterine didelphys	Unicornuate uterus	Müllerian agenesis
Number of subcategories under ASRM classification				Seven	Six		Four	Three	Five	Three
General outline of defined anomalies										

ASRM (American Society for Reproductive Medicine) also defines two other categories, including: complex anomalies (five subclassifications) and cervical agenesis (two subclassifications). ESHRE: European Society of Human Reproduction and Embryology. Pictures by Philomena Kahler, RN

ultrasound, 3D ultrasound, saline sonogram, MRI, hysteroscopy, and/or laparoscopy. Occasionally, anomalies are diagnosed incidentally during cesarean delivery (CD) [4].

There is limited guidance on management of pregnancies with these maternal complications, due to the rarity of the anomalies in combination with the risk of infertility and early pregnancy loss, but also due to the complexity and individuality of each anomaly [4]. However, there are numerous studies that demonstrate, in meta-analysis or retrospectively, patients who have Müllerian anomalies have increased risk for many adverse obstetric outcomes [1].

The more severe the anomaly, the more likely it is to impact all stages of reproduction [5]. One theory suggest that uterine growth anomalies cause increased muscular tissue in the cavity and decreased connective tissue in the cervix that prevent appropriate distention of the cavity causing asymmetric uterine pressure on the cervix [6]. Additionally, decreased blood flow through abnormal tissue in the septum is theorized to cause poor decidualization and uncoordinated muscle contractility, also contributing to poor reproductive outcomes [1]. Finally, just a change in space of the uterine cavity likely contributes to the significant risk of malpresentation [6].

Management

Despite the lack of congruent data, many reports indicate that pregnancy with known Müllerian anomaly is likely to have increased risk of adverse obstetric outcomes with unclear etiology [7]. Given the reported increased risk for adverse obstetric outcomes, patients with known Müllerian anomalies should be followed by maternal fetal medicine specialists for aid with individualization of risks and management [4].

Patients with this history often have a complex infertility and antepartum course, often requiring psychosocial support and counseling to combat the functional and emotional effects of these anomalies [4]. Further, given the possibility of concomitant renal anomalies with Müllerian anomalies, appropriate imaging and evaluation should be performed if not already completed on presentation [4].

When counseling patients, recognizing the differing risks of various anomalies is vital to patient education. In general, it appears that arcuate uteri, the mildest form of Müllerian anomalies, has less statistically significant risks and the odds ratio or risk ratios tend to be decreased from other anomalies (Table 86.2) [7]. While canal defects have the poorest outcomes in early pregnancy and conception, they tend to have lower risks in later pregnancy [5]. Depending on the type of unification defects, the outcomes and risks will likely differ, again reinforcing the need for individualization of counseling and management [5].

Preterm Delivery/Cervical Incompetence/PPROM

The increased risk for preterm delivery and cervical incompetence seems to be consistently strong despite the type of anomaly [4]. While the recommendations for close

monitoring and individualization of risks are clear, there are no other clear recommended interventions. Specifically, there are no recommendations for progesterone supplementation or cervical length monitoring in otherwise asymptomatic patients [4]. Further, there are no recommendations for prophylactic cerclage in patients with known uterine anomaly without other factors that would otherwise indicate a cerclage [4].

Malpresentation

Malpresentation at term occurs at a higher rate for patients with Müllerian anomalies. Given this, but also considering the increased risk of cesarean over vaginal delivery, it is interesting to note that there are no clear recommendations for or against ECV in these patients. The only absolute contraindications to ECV reported by American College of Obstetricians and Gynecologists (ACOG) include any contraindications to vaginal delivery [8]. Simply, presence of a canal or septal defect, except for a vaginal septum that would prevent vaginal delivery, there are no outright contraindications to vaginal delivery with a Müllerian anomaly.

Consideration and patient counseling should include the increased risk for placental abruption, an already known risk of performing an ECV. Placental abruption in patients with Müllerian anomalies is reported to be as high as ninefold higher in canalization defects and even fivefold higher in arcuate uteri at baseline [5].

Fetal Growth Restriction

The analyses consistently show an increased risk of fetal growth restriction (FGR) regardless of classification of anomaly, except in arcuate uterus (Table 86.2). It is now recommended by ACOG to consider serial growth scans in patients with any known risks for FGR [9]. Given this, patients should be considered for serial growth evaluations in pregnancies complicated by Müllerian anomalies [3].

Cesarean Delivery

The rate of CD is universally increased throughout the reviews and studies on Müllerian anomalies in pregnancy with the pooled estimated risk as high as 86.4% [10]. While the increased risk of malpresentation certainly plays a role in this increase [5], there is evidence of increased risk of non-breech, non-previa indicated cesarean with an adjusted odds ratio of 2.6 [3]. This is likely related to the abnormal distribution of muscle versus connective tissue and the change in shape of the uterine cavity leading to inadequate contractility, though there is no causal relationship demonstrated in research [1]. With the increased safety of vaginal delivery over cesarean in mind, patients should be counseled adequately, labor curves monitored closely, and consideration of ECV in the right patient may be appropriate. This while keeping in mind that placental abruption and uterine rupture are both increased in patients with a Müllerian anomaly. The incidence of uterine rupture in one review increased to 2.8 versus 1.6% in patients without a Müllerian anomaly [6].

Table 86.2 Odds ratio of perinatal outcomes with Müllerian anomalies versus patients without Müllerian anomalies

Adverse prenatal outcome	Wang et al. [6]		Kim et al. [8]			Panagiotopoulos et al. [1]			
	All Müllerian anomalies	All Müllerian anomalies	Canal defects	Unification defects	Arcuate	Subcategory of classification			
						All Müllerian anomalies	Canal defects (U2 ESHRE classification)	Unification defects (U3 ESHRE classification) bicorporeal	Unification defects (U4 ESHRE classification) hemi-uterus
Preterm delivery – All	3.46	2.98	3.11	3.5	1.62*	3.89	4.06	4.98	3.74
Preterm delivery <37 weeks	2.58								
Preterm delivery <34 weeks	5.29								
PPROM	1.41*	3.5	4.66	4.66		2.48	1.44*	2.11	1.54*
Malpresentation	8.83	9.1	11.39	8.68	3.27	11.11	13.76	10.41	11.6
Placenta previa	0.83*	1.56*	1.21*	3.37	1.68*	4			
Placental abruption	3.89	3.12	9.22	6.53	4.56	5.21	10.7	7.61	9.76
PPH	0.92*	1.02*							
Intrauterine growth restriction (IUGR)	2.97	2.53	2.14	3.3	3.77*	3.75	2.99	3.86	4.43*
Low birth weight	1.8*	1.59*	1.73*	1.99	1.5*	3.23			
Cesarean section	2.1	2.87	5.02	3.91	2.22*	4.52	5.19	7.82	2.06
Cervical incompetence		7.94	9.13	9.04		15.13			
Intrauterine fetal demise		2.06	1.04*	2.5					
Preeclampsia		1.25	0.25*	1.49*	0.76*				

* Indicates value is not statistically significant per published criteria

Preeclampsia

There is conflicting evidence on the risk of preeclampsia in patients with Müllerian anomalies at baseline, or only if the patient has a concomitant renal agenesis [1]. Given there is some evidence for increased risk, with known low-risk intervention, it would be appropriate to consider use of low-dose aspirin prophylaxis in pregnancy for patients with confirmed Müllerian anomalies, particularly those with known renal agenesis and no contraindications to aspirin use.

History of Surgical Intervention

It is unclear if patients who undergo surgical intervention for known anomaly prior to pregnancy should be managed differently, so each patient should be managed individually [4]. Patients with significant anomalies and a history of adverse reproductive outcomes can be considered, with specialist consultation, for surgical intervention prior to a subsequent

pregnancy should this be appropriate after review of history and physical [5].

Key Teaching Points

- Evidence suggests that presence of any Müllerian anomaly is associated with increased adverse prenatal and obstetric outcomes.
- Prenatal care for patients with known Müllerian anomaly should be conducted in conjunction with maternal fetal medicine specialist to best individualize the care plan as there are no clear general guidelines for management of pregnancy with known Müllerian anomaly.
- Consideration of performing serial growth assessments and addition of prophylactic low-dose aspirin in pregnancy may decrease the risks of some adverse prenatal outcomes.

References

- 1 Panagiotopoulos M, Tseke P, Michala L. Obstetric Complications in Women with Congenital Uterine Anomalies According to the 2013 European Society of Human Reproduction and Embryology and the European Society for Gynaecological Endoscopy Classification: A Systematic Review and Meta-analysis. *Obstet Gynecol.* 2022;139(1):138–148.
- 2 Pfeifer SM, Attaran M, Goldstein J, et al. ASRM Müllerian Anomalies Classification 2021. *Fertil Steril.* 2021;116(5):1238–1252.
- 3 Hua M, Odibo AO, Longman RE, et al. Congenital Uterine Anomalies and Adverse Pregnancy Outcomes. *Am J Obstet Gynecol.* 2011;205(6):558.e1–558.e5.
- 4 Akhtar MA, Saravelos SH, Li TC, Jayaprakasan K; Royal College of Obstetricians and Gynaecologists. Reproductive Implications and Management of Congenital Uterine Anomalies: Scientific Impact Paper No. 62 November 2019. *BJOG.* 2020;127(5):e1–e13.
- 5 Kim MA, Kim HS, Kim YH. Reproductive, Obstetric and Neonatal Outcomes in Women with Congenital Uterine Anomalies: A Systematic Review and Meta-analysis. *J Clin Med.* 2021;10(21):4797.
- 6 Wang S, Wang K, Hu Q, et al. Perinatal Outcomes of Women with Müllerian Anomalies. *Arch Gynecol Obstet.* 2023;307(4):1209–1216.
- 7 Chan YY, Jayaprakasan K, Tan A, et al. Reproductive Outcomes in Women with Congenital Uterine Anomalies: A Systematic Review. *Ultrasound Obstet Gynecol.* 2011;38(4):371–382.
- 8 External Cephalic Version: ACOG Practice Bulletin, Number 221. *Obstet Gynecol.* 2020;135(5):e203–e212.
- 9 American College of Obstetricians and Gynecologists' Committee on Practice Bulletins – Obstetrics and the Society for Maternal-Fetal Medicine. ACOG Practice Bulletin No. 204: Fetal Growth Restriction. *Obstet Gynecol.* 2019;133(2):e97–e109.
- 10 Lü Y, Ji M, Deng S, Gao J, Zhou X. Association of a Unicornuate Uterus with Adverse Obstetric Outcomes: A Retrospective Cohort Study. *J Obstet Gynaecol Res.* 2021;47(9):3136–3143.

A 40-Year-Old at 24 Weeks' Gestation Presents with Multiple Fibroids Seen on Ultrasound

Erin M. Conroy

History of Present Illness

A nulliparous, 40-year-old patient presents for her scheduled prenatal visit at 24 weeks' gestation. She had her routine level 2 anatomy scan completed at 22 weeks and would like to discuss the results. She has questions about how this will impact her pregnancy and delivery. Her anatomy scan shows a normally grown fetus in breech presentation with three large fibroids and several small fibroids. The fetus moves freely, and the amniotic fluid is grossly normal. The large fibroids measure 7 cm, 8 cm, and 12 cm in size. The 12 cm fibroid is pedunculated off the right lateral aspect of the uterine fundus. The 7 and 8 cm fibroids are anterior intramural. The smaller fibroids range from 1 to 2 cm in size. She has a family history of fibroids but does not recall being told prior to pregnancy that she has fibroids. She has no major medical or surgical history. She has a history of anemia for which she takes a prenatal vitamin with iron and a daily iron supplement. She has no known drug allergies.

Physical Examination

General appearance Well-developed female in no apparent distress

Vital signs:

Temperature: 37.3°C

Pulse: 78 beats per minute

Blood pressure: 104/68 mmHg

Respiratory rate: 14 breaths per minute

Height: 65 inches

Weight: 145 lbs

BMI: 24 kg/m²

Abdomen: Soft, non-tender, nondistended. Fundal height is 27 cm

Pelvic: Deferred, no active issues

Fetal heart rate: 145 beats per minute on fetal Doppler

Laboratory studies:

Hgb: 9.5 g/dL

Hematocrit (Hct): 28.5%

Imaging:

Normal fetal anatomic survey. Singleton fetus in breech presentation. Three large fibroids measured, multiple smaller fibroids (all ≤ 2 cm). 12 cm pedunculated fibroid off right lateral fundus. Two additional anterior intramural fibroids measuring 7 and 8 cm. Fundal placenta. Normal amniotic fluid level

How Would You Manage This Patient?

This patient presents to discuss the results of her anatomic survey and how it will impact her pregnancy. The appointment includes her routine prenatal care, but much of the visit is spent discussing fibroids in pregnancy and creating an individualized care plan for this patient. Specifically, she was informed of the possible risks of fibroids during pregnancy and delivery including pain, preterm labor and delivery, malpresentation, hemorrhage, and increased risks of cesarean delivery (CD).

Serial growth scans were recommended given that her fundal height is currently 27 cm and an inaccurate assessment of fetal growth. A risk assessment of post partum hemorrhage (PPH) was performed, and her history of anemia was flagged in addition to her fibroid uterus. A repeat complete blood count (CBC) was drawn, which showed a Hct of 28.5%. The patient was counseled to begin outpatient intravenous (IV) iron treatments and continue her daily oral iron supplement. A repeat CBC was performed at her 36-week visit that showed an improvement in her Hct to 31.2% following her weekly IV iron infusions.

Throughout pregnancy, the patient's fetus measured appropriate for gestational age and was in cephalic presentation. She went into spontaneous labor at 39.5 weeks and delivered a live female infant with an Apgar score of 9,9. She had a PPH due to uterine atony of 1.2 L that was managed with uterotonics and a transfusion of 1u packed red blood cells. The patient and her infant did well and were discharged home on postpartum day 2/day of life 2. Her discharge plan included a 2- and 6-week postpartum visit, and an interval ultrasound to evaluate fibroid. The patient was counseled on the benign nature of fibroids and that both medical and surgical interventions were available for symptomatic fibroids.

Fibroids in Pregnancy

Fibroids are benign, smooth muscle tumors of the uterus that are the most common pelvic neoplasm in females. They commonly present with symptoms such as irregular menstrual bleeding and pelvic pressure [1]. Fibroids are classified based on their location within the uterus. There is a standard leiomyoma subclassification system developed by the International Federation of Gynecology and Obstetrics (FIGO) to describe fibroid location related to the endometrium and serosa [1].

Fibroids are present in approximately 1.6–10.7% of pregnancies [2]. Most people will not experience fibroid-related complications during pregnancy. Large fibroids, or those measuring ≥ 5 cm, are more likely to be associated with

pregnancy complications [3]. Adverse pregnancy outcomes associated with fibroids include early pregnancy loss, preterm labor and delivery, PPH, and malpresentation. Individuals may be at higher risk for preterm delivery if they have multiple fibroids compared with those with single fibroids [2]. Studies have not consistently linked fibroids to FGR, placenta previa, or placental abruption [4].

Currently there are no specific guidelines from American College of Obstetricians and Gynecologists recommending serial growth scans for pregnant individuals with fibroids. For most low-risk individuals, growth is best assessed with serial fundal heights [1]. However, when there is an increased risk of a growth disturbance due to medical or obstetric conditions, as may be the case with large fibroids, ultrasound can identify abnormal growth. The error rate of ultrasound estimated fetal weight may be as high as 20%. Growth scans are typically performed no closer than 3–4 weeks apart unless the fetal growth falls below the 10th percentile, in which scans every 2 weeks can be considered [5].

Pain is the most common fibroid-related pregnancy complication and occurs in approximately 10% of individuals [3]. The prevalence of pain increases with larger fibroid size. Typically, pain is an isolated symptom, but it can also be seen with fever, nausea, vomiting, and mild leukocytosis. Patients should be counseled that fibroids may grow larger during pregnancy, most commonly during the late first or early second trimester [2]. Fibroids are also more prone to degeneration during this time. Degeneration typically presents as pain near the fibroid. Hyaline and red degeneration are the two most common types seen during pregnancy [3]. It can be visualized both on ultrasound and MRI. Ultrasound findings include a heterogeneous echogenic pattern or cystic changes [3] while MRI may show cystic areas with portions of high T2 signal.

Fibroid pain can be managed with a short course of non-steroidal anti-inflammatories (NSAIDs) such as

indomethacin. This can only be done prior to 28 weeks, as NSAID use in the third trimester can be associated with premature closure of the ductus arteriosus and low amniotic fluid levels [6,7]. Indomethacin 25–50 mg by mouth every 6 hours can be used for a maximum of 48 hours [6]. Other pain management strategies include acetaminophen, warm compresses, and pregnancy belts.

Fibroids and Delivery

In addition to impacting antenatal care, fibroids may also impact delivery. If pregnant individuals have a history of fibroids, understanding any prior treatment is essential in delivery planning. Specifically, if a patient had a myomectomy, the operative report should be reviewed to identify fibroid and uterine incision location. If the uterine cavity was entered, patients should be counseled about the recommendation for a planned cesarean section at 37–38 weeks' gestation [5].

Fibroids may also increase the risk for CD, particularly with lower uterine segment fibroids (Figure 87.1) [2]. Additionally, fibroids may alter the shape of the uterine cavity and increase the risk of fetal malpresentation. The increase in CD is multifactorial, specifically due to an increase in malpresentation, dysfunctional labor, obstruction of birth canal, and fetal heart rate abnormalities due to placental abruption. Causality has not been definitely established. There are currently no specific guidelines on timing of delivery for individuals with large fibroids and a collaborative discussion should occur between obstetric provider and patient to identify a safe delivery plan.

A delivery discussion should start early in pregnancy and be a continued conversation throughout antenatal care. These conversations should be scheduled in advance to allow involvement of a patient's support team. There should be time allocated both for the physician to explain their

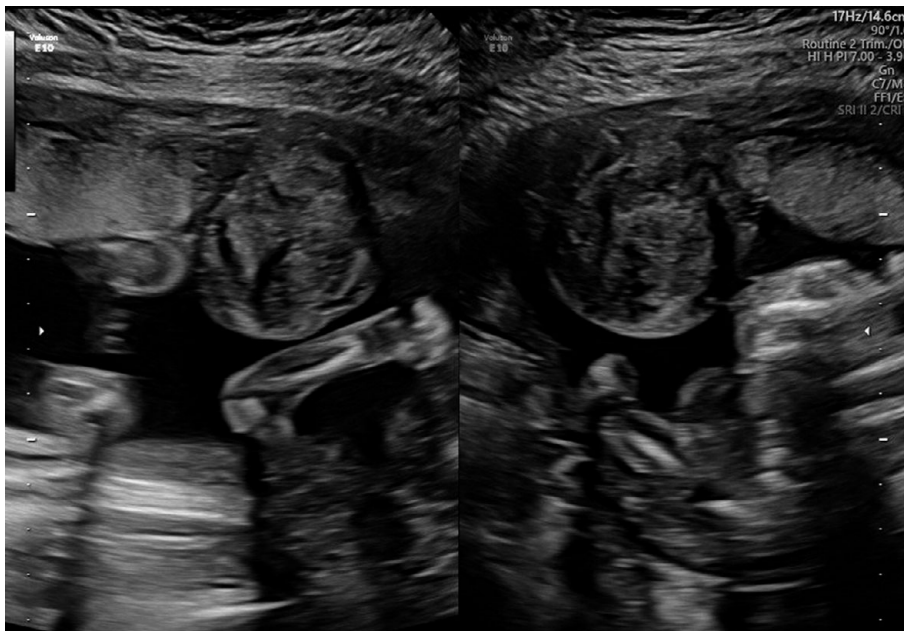


Figure 87.1 Anterior lower uterine segment fibroid

recommendations for delivery and for patients to express their birth preferences. Recommendations for delivery should be based on fibroid location, growth of fibroids and fetus, prior fibroid surgery, and a recent physical exam. Specifically, a pelvic exam can help identify if a fibroid may physically obstruct a vaginal birth. Additionally, physicians can refer patients for an maternal fetal medicine consultation for further discussion.

Antepartum myomectomy is not routinely performed. Cesarean myomectomy is generally avoided due to concern for a significant increase in blood loss and subsequent cesarean hysterectomy. However, an increase in transfusion with cesarean myomectomy has not been identified [8]. Myomectomy at the time of CD has been associated with longer operative time and a decline in hemoglobin [8]. Cesarean myomectomy can be considered in appropriate candidates, for example, a patient with a single large pedunculated fibroid. If performed, myomectomy should be performed after delivery of the infant unless required for safe delivery of the infant. Location of uterine incision and patient's eligibility for a future trial of labor after CD should be documented in the operative report and discussed with the patient. Intraoperative ultrasound can be utilized for incision planning, and 3D uterine models can additionally facilitate delivery planning when these resources are available.

Furthermore, fibroids are a risk factor for PPH [2,3,4]. Any contraindications to uterotonics should be identified prior to delivery and patients should be asked at an antenatal visit if they will accept a blood transfusion. Patients who are anemic should be maintained on oral iron supplements in addition to a prenatal vitamin containing iron. Patients nonresponsive to oral iron supplements should be scheduled for IV iron

infusions. There are no current recommendations to give prophylactic uterotonics or tranexamic acid to individuals with fibroids prior to or during delivery. However, it would be reasonable to consider as studies have demonstrated decreased blood loss when given preoperative for both myomectomy and cesarean birth. Rates of PPH in individuals with fibroids has been quoted at 2.5 versus 1.4% in individuals without fibroids [3]. The increase in PPH is due to uterine atony as fibroids may distort the uterine architecture, thus interfering with myometrial contractility [3].

Black individuals carry a fibroid diagnosis at a rate two to three times that of white individuals. Black women also are more likely to be anemic, develop fibroids at a younger age, and have larger uteri at time of presentation [9]. A detailed discussion of the disparities in outcomes specifically for Black pregnant individuals is beyond the scope of this case study but these risks should be discussed honestly with patients.

Following delivery, patients should be counseled that most fibroids will resolve or decrease in size [5]. Future pregnancy planning should be discussed on an individual basis.

Key Teaching Points

- Fibroids are seen in $\leq 10\%$ of pregnant individuals and the most common side effect is pain.
- Fibroids during pregnancy may increase risks of malpresentation, cesarean section, and PPH.
- Fibroids disproportionately impact Black pregnant individuals at a rate two to three times higher than white pregnant individuals.
- Cesarean myomectomy can be considered when medically indicated but is not the standard of care.

References

- 1 American College of Obstetricians and Gynecologists' Committee on Practice Bulletins – Gynecology. Management of Symptomatic Uterine Leiomyomas: ACOG Practice Bulletin, Number 228. *Obstet Gynecol.* 2021;137(6):e100–e115.
- 2 Lam SJ, Best S, Kumar S. The Impact of Fibroid Characteristics on Pregnancy Outcome. *Am J Obstet Gynecol.* 2014;211(4):395.e1–395.e5.
- 3 Lee HJ, Norwitz ER, Shaw J. Contemporary Management of Fibroids in Pregnancy. *Rev Obstet Gynecol.* 2010;3(1):20–27.
- 4 Ciavattini A, Clemente N, Delli Carpini G, et al. Number and Size of Uterine Fibroids and Obstetric Outcomes. *J Matern Fetal Neonatal Med.* 2015;28(4):484–488.
- 5 Committee on Practice Bulletins – Obstetrics and the American Institute of Ultrasound in Medicine. Practice Bulletin No. 175: Ultrasound in Pregnancy. *Obstet Gynecol.* 2016;128(6):e241–e256.
- 6 Koren G, Florescu A, Costei AM, et al. Nonsteroidal Antiinflammatory Drugs during Third Trimester and the Risk of Premature Closure of the Ductus Arteriosus: A Meta-analysis. *Ann Pharmacother.* 2006;40:824–829.
- 7 Dildy GA 3rd, Moise KJ Jr., Smith LG Jr., et al. Indomethacin for the Treatment of Symptomatic Leiomyoma Uteri during Pregnancy. *Am J Perinatol.* 1992;9:185.
- 8 Pergialiotis V, Sinanidis I, Louloudis IE, et al. Perioperative Complications of Cesarean Delivery Myomectomy: A Meta-analysis. *Obstet Gynecol.* 2017;130:1295.
- 9 Committee on Practice Bulletins – Obstetrics. Practice Bulletin No. 183: Postpartum Hemorrhage. *Obstet Gynecol.* 2017;130(4):e168–e186.

CASE 88

A 25-Year-Old at 13 Weeks' Gestation Presents with Vaginal Spotting

Olivia Lisa Dziadek

History of Present Illness

A 25-year-old gravida 1 para 0 at 13 weeks' gestation presents with vaginal spotting for 1 week. She has been concerned that the bleeding may be due to miscarriage. Patient reports episodes of intermenstrual spotting and postcoital bleeding prior to pregnancy. Patient reports a slight watery discharge. She denies heavy bleeding or abdominal pain. She denies dysuria, urinary frequency, or rectal bleeding. This pregnancy has been otherwise uncomplicated. She has no previous medical or surgical history. She has had normal Pap smears; the last was 1 year ago. Genital cultures are negative for gonorrhea and chlamydia. She denies any family history of gynecologic cancers. Her mother had a hysterectomy secondary to fibroids.

Physical Examination

General appearance: Well-developed, no acute distress

Vital signs:

Temperature: 37.1°C

Blood pressure: 100/65 mmHg

Respiratory rate: 18 breaths per minute

Height: 167 cm

Weight: 54 kg

BMI: 32 kg/m²

Abdomen: Soft, non-tender, no organomegaly

Pelvic: Normal external genitalia, small polyp protruding from cervical os, normal vaginal mucosa with scant vaginal discharge, small amount of brown blood in the vaginal vault

Wet mount: No clue cells, yeast or trichomonas

Laboratory studies:

Blood type: O positive

Hgb: 12 g/dL

Plt: 290 µL

Imaging:

Intrauterine pregnancy measuring 13 0/7 weeks, fetal heart rate is 160 beats per minute, small cervical nabothian cyst and 0.5 cm polyp protruding through the cervix, with base of polyp noted to be in the endometrium, no adnexal masses

How Would You Manage this Patient?

Physical exam findings are consistent with a small prolapsing polyp that is nonobstructive. Given the minimal symptoms associated with this polyp, the patient was counseled regarding expectant management versus polypectomy. Expectant

management is appropriate in this case as this polyp is not causing significant bleeding and has a low risk of malignancy. Ultrasound also suggests that this polyp is decidual and resection may increase the risk of preterm delivery. If the patient were to develop increased vaginal bleeding or other symptomatology and elect surgical removal of the polyp with polypectomy, careful counseling regarding potential complications including preterm delivery is warranted. This patient ultimately delivered at term and underwent a polypectomy after her postpartum visit.

Cervical Polyps

Cervical polyps are benign growths of the cervix and affect 10% of women [1]. They can be the result of chronic inflammation leading to focal hyperplasia, a reaction to foreign bodies, localized congestion of cervical vasculature, or abnormal local response to estrogen stimulation. Cervical polyps are typically benign, while the risk of malignancy increases with size.

In pregnancy, cervical polyps are often asymptomatic but can be a source of bleeding, discharge, infection, premature labor, and chorioamnionitis. It remains part of the differential diagnosis for patients having recurrent vaginal bleeding in pregnancy.

Cervical polyps may increase the risk of preterm birth [2]. Proposed mechanisms that contribute to the risk of preterm birth include vaginal bleeding, which may cause uterine contractions, and inflammation. It is also thought that cervical insufficiency associated with cervical polyps may also contribute to preterm birth.

Endometrial Polyps

Endometrial polyps are a common gynecologic condition, with localized endometrial overgrowth that may be single or multiple, may measure from a few millimeters to centimeters, and may be sessile or pedunculated [2]. Endometrial polyps consist of endometrial glands, stroma, and blood vessels [3]. Risk factors for the development of endometrial polyps include age, hypertension, obesity, and tamoxifen use. Endometrial polyps may be asymptomatic, and when symptoms occur, they most commonly include abnormal (including postmenopausal) uterine bleeding and less commonly infertility [1]. Malignancy is uncommon and occurs in 0–12.9% of endometrial polyps [4]. Endometrial polyps, like cervical polyps, can regress. This is more likely with smaller polyps. Endometrial polyps have been associated with recurrent pregnancy loss.

In pregnancy, with the preparation and decidualization of the endometrial lining, endometrial polyps can be thought of as decidual polyps arising from decidua, of which origins can rise within the cavity as the uterus enlarges. This process is largely unseen unless the distal portion of the decidual polyp descends and protrudes through the cervical os [5]. The decidual polyp then can be indistinguishable from the cervical polyp, which principally arises from the endocervix. This has implications as the risks of a decidual polyp and cervical polyp and their removal may be distinct [5].

Management of Polyps in Pregnancy

In general, there have been no formal guidelines published regarding management of polyps in pregnancy. Data regarding the natural outcome and removal of polyps in pregnancy may be confounded by not distinguishing between endocervical polyps and decidual polyps. A study by Wakimoto et al. [2] suggests that patients diagnosed with polyps at <13 weeks' gestation have an increased risk of complications even without interventions. The incidence of spontaneous preterm birth <34 weeks' gestation was higher in pregnant women with cervical polyps than in those without them [2].

While there is evidence that the presence of polyps increases risks of preterm birth, some studies show no improvement in outcome or worse outcomes with removal. In a study by Fukuta et al., cervical polyps may be a risk factor for delivery at <34 weeks, potentially due to the inflammation induced by the polyp itself or polypectomy. When cervical polyps with genital bleeding or a large size (width ≥ 12 mm) during pregnancy are resected at ≤ 10 weeks' gestation, the risk of delivery at <34 weeks can be as high as 21% and needs to be considered [6,7].

More recent studies suggest that distinguishing between endocervical and decidual polyps are key to determining risks of removal and may aid in management decisions. Tokunaka et al. wrote that patients undergoing removal of decidual polyps had a 12.2% risk of spontaneous abortion versus 0% for cervical polyps and 34.2% risk of preterm delivery for decidual polyps versus 4.8% for cervical polyps [6]. Decidual or endometrial polyps may be managed expectantly given risk of early pregnancy loss and preterm delivery with polypectomy [8]. Of course, if there is concern for malignancy, polypectomy should be performed. Ultrasound is helpful in determining the type of polyp present. In an article by Kondagari [5], an algorithm is proposed to guide management of polyps. In patients who are asymptomatic, expectant management is encouraged. For those with significant bleeding, determination of the origin of the polyp is performed and polyps arising from the cervix are then removed. The severity of symptoms and clinical risk factors should guide the need for removal in patients with decidual polyps given their associated morbidity [5].

One reason postulated for the increased risk of removal with decidual polyps is potential damage to the endometrium resulting in inflammation/infection as the bed of the removed polyp migrates upward in the uterine cavity in proximity to the chorion as the pregnancy progresses. Therefore, ultrasound is key in distinguishing the exact origin of the cervical polyp and will guide management [5].

Ultrasound

Transvaginal ultrasound may be used to assist with diagnosis, providing both the size and location of the cervical and endometrial polyp (Figure 88.1a). On ultrasound, if endocervical, feeding vessels will be noted in the endocervix. Decidual polyps are continuous with the decidua and reach the surface

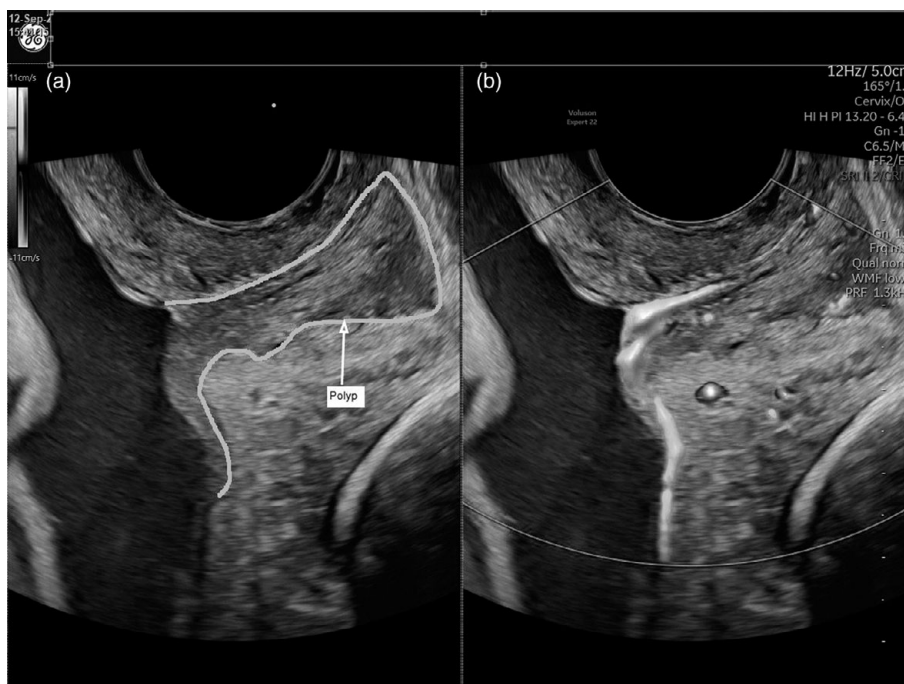


Figure 88.1 (a) Endocervical polyp; (b) Doppler ultrasound of a feeding vessel to polyp (A black and white version of this figure will appear in some formats. For the color version, please refer to the plate section.)

of the chorion [8]. Ultrasound is helpful in ruling out inevitable miscarriage or endocervical polyp in cases of early first-trimester bleeding. Doppler ultrasound can be used to diagnose causes of first-trimester bleeding such as endocervical polyps (Figure 88.1b) [1].

Polypectomy in Pregnancy

There is little evidence available guiding the surgical removal of polyps during pregnancy. If it is determined that removal of a polyp is necessary, similar strategies can be used to those employed outside of pregnancy. Typically, the polyp is connected by a pedicle and may be removed using ring forceps. Larger polyps can be removed using an energy source like an ultrasonic knife [9]. While expectant management is appropriate in asymptomatic cases, as discussed, any cervical or endometrial mass that is large, or growing quickly, should be evaluated promptly. If malignancy is suspected given behavior of the mass, immediate referral to gynecologic oncology would be advised. Small polyps

may regress with time and polypectomy may be completed in the postpartum period in cases where polyps remain. More studies are needed to guide clinicians on the best management strategies for polyps found in pregnancy.

Key Teaching Points

- Cervical and endometrial polyps are generally benign.
- The presence of polyps in pregnancy can be a source of vaginal bleeding, discharge, and increased risk of preterm birth.
- Resection of polyps in pregnancy should be reserved for large symptomatic polyps.
- Transvaginal ultrasound can aid in management of polyps, providing the size, location, and origin of the polyps.
- Removal of an endometrial or decidual polyp carries a higher risk of adverse outcome than removal of a polyp that arises from the endocervix.

References

- 1 Robertson M, Scott P, Ellwood DA, et al. Endocervical Polyp in Pregnancy: Gray Scale and Color Doppler Images and Essential Considerations in Pregnancy. *Ultrasound Obstet Gynecol.* 2005;26:583–584.
- 2 Wakimoto T, Hayashi S, Koh I, et al. Relationship between Unremoved Cervical Polyp in Pregnancy and Spontaneous Preterm Birth. *Am J Obstet Gynecol.* 2022;227(6):899.e1–899.e6.
- 3 American Association of Gynecologic Laparoscopists. AAGL Practice Report: Practice Guidelines for the Diagnosis and Management of Endometrial Polyps. *J Minim Invasive Gynecol.* 2012;19(1):3–10.
- 4 Sasaki LMP, Andrade KRC, Figueiredo ACMG, et al. Factors Associated with Malignancy in Hysteroscopically Resected Endometrial Polyps: A Systematic Review and Meta-analysis. *J Minim Invasive Gynecol.* 2018;25(5):777–785.
- 5 Kondagari L, Josephs LS. Role of Ultrasound in Managing Cervical Polyps during Pregnancy. *Cureus.* 2021;13(10):e18702.
- 6 Tokunaka M, Hasegawa J, Oba T, et al. Decidual Polyps Are Associated with Preterm Delivery in Cases of Attempted Uterine Cervical Polypectomy during the First and Second Trimester. *J Matern Fetal Neonatal Med.* 2015;28:1061–1063.
- 7 Fukuta K, Yoneda S, Yoneda N, et al. Risk Factors for Spontaneous Miscarriage above 12 Weeks or Premature Delivery in Patients Undergoing Cervical Polypectomy during Pregnancy. *BMC Pregnancy Childbirth.* 2020;20(1):27.
- 8 Seo N, Tachibana D, Misugi T, et al. First Trimester Findings of Decidual Polyp: Caution to Avoid Polypectomy. *Eur J Obstet Gynecol Reprod Biol.* 2020;249:109–110.
- 9 Han L, Shi G, Zheng A, et al. A Rare Case of Large Cervical Polyp in Pregnancy Removed through a Minimally Invasive Polypectomy Procedure. *J Minim Invasive Gynecol.* 2022;29(12):1281–1282.

A 35-Year-Old at 28 Weeks' Gestation Presents with a Velamentous Cord Insertion Seen on Ultrasound

Robyn A. Gray-Puleo

History of Present Illness

A 35-year-old gravida 2 para 1 patient at 28 weeks' gestation presents for a consult visit for a follow-up ultrasound for concern for velamentous cord insertion. She is being referred today from her primary obstetric provider who is a family medicine doctor at the community hospital 2 hours from the tertiary care hospital, she has no complaints today. She reports normal fetal movement, no leaking fluid, or vaginal bleeding. She denies contractions or cramping. Her obstetric history is significant for in vitro fertilization (IVF) pregnancy, 41-week uncomplicated vaginal delivery, 8 lb 7 oz (3.8 kg) male infant. Her gynecologic history is significant for infertility/polycystic ovary syndrome, and normal PAPs. She is a nonsmoker, denies illicit drugs, alcohol, and has been married 5 years. Her medical and surgical history are noncontributory.

Physical Examination

General appearance: Well-appearing female in no distress

Vital signs:

Temperature: 37.5°C

Pulse: 95 beats per minute

Respiratory rate: 20 breaths per minute

Blood pressure: 120/60 mmHg

Weight: 73 kg

BMI: 35 kg/m²

Cardiovascular: Normal rate and rhythm

Abdomen: Soft, gravid, non-tender

Extremities: No edema

Laboratory studies:

CBC: Pending

Type and screen: Pending

1-hour glucola: Pending

Imaging:

Ultrasound(s): 20 week: Transvaginal performed to visualized edge of the placenta. Low lying with concern for vasa previa; 25 week: Point of cord insertion (PCI) is anterior velamentous with vessels connecting to the posterior placenta crossing the internal cervical os; 28 week: Single intrauterine pregnancy with a gestational age of 28 0/7 weeks. Current growth parameters are consistent with prior dating indicating normal growth. Amniotic fluid volume is subjectively normal for gestational age. Transvaginal done for placental vessels. Vasa previa again seen

How Would You Manage This Patient?

This patient is being referred for recommendations for management of velamentous cord insertion found on her second-trimester morphology ultrasound now confirmed along with vasa previa on a 28-week scan.

This visit will be a counseling appointment with recommendations for antepartum management, including surveillance (ultrasound and fetal testing) and delivery mode. The plan for her moving forward would be growth ultrasounds every 4 weeks with continued evaluation of the vasa previa/velamentous cord insertion due to increased risk for fetal growth restriction (FGR). If vasa previa persists regardless of growth restriction, then delivery would be by cesarean. Counseling would center around a patient-informed decision regarding timing of delivery between 34 and 37 weeks. Additional discussion centers around the need of transfer to a higher level of neonatal care in anticipation of preterm delivery and timing of inpatient hospitalization for possible emergent delivery.

After extensive counselling, the patient opted for inpatient management starting at 32 weeks with antepartum corticosteroids to be given on admission, and delivery at 36 weeks.

Velamentous Umbilical Cord

A velamentous umbilical cord insertion is both an ultrasonographic and pathologic finding. It is defined as umbilical vessels that travel through the chorioamniotic membranes (fetal membranes: amnion and chorion) toward the placental margin. Therefore, it is unprotected by Wharton's jelly, and at increased risk for compression and rupture. The incidence of a velamentous cord insertion in singletons has been reported as 0.5–2.4% [1] and 15% in onochorionic twin gestations [2]. Risk factors include nulliparity, obesity, assisted reproductive technology, and other placental anomalies. Velamentous cord insertion can be detected antepartum with transvaginal and/or transabdominal ultrasound with color Doppler. Noting the “gold standard” as pathologic evaluation.

Velamentous cord insertion has been associated with increased antepartum hemorrhage that can lead to increased perinatal mortality. Additionally, “peripheral cord insertions” that include velamentous cord insertion and marginal cord insertion are believed to be associated with other complications of pregnancy including vasa previa, placenta previa, placental abruption, preeclampsia, preterm birth, low Apgar score, low birth weight, neonatal intensive care unit admission, and small for gestational age (SGA) [1]. There is conflicting data about



Figure 89.1 Color Doppler flow transvaginal ultrasound probe: transplacental view showing velamentous cord insertion (indicated by white arrow) and single vessel crossing internal cervical os (indicated by green arrow). Please note color version of figure will only be present in some formats. Courtesy of Rebecca Pschirrer, MD, Obstetrics and Gynecology, Director of Prenatal Diagnosis Program, Maternal Fetal Medicine Department, Dartmouth Health, Lebanon, NH, Associate Professor of Obstetrics and Gynecology, Geisel School of Medicine, Dartmouth (A black and white version of this figure will appear in some formats. For the color version, please refer to the plate section.)

increased rates of fetal demise and cesarean delivery (CD) with a velamentous cord insertion alone (without vasa previa) reported in the literature. O’Quinn et al.’s 2020 cohort study showed an increased rate of cesarean and fetal demise in antenatally diagnosed velamentous cord insertion, specifically excluding vasa previa [1]. However, the actual numbers were too small to make strong recommendations toward delivery management by this study alone.

Vasa Previa

By definition, “fetal vessels that run through the membrane and traverse the cervical os, under the presenting fetal part and unprotected by placenta or umbilical cord” [3]. The reported incidence of vasa previa is 1 in 2,500 pregnancies [3,4]. Antepartum concern for vasa previa should be elevated with an ultrasonographic finding of velamentous cord insertion, low-lying placenta or placenta previa (even if it resolves in the third trimester), or known succenturiate lobe [3,4]. Other risk factors include IVF and multiple gestation. Given its rarity, a risk-factor-based approach for screening is currently recommended. In a systematic review and meta-analysis by Pavalagantharajah et al., they found a low-lying placenta to be the highest associated risk at 61.5%, followed by velamentous cord at 52.2%, bilobed or succenturiate lobed placenta at 33.3% IVF at 26.4%, and multiple gestation at 8.9%, based on an overall incidence of 0.46 cases per 1,000 [5]. Importantly, the rate of perinatal morbidity and mortality has decreased due to increased antepartum detection, with most literature citing survival rates around 44% (undetected) to 97% (detected) [3,4]. Such a dramatic increase in detection has been a direct result of recommendations to evaluate the placenta and cord insertion at the time of second-trimester ultrasound [3,4].

Diagnosis/Recognition

Ultrasonography is essential for antepartum management for both velamentous cord insertion and vasa previa (Figure 89.1).

Early recognition is critical to improved outcomes for detection of growth restriction and for delivery recommendations. Ultrasonographically, vasa previa looks like a “linear echolucent” structure overlying the cervix on grayscale (Figure 89.2) [3]. Confirmation requires color Doppler that will demonstrate flow through the vessels, and pulsed Doppler will detect fetal umbilical arterial or venous waveforms (Figures 89.3, 89.4, and 89.5) [3]. When this is seen, it is important for the sonographer to differentiate a funic presentation [3]. In funic presentation unlike vasa previa, the vessels will move with patient repositioning. A majority of vasa previa cases are found during evaluation for low-lying placenta with the use of transvaginal ultrasound and “permissible cervical length screening” by American College of Obstetricians and Gynecologists, the question of a more universal screening approach for vasa previa could be considered.

As velamentous umbilical cord insertion can be associated with FGR and SGA, current recommendations are for growth ultrasound every 4 weeks beginning at 28–32 weeks [6]. If FGR develops, then evaluate for fetal Doppler flow, nonstress test, and amniotic fluid index twice weekly [6].

As always, any acute presentation with vaginal bleeding should include fetal monitoring, and if fetal monitoring is reassuring and the maternal status is stable, an ultrasound performed to rule out abnormal placentation (i.e. placenta previa and/or vasa previa).

Management/Delivery

The Society for Maternal-Fetal Medicine recommends delivery for vasa previa between 34 and 37 weeks (Grade IB evidence) and emergently for known diagnosis and any presentation of vaginal bleeding [4]. A recent systematic review presented a theoretical decision tree analysis noting highest quality of life years with delivery between 34 and 35 weeks’ gestation [7]. This review suggested that the decrease in complications before 36 weeks and the increase after 37 weeks would lean toward best timing of delivery in the late preterm in otherwise



Figure 89.2 Grayscale transvaginal ultrasound probe: fetal vessels crossing the internal cervical os (indicated by white arrow). Courtesy of Rebecca Pschirrer, MD, Obstetrics and Gynecology, Director of Prenatal Diagnosis Program, Maternal Fetal Medicine Department, Dartmouth Health, Lebanon, NH, Associate Professor of Obstetrics and Gynecology, Geisel School of Medicine, Dartmouth

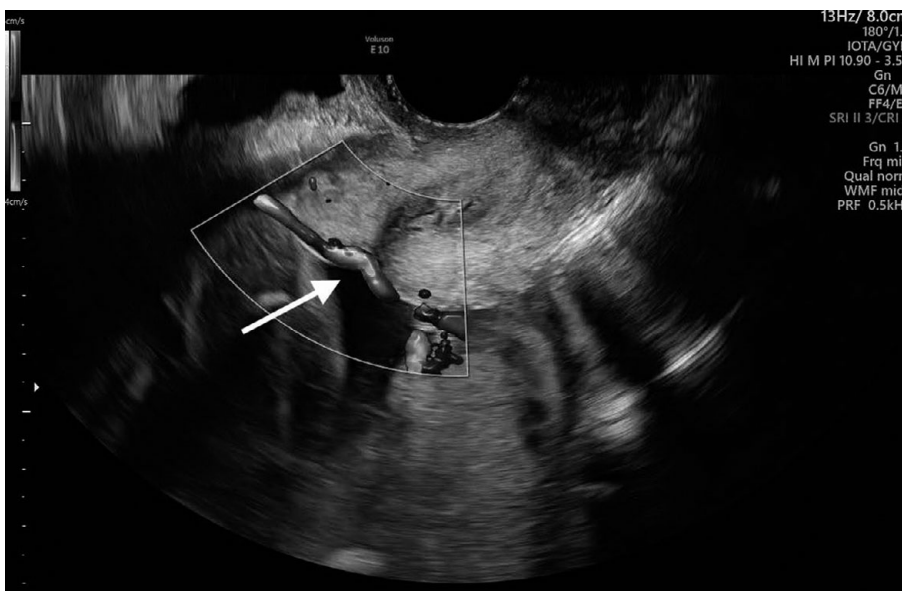


Figure 89.3 Color Doppler flow transvaginal ultrasound probe: fetal blood flow across the internal cervical os consistent with vasa previa (indicated by white arrow). Courtesy of Rebecca Pschirrer, MD, Obstetrics and Gynecology, Director of Prenatal Diagnosis Program, Maternal Fetal Medicine Department, Dartmouth Health, Lebanon, NH, Associate Professor of Obstetrics and Gynecology, Geisel School of Medicine, Dartmouth (A black and white version of this figure will appear in some formats. For the color version, please refer to the plate section.)

uncomplicated pregnancies with only vasa previa as prenatal diagnosis [7].

In 2015, Vintzileos et al. published in the *American Journal of Obstetrics and Gynecology* a management diagram for antepartum surveillance in known vasa previa patients. They proposed using cervical length by transvaginal ultrasound (every 1–2 weeks) as a screening tool for risk of preterm, premature rupture of membranes as a way to determine need for hospitalization, antepartum steroids, and delivery timing over “opinion-based recommendations of hospitalizing and delivery timing at a predetermined gestational age” [6]. The recommendations from this article are [6]:

For a cervical length of ≥ 25 mm, consider delivery at 35–36 weeks.

For a cervical length of < 25 mm, consider hospitalization and steroids (if viable).

For a cervical length of < 10 – 15 mm, consider hospitalization, ± 1 steroids, and delivery (if viable)

Currently, there is no consensus on antepartum in hospital management, with some offering patients hospitalization around 30–32 weeks for antepartum corticosteroids and proximity to an operating room for emergent cesarean, given approximately 10% will have spontaneous rupture before the onset of labor [7]. There are limited data to evaluate cost effectiveness of this strategy.

Mode of delivery for velamentous umbilical cord insertion without vasa previa would be vaginal delivery, unless other indication for CD. Continuous fetal monitoring during labor

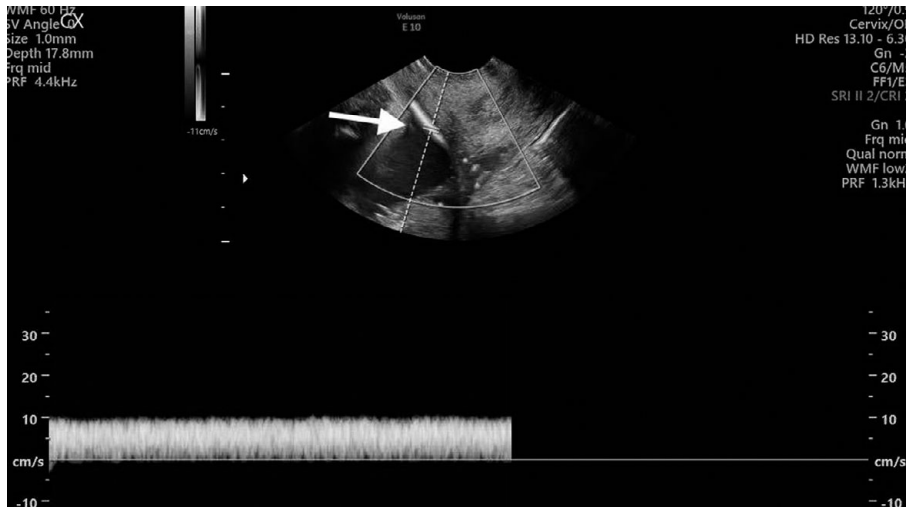


Figure 89.4 Color Doppler flow transvaginal ultrasound probe: fetal blood flow across the internal cervical os consistent with vasa previa, and waveform (indicated by white arrow). Courtesy of Rebecca Pschirrer, MD, Obstetrics and Gynecology, Director of Prenatal Diagnosis Program, Maternal Fetal Medicine Department, Dartmouth Health, Lebanon, NH, Associate Professor of Obstetrics and Gynecology, Geisel School of Medicine, Dartmouth (A black and white version of this figure will appear in some formats. For the color version, please refer to the plate section.)



Figure 89.5 Color Doppler flow transvaginal ultrasound probe: fetal blood flow across the internal cervical os consistent with vasa previa (indicated by black arrow). Courtesy of Rebecca Pschirrer, MD, Obstetrics and Gynecology, Director of Prenatal Diagnosis Program, Maternal Fetal Medicine Department, Dartmouth Health, Lebanon, NH, Associate Professor of Obstetrics and Gynecology, Geisel School of Medicine, Dartmouth (A black and white version of this figure will appear in some formats. For the color version, please refer to the plate section.)

would be highly recommended due to concern of fetal hemorrhage with rupture of membranes. For known vasa previa, delivery is by cesarean and should be at an institution with immediate access to neonatal resuscitation and blood transfusion if needed [3,6,7]. With fetal blood volumes being 80–100 mL/kg, even the smallest amount of fetal hemorrhage can be life threatening [3].

In Conclusion

Although velamentous umbilical cord insertion and vasa previa are exceedingly rare, antepartum diagnosis decreases morbidity and mortality for neonates. Management regarding antepartum hospitalization is varied and based on opinion with no strong evidence to guide obstetricians and their patients. Therefore, patient-centered care with informed guidance and consent should be individualized based on several factors: including but not exclusive to patient social situation, proximity to hospital, especially given increased areas of

obstetric deserts, and overall emotional well-being of patient given the high morbidity and mortality of vasa previa.

Key Teaching Points

- Velamentous umbilical cord insertion and vasa previa are rare findings in pregnancy. However, without prenatal diagnosis, they carry high rates of morbidity and mortality.
- Screening ultrasound for vasa previa is a risk factor–based approach. These factors include increased incidence with IVF/multiple gestation, velamentous cord insertion, low-lying placenta or placenta previa (even if it resolves in the third trimester), or known succenturiate lobe.
- Ultrasound is a diagnostic tool and is improved when transabdominal and transvaginal are combined with Doppler flow.
- There is an increased risk for FGR, SGA, preterm birth, and increased NICU admissions.
- Most recommend delivery by cesarean for vasa previa between 34 and 37 weeks.

References

- 1 O'Quinn C, Cooper S, Tang S, et al. Antenatal Diagnosis of Marginal and Velamentous Placental Cord Insertion and Pregnancy Outcomes. *Obstet Gynecol.* 2020;135(4):953–959.
- 2 Sinkin JA, Craig WY, Jones M, et al. Perinatal Outcomes Associated with Isolated Velamentous Cord Insertion in Singleton and Twin Pregnancies. *J Ultrasound Med.* 2018;37(2):471–478.
- 3 Oyelese Y, Smulian J. Placenta Previa, Placenta Accrete and Vasa Previa. *Obstet Gynecol.* 2006;107(4):927–941.
- 4 Society for Maternal-Fetal Medicine; Gyamfi-Bannerman C. Society for Maternal Fetal Medicine Consult Series #44: Management of Bleeding in the Late Preterm. *Am J Obstet Gynecol.* 2017;44:82–88.
- 5 Pavalagantharajah S, Villani L, D'Souza R. Vasa Previa and Associated Risk Factors: A Systematic Review and Meta-analysis. *Am J Obstet Gynecol MFM.* 2020;2(3):100117.
- 6 Vintzileos A, Ananth C, Smulin J. Using Ultrasound in the Clinical Management of Placental Implantation Abnormalities. *Am J Obstet Gynecol.* 2015;231(4 Suppl.):S70–S77.
- 7 Mitchell S, Ngo G, Maurel K, et al. Timing of Birth and Adverse Pregnancy Outcomes in Cases of Prenatally Diagnosed Vasa Previa: A Systematic Review and Meta-analysis. *Am J Obstet Gynecol.* 2022;227(2):173–181e24.

A 40-Year-Old at 24 Weeks' Gestation Presents with Food and Housing Insecurity

Stacey L. Holman

History of Present Illness

A 40-year-old gravida 3 para 2 patient presents at 24 weeks' gestation for routine prenatal care visit. Her past medical history is remarkable for depression, and she has been on medication in the past. She is not on medications currently. Her prior pregnancies were notable for limited prenatal care but ultimately with uncomplicated vaginal deliveries at term. This pregnancy is significant for advanced maternal age. Today the patient notes that she is having worsening symptoms of depression, including decrease appetite, fatigue, and difficulty sleeping.

A social determinants of health (SDOH) screen is completed during her triage and the nurse notes that the patient has unstable housing and food insecurity. When asked for more information, the patient notes that she lives with her partner, and they have been struggling to find stable housing over the past few months. The current apartment that the family lives in has maintenance issues; the landlord has been dismissive of those concerns and is now threatening eviction if they continue to complain. Both the patient and her partner have part-time jobs and are having difficulty with the cost of alternative housing options. The patient notes that she is worried about being able to afford healthy food for her family and formula for the new baby. The patient states that obtaining childcare to attend prenatal visits can also be a challenge in her current environment.

Physical Examination

General appearance: Well-appearing gravid female in no acute distress.

Vital signs:

Pulse: 90 beats per minute

Blood pressure: 125/70 mmHg

Body mass index (BMI): 27.2 kg/m² (no weight gain since prior visit)

Abdomen: Fundal height: 22 cm

Fetal heart tones: 140 beats per minute

How Would You Manage This Patient?

This patient should complete a comprehensive screening for SDOH, and responses to those questions should be integrated into the electronic medical record. Many screening tools exist and can be modified for different medical records and organizations. Entities such as the American College of Obstetricians and Gynecologists (ACOG), Association of Women's Health, Obstetric and Neonatal Nurses, Centers for Medicare and

Medicaid Services, and state perinatal collaboratives provide these tools as a reference [1]. They should be utilized for all patients who are enrolled in prenatal care. A comprehensive screening may review the following areas: food access, housing stability, childcare, financial status, transportation, violence, health literacy, and others. A mental health screen is a critical part of the SDOH evaluation, and a validated tool such as the patient Health Questionnaire-9 (PHQ-9) or Edinburgh Postpartum Depression Scale can be utilized for this purpose. The recommendation of ACOG is that screening for perinatal depression and anxiety occur at the initial prenatal visit, later in pregnancy, and at postpartum visits [2].

When a patient screens positive, it is important for the health care team to conduct a detailed assessment of the areas in which the patient needs support. For example, this patient is noted to have both housing and food insecurity. An assessment can help to identify the specific stressors that she is facing, such as access to resources, safety in the home, and potential legal implications as a tenant.

Once areas of concern are identified, it is important for health care professionals to collaborate with social workers, community organizations, and assistance programs to provide resources. Patient needs can be mapped with federal, state, and local resources. This might include rental assistance, legal aid, financial counseling, and connections to affordable food sources, such as Women, Infants, and Children.

Examples of federal resources include:

1. Women, Infants, and Children benefits:
www.fns.usda.gov/wic/who-gets-wic-and-how-apply.
2. Substance Abuse and Mental Health Services Administration (SAMHSA): Agency within the US Department of Health and Human Services that leads public health efforts to advance the behavioral health of the nation. The mission of SAMHSA is to reduce the impact of substance abuse and mental illness on America's communities:
www.samhsa.gov/find-help/national-helpline.
3. National Diaper Banks:
<https://nationaldiaperbanknetwork.org/get-help-now/>.
4. National Domestic Violence Hotline:
Available 24/7 at 1-800-799-SAFE (7233).

Organizations providing prenatal care optimally develop partnerships with delivery hospitals to streamline referrals of patients who are in need of services.

For this patient who lives in a low-income environment, additional barriers to care should also be assessed. This may

include the need for interpreter services and ability to obtain transportation to health care. Many hospital systems also provide liaisons or navigators for pregnant patients, and these collaborations should be explored if available.

Finally, it is important to acknowledge these social and structural barriers with the patient and provide emotional support. It is critical for this patient to also be screened for perinatal mood disorders and/or need for mental health services. There is evidence to support that increased SDOH needs can increase likelihood of worsening self-reported health outcomes, especially as it relates to the state of mental health of a patient [3]. The physician plays a critical role in coordination of services needed to improve pregnancy outcomes. It is important to establish ongoing communication and regular follow-ups throughout the antepartum period.

Over the course of this pregnancy, the provider team should explore the patient's family planning goals. Non-directive counseling and education regarding pregnancy spacing and contraceptive options are best delivered antenatally rather than being introduced in the postpartum period.

Social Determinants of Health

Social determinants of health are the nonmedical factors that influence health outcomes. They are the conditions in which people are born, grow, work, live, and age, and the wider set of forces and systems shaping the conditions of daily life. These forces and systems include economic policies and systems, development agendas, social norms, social policies, racism, climate change, and political systems. The Centers for Disease Control and Prevention (CDC) has adopted this SDOH definition from the World Health Organization (WHO) [4].

There are five domains of the SDOH as set forth by the guidelines for Healthy People 2030 and the US Department of Health and Human Services. These domains include economic stability, education, health care access and quality, community context, and the built environment.

neighborhood and built environment, and social and community context (Figure 90.1) [5].

Social determinants of health have been shown to affect many conditions that are treated by obstetrician-gynecologists (Ob/Gyns), including but not limited to infertility, cervical cancer, unintended pregnancy, preterm birth, perinatal depression, and maternal mortality [6]. Race, gender, socioeconomic status, and discrimination also have implications to SDOH and further impact accessibility of health care for women. There are three major areas of prenatal care delivery that are impacted by SDOH: delays in care initiation, late arrivals to clinic appointments, and delays in the provision of adequate care for patients. This creates disparities in care and impacts maternal outcomes [7].

Health care providers play an important role in the referral for and collaboration of care services that can provide support and structure for patients who screen positive during pregnancy. In addition, providers can advocate for policies and programs that address these insecurities and its impact on pregnancy outcomes. Opportunities for advocacy may include engaging with local organizations and municipalities to promote awareness of the impacts of SDOH on maternal morbidity and mortality.

It is also important to acknowledge the bias that providers may have in providing care to patients with additional SDOH risks. Interactions between health care professionals and patients are complex and implicit bias can influence the relationship between the two; this may impact diagnosis, treatment, patient counseling, and clinical decision-making. Patient characteristics that may trigger bias include race, ethnicity, sexual identity, and SDOH risks.

Physicians must recognize and address implicit bias to reduce disparities and provide comprehensive care for individuals such as the patient in this scenario. This also includes the development of a diverse and inclusive culture in the environment where care is provided. This includes training for all health care team members, including office and hospital staff [8,9].



Figure 90.1 SDOH, adapted from Healthy People 2030 [5]

In conclusion, SDOH are a critical aspect of the provision of prenatal care. However, in a busy practice with limited support or resources available, it is often overlooked. Providers should seek knowledge about the resources that are applicable to patients with a positive screen. They should look to birthing hospitals as a means of obtaining help for patients. Many states also partner within quality collaboratives to find resources for patients within the community. Encouraging open dialogue with patients is an opportunity to develop trust between patient and provider, to acknowledge barriers to care, and to create a supportive environment for developing pregnancies. This will ultimately lead to improved maternal outcomes.

Key Teaching Points

- Every patient enrolled in prenatal care should be screened for SDOH and mental health disorders.
- A patient-centered approach to care includes: acknowledgment of barriers, coordination of resources in accordance with patient needs, and provision of an environment that focuses on cultural awareness and mutual respect.
- Health care providers must recognize that structural racism, discrimination, and bias also impact SDOH as well as the care that we provide to patients with these risks.

References

- 1 ACOG Committee Opinion No. 729 Summary: Importance of Social Determinants of Health and Cultural Awareness in the Delivery of Reproductive Health Care. *Obstet Gynecol.* 2018;131(1):198–199.
- 2 ACOG Clinical Practice Guideline Number 4: Screening and Diagnosis of Mental Health Conditions during Pregnancy and Postpartum. *Obstet Gynecol.* 2023;141(6):1232–1261.
- 3 Jones KG, Roth SE, Vartanian KB. Health and Health Care Use Strongly Associated with Cumulative Burden of Social Determinants of Health. *Popul Health Manag.* 2022;25(2):218–226.
- 4 Centers for Disease Control and Prevention. Social Determinants of Health (SDOH). www.cdc.gov/about/priorities/why-is-addressing-sdoh-important.html (accessed November 7, 2024).
- 5 US Department of Health and Human Services, Office of Disease Prevention and Health Promotion. Healthy People 2030. <https://health.gov/healthypeople/objectives-and-data/social-determinants-health> (accessed October 20, 2024).
- 6 Society for Maternal-Fetal Medicine; Greenberg MB, Gandhi M, et al. Society for Maternal-Fetal Medicine Consult Series #62: Best Practices in Equitable Care Delivery – Addressing Systemic Racism and Other Social Determinants of Health as Causes of Obstetrical Disparities. *Am J Obstet Gynecol.* 2022;227(2):B44–B59.
- 7 Wang E, Glazer KB, Howell EA, et al. Social Determinants of Pregnancy-Related Mortality and Morbidity in the United States: A Systematic Review. *Obstet Gynecol.* 2020;135(4):896–915.
- 8 Fitzgerald C, Hurst S. Implicit Bias in Healthcare Professionals: A Systematic Review. *BMC Med Ethics.* 2017;18:19.
- 9 Arvizo C, Garrison E. Diversity and Inclusion: The Role of Unconscious Bias on Patient Care, Health Outcomes and the Workforce in Obstetrics and Gynaecology. *Curr Opin Obstet Gynecol.* 2019;31(5):356–362.

A 40-Year-Old at 24 Weeks' Gestation Presents with Food and Housing Insecurity

Stacey L. Holman

History of Present Illness

A 40-year-old gravida 3 para 2 patient presents at 24 weeks' gestation for routine prenatal care visit. Her past medical history is remarkable for depression, and she has been on medication in the past. She is not on medications currently. Her prior pregnancies were notable for limited prenatal care but ultimately with uncomplicated vaginal deliveries at term. This pregnancy is significant for advanced maternal age. Today the patient notes that she is having worsening symptoms of depression, including decrease appetite, fatigue, and difficulty sleeping.

A social determinants of health (SDOH) screen is completed during her triage and the nurse notes that the patient has unstable housing and food insecurity. When asked for more information, the patient notes that she lives with her partner, and they have been struggling to find stable housing over the past few months. The current apartment that the family lives in has maintenance issues; the landlord has been dismissive of those concerns and is now threatening eviction if they continue to complain. Both the patient and her partner have part-time jobs and are having difficulty with the cost of alternative housing options. The patient notes that she is worried about being able to afford healthy food for her family and formula for the new baby. The patient states that obtaining childcare to attend prenatal visits can also be a challenge in her current environment.

Physical Examination

General appearance: Well-appearing gravid female in no acute distress.

Vital signs:

Pulse: 90 beats per minute

Blood pressure: 125/70 mmHg

Body mass index (BMI): 27.2 kg/m² (no weight gain since prior visit)

Abdomen: Fundal height: 22 cm

Fetal heart tones: 140 beats per minute

How Would You Manage This Patient?

This patient should complete a comprehensive screening for SDOH, and responses to those questions should be integrated into the electronic medical record. Many screening tools exist and can be modified for different medical records and organizations. Entities such as the American College of Obstetricians and Gynecologists (ACOG), Association of Women's Health, Obstetric and Neonatal Nurses, Centers for Medicare and

Medicaid Services, and state perinatal collaboratives provide these tools as a reference [1]. They should be utilized for all patients who are enrolled in prenatal care. A comprehensive screening may review the following areas: food access, housing stability, childcare, financial status, transportation, violence, health literacy, and others. A mental health screen is a critical part of the SDOH evaluation, and a validated tool such as the patient Health Questionnaire-9 (PHQ-9) or Edinburgh Postpartum Depression Scale can be utilized for this purpose. The recommendation of ACOG is that screening for perinatal depression and anxiety occur at the initial prenatal visit, later in pregnancy, and at postpartum visits [2].

When a patient screens positive, it is important for the health care team to conduct a detailed assessment of the areas in which the patient needs support. For example, this patient is noted to have both housing and food insecurity. An assessment can help to identify the specific stressors that she is facing, such as access to resources, safety in the home, and potential legal implications as a tenant.

Once areas of concern are identified, it is important for health care professionals to collaborate with social workers, community organizations, and assistance programs to provide resources. Patient needs can be mapped with federal, state, and local resources. This might include rental assistance, legal aid, financial counseling, and connections to affordable food sources, such as Women, Infants, and Children.

Examples of federal resources include:

1. Women, Infants, and Children benefits:
www.fns.usda.gov/wic/who-gets-wic-and-how-apply.
2. Substance Abuse and Mental Health Services Administration (SAMHSA): Agency within the US Department of Health and Human Services that leads public health efforts to advance the behavioral health of the nation. The mission of SAMHSA is to reduce the impact of substance abuse and mental illness on America's communities:
www.samhsa.gov/find-help/national-helpline.
3. National Diaper Banks:
<https://nationaldiaperbanknetwork.org/get-help-now/>.
4. National Domestic Violence Hotline:
Available 24/7 at 1-800-799-SAFE (7233).

Organizations providing prenatal care optimally develop partnerships with delivery hospitals to streamline referrals of patients who are in need of services.

For this patient who lives in a low-income environment, additional barriers to care should also be assessed. This may

include the need for interpreter services and ability to obtain transportation to health care. Many hospital systems also provide liaisons or navigators for pregnant patients, and these collaborations should be explored if available.

Finally, it is important to acknowledge these social and structural barriers with the patient and provide emotional support. It is critical for this patient to also be screened for perinatal mood disorders and/or need for mental health services. There is evidence to support that increased SDOH needs can increase likelihood of worsening self-reported health outcomes, especially as it relates to the state of mental health of a patient [3]. The physician plays a critical role in coordination of services needed to improve pregnancy outcomes. It is important to establish ongoing communication and regular follow-ups throughout the antepartum period.

Over the course of this pregnancy, the provider team should explore the patient's family planning goals. Non-directive counseling and education regarding pregnancy spacing and contraceptive options are best delivered antenatally rather than being introduced in the postpartum period.

Social Determinants of Health

Social determinants of health are the nonmedical factors that influence health outcomes. They are the conditions in which people are born, grow, work, live, and age, and the wider set of forces and systems shaping the conditions of daily life. These forces and systems include economic policies and systems, development agendas, social norms, social policies, racism, climate change, and political systems. The Centers for Disease Control and Prevention (CDC) has adopted this SDOH definition from the World Health Organization (WHO) [4].

There are five domains of the SDOH as set forth by the guidelines for Healthy People 2030 and the US Department of Health and Human Services. These domains include economic stability, education, health care access and quality, community context, and the built environment.

neighborhood and built environment, and social and community context (Figure 90.1) [5].

Social determinants of health have been shown to affect many conditions that are treated by obstetrician-gynecologists (Ob/Gyns), including but not limited to infertility, cervical cancer, unintended pregnancy, preterm birth, perinatal depression, and maternal mortality [6]. Race, gender, socioeconomic status, and discrimination also have implications to SDOH and further impact accessibility of health care for women. There are three major areas of prenatal care delivery that are impacted by SDOH: delays in care initiation, late arrivals to clinic appointments, and delays in the provision of adequate care for patients. This creates disparities in care and impacts maternal outcomes [7].

Health care providers play an important role in the referral for and collaboration of care services that can provide support and structure for patients who screen positive during pregnancy. In addition, providers can advocate for policies and programs that address these insecurities and its impact on pregnancy outcomes. Opportunities for advocacy may include engaging with local organizations and municipalities to promote awareness of the impacts of SDOH on maternal morbidity and mortality.

It is also important to acknowledge the bias that providers may have in providing care to patients with additional SDOH risks. Interactions between health care professionals and patients are complex and implicit bias can influence the relationship between the two; this may impact diagnosis, treatment, patient counseling, and clinical decision-making. Patient characteristics that may trigger bias include race, ethnicity, sexual identity, and SDOH risks.

Physicians must recognize and address implicit bias to reduce disparities and provide comprehensive care for individuals such as the patient in this scenario. This also includes the development of a diverse and inclusive culture in the environment where care is provided. This includes training for all health care team members, including office and hospital staff [8,9].



Figure 90.1 SDOH, adapted from Healthy People 2030 [5]

In conclusion, SDOH are a critical aspect of the provision of prenatal care. However, in a busy practice with limited support or resources available, it is often overlooked. Providers should seek knowledge about the resources that are applicable to patients with a positive screen. They should look to birthing hospitals as a means of obtaining help for patients. Many states also partner within quality collaboratives to find resources for patients within the community. Encouraging open dialogue with patients is an opportunity to develop trust between patient and provider, to acknowledge barriers to care, and to create a supportive environment for developing pregnancies. This will ultimately lead to improved maternal outcomes.

Key Teaching Points

- Every patient enrolled in prenatal care should be screened for SDOH and mental health disorders.
- A patient-centered approach to care includes: acknowledgment of barriers, coordination of resources in accordance with patient needs, and provision of an environment that focuses on cultural awareness and mutual respect.
- Health care providers must recognize that structural racism, discrimination, and bias also impact SDOH as well as the care that we provide to patients with these risks.

References

- 1 ACOG Committee Opinion No. 729 Summary: Importance of Social Determinants of Health and Cultural Awareness in the Delivery of Reproductive Health Care. *Obstet Gynecol.* 2018;131(1):198–199.
- 2 ACOG Clinical Practice Guideline Number 4: Screening and Diagnosis of Mental Health Conditions during Pregnancy and Postpartum. *Obstet Gynecol.* 2023;141(6):1232–1261.
- 3 Jones KG, Roth SE, Vartanian KB. Health and Health Care Use Strongly Associated with Cumulative Burden of Social Determinants of Health. *Popul Health Manag.* 2022;25(2):218–226.
- 4 Centers for Disease Control and Prevention. Social Determinants of Health (SDOH). www.cdc.gov/about/priorities/why-is-addressing-sdoh-important.html (accessed November 7, 2024).
- 5 US Department of Health and Human Services, Office of Disease Prevention and Health Promotion. Healthy People 2030. <https://health.gov/healthypeople/objectives-and-data/social-determinants-health> (accessed October 20, 2024).
- 6 Society for Maternal-Fetal Medicine; Greenberg MB, Gandhi M, et al. Society for Maternal-Fetal Medicine Consult Series #62: Best Practices in Equitable Care Delivery – Addressing Systemic Racism and Other Social Determinants of Health as Causes of Obstetrical Disparities. *Am J Obstet Gynecol.* 2022;227(2):B44–B59.
- 7 Wang E, Glazer KB, Howell EA, et al. Social Determinants of Pregnancy-Related Mortality and Morbidity in the United States: A Systematic Review. *Obstet Gynecol.* 2020;135(4):896–915.
- 8 Fitzgerald C, Hurst S. Implicit Bias in Healthcare Professionals: A Systematic Review. *BMC Med Ethics.* 2017;18:19.
- 9 Arvizo C, Garrison E. Diversity and Inclusion: The Role of Unconscious Bias on Patient Care, Health Outcomes and the Workforce in Obstetrics and Gynaecology. *Curr Opin Obstet Gynecol.* 2019;31(5):356–362.

A 30-Year-Old at 25 Weeks' Gestation Presents after a Fall with Back Pain and Bruising

Kamilah Dixon

History of Present Illness

A 30-year-old gravida 2 para 1 patient presents to hospital triage at 25 weeks' gestation complaining of a fall with back pain. She is accompanied by her boyfriend and during the interview, she is silent as her boyfriend says that she tripped over their child's toy earlier that day and landed on her buttocks. He mentions that she has been clumsy lately and stated that she had to come to triage a month earlier due to a fall as well. When you question her directly, she states that she has had back pain since the fall. She reports that the baby is moving well and denies vaginal bleeding, contractions, or leakage of fluid. She asks if her baby will be okay.

Physical Examination

General appearance: Well-developed, slightly disheveled

Vital signs:

Temperature: 36.8°C

Pulse: 94 beats per minute

Blood pressure: 112/74 mmHg

Oxygen saturation: 99% on room air

Height: 168 cm

Weight: 65 kg

BMI: 23.2 kg/m²

Abdomen: Gravid, normal active bowel sounds, non-tender to palpation

Extremities: Multiple contusions on upper extremities and on lower extremities

Back: Contusion noted on upper back, non-tender to palpation at lower back. No costovertebral angle tenderness

Pelvic: Normal external genitalia, no lesions. Sterile speculum exam, normal vagina, no discharge, cervix closed; cervix is closed and long

Fetal assessment: Fetal heart rate monitoring: Baseline: 150, moderate variability, +accelerations, no decelerations.

Tocometry: No contractions

Laboratory studies:

Hgb: 12.1 g/dL

Hct: 36.3%

PT: 9.5

PTT: 22.9

Fibrinogen: 450 mg/L

How Would You Manage This Patient?

After initial assessment, staff asked the partner of the patient to leave the room during the exam as part of their standard intake process for the patients. The patient was then asked again about the events. She stated that she had an argument with her partner earlier that day at which time he pushed her, which resulted in her landing on her buttocks on the floor. When asked about the bruises on her arms and legs, she stated that he has been punching and hitting her more often throughout this pregnancy and has been threatening her more. She divulged that she does not feel safe at home or in her current relationship as she shares an apartment with her boyfriend. She reported that they do not have any weapons in the house. She has hidden the extent of the abuse from her family as she does not want them to be concerned. She has thought about leaving him and, if need be, she could go to her mother's house. The patient was offered a consult with the social worker once the medical assessment was completed. The patient agreed to meet with the social worker once reassured that the contents of the conversation would not be revealed to her partner. She was examined with the aforementioned findings and the fetal assessment was found to be reassuring on the nonstress test. The fetus was monitored for a total of 4 hours, during which time no contractions were noted. Her pain responded well to Tylenol. The hospital social worker met with the patient and informed her of local and national resources. Laboratory and fetal assessment results were shared with the patient and her partner, and she felt reassured. The patient decided to go stay with her mother at discharge. She was given outpatient follow-up in a week with her obstetrician and given strict return precautions if she developed contractions, vaginal bleeding, or leakage of fluid.

Intimate Partner Violence

Intimate partner violence (IPV) is defined by the Centers for Disease Control (CDC) as "abuse or aggression that occurs in a romantic relationship," which can include physical and sexual violence, stalking, and psychological aggression [1]. The World Health Organization (WHO) goes further to state that IPV "refers to behavior by an intimate partner or ex-partner that causes physical, sexual or psychological harm, including

physical aggression, sexual coercion, psychological abuse and controlling behaviours” [2]. Intimate partner violence is prevalent and has affected an estimated 1 in 3 women in their lifetime worldwide [2]. In a WHO multicountry study, it was reported that between 1 and 28% of women reported being physically abused during pregnancy [3]. The range in these reports reflect that often IPV goes unreported. Additionally, IPV has been associated with a major cause of maternal mortality. In 2011, it was noted that 54.3% of pregnancy-associated suicides and 45.3% of pregnancy-associated homicides were associated with IPV [4]. Beyond the effects on mortality, pregnant patients with history of IPV have increased risks of missing prenatal appointments and late entry to prenatal care [4]. They also have increased risks of developing post-traumatic stress disorder (PTSD), depression, and substance use [4]. In addition to the risks to the pregnant person, there are risks to the pregnancy when pregnant people experience IPV. Pregnant people who experience IPV have increased risk of preterm labor and low birth weight [4]. Both of these outcomes are connected to increased risks of infant mortality. This further demonstrates the importance of screening for IPV during pregnancy to address IPV and provide resources and support to birthing people.

Screening

While there is not sufficient evidence to support the universal screening of all patients for IPV, US Preventive Services Taskforce (USPSTF) recommends the screening of all reproductive-age women, and American College of Obstetricians and Gynecologists (ACOG) advocates for the screening of all pregnant people [5,6]. Pregnant people should be screened at the beginning of pregnancy, at each trimester, and in the postpartum period [6]. Complete screening when the patient is alone and alert the patient that these questions are asked of all patients, normalizing the screen so that the patient does not experience additional stigma or shame. Reassuring the patient that their responses are confidential is essential to promoting a trusting environment [5]. Beyond screening recommended by ACOG and USPSTF, health care providers should familiarize themselves with signs of IPV. Signs of IPV include pain not explained by an underlying condition, traumatic brain injury, injuries to neck, abdomen, breasts, uterus, and forearms, multiple visits to triage for injury during pregnancy, and extreme anxiety and aversion of pelvic exams [6,7,8]. Additionally, the injuries reported may not be congruent with the manner of how they reportedly occurred [6]. Suspicion for IPV should be raised with a partner who is threatening or refuses to leave the patient during the interview [6].

Validated Screening Tools

There are many validated screening tools used to detect IPV. The USPSTF supports the use of HARK (humiliated, afraid, rape, kick), HITS (hit, insult, threatened, scream), E-HITS (extended-HITS), PVS (partner violence screen), and WAST (woman abuse screening tool) and has stated they accurately detect IPV [6]. Examples of screening tool questions are in Table 91.1.

Table 91.1 Examples of validated screening tools for IPV

Tool	Questions
HARK	Within the past year: Have you been humiliated or emotionally abused in other ways by your partner or ex-partner? Have you been afraid of your partner or ex-partner? Have you been raped or forced to have any kind of sexual activity by your partner or ex-partner? Have you been kicked , hit, slapped, or otherwise physically hurt by your partner or ex-partner?
HITS	How often does your partner hit you? How often does your partner insult you? How often does your partner threaten you? How often does your partner scream at you?
PVS (partner violence screen)	Have you been hit, kicked, punched, or otherwise hurt by someone in the past year? Do you feel safe in your current relationship? Is there a partner from a previous relationship who is making you feel unsafe now?

Table 91.2 Resources for IPV

National Sexual Assault Hotline	1-800-656-4673
RAINN (Rape, Abuse and Incest National Network)	www.rainn.org/
National Domestic Violence Hotline	1-800-799-SAFE; www.thehotline.org/
Futures without Violence	www.futureswithoutviolence.org/
Love Is Respect – Healthy Relationships	www.loveisrespect.org/
National Coalition against Domestic Violence	https://ncadv.org/

The provider is encouraged to use the tool that they are most comfortable with, understanding that creating an open environment for the patient to share their experiences and supporting the patient with resources is of paramount importance. Once a patient reveals experiences with IPV, it is important to provide support with resources and addressing safety concerns. This can be facilitated in collaboration with a social worker connected to the clinic or hospital or by utilizing the various hotlines and websites in Table 91.2. It is important to remember the safety of the patient and to not force information that might be discovered by a partner who is committing violence against the patient. As such, many practices have this information available in bathrooms that can only be accessed by the patients. Ultimately, it is important to understand patient autonomy in that they may not be ready or able to leave an abusive relationship, but by providing resources and a safe environment, patients will know where to seek help in the future. Notably, in a meta-analysis, women reported that they wanted health care providers to be aware of complexity of the issue, address it in a nonjudgmental way, and not medicalize it [9].

Key Teaching Points

- Intimate partner violence is prevalent with upward of 28% of pregnant people experiencing IPV.

- All reproductive-age women should be screened for IPV and pregnant patients should be screened at the beginning of pregnancy, during each trimester, and during the postpartum period.
- When patients present for assessment of injury, it is always important to screen for IPV.
- There are many resources available to help patients who are experiencing IPV.

References

- 1 CDC. Fast Facts: Preventing Intimate Partner Violence. Intimate Partner Violence. www.cdc.gov/intimate-partner-violence/about/index.html?CDC_AAref_Val=https://www.cdc.gov/violenceprevention/intimatepartnerviolence/index.html (accessed November 12, 2024).
- 2 WHO. Violence against Women. www.who.int/news-room/fact-sheets/detail/violence-against-women (accessed June 7, 2023).
- 3 *Responding to Intimate Partner Violence and Sexual Violence against Women: WHO Clinical and Policy Guidelines*. Geneva: WHO, 2013. www.ncbi.nlm.nih.gov/books/NBK174254/ (accessed June 7, 2023).
- 4 Alhusen JL, Ray E, Sharps P, et al. Intimate Partner Violence during Pregnancy: Maternal and Neonatal Outcomes. *J Womens Health (Larchmt)*. 2015;24(1):100–106.
- 5 Intimate Partner Violence: Committee Opinion No. 518. American College of Obstetricians and Gynecologists. *Obstet Gynecol*. 2012;119:412–417.
- 6 *Screening for Intimate Partner Violence and Abuse of Elderly and Vulnerable Adults: US Preventive Services Task Force Recommendation Statement*. Rockville, MD: US Preventive Services Task Force, 2013.
- 7 Drexler KA, Quist-Nelson J, Weil AB. Intimate Partner Violence and Trauma-Informed Care in Pregnancy. *Am J Obstet Gynecol MFM*. 2022;4(2):100542.
- 8 Lutgendorf MA. Intimate Partner Violence and Women's Health. *Obstet Gynecol*. 2019;134(3):470–480.
- 9 Feder GS, Hutson M, Ramsay J, et al. Women Exposed to Intimate Partner Violence: Expectations and Experiences When They Encounter Health Care Professionals: A Meta-analysis of Qualitative Studies. *Arch Intern Med*. 2006;166(1):22–37.

CASE 92

A 25-Year-Old at 29 Weeks' Gestation Presents with Opioid Use Disorder and Nausea, Vomiting, and Abdominal Pain

Molly Zielenbach

History of Present Illness

A 25-year-old gravida 3 para 2 at an unknown gestational age presents to the obstetrical triage unit with 4 hours of nausea, vomiting, and diffuse cramping abdominal pain. She reports intranasal heroin use several times per day for 3 years and has been trying to stop since learning she was pregnant but has been unsuccessful. Last use was about 8 hours ago. She reports positive fetal movement and denies loss of fluid, vaginal bleeding, and urinary symptoms. She feels "feverish" with aching joints and muscles. Her last menstrual period is unknown. Her obstetric history is notable for two term vaginal deliveries. She reports smoking a half pack of cigarettes per day but denies use of other substances. Her medical and surgical history are unremarkable, and she has no known drug allergies.

Physical Examination

General: Restless, pacing, and yawning throughout interview

Vital signs:

Temperature: 37.1°C

Pulse: 112 beats per minute

Blood pressure: 118/78 mmHg

Respiratory rate: 18 breaths per minute

HEENT: Pupils moderately dilated, symmetric, and equally reactive. Clear nasal discharge

Abdomen: Gravid, non-distended, soft, diffusely tender to palpation, no rebound

Integumentary: Moderate flushing with beads of sweat on the brow. Visible piloerection

Neurologic: Alert and oriented $\times 3$, slight resting tremor of upper extremities, normal gait

Sterile vaginal exam: 1 cm dilated/20% effaced/−3 station

Fetal assessment: Fetal heart tracing: Baseline: 150 beats per minute, moderate variability, no accelerations, no decelerations. Tocometer: Irritable, irregular contractions every 2–5 minutes

Laboratory studies:

Complete blood count (CBC): WBC $11.0 \times 10^9/L$

Hgb: 11.2 g/dL

Plt: $175 \times 10^9/L$

ALT: 24 U/L

AST: 26 U/L

Blood type and screen: A positive, antibody negative

HIV and syphilis antibody screens: Non-reactive

Hepatitis serologies: Non-reactive

Chlamydia/gonorrhea nucleic acid amplification test : Negative

Urine drug screen: Presumptively positive for heroin, otherwise negative

Imaging:

Bedside ultrasound: Singleton intrauterine gestation, cephalic presentation, anterior placenta, maximum vertical pocket 3.7 cm

Biometry: Estimated fetal weight 1,380 g consistent with 29 0/7 weeks' gestation

How Would You Manage This Patient?

This patient presents with symptoms and signs of acute opioid withdrawal. Initial assessment evaluated for and excluded other possible etiologies, including preterm labor, placental abruption, infection, or acute gastrointestinal pathology. After obtaining her consent, urine drug testing was performed and confirmed her reported substance history. Severity of withdrawal was quantified using the Clinical Opiate Withdrawal Scale (COWS) and classified as severe [1]. After counseling on the benefits, risks, and alternatives of available management options, she agreed to proceed with pharmacologic management with buprenorphine. Antiemetics, loperamide, and nicotine replacement therapy were provided during buprenorphine induction. Continuous fetal monitoring was extended until reassuring fetal status was confirmed. Once her acute withdrawal was adequately treated, a comprehensive medical and psychosocial assessment was completed. She was screened for concurrent mental health disorders, viral hepatitis, and sexually transmitted infections (STIs), which returned negative. She expressed motivation for treatment of her opioid use disorder and readiness to change. Social work was consulted and facilitated linkage to a nearby outpatient substance use treatment program. The patient was discharged with a bridge prescription for buprenorphine to last until her scheduled treatment program intake, as well as an appointment for continued prenatal care with a provider familiar with the care of patients in treatment for opioid use disorders. She received teaching on prevention, recognition, and treatment of

opioid overdose and an intranasal naloxone kit prior to discharge.

Opioid Use Disorder in Pregnancy

Rates of opioid use disorder among pregnant and postpartum patients have increased in recent years, concurrent with the nationally recognized epidemic of opioid use. Substance use disorders are a major risk factor for maternal mortality, and opioid overdose is a leading cause of maternal mortality in several states [2]. National organizations including American College of Obstetricians and Gynecologists (ACOG), the American Society of Addiction Medicine (ASAM), and the Substance Abuse and Mental Health Services Administration (SAMHSA) strongly recommend universal screening for the presence of substance use disorder at entry to prenatal care, with additional screening and risk assessment throughout pregnancy as indicated [3,4,5]. Screening should be conducted using a validated tool, for example, the 4Ps or National Institute on Drug Abuse Quick Screen [4]. Urine drug testing is not an acceptable screening modality for substance use disorders [3]. Any positive screen should be promptly followed by brief intervention, for example, using motivational interviewing, and referral for treatment – these steps comprise the standardized approach known as screening, brief intervention, and referral to treatment (SBIRT) [4].

For patients presenting for obstetric care with current or prior substance use disorder, ASAM practice guidelines recommend a comprehensive assessment for the following components:

- acute intoxication or withdrawal
- biomedical conditions and complications
- emotional, behavioral, or cognitive conditions or complications
- readiness for change
- continued use or continued problem potential
- recovery and/or living environment [5]

If present, intoxication or withdrawal should be treated promptly and the remainder of the assessment deferred until the patient's acute condition is stabilized. Table 92.1 describes

the signs and symptoms of acute opioid intoxication and withdrawal.

In contrast to opioid intoxication, opioid withdrawal is not life threatening, but it is associated with obstetric complications including preterm labor, preterm birth, placental abruption, and intrauterine meconium passage [2]. Initial assessment should also exclude concurrent obstetric, medical, and mental health emergencies. Urine drug testing is useful for confirming the patient's history and informing management, as illicitly obtained opioids may be contaminated with other substances [6]. It is imperative to obtain informed consent for urine drug testing, which should include a discussion of the medical indications for testing and risks of refusal, the right of the patient to refuse testing, and the legal implications for mandated reporting to state agencies (which vary by state) [3]. Additional laboratory evaluation for patients presenting with opioid use disorder should include CBC and liver enzymes, viral hepatitis serologies, and testing for STIs [5].

Pharmacotherapy with an opioid agonist is the preferred treatment for opioid use disorder in pregnancy [2,4,5]. Medically assisted withdrawal, colloquially known as detoxification or “detox,” is not recommended due to high relapse rates (averaging 48%), lack of evidence supporting a reduction in risk of neonatal abstinence syndrome (NAS), potential increased risk of opioid overdose if relapse occurs, and potential detrimental impact of acute withdrawal on the biochemical status of the fetus. If necessary, medically assisted withdrawal should be overseen by an experienced clinician in a closely monitored setting. Opioid antagonist therapy with naltrexone is not currently recommended in pregnancy due to lack of evidence evaluating its safety; however, for patients managed on naltrexone prior to pregnancy, continuation is acceptable following careful discussion of risks and benefits [7].

Methadone and buprenorphine monotherapy are both acceptable treatments for opioid use disorder in pregnancy. Randomized control trials have demonstrated improved neonatal outcomes with buprenorphine therapy when compared to methadone, including reduced length of neonatal admission and reduced total morphine dose required for treatment of NAS [8]; however, a recent Cochrane review found overall no difference in maternal or neonatal outcomes for buprenorphine compared to methadone among pregnant patients [9]. Choice of agent should therefore be individualized to the patient's preferences and care setting.

Buprenorphine, a partial mu-receptor agonist, should be initiated when a patient is experiencing at least moderate withdrawal (COWS score 10–12) to avoid the risk of precipitated withdrawal. It may be initiated with an initial dose of 4 mg sublingual followed by a repeat dose 30–60 minutes later if withdrawal is not precipitated, then serial dosing every 2–4 hours until symptoms are controlled. A 12–16 mg initial daily dose is most typical among pregnant patients presenting in acute withdrawal, but higher doses of 20–24 mg may be required [6]. Buprenorphine can be prescribed outpatient for maintenance, and as of 2023, may be prescribed by any provider with Drug Enforcement Administration registration

Table 92.1 Signs and symptoms of acute opioid intoxication and withdrawal

Organ system	Intoxication	Withdrawal
HEENT	Drooping eyelids Constricted pupils Head nodding	Dilated pupils Eye tearing Rinorrhea/“sniffles”
Respiratory	Reduced respiratory rate	Yawning
Cardiovascular	Hypotension	Tachycardia
Abdominal	Nausea/vomiting	Nausea/vomiting Diarrhea
Integumentary	Itching	Flushing/sweating Piloerection
Neurologic	Altered mental status Sedation or coma	Anxiety, irritability, agitation Tremor

[10]. Methadone, a full mu-receptor agonist, does not precipitate withdrawal. It can be initiated at a dose of 20–30 mg/day and increased at a rate of 5–10 mg/day over the first 5 days. The time to reach a steady state is longer compared to buprenorphine due to its long half-life. Twice-daily or “split” methadone dosing is preferred in pregnancy due to increased metabolic clearance. An electrocardiogram should be performed due to the risk of qTC prolongation. Outpatient methadone is only available through licensed prescribing facilities; it is therefore imperative that an appointment be secured for ongoing therapy prior to discharge [6].

For patients presenting in acute withdrawal past viability, fetal monitoring should be performed during opioid agonist induction until reassuring fetal status is confirmed [6]. While titrating opioid agonists, withdrawal symptoms may be treated with adjunctive medications including antiemetics and anti-diarrheals. Patients should also receive evaluation for and treatment of co-occurring mental health disorders and other substance use disorders [2]. All patients presenting with opioid use disorder should receive a prescription for naloxone for treatment of acute overdose, as well as education on overdose prevention and recognition. Referral to a comprehensive outpatient treatment program is recommended as an important adjunct to maintenance pharmacotherapy. Consultation with social work for home safety assessment

and ongoing psychosocial support should be obtained as indicated. Finally, patients should receive education on NAS and its treatment, including encouragement of skin-to-skin contact, rooming in, and breastfeeding for patients stable on maintenance therapy [4].

Key Learning Points

- Assess all pregnant patients for substance use disorders, including opiate use disorder, using a validated screening tool. Urine drug testing should be performed for medical indications and only with the explicit consent of the patient.
- Opioid agonist pharmacotherapy is the preferred management approach for opioid use disorder in pregnancy. It is most effective when paired with psychosocial treatment.
- Referral for maintenance pharmacotherapy and substance use treatment programs must be secured prior to discharge from the acute care setting.
- Opioid overdose is a leading cause of maternal mortality and risk is elevated in the year following delivery. Patients at risk of opioid overdose should receive an outpatient prescription for naloxone and education on recognition and treatment.

References

- 1 Wesson DR, Ling W. The Clinical Opiate Withdrawal Scale (COWS). *J Psychoactive Drugs*. 2003;35:253–259.
- 2 American College of Obstetricians and Gynecologists. Opioid Use and Opioid Use Disorder in Pregnancy: Committee Opinion No. 711. *Obstet Gynecol*. 2017;130:e81–e94.
- 3 American College of Obstetricians and Gynecologists. Alcohol Abuse and Other Substance Use Disorders: Ethical Issues in Obstetric and Gynecologic Practice: Committee Opinion No. 633. *Obstet Gynecol*. 2015;125:1529–1537.
- 4 Substance Abuse and Mental Health Services Administration. *Clinical Guidance for Treating Pregnant and Parenting Women with Opioid Use Disorder and Their Infants*. Rockville, MD: SAMHSA; 2018.
- 5 The ASAM National Practice Guideline for the Treatment of Opioid Use Disorder: 2020 Focused Update. *J Addict Med*. 2020;14 (2S):1–91.
- 6 Leeman L, Starer J. Medication Assisted Treatment for Opioid Use Disorder during Pregnancy. In: *Opioid-Use Disorders in Pregnancy: Management Guidelines for Improving Outcomes*. Cambridge: Cambridge University Press; 2018. 84–92.
- 7 Jones HE. Treatment Approaches in Women with Substance Use Disorders Who Become Pregnant. In: *Opioid-Use Disorders in Pregnancy: Management Guidelines for Improving Outcomes*. Cambridge: Cambridge University Press; 2018. 72–83.
- 8 Jones HE, Kaltenbach K, Heil SH, et al. Neonatal Abstinence Syndrome after Methadone or Buprenorphine Exposure. *N Engl J Med*. 2010;363:2320–2331.
- 9 Minozzi S, Amato L, Jahanfar S, et al. Maintenance Agonist Treatments for Opiate-Dependent Pregnant Women. *Cochrane Database Syst Rev*. 2020;11 (11):CD006318.
- 10 Waiver Elimination (MAT Act) 2023. www.samhsa.gov/medications-substance-use-disorders/waiver-elimination-mat-act (accessed June 14, 2023).

CASE 93

A 35-Year-Old Somali-Speaking Patient at 40 Weeks' Gestation Presents in Active Labor with Her Husband as Her Interpreter

Heather Wolfe

History of Present Illness

A 35-year-old gravida 4 para 3 patient at 40 weeks' gestation presents to triage with regular painful contractions. She is moaning, grimacing, and swaying side to side, standing at the bedside. When questioned, she states, "no English" and gestures to her partner who introduces himself as her husband and states that she only speaks Somali, and he will interpret for her. The obstetric provider does not speak Somali.

Physical Examination

General appearance: 35-year-old adult, well-developed, well-nourished, in apparent pain holding her gravid abdomen, swaying

Vital signs:

Temperature: 37.1°C

Pulse: 97 beats per minute

Blood pressure: 122/78 mmHg

Respiratory rate: 18 breaths per minute

Height: 160 cm

Weight: 71 kg

BMI: 27.6 kg/m²

Abdomen: Regular uterine contractions palpated with moderate intensity, normal resting tone

Fetal assessment: Fetal heart monitoring: Baseline: 150, moderate variability, accelerations present, no decelerations present. Tocometry: Contractions every 2–4 minutes

How Would You Manage This Patient?

This patient has signs and symptoms consistent with active labor. It is important to fully evaluate her by taking a history and performing a physical exam including an assessment of cervical dilation. Usual practice includes a verbal review of the patient's presenting symptoms and history as well as obtaining explicit verbal consent for cervical examination. In this setting, there is a barrier to usual care due to nonconcordant language between the patient and the provider. Options to proceed include using a formal medical interpreter or her husband as an untrained interpreter. Disregarding communication with the patient entirely would clearly be unethical. Many hospitals have various methods to contact interpreter services including remote interpreters. A video interpreter can be used to communicate with the patient in Somali if an in-person interpreter

is not available. We recommend interpreter use to reduce miscommunication or errors in relying on her husband and to allow the partner to focus on the support role. If the patient agrees, the interpreter can be used for the history and to obtain consent for an exam. If the patient declines interpreter use despite knowing that there is no cost, her wishes will be respected and the team will rely on the husband for interpretation.

Limited English Proficiency and Requirement for Interpretation

Almost 1 in 5 people in the United States speak a language other than English at home [1]. The most common language is Spanish by a significant margin (62%) followed by Chinese, Tagalog, Vietnamese, and Arabic [1]. It is important to realize that the majority of people who speak a language other than English at home also report speaking English at least very well, though 41% of this population does not [2]. A person is considered to have limited English proficiency or be limited English proficient (LEP) if English is not their primary language and they are not consistently able to read, write, speak, and/or understand English. The overall rate of LEP in the US population is approximately 8% as of 2013, which was an 80% increase since 1990 and reflects the changing demographics of the country (Figure 93.1) [2].

Of note, there is a proposal to change the terminology from LEP to NELP (non-English language preference) [3]. This takes into account the experience of individuals who don't identify with only one primary language and to mitigate the vague definition of limited ability and remove the implied deficiency in the term LEP [3]. As LEP is the more commonly used term, this will be used for the remainder of this case study, however, patients and providers may prefer to use NELP.

The Civil Rights Act of 1964 Title VI banned discrimination on the basis of race, color, and national origin [4]. The Supreme Court, federal government, and numerous federal agencies have since used language as a proxy for national origin, cementing protection for non-English speakers [4].

In 2000, Executive Order 13166 "Improving Access to Services for Persons with Limited English Proficiency" was enacted, which requires nonfederal entities that receive federal funding to provide meaningful access to people with LEP [4]. This applies to all recipients of federal financial funds



Figure 93.1 Limited English proficiency in the United States, original figure, information from [2]. LEP, limited English proficiency

including but not limited to Medicaid and Medicare reimbursements as well as National Institutes of Health grants and CDC resources [4]. Hospitals have been the subject of complaints to the Office of Civil Rights on behalf of LEP patients and, as a result, have significantly improved their access to language services [4]. Further publication was issued in 2003 that upholds this order and attempts to balance the importance of language access without placing undue burden on small groups with limited budgets [4]. There are four factors that an organization or practice must consider in developing a plan for language services including: 1. the number or proportion of LEP patients served; 2. the frequency of contact with certain language groups; 3. the nature and importance of the service provided; and 4. the resources available [4]. Given the significant nature and importance of health care, however, medical providers have “a special obligation” to provide language access, and the methods and resources should be strongly considered even in the setting of small practices [4].

In addition to federal protection against language discrimination, there are also state-specific regulations. At least 43 states have at least one law addressing language services in the health care setting [4]. California, which has the highest proportion of LEP individuals of any state [2], has over 70 laws pertaining to language services in health care including, one passed in 2003 that requires private insurers to cover language assistance for their clients [4].

Providing appropriate language services is essential in optimal patient care. Limited English proficiency patients have been shown to have lower rates of access to care and preventative

visits as well as poor adherence and follow-up [5]. Studies consistently show a decrease in quality of care for patients who need but do not receive an interpreter including worse understanding of their diagnoses and treatment, additional testing and higher overall cost, increased rates of hospitalization, delay in care, and have lower satisfaction with their care [5,6]. Use of professional medical interpreters or bilingual health providers decreases disparities, improves patient comprehension, decreases medical error, and improves patient and staff satisfaction [5,6]. Use of an interpreter raises the quality of and satisfaction with care for a patient with LEP up to the level of a patient who does not require language assistance [5].

Use of a family member, while convenient, can lead to miscommunication as well as “alter family dynamics” and reduce the patient’s privacy [7]. Studies have shown that using a family member is associated with a lower likelihood of having medication side effects explained, a higher risk of interpretation errors, and a decreased satisfaction with care [6]. In one study, ad hoc interpreters misinterpreted or omitted 23–52% of questions asked by physicians [6]. If the patient declines the use of an interpreter, this should be respected based on autonomy, but it is recommended to first explain the benefits in detail with use of a trained interpreter and reassure them that this is a service provided at no cost to them, and to formally document the patient’s decision.

Provision of Interpreter Services

Language concordant care is ideal for efficient patient care and provider satisfaction, though in our global society this is not

always possible [7]. Ways to improve access to care in a variety of languages include implementing non-English language training in medical school [7], and identifying providers with “non-English language skills” and certifying and valuing these abilities in the workforce [3]. This is one more reason why diversification of providers is an important aspect to reducing health care disparities [7].

When faced with a language discrepancy, there are two primary ways in which language services can be provided: via oral interpretation or with use of written translation. Oral interpretation can be with an in-person individual or use of a remote service including telephone or video. Written translation includes patient information pamphlets, consent forms, discharge paperwork, and signage around the hospital and should also be used for email or text reminders about appointments or results [7].

There is little published on best practices for a medical provider using an interpreter beyond simply ensuring that a qualified medical interpreter is used. Some practices to consider include physical positioning of all parties so that hearing is not an issue, maintaining eye contact with the patient [8], monitoring body language, speaking to the patient and not the interpreter [8], and avoiding interruption while waiting for interpretation and conveyance of the patient’s response and any questions or clarifications.

Most medical providers are aware of the importance of using formal interpreters, though studies have shown that these are still not used effectively in many encounters [9]. The most commonly identified barriers to appropriate use of interpreter services include workflow and time constraints [9]. The patient declining services and technical problems were second and third most common reasons cited, respectively [9]. Many providers prefer in-person interpretation, however, it

has an associated increase in cost [9]. Demand may exceed the supply for certain languages via remote means and this can lead to longer wait times [9].

Barriers to implementation of consistent, correct use of interpreter services can impact patient care and the provider experience, specifically leading to burnout as providers are aware of the importance of these resources but at times face significant challenge in its practical use [9].

An additional concern is the variable quality of interpretation, which has been attributed to ambient noise, connection issues, or lack of interpreter skill [9]. One study examined interpreter errors and found errors including omission, false fluency, substitution, editorialization, and addition in most clinical encounters, though errors were significantly higher when using untrained instead of professional interpreters (77 vs. 53%) [10].

Key Teaching Points

- Limited English proficiency currently affects 8% of the population in the United States, and is increasing.
- There are legal requirements for the provision of language services.
- Not using a trained interpreter is associated with medical errors, decreased patient satisfaction, and worse outcomes.
- Barriers to correct interpreter use include workflow and time constraints – these can be addressed at the individual and system level.
- Language concordant care is associated with improved outcomes, and this can be encouraged by formalizing the process to certify and acknowledge providers with non-English language skills, training learners in non-English languages, and diversifying the workforce.

References

- 1 What Languages Do We Speak in the United States? Nearly 68 Million People Spoke a Language Other Than English at Home in 2019. www.census.gov/library/stories/2022/12/languages-we-speak-in-united-states.html (accessed May 10, 2023).
- 2 The Limited English Proficient Population in the United States in 2013. www.migrationpolicy.org/article/limited-english-proficient-population-united-states-2013 (accessed May 10, 2023).
- 3 Ortega P, Shin TM, Martinez GA. Rethinking the Term “Limited English Proficiency” to Improve Language-Appropriate Healthcare for All. *J Immigr Minor Health*. 2022;24:799–805.
- 4 Chen AH, Youdelman MK, Brooks J. The Legal Framework for Language Access in Healthcare Settings: Title VI and Beyond. *J Gen Intern Med*. 2007;22:362–367.
- 5 Karliner LS, Jacobs EA, Chen AH, et al. Do Professional Interpreters Improve Clinical Care for Patients with Limited English Proficiency? A Systematic Review of the Literature. *Health Serv Res*. 2007;42:727–754.
- 6 Flores G. The Impact of Medical Interpreter Services on the Quality of Health Care: A Systematic Review. *Med Care Res Rev*. 2005;62:255–299.
- 7 Togioka BM, Seligman KM, Delgado CM. Limited English Proficiency in the Labor and Delivery Unit. *Curr Opin Anaesthesiol*. 2022;35:285–291.
- 8 Gurman TA, Moran A. Predictors of Appropriate Use of Interpreters: Identifying Professional Development Training Needs for Labor and Delivery Clinical Staff Serving Spanish-Speaking Patients. *J Health Care Poor Underserved*. 2008;19:1303–1320.
- 9 Fox MT, Godage SK, Kim JM, et al. Moving from Knowledge to Action: Improving Safety and Quality of Care for Patients with Limited English Proficiency. *Clin Pediatr (Phila)*. 2020;59:266–277.
- 10 Flores G, Laws MB, Mayo SJ, et al. Errors in Medical Interpretation and Their Potential Clinical Consequences in Pediatric Encounters. *Pediatrics*. 2003;111:6–14.

CASE 94

A 25-Year-Old Presents 1 Week after a Cesarean Delivery with Erratic Behavior

Holly E. Metzgar

History of Present Illness

A 25-year-old female, gravida 2 para 2, is brought to the Emergency Department by her partner 1 week after a cesarean delivery (CD). She was discovered lying on the kitchen floor attempting to reopen her Pfannenstiel incision with a cutlery knife, to remove “the maggots wiggling inside me.” Her partner endorses that she has not slept for days, instead spending hours scouring the house with bleach, swatting at imaginary flies, and repeatedly bathing the baby after each soiled diaper. Yesterday, she angrily accused him of contaminating the baby’s formula and began to hide bottles in strange locations around the house. Prior to this week, her pregnancy course was uncomplicated, as was her 39-week scheduled repeat CD and routine postpartum hospital stay. Although she has a personal history of bipolar disorder, she has not taken any medication since she became pregnant with her first child at age 23, and currently sees no mental health provider. There is no history of physical or sexually aggressive behaviors, substance abuse, prior mental health hospitalizations, or suicide attempts. When asked if her incision hurts, the patient states: “If I can’t get this infection cleaned up, she’d be better off without me.”

Physical Examination

General appearance: Well-developed, unkempt

Vital signs:

Temperature: 37.1°C

Pulse: 90 beats per minute

Blood pressure: 110/75 mmHg

Respiratory rate: 18 breaths per minute

BMI: 30.5 kg/m²

Cardiopulmonary: Regular rate and rhythm, lungs clear to auscultation bilaterally

Abdomen: 2 cm superficial separation of Pfannenstiel incision in midline, 0.5 cm at maximal depth, with no active bleeding. Abdomen otherwise soft, non-tender, non-distended with active bowel sounds. Uterine fundus firm, non-tender, 4 cm below umbilicus

Neurological: No focal deficits

Mental Status Examination

Appearance: Appears stated age, dressed in pajamas, messy hair, worn out

Behavior: Poor eye contact, erratic, psychomotor agitation

Speech: Spontaneous, rapid, pressured

Mood: Manic, erratic, labile

Affect: Increased intensity and increased range

Thought process: Circumstantial

Thought content: Delusions: paranoid, persecutory; hallucinations: visual (maggots, flies, dirt); suicidality: denies, but insinuated; homicidality: denies

Attention and concentration: Fair

Judgment: Poor

Insight: Poor

Cognitive exam: Normal in terms of orientation, language, and fund of knowledge

Laboratory studies:

CBC: Normal

Comprehensive metabolic panel: Normal

Urine toxicology screen: Negative

Ammonia level: Negative

TSH, T4, and TPO antibodies: Normal

Imaging:

CT brain: No acute process identified, no mass lesion. CT abdomen/pelvis: no interruption to fascia, pelvic findings consistent with postoperative day 7 status post cesarean section

How Would You Manage This Patient?

This patient presents with postpartum psychosis (PPP). In this case, the patient is experiencing paranoid delusions and visual hallucinations that have resulted in inadvertent self-harm. After excluding any medical causes of altered mental status, an immediate psychiatric consultation was ordered in the Emergency Department. Her Pfannenstiel wound was cleansed with a peroxide solution diluted 1:1 with sterile saline, packed with iodoform gauze, and a sterile dressing applied. While waiting for psychiatry to arrive, her obstetrician initiated a sedative antipsychotic medication (haloperidol) along with a short-acting benzodiazepine (lorazepam). She was maintained on one-to-one continuous observation to ensure the safety of herself and the infant. Psychiatry recommended voluntary admission to the inpatient psychiatry unit, but the patient refused, not trusting her partner to care for the baby in her absence. A “302” involuntary commitment for psychiatric placement at an inpatient psychiatric unit was obtained urgently through the local county legal system. It was recommended that she forego breast-feeding/pumping so that her sleep would be better preserved, and that

pharmacotherapy could be optimized. Lithium was initiated by psychiatry, and titrated to achieve serum levels of 0.8–1.2 mEq/L. She completed a 14-day inpatient treatment followed by an intensive outpatient therapy (“day program”) for another 28 days. Once symptom remission was achieved, the benzodiazepine and antipsychotic medications were tapered down and discontinued. In addition to weekly psychotherapy appointments, it was recommended she remain on lithium monotherapy for a minimum of 9 months, if not lifelong.

Postpartum Psychosis

Postpartum psychosis is the least understood and most dangerous of the perinatal psychiatric disorders. Affecting approximately 1–2 per 1,000 birthing persons, it is an obstetric and psychiatric emergency associated with increased risks of suicide and infanticide (5 and 4%, respectively) [1]. The symptoms of PPP are often distinctive and unique from other primary psychotic disorders. Symptom onset is typically sudden, most often occurring within the first 2 weeks postpartum, and can be waxing and waning in presentation. Clinical features (see Table 94.1) include delusional thoughts or bizarre beliefs, hallucinations, paranoia, rapid mood swings, irritability, hyperactivity, and decreased need for or difficulty sleeping. While the psychotic symptoms are often the most dramatic manifestation, women with PPP also present with mood symptoms: mania and/or irritability (34%), depression and/or anxiety (41%), or mixed symptoms (25%) [2].

For women, the perinatal period is well established as a time of increased vulnerability to a first onset of mental health disorders or relapse in those with known illness. There is no standardized screening tool for PPP. Commonly used depression screens may elicit symptoms of depression or anxiety, but they cannot distinguish between unipolar and bipolar depression, nor can they assess symptoms of psychosis. The strongest single risk factor for PPP is a personal history of bipolar disorder, with 20–30% of parous women with known bipolar disorder experiencing PPP [3]. However, only 33% of

women presenting with PPP have a prior psychiatric history, and of those, only one-third had been diagnosed with bipolar disorder. Most women who present with PPP as their first psychiatric episode will eventually meet criteria for bipolar disorder, with one comprehensive study showing a risk of a subsequent nonpuerperal episode of 69% [4]. A presentation of PPP should therefore be considered bipolar disorder – and treated as such – until proven otherwise. Furthermore, approximately one-third of those who have had a previous episode of PPP experience a recurrence in a subsequent pregnancy [5].

Postpartum psychosis is a medical emergency. Psychiatric hospitalization is generally indicated, including one-to-one continuous observation to ensure the safety of the patient and her child. Key correlates of self-harm during pregnancy and the postpartum period include a known mental health disorder, substance misuse, younger age, and a history of self-harm or fetal or infant loss [6]. Twenty-five percent of women self-harm in the 3 months preceding suicide, and acts of self-harm in women with an initial onset of a severe mental disorder are a risk factor for suicide later. Other risk factors for pregnancy-related mental health deaths include a history of prior suicide attempt, abrupt discontinuation of psychotropic medications during pregnancy, sleep disturbances, stillbirth, history of childhood abuse (Adverse Childhood Experiences score ≥ 3), financial instability, and major illness in the newborn [7,8].

Given that PPP can present with symptoms that mimic delirium, it is important to assess for other medical illnesses that can either cause or exacerbate psychiatric illness: infection, metabolic encephalopathy, endocrine dysfunction, drug use, and central nervous system events (stroke, neoplasm, trauma). Each patient requires a comprehensive evaluation, including a history, physical examination, and laboratory testing to exclude other medical causes of psychosis. The history should consider past and current general medical and psychiatric conditions, current medications, and the use of alcohol and illicit substances. The physical examination should include a basic neurologic and mental status evaluation. Initial laboratory workup should include CBC with differential, complete metabolic panel, thyroid-stimulating hormone and thyroperoxidase antibodies, urinalysis, toxicology screen, and head imaging.

Generalist obstetricians are encouraged to administer pharmacotherapy to stabilize the patient while awaiting further assessment and recommendations by a psychiatrist. Initiation of a sedative antipsychotic medication with short-acting benzodiazepines is the first-line treatment for PPP (Table 94.2) [8,9]. For individuals who present with agitation, aggression, or who are too disorganized to take or refuse to take medications orally, **haloperidol** can be given intramuscularly (IM): 0.5–2 mg IM for mild agitation; 2–5 mg IM for moderate agitation; and ≥ 10 mg IM for severe agitation. This can be repeated every 30 minutes until desired level of sedation is achieved.

Once maternal and infant safety are secured, an extensive interview of the partner and/or family members present is

Table 94.1 Clinical features of PPP

Hallucinations	Seeing, hearing, feeling, or smelling things that others cannot because they are not there
Delusions	Thoughts or beliefs unlikely to be true Content may be bizarre, religious, persecutory, violent, or sexual <i>May not cause the patient significant distress</i>
Manic or high mood	General sense of being hyper, euphoric, or irritable Thinking or talking too quickly or too much
Depressed or low mood	General sense of being down, sad, or hypoactive
Loss of inhibitions	Behaving in a way that is incongruent with usual values or out of character
Paranoia	Feeling suspicious or fearful
Insomnia	Decreased need for sleep or difficulty sleeping, restlessness. Not able to sleep even when afforded the opportunity
Confusion	Disorganized thought process, rapid mood fluctuation

Table 94.2 Pharmacotherapy for initial stabilization of acute PPP

Drug name	Drug class	Initial dose	Repeat	Maximum dose
Haloperidol (Haldol)	First-generation antipsychotic	1–5 mg IM/intravenous	Every 30 minutes PRN	100 mg/day
Lorazepam (Ativan)	Short-acting benzodiazepine	1–2 mg IM/intravenous	Every 2–4 hours PRN	10 mg/day
Lithium	Mood stabilizer	300–600 mg PO	Twice to three-times a day	Serum level 1.5 mEq/L

also included as part of the psychiatric evaluation, diagnosis, and risk assessment [10]. Psychiatry will initiate lithium monotherapy; optimal response is typically seen with 1,800 mg/day PO divided into two or three doses. Titration is based on a response and target serum concentration range of 1.0–1.5 mEq/L. Maintenance is usually 900–1,200 mg/day in divided doses titrated to therapeutic trough level of 0.6–1.2 mEq/L. Recommended duration of treatment is at least 1 year. Based upon limited evidence, breast-feeding females with PPP may take antipsychotic medications, antidepressants, or mood stabilizers as indicated. However, some patients with more severe illness may be too disorganized or present too great a risk to the child to safely breast-feed. Furthermore, interruption to sleep should be minimized.

Key Teaching Points

- Postpartum psychosis is a medical emergency that impacts an estimated 1–2 women per 1,000 births and can endanger the lives of mother and child.
- There is an estimated 5% risk of suicide and 4% risk for infanticide associated with PPP.
- The onset of psychosis can be sudden, typically within the first 2–3 weeks following childbirth. Psychosis can also occur during pregnancy and immediately following childbirth.
- The most significant risk factors for PPP are a personal history of bipolar disorder or a previous psychotic episode.
- Treatment for PPP almost always consists of hospitalization, medication, and therapy.

References

- 1 Vanderkruik R, Barreix M, Chou D, et al. The Global Prevalence of Postpartum Psychosis: A Systematic Review. *BMC Psychiatry*. 2017;17:272.
- 2 Kamperman AM, Veldman-Hoek MJ, Wesseloo R, et al. Phenotypical Characteristics of Postpartum Psychosis: A Clinical Cohort Study. *Bipolar Disord*. 2017;19(6):450–457.
- 3 Di Florio A, Forty L, Gordon-Smith K, et al. Perinatal Episodes across the Mood Disorder Spectrum. *JAMA Psychiatry*. 2013;70(2):168–175.
- 4 Robertson Blackmore E, Rubinow DR, O'Connor TG, et al. Reproductive Outcomes and Risk of Subsequent Illness in Women Diagnosed with Postpartum Psychosis. *Bipolar Disord*. 2013;15(4):394–404.
- 5 Osborne LM. Recognizing and Managing Postpartum Psychosis: A Clinical Guide for Obstetricians. *Obstet Clin North Am*. 2018;45(3):455–468.
- 6 Ayre K, Gordon HG, Dutta R, et al. The Prevalence and Correlates of Self-harm in the Perinatal Period: A Systematic Review. *J Clin Psychiatry*. 2019;81:19r12773.
- 7 Rodriguez-Cabezas L, Clark C. Psychiatric Emergencies in Pregnancy and Postpartum. *Clin Obstet Gynecol*. 2018;61:615–627.
- 8 ACOG Clinical Practice Guideline Number 4: Screening and Diagnosis of Mental Health Conditions during Pregnancy and Postpartum. *Obstet Gynecol*. 2023;141(6):1232–1261.
9. ACOG Clinical Practice Guideline Number 5: Treatment and Management of Mental Health Conditions during Pregnancy and Postpartum. *Obstet Gynecol*. 2023;141(6):1262–1288.
- 10 Bergink V, Rasgon N, Wisner KL. Postpartum Psychosis: Madness, Mania, and Melancholia in Motherhood. *Am J Psychiatry*. 2016;173(12):1179–1188.

CASE 95

A 30-Year-Old Presents for a First Prenatal Visit with a Previous Emergency Operative Delivery Requesting a Planned Primary Cesarean

Cheryl Godcharles

History of Present Illness

A 30-year-old gravida 2 para 1001 presents at 10 weeks' gestation for her first prenatal visit. Her first pregnancy was complicated by gestational hypertension, requiring induction of labor at 37 weeks' gestation. Her induction was largely uncomplicated. However, she reports the attending obstetrician recommended a forceps-assisted delivery to expedite the second stage due to prolonged fetal heart rate decelerations. Delivery was complicated by a second-degree perineal laceration that was repaired. She shares that the infant did not cry at delivery and did need to go to the neonatal intensive care unit (NICU) for hypoglycemia. Review of her records shows that Apgar scores were 8 and 9 at 1- and 5-minutes, respectively. Her son is now 5 years old and meeting all milestones.

She requests a primary cesarean delivery (CD) for this pregnancy due to post-traumatic stress disorder (PTSD) from her first. Her sister has had three CDs without complication and recovered well.

Physical Examination

General appearance: 30-year-old adult, well-developed and well-nourished, in no apparent distress

Vital signs:

Temperature: 37.2°C

Pulse: 93 beats per minute

Blood pressure: 117/72 mmHg

Respiratory rate: 16 breaths per minute

BMI: 24.8 kg/m²

Cardiopulmonary: Unremarkable

Abdomen: Soft, non-tender, non-distended, normal active bowel sounds, no rebound or guarding

Pelvic: Normal external genitalia, vaginal and cervical mucosa normal, uterus 10-week-sized without tenderness, normal adnexa with no masses or tenderness appreciated

Psychologic: Mood and affect appropriate, normal though content

Imaging:

Ultrasound reveals a single, live, intrauterine pregnancy with cardiac activity. Crown rump length (CRL) measures 32 mm, which corresponds to 10 1/7 weeks.

How Would You Manage This Patient?

This patient presents requesting a primary CD following a forceps-assisted vaginal delivery due to delivery-related PTSD. She was referred to a trauma-informed therapist and counseled on the importance of mental health during the perinatal period. Her feelings about her prior birth experience were validated, and she was informed that approximately 4% of women experience PTSD following childbirth, particularly those with operative vaginal deliveries or those whose babies go to the NICU. She was counseled on the risks and benefits of a primary CD including the risks in subsequent pregnancies. Ultimately, she was scheduled for and underwent a primary delivery at 39 weeks' gestation. At her 2- and 6-week postpartum visits, she was doing well without significant concern for perinatal mood or anxiety disorders.

Delivery-Related PTSD

Approximately 4% of pregnant people experience PTSD following delivery [1]. Risk factors include unplanned CD, operative vaginal delivery, obstetric emergencies such as cord prolapse, NICU admission, previous trauma, and severe physical complications. Additionally, factors such as prior miscarriage, infertility, high levels of anxiety and depression during pregnancy, lack of social support, and a previous diagnosis of mental health disorders may also contribute to an increased risk of PTSD [2].

Post-traumatic stress disorder related to childbirth may present with symptoms similar to those seen in other traumatic events. These symptoms can be categorized into four clusters: intrusive thoughts, avoidance, negative alterations in mood and cognition, and hyperarousal [3]. Intrusive thoughts may manifest as intrusive memories, nightmares, or flashbacks of the delivery. Avoidance behaviors may include avoiding situations or reminders related to the delivery. Negative alterations in mood and cognition may involve feelings of guilt, shame, or a diminished interest in previously enjoyable activities. Hyperarousal symptoms can manifest as irritability, hypervigilance, or difficulty sleeping.

Post-traumatic stress disorder can have a significant impact on a woman's well-being and her ability to care for her newborn. Women with PTSD may experience difficulties in bonding with

their infants, breast-feeding, or engaging in postnatal care [2]. Post-traumatic stress disorder can also lead to an increased risk of postpartum depression and anxiety disorders. Moreover, the psychological distress experienced by women with PTSD can affect their relationships with their partners, family, and friends [4,5,6].

Little data exist on specific means to prevent delivery-related trauma. However, there are some theories on interventions to prevent PTSD after a traumatic birth experience. Expressive writing significantly decreases postpartum PTSD symptoms. Twenty minutes of writing a day where the patient notes their thoughts, expectations, and emotions related to delivery has been effective as secondary prevention [7].

Early identification and appropriate management of PTSD after operative vaginal delivery are crucial for supporting affected women. Health care providers should be trained to recognize the signs and symptoms of PTSD and routinely assess women's mental health in the postpartum period. This may present as having nightmares or feelings of reliving the birth, avoiding things reminiscent of birth (i.e. visiting the hospital or discussing delivery), expressing feelings of guilt or failure due to intervention experienced during birth, and/or excessive alertness and checking on the baby [2].

Screening can start with asking a simple question such as "How did you experience the delivery?" followed by "Would you describe your childbirth as traumatic or very upsetting?", or "Are you currently experiencing psychological symptoms that you think are caused by childbirth?" [2]. Validated screening tools specifically designed for recognizing PTSD, such as the Posttraumatic Stress Disorder Checklist for Diagnostic and Statistical Manual-5 (DSM-5) (PCL-5) or the City Birth Trauma Scale, can aid in identifying at-risk individuals (Table 95.1). Screening should be integrated into routine postpartum assessments for every postpartum patient, ensuring privacy and sensitivity to women's emotional well-being. Health care providers should receive adequate training to administer and interpret screening results. A cutoff score between 31 to 33 on the PCL-5 offers balance between specificity and sensitivity and warrants further evaluation for PTSD [8]. Early identification enables appropriate interventions, facilitating the path toward recovery and promoting overall maternal mental health.

Once diagnosed, a multidisciplinary approach involving obstetricians, psychologists, and other mental health professionals should be implemented. Treatment options may include trauma-focused cognitive behavioral therapy, eye

Table 95.1 PTSD checklist for DSM-5 (PCL-5)

In the past week, how much were you bothered by:	Not at all	A little bit	Moderately	Quite a bit	Extremely
Repeated, disturbing, and unwanted memories of the stressful experience?	0	1	2	3	4
Repeated, disturbing dreams of the stressful experience?	0	1	2	3	4
Suddenly feeling or acting as if the stressful experience were actually happening again (as if you were actually back there reliving it)?	0	1	2	3	4
Feeling very upset when something reminded you of the stressful experience?	0	1	2	3	4
Having strong physical reactions when something reminded you of the stressful experience (for example, heart pounding, trouble breathing, sweating)?	0	1	2	3	4
Avoiding memories, thoughts, or feelings related to the stressful experience?	0	1	2	3	4
Avoiding external reminders of the stressful experience (for example, people, places, conversations, activities, objects, or situations)?	0	1	2	3	4
Trouble remembering important parts of the stressful experience?	0	1	2	3	4
Having strong negative beliefs about yourself, other people, or the world (for example, having thoughts such as: I am bad, there is something seriously wrong with me, no one can be trusted, the world is completely dangerous)?	0	1	2	3	4
Blaming yourself or someone else for the stressful experience or what happened after it?	0	1	2	3	4
Having strong negative feelings such as fear, horror, anger, guilt, or shame?	0	1	2	3	4
Loss of interest in activities that you used to enjoy?	0	1	2	3	4
Feeling distant or cut off from other people?	0	1	2	3	4
Trouble experiencing positive feelings (for example, being unable to feel happiness or have loving feelings for people close to you)?	0	1	2	3	4
Irritable behavior, angry outbursts, or acting aggressively?	0	1	2	3	4
Taking too many risks or doing things that could cause you harm?	0	1	2	3	4
Being "superalert" or watchful or on guard?	0	1	2	3	4
Feeling jumpy or easily startled?	0	1	2	3	4
Having difficulty concentrating?	0	1	2	3	4
Trouble falling or staying asleep?	0	1	2	3	4

Weathers FW, Litz BT, Keane TM, et al. The PTSD Checklist for DSM-5 (PCL-5) – Standard [Measurement instrument]. www.ptsd.va.gov/ [9].

movement desensitization and reprocessing (EMDR), pharmacotherapy including selective serotonin reuptake inhibitors, and support groups. Cognitive behavioral therapy is a form of talk therapy that helps people understand how their thoughts affect their feelings and actions; it provides a framework for coping with trauma. EMDR allows patients to reprocess memories into less traumatic memories using bilateral stimulation (typically eye movements). It is important to provide a safe and supportive environment where patients can openly discuss their experiences and emotions.

Cesarean for Maternal Request

It is estimated that 2.5% of births in the United States are done via CD for maternal request [10]. Guidance for physicians when a patient requests a primary CD without other indications is provided by ACOG. In their committee opinion, ACOG concludes that in the absence of a fetal or maternal indication for CD, a trial of labor should be recommended given the paucity of data to recommend otherwise. If a patient's motivation for requesting a CD is related to fear of pain in labor, options for analgesia and anesthesia should be reviewed, and the patient should be offered prenatal childbirth education and labor support.

It is imperative to discuss the risks with the patient including increased risk of placenta previa, placenta accreta

spectrum, and hysterectomy with each CD. Additionally, consideration should be made to the patient's intended family size. While there is not a large difference in outcomes with a planned primary CD and a planned vaginal delivery, subsequent CDs carry significantly more risk of severe morbidity. Without additional maternal or fetal indications, delivery should not take place <39 weeks' gestation. After a thorough discussion with the patient, it is reasonable to perform a CD purely for maternal request.

Key Teaching Points

- Post-traumatic stress disorder after birth trauma affects a large number of people.
- Risk factors for PTSD include operative vaginal delivery, cesarean section, NICU admission, previous trauma, and severe physical complications.
- Postpartum PTSD can impact both the health of the parent and the infant.
- It is important to screen for and address postpartum PTSD using validated tools.
- Patients with PTSD should be referred to a trauma-informed psychologist, psychiatrist, and/or support groups.

References

- 1 Yildiz PD, Ayers S, Phillips L. The Prevalence of Posttraumatic Stress Disorder in Pregnancy and after Birth: A Systematic Review and Meta-analysis. *J Affect Disord*. 2015;208:634–645.
- 2 Kranenburg L, Lambregtse-van den Berg M, Stramrood C. Traumatic Childbirth Experience and Childbirth-Related Post-traumatic Stress Disorder (PTSD): A Contemporary Overview. *Int J Environ Res Public Health*. 2023;20(4):2775.
- 3 American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders*, 5th ed. Arlington, VA: American Psychiatric Publishing; 2013.
- 4 Ayers S, Bond R, Bertullies S, et al. The Aetiology of Post-traumatic Stress Following Childbirth: A Meta-analysis and Theoretical Framework. *Psychol Med*. 2015;46(6):1121–1134.
- 5 Cook N, Ayers S, Horsch A. Maternal Posttraumatic Stress Disorder during the Perinatal Period and Child Outcomes: A Systematic Review. *J Affect Disord*. 2018;225:18–31.
- 6 van Sielegheem S, Danckaerts M, Rieken R, et al. Childbirth Related PTSD and Its Association with Infant Outcome: A Systematic Review. *Early Hum Dev*. 2022;174:105667.
- 7 DeGraff LF, Honig A, Van Pampus MG, et al. Preventing Post-traumatic Stress Disorder following Child-Birth and Traumatic Birth Experiences: A Systematic Review. *Acta Obstet Gynecol Scand*. 2018;97:648–656.
- 8 Forkus SR, Raudales AM, Rafiuddin HS, et al. The Posttraumatic Stress Disorder (PTSD) Checklist for DSM-5: A Systematic Review of Existing Psychometric Evidence. *Clin Psychol*. 2023;30(1):110–121.
- 9 Weathers FW, Litz BT, Keane TM, et al. The PTSD Checklist for DSM-5 (PCL-5) – Standard [Measurement instrument]. www.ptsd.va.gov/.
- 10 ACOG Committee Opinion No. 559: Cesarean Delivery on Maternal Request. *Obstet Gynecol*. 2013;121(4):904–907.

CASE 96

A 26-Year-Old Presents Late to Prenatal Care with Her Partner and Has a Flat Affect and Limited English Proficiency

Deepti Sharma

History of Present Illness

A 26-year-old gravid 1 para 0 at 27 weeks' gestation presents for an initial prenatal visit. She has cancelled several appointments prior to this visit. She is not English speaking and is accompanied by her husband who declines interpretation services on her behalf. He answers all the questions during her intake. She has a flat affect and appears disconnected from him. When he is asked about her symptoms, he reports she has body pain but does not further characterize her pain. He is worried because the pain is limiting her ability to work. When asked about details of her job, he gives vague answers.

Physical Examination

General appearance: 26-year-old adult, well-developed and well-nourished, in no apparent distress

Vital signs:

Temperature: 36.7°C

Pulse: 88 beats per minute

Respiratory rate: 16 breaths per minute

Height: 160 cm

Weight: 48 kg

BMI: 18.6 kg/m²

Neurologic/psychologic: Alert, oriented, flat affect, low mood

Abdomen: Gravid, non-tender

Fetal assessment: Fundal height: 27 cm. Fetal Heart Rate by Doppler: 128 beats per minute

How Would You Manage This Patient?

The partner was asked to leave the room for the exam. He became upset and stated that he will not leave the room as he is her husband, and she cannot speak English. He was informed that it is standard protocol to give the patient privacy during this portion of the visit and that a certified interpreter would be used. He stepped immediately outside of the room and the clinic staff escorted him to the waiting room. When he left, the patient reported that he was not her husband. He had promised her marriage and a good life, but instead when she arrived, she was forced to work long hours for his cleaning service and she had not yet received payment. She stated that he always said he would pay, but there was always an excuse for why he could not pay her. She lived in a

small apartment with several other women who were going through the same thing. She desired to find a way out of her situation and to involve law enforcement. Appropriate authorities were involved. Social work was also consulted for resources.

Human Trafficking

Human trafficking is an international problem that involves involuntary or forced labor. This can occur in a range of settings including sex work, agriculture, manufacturing, and hospitality. This also can include child labor. Given the illicit nature of trafficking, data are difficult to collect. It is estimated that over 400,000 individuals in the United States are victims of trafficking [1]. Estimates suggest that more than 70% of victims are female [1].

Patients at risk of trafficking include those who are from disadvantaged backgrounds, have unstable living conditions, a history of assault, are migrants or undocumented, identify as lesbian, gay, transgender, queer or non-conforming, have a substance use disorder, and experience poverty or low socioeconomic status. Children who are at risk include unhoused children, children who have run away, and children in foster care or in juvenile detention systems [1].

Traffickers may be known to the victim or a stranger. They use a variety of tactics that may involve deception or coercion and removing access to passports, documentation, or funds. They may engage in a romantic relationship, use physical threats, or gain trust from the victim and then isolate and manipulate the victim into servitude. Victims may believe that exploitation is normal and that they are at fault for being in this situation.

Victims have a range of experiences. They may feel pressure to stay in a situation they want to leave due to fears of retaliation, being investigated, or being deported. Sometimes they do not have control of their finances or documents and may have been told that they owe their employer. They are often constantly monitored and may be isolated from social support. Frequently they work or live in substandard conditions [2].

One study reports 28% of trafficking survivors had received health care services during their captivity [3]. Frequent barriers to care include lack of access to care, fear of traffickers or law enforcement, and language barriers [4].

Patients may present with a variety of medical problems including STIs, pregnancy, mental health conditions (depression,

Table 96.1 Red flags for human trafficking

Red flags for human trafficking include[1,2,5]:	
	Someone else speaking for the patient or refusing privacy for the patient
	Refusal of interpreter services
	Patient not aware of their address or location
	Signs of fear, anxiety
	Signs of abuse or neglect
	History that is inconsistent
	Vague or scripted answers
	Inability to provide identification documents (license, passport)

anxiety, PTSD), poor health or neglect, substance use disorders, and injuries [1,5]. Recognition of signs of trafficking by providers is an opportunity for intervention for these victims.

Red flags for trafficking are listed in Table 96.1. If any red flags are noted, it is critical to screen patients when they are alone. Professional interpreter services should universally be used when required. Several strategies can be used to isolate patients for screening, including normalizing privacy during the pelvic exam, creating a distraction, sending the accompanying person to complete paperwork, following the patient to the bathroom, and so on [3,4]. Another opportunity is placing signs with graphics (for those who are not English speaking) and phone numbers for the National Human Trafficking Hotline (1-888-373-7888) in restrooms where patients are generally unaccompanied [3]. The Vera Screening Tool for Human Trafficking is one validated screening tool covering domains of migration, work, and work/living conditions [6]. The short form of the tool contains 16 statistically validated questions and can be shortened based on the patient's circumstances. The US Department of Health and Human Services also provides a human trafficking screening tool, although this is not validated [7]. These questions are listed here and any "yes" answer indicates a positive screen.

1. *Sometimes lies are used to trick people into accepting a job that doesn't exist, and they get trapped into a job or situation that they never wanted. Have you ever experienced this?*
2. *Sometimes people make efforts to repay a person who provided them with transportation, a place to stay, money, or something else they need. The person they owe money to may require them to do things if they have difficulty paying because of the debt. Have you ever experienced this?*
3. *Sometimes people do unfair, unsafe, or even dangerous work or stay in dangerous situation because if they don't, someone might hurt them or someone they love. Have you ever experienced this?*
4. *Sometimes people are not allowed to keep or hold on to their own identification or travel documents. Have you ever experienced this?*
5. *Sometimes people work for someone or spend time with someone who does not let them contact their family, spend*

time with their friends, or go where they want when they want. Have you ever experienced this?

6. *Sometimes people are told to lie about their situation, including the kind of work they do. Has anyone ever told you to lie about the kind of work you're doing or will be doing?*
7. *Sometimes people are told to lie about their situation, including the kind of work they do. Has anyone ever told you to lie about the kind of work you're doing or will be doing?*
8. *Sometimes people are hurt or threatened, or threats are made to their family or loved ones, or they are forced to do things they do not want to do in order to make money for someone else or to pay off a debt to them. Have you ever experienced this?*

If there is an immediate safety threat, follow hospital protocols and involve local law enforcement if needed. In cases involving a minor, disabled persons, or elders, state-specific mandatory reporting protocols should be followed. For cases that involve a competent adult, law enforcement and social services should be involved with the patient's express consent [1]. If available, a patient advocate or social worker can assist in referring the patient to community resources. The National Human Trafficking Resource Center provides a hotline (1-888-373-7888) that can help health care providers assess for next steps and available resources [8]. Their website also provides an option to submit a tip in an anonymous online reporting form.

Appropriate care should be provided to the patient based on presenting symptoms, including a history and physical exam, STI testing, imaging, and mental health screenings as indicated [5].

It is also crucial to incorporate trauma-informed practices into patient care [9]. A trauma-informed approach to care involves understanding the impact of trauma and caring for the physical, psychological, and emotional safety of the patient. Clinicians should strive for a safe and comfortable physical environment for the patient. Care should be respectful, nonjudgmental, and compassionate. Providers should avoid traumatization with sensitivity to the specific aspects of care in gynecology (closed doors, power differential, disrobed patients, language during physical examination). Effort should be made to involve the patient in shared decision-making and allow for patient agency.

Care should be taken to document the clinical encounter with details. If possible, patient quotes and pictures should be included in the medical record. These can be useful evidence if there is a legal case in the future [5].

Obstetrician-gynecologists should be familiar with recognition of human trafficking and be prepared to assist victims [1]. In a search of the literature, there are no specific studies regarding perinatal complications or outcomes in this population. Pregnancy occurs in women who are trafficked, and obstetric care is an opportunity to identify victims and offer support. It is also important for hospital staff to have targeted training related to human trafficking as prior studies suggest many staff have never received human trafficking training [10]. Additional concerns for women who experience a

pregnancy while trafficked include financial concerns if they leave their current situation as well as legal concerns regarding custody of child. Laws are state-specific and legal counsel could aid victims to leave their captors.

Key Teaching Points

- Human trafficking is an international problem involving forced labor (sexual or otherwise).
- Obstetrician-gynecologists should be aware of human trafficking red flags and screen patients. If trafficking is identified, law enforcement should be involved and resources should be provided with the patient's consent (if mandatory reporting is not required).
- Appropriate medical care should be given including attention to presenting concern, STI screening, and mental health screening.

References

- ACOG Committee Opinion #787: Human Trafficking. *Obstet Gynecol.* 2019;134:90–95.
- National Human Trafficking Hotline. Recognizing the Signs. <https://humantraffickinghotline.org/en/human-trafficking/recognizing-signs> (accessed August 2, 2023).
- Family Violence Prevention Fund. Turning Pain into Power: Trafficking Survivors' Perspectives on Early Intervention Strategies 2005. www.futureswithoutviolence.org/userfiles/file/ImmigrantWomen/Turning%20Pain%20intoPower.pdf (accessed August 2, 2023).
- Prakash J, Oriola B, Kurtzer T, et al. "Praying for Freedom": A Story of Labor Trafficking during Pregnancy. *Am J Obstet Gynecol MFM.* 2023;5: 100873.
- Tracy EE, Macias-Konstantopoulos W. Identifying and Assisting Sexually Exploited and Trafficked Patients Seeking Women's Health Care Services. *Obstet Gynecol.* 2017;130 (2):443–453.
- Simich L, Goyen L, Powell A, et al. *Improving Human Trafficking Victim Identification: Validation and Dissemination of a Screening Tool. Final Report.* Washington, DC: National Institute of Justice; 2014. www.ojp.gov/pdffiles1/nij/grants/246712.pdf (accessed October 20, 2024).
- Adult Human Trafficking Screening Toolkit and Guide.* Washington, DC: US Department of Health and Human Services; 2018.
- National Human Trafficking Hotline. Framework for a Human Trafficking Protocol in Healthcare Settings. <https://humantraffickinghotline.org/en/resources/framework-human-trafficking-protocol-healthcare-settings> (accessed August 2, 2023).
- ACOG Committee Opinion #825: Caring for Patients Who Have Experienced Trauma. *Obstet Gynecol.* 2021;137:94–99.
- Engler LA, Mercer L. Assessment of Human Trafficking Knowledge among Staff in a Tertiary Care Academic Medical Center [05G]. *Obstet Gynecol.* 2020;135:71S–72S.

A 25-Year-Old Primigravida with a History of Female Genital Mutilation

Yvonne S. Butler Tobah

History of Present Illness

A 25-year-old recent immigrant from West Africa presents for her initial prenatal care appointment. She reports mild nausea of early pregnancy without vomiting. She has a long-standing history of constipation, urinary dribbling, and dyspareunia. She denies vaginal bleeding or cramping. No further acute symptoms of concern.

Her first pregnancy resulted in the vaginal delivery of a male infant, after a prolonged second-stage labor, in a refugee camp. She attributes her prolonged labor to the “cut” she underwent at approximately 10 years of age. She reports her vaginal introitus was “opened” surgically for delivery of her son, and subsequently “closed” after delivery. She occasionally has anxiety from the experience. She denies any further pertinent medical or surgical history.

Physical Examination

General appearance: Well-groomed, alert and oriented

Vital signs:

Temperature: 37.0°C

Pulse: 80 beats per minute

Blood pressure: 110/65 mmHg

Respiratory rate: 15 breaths per minute

BMI: 25.6 kg/m²

Cardiopulmonary: Clear to auscultation, with regular rate and rhythm, non-labored respirations

Abdomen: Soft, non-tender to palpation

External genitalia: Genitalia appears hairless, with hypertrophied midline scar extending anteriorly from a remnant prepuce to a narrowed introitus. Labia majora and minora appear absent. A clitoris or urethra cannot be identified. Bimanual exam was deferred due to her discomfort

Laboratory studies:

Human chorionic gonadotropin: 87,000 IU/L

Imaging:

Transabdominal ultrasound: Shows a singleton viable intrauterine pregnancy, with a CRL of 2.54 cm, consistent with 9 2/7 weeks. Fetal heart rate is 163 beats per minute.

How Would You Manage This Patient?

A culturally appropriate and sensitive history was obtained, that included her experience surrounding female genital

mutilation (FGM)/cutting (FGC), prior obstetric and pertinent gynecologic history, and her expectations regarding her current care. She relates a history of frequent urinary tract infections, urinary dribbling, chronic vaginitis, and dyspareunia. A thorough physical exam with a chaperone present was completed at her subsequent visit. Her pelvic exam was notable for nonvisualization of her clitoral glans and labia minora. Her labia majora and vaginal introitus appeared altered and scarred. She was diagnosed with Type 3 FGM/C.

She was educated on female reproductive anatomy, using culturally appropriate images and models. Surgical restoration of her external genitalia was recommended during her second trimester or at least 4–6 weeks prior to delivery.

At 20 weeks' gestation, she was counseled and consented, and underwent a defibulation procedure under regional anesthesia. An exam under anesthesia confirmed her prior physical exam findings. A mosquito clamp was placed through the narrowed vaginal orifice, under the cutaneous bridge of the scarred tissue and tented upward, to determine the length of the incision needed. The clitoral region was palpated to assess if a buried clitoris was present. Keeping the clamp in the midline and tented up, the scar was incised midline with Mayo scissors, inferiorly to superiorly, ending just beyond the urethral meatus, with care to avoid injury of her urethra or underlying clitoris. Her clitoris was visualized beneath the scar once the anterior incision was completed. The raw edges of the retracted tissue were sutured in a subcuticular fashion to prevent re-anastomosis, restoring her labia majora, minora and vaginal orifice. Her postoperative care included counseling on vulvar hygiene, expectations when urinating, and instructions for manual separation of the labia to avoid spontaneous adhesion. She returned in 2 weeks for postoperative care, and examination showed restoration of her anatomy. She resumed routine obstetric care and had a subsequent vaginal delivery at term that did not require any additional repair.

Female Genital Mutilation/Cutting

Female genital mutilation/cutting is a practice that involves the partial or total removal of the external female genitalia, or other injury, alteration, or manipulation of the female genital organs for nontherapeutic reasons. The WHO classifies FGM/C into four types, based on the extent of genital modification (Table 97.1, Figure 97.1) [1].

Table 97.1 WHO classification of FGM/C

Type 1	Partial or total removal of the prepuce/clitoral hood and/or the clitoral glans (clitoridectomy).
Type 1a	Removal of the clitoral hood or prepuce only.
Type 1b	Removal of the clitoris with the prepuce.
Type 2	Partial or total clitoridectomy and removal of the labia minora, with or without excision of the labia majora. There is no stitching of the raw edges but the raw surfaces of the labia majora or minor may fuse together during healing.
Type 2a	Removal of the labia minora only.
Type 2b	Partial or total removal of the clitoris and labia minora.
Type 2c	Partial or total removal of the clitoris, labia minora, and the labia majora.
Type 3	Also known as infibulation. It is the most severe form of FGM/C. Involves narrowing of the vaginal orifice by cutting and appositioning the labia majora and/or labia minora, often by stitching or otherwise sealing the raw edges. There may or may not be extensive injury to the clitoris. If the neointroitus is opened (for a vaginal delivery) and restitched, this is known as re-infibulation, and included in this definition.
Type 3a	Removal and apposition of the labia minora.
Type 3b	Removal and apposition of the labia majora.
Type 4	Any other form of nontherapeutic genital alteration, including pricking, piercing, incising, cauterizing, use of corrosive substances, scraping the vaginal orifice, stretching, and so on.

Approximately 200 million girls and women have undergone FGM/C, in approximately 30 countries across Africa, the Middle East, and Asia [2]. Given the rapid increase in global immigration trends, Ob/Gyns may increasingly encounter patients who have undergone FGM/C. The practice has no health benefits and is considered internationally as a violation of the human rights of girls and women [1]. In the United States, it is a federal crime to perform FGM/C on patients younger than 18, or to send or attempt to send her outside of the United States so an FGM/C procedure can be performed [3]. Immediate complications include severe pain, hemorrhaging (secondary to laceration of the dorsal artery of the clitoris or the labial branches of the pudendal artery), injury to adjacent genital tissue, and infection, including cellulitis, sepsis, tetanus, and occasionally abscesses. Genital tissue swelling, oliguria due to dehydration and urinary retention, shock, and death have been reported [3,4].

Obstetric complications are most likely to occur with Type 3 FGM/C [2,3]. The narrowed introitus may prohibit or limit bimanual exams, making monitoring labor challenging. Placement of intravesical and intracervical catheters, if clinically indicated, may be difficult. Labor may be obstructed and require an episiotomy or surgical opening of the narrowed vaginal orifice. Studies have documented an increased risk of CD, prolonged second stage of labor, perineal tears and infections, breakdown of perineal repair, and postpartum hemorrhage [4]. Fetal complications include low birth weight, increased need for neonatal resuscitation, lower Apgar scores, and intrauterine fetal demise. Inadequate cervical evaluation limiting accurate monitoring of labor, and difficulty placing

fetal scalp electrode and intrauterine catheter when clinically indicated also adds to prolonged labor and subsequent neonatal compromise [3,4].

Long-term complications include persistent urinary tract infections, dysuria, dysmenorrhea, dyspareunia, decreased or lack of sexual satisfaction, chronic vaginitis, infertility, fibrosis and keloid of genital tissue, fistula, hematocolpos, and psychological trauma [4,5].

Patients with Type 3 FGM/C and some with Type 2 should be evaluated for surgical restoration of their external genitalia by performing a defibulation procedure, ideally before pregnancy. If diagnosed at the time of pregnancy, defibulation should be performed during the second trimester or at least 4–6 weeks prior to delivery, allowing time for incisional healing and restoration of vaginal anatomy prior to labor. While intrapartum defibulation may also be performed, this is not the optimal time. Patients presenting with active labor may not have an opportunity for a deliberate, careful procedure, labial adhesion may recur in the postpartum period, and pain management may be suboptimal for patients who prefer to avoid regional anesthesia at the time of delivery.

Defibulation may be performed in an outpatient procedural clinic or operating room as a same day procedure. The surgical technique consists of performing a midline anterior incision, recreating labia majora and restoring the obstructed vaginal anatomy. Regional anesthesia is recommended. However, general or local anesthesia may be options, depending on the clinical circumstance. Some patients undergoing local anesthesia may experience flashbacks of their FGM/C experience and should be appropriately counseled prior to choice of anesthetic approach. During the procedure, a Shallcross or mosquito clamp is inserted below the infibulation scar in the posterior introital opening, and gently pulled distally to tent the underlying tissue. An intact clitoris or a clitoral stump may be palpated in the clitoral region. Care must be taken to avoid trauma to this region. To avoid labial asymmetry, the incision should be kept midline. The incision is made using a Metzenbaum or Mayo scissors, or Bovie electrocautery on cut mode, proceeding inferiorly to superiorly. The incision should extend just beyond the urethral meatus, with care to avoid incising or injuring the urethra. The labia majora and/or minora may be reconstructed by suturing the raw edges using absorbable suture in a subcuticular fashion bilaterally, or with interrupted horizontal mattress stitches [6].

If defibulation is performed intrapartum, the surgical steps are similar. The procedure should be performed during the second stage of labor to limit blood loss and patient discomfort. If the patient has not received regional anesthesia, local anesthetic should be injected along the midline scar. One to two fingers placed below the incision may protect the emerging head from injury. When the incision is made, the raw edges will retract as the head crowns. Scarring from infibulation may not stretch well, and an episiotomy may be clinically indicated to avoid severe anterior laceration. After

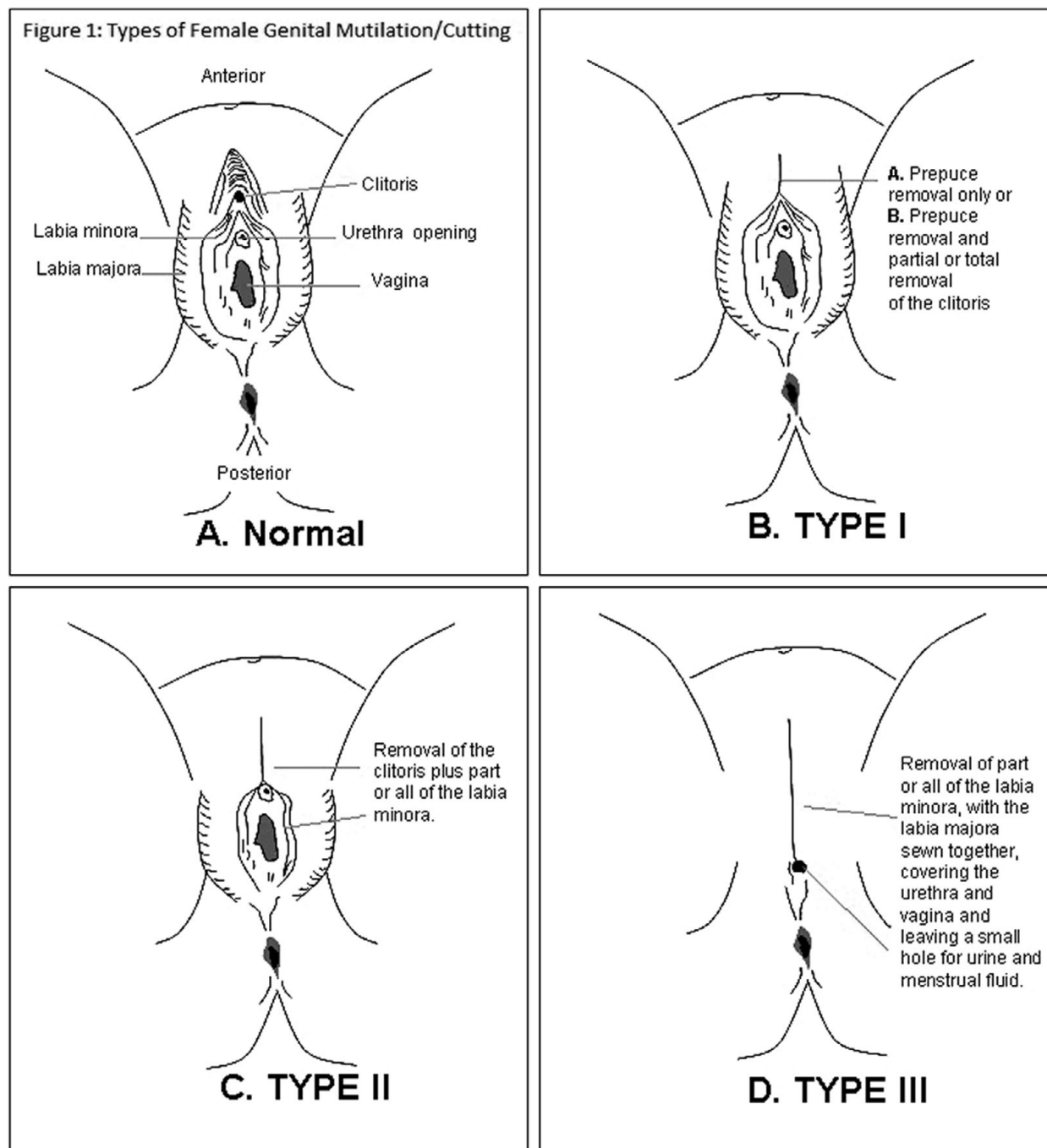


Figure 97.1 WHO classification of FGM/C

delivery, the retracted tissue is repaired along with any other obstetric lacerations.

In patients requiring more complex repair, for example, with distorted anatomy or severe keloid formation, referral to a female pelvic and reconstructive surgeon may be necessary prior to pregnancy or during the second trimester.

Key Teaching Points

- Female genital mutilation/cutting is considered a violation of human rights.

- The procedure can have severe infectious, gynecologic, urologic, obstetric, and psychological complications.
- Patients who have undergone FGM/C require counseling in a holistic, culturally competent manner, recognizing that their norms and understanding of obstetric and gynecologic care may be different from standard Western practices.
- More extensive forms of FGM/C may have worse obstetric outcomes.
- Defibulation is recommended prior to delivery for girls and women who have undergone FGM/C Types 2 and 3.

References

- 1 World Health Organization (WHO). Female Genital Mutilation. Fact Sheet No. 241, Updated Feb 2024. www.who.int/news-room/fact-sheets/detail/female-genital-mutilation (accessed October 28, 2024).
- 2 *Care of Women and Girls Living with Female Genital Mutilation: A Clinical Handbook*. Geneva: World Health Organization; 2018.
- 3 American College of Obstetricians and Gynecologists' Task Force on Female Circumcision/Female Genital Mutilation. *Female Genital Cutting: Clinical Management of Circumcised Women*, 2nd ed. Washington, DC: American College of Obstetricians and Gynecologists, 2007.
- 4 Sarayloo K, Latifnejad Roudsari R, Elhadi A. Health Consequences of the Female Genital Mutilation: A Systematic Review. *Galen Med J*. 2019;8:e1336.
- 5 Pérez-López FR, Ornat L, López-Baena MT, et al. Association of Female Genital Mutilation and Female Sexual Dysfunction: A Systematic Review and Meta-analysis. *Eur J Obstet Gynecol Reprod Biol*. 2020;254:236–244.
- 6 Anand M, Stanhope TJ, Occhino JA. Female Genital Mutilation Reversal: A General Approach. *Int Urogynecol J*. 2014;25(7):985–986.

Index

- abdomen
 cramping, 54, 124, 215
 pain, 19, 57, 94, 95, 174, 175
 trauma, 26, 71–72, 89
 wall bulge, 83–84
abdominoplasty, 84–85
abortion, 15, *see* termination of pregnancy.
abscess, 58, 196, 221, 222, 305
 breast, 49–50
absent fetal movement, 91
ACE (angiotensin-converting enzyme), 206
acetaminophen, 22, 23–24, 208, 219, 221, 222
acute respiratory distress syndrome (ARDS), 82
acyclovir, 128, 129, 132, 133
adenocarcinoma, 11
advanced cardiac life support (ACLS), 177, 180, 181, 182
alpha-thalassemia, 113
amniocentesis, 26–27, 120, 154–155, 229, 242, 243
amnion, 5, 7, 14, 238, 252–253, 278
amniotic cavity, 5, 155, 156
amniotic fluid, 69, 70, 154–155, 211–212, 261, 263
amniotic fluid embolism, 211
amniotic fluid index (AFI), 100, 149, 150, 261–265
amniotic membranes, 38, 88, 236
analgesics, 22, 24, 55, 184, 219
anal sphincter, 171, 173
anatomy ultrasound, 40, 42, 258, 260, 261, 272
anemia, 109, 112–114, 246, 249, 250, 272
 fetal, 28, 135
 mild, 94, 113, 245, 249
 sickle cell, 33–34, 113, 134, 199
anesthesia, 52, 175–176, 187, 188, 207, 208
 general, 52, 174, 175, 216, 247
 neuraxial, 51–52, 150, 174, 200–201, 208, 209
aneuploidy, 8, 41–42, 149, 242, 243, 265
angiotensin-converting enzyme (ACE), 206
angiotensin-receptor blockers (ARBs), 206
antibiotic prophylaxis, 64, 67, 81, 170, 173, 198
antibiotics, 155, 156, 196, 197, 198, 222–223
 perioperative, 217
antidepressants, 16–18, 297
antiphospholipid antibody syndrome, 90, 104
anxiety, 17, 41–42, 46–47, 202–203, 298–299
appendicitis, 19, 43, 57–58, 198
arthritis, 93, 131, 137, 138–139, 219
 crystal-induced, 139
asplenia, 33–34
atropine, 212–213
aura, 23
basal plate myometrial fibers, 258, 260
beta-thalassemia, 112–113
bicornuate uterus, 29–30, 267–268
biopsy, 10, 11, 50, 77
 cervical, 11–12
 core needle, 50
bipolar disorder, 202, 203, 295, 296, 297
Birth in Brazil study, 8
birth weight, 30, 97–98, 190, 233
bladder, 37, 51, 52, 167–169, 244, 246
 fetal, 238, 261
bleeding, vaginal, 5, 54, 249, 252, 254–255, 275
bloating, 85, 95
blood loss, 193, 194, 216, 247, 250–251
blood transfusions, 156, 163, 165–166, 175–176, 247, 250
body mass index (BMI), 1, 84
Boston Carpal Tunnel Questionnaire, 92, 93
breast
 abscess, 49–50
 biopsy, 48, 49
 cancer, 48, 49, 50
 mass, 48–50
breast milk, 16, 49, 119, 202, 221
breast pumps, 222
breech delivery, 37, 149–151, 153, 235, 236–237, 272
breech presentation, persistent, 64, 149, 267
brow presentation, 152–153, 289
buprenorphine, 289, 290–291
butalbital, 24
caffeine, 23–24, 209
calyces, 82
cancer, 1, 10–12, 34, 49
 adenocarcinoma, 11
 breast, 48, 49, 50
 cervical, 10–11, 284
 colon, 94
captopril, 206
cardiac arrest, 178, 179, 181, 212, 213
cardiology, 200, 205, 206–207
cardiomyopathy, peripartum, 200, 205, 206, 207
cardiovascular disease, 98, 179, 181, 194
carpal tunnel syndrome, 92–93
CBT (cognitive behavioral therapy), 17, 203
ceftriaxone, 137, 139
cerclage, 37, 38–39, 64, 269
cerebrospinal fluid, 208–209
cervical cancer screening, 2, 10, 12, 117
cervix
 dysplasia, 11
 examination, 65, 87, 141–142, 146, 183
 insufficiency, 37–39, 275
 intraepithelial neoplasia, 10–12
 measurement, 62
 polyps, 275–276
 ripening, 62, 87, 141–142
cesarean delivery, 174, 269, 300
 bladder injury, 169
 breech delivery and, 150–151
 counseling, 100
 emergency, 8, 157, 165, 168, 176, 250
 emergent, 58
external cephalic version, 150
extreme prematurity, 64
failed induction of labor, 141–142
fibroids and, 273, 274
hemorrhage, 193
hernia and, 85
HIV and, 117
HSV and, 130
impacted fetal head, 161
maternal request, 300
monochronic monoamniotic (MCMA) gestations, 9
preterm, 52
prolonged latent phase of labor, 144
scheduled, 98, 169, 175, 200, 233, 234
trial of labor after cesarean delivery (TOLAC), 168
twin pregnancy, 235–236, 237
uterine anomalies, 30, 52
uterine extension and, 165
uterine rupture, 174, 176
vaginal assisted, 162
chicken pox, 32, 131
chlamydia, 115, 121, 137, 139, 198, 252
cholecystitis, 43, 69, 198
chorioamnionitis, 62, 154–156, 197, 198, 258–259
chorion, 5, 7, 8, 252–253, 276–277, 278
clonazepam, 16, 17
Clostridium perferingens, 125
cognitive behavioral therapy, 17, *see* CBT.
colon, 48, 49, 94
colposcopy, 10, 11–12
coma, 107, 225, 290
complete blood count (CBC), 112–113, 249, 250, 272, 289, 290
comprehensive metabolic panel (CMP), 104, 295
computed tomography (CT), 5, 58, 79, 84, 226
conception, 2–3, 196, 197, 198, 215–216, 217
condoms, 115, 117–118
congenital anomalies, 20, 29–30, 33, 135, 235

- constipation, 20, 52–54, 94–95, 109, 173
- contraception, 1, 2, 14, 199
- contraceptives, 207
- cord clamping, delayed, 183
- cordocentesis, 26, 27
- cord traction, excessive, 184
- corticosteroids, 20, 24, 70, 155
- counseling, 1–2, 16, 66, 67, 233–234, 269, 283–284
- delivery modes, 233
- during pregnancy, 16, 67, 104, 267
- medication exposure, 16
- genetic screening, 2, 40, 42, 231
- HIV in pregnancy, 116
- mastitis, 223
- preconception, 1, 2, 3, 18
- risk factors, 15, 65, 79, 90
- Couvellaire uterus, 257
- COVID-19, 32, 34
- vaccinations, 1, 2
- cystic fibrosis, 1, 2
- cysts, 43, 78, 222
- choroid plexus, 41
- ovarian, 4, 44, 78, 109
- cytomegalovirus, 27, 90, 119–120, 231, 259
- decidua, 5, 38, 245, 253, 276
- decidual polyps, 276–277
- deep vein thrombosis (DVT), 199–200
- delivery, 62–65, 69–71, 157–159, 180–182, 233–237, 272–274
- breech, 37, 149–151, 153, 235, 236–237, 272
- forceps, 153, 157–160, 171, 216, 219, 277
- planning, 9, 29, 30, 117, 245, 246, 273–274
- see also* cesarean delivery.
- depression, 16–17, 202–203, 283, 296
- moderate, 202, 204
- screening for, 17, 283
- untreated, 16
- dermatitis, 138
- diabetes, 33, 97–98, 99, 113–114, 234, 262
- family history, 199, 233
- gestational, 7–8, 232, 233, 235, 261
- diarrhea, 19, 75, 77, 124, 125, 126
- diastasis, 84–85, 218, 219
- diastasis recti abdominis, 84, 85
- diazepam, 102, 187
- diethylstilbestrol, 38
- digital breast tomosynthesis (DBT), 49, 203
- digoxin, 205, 206
- disseminated gonococcal infection, 137–139
- domestic violence, 1, *see* intimate partner violence.
- Down's syndrome, 40, 42, 243
- dyspareunia, 47, 304, 305
- early pregnancy, 1, 16, 17, 22, 52, 113
- Ebstein's anomaly, 17
- echogenic intracardiac focus, 40–41, 42
- eclampsia, 100, 101–102, *see also* preeclampsia
- ectopic pregnancy, 4, 26
- edema
- ovarian, 44
- pulmonary, 81, 101, 104, 206, 211, 212
- stromal, 221–222
- Edinburgh Postnatal Depression Screen, 202–203
- Ehlers–Danlos Syndrome, 38
- embolism, amniotic fluid, 211
- EMDR (eye movement desensitization and reprocessing), 299–300
- emollient laxatives, 95
- enalapril, 205, 206
- encephalitis, 23, 131, 132
- encephalopathy, 225
- endocarditis, 138–139
- endocervix, 276–277
- endometrial polyps, 275–277
- endometritis, 196, 197, 198, 216, 260
- postoperative, 216–217
- endometrium, 184, 216, 217, 272, 275, 276
- enterococci, 196, 198
- erythema, 33, 137, 138, 196, 199, 221–222
- erythema infectiosum, 134, *see* fifth disease.
- estrogen, 20, 49, 55, 84, 94, 219
- examination
- abdominal, 4, 57, 66, 193
- cervical, 102, 141, 143, 152, 165, 292
- expectant management, 37, 50, 88, 144, 153, 276–277
- external cephalic version, 26, 149–151, 236–237, 267, 269
- face presentation, 152–153, 159
- family history, 1, 48, 49, 112, 199, 201
- fatigue, 22–23, 46, 109, 110, 143, 144
- fecalith, 58
- female genital mutilation/cutting, 304–306
- Female Sexual Function Index, 46
- fetal anemia, 26–28, 72, 135–136
- fetal aneuploidy, 242–243, 244
- fetal death, 27, 37, 70, 71–72, 89–91, 239–240
- fetal growth restriction, 113–114, 206, 229–241, 259–260, 264–265
- fetal maternal hemorrhage, 26, 27, 72, 73, 90
- fetal pillow, 163
- fetus
- continuous monitoring, 61, 67, 71, 72, 175, 179
- demise, 27, 37, 70, 71–72, 89–91, 239–240
- impacted head, 161–163, 166
- monitoring, 67, 69, 71, 72–73, 123, 143
- vascular malperfusion, 258–259, 260
- fibroids, 4, 51, 52–56, 78, 272–275
- degeneration, 54, 55
- growth, 55–56, 274
- large, 55, 272–273
- fifth disease, 134, 136
- flank pain, 57, 78–79, 82, 83
- Foley bulb, 157, 169
- food-borne illness, 124
- forceps delivery, 153, 157–160, 171, 216, 219, 277
- galactoceles, 49–50, 222
- ganciclovir, 120
- gender-nonconforming parents, 2
- genetic histories, 1, 2
- genetic screening, 8, 40, 261
- genetic testing, 1, 2, 3, 8, 89–90, 113
- genital lesions, 129
- gentamicin, 154, 155, 196, 197, 198
- gestational diabetes, 7–8, 232, 233, 235, 261
- gestational hypertension, 7, 100, 102, 144, 224, 256
- gestational sac, 4
- gestational trophoblastic disease (GTD), 14–15
- gonorrhea, 115, 121, 137–139, 275
- disseminated gonococcal infection, 137–139
- Graves' disease, 106–107
- group B streptococcus (GBS), 61, 62, 90, 196–197, 267
- Hashimoto's thyroiditis, 110, 111
- Hasson technique, 43, 44–45
- headache, 19, 22–23, 208–209, 224–225, 226
- cluster, 22, 209
- medication overuse, 24
- migraine, 20, 22–24, 209
- refractory, 101
- severe, 23, 24, 225
- heart failure, 107, 179, 205, 206, 207
- heat intolerance, 106
- hematoma, 5, 166, 167, 256
- expanding, 166–167
- hemoglobinopathies, 2, 112–113, 114
- hemolysis, 103–104, 113
- hemolysis, elevated liver enzymes, and low platelets (HELLP) syndrome, 101, 103–105, 225
- hemolytic uremic syndrome (HUS), 104
- hemorrhage, 141–142, 178–179, 183–184, 186, 250, 251
- hepatitis, 29, 32, 33–34, 115, 132, 252
- hernia, ventral, 84–85
- herpes, 76, 119, 128–130, 131, 132, 231
- genital, 128
- neonatal, 128, 130
- herpes gestationis, 76
- HIV, 33–34, 115–118, 121–122, 123, 137, 197
- homelessness, 32, 33–34
- human papilloma virus, 1, 10–11, 32, 34
- hydronephrosis, 78, 81–83, 242–243, 244
- hydrops fetalis, 26–27, 132, 135–136, 239
- hydroureter, 81–83
- hyperemesis gravidarum, 7, 19–21, 202
- treatment of, 20, 21
- hyperlactation, 221, 222
- hypertension, 103, 104–106, 179, 205–206, 255–256
- hyperthyroidism, 106–107
- hypoglycemia, 104, 231, 233, 298
- neonatal, 97
- hypothyroidism, 94, 107, 109, 110–111
- hysterectomy, 166–167, 168, 169, 198, 247, 251
- IAI (intra amniotic infection), 154–155, 156
- ibuprofen, 24, 196, 208, 218
- idiopathic polyhydramnios, 262
- imaging studies, 5, 72, 198, 226, 256, 289
- immunization, 2, *see* vaccination.
- immunoglobulin C, 119, 120, 122, 134, 135, 136
- immunoglobulin G, 26
- impacted fetal head, 161–163, 166
- induction of labor, 90, 141, 142, 144, 190, 232
- failed induction, 141, 142
- fetal macrosomia, 233
- HELLP syndrome, 103
- intrauterine fetal demise, 90
- postterm pregnancy, 88
- retained placenta, 67
- uterine rupture, 88, 175
- infertility, 2, 30, 267–269, 275, 284
- inflammation, 58, 154–155, 156, 219, 221–222, 275–276

- influenza, 32, 34
 insulin, 98–99, 180, 189, 233
 intercourse, 4, 46, 47, 250
 interuterine fetal demise, 89–91, 122
 intimate partner violence, 1, 2, 71, 73, 286–288
 intraamniotic infection (IAI), 58, 155, 156, 256
 intrahepatic cholestasis of pregnancy (ICP), 69–70, 76
 intrauterine balloons, 195, 211, 216
 intrauterine fetal demise (IUFD), 77, 89, 107, 258, 262, 270
 isoimmunization, 26–28, 72
 itching, 33, 69–70, 75, 77, 290
 Jarisch–Herxheimer (JH) treatment reaction, 123
 Kleihauer–Betke test, 71, 256, 257
 labor
 active phase, 141–144, 146–147, 148, 208, 211
 latent phase, 141–144
 induced labor, 141–142
 preterm, 9, 38, 47, 54–55, 58, 61–62, 66–67
 see also induction of labor.
 labor augmentation, 65, *see* induction of labor.
 lactation, 16, 17–18, 49–50, 92, 93, 206
 lactational adenomas, 48, 49–50
 laparotomy, 38, 52, 184
 latent labor, 141–144
 latent phase, induced labor, 141–142
 laxatives, 95, 173
 osmotic, 95, 109
 leiomyomata, 55
 LGBTQIA+ patients, 2
 libido, 46
 limited English proficiency patients, 292–293, 294
Listeria monocytogenes, 124–126, 259
 lithium, 17
 macrosomia, 87, 97, 98, 193, 232–234
 magnesium sulfate, 24, 62, 101–102, 103, 104, 224–225
 magnetic resonance imaging (MRI), 23, 30, 57–58, 79, 226
 malformations, 33, 131
 congenital, 17, 20, 32, 44
 mammography, 49, 50
 marginal hematoma, 5
 masses, multicystic intrauterine, 13
 mastitis, 221, 222, 223
 bacterial, 221, 222
 idiopathic granulomatous, 49–50
 maternal deaths, 17, 20, 72, 181, 193, 197
 maternal vascular malperfusion, 258–259, 260
 median nerve, 92–93
 medication overuse headache (MOH), 24
 membrane rupture, 65, 117, 118, 147, 149, 265
 premature, 55, 72, 130, 139, 161, 239–240
 preterm, 38, 253
 mental health, 18, 202–204, 284, 285, 298–299
 anxiety, 17, 41–42, 46–47, 202–203, 298–299
 mentum anterior/posterior, 153
 methicillin-resistant *Staphylococcus aureus* (MRSA), 222
 methimazole, 107–108
 methotrexate, 50, 247
 methylprednisolone, 20–21
 middle cerebral artery (MCA), 26, 27, 135
 migraine headaches, 20, 22–24, 209
 miscarriage, 5, 16, 17, 33, 46, 47
 modifications, lifestyle, 1, 49, 77, 79, 95, 98–99
 molar pregnancy, 13–15, 19
 monochorionic monoamniotic (MCMA) gestations, 9
 motor vehicle accidents, 71–72, 73
 MRI, 5, *see* magnetic resonance imaging.
 Müllerian anomalies, 30, 38, 267–271
 multifetal gestations, 62, 100, 199, 229, *see also* twin pregnancies.
 multiple gestation, 19–20, 90, 91, 149, 193, 279
 muscle cramps, 109, 110
 myomectomy, 56, 174–175, 273–274
 naloxone, 291
 naltrexone, 290
 nausea, 19, 20, 22–23, 57, 194, 209
 nausea and vomiting, 19, 20, 43, 44, 55, 81
 necrosis, 55, 222
 neonatal abstinence syndrome, 24, 290, 291
 nephrolithiasis, 54, 78–80, 82
 neurosyphilis, 121, 123
 neutrophils, 78, 137, 139, 259
 nipple inversion, 48
 nipple shields, 222
 nonsteroidal anti-inflammatory drugs (NSAID), 23, 56, 171, 223, 273
 nontreponemal tests, 122
 nucleic acid amplification tests, 10, 122, 129, 130, 137
 nulliparous patients, 77, 121, 142, 149
 obesity, 84, 98, 165, 180, 199
 pre-pregnancy, 181, 232
 obstetric care, 290, 302
 Obstetric Care Consensus on Periviable Birth, 67, 147, 258
 oligohydramnios, 87–88, 229, 231, 238–239, 252, 264–266
 ondansetron, 20, 212–213
 operative vaginal delivery (OVD), 157
 opioid use disorder, 289–290, 291
 osmotic laxatives, 95, 109
 ovaries
 cysts, 4, 44, 78, 109
 torsion, 43–44
 oxytocin, 141–142, 144, 161, 183, 186–187, 192–194
 pain
 intractable, 79
 pelvic, 4, 7, 43–44, 54, 55, 78
 palate, 17, 262
 pancreatitis, 19, 43, 198
 paroxetine, 17
 parvovirus B19, 90, 134–136
 paternity, 26–27, 28
 patient counseling, 15, 66, 117, 263, 265, 269
 patient portals, 42
 PCR (polymerase chain reaction), 120, 122, 129, 135
 PDPH (post-dural puncture headache), 208–209
 PE (pulmonary embolism), 199, 200, 206, 212
 peak systolic velocity (PSV), 27, 135, 240
 pedicle, vascular, 44
 pelvic pain, 4, 7, 43–44, 54, 55, 78
 perineal laceration, 171, 172, 173, 189, 298
 peripartum cardiomyopathy, 200, 205, 206, 207
 Pfannenstiel incision, 295
 Phalen test, 92, 93
 pillai, 29
 placenta, 254
 abdominal trauma and, 72
 abruption, 38, 72, 90, 255–257, 269–270
 accreta, 150, 184, 216–217, 245, 250, 251
 blood flow, 231
 circumvallate, 252–254
 edge, 247, 250–253
 percreta, 245
 previa, 246, 249–250, 251, 255–256, 278–279
 removal, 184, 186, 187–188
 retention, 187, 188
 separation, 188
 twin pregnancy, 8
 ultrasound imaging, 256
 poliovirus, 33
 polyhydramnios, 82, 149, 152, 238–239, 241, 261–263
 polymerase chain reaction (PCR), 120, 122, 129, 135
 polypectomy, 275, 276–277
 polyps, 4, 275–277
 post-dural puncture headache (PDPH), 208–209
 postpartum hemorrhage, 7, 250, 251, 272–273, 274
 postpartum psychosis, 202, 295–296, 297
 posttraumatic stress disorder, 298–300, 302
 posture modification devices, 95
 preconception care, 2, 32
 preconception counseling, 1, 2, 3
 preeclampsia, 5, 7, 103–104, 209, 226, 231
 pregnancy-associated breast cancer, 49
 pregnancy tests, 4, 110
 prenatal care, 121, 283, 285, 289–290
 prenatal visits, 4, 5, 7, 46, 48, 283
 presentation
 breech, 64, 149, 267
 brow, 152–153, 289
 funic, 279
 mentum, 153
 preterm labor, 38, 47, 54–55, 58, 61–62, 66–67
 preterm premature rupture of membranes, 62, 65, 67, 252, 267–270
 progesterone, 49, 55, 82, 84, 94, 178
 propylthiouracil, 107
 proteinuria, 100–101, 103, 104, 105, 224
 prurigo of pregnancy, 75–76
 pruritic urticarial papules and plaques of pregnancy, 75
 psychosis, 107, 202–203, 295–297
 pubic symphysis, 46, 51, 106, 153, 218, 219
 pulmonary embolism (PE), 199, 200, 206, 212
 pulseless electrical activity), 181
 pyelonephritis, 19, 79, 81–83, 198
 pyridoxine, 20
 rash, 69–70, 75–76, 131–132, 134, 197
 red blood cells (RBCs), 26, 27, 104, 113–114, 194, 211
 relaxin, 84, 219
 resuscitation, 178, 179, 180, 211–212

- retained products of conception (RPOC), 216–217
- Rhesus D immune globulin, 27, 71, 72, 150, 256, 257
- risk, absolute, 125, 126, 150
- rubella, 32–33, 120, 231
- Rubin maneuver, 190
- SARS-CoV-2, 259
- seizure, 23, 24, 100, 101–102, 224–225, 226
- sertraline, 16, 17, 202, 203
- sexual (dys)function, 46–47, 287
- shoulder dystocia, 87, 97, 98, 189–192, 232, 233–234
- sickle cell anemia, 33–34, 113, 134, 199
- smoking, 13, 90, 91, 197
cigarette, 33, 256
- sonohysterography, 216
- spinal muscular atrophy (SMA), 2
- Squatty Potty, 95
- stillbirth, 9, 33, 69, 98, 258–260
- subchorionic hematoma, 4–5, 254
- syphilis, 90, 121–123, 252, 259
latent, 121, 122–123
- teratogenicity, 17
- Term Breech trial, 149, 150
- termination of pregnancy, 58, 65, 67, 238, 239, 241
- thalassemia
alpha, 113
beta, 112–113
- thromboembolism, 52, 206
venous, 141, 179, 199, 201
- thrombophilia, 201
- thrombotic thrombocytopenic purpura (TTP), 104
- thyroid disease, 1, 106–111
hyperthyroidism, 106–107
screening, 107
thyroid storm, 14, 107–108
- thyroid stimulating hormone (TSH), 106–108, 109, 110, 295, 296
- tocolytics, 62, 64, 67, 150, 184
- tocometry, 61, 65, 66, 71, 72, 283
- trial of labor after cesarean delivery (TOLAC), 88
- twin gestations, uncomplicated, 235
- twin pregnancies, 7–9, 76, 235–236, 237, 239–241
diamniotic, 81, 236, 237, 238
dichorionic, 235
dizygotic, 7
mono chorionic, 235, 238, 278
monoamniotic, 237
mono chorionic diamniotic, 238, 240
monozygotic, 7
- twin-twin transfusion syndrome, 8, 235
- ultrasonography, 44, 79, 80, 104, 216, 233
- ultrasound
appendicitis, 57
breast cancer screening, 49
- fetal soft markers, 41–42, 243
- fetal weight estimation, 233
- infections, 132
- placenta accreta, 250
- placental abruption, 256
- polyhydramnios, 262
- polyps, 276–277
- postnatal renal, 243–244
- retained placental tissue, 187, 197
- subchorionic hematoma, 5
- uterine anomalies, 30, 55–56, 273
- umbilical cord, 89–90, 183–184, 186, 259–260, 278–281
- unicornuate uterus, 30, 267–268
- urethra, 29, 252, 304, 305
- urinalysis, 51, 54, 78, 79, 81, 83
- urinary dribbling, 304
- urinary tract, 78–79, 168, 242–243, 244
- urinary tract infection (UTI), 78, 79, 82, 304, 305
- uterine anomalies, 29–31, 149, 186
- uterine incarceration, 51–52
- uteroplacental apoplexy, 257
- uterus
bicornuate, 29–30, 267–268
didelphys, 30, 267
- vaccines, 2, 32–34, 131, 132
acceptance, 32
dengue fever, 33
- influenza, 33–34
- live, 33, 132
- measles, mumps, and rubella (MMR), 2, 32–33
- meningococcal conjugate, 32
- pneumococcus, 33
- polysaccharide, 33
- preconception, 32
- typhoid, 33–34
- vaginal bleeding
first trimester, 15
placental abruption, 90
second trimester, 14
- valacyclovir, 120, 128, 129–130, 132, 238
- varicella, 2, 32, 33–34, 131–133
congenital, 132
neonatal, 132
vaccines, 32–33, 131–133
- varicella zoster immune globulin, 131, 132–133
- vasa previa, 250, 278–281
- velamentous cord insertion, 250, 278–279, 281
- venous thromboembolism, 43, 141, 179, 194, 199, 201
- ventral hernia, 84–85
- Wernicke encephalopathy, 20, 21
- whirlpool sign, 44
- Woods Screw maneuvers, 190
- yellow fever, 33
- zidovudine, 115, 117, 118

