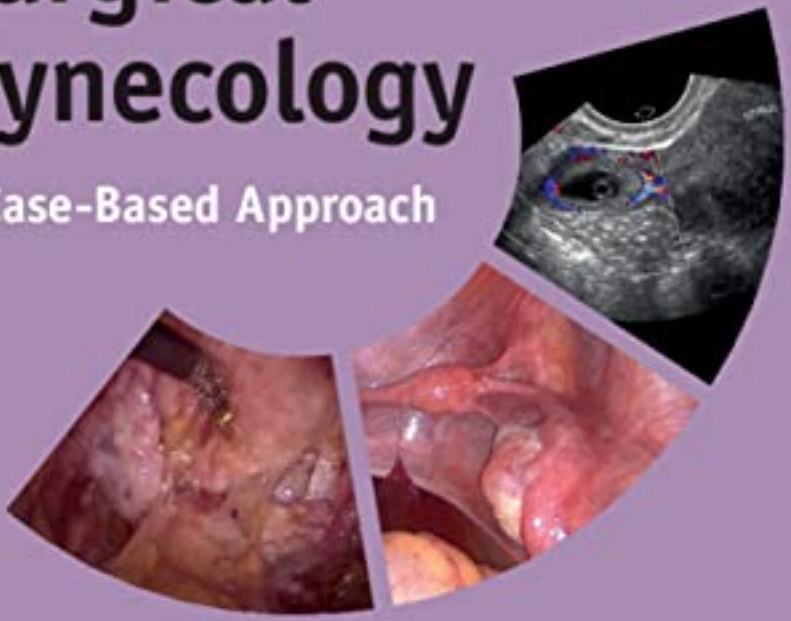
Surgical Gynecology

A Case-Based Approach



EDITED BY:
Todd R. Jenkins, Lisa Keder,
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Preface

Despite advances in the medical management of gynecologic conditions, many common disorders continue to require surgical intervention to resolve. Our patients literally put their life in our hands each time they agree to a gynecologic procedure. As a result, it behooves each gynecologic surgeon to be prepared to provide the best care possible to each and every patient. Many books and references are available covering surgical anatomy or specific techniques in gynecology; however, nearly all of these references are traditional textbooks. Research has demonstrated that contemporary practitioners and learners are more comfortable with a case-based approach to learning since, in practice, problems present themselves as cases in the form of real patients.

Surgical Gynecology: A Case-Based Approach was designed with this educational preference in mind. In this textbook, our authors present common problems encountered during gynecologic surgery in a case-based format. Similar to the SASGOG written book *Office Gynecology: A Case-Based Approach*, this book is designed to both be read cover-to-cover as a comprehensive guide and is also suitable as a quick reference when similar cases present in the course of patient care.

We chose approximately 90 common surgical situations for this book. Most were chosen because they are frequently encountered surgical dilemmas in practice; however, we also included some unusual but highly interesting cases. The cases in *Surgical Gynecology: A Case-Based Approach* are divided based on the surgical approach to the procedure: hysteroscopic, laparoscopic, robotic, transvaginal, and abdominal. The authors have also attempted to ensure that the cases cover the entire spectrum of surgical gynecology from preoperative to intraoperative to postoperative challenges.

As we constructed the cases included in this book, we encouraged our authors to base their writing and recommendations on previously published clinical guidelines that were created by national organizations and based on high quality evidence. Unfortunately, in many surgical situations, national guidelines do not exist. In these cases without high-quality evidence, we present the best evidence available for management combined with carefully reasoned expert opinion in order to bridge the gaps in the available evidence.

The cases were written to be of particular relevance to specialists in general obstetrics and gynecology, but are intended to be useful to anyone caring for women undergoing gynecologic surgery. We are very grateful to our extensive team of authors. All authors are members of the Society for Academic Specialists in General Obstetrics and Gynecology (SASGOG). Without their hard work and dedication to the education of women's health care providers, this book would not be possible. We hope you find this book both educational and a trusted reference as you care for your patients.

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CASE 1

A 45-Year-Old Woman Undergoing Hysterectomy Requests Oophorectomy

Sarah Alhaddad Tout

History of Present Illness

A multiparous, 45-year-old woman presents for preoperative evaluation. She has a long history of abnormal uterine bleeding that has been inadequately managed with her current levonorgestrel intrauterine device. She now desires definitive surgical management by hysterectomy. During her visit today, she requests that her ovaries be removed during the surgery. She shares that a good friend recently passed away after a long battle with ovarian cancer and she wants to lower her own risk of ovarian cancer as much as possible. Her past medical history includes depression managed on escitalopram 20 mg daily, and borderline hypertension currently managed with lifestyle modification. She has had no prior surgery.

Her gynecologic history is otherwise unremarkable. Her social history is remarkable for moderate alcohol use. There is no family history of ovarian cancer or premature atherosclerotic disease. She has a paternal aunt with postmenopausal breast cancer and her mother developed dementia at age 77.

Physical Examination

General appearance: 45-year-old adult, well-developed and well-nourished, in no apparent distress

Vital signs:

Temperature: 37.1°C

Pulse: 78 beats/min

Blood pressure: 138/89 mmHg

Respiratory rate: 16 breaths/min

Height: 65 inches

Weight: 172 lb

BMI: 28.6 kg/m^2

Cardiopulmonary: Unremarkable

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-sacs unobstructed, uterus slightly enlarged with several small fibroids palpable, mobile with grade 1 prolapse and good descensus, normal adnexa with no masses or tenderness appreciated

Neuro/psych: Alert, affect and mood appropriate to situation, good insight and judgment

Laboratory studies:

Hb: 11.4 g/dL (normal 12.1–14.4 g/dL)

Pathology: Endometrial biopsy demonstrates disordered proliferative endometrium with glandular and stromal breakdown

Imaging: Pelvic ultrasound demonstrates an anteverted, anteflexed uterus measuring 11.4 × 6.3 × 6.1 cm, endometrial thickness 8 mm with endometrial stripe slightly distorted by intramural and submucosal fibroids, the largest measuring 4.5 × 4.1 × 3.8 cm, and unremarkable adnexa

How Would You Manage This Patient?

This patient presents requesting oophorectomy at the time of hysterectomy. A careful review of her own medical and family histories is not suggestive of endometriosis, an inherited cancer syndrome, or otherwise increased risk of malignancy. Conversely, her personal and family history raises concern for the risk of several conditions that might be worsened by the loss of endogenous estrogen production. This premenopausal patient was counseled that, weighing the risks and benefits of the procedure, elective oophorectomy is not recommended. Specifically, she was informed of the potential risks of surgical menopause including effects on cardiovascular, neurologic, bone, and psychological/emotional health. She was also advised of option of salpingectomy at the time of hysterectomy as a risk-reducing strategy. The patient underwent total vaginal hysterectomy with bilateral salpingectomy. Intraoperative inspection of the ovaries was normal. She was discharged to home on the same day and was doing well at her visit six weeks postoperatively. Physical examination demonstrated a well-healed vaginal cuff. She was advised that, given her lack of any history of cervical dysplasia, she would no longer require routine screening for cervical cancer.

Elective Oophorectomy

This patient presents requesting additional surgical intervention, oophorectomy, which, on the surface, is not pertinent to her presenting complaint of abnormal uterine bleeding. As in all cases, however, in addition to providing the patient with evidence-based counseling and recommendations, careful attention must be paid to the patient's own history, as well as her background knowledge and values, which are driving her request. In this case, the patient has shared fears about ovarian cancer, a relatively rare condition, based on the experiences of a close friend, but non-relative. Historically, routine oophorectomy at the time of hysterectomy for benign indications was accepted practice to reduce ovarian cancer-related mortality. More recently, however, this practice has come to be generally discouraged, due to low rates of ovarian cancer, and findings from several large studies regarding potential long-term health impacts of oophorectomy. The lifetime risk of ovarian cancer in the general population is at 1.3%. The majority of ovarian cancers are diagnosed at a late stage, and, to date, no screening program has demonstrated effectiveness in decreasing mortality rates from this disease [1]. With no effective screening program available, primary prevention against ovarian malignancy, via

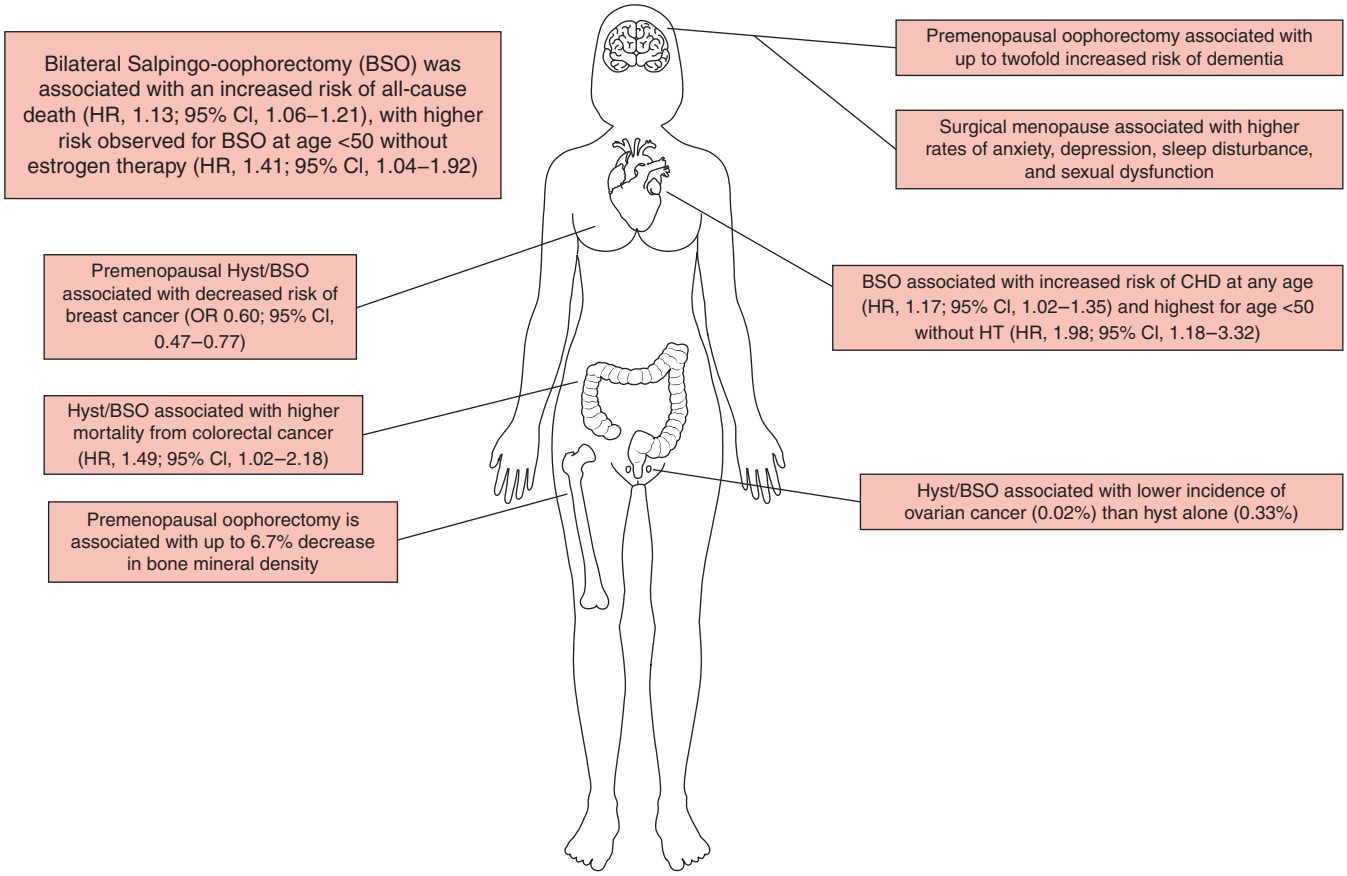

Figure 1.1 Effects of bilateral salpingo-oophorectomy.

oophorectomy, for those women approaching the age of menopause therefore once seemed a reasonable strategy. Additionally, ovarian retention was thought, potentially, to expose the patient to the risk of additional surgery for subsequent benign ovarian pathology. Ovarian retention was also posited to leave the patient at increased risk of breast cancer due to ongoing estrogen exposure. The sequelae from loss of endogenous estrogen production for those women, who underwent oophorectomy, it was reasoned, could be avoided via exogenous replacement. Unfortunately, more recent research has demonstrated that hormone therapy is not a viable strategy for the primary prevention of serious and potentially fatal conditions such as coronary heart disease (CHD), breast cancer, dementia, or osteoporosis, and increases the risk of stroke and thromboembolic disease [2, 3]. Data now show that, while those with elective oophorectomy at the time of hysterectomy were at lower risk of death from ovarian cancer, rates of all-cause mortality were higher after elective oophorectomy than with ovarian preservation [4, 5]. Additional concerns related to the early loss of endogenous estrogen production include elevated rates of cognitive decline, depression, anxiety, sexual dysfunction, and osteoporosis (Figure 1.1) [5, 6].

The routine practice of oophorectomy at the time of hysterectomy also confers additional surgical risk beyond that of the hysterectomy itself. For instance, that ligation of the infundibulopelvic ligament is a common point of ureteral injury during gynecologic surgery. Thus, oopherectomy for this patient would increase surgical risk without added benefit in the treatment of her presenting complaint. Evidence against the practice of elective oophorectomy has become so abundant that the majority of societies related to the field of obstetrics and gynecology recommend against it. The preponderance of evidence led the American Association of Gynecologic Laparoscopists to recommend, as the second item in its top-five list of practices to be avoided, "Do not perform routine oophorectomy in premenopausal women undergoing hysterectomy for non-malignant indications who are at low risk for ovarian cancer." [7]

However, while oophorectomy in premenopausal women should not be done routinely, there are, of course, situations in which oophorectomy should be considered, or even recommended, for women prior to the age of menopause. The performance of risk-reducing salpingo-oophorectomy (RRSO) in premenopausal women with hereditary breast and ovarian cancer syndrome is accepted practice [8]. In women for whom the risk of ovarian cancer is high, RRSO is preferred and hormone therapy is considered safe and effective for the treatment or prevention of a multitude of sequelae from the loss of endogenous estrogen production [6].

Finally, for low-risk patients, such as the one in this case, the discussion of whether to perform any therapy should include, in addition to risks and benefits, a review of the alternatives to that

therapy. In this case, the patient was offered salpingectomy, sometimes known as "opportunistic salpingectomy," in order to reduce her already low risk of ovarian cancer. This recommendation is based on a growing body of evidence that the precursor lesions to the majority of ovarian malignancies arise in the fimbriae of the fallopian tube [9]. Such lesions were originally identified in RRSO specimens from women with *BRCA1/2* mutations and have subsequently been identified in women who were negative for any known deleterious mutations. Long-term data regarding the safety and efficacy of this practice are not yet available. However, short-term outcome and cost-effectiveness data suggest that, for women already undergoing other pelvic surgery such as hysterectomy or sterilization, there may be benefit from the performance of bilateral salpingectomy as a primary preventive strategy for ovarian cancer.

Key Teaching Points

- In premenopausal women at low risk of ovarian cancer, the practice of elective oophorectomy should be avoided
- Counseling regarding prophylactic oophorectomy at the time of hysterectomy for benign disease should be patient-centered
- All-cause mortality is increased in elective oophorectomy
- Opportunistic salpingectomy may be an effective strategy to decrease ovarian cancer risk in low-risk women

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CASE 2

A 40-Year-Old G0 Developmentally Delayed Woman Requires Hysterectomy

Amy Boone

History of Present Illness

A 40-year-old nulligravid woman with developmental disabilities presents to the office with her mother. She is being followed for a long-standing history of heavy menstrual bleeding and pelvic pain. She had previously been treated with depot medroxyprogesterone acetate but had persistent light bleeding that presented hygiene issues. Her past medical history is significant for hypertension and constipation. She has never had abdominal or pelvic surgery. She has never been sexually active. She is not employed. She lives with her mother who is her caregiver.

Physical Examination

General appearance: Intellectual delay, non-verbal, no acute distress

Vital signs:

Temperature: 36.9°C

Pulse: 86 beats/min

Blood pressure: 144/96 mmHg

Respiratory rate: 18 breaths/min

Chest: Clear to auscultation bilaterally, non-labored respirations

Cardiovascular: Regular rate and rhythm, no murmurs

Abdomen: Uterus enlarged to 14-week size, mobile. Mild tenderness to palpation

Pelvic: Deferred due to patient discomfort

Extremities: Upper extremity contractures, shuffled gait

Neurologic: Alert, cooperative

Laboratory studies:

WBCs: 7500/μL (normal: 4000–11 000/μL)

Hb: 10 g/dL (normal: 11.3–15.2 g/dL)

Hct: 33% (normal: 33–45%)

Platelets: 251 000/μL (normal: 150 000–400 000/μL)

Urine pregnancy test: Negative

Imaging: Anteverted, enlarged uterus measuring 15.6 × 10.2 × 13.7 cm. Multiple fibroids seen without well-defined borders. The largest measurable fibroid is 7.5 × 6.2 × 6.3 cm. Endometrial echo complex measures 7 mm, which is normal. Right ovary measures 5.3 × 2.4 × 3.3 cm and has a fluid-filled, simple appearing 1.6 × 0.8 × 1.2 cm cyst. Left ovary measures 3.5 × 1.7 × 2.3 cm and appears normal. No free fluid is noted. Large stool burden noted

How Would You Manage This Patient?

This patient requires surgery but lacks capacity for informed decision-making based on her profound cognitive delay and non-verbal status. Her mother is her full legal guardian and thus is her surrogate decision maker. Her mother was counseled on the management options for fibroids and heavy menstrual bleeding refractory to medical therapy. The risks, benefits, and alternatives to the hysterectomy were presented. Additionally, the expected hospital and postoperative course were discussed in detail. Her mother was given time to ask questions and then signed a written consent for the procedure, as she felt it aligned with the patient's best interest and perceived values. The surrogate decision maker's identity and the details of the consent process were included in the preoperative note.

Informed Consent

The process of informed consent occurs when communication between a patient and physician results in the patient's agreement to undergo specific medical treatment. The concept of informed consent is based on the ethical principles of autonomy, beneficence, non-maleficence, and justice. The informed consent process has been described and refined by the law. In the landmark 1914 *Shloendorff* v. *Society of New York Hospital* case, Justice Benjamin Cardozo's stated, "Every human being of adult years and sound mind has a right to determine what shall be done with his own body; and a surgeon who performs an operation without his patient's consent commits an assault, for which he is liable in damages." This principle of self-determination became the primary basis of the legal mandate to obtain consent from patients prior to procedures [1, 2].

The exact term informed consent first appeared in 1957 in the case of *Salgo* v. *Leland Stanford Jr*. The decision in this case mandated that physicians are obliged to disclose any facts needed to form an informed agreement by the patient to proceed with the recommended treatment [1, 3]. Many cases since then have further defined informed consent as the process we know today: an ongoing interaction between a provider and a consenter in which information is thoroughly and mutually shared. The American College of Obstetrics and Gynecology (ACOG) has defined adequacy of disclosure as including the following: "1. The common practice of the profession, 2. The reasonable needs and expectations of the ordinary individual who might be making a particular decision, 3. The unique needs of an individual patient faced with a given choice." [4]. By default the informed consenter is the adult patient who has the capacity to comprehend and weigh the consequences of their decision. This requires the patient to understand the information presented and to be free from coercion. When these criteria are not met because the individual cannot comprehend, as in the case of this developmentally delayed adult patient, a surrogate decision maker is needed.

Capacity to Consent and Surrogate Decision Maker

It is imperative to distinguish competence from capacity. All adults are presumed competent, a legal term, unless a court had deemed said individual incompetent. Capacity, on the other hand, is a task-specific term. It implies the ability to understand, express a choice, appreciate the personal effects of, and reason through the implications of a decision. Lack of capacity may be short-lived as in a patient with altered mental status or long-term as in a patient with cognitive deficits [1]. The incidence of medical inpatients lacking decisional incapacity was estimated to be 26% in one 2011 comprehensive review [5]. There are many instruments available to assess healthcare decision-making capacity. However, consent capacity must take into account the context of the decision that the patient is being asked to make. This relative lack of standardization decreases the utility of these assessment tools. While assessing capacity, collateral information should also be collected to evaluate the consistency of a patient's currently expressed views with his/her long-standing values [5].

According to the AMA's 2019 Code of Medical Ethics, physicians must identify a suitable surrogate to make decisions on behalf of the patient when the patient does not have decision-making capacity. This surrogate is owed the same respect as the patient and deserves proper advice, guidance, and support. This decision maker should base choices on the patient's wishes as previously documented, previously expressed views about how life should be lived, as well as the patient's perceived attitudes regarding sickness and suffering. If this information is unknown, decisions should be based on her best interest considering the level of pain and suffering that will accompany the intervention or treatment, prospective benefit, resulting impairments from treatment, and patient's quality of life [6].

In the best-case scenario, the incapacitated patient has an advanced directive outlining his or her wishes. Unfortunately, only 20% to 29% of the United States population has a completed advanced directive. As a result, all 50 United States and the District of Columbia have enacted laws to address surrogate decision making for patients lacking capacity. Only 41 of those jurisdictions provide guidelines to appoint a surrogate decision maker for at least some medical decisions to safeguard those individuals who are, or who become incapacitated prior to completion of advanced directives. The process for both appointing and contesting surrogate decision makers varies widely among jurisdictions, which can lead to confusion when this process becomes necessary. This variation also limits efforts to research and improve compassionate decision-making [7]. In this case, full guardianship awarded to the mother in the family's state of residence is a formal recognition of incompetence on a permanent basis. Healthcare providers, patients, and healthcare systems must be aware of the laws surrounding the identification and appointment of a default surrogate in their jurisdiction. Hospitals are also required to have an ethics committee or other institutional resource to serve as a non-biased opinion to help settle decision-making disputes or when no default surrogate is identified [7]. In emergencies, decisions can be made solely based on what is determined to be in the best interest of the patient [4].

Key Teaching Points

- A surrogate decision maker is needed if a patient lacks decision-making capacity
- Assignment of a surrogate decision maker is made based on applicable state law
- Surrogate decision makers should respect the patient's preference and act in the patient's best interests
- In emergency situations when a surrogate is unavailable, physicians should proceed with care based on the best interests of the patient

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CASE 3 A 45-Year-Old Woman with Possible Penicillin Allergy Scheduled for Hysterectomy

Katherine Strafford

History of Present Illness

A 45-year-old presents for a preoperative visit. She reports regular menses that have become increasingly heavy in the past year and have not improved with hormonal management. Three weeks ago, she received a transfusion in the emergency department where imaging was notable for uterine fibroids. She received counseling on treatment options and desires hysterectomy. Her history is remarkable for two full-term vaginal deliveries. She has no history of abnormal cervical cytology or sexually transmitted diseases. Her past medical history is significant for exercise-induced asthma and surgical history for tonsillectomy. She is currently taking combined oral contraceptives, multivitamins, iron, and calcium with vitamin D. She is a non-smoker, does not drink alcohol, and is sexually active with one female partner. She reports a penicillin allergy characterized by the development of hives during prior treatment for a urinary tract infection 10 years ago.

Physical Examination

General appearance: Well-groomed, alert and oriented, no apparent distress

Vital signs:

Temperature: 37.1°C

Pulse: 78 beats/min

Blood pressure: 114/74 mmHg

Respiratory rate: 18 breaths/min

Height: 64 inches

Weight: 140 lb

BMI: 24 kg/m^2

Abdomen: Normal bowel sounds, soft, non-distended, no guarding or rebound, no palpable masses

External genitalia: Normal

Vagina: Normal rugae, normal discharge

Cervix: parous, no bleeding noted, no cervical motion tenderness

Uterus: Mid-position, non-tender, mobile, bulky, 10-week size

Adnexa: No palpable masses

Laboratory studies:

Urine pregnancy test: negative

Hb: 9.0 g/dL (normal 11.4–15.2 g/dL)

Endometrial biopsy: secretory endometrium

Imaging: Transvaginal ultrasound shows uterus is homogeneous in echotexture and measures 11.2 × 6.6 × 5.3 cm. The endometrial stripe is distorted by a submucosal fibroid measuring 3.2 × 2.3 × 3.0 cm. An additional fibroid extending into the left adnexal region measures 4.1 × 3.2 × 3.0 cm. The right ovary measures 2.7 × 1.9 × 1.6 cm, and the left ovary measures 2.7 × 1.5 × 2.4 cm. They are normal in appearance

How Would You Manage This Patient?

This patient's history is significant for a report of penicillin allergy that could influence the choice of prophylactic antibiotic for her hysterectomy. Obtaining additional details is important, so the following information questions were posed: What was her allergic response to penicillin? How recent and how rapid was it? Was treatment required? Has she ever taken a cephalosporin? Are there other antibiotics that she has tolerated well? Has she ever had an anaphylactic or life-threatening allergic event? The patient reported that her reaction was 10 years ago when she developed hives on the fifth day of a seven-day course of amoxicillin. She discontinued the antibiotic and the reaction resolved without treatment. She has since been treated twice with antibiotics for sinus infection without difficulty. She has never had anaphylaxis. With this additional information in mind, after counseling on the relative risks of allergic cross-reaction to cefazolin and the limitations of second-line antibiotics, she received cefazolin at the time of surgery. She was referred for allergy evaluation postoperatively and with negative testing was able to have penicillin allergy removed from her medical record.

Penicillin Allergy

Ten percent of the US population reports an allergy to penicillin. The most common reactions found in medical records include rash (38%), "unknown," (26%) and hives (18%) in comparison to reports of anaphylaxis (5%). The rash reported most commonly in reaction to penicillin exposure is a delayed benign rash, likely a type IV hypersensitivity reaction, which may or may not recur. More than 95% of allergy reporting individuals are actually able to tolerate the drug. Furthermore, serious IgE-mediated allergies wane with age and 80% of individuals become tolerant over the course of a decade. Evaluation with amoxicillin challenge and/or penicillin skin testing may give the patient and future healthcare providers the confidence to utilize these drugs safely and remove the penicillin allergy label [1]. True type I IgE-mediated or severe T-lymphocyte-mediated penicillin hypersensitivity is uncommon. IgE-mediated reactions include anaphylaxis, rapid (minute to hours) development of raised pruritic lesions, flushing, difficulty breathing, chest tightness or arrhythmia and significant abdominal pain, nausea, and vomiting. Severe T-cell-mediated reactions may have a more delayed onset (days to weeks) with blistering, desquamation, organ and/or mucosal involvement,

a delayed, benign, cutaneous reaction that occurred 10 years ago, thus routine prophylaxis with cefazolin was considered safe.

General cross-reactivity between penicillin and cephalosporins occurs in about 2% of cases [4]. The concern for cephalosporin reactions in patients with penicillin allergy stems from the existence of a beta-lactam ring in both drugs. More specifically, cross-reactivity risk is linked to similarities in the R1 side chain of the beta-lactam ring. These R1 chains vary independently from the cephalosporin generations [2]. Cefazolin possesses a unique R1 side chain that significantly reduces the risk for cross-reactivity in those with penicillin allergy. Cefotetan and cefoxitin also have R1 side chains with little similarity to penicillin [9]. Only the aminocephalosporins (cephalexin, cefadroxil, cefprozil, cefaclor) share an identical side chain with aminopenicillins and thus a significant risk for cross-reactivity in those confirmed to have life-threatening penicillin allergy [10]. Due to R1 side chain differences, some authors report that even those with immediate IgE-mediated penicillin reactions can receive cefazolin, cefotetan, and cefoxitin [2, 9, 10]. Those with life-threatening T-lymphocyte-mediated delayed reactions to penicillin are generally recommended to avoid all cephalosporins [2].

Key Teaching Points

- Charted penicillin allergies should be carefully evaluated to determine their severity
- Many patients with penicillin allergies can safely receive cephalosporins due to differences in chemical structure
- Cefazolin is the most commonly recommended prophylactic antibiotic for hysterectomy and has a unique structure that makes cross-reactivity with penicillin unlikely
- Clindamycin or metronidazole plus gentamicin or aztreonam are the recommended antibiotic prophylaxis for hysterectomy in patients with cephalosporin allergy or severe penicillin allergy
- Coverage with antibiotics other than cephalosporins results in increased infection risk, healthcare costs, and adverse events

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CASE 4

A 50-Year-Old Woman with Prior DVT Undergoing Hysterectomy

Jacqueline Rohl

History of Present Illness

A 50-year-old, gravida 1, para 1, with prior deep vein thrombosis (DVT) presents for a preoperative visit due to upcoming hysterectomy. She is scheduled for a total abdominal hysterectomy due to abnormal uterine bleeding and uterine fibroids. The patient's medical history is significant for obesity and prior history of DVT. Her DVT occurred 10 years ago and was unprovoked. She completed a course of anticoagulation with warfarin for three months. She takes aspirin 81 mg a day. She has no family history of thromboembolic disease. She does not smoke. She is sexually active with one female partner. She has had one prior cesarean section and one vaginal delivery.

Physical Examination

General appearance: Awake and alert, in no acute distress
Vital signs:

Temperature: 36.9°C
Pulse: 85 beats/min
Blood pressure: 120/76 mmHg
Respiratory rate: 16 breaths/min
Height: 60 inches
Weight: 210 lb
BMI: 41 kg/m^2

Heart: Regular rate, rhythm, no murmurs
Lungs: Clear to auscultation bilateral
Abdomen: Obese, soft, not tender, no masses
Pelvic: Normal external genitalia, normal vagina without discharge or lesions, normal cervix without lesions, uterus 20 weeks' size, irregular due to uterine fibroids, adnexa without enlargement or tenderness
Extremities: No edema, tenderness, pulses present
Laboratory studies:

Hb: 10.5 g/dL (normal 12.1–15.1 g/dL)
Platelets: 350 000/μL (normal 150 000–400 000/μL)

How Would You Manage This Patient?

The patient has a history of DVT and is not currently anticoagulated. DVT prophylaxis is indicated. Her risk for perioperative thrombosis is increased due to history of DVT, age, weight, and major open surgery planned. Utilizing a standardized assessment for perioperative DVT risk, the Caprini Risk Assessment Method (RAM) for venous thromboembolism (VTE), she has a score of 7, which places her in the highest risk category (age, BMI – 1 point each, major open surgery – 2 points, history of VTE – 3 points). Her assessment for major risk of bleeding revealed no history of easy bruising, need for prior transfusion, coagulopathy, bleeding disorders, or thrombocytopenia. Based on her Caprini RAM score, both pharmacologic and mechanical VTE prophylaxis are indicated. Intermittent pneumatic compression (IPC) devices were placed on her lower extremities prior to the start of surgery and continued during her hospital stay until discharge on postoperative day 2. In addition, unfractionated heparin (UFH), 7500 units subcutaneously, was administered prior to surgery and continued every 8 hours after surgery until discharge. After discharge, VTE prophylaxis was continued for an additional 14 days with a low molecular weight heparin (LMWH), enoxaparin 40 mg, subcutaneously twice daily.

Indications for Perioperative Venous Thromboembolism Prophylaxis

Venous thromboembolism (VTE) is a high concern in the perioperative period and the leading cause of perioperative morbidity and mortality in hospitalized patients. More than half of blood clots occurring in the outpatient setting (after discharge) are directly linked to a recent hospitalization or surgery [1]. Risk factors for VTE described in Virchow's triad are increased around the time of surgery and include stasis, vessel injury and hypercoagulability [2]. Thoughtful evaluation of patient's risk and implementation of perioperative VTE prophylaxis is of utmost importance. The type and timing of thromboprophylaxis must be judiciously weighed against the risk of bleeding due to surgery.

If pharmacologic VTE prophylaxis is recommended, risk for major bleeding should be obtained from the patient's history. Conditions that would likely preclude pharmacologic VTE prophylaxis would include those with history of active bleeding as the indication for surgery such as a gastrointestinal bleed or trauma; a history of moderate or severe coagulopathy such as patients with liver disease; and inherited bleeding disorders or thrombocytopenia. Relevant questioning should inquire about easy bruising, severe bleeding with resultant anemia, and prior need for transfusion.

Although there is variation, most societies and hospital VTE prophylaxis guidelines adhere to recommendations of the American College of Chest Physicians (ACCP), initially outlined in 2012 [3]. There are numerous risk factors for development of postoperative VTE and the ACCP recognizes that each clinical scenario will demand individualization despite these guidelines. The ACCP suggests use of a risk assessment model (RAM). The Caprini RAM is the most widely used and well-validated model to predict VTE in non-orthopedic post-surgical patients [4, 5]. Thirty-nine factors were included in the original score plus a box for additional risk factors. The scoring tool involves assigning a point value to each risk factor according to the significance of the risk factor

prophylaxis, but in general, it is recommended 2–12 hours preoperatively. Ongoing postoperative pharmacologic prophylaxis would be initiated 2–72 hours post-procedure depending on the risk of bleeding. However, with neuraxial anesthesia or spinal puncture, the risk of spinal or epidural hematoma is of concern. It is recommended, if undergoing procedures with this type of anesthesia, preoperative pharmacologic VTE prophylaxis should be avoided and should be delayed postoperatively until at least 6–8 hours after catheter removal.

VTE prophylaxis is typically continued until the patient is fully ambulatory or until hospital discharge. Routine extended therapy postoperatively is not recommended in most non-orthopedic surgical patients unless they are undergoing abdominal or pelvic surgery for cancer. In patients undergoing cancer surgery, extending prophylaxis may be recommended for up to 12 weeks postoperatively. VTE risk has been shown to remain elevated during this time. Given this elevated risk and that patients' ambulatory status may vary, there may be justification to extend (10–14 days) therapy for non-cancer patients that have a risk assessment score in the highest risk category [9].

In patients currently anticoagulated, similar to the decision regarding VTE prophylaxis, management of anticoagulant interruption for surgery is dependent on the risk of thromboembolic disease as well as risk of bleeding due to the procedure. There are multiple anticoagulation therapies used at this time including vitamin K antagonist (VKA), such as warfarin, and direct oral anticoagulants (DOAs). Due to their differing half-lives, the recommendations differ on when to stop use prior to surgery. In procedures at low risk for bleeding, there may be no need to stop anticoagulation.

If interruption is recommended due to bleeding risk of the procedure, guidelines of the ACCP can be used [10]: In patients with a mechanical heart valve, atrial fibrillation, or VTE at high risk for thromboembolism, it is recommended to have bridging anticoagulation rather than interruption of VKA therapy. In patients at low risk for VTE, no bridging is recommended and interruption can occur. In patients at moderate risk for VTE, the decision may be individualized and bridging or interruption may occur based on risks. In patients who are receiving bridging anticoagulation with therapeutic-dose IV UFH, it is recommended to stop UFH approximately 4–6 hours before surgery. In patients who are receiving bridging anticoagulation with therapeutic-dose LMWH, it is recommended to have the last preoperative dose of LMWH approximately 24 hours before surgery. In patients who require temporary interruption of a VKA before surgery, it is recommended to stop VKAs approximately 5 days before surgery. In patients who require temporary interruption of a DOA before surgery, it is recommended to stop DOAs approximately 24–48 hours before surgery. Resumption of anticoagulation is recommended beginning approximately 12–24 hours after surgery if there is no concern for bleeding risk. For patients who are undergoing surgery with high risk of bleeding, postoperative anticoagulation may be deferred until 48–72 hours.

Key Teaching Points

- VTE is the leading cause of death in the hospital setting and half occur in association with surgery
- VTE prophylaxis should be chosen based on type of surgery, patient risk factors for thrombosis, and risk of major bleeding
- Risk assessment models aid in the decision but should be individualized
- Methods that are implemented to reduce VTE include early ambulation, mechanical methods, and pharmacologic prophylaxis
- Interruption or bridging of anticoagulation prior to surgery is dependent first on risk of VTE and balanced by risk of bleeding due to the procedure

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CASE 5

A 40-Year-Old Woman with Severe Anemia Scheduled for Surgery Refuses Blood Products

Amanda H. Ritter

History of Present Illness

A 40-year-old nulligravid woman presents to the office for management of abnormal uterine bleeding. She reports a four-year history of heavy menses, which often lasts for two weeks in length and requires at least 10 sanitary pads per day. She denies abdominal pain or associated dizziness during menses. She reports prior use of multiple hormonal medications, including oral medroxyprogesterone and combined oral contraceptive pills, without improvement in her bleeding patterns. She is not currently taking any medications other than over-the-counter ferrous sulfate. Her past medical history is significant for iron deficiency anemia. She denies any surgical history. She has no plans for future fertility and would like definitive surgical management. When signing the surgical consent, she refuses transfusion of blood products.

Physical Examination

General appearance: Well-nourished female in no acute distress

Vital signs:

Temperature: 37.1°C
Pulse: 90 beats/min
Blood pressure: 118/78 mmHg
Respiratory rate: 12 breaths/min
Oxygen saturation: 99% on room air
BMI: 34 kg/m^2

Eyes: Conjunctiva pale

Abdomen: Soft, non-distended, non-tender, uterine fundus palpable at umbilicus

Pelvic: Normal external female genitalia, vagina normal, cervix difficult to visualize

Uterus: Bulky, filling pelvis to level of umbilicus and with pedunculated myoma present on the right uterine fundus

Laboratory studies:

Urine pregnancy test: Negative
Hb: 8.4 g/dL
MCV: 72.6 fL
Platelets: 273 000/μL
TSH: 2.05 mIU/L (normal 0.5–5.0 mIU/L)
Endometrial biopsy: Benign proliferative endometrium

Imaging: Transabdominal ultrasound shows an enlarged uterus measuring 13.2 × 11.4 × 14.2 cm with multiple myomas present, including an 80 mm subserosal fundal myoma; a 60 mm subserosal anterior myoma; and a 75 mm right lateral pedunculated myoma. Normal appearing endometrium. Normal bilateral ovaries. No free fluid noted

How Would You Manage This Patient?

This patient has a long history of abnormal uterine bleeding due to a myomatous uterus. She has tried multiple hormonal medication regimens without improvement in her bleeding patterns, so proceeding with definitive surgical management with hysterectomy is indicated. Because she has iron deficiency anemia and refuses blood products during surgery, optimization of her hemoglobin preoperatively is prudent.

When obtaining surgical consent, the patient was counseled regarding the likelihood of requiring blood transfusion in the event of significant intraoperative blood loss. The risks and benefits of transfusion were discussed, to ensure an informed refusal of blood products, including counseling about the possibility of death in the event of massive hemorrhage. Since the patient refused blood transfusion, alternatives to blood products, including albumin and blood collection via cell saver, were discussed, and outlined on the blood consent form.

Since this patient is anemic and has a high likelihood of intraoperative blood loss during hysterectomy, preoperative strategies were presented that would optimize her hemoglobin and decrease her overall risk of morbidity and mortality during and after surgery. She was started on parenteral iron supplementation and underwent a six-month course of gonadotropin-releasing hormone (GnRH) therapy. Goals of this pretreatment were twofold: (1) decreasing menstrual blood loss to improve anemia and (2) decreasing both the size of individual myomas and the overall uterine volume to facilitate surgery. Her hemoglobin rose to 12 g/dL and she underwent an uncomplicated abdominal hysterectomy through a transverse incision.

Preoperative Optimization of Hemoglobin

Anemia in reproductive-aged women is quite common and affects approximately 30% of non-pregnant women worldwide. Anemia is defined as hemoglobin less than 12.0 g/dL and is most often due to iron deficiency. The initial evaluation of anemia involves hemoglobin (Hb) and hematocrit (Hct) levels, which measure the amount of functional iron in the body. These studies are low cost and easily obtainable. However, they detect late stages of iron deficiency. The most specific study for iron deficiency anemia is the serum ferritin level, which is an early marker of depleted iron stores [1]. A ferritin level less than or equal to 15 mcg/L confirms iron deficiency anemia, while a serum ferritin value greater than this indicates an alternate etiology.

Other than the likelihood of requiring blood transfusion during surgery or postoperatively, preoperative anemia may

Unlike GnRH agonists, pretreatment with SPRMs was not shown to decrease overall uterine volume [6].

Finally, several less commonly utilized medical therapies for hemoglobin optimization exist, including tranexamic acid (TXA), erythropoietin and darbepoetin, and desmopressin. Of these, the most studied is TXA, which is an antifibrinolytic therapy that is often used in the management of postpartum hemorrhage or massive trauma. When used to treat abnormal uterine bleeding, standard dosing of TXA is 1300 mg three times daily for a maximum of five days each month. Matteson et al. reported a 26–54% decrease in menstrual blood flow when TXA was used for the management of abnormal uterine bleeding [7]. Alternatively, erythropoietin and darbepoetin, which stimulate bone marrow production of red blood cells, and desmopressin, an analog of vasopressin, have been studied for minimizing blood loss in non-cardiac surgical patients, but inadequate evidence exists for use in gynecologic procedures [3].

Key Teaching Points

- Iron deficiency is the most common reason for anemia in reproductive-aged women, and a serum ferritin level is the most specific marker for iron deficiency anemia
- Informed refusal of blood products should be documented preoperatively, as should a patient's desires regarding use of albumin and blood collection systems
- Strategies for optimizing preoperative hemoglobin involve treating anemia and decreasing menstrual blood loss
- Parenteral iron supplementation is superior to oral iron formulations
- Leuprolide acetate, a GnRH agonist, is effective in optimizing preoperative hemoglobin by decreasing menstrual blood loss and reducing uterine size

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CASE 6

A 55-Year-Old Woman Inquires about Your Institution's Protocols for Enhanced Recovery after Surgery

Brett Worly

History of Present Illness

A 55-year-old woman presents to the office to discuss a scheduled total abdominal hysterectomy and bilateral salpingectomy that is planned due to uterine fibroids and pressure symptoms. She has no contributory past surgical history and has no known drug allergies. The patient has severe gastroesophageal reflux disease (GERD), and was told by her primary care provider to never take ibuprofen. During preoperative counseling, she enquires about your institution's protocols for enhanced recovery after surgery.

Physical Examination

General appearance: Friendly, engaged adult woman who appears comfortable sitting upright

Vital signs:

Temperature: 37.0°C
Pulse: 70 beats/min
Blood pressure: 134/78 mmHg
Respiratory rate: 12 breaths/min
Height: 60 inches
Weight: 140 lb
BMI: 27.3 kg/m^2

Abdomen: Normal bowel sounds, soft, non-distended, no rebound or guarding; firm, mobile pelvic mass palpable, 16 weeks' size, non-tender on deep palpation

External genitalia: Normal

Vagina: Atrophic, no vaginal discharge

Cervix: No masses or lesions. No bleeding noted. No cervical motion tenderness

Uterus: Non-tender, mobile, 16-week' size, irregular

Adnexa: No palpable masses, non-tender

Laboratory studies:

Urine pregnancy test: Negative
Hb: 11.3 g/dL (normal 11.4–15.2 g/dL)
Platelets: 290 000/μL (normal 150 000–395 000/μL)
Creatinine: 1.10 mg/dL (normal 0.50–1.20 mg/dL)

Imaging: Transvaginal ultrasound shows a uterus with multiple fibroids, the largest 6 cm in diameter. The total uterine size is 20 × 16 × 18 cm. No adnexal masses visualized

How Would You Manage This Patient?

In response to the patient's inquiry, a list of evidence-based recommendations and their rationale was reviewed with the patient. She was educated about expected hospital length of stay and postoperative home care needs. She was instructed to bathe with antibacterial soap twice the evening before surgery and the morning of surgery and not to shave the operative site for at least 72 hours prior to surgery. She was informed about fluid intake and management prior to surgery and provided with a carbohydrate drink supplement to use 2 hours preoperatively. A plan for use of preoperative medications to reduce nausea and pain was presented. Expectations for early postoperative oral intake and early ambulation were discussed. Postoperative care was discussed and a follow-up visit scheduled. At the time of surgery, the institution's enhanced recovery after surgery (ERAS) protocol was followed. Based on her preoperative counseling, the patient chose to proceed with transversus abdominis plane (TAP) block immediately prior to the procedure. Non-steroidal medications were avoided due to her history of GERD, but a multimodal medication strategy using other agents was given including gabapentin, acetaminophen, and celecoxib. She subsequently underwent an uncomplicated hysterectomy and was discharged on postoperative day 2.

Enhanced Recovery after Surgery

Enhanced recovery after surgery (ERAS) involves a multimodal, multidisciplinary, standardized care plan for perioperative patient care [1–3]. These enhanced recovery pathways have been shown to reduce hospital length of stay, create financial savings, and improve patient outcomes [1, 4]. The general principles of most ERAS pathways include: improved education to prepare for surgery and recovery; avoidance of a catabolic state through use of carbohydrate intake and early postoperative feeding; careful management of fluids to maintain a physiologic state; and proactive management of pain and nausea to facilitate recovery [2]. No increased rates of readmission, urgent care use, or emergency department visits have been found in ERAS groups in small observational studies and patient satisfaction is high (Table 6.1) [3].

Preoperative Preparation

Patient counseling, care coordination, and education across the healthcare team are essential to successful use of ERAS protocols [4, 5]. This educational experience should include setting patient expectations based on preoperative fitness for early mobilization, early postoperative feeding, postoperative pain goals and pain management, and hospitalization duration [4, 6]. Consideration should be given to the need for postoperative use of physical therapy, home health care, or skilled nursing care. Patient counseling has been found to decrease postoperative complications, provide superior pain control, and lead to shorter recovery [4]. A light meal is advised at least 6 hours prior to surgery and intake of clear liquid is allowed up to 2 hours prior to general anesthesia.

Table 6.1 Sample ERAS protocol

Surgical phase	Interventions
Preoperative office visit	Dedicated preoperative counseling including tobacco cessation, alcohol avoidance, treatment of anemia if indicated, and education about postoperative expectations. Referral to PT or home health care if needed Provide instructions for oral intake: Light meal up to 6 hours prior to procedure Clear liquids up to 2 hours prior to procedure Drink supplement containing 50 g of carbohydrate (200 calories) 2 hours preoperatively Necessary medication can be taken with sip of water Provide preoperative surgical wash
Day of surgery	**Preoperative care:** • Consult acute pain service for preoperative block • Verify use of carbohydrate solution and surgical wash • Administer standard DVT and antibiotic prophylaxis • Administer preoperative pain medications: ◦ Acetaminophen 1000 mg ◦ Gabapentin 600 mg orally ◦ Celcoxib 400 mg • Apply scopolamine patch 30 minutes prior to surgery **Intraoperative care** • Administer: Dexamethasone 4–8 mg IV at induction and ondansetron 4 mg IV at emergence • Manage crystalloid administration (goal is 1 L IV crystalloid only) and add colloid administration as needed to maintain euvolemia • Remove orogastric tube and Foley prior to extubation, avoid packs • Maintain normothermia by intraoperative temperature monitoring and use of warmed fluids and forced air blanket
Postoperative care	**Day of surgery** • Out of bed more than 2 hours (including walks and sitting in a chair) • Encourage chewing gum use • Encourage liquid carbohydrate supplement (800–2000 mL) • Start regular diet and advance as tolerated • Provide scheduled acetaminophen, gabapentin, and celecoxib or NSAID • Provide oral narcotic as needed or IV for breakthrough pain **Day after surgery** • Out of bed at least 8 hours with meals in chair • Regular diet and two boxes of liquid nutrition supplement • Offer osmotic laxatives as needed to improve bowel function **Day of discharge** • Provide discharge instructions orally and in writing • Arrange follow-up as needed • Ensure prescriptions provided

DVT, deep vein thrombosis; NSAID, non-steroidal anti-inflammatory drug; PT, physical therapy.

Carbohydrate-loading drinks may help reduce the effects of preoperative caloric restriction, improve insulin resistance, and reduce hospital length of stay [4]. Bowel preparation should be avoided when bowel resection is not anticipated, as mechanical and antibiotic bowel preparation have adverse effects on patient satisfaction, dehydration, electrolyte disturbances, and return to bowel function [4]. Preemptive perioperative analgesia is commonly used in ERAS pathways to prevent pain and decrease narcotic usage. This can include gabapentin, non-steroidal anti-inflammatory drugs (NSAIDs), COX-2 inhibitors, or acetaminophen [4]. Preoperative administration of regional anesthesia or nerve blocks, such as TAP blocks, can also assist with postoperative pain control, as was done in this patient.

Intraoperative Management

Anesthesia techniques intended to decrease postoperative nausea and vomiting include use of short-acting volatile anesthetics or continuous infusion of propofol with avoidance of narcotics [4, 7]. Additionally, use of a scopolamine patch in combination with preemptive use of medications such as $5HT_3$ antagonists, NK-1 antagonists, corticosteroids, antihistamines, anticholinergics, butyrophenones, or phenothiazines will reduce nausea. Maintaining normothermia has been found to be beneficial. Patient body temperatures less than 36°C are associated with increased coagulopathy, impaired drug metabolism, impaired oxygen transport, increased peripheral oxygen consumption, cardiac morbidity, and infectious wound morbidity. Active warming techniques should be employed, which include forced-air blankets, heating mattress pads, circulating water garments, and IV fluid warming [4, 7]. Additionally, maintenance of euvolemia with careful intraoperative fluid management is important, as fluid overload can lead to electrolyte abnormalities, peripheral edema which can limit mobility, small bowel edema with slow return to bowel function, and pulmonary congestion. Hypovolemia is also concerning, and minimizing crystalloid and maximizing colloid use in addition to the correct use of vasopressors may be beneficial [4]. Intraoperative management should also emphasize removing oral or nasogastric tubes, peritoneal drains, and indwelling catheters before leaving the operating room, which helps to reduce length of stay [4].

Postoperative Management

Early mobilization is a key component of ERAS protocols and is focused on prevention of venous thromboembolism and reduction of deconditioning. It has been shown to decrease hospital stay. Early mobilization begins the day of surgery with time spent out of bed either in a chair or ambulating, as permitted by the patient's clinical and underlying medical condition [7, 8]. Additionally, early feeding is a key component of postoperative care. Chewing gum is advised to decrease postoperative ileus [9]. Return to regular diet is planned within 24 hours of surgery, and IV fluids are discontinued as soon as oral intake is adequate. Postoperatively, flatus is not necessary prior to discharge. For diabetic patients, blood glucose is targeted to maintain normal glycemic levels, ideally below 180 mg/dL. Ideally, hospital discharge planning is initiated preoperatively with patient counseling regarding expectations. Discharge occurs once criteria for mobility, pain control, and oral intake have been met. Written discharge instructions should be provided.

Contraindications to ERAS Protocols

Patients may not be good candidates for some portions of ERAS protocols if they have NSAID allergies or intolerance (as was this patient's case), immobility due to previous injury or illness, severe chronic liver or kidney disease, highly complex surgery, or multiple complicated comorbidities. While most benign gynecologic surgical patients may be appropriate for a standardized ERAS protocol, it is important to tailor patients' care plan based on their needs.

Key Teaching Points

- ERAS protocols decrease hospital stay and improve patient outcomes
- ERAS protocols include all phases of care and should be multidisciplinary in implementation
- Key components of these protocols include: patient education, maintenance of euvolemia and normothermia, proactive nausea and pain management, early feeding, and early mobilization

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CASE 7

A 55-Year-Old Female with a 25-Year Smoking History and COPD Is Undergoing a Robotic Hysterectomy

Randa Jalloul

History of Present Illness

A 55-year-old gravida 3, para 3, perimenopausal female presents with complaints of pelvic pressure, abnormal uterine bleeding, and urinary frequency. Her evaluation reveals uterine fibroids. A trial of hormonal treatment with iron supplementation failed to resolve her symptoms and the patient desires definitive treatment. A hysterectomy is planned. Her medical history is significant for chronic obstructive pulmonary disease (COPD) and a 25 pack-year history of cigarette smoking. Her surgical history included cholecystectomy and bilateral tubal ligation. Her medications include a long-acting muscarinic antagonist inhaler, norethindrone 5 mg daily, and oral iron supplement. She has no shortness of breath at rest, but reports a chronic cough and difficulty walking up more than one flight of stairs. She has no chest pain with activity and no family history of cardiovascular disease.

Physical Examination

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

Vital signs:

Temperature: 36.7°C
Pulse: 80 beats/min
Blood pressure: 117/82 mmHg
Respiratory rate: 17 breaths/min
Oxygen saturation: 97% on room air
Weight: 140 lb

Chest: Decreased breathe sounds, wheezes and crackles at the lung bases. Cough with deep inspiration

Cardiovascular: Regular rate and rhythm, no murmurs

Abdomen: Soft, non-tender

Pelvic: Normal external genitalia, normal vagina, cervix distorted posteriorly. Uterus 14 weeks in size with a low anterior mass noted. Mobile, non-tender. Inability to feel adnexa on examination due to uterine size

Laboratory studies:

Hb: 9.5 g/dL (normal 11.4–14.8 g/dL)
HbA1c: 5.5% (normal <5%)
Urine culture: No growth
Endometrial biopsy: Secretory endometrium
ECG: Normal sinus rhythm

Imaging: Ultrasound shows uterus is anteverted normo-flexed and measures 13.9 × 10 × 7.2 cm, with multiple fibroids, largest is 7 cm anterior lower segment fibroid compressing the bladder. Endometrial lining is not well defined due to shadowing, but when seen clearly is 6 mm. Normal bilateral adnexa noted

How Would You Manage This Patient?

This patient has symptomatic COPD and is scheduled for robotic hysterectomy. Preoperatively her primary care physician recommended continuation of her long-acting inhaler therapy and added a short-acting beta agonist rescue inhaler for episodic use. She was educated preoperatively about use of incentive spirometry in the postoperative period. After discussion regarding the surgical options for hysterectomy she and her surgeon chose a robotic approach to improve mobilization postoperatively. On the day of surgery, she used her normal inhaler and then prior to going to the operating room, a short-acting bronchodilator was administered by anesthesia personnel. A 3-hour surgery was performed without difficulty and she was extubated in the operating room. Postoperatively, she continued her inhaler therapy throughout her hospital stay with one additional nebulizer bronchodilator therapy on postoperative day 1 due to symptomatic wheezing. She was provided with an incentive spirometer that she used through her hospital course and was instructed to use at home. She was discharged home on postoperative day 2.

Chronic Obstructive Pulmonary Disease

COPD affects 5% of the population and is associated with increased morbidity and mortality in patients undergoing surgery. The most significant risk factor for COPD is cigarette smoking; the amount and duration of use contributes to disease severity. COPD causes changes in the airways including chronic inflammation, narrowing, and alveolar wall damage [1]. The lung parenchyma and pulmonary vasculature are also affected with enlargement of the acinus and intimal hyperplasia. The three predominant symptoms of COPD are chronic cough, exertional dyspnea, and sputum production. Physical examination may reveal hyperinflation (barrel chest) with distant heart sounds, wheezes, crackles, or decreased breath sounds. Once suspected, diagnosis of COPD is based on pulmonary function testing, which also aids in evaluating the severity of the disease. Spirometry criteria for diagnosis of COPD include a one-second forced expiratory volume (FEV1)/forced vital capacity (FVC) ratio less than 0.7 or less than the lower limit of normal, which is incompletely reversed by the administration of a bronchodilator. This must be in the absence of other explanatory causes [1]. Patients with COPD may have hypoxemia and hypercapnia as a result of increased airflow resistance, hyperinflation, decreased gas transfer, and pulmonary vasoconstriction. They are sensitive to airway manipulation and can have a reflex-induced bronchoconstriction with severe bronchospasm during intubation or extubation [2–4]. Controlled ventilation during the surgery may exacerbate the hyperinflation, cause barotrauma, which

increases risk of pneumothorax. Postoperative complications in patients with COPD may include atelectasis, aspiration pneumonia, prolonged intubation (>48 hours), reintubation, and increased length of stay. Surgical processes that may contribute to respiratory complications include long surgical duration, surgical site proximity to the diaphragm, and positioning that reduces the functional reserve capacity [2–4].

A minimal invasive approach to hysterectomy is associated with less pain, faster recovery, decreased blood loss, and a good functional outcome compared with open hysterectomy and thus was preferred for this patient. However, the robotic and laparoscopic surgery techniques create several challenges in a patient with COPD. The pneumoperitoneum required causes absorption of carbon dioxide and may cause hypercapnia and respiratory acidosis. Maintaining the steep Trendelenburg position for the duration of the case may result in reduction of pulmonary compliance and ventilation, reduction of the functional residual capacity, and ventilation/perfusion (V/Q) mismatch. Lastly, pneumoperitoneum increases intra-abdominal pressure, shifts the diaphragm cephalad, increases intrathoracic pressure and thus has the potential of worsening hypoxemia [5]. In this case the advantages of robotic surgery were felt to outweigh the risks. However, patients with an already compromised pulmonary function such as those with COPD or obstructive sleep apnea (OSA) will require additional precautions in the preoperative, intraoperative, and recovery periods to avoid complications.

Preoperative Care

A detailed history and physical examination should be performed preoperatively. Several studies have shown that inability to perform average levels of exercise (4–5 metabolic equivalents) identifies patients at risk of perioperative complications. At a minimum, the pre-anesthetic examination includes measurement of vital signs, height and weight measurement, auscultation of the heart and lungs, and an airway assessment. The patient should also be evaluated for clinical indicators of OSA including loud snoring and excessive daytime sleepiness. If OSA is suspected, a polysomnogram should be performed to establish this diagnosis. Patients should be instructed to stop smoking prior to surgery. Recent evidence shows that smoking cessation, even if brief, is associated with lower morbidity. However, for better outcomes, smoking cessation longer than eight weeks prior to surgery is recommended. Patients should aim to achieve the best possible baseline pulmonary function preoperatively [6]. There is no function level below which the surgery would be absolutely contraindicated. If the patient experiences respiratory symptoms such as dyspnea at rest or with exertion, has increased sputum production, or is found to have new clinical findings, surgery should be delayed until the patient is treated appropriately to maximize control of their disease. Preoperative pulmonary function tests are not necessary in patients with treated or controlled COPD, especially those undergoing lower abdominal surgery. However, spirometry can be obtained to assess disease control and need for more intensive preoperative therapy [7]. Arterial blood gases are generally not indicated but should be considered if the FEV1 is <50% on spirometry, hypercapnia is suspected based on abnormal serum bicarbonate, if lung resection is planned, or oxygen saturation on room air is less than 93%. In this patient, spirometry would not be required. A chest x-ray is not routinely indicated but can be obtained if patients have new clinical symptoms or signs on examination. Because patients with COPD can have associated comorbidities, a detailed cardiac history should be performed, and when indicated, electrocardiogram or cardiac stress test should be obtained. Finally, good preoperative oral care reduces the burden of oral bacteria and reduces rates of postoperative pulmonary complications in certain settings [7].

Intraoperative Care

Baseline treatment with bronchodilators and inhaled glucocorticoids should be continued up to the morning dose prior to surgery. Short-acting bronchodilators are indicated perioperatively. Albuterol, two to four puffs is given within 30 minutes of intubation, a common regimen. An anxiolytic such as midazolam can be used to reduce anxiety and the associated tachypnea and increased respiratory rate, without leading to respiratory depression. However, anesthesiologists and surgeons should avoid the combination of sedatives and opioids to avoid respiratory depression. Regional anesthesia such as quadratus lumborum or transversus abdominis plane blocks can be administered to reduce the use of opioids perioperatively and to reduce pain at the surgical site. Intraoperatively, standard American Society of Anesthesiologists monitoring is required (continuous pulse oximetry, capnography, electrocardiogram, temperature, and blood pressure). Supplemental oxygen is administered to maintain saturation of 88–92%. A meta-analysis of studies comparing routine use of a nasogastric tube (NGT) concluded that routine use of an NGT significantly increased postoperative pulmonary complications including pneumonia and atelectasis. Thus, it should be avoided if possible. Specific induction techniques are used to reduce the chance of bronchoconstriction. Intravenous induction of anesthesia with a short-acting hypnotic such as propofol, with adjuvant medications such as lidocaine to suppress airway reflexes, is preferred. A neuromuscular blocking agent (such as rocuronium) is also administered to facilitate laryngoscopy. For maintenance of general anesthesia, a potent volatile inhalation agent with bronchodilator properties is recommended. Tidal volume is targeted at 5–8 mL/kg to decrease the risk of barotrauma. A reduced respiratory rate with longer expiratory time is used. Other considerations include maintenance of plateau pressures of less than 15 cm of H_2O, cautious use of positive end-expiratory pressure of 5–10 cm of H_20, and adjustment of the fraction of inspired oxygen to the lowest level required to maintain oxygen saturation of 90%. In patients with severe COPD, undergoing a procedure with pneumoperitoneum, it may be necessary to use intermittent desufflation or lower insufflation pressures to minimize the adverse effects. During anesthetic emergence, complete reversal of neuromuscular blockade is essential in order to reduce the risk of hypoventilation and pulmonary complications in the immediate postoperative period. Patients with COPD may

benefit from treatment with a bronchodilator shortly before emergence from general anesthesia [1].

Postoperative Care

In the immediate postoperative period, patients with COPD may develop bronchospasm or hypoventilation due to residual sedation caused by inhalation agents or opioids, or due to weakness caused by neuromuscular blocking agents. A variety of lung expansion maneuvers reduce postoperative pulmonary complications, including chest physical therapy, deep breathing exercises, incentive spirometry, intermittent positive pressure breathing, and continuous positive airway pressure [8–11]. These interventions are more effective if patient teaching begins before surgery. Because the supine position worsens OSA, it is prudent to maintain postoperative OSA patients in the upright or semi-upright position, if not contraindicated by the surgical procedure. Timing of discharge from the post-anesthesia care unit, disposition, and ongoing monitoring should take into account underlying risk and clinical events occurring since extubation. Postoperative care to avoid respiratory complications should include adequate pain control, resumption of bronchodilator therapy, early ambulation, and deep venous thrombosis prophylaxis.

Key Teaching Points

- If COPD is poorly controlled, surgery should be delayed until the patient is treated appropriately to maximize control of their disease
- Pulmonary function testing and exclusion of other etiologies is used to establish the diagnosis
- Bronchodilators and inhaled glucocorticoids are continued up to the morning dose prior to surgery, short-acting bronchodilators are indicated perioperatively
- Laparoscopic or robotic surgery pose additional challenges to patients with COPD due to the use of carbon dioxide gas for insufflation and the use of steep Trendelenburg
- In the immediate postoperative period, patients with COPD are at risk of bronchospasm or hypoventilation

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CASE 8

A 48-Year-Old with Adult-Onset Diabetes Is Undergoing a Hysterectomy for Recurrent Simple Hyperplasia

William Po

History of Present Illness

A 48-year-old female, gravida 5, para 5, has abnormal uterine bleeding. Two years ago, when her symptoms started, her endometrial biopsy revealed simple endometrial hyperplasia without atypia and an ultrasound was normal. After progestin therapy, the hyperplasia and abnormal bleeding resolved. Recently her abnormal bleeding returned, and a current biopsy revealed a return of simple hyperplasia without atypia. The patient is finished having children and would like to pursue definitive treatment. Eight years ago, she was diagnosed with adult-onset diabetes, which has been controlled with an oral hypoglycemic (metformin). The patient's BMI is 30 kg/m^2. She has had no previous surgeries and has no other medical conditions.

Physical Examination

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

Vital signs:

Temperature: 36.8°C
Pulse: 72 beats/min
Respiratory rate: 16 breaths/min
Blood pressure: 126/78 mmHg
BMI: 30 kg/m^2

Lungs: Clear to auscultation bilaterally; equal respirations bilaterally

Heart: Regular rate and rhythm, no gallops or rubs noted

Abdomen: Normal bowel sounds, soft, moderately obese, non-tender, no guarding or rebound

Pelvic: Normal external female genitalia. Vagina, normal rugae no atrophic changes. Cervix multiparous without lesions, non-tender with moderate descent to the introitus with minimal tugging. No rectocele, enterocle, or cystocele. Adnexa are without tenderness or mass

Extremities: No calf tenderness or edema

Neurologic: Alert and oriented × 3

Laboratory studies:

Urine pregnancy test: Negative
HbA1c: 5 mmol/L
Platelets: 251 000/μL
Hb: 12.2 g/dL
Creatinine clearance: 80 mL/min (60–95 mL/min)
ECG: Normal sinus rhythm

Imaging: Pelvic ultrasound shows normal uterus with an endometrial thickness of 5 mm. The adnexa are normal, and no fluid is visualized

How Would You Manage This Patient?

This patient has diabetes and needs a major surgical procedure that is not emergent. Prior to proceeding with the surgery, the next step is an assessment of her surgical risk. Her history revealed glucose levels that were under good control and her glycosylated hemoglobin (HbA1c) was normal. Her primary care physician had assessed that there was no end-organ damage, coronary artery disease, or nephropathy. Her metformin was held the night before surgery and her glucose levels were checked upon admission and monitored every 1–2 hours during surgery and in the post-anesthesia care unit. Her glucose levels stayed under 180 mg/dL [1]. There were no surgical complications during the vaginal hysterectomy and blood loss was minimal. The patient tolerated the surgery well and by post-op day 1 was resuming a diabetic diet and ambulating well. Metformin was resumed the morning after surgery and her blood glucose was monitored before meals and bedtime. She was discharged to home in stable condition. At her post-op visit she was doing well, her vaginal cuff was well healed, and the pathology report revealed simple endometrial hyperplasia without atypia.

Diabetes Mellitus and Surgery

The incidence of diabetes mellitus has increased in the United States as the rates of obesity have risen. In 2018, the American Diabetic Association noted approximately 34.2 million Americans or 10.5% of the population had diabetes. At least 15–20% of surgical patients have diabetes as a comorbidity [2]. Diabetic patients are at higher risk of perioperative complications including wound infection, impaired wound healing, cardiovascular and renal complications [3]. Cardiovascular risks are higher in women with diabetes than in men with diabetes [2].

Hyperglycemia affects wound healing by reducing phagocyte activity, granulocyte function, and collagen synthesis [3]. Often patients with diabetes have vascular disease, which impairs delivery of oxygen to the tissues. Overall, these factors, especially obesity, contribute to impaired wound healing and predispose women with diabetes to a higher infectious morbidity [4]. A number of studies show a substantial reduction in infectious morbidity when glucose levels are under good control [3].

In patients undergoing surgery, minimizing conditions that might increase perioperative morbidity or mortality is essential. With diabetes, an evaluation of disease control is important preoperatively to assess and mitigate surgical risk. Does the patient have type 1 or type 2 diabetes? How long have they had it? How well controlled is the

blood sugar? Is it controlled by diet, oral hypoglycemic agents, insulin? How much is she taking? Careful review of her glucose logs and appropriate HbA1c tests can also help determine how controlled the diabetes is. Diabetes longer than 10 years' duration has a higher risk of vascular damage [3]. An assessment of any end-organ dysfunction such as peripheral vascular disease, renal dysfunction, peripheral neuropathy, and cardiac disease should be part of the evaluation. Physical examination can highlight findings consistent with end-organ damage. Assess the patient's peripheral pulses, look for peripheral neuropathy and examine the skin and feet for evidence of skin changes. As diabetic patients have an increased risk of coronary artery disease, an ECG is indicated prior to surgery. Other labs may include a complete blood count, electrolyte assessment, creatinine clearance, and a recent HbA1c. Additional labs may be required, tailored to the patient's specific condition [5]. A HbA1c more than 7–8 mmol/L may indicate poor control. Consultation with endocrinology or the patient's primary care physician to control glucose levels before surgery is preferred.

Preparing the patient for surgery targets a euglycemic state balanced with a reduced caloric intake the day before and the day of surgery. The goal is to maintain a preoperative glucose level of 150–180 mg/dL or less [6]. Patients on metformin, thiazolidinediones, and DPP-4 inhibitors should take the medication the day before and the day of surgery if normal oral intake is anticipated later that day. Patients who use sulfonylurea agents (glipizide, glyburide, or glimepiride) or meglitinides (nateglinide or repaglinide) should take their normal doses the day before surgery but hold the day of the procedure. Sodium-glucose cotransporter-2 (SGLT-2) inhibitors (canagliflozin, dapagliflozin, empagliflozin) should be stopped 24 hours before surgery as well as held the day of surgery [6]. All of these medications except DPP-4 inhibitors should be held the day of surgery if reduced postoperative oral intake or extensive surgery is anticipated [7]. Table 8.1 reviews classifications of oral agents used to treat diabetes. For women with type 1 diabetes, it is important to remember that if they do not receive exogenous insulin, they can go into diabetic ketoacidosis even with normal blood sugars. Insulin management must be tailored to their oral intake status and normal insulin regimens.

Patients with type 2 diabetes on insulin should continue their insulin therapy. Institutions often have preoperative protocols. One regimen is to have the patient's basal insulin (glargine or detemir) dose reduced by 20% of normal dose the evening before (and morning of surgery if dosing is twice daily). For those on NPH insulin or premixed formulations the doses are reduced by 20% the evening before surgery and by 50% the morning of surgery. In addition, NPH or premixed insulin is held the morning of surgery in patients with type 2 diabetes whose fasting glucose is less than 120 mg/dL. Patients with type 1 diabetes undergoing surgical procedures require insulin during the perioperative period. The stress of surgery may result in severe hyperglycemia or ketoacidosis. These patients should receive 80% of basal insulin dose the evening before surgery and on the morning of surgery to prevent hypoglycemia. After meal insulin is stopped when the fasting state begins [7]. Intraoperatively some studies have shown that too high or too low glucose may increase morbidity and mortality in patients undergoing surgery [8]. The target glucose levels should be between 141 and 180 mg/dL and the patient monitored every 1–2 hours during both major and minor procedures [1, 3, 7]. Subcutaneous rapid-acting insulin can be used for intraoperative blood glucose management in those patients undergoing procedures that will allow early postoperative oral intake. However, intravenous insulin drips are needed for management of blood glucose during procedures that involve large fluid shifts, significant blood loss, potential hypothermia, or are lengthy. In these cases, glucose is monitored hourly. Postoperatively the Joint Commission's Surgical Care Improvement Project recommends target blood glucose levels less than 180 mg/dL for the 18–24 hours after the end of anesthesia [9]. Postoperative management will depend upon surgical case duration, complexity, intraoperative glycemic control, oral intake, and preoperative regimen. Most oral agents can be resumed once the patient is eating and glucose can be monitored before meals and at bedtime. In patients with type 2 diabetes who are insulin requiring, basal insulin is continued postoperatively by reducing the total daily dose by 20–25% while they remain NPO. Rapid-acting insulin is administered on a sliding scale basis to maintain blood sugar less than 180 mg/dL. Once tolerating normal intake, patients can resume their normal insulin regimen [10].

Table 8.1 Oral agents used for type 2 diabetes

Secretagogues	SGLT-2 inhibitors*	Thiazolidinediones	Metformin	DPP-4 inhibitors
Glipizide	Canagliflozin	Rosiglitazone		Alogliptin
Glimepiride	Dapagliflozin	Pioglitazone		Linagliptin
Gliclazide	Empagliflozin			Saxagliptin
Repaglinide	Ertugliflozin			Sitagliptin
Nateglinide				

* Hold on the day prior to surgery.

Key Teaching Points

- Preoperative glycemic control is essential in reducing morbidity and mortality in diabetic patients
- Perioperatively the majority of oral agents can be taken up to the day before surgery
- Patient's blood glucose levels should be maintained between 141 and 180 mg/dL during surgery
- Postoperative target blood sugar is less than 180 mg/dL

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CASE 9 A 10-Year-Old Girl with a Vulvar Hematoma after Playground Injury

Janeen L. Arbuckle

History of Present Illness

A 10-year-old female is brought to the emergency room by her grandparents after sustaining an unwitnessed fall while on the playground. The patient reports having been swinging on the monkey bars, slipping on the edge of the landing, and ultimately straddling the handrail of the landing. She had immediate onset of pain and was able to walk to her grandmother and describe her fall. They went to the bathroom to assess her injury and noted blood in her undergarments, prompting them to come immediately to the emergency room. She remains in pain currently. She and her grandmother report heavy bleeding from the injury. Prior to this event the child was in her usual health. She has not yet had menarche, though they have noted some breast development. She has not had prior genital trauma or vaginal bleeding. She has been in her grandparents' custody for the last six months.

Physical Examination at Presentation

General appearance: Well-developed female, tearful but consolable

Vital signs:

Temperature: 36.6°C
Pulse: 122 beats/min
Blood pressure: 112/70 mmHg
Respiratory rate: 22 breaths/min
Oxygen saturation: 100% on room air

Chest: Regular rate and rhythm without murmur, rub, or gallop

Respiratory: Clear to auscultation bilaterally; no appreciable wheeze

Breast: Tanner 2 thelarche

Abdomen: Normoactive bowel sounds, soft, non-distended, non-tender to palpation

Genitourinary: Tanner 1 pubarche; bilateral labia are covered in old blood with a small degree of active bleeding appreciated; the right labium majus has extensive bruising and swelling and is tender to palpation; palpation of the right labium majus reveals a 2 × 3 cm mass, consistent with underlying hematoma; there is a 2 cm linear laceration between the left labium minus and labium majus which appears to be the source of bleeding; gentle irrigation of the area confirms the source of blood loss to be the left labial laceration; bleeding from the vaginal orifice is not appreciated; gentle traction reveals a prepubertal crescentic hymen without injury; the perineum is intact and the anus is without injury

Hb: 14.8 g/dL (normal 11.9–15.0 g/dL)

Focused Physical Examination an Hour Later

Genitourinary: The hematoma on the right labium majus has expanded and now measures 3.5 × 6 cm and the patient reports worsening pain. The left-sided laceration has since become hemostatic

Repeat Hb: 13.5 g/dL (normal 11.9–15.0 g/dL)

How Would You Manage This Patient?

This patient presents with a straddle injury. In this case, the patient's self-reported history is consistent with a common cause of genital trauma and examination findings are consistent with what is commonly observed with such injury. Due to the rapid expansion of the hematoma, she was taken to the operating room to evacuate the hematoma. In the operating room, under general anesthesia, a linear incision was made down the midline of the hematoma. Sterile water was used to irrigate the lesion and two unique bleeding vessels were identified and ligated. Excellent hemostasis was noted. The resulting defect created by the evacuated hematoma was reapproximated in two layers with a series of figure-of-eight sutures. The patient was admitted for observation overnight. That evening she was able to ambulate and void independently. Examination the next morning showed stable swelling without further accumulation of a hematoma. Her hemoglobin was stable. She was discharged home with instructions on wound care and instructed to follow up for repeat examination of her injury. In-office assessment of the vulva five days later revealed a modest reduction in swelling. The left labial laceration demonstrated moderate healing and was without bleeding edges. Repeat evaluation one month later revealed resolution of all acute examination findings.

Straddle Injury

The primary challenge in a case of vulvar injury in a child is to discern if the injury was accidental in nature or concerning for potential sexual abuse. It is important to obtain a detailed history from the patient and to confirm that the examination findings support the reported mechanism of injury. In a recent review of pediatric genital injury, the mean age at injury was 7.1 years of age, with the majority of patients sustaining laceration or contusion/abrasion (43.3% and 42.2%, respectively) [1]. Straddle injuries such as that described here are the most common form of acute genital trauma [2–5] and occur when the victim straddles an object with the full weight of the body, resulting in a crushing injury to the genitalia. Common objects involved in straddle injuries include bicycles, monkey bars, bathtubs, and furniture [1, 2]. Straddle injuries are more common in children due in part to the relative paucity of the labial fat pads in the prepubertal vulva. Due to the highly

vascularized nature of the vulva, straddle injuries can result in significant bleeding. Genital trauma can also occur because of blunt trauma to the perineum by a non-straddled object or as a penetrating injury of the vagina or rectum. Differentiating between accidental and intentional injury requires a careful history and examination with efforts to assure that the proposed mechanism of injury is corroborated by examination findings. Findings which raise suspicion for sexual abuse include, but are not limited to, extensive or severe genital trauma; penetrating injury to the hymen, vagina, rectum, or posterior fourchette; presence of suspicious traumatic findings in addition to genital injury; and genital injury in preambulatory infants [6].

Evaluation of acute genital trauma requires a thorough inspection of the genitalia including the anus, perineum, labia majora/minora, urethra, clitoris, hymen, and vagina. For non-penetrating genital trauma, injury to the vagina is uncommon, particularly if the hymen is without injury. For those in whom a thorough examination cannot be completed at the bedside or in whom extensive injury is suspected, sedation and/or an examination under anesthesia may be necessary. In a retrospective case review of acute genital trauma, Dowlut-McElroy et al. identified injury in older children, penetrating injuries, and injuries greater than 3 cm as factors associated with treatment in the operating room [3]. Spitzer et al. similarly found older age and laceration size to correlate with surgical evaluation, as did a shorter time to presentation and hymenal injury [5]. An examination under anesthesia may also be considered if there is concern for urethral or anal injury, concern for ongoing bleeding, which may require suture for hemostasis, as seen in this case, or a patient is unable to void [2]. Patients should be assessed for the ability to urinate prior to discharge home, and, if unable to do so, may require placement of an indwelling catheter [2]. When a penetrating injury has occurred, need for tetanus prophylaxis should be assessed.

Indications for surgical intervention for a straddle injury include a rapidly expanding hematoma, ongoing bleeding, hemodynamic instability, and a significant drop in the patient's hemoglobin. When the source of bleeding is not readily apparent on external examination, adjunctive measures such as proctoscopy, vaginoscopy, and cystoscopy may be employed. When indicated, surgical management of a vulvar hematoma includes evacuation of the hematoma to identify the source and to control the bleeding, as well as to prevent necrosis of tissue devascularized by the pressure of a large hematoma. An incision is made in the medial aspect of the hematoma and the clot is removed. If individual bleeding vessels are identified these should be ligated. Deep closure of the hematoma cavity can be done, once bleeding is well controlled. If the skin condition allows, it is then closed primarily. If the cavity is large, or there is concern for ongoing bleeding, placement of packing, a drain or Word catheter can be considered to prevent reaccumulation of the hematoma. Bleeding and/or hematoma formation in excess of what would be expected for the degree of injury may prompt evaluation for a bleeding disorder [7]. Initial evaluation for a possible bleeding disorder includes a complete blood count, peripheral blood smear, prothrombin time, and partial thromboplastin time. Although in this case surgery was warranted due to rapid expansion of the hematoma, most acute genital trauma is limited and can be expectantly managed [3–5, 8]. Most vulvar bleeding stops with gentle, constant pressure and does not require primary closure. Stable vulvar hematomas most often resolve spontaneously. Conservative management of straddle injury includes the use of frequent sitz baths, analgesics, and cold compresses [2].

Key Teaching Points

- The history and proposed mechanism of genital injury are assessed to determine if they are consistent with the physical examination findings
- Evaluation for sexual abuse should occur if the physical examination findings cannot be corroborated by the reported history
- Evaluation in the operating room is warranted when a thorough examination cannot be achieved at the bedside, if there is concern for extensive injury, or if there is a large and expanding hematoma
- Surgical evacuation of hematomas focuses on control of bleeding and reduction of size to mitigate pain and tissue necrosis

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CASE 10 A 50-Year-Old Woman with a Discrete Area of Leukoplakia That on In-Office Punch Biopsy Showed VIN 3

Sarah M. Page-Ramsey

History of Present Illness

A 50-year-old postmenopausal woman, gravid 2, para 2, is referred for evaluation after her primary physician noted a vulvar lesion during a recent well woman examination. The patient reports a remote history of abnormal Pap smear for which she underwent an excisional procedure 15 years ago with normal follow-up cytology. Her last menstrual cycle was three years ago and she is not on hormone replacement. She is regularly sexually active with one male partner. She has smoked cigarettes for the past 30 years. An in-office biopsy of the lesion was performed.

Physical Examination

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

Vital signs:

Temperature: 36.9°C
Pulse: 76 beats/min
Blood pressure: 126/78 mmHg
Respiratory rate: 18 breaths/min

Skin: Dry, warm. No visible lesions other than genital examination

Oral mucosa: No lesions, ulcerations

External genitalia: Atrophic external genitalia with normal clitoris and hair distribution. No masses palpated. Discrete well-demarcated raised white lesion of right posterior labium and posterior forchette, 1.2 cm in size. No ulcerations. Non-tender. No drainage

Vagina: Atrophic, pale epithelium with loss of rugae. No lesions and no ulcerations. No abnormal discharge

Cervix: Atrophic, with small round os. No lesions and no abnormal discharge

Laboratory studies:

Cervical cytology: Adequate for interpretation, endocervical cells present. Negative for intraepithelial lesion or malignancy (NILM). High-risk human papillomavirus testing negative

Vulvar biopsy: High grade squamous intraepithelial lesion (HSIL)/usual type vulvar intraepithelial neoplasia (uVIN)

How Would You Manage This Patient?

This menopausal patient presented with an asymptomatic discrete, white vulvar lesion of her vulva, which on biopsy was found to be HSIL (Table 10.1). At presentation, the vagina and cervix were carefully examined and assessed for the presence of any lesions or cytologic abnormalities in a patient with suspected HSIL. Once the diagnosis of HSIL/usual type VIN was made, the patient was treated with a wide local excision of the vulva. This was performed in the office under local anesthesia. After application of acetic acid to define and mark the area, local anesthetic was injected. An elliptical area was excised around the lesion including 1 cm border of normal tissue. The base of the area was closed with interrupted figure-of-eight sutures of delayed absorbable suture and the skin closed with a subcuticular stitch of similar material. The patient was advised to call with signs of infection. On two-week follow-up in the office, the area was healing well. She was instructed to be seen in six months and then yearly due to the risk of recurrence.

Table 10.1 Indications for biopsy of vulvar lesions

Postmenopausal genital condyloma
Suspicion for malignancy
Clinical diagnosis unclear
Lack of response to treatment for clinically presumed diagnosis
Change in size
Change in color
Change in borders

High Grade Squamous Intraepithelial Lesion of the Vulva (HSIL)

In a patient found to have vulvar skin changes, the differential diagnosis includes scarring, lichen sclerosus, squamous hyperplasia, lichen simplex chronicus, HSIL/usual typeVIN, differentiated VIN, and malignancy, among other dermatoses and infectious etiologies. Initial evaluation of the lesion includes a biopsy. This can be performed in an office setting with local anesthetic. Generally, a 3 mm to 5 mm punch biopsy tool can be used to obtain an adequate sample. Other approaches may include elevating the lesion with tissue forceps and sharply excising a small elliptical biopsy or using an alligator style instrument to obtain a sample. It is important to obtain a full thickness biopsy of the lesion to permit appropriate histologic review.

Vulvar HSIL or usual type VIN is considered a premalignant condition. Spontaneous regression can occur, but prediction of progression or regression is not reliable. Therefore, treatment is recommended once diagnosis is established. Vulvar HSIL has a varied appearance. Colors may include white, gray, red, and brown. Most lesions are raised, but some may be flat. Biopsy is recommended whenever malignancy is suspected; clinical diagnosis is unclear; a patient with a presumed clinical diagnosis is not responding to therapy;

or unexplained focal pruritis or pain without a visible lesion. There is no good screening test for recurrent dysplasia aside from visual examination.

Key Teaching Points

- Vulvar HSIL should be treated due to its malignant potential
- Wide local excision is recommended when there is concern for occult malignancy, a single lesion, or if differentiated VIN is diagnosed
- A margin of 10 mm is recommended during surgical excision
- Close monitoring of patients after treatment is important, as recurrence rates vary widely and are not predictable

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CASE 11 A 50-Year-Old Woman with a Recurrent Bartholin's Gland Cyst

Shweta N. Patel

History of Present Illness

A 50-year-old female, gravida 2, para 2, presents to the office with vulvar pain. For the past three months, she reports noticing a "walnut" sized bump on the left vulva that has increased in size in the past week. She reports it is tender, and it is difficult to sit for long periods of time. She also reports dyspareunia. She is currently taking ibuprofen for pain and using warm compresses without alleviation of symptoms. She reports similar symptoms on the same side that required incision and drainage, once in her 30s and, more recently, four months ago when a Word catheter was placed. She denies fevers, chills, and nausea/vomiting. Her last menstrual period was two weeks ago and has regular monthly cycles with light bleeding. Past medical history is significant for hypertension, obesity, and hyperlipidemia. Past surgical history is significant for bilateral tubal ligation. She is sexually active with husband of 25 years.

Physical Examination

General appearance: Well-developed, well-nourished, appears uncomfortable and leaning toward right side while sitting

Vital signs:

Temperature: 37.1°C
Pulse: 88 beats/min
Blood pressure: 144/90 mmHg
Respiratory rate: 14 breaths/min
Height: 66 inches
Weight: 195 lb
BMI: 31.5 kg/m^2

Abdomen: Soft, non-tender, non-distended, no rebound or guarding

Pelvic:

External genitalia: Normal appearing right labium majus and minus. Lower left labium enlarged with a palpable soft mass at 4 o'clock, measuring 4 × 4 cm with slight bulge just inside the introitus, tender to touch, fluctuant, no induration, no erythema, no drainage
Vagina: Normal rugae, no discharge, no lesions
Cervix: Multiparous appearing, no lesions, no cervical motion tenderness
Uterus: anteverted, non-tender, mobile, six-week size
Adnexa: non-tender, no fullness or palpable masses

Laboratory studies: Gonorrhea and chlamydia testing negative

How Would You Manage This Patient?

This patient presents with left lower vulvar pain and mass, which is consistent with a recurrent left Bartholin's duct cyst. Given the size, tenderness, and fluctuance, there is concern for Bartholin's abscess. In the setting of recurrence and prior failed treatment with Word catheter, marsupialization or excision was discussed. Due to the higher morbidity associated with excision, a marsupialization and cyst biopsy were chosen.

A cruciate incision, measuring about 2 cm, was made just distal to the hymenal ring where the cyst bulged into the vestibule. Copious amounts of foul-smelling, purulent material returned. Aerobic and anaerobic culture swabs of the drainage were obtained prior to irrigating. The cyst was inspected and noted to be smooth-walled with no visible thickening or mass within the gland. A portion of the cyst wall was removed and submitted for pathologic evaluation. The remainder of the cyst wall was everted onto the epithelium with interrupted, absorbable suture. The patient was seen in follow-up in four weeks. The marsupialization site was patent and edges healing well with no signs of infection. The cyst wall biopsy showed acute and chronic inflammation and no signs of malignancy. The patient was instructed to call with symptoms of recurrence.

Bartholin's Gland Cyst Management

When a patient presents with a vulvar mass, there is a broad differential that could include the following: Bartholin's gland cyst, Skene's duct cyst, Gartner duct cyst, inclusion cyst, vulvar malignancy, folliculitis, lipoma, hidradenitis suppurativa, or urethral diverticulum. The location and appearance of the vulvar mass aids in the diagnosis of a Bartholin's mass. Anatomically, Bartholin's glands can be found at 4 o'clock and 8 o'clock of the vaginal opening. Blockage of the Bartholin's duct can lead to the formation of a cyst or abscess, usually unilateral on presentation. The prevalence of Bartholin's gland cyst is about 2–3 in 100 women [1]. Other causes of Bartholin's enlargement, such as gland carcinoma or benign tumor, are very rare [2].

Bartholin's gland cysts are often incidentally found during routine pelvic examination and may be asymptomatic. When symptomatic, common clinical presentations include pain, especially with walking or sitting, vulvar swelling, and pain with intercourse. Management of Bartholin's gland cyst is typically based on size, symptoms, and history of recurrence [3]. If the patient is asymptomatic and the Bartholin's gland cyst measures less than 3 cm, then typically expectant management with warm compresses is recommended since it may resolve. If the patient is symptomatic despite it measuring less than 3 cm, then bedside incision and drainage (I&D) can be offered. Regardless of symptoms, when a Bartholin's gland cyst measures greater than 3 cm, intervention is often necessary. I&D can be performed with or without the placement of a Word catheter. Simple I&D involves first applying local

anesthesia and making a 1–2 cm incision just distal to the hymen on the inner labia minora. In contrast, it is important to make a smaller, stab incision (about 3–5 mm in size) in the same location when placing a Word catheter to prevent it from coming out. Once the balloon is inflated with 2–3 mL of sterile saline, the catheter is tucked into the vagina. Because Word catheters can be uncomfortable for patients, especially with the placement duration of up to four weeks, simple I&D is most often preferred for the first episode of a cyst formation [4]. In setting of recurrence, the options include Word catheter or marsupialization. Although there is no significant difference in rate of recurrence when comparing Word catheters and marsupialization procedures, Word catheters are often attempted prior to marsupialization because Word catheter insertion can be performed at bedside and is a less complex procedure [1, 5]. Traditionally, antibiotics were not recommended for Bartholin's gland abscesses. However, due to increase in community methicillin-resistant *Staphylococcus aureus* (MRSA) infections that could lead to vulvar abscesses, culture of purulent drainage material from I&D (or spontaneous drainage) is recommended [6]. Antibiotic treatment could be directed based on gram stain and culture or empirically started to cover staphylococcal and streptococcal species in addition to gram-negative aerobes. Therefore, oral trimethoprim-sulfamethoxazole is considered first-line therapy. Treatment rarely requires IV antibiotics unless there are signs of systemic infection [6].

Marsupialization

Marsupialization is a surgical technique in which a permanent drainage tract is developed for the Bartholin's gland. It is usually performed in the operating room. To allow best exposure and traction, the labium is grasped with an Allis clamp and retracted laterally. Then an incision is made with a scalpel where the cyst bulges into the vestibule, just distal to the hymenal ring, on the vaginal epithelium. Care is taken not to make the incision on the labium due to associated increased pain and scarring/poor healing. The incision can be either a 2 cm longitudinal incision or a cruciate incision. An incision is then made in the cyst wall in the same fashion if incidental incision into the cyst wall does not already occur with skin opening. Culture is taken of the abscess drainage and then the cavity is irrigated. Allis clamps are then used to grasp the cyst wall laterally and medially. Any noted loculations are disrupted with a Kelly clamp or hemostat. Circumferentially, the cyst wall is sutured to the epithelium using interrupted absorbable 3–0 suture, which everts the cyst wall. Ensure hemostasis with pressure and cauterization. Postoperatively, ice packs, sitz baths, and bowel regimen are recommended. Postoperative pain is often managed with over-the-counter pain regimens. Pelvic rest is recommended for at least four weeks and restrictions are lifted once evaluated at four weeks.

At the time of marsupialization, biopsy of the cyst should be performed based on the characteristics of the Bartholin's mass and patient's age. Some data suggest that all patients aged 40 or older with a Bartholin's gland cyst should be biopsied, and especially if it presents in a postmenopausal patient [2]. Other characteristics of the Bartholin's mass that should prompt biopsy include a fixed mass/cyst wall, solid component, or recurrence/enlarging in size despite treatment.

Excision

Bartholin's gland excision is an alternative to marsupialization for recurrent abscesses and when malignancy should be ruled out. Although this is definitive treatment, excision of the gland is a more extensive procedure and has greater associated risk, in particular increased amount of bleeding. Other complications could include wound infection, hematoma, and dyspareunia [7]. In addition, since Bartholin's gland excision is not performed frequently, it is important to have an experienced operator to reduce complications.

First an examination under anesthesia is performed to delineate the full extent of the Bartholin's gland cyst, including a rectovaginal examination. Similar to the marsupialization procedure, the labium is retracted laterally with Allis clamps and a linear incision is made with a 15 blade in the vaginal epithelium overlying the cyst. Care is taken to avoid incision on the labia or into the cyst. While the vaginal epithelium is retracted medially and skin of the labia retracted laterally, Metzenbaum or Mayo scissors can be used to dissect the wall of the abscess off the vaginal tissue while grasping the cyst wall with forceps. Retracting the cyst wall with the forceps and careful blunt dissection and with scissors allows identification of the blood supply, which is branches of the pudendal artery. Cauterization may be required intermittently for hemostasis to allow for better visualization. Once the entire gland is removed, there is often bleeding at the base of the gland. Cauterization and suture ligation is used to achieve hemostasis. Once hemostasis is achieved, the base of the excision is closed with interrupted absorbable suture, to close the dead space. Then the vaginal epithelium is reapproximated at the introitus in either a running fashion or interrupted fashion, using a delayed absorbable suture. A small drain is often placed at the base and sutured to the skin to allow fixation; this helps to avoid hematoma formation. The drain is removed in clinic about three to five days after surgery. Postoperatively, ice packs, sitz baths, and bowel regimen are recommended. Postoperative pain is often managed with over-the-counter pain regimens. Pelvic rest is recommended for at least four weeks and restrictions are lifted once evaluated at four weeks.

Key Teaching Points

- Initial treatment options for Bartholin's abscesses include I&D or Word catheter placement
- Marsupialization should be performed for recurrent Bartholin's gland abscess
- Bartholin's gland excision is reserved for multiple recurrences and for suspicion of malignancy
- Biopsy of the cyst wall should be performed in women aged 40 or older or if concerning characteristics are present on inspection at the time of marsupialization

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CASE 12 A 21-Year-Old Woman with Labial Pain During Exercise

Christine Isaacs

History of Present Illness

A 21-year-old nulligravid woman presents complaining of vulvar pain and irritation noted during exercise and with tampon insertion. She is an avid cyclist and rides approximately 75 miles per week as her routine. Her gynecologic history is unremarkable, but upon further questioning, she notes frequent friction and a "pulling sensation" with sexual activity. She has no medical or surgical history and uses a levonorgestrel intrauterine system for contraception. She takes no medication and has no allergies.

Physical Examination

General appearance: Healthy, woman in no acute distress

Vital signs:

Temperature: 36.7°C
Pulse: 70 beats/min
Blood pressure: 111/72 mmHg
Height: 66 inches
Weight: 138 lb
BMI: 22 kg/m^2

Abdomen: Soft, non-tender, no pain with palpation

External genitalia: Normal appearing labia majora. Prominent labia minora noted. With lateral traction, the left labium minus measures approximately 5 cm in length. The right labium minus measures approximately 4 cm. There is a normal introitus and perineal body

Vagina: Normal rugae, no lesions or discharge

Cervix: Normal appearance with intrauterine device strings approximately 2 cm in length noted to be exiting the cervical os

Bimanual examination: Normal size, anteverted, non-tender, mobile uterus with no adnexal masses

How Would You Manage This Patient?

The patient's history and physical examination findings are consistent with labial hypertrophy, which is causing her significant discomfort. Labioplasty, which is the resection of the hypertrophied labia minora, is a reasonable option to discuss with the patient. After a discussion of risk and benefits of the procedure, she underwent a bilateral wedge resection of her labia minora. Her outpatient surgery was uncomplicated and, after six weeks, she was able to return to full exercise activities. At six-month follow-up, her labial pain and friction symptoms associated with cycling, sexual activity, and tampon insertion had resolved.

Labioplasty Indications and Techniques

Labioplasty, or reduction of the labia minora, has been increasing in popularity and has become a common surgical procedure. The National Health Service of England reported a near-doubling of labioplasty from 1999 to 2005 with similar trends noted in the United States and worldwide [1]. A major reason for increased interest in genital surgery has been for aesthetics, which are often rooted in women having a perception that their genitalia are abnormal in comparison to images portrayed in the adult sex/media industry. Increased emphasis on shaving, waxing, and removal of pubic hair also leads to increased inspection of the genitals by both women and their partners, and this can lead to concerns about their appearance despite no structural or functional abnormality [2].

The American College of Obstetrics and Gynecology (ACOG) refers to "female genital cosmetic surgery" as procedures done to alter the sexual appearance or function of the genitals when there is a lack of a medical indication, and notes that there are associated risks without safety or efficacy data. This categorization EXCLUDES procedures on the genitals that are performed for clinical indications, such as the pain caused with exercise, sexual activity, and tampon insertion as was noted for this patient. Caution is strongly advised when considering labioplasty in girls younger than age 18 unless there is a significant congenital malformation, or persistent symptoms exist that the clinician believes are caused directly by the labial anatomy. Surgical alteration of the labia, not indicated for the health of a patient younger than the age of 18, is a violation of federal criminal law [2].

Labial Hypertrophy

The labia minora naturally vary in length, thickness, symmetry, and protuberance. No anatomical standard regarding the size of the labia minora or diagnostic criteria for hypertrophy exists. An early proposed definition of labial hypertrophy was a length greater than 5 cm from the midline to the most lateral free edge of the labium when extended, but more recently some have proposed to reduce this distance to 3 or 4 cm [3].

Labial hypertrophy is most commonly congenital and requires no intervention unless symptoms are present. Symptoms can include dyspareunia, interference with sporting activities, hygiene problems such as difficulty with tampon insertion, and pain or irritation. Surgery is often sought for relief of the functional impairment; however, there is a paucity of data to guide treatment approaches and no standardized criteria to assess outcomes [3]. Surgery to correct labial hypertrophy should only be considered when chronic symptoms create functional problems, as was the case for this patient. The most common labioplasty techniques described include edge excision, wedge excision, and central deepithelialization [3, 4].

- **Edge excision** involves the removal of the hypertrophied labial edge and was the first reported labioplasty technique. It

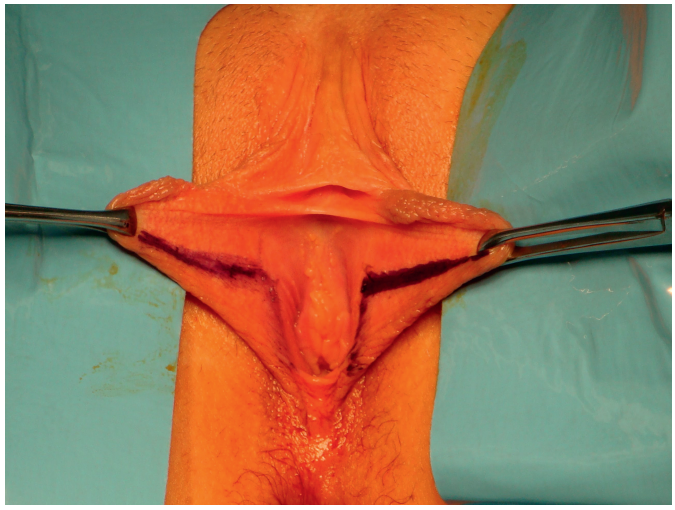

Figure 12.1 Preoperative marking of surgical site.

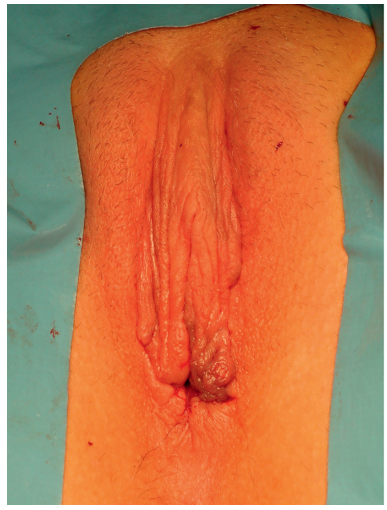

Figure 12.2 Appearance after labioplasty.

has the advantage of being technically simple and adaptable to all sizes of labia, but may lead to unnatural pigment transitions, scarring, or scalloping of the labial edge with scar contraction. Overzealous resection is also possible, which may compromise the clinical results

- **Wedge excision** (the surgery performed on this patient) preserves the labial edges and eliminates the possibility of scarring but is technically more difficult and may be complicated by an incisional line dehiscence which would require further repair. In this patient, the excised wedges are illustrated with the marked lines (Figure 12.1). They were resected and the exposed surface edges were reapproximated in a two-layer closure consisting of interrupted stitches of delayed absorbable suture, followed by a subcutaneous layer closure (Figure 12.2)
- **Central excision/deepithelialization** involves deepithelialization of an elliptical portion of the central labia minora and reapproximation of the central edges. It is less commonly performed but has the advantage of preserving the labia minora edge similar to the wedge excision approach. Disadvantages can include excessive postoperative tissue edema, increased labial thickness, and suboptimal size reduction [4]

There is a notable lack of evidence to guide surgeons on perioperative and postoperative care for labioplasty. General principles include performing surgical markings prior to the injection of any local anesthetic to avoid tissue distortion, and careful attention to hemostasis. A single-layer closure with an interrupted 4.0 delayed absorbable suture such as polyglactin is appropriate for an edge excision. For a wedge resection technique, a two-layer closure is generally advised to reduce the potential for dehiscence. A 4.0 poliglecaprone is recommended for the subcutaneous layer [2, 4].

Postoperative complications can include wound dehiscence and/or flap necrosis (in particular for wedge excision techniques), hematoma formation, dyspareunia, visible scarring, superficial infections, under- or over-reduction, and asymmetry after complete wound healing. Revision rates for persistent under-reduction are reported to be 3.5% [1, 4]. Patient satisfaction rates with labioplasty have been reported in excess of 94%. It should be noted that these satisfaction rates include those patients having labioplasty for strictly aesthetic reasons and without a clinical indication [3].

Key Teaching Points

- The size and shape of the labia minora vary considerably and no standardized norm exists
- Labioplasty may be considered when clinical symptoms (pain/dyspareunia, interference with activities, hygiene) are directly related to prominent labial tissue
- While various surgical techniques for labioplasty exist, lack of published studies and standardized definitions translate to limited evidence regarding risks, benefits, and outcomes
- Patient satisfaction with labioplasty is very high and the request for labioplasty (for aesthetic as well as clinical reasons) has steadily increased
- Labioplasty in a patient younger than age 18, without a clear clinical health indication, is against the law

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CASE 13 A 33-Year-Old Woman with Localized Vulvodynia without Vaginismus

Jonathan Schaffir

History of Present Illness

A 33-year-old nulligravid woman presents with a complaint of insertional dyspareunia. She has been partnered with the same man for three years and had no issues with coitus until about one year ago. Since that time, she has experienced increasingly severe pain with any attempt at vaginal insertion. She describes the pain as sharp and tearing, occurring when her partner enters her. Because of the pain, she has also experienced diminished arousal and a lack of sexual desire. She denies any vulvar pain in other situations but has a similar sensation with placement of a tampon or sex toy. A trial of topical estrogen worsened her symptoms. Application of lidocaine jelly to the area resulted in improvement of symptoms temporarily, but intercourse without it was persistently painful. Her gynecologic history is notable only for a history of recurrent candida vaginitis, though she has no symptoms currently. She uses a combined oral contraceptive for birth control. She has no significant medical history and has never had surgery. She is a non-smoker and uses alcohol occasionally.

Physical Examination

General appearance: Well-developed female in no distress, though slightly anxious

Vital signs:

Height: 64 inches
Weight: 148 lb
BMI: 25.4 kg/m^2

Abdomen: Soft, non-distended, normal bowel sounds, and no masses. No tenderness in the lower abdomen, inguinal area, or symphysis

External genitalia: Normal appearance with no lesions noted. Normal urethral orifice. Slight erythema of vulvar vestibule. Cotton tip applicator elicits no tenderness of labia or perineum but marked tenderness of vestibule

Vagina: Normal rugae, no significant discharge or lesion. Cotton tip applicator elicits no tenderness of epithelium proximal to the hymen

Cervix: Normal nulliparous appearance, with no discharge or friability. No cervical motion tenderness

Bimanual examination: Normal-sized anteverted non-tender uterus. No adnexal mass or tenderness. Palpation of levator muscles with no significant tenderness or tension

Laboratory studies:

Wet mount: Moderate leukocytes with normal lactobacilli present, no hyphae, clue cells, or trichomonads
Cervical swab: Negative for gonorrhea and chlamydia
Serology: Negative for HSV antibodies

How Would You Manage This Patient?

Based on her symptoms and examination findings, this patient has a localized provoked vulvodynia limited to the vulvar vestibule. The vulvar vestibule is the most common area for this type of pain to occur, and this specific condition is referred to as provoked vestibulodynia (PVD). Given her persistent symptoms despite therapy with topical agents, she was counseled about the risks and benefits of vestibulectomy. Preoperative counseling included an explanation that excision of this sensitive area is not guaranteed to resolve her pain but is successful in most cases where a trial of local anesthetic has suppressed well-localized pain. She consented to surgery and underwent excision of the affected area. She was instructed to refrain from any vaginal penetration until the area was completely healed six weeks later, and to use appropriate lubrication with trials of coitus. She also continued to visit a sex therapist to discuss her apprehension regarding coitus. She returned for a follow-up visit three months following her surgery. She was very satisfied with her results. Although she experienced slight tenderness initially related to surgical scarring, she had no-going pain during penetration. Her arousal and sexual desire had also improved.

Provoked Vestibulodynia and Vestibulectomy

Chronic vulvar pain (or vulvodynia) is a common gynecologic complaint, expressed by up to 15% of women during their lifetime [1]. PVD, the most common subtype of vulvodynia, involves pain limited to the epithelium of the vulvar vestibule, identified as the part of the introitus demarcated by the hymen internally and the junction between keratinized and non-keratinized epithelium of the vulva (Hart's line) externally. Although this condition has been described for well over one hundred years, much about it remains a mystery, including why this tiny strip of tissue should be so vulnerable to abnormal nociception. Causes of this condition remain unclear. Researchers have suggested a link between PVD and recurrent infection or trauma, which may trigger sensitivity, or a hormonal trigger from reduced estrogenization (as from combined hormonal contraceptive use) [2]. In a survey of women with the condition, causes they believed to be at the root of the problem included coitus, yeast, other infections, childbirth, and contraception use, but the most common response was that no cause could be identified [3]. Regardless of the cause, there do appear to be histologic findings common to women with this diagnosis. Tissue samples from the vestibule of affected women reveal increased markers of chronic inflammation, increased density and thickness of nerve fibers, and increased mast cell density [4].

The diagnosis of PVD, however, is made clinically. Diagnostic criteria are simply the presence of severe pain with attempted vaginal penetration and tenderness on light palpation confined to the vestibule. PVD may occur primarily from the time of coitarche or be secondary after a period of normal sexual function without pain. Erythema may be present on examination but is not universally present. No specific risk factors have been identified, though women with primary disease are likely to be younger and have a longer duration of symptoms [3]. A history of sexual abuse is infrequent. Prior to treatment recommendations, other causes of vulvar pain should be ruled out. If an infection or lesion is present on examination, this should be addressed first. Although painful attempts at coitus may lead to involuntary muscular contraction and spasm, vaginismus is more likely to be a reaction to this condition than an underlying cause. Nevertheless, pelvic floor physical therapy and dilator therapy may be useful adjuncts to treatment, particularly when there is scarring present from surgical or obstetric trauma. Concurrent sexual dysfunction issues such as low sexual desire and impaired arousal frequently accompany this condition. Referral to a therapist with experience in sexual dysfunction may be helpful, and both cognitive behavioral therapy and biofeedback have been proven to be helpful [1].

Because of their low risk and non-invasive nature, medical interventions are generally suggested as first-line treatment. Many treatments have been proposed for PVD, including topical or subcutaneous application of antinociceptive agents, anti-inflammatory agents, and compounded neuromodulators such as tricyclic antidepressants or gabapentin [5]. Efficacy of most of these agents has been understudied, but those with the greatest evidence for offering relief are topical lidocaine and injections of combined corticosteroids with lidocaine. Spontaneous resolution may also occur, particularly in those with lower pain scores initially [6]. Though not typically offered as the first treatment choice, the modality with the most success for cure is surgical excision of the vestibule as was done in this case. Vestibulectomy leads to relief of pain and dyspareunia in 60–100% of patients [7]. Various techniques have been described, with the original descriptions including excision of the entire vestibule and part of the perineum. More conservative adaptations involve a simple skinning resection of the affected vestibular epithelium with equal success rates [8]. A key factor in surgical success is careful patient selection and surgical planning. Those patients with tenderness confined to the mucosa within Hart's line that resolves with application of topical anesthetics are more likely to be pain-free following vestibulectomy. In advance of surgery, the surgeon should carefully demarcate the specific areas of tenderness to delineate the margins for resection (Figure 13.1). Since the posterior vestibule is most commonly affected, the surgical margins may involve only a horseshoe-shaped area of tissue from approximately 2 to 10 o'clock. However, if anterior tenderness is present as well, these areas may be excised separately. The area to be excised is infiltrated with local anesthetic prior to excision to aid with postoperative pain. Posterior vaginal epithelium may need to be undermined to advance the tissue sufficiently for tension-free closure. This step may be unnecessary if sufficient hymenal tissue is spared and used in closure. The excision bed is closed with interrupted delayed absorbable suture (e.g. 3–0 or 4–0 polyglycolic acid). At the conclusion of surgery, the vaginal epithelium abuts the perineum (Figure 13.2). Patients should maintain pelvic rest until the surgical site is completely healed (usually six weeks) but should be seen sooner to assess for wound healing and to provide anticipatory counseling regarding sexual function.

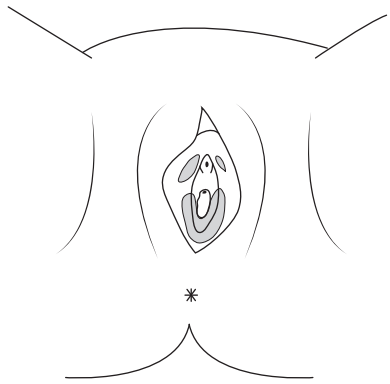

Figure 13.1 Shaded areas of vestibule indicating points of tenderness on examination.

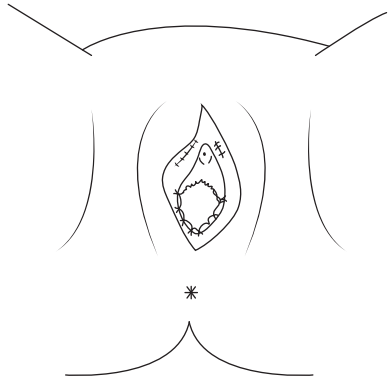

Figure 13.2 Appearance of vulva after resection of affected areas.

Complication rates of surgery are generally low, with localized bleeding and pain being the most common issues in the short term. Because the ostia of the Bartholin's ducts may be occluded by the closure, there is a risk of forming a Bartholin's cyst postoperatively. In a study of women followed for 36 months after vestibulectomy, only 4/70 (6%) experienced this complication [9]. Sixty-four percent of women had no tenderness to palpation at all at this juncture, and 91% expressed overall satisfaction with the surgery. Due to the concerns for surgical complications, vestibulectomy remains a second-line treatment for PVD. Given the literature supporting a success rate twice that of medical treatments, however, it is reasonable to offer surgery initially in well-selected patients who are likely to benefit. Concurrent treatment for levator muscle spasm and counseling regarding sexual dysfunction is equally important for women with these concerns. However, women with PVD who experience pain, anxiety, and profound detriment to their sexual well-being

should be reassured that surgery is a safe and effective treatment for this condition.

Key Teaching Points

- Provoked vestibulodynia (PVD) is a common type of vulvodynia that involves provoked pain confined to the vulvar vestibule
- Various topical products have been proposed as medical treatment, with the most successful being topical anesthetics and corticosteroid-anesthetic combinations
- In well-selected women with tenderness confined to the vulvar vestibule, vestibulectomy has a high rate of success
- Post-surgical complications are rare but may include Bartholin's gland cysts

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CASE 14 A 24-Year-Old Woman with Multiple Large Vulvar Condyloma

Celeste Ojeda Hemingway

History of Present Illness

A 24-year-old woman presents to the office with complaint of bumps on her vulva. She first noticed them several months ago and feels they have grown since then. She currently feels the lesions are the size of grapes and bumpy in texture. The site is not painful, but there is discomfort and irritation when the lesions rub against her clothing. Recently, she has been avoiding intercourse because of the bumps. She has been sexually active with a new partner in the last year and they do not consistently use condoms. Her gynecologic history is significant for regular withdrawal bleeding on oral contraceptive pills with good compliance. She has seasonal allergic rhinitis and exercise-induced asthma but otherwise denies medical or surgical history. She denies medication allergies and has no contributory family history.

Physical Examination

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

Vital signs:

Temperature: 36.6°C
Pulse: 101 beats/min
Blood pressure: 128/78 mmHg
Respiratory rate: 16 breaths/min

Abdomen: Soft, non-distended, non-tender

External genitalia: Multiple confluent condylomatous lesions on the left inferiolateral labium majus obstructing the vaginal opening approximately 2 × 6 cm with surface irritation; several smaller condylomata on right labium minus

Vagina: Careful speculum examination reveals normal vaginal epithelium without lesions or discharge

Cervix: Normal in appearance without lesions or discharge

Uterus/adnexa: Bimanual examination deferred due to patient discomfort

Laboratory studies:

HIV serology: Negative
Gonorrhea probe: Negative
Chlamydia probe: Negative
Trichomonas NAAT: Negative
Hepatitis B serology: Negative
Hepatitis C serology: Negative
Syphilis serology: Negative
Normal cervical cytology 14 months prior to today's visit

How Would You Manage This Patient?

This patient has multiple large vulvar condylomata acuminata (genital warts) based on classic clinical examination findings (Figure 14.1). A thorough examination of the vagina and cervix did not reveal any additional condylomata. Complete testing for other sexually transmitted infections was performed. Cervical cytology was not indicated because screening was up to date. Surgical treatment was advised due to the size and extent of the lesions. Examination under anesthesia allowed for a complete assessment of the extent of the lesions. The larger, bulky lesions were excised sharply to the level of the vulvar epithelium. The bases of the larger lesions were treated with carbon dioxide laser vaporization, which was also used to treat smaller lesions that were visualized after removal of bulky warts. Sulfadine cream was applied to the treated areas, and the patient was discharged home on day of surgery with instructions to apply sulfadine cream twice daily and use sitz baths for comfort. At two weeks postoperatively the area was still open but without signs of infection, and at four weeks was completely healed. She was advised of the potential for recurrence of human papillomavirus (HPV)-related genital warts, advised to follow-up as needed for recurrent symptoms, and instructed to continue routine cervical cytology screening.

Vulvar Condylomata

Genital warts result from the sexual transmission of HPV and are among the most common sexually transmitted infections. Estimates of prevalence depend greatly on methodology and vary by study population. The worldwide prevalence of anogenital warts ranges from 0.13% to 5.1% [1]. Of the estimated 40 low-risk HPV strains associated with this condition, HPV-6 and HPV-11 infections are responsible for the majority of cases. While most genital warts will arise two to four months after exposure to HPV, the estimated incubation time can range from one month to two years [2]. Condyloma acuminata are highly contagious with an estimated 65% of partners of infected individuals developing lesions within eight months of exposure. HPV infection of keratinocytes results in abnormal growth of these cells resulting in the clinical findings. Rarely, malignant transformation of squamous cells results in Buschke–Lowenstein tumors, verrucous carcinoma. Genital warts present as one of four morphological types: condylomata acuminata (cauliflower-like lesions) such as those seen in this patient, papular warts (domed), keratotic warts (thick layer resembling seborrheic keratosis), or flat warts. Whereas condylomata acuminata are more common on the moist, partially keratinized mucous membranes, keratotic and papular lesions tend to develop on fully keratinized skin. Flat warts can occur in any portion of the genital area [3]. Although some genital warts are asymptomatic, patients can present with symptoms of bumps, itching, discomfort, or bleeding.

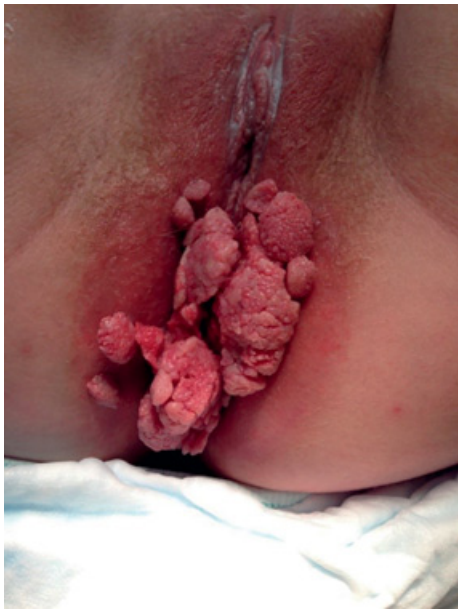

Figure 14.1 Bulky perineal and perianal condylomata. (Photo courtesy of Dr. Emma Grabinski.)

Each individual lesion can grow rapidly, causing bulk symptoms or obstruction. Some lesions may regress spontaneously. However, untreated they can also progress and grow in size. Immunosuppressive medications and conditions such as HIV infection and pregnancy can be associated with more rapid growth. HIV testing should be considered in patients with new diagnoses of condylomata acuminata. Although the diagnosis is often based on classic appearance, biopsy should be considered whenever there is suspicion for dysplasia or malignancy such as an atypical appearance, history of dysplasia, immunocompromised state, and non-responsive or worsening lesions despite treatment [4]. Even with treatment, 25–67% of patients experience recurrence of genital warts within three months [5].

Bulky condylomata or keratotic warts may not be amenable to initial treatment with topical agents. However, many cases of papular or flat warts as well as smaller condylomata and keratotic warts <10 cm^2 in total surface area may respond well to topical methods as a first-line treatment. Patient-directed topical treatments include podofilox and imiquimod. Podofilox, an antimitotic agent in 0.5% solution or gel preparations, achieves total clearance for 45–82% of patients within four to six weeks when treated twice daily for three consecutive days per week for no more than four weeks. Imiquimod, an immunomodulator in 3.75% or 5% cream preparation, achieves total clearance for 27–85% of patients over 8–16 weeks when used for up to 16 weeks [3].

Clinician-directed topical treatments include cryotherapy, podophyllin, and trichloroacetic acid (TCA) or bichloroacetic acid (BCA). Cryotherapy with nitrous oxide or liquid nitrogen achieves total clearance for 60–97% of patients over three to six weeks, but clinicians should target cryotherapy for destruction of the epidermal layer only, careful not to undertreat or overtreat. Clinician treatment with podophyllin, a compounded solution of podofilox and other mutagenic flavonoid compounds, achieves total clearance for 19–80% of patients when treated weekly for up to six weeks. TCA and BCA in concentrations of 85–95% are caustic agents that chemically coagulate genital warts. Clinician treatment with TCA or BCA achieves total clearance in 50–100% of patients when treated weekly for up to four weeks [3]. Because of the solution's low viscosity, care must be taken to avoid solution contact with other non-affected tissues by applying petroleum barrier or neutralization with sodium bicarbonate. Side effects for all topical treatments are similar and primarily local, including pain, ulceration, redness, and irritation. None of the patient-directed or clinician-directed topical therapies demonstrates significant benefit or superiority in terms of reduction of recurrence. Podophyllin and imiquimod are contraindicated in pregnant women, and cryotherapy or TCA/BCA may be the treatments of choice in pregnancy [5]. Table 14.1 summarizes topical therapies.

Surgical treatment is generally recommended as primary treatment for large or bulky disease, as was seen in this patient. It is also used as second-line treatment for patients in whom improvement has not occurred after three clinician-directed treatment sessions or total clearance has not occurred after six sessions. Surgery would also be recommended if patient-directed treatments have reached the recommended limits of treatment without resolution. Under some circumstances, surgical treatment might be the most cost-effective primary treatment option [5]. Surgical treatment options for condylomata include excision, electrocautery, and laser vaporization. Excision of condylomata can be achieved by sharp excision with either scissors or scalpel under local, regional, or general anesthesia. Hemostasis can be achieved with electrocautery, silver nitrate, or Monsel's solution. Depending on the size of the lesion base and resultant defect, placement of absorbable sutures may occasionally be required for hemostasis, healing, or cosmesis. The advantage of excision is a 100% clearance of visible, treated warts at the time of surgery. Thermal disruption with electrocautery can be completed under local, regional, or general anesthesia and typically does not require additional hemostasis. Loop electrocautery treatment is an efficient option for larger, pedunculated lesions. Total clearance rates with electrocautery are similar to those of cryotherapy, and like cryotherapy, the surgeon should exercise caution not to over or undertreat by targeting thermal destruction of the epidermal layer only. Carbon dioxide laser vaporization requires specialized equipment and surgeon training. Patients undergoing laser vaporization will often require sedation or even general anesthesia for complex or extensive lesions. Total clearance of 60–100% is typically achieved immediately after laser vaporization. Because genital condylomata are epidermal lesions, it is not necessary to go deeply into the dermis to destroy them. In fact, it is important that the dermis be conserved as it is critical to the healing and re-epithelialization that occurs after laser vaporization. To achieve isolated destruction of the epidermis and papillary dermis without excess damage to surrounding and underlying tissues, a carbon dioxide laser power

CASE 15 A 70-Year-Old with Vulvar Paget's Disease

Erica Nelson

History of Present Illness

A 70-year-old presents with left-sided vulvar itching and pain, which has worsened over the past 12 months. She has been treated with antifungals several times with no relief. The pain keeps her up at night. She is using a petroleum-based ointment to prevent her labia from sticking to her underwear. She has had no vaginal bleeding or urinary leakage. The patient experienced menopause in her early 50s. Her gynecologic history is unremarkable: she has never had an abnormal Pap smear or any sexually transmitted diseases. Her regular, yearly screening mammograms and colonoscopy done 10 years ago have been normal. Her hypertension is well controlled on medications. She denies any surgeries or medication allergies.

Physical Examination

General appearance: Well-appearing elderly female in no distress

Vital signs:

Temperature: 37.1°C
Pulse: 84 beats/min
Blood pressure: 138/72 mmHg
Respiratory rate: 16 breaths/min
Height: 59 inches
Weight: 126 lb
BMI: 26.3 kg/m^2

Abdomen: Normal bowel sounds, thin, soft, non-distended, non-tender on deep palpation

Pelvic: Normal clitoris and urethra, right labium majus is normal, left labium majus is larger than the right. There is an erythematous lesion measuring 4 × 4 cm with ill-defined borders. The area is tender to palpation. Erythema extends to the hymenal ring. The vaginal mucosa appears normal, with no ulcers or discharge. The cervix is normal. Bimanual examination reveals a small, mobile uterus, and no adnexal masses. Anus appears normal. Rectovaginal examination is unremarkable

Neurologic: Alert and oriented ×3

Laboratory studies: Vulvar biopsy positive for Paget's disease (Figure 15.1)

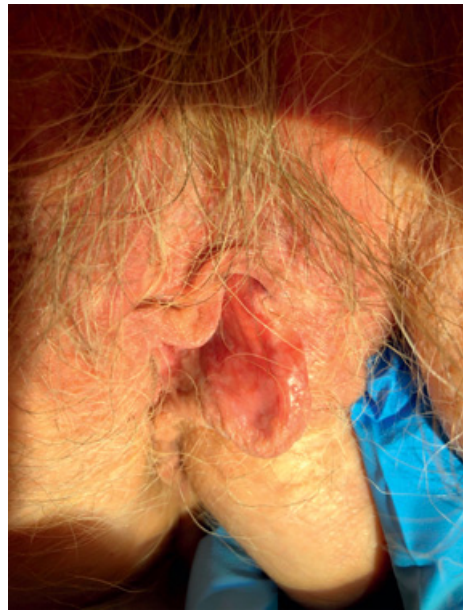

Figure 15.1 Vulvar Paget's disease.

How Would You Manage This Patient?

This patient has a large vulvar lesion on the labium, which on biopsy was confirmed to be Paget's disease. The patient underwent a partial vulvectomy to remove the lesion and provide symptom relief. An elliptical resection of the entire visible lesion with a 1 cm margin was performed. The specimen was reviewed by a pathologist with frozen section analysis of the surgical margins. After initial resection, the lateral margin was positive for a small focus of disease and another 1.5 cm of tissue was removed. The final surgical site measured 7 cm in length and 5 cm in width and was reapproximated in layers with good closure. At the time of follow-up visit, four weeks postoperatively, the area was well healed. Final pathology revealed negative margins and confirmed the diagnosis. She was instructed to return for annual surveillance and to notify her healthcare provider of recurrent symptoms.

Vulvar Paget's Disease

Paget's disease is a rare intraepithelial adenocarcinoma that is hypothesized to arise from the apocrine glands of the vulvar epithelium. It comprises less than 1% of all diagnosed vulvar malignancies. It most commonly affects postmenopausal, white females with the average age of 70. Paget's disease is classified as either primary with a vulvar cutaneous origin, or secondary with origin such as bladder, anus, or rectum. The typical appearance is a red, velvety lesion with areas of white patches, but it can also be scaly or ulcerated. As in this case, patients often present with complaints of unrelenting pain or pruritus; however, women can be asymptomatic [1–3]. Unfortunately, these lesions are often misdiagnosed and inappropriately treated prior to definitive diagnosis. The differential diagnosis is broad, including lichen sclerosis, lichen planus, psoriasis, squamous vulvar intraepithelial neoplasia, candidiasis, and contact dermatitis. A vulvar biopsy is critical for diagnosis and can easily be achieved with a local anesthetic and a Keyes punch instrument. Multiple biopsies from different areas of the lesion, including the visible edge, are useful for diagnosis and to rule out invasive

vulvar adenocarcinoma. Histologically Paget's disease cells have a prominent nucleolus with clear chromatin and cells appearing vacuolated. Nests of the atypical glandular cells are scattered in the squamous epithelium. Immunohistochemistry techniques aid with identification of the Paget cells by differentiating the disease from high-grade squamous intraepithelial lesions or melanoma. [2].

The ideal treatment for Paget's disease would result in minimal tissue destruction, low recurrence rate, and minimization of post-treatment pain and scarring. Surgical management has been the traditional mainstay in the form of wide local excision, simple vulvectomy, or rarely radical vulvectomy depending on the size of the lesion. Lymphadenectomy would only be required if an invasive lesion is identified. Since the lesions are multicentric and often extend beyond the visible lesion, margins are frequently positive. Frozen section analysis can be used to guide the extent of surgical excision [4, 5]. However, frozen section may have false-negative rate as high as 13%. Additionally, the relationship between positive margins and recurrence is unclear. Reported recurrence rates after surgical treatments are between 34% and 56% [6–8]. Multiple surgical procedures are often required, resulting in anatomic distortion, scarring, and pain of the vulva. Unfortunately, a chronic and relapsing course over decades is common [5, 6]. Alternative treatments for primary and recurrent Paget's disease include imiquimod 5% cream, radiotherapy, carbon dioxide laser ablation, photodynamic therapy, and topical fluorouracil. Imiquimod 5% cream has been used most frequently. The cream is applied every other day until resolution of disease based on biopsies of the affected area. This treatment can take over six months. Imiquimod's side effects that can limit use include local irritation, skin erosion, fever, and flu-like symptoms. Multiple case studies show promising response to imiquimod, but to date no randomized trial comparing imiquimod with surgical excision has been published [9]. Therefore, currently there is no evidence confirming one treatment is superior to another for resolution of Paget's disease or prevention of recurrence [5].

An association between vulvar Paget's disease and other malignancies, including breast cancers, has been reported. However, the majority of studies examining the rate of secondary cancers had no age-matched controls. The large variation in incidence of other reported malignancies, wide spectrum of associated cancers, and elevated risk of malignancy in the aged population has called this association into question [1, 6]. Thus, it is unclear if rates of secondary cancers are higher than those of the general population. Any abnormal genital bleeding must be evaluated whether vaginal, uterine, urinary tract, or colon. However, no consensus currently exists regarding testing for evaluation for other malignancies [1]. Women with Paget's disease should be encouraged to maintain up-to-date routine screenings including those for breast, colon, cervical, and lung cancers.

Key Teaching Points

- Paget's disease should be considered in the differential diagnosis of vulvar itching and pain
- Definitive diagnosis of Paget's disease is based on tissue biopsy with histology and immunohistochemistry
- Surgical excision is most commonly used as first-line therapy
- Other treatment options commonly include imiquimod, radiotherapy, or topical chemotherapies
- Recurrence rates are high, requiring multiple surgical procedures or alternative therapies

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CASE 16 A 45-Year-Old Female with Multifocal VIN

Esther Fuchs

History of Present Illness

A 45-year-old female presents to the office with itching in the vulvar area. The symptoms have been present for several weeks and are progressively getting worse. She recently felt some skin thickening between the vaginal introitus and anus. Her history is remarkable for genital warts that resolved after cryotherapy 10 years ago. Additionally, she had a loop electrosurgical excision procedure (LEEP) procedure six years ago for severe cervical dysplasia but has had normal cervical cytology on follow-up.

The patient has been sexually active with several male partners over the past six years. She is generally healthy and had recently negative testing for sexually transmitted diseases including HIV and syphilis. She is a non-smoker and did not receive the HPV vaccine. She is not taking any medications and has no drug allergies.

Physical Examination

General appearance: Well-developed female, appears comfortable

Vital signs:

Temperature: 37.0°C
Pulse: 96 beats/min
Blood pressure: 110/70 mmHg
BMI: 23 kg/m^2

Abdomen: Soft, not tender, not distended, no masses palpable. Inguinal areas without enlarged lymph nodes

Pelvic:

Vulva: Multiple, minimally raised, 5 mm whitish appearing plaques distributed between the posterior fourchette and anus, several smaller lesions of 2 mm diameter are visible on both labia minora and one on the clitoral hood. One reddish macular area of 1 cm diameter present on the left posterior labium minus
Vagina: Physiologic discharge, no lesions visible
Cervix: No lesions, central defect consistent with prior LEEP
Bimanual examination: Uterus normal size, anteverted, mobile, not tender. No adnexal masses or tenderness
Rectovaginal examination: Parametria smooth, no indurations palpated in the rectovaginal area
Anus/rectum: Perineal lesions do not involve the anus, normal rectal examination

Laboratory studies:

Cervical cytology: Negative for intraepithelial neoplasia, HPV-high risk negative
Gonorrhea and chlamydia/HIV/ syphilis/hepatitis B and C: Negative
Vulvar punch biopsy: Usual type VIN/HSIL

How Would You Manage This Patient?

Based on punch biopsy, this patient has high grade vulvar intraepithelial neoplasia, a premalignant condition for which treatment is indicated. Because of the multifocal nature of the disease noted at the time of initial examination, vulvoscopy was performed. After a 3- to 5-minute application of a gauze soaked with 5% acetic acid, the vulva was inspected with the colposcope and several areas appeared white. No ulcerative or irregular borders were noted that would have raised concern for invasive disease. The patient was counseled about treatment options, and due to the widespread, multifocal disease chose to proceed with laser ablation. The procedure was performed in the operating room as a same-day surgery. Postoperatively, she was instructed to apply silver sulfadiazine cream and perform sitz baths twice daily. At two weeks post-surgery there was no sign of infection. At six weeks, the areas were completely healed. The patient was scheduled to return in six months and yearly thereafter or if she developed new symptoms.

Vulvar Intraepithelial Neoplasia (VIN)

VIN incidence increased more than fourfold between 1973 and 2000. In 2000, the incidence of VIN 3 was 2.86 per 100 000. The average age at diagnosis is 46 years old [1]. Risk factors are HPV infection, cigarette smoking, and immunodeficiency or immunosuppression. In 2004, the International Society for the Study of Vulvovaginal Disease (ISSVD) changed the classification nomenclature and then further redefined it in 2015 [2]. The designation VIN 1 was eliminated as evidence is lacking that such lesions are cancer precursors. Flat condyloma or HPV effect are now known as low grade squamous intraepithelial lesion. VIN 2 and 3 were combined and are now called VIN. There are two categories: high grade squamous intraepithelial lesion (HSIL), also known as usual type (uVIN), and vulvar intraepithelial neoplasia, differentiated type (dVIN). Both are squamous lesions and considered premalignant conditions of the vulva. In general, HPV-related high-grade VIN lesions (uVIN) tend to be multicentric and less frequently progress to squamous cell vulvar carcinoma. In contrast dVIN is related to other dermatologic disorders such as lichen sclerosus and has greater malignant potential. Only 5% of VIN is differentiated type, but dVIN is responsible for 80% of vulvar cancers. This patient was diagnosed with multifocal, HSIL/VIN usual type of the vulva. Figures 16.1 and 16.2 demonstrate the histologic appearance of uVIN. Multifocal disease, as in our example, signifies that there are multiple foci of the disease within the same organ. Multicentric disease involves different organs such as cervix, vagina, or anal canal.

Wide local excision is the surgical treatment of choice for initial therapy of discrete lesions but was not appropriate in

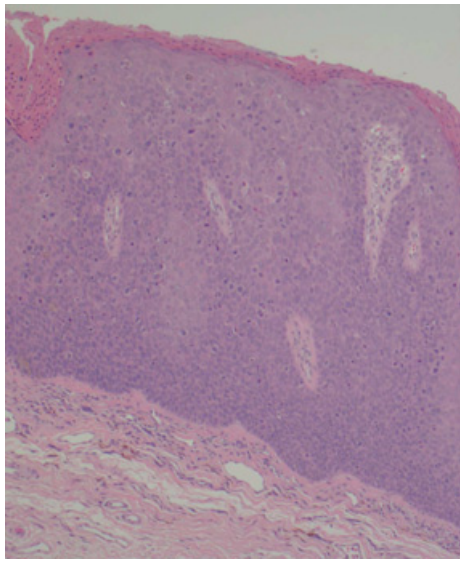

Figure 16.1 VIN usual type (20× intermediate power). (Photo courtesy of Dr. V Grieco, Professor of Pathology, University of Washington.)

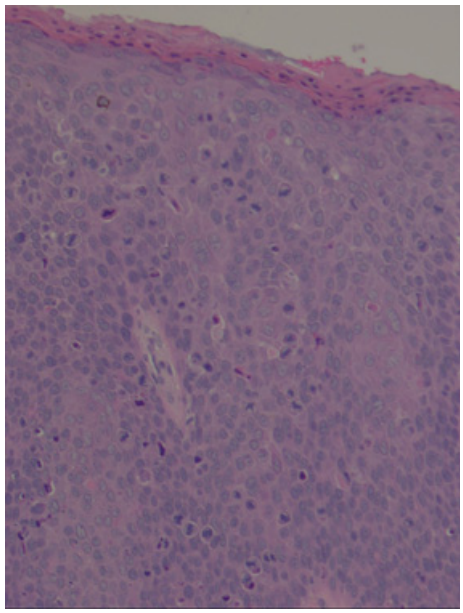

Figure 16.2 VIN usual type (40× high power field view of epithelium). (Photo courtesy of Dr. V Grieco, Professor of Pathology, University of Washington.)

this case due to the multifocal nature of the lesions. Excision is recommended for large VIN lesions, differentiated VIN lesions, or if there is suspicion of invasive carcinoma. The recommended surgical margin is traditionally 10 mm of normal tissue. In locations in which 10 mm is not possible, at least 5 mm margin should be obtained. A small amount of tissue underlying in the dermis should be removed during the procedure. The rate of invasive disease found at the time of surgery for high-grade VIN is about 3.2% [1]. Lesions involving hair-bearing areas are best excised since dysplasia may extend into hair follicles. Surgical treatment can be disfiguring, cause pain and loss of function dependent upon the area and extent of excision. Skinning or simple vulvectomy is rarely indicated except for extensive VIN lesions that are either multifocal or very large, and usually failed another treatment approach.

Laser vaporization, as done in this case, is appropriate when malignancy has been excluded and was chosen for this patient due to the extensive, multifocal disease. Preoperatively, the risks of scarring, loss of architecture, labial adhesions, dyspareunia, chronic vulvar pain, poor wound healing, infection, and accidental burn to other areas from the laser beam should be reviewed. In contrast to condylomata where superficial ablation is acceptable, VIN needs to be treated with destruction of cells through the entire thickness of the epithelium. VIN in mucosal surfaces tends to be more superficial. The recommended goal for depth of treatment in non-hair-bearing areas is between 1 and 2 mm [3]. VIN involving hair-bearing areas may extend deeper into pilosebaceous units and laser procedures must ablate the hair follicles; thus, a 3 mm depth is appropriate in those areas. It is important not to laser beyond reticular dermis to prevent scarring. If fine, white, subvulvar fat is visible, the ablation is too deep. Excessive depth of ablation can lead to severe scarring. The diseased area should be treated with ablation including a 0.5–1 cm surrounding margin of normal appearing skin, as with wide local excision.

Laser safety protocols are important for both the patient and operating room team. The patient's eyes are protected with special glasses or moist gauze. The entire team should wear protective glasses except the surgeon looking into the colposcope. N95 masks are indicated to protect the airways from inhaling HPV particles. Adequate removal of "plume" is ensured with a smoke evacuator system. The patient is draped with damp towels to protect the surrounding skin from misdirected laser beams. A gauze soaked with 5% acetic acid is applied to the vulva and reapplied for a total of 3–5 minutes to perform vulvoscopy to outline the lesions. Carbon dioxide laser settings are on either super-pulse or continuous setting. An appropriate starting setting is 10 W (in contrast to the cervix ablation using 20–30 W) [4]. In very young or postmenopausal, the power may need to be further reduced to 5 W due to thinner skin. Preferred power density is between 750 and 1250 W/cm^2, to avoid deep tissue injury. The super-pulse setting may reduce thermal damage. The width of the laser beam should be between 1.5 and 2 mm. The higher the power density, the greater the laser's ability to vaporize and cut. The smaller the spot size, the more energy is applied to that area. To limit deep tissue damage, it is important to move the beam back and forth or in small circles using a micromanipulator or a hand piece. The area to treat can be outlined with dots or tracer spots. For hemostasis, the laser beam can be either broadened or decreased in power. After laser treatment, the char material can be swabbed off with acetic acid or sterile saline.

Postoperatively it is important to prevent adhesions and promote wound healing with sitz baths four times a day and use of a squirt bottle after urination and defecation. Silver sulfadiazine cream may be used to cover the skin several times a day. Application should include separating labia

minora/majora to prevent adhesions. For pain management, ice packs are useful initially. Additionally, lidocaine jelly (2%) or ointment (5%) can be applied and non-steroidal anti-inflammatory drugs or narcotic pain medication may be needed. Patients should wear loose cotton underwear and should be followed for postoperative wound checks every two weeks. Usually, healing is complete at six weeks [5]. Instructions should include pelvic rest (no tampons, douching, and intercourse) and attention to signs of infection. VIN often recurs; therefore, it is important to have the patients' follow-up for vulvar inspection in six months and yearly thereafter if the lesions are resolved [2]. Overall, one-third of females experience recurrent VIN. With surgical treatment, positive margins were associated with 32–50% incidence of recurrence, whereas negative margins were 11–17% [1, 6, 7]. Higher risk of recurrence is associated with smoking, larger lesions, positive margins, and multicentric or multifocal disease. Most data show similar recurrence rates after vulvectomy, local excision, and laser vaporization [1, 7, 8]. The risk of cancer remains during lifetime for either "treatment failure" or a new "field" carcinoma at a location distinct from the previously treated site [3].

Other treatment options for VIN include medical therapy. Imiquimod is an immunomodulator that stimulates local cytokine production and cell-mediated immunity. The 5% cream is applied topically three times weekly (Monday, Wednesday, Friday), prior to bedtime, to affected areas on the vulva, followed by cleaning of vulva in the morning (8 hours after application). If this regimen is not well tolerated, trial of once or twice weekly application can be considered. Side effects that limit tolerability include erythema and vulvar pain [5]. The typical treatment is 16 weeks (12–20 weeks), with assessment every 4–6 weeks and vulvoscopy follow-up at 4–6 months. Imiquimod may have decreased effectiveness in immunocompromised females. 5-Fluorouracil is a topical chemotherapeutic agent that causes chemical desquamation of the VIN lesion. It is applied directly to the lesions as a 5% cream, which is removed in 3–10 hours. However, it is not often used as it is poorly tolerated due to burning, pain, edema, inflammation, and ulceration. Cidofovir is a topical agent with antiviral activity that has been tested in limited clinical trials [5].

Key Teaching Points

- VIN is a precancerous condition
- High grade intraepithelial neoplasia, usual type VIN, is often multifocal and associated with HPV
- Differentiated VIN has a much higher risk for cancer and recurrence than usual type VIN
- Wide local excision should include a 10 mm margin and is preferred for hair-bearing areas
- Treatment with laser ablation is appropriate for extensive, multifocal disease, but too deep therapy carries with it a risk of scarring
- VIN requires long-term follow-up due to risk of recurrence

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CASE 17

A 70-Year-Old Woman with Diabetes, Exquisitely Painful 2 cm Vulvar Ulcerative Lesion, and Subcutaneous Gas on CT Scan

Courtney Rhoades

History of Present Illness

In the emergency room, a 70-year-old morbidly obese woman reports she has an ingrown hair on the right vulva. In the past day, it has grown dramatically in size. It is quite painful at rest and exquisitely painful with touch. She denies fever, nausea, or vomiting. Denies sexual activity in the past 10 years. Denies vaginal bleeding, discharge, and itching. Her past medical history is significant for diabetes for the past 40 years, hypertension, and urinary incontinence for which she wears pads. She states her blood sugar was in poor control in the past day or so. She does not smoke or have any other pertinent social history. Her medications include insulin and blood pressure medication. She denies a significant surgical history and had two term vaginal deliveries.

Physical Examination

General appearance: Black female in moderate distress but oriented to person, place, and time

Vital signs:

Temperature: 37.0°C
Pulse: 100 beats/min
Blood pressure: 130/80 mmHg
Respiratory rate: 25 breaths/min
Oxygen saturation: 98% on room air
Height: 64 inches
Weight: 235 lb
BMI: 40.3 kg/m^2

Heart: Regular, tachycardia without murmur

Lungs: Clear bilaterally

Abdomen: Obese and non-tender

Genitourinary: Vulva: Left labium majus with swelling and 2 cm central area with discoloration and draining pus. The edema extends from the left vulva down to the left buttock. Bullae are present over the edematous skin. The area is exquisitely tender to light palpation. Bimanual examination reveals no cervical or vaginal mass

Extremities: No edema or erythema

Laboratory studies:

WBCs: 26 000/μL (normal 4500–11 000/μL)
Differential: Neutrophils 83%, lymphocytes 6%, monocytes 4%, absolute immature granulocytes 1320/μL
Hb: 10 g/dL (normal 12–16 g/dL)
Platelets: 284 000/μL (normal 150 000–400 000/μL)
Chemistry:

Glucose: 234 mg/dL (normal 70–109 mg/dL)
Creatinine: 2.1 mg/dL (normal 0.6–1.0 mg/dL)
Lactic acid: 2.5 mmol/L (normal 5–2.2 mmol/L)

Imaging: CT scan shows subcutaneous gas and edema under the mons pubis tracking back to the buttocks and small fluid collection 2 × 2 cm in the left labium majus

How Would You Manage This Patient?

This patient has a vulvar abscess with evidence of necrotizing fasciitis (NF) based on clinical examination findings and evidence of tissue necrosis with subcutaneous gas on imaging. Figure 17.1 shows the vulva preoperatively. She was started immediately on IV broad-spectrum antibiotics – piperacillin/tazobactam and clindamycin. She was fluid resuscitated and was consented for surgical debridement. A blood type and crossmatch was obtained for possible transfusion intraoperatively. General surgery was consulted to assist, and she was taken to the operating room where under general anesthesia, the left vulvar abscess was opened. All the infected, gray skin and liquified subcutaneous tissue was removed down to the firm and bloody, uninfected subcutaneous tissue. Copious lavage was also performed. Swabs of the purulent material and tissue were sent for culture and pathologic examination. A wound vacuum was placed on the open area. Figures 17.2 and 17.3 show the area postoperatively. Postoperatively, she was continued on piperacillin/tazobactam and clindamycin. Due to concern for sepsis, the expected fluid shifts, and need for close electrolyte replacement, she was initially cared for in the

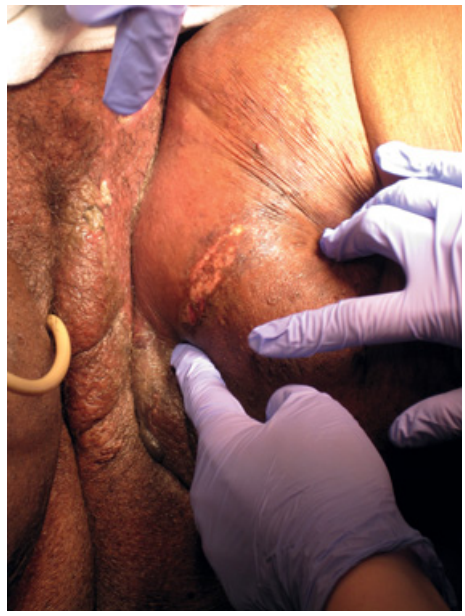

Figure 17.1 Appearance on presentation.

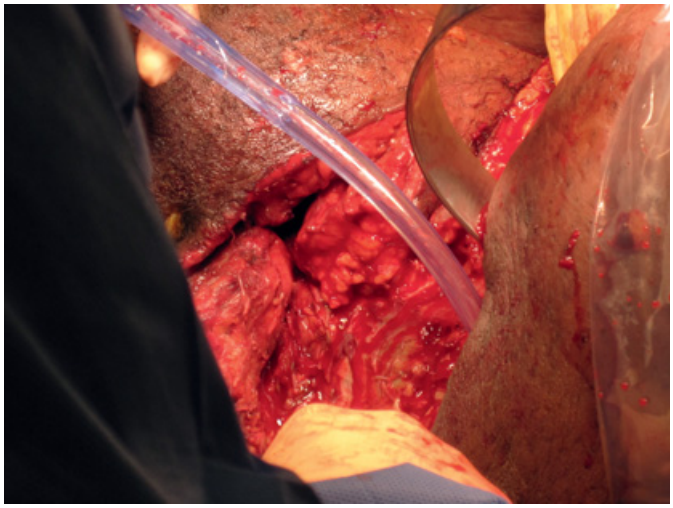

Figure 17.2 After debridement in the operating room.

intensive care unit. She was subsequently transferred to the medical surgical unit.

Necrotizing Fasciitis

Vulvar necrotizing fasciitis (NF) is a rare but potentially deadly infectious process with the hallmark of tissue necrosis. The Centers for Disease Control and Prevention track only cases of NF caused by Group A streptococcus. They report approximately 1000 cases a year in the United States. The mortality rate ranges in studies from as low as 6% to high of 76%. With the risk factors of diabetes, obesity, vascular disease, and a compromised immune system all increasing in the United States, NF is thought to be underreported and rising in incidence. NF is most commonly caused by a polymicrobial infection, but monomicrobial infections also can be causative. Polymicrobial infection can include anaerobes, facultative anaerobes, or aerobic bacteria and account for 70–80% of NF cases – these are considered Type 1. They generally develop more slowly and have a better prognosis. Type 2 are monomicrobial and occur in postpartum patients or patients with other surgical procedures infected with aggressive *Streptococcus* or *Staphylococcus* species. These account for 20–30% of cases [1]. Type 2 patients include those with methicillin-resistant *Staphylococcus aureus* (MRSA), which is a common cause of non-necrotizing vulvar infections. Up to half of Type 2 infections have toxic shock symptomatology. *Vibrio* species or other extremely virulent microbes such as *Clostridium* cause Type 3 cases. The high mortality rate associated with Type 3 is due to alpha and other toxins causing hemolysis, microvascular thrombosis, and myonecrosis. This in turn increases the risk for amputation and shock [2]. Type 4 disease is an aggressive fungal infection mostly in the immunocompromised and carries a greater than 47% mortality rate [1].

Upon early presentation, differentiating NF of the genital area, also known as Fournier's gangrene or necrotizing soft tissue infection, from a cellulitis or a non-necrotizing vulvar abscess can be difficult. All have swelling, often a fluctuant mass, edema, and erythema. However, cellulitis or a benign abscess is treated with incision and drainage and antibiotics, while NF requires timely and complete debridement with antibiotics for patient survival. Thus, correct diagnosis is essential. NF patients may have a history of infection, trauma, or incision to the area and then develop increasing pain out of proportion to the expected amount of discomfort. Often, they appear sicker than expected and meet criteria for shock. Drainage, which is not always present, has a strong foul odor with a "dirty dishwater" appearance. Hemorrhagic bullae and/or crepitus from subcutaneous gas may or may not be appreciated, as it develops later in the disease process. As in our patient, NF patients overwhelmingly have comorbidities such as diabetes, obesity, vasculopathy, pregnancy, hypertension, immunocompromised, or renal disease. Theses comorbidities increase mortality and prolong hospitalization [3].

The evaluation of suspected NF should start with a careful history including recent surgery, trauma, vaginal delivery with episiotomy or laceration, and prior infection. A complete blood count, chemistry panel, lactic acid, C-reactive protein (CRP), and aerobic and anaerobic cultures of any draining material are helpful. Plain film x-ray, ultrasound, and CT have been used to diagnose subcutaneous emphysema in the area and can be helpful to determine the extent of disease. Although only 48.9% sensitive, plain film radiography is quick and can be done at the bedside. CT has a much higher sensitivity of 88.5% but takes longer to obtain and may delay treatment. Both are extremely specific when there is a finding of gas. Due to the need for expeditious debridement and lack of sensitivity of gas on imaging, waiting for imaging should not delay surgery when NF is suspected [4].

The labs collected can be used in the Laboratory Risk Indicator for Necrotizing Fasciitis (LRINEC). Wong et al. retrospectively compiled this scoring system to aid in the diagnoses of NF. The score depends on the CRP, white blood count, hemoglobin, sodium, creatinine, and glucose at the time of presentation. A score of greater than 6 or more has a positive predictive value of 92% and negative predictive value of 96% [5]. Loar et al. also described a Fournier's Gangrene Severity Index (FGSI) that incorporates nine metrics: temperature, respiratory rate, heart rate, sodium, potassium, creatinine, serum bicarbonate, leukocyte count, and hematocrit. Using the FGSI Loar et al. found a 75% probability of death with a score greater than 9, while a score of 9 or less predicted 78% would survive [6]. Neither of these scoring systems has been prospectively validated and currently they are used primarily to define disease severity. The patient described would have a LRINEC score of 7 without the CRP, affirming our suspicions for NF.

Once the diagnosis is made or highly suspected, broad-spectrum IV antibiotics to include coverage for anaerobes should be started. Complete surgical debridement is required for treatment of all NF. The longer delay in surgical debridement, the higher the morbidity and mortality risk is for the patient [7]. A multispecialty team of general surgeons, gynecologists, and reconstruction surgeons may be needed since it often requires more extensive debridement than the initial presenting area of concern. For this reason, the patient should be consented for extensive surgery with the possibility of diversion of the colon or urinary system. Infection spreads along the superficial and deep fascial plains, often undermining the skin, so debridement involves opening the area up and removing the gray, devascularized tissue including involved skin. Key to patient improvement is removing all affected tissue. To determine whether the tissue is infected the "finger test" has been described in the literature. It involves testing the tissue with a touch of a finger. The tissue that is infected shows no normal tissue resistance and separates easily or feels liquefied. Removal and debridement should continue until the tissue is pink, bleeds easily, and no longer separates easily with a finger [1].

Lipolysis, micro-thrombosis, and necrosis from the inciting bacteria allow anaerobic bacteria to proliferate synergistically, causing the dark gray appearance characteristic of this infection. Gram stain and cultures of the tissue and purulent material will help narrow the antibiotic treatment focus. Histologic verification of leukocyte infiltration of the soft tissue and fascia with thrombosis and necrosis by pathologic examination confirms the diagnosis. Frozen sampling of the area prior to wide debridement has been purported; however, the accuracy of this approach has not been delineated nor is it always available [2, 7].

The area should not be closed but left with packing or a wound vacuum so it can be closely monitored. If improvement in vitals, white count, or wound color is not seen, re-debridement under anesthesia 4 to 24 hours later is needed. This should continue until the wound is clean and the patient shows signs of improvement. Wound vacuums decrease the number of needed dressing changes, as well as decrease patient pain while promoting healing and contracture of the wound [8]. Skin grafts and flaps may also aid in the healing process and wound resolution once the area is showing significant improvement. With adequate debridement, the patient's hemodynamic status usually improves significantly and for this reason taking the patient to the operating room should not be delayed trying to correct the septic state [2].

Close monitoring after surgery is warranted in the intensive care unit, to observe for clinical deterioration. NF patients often are coagulopathic and may need blood products. Nutritional supplementation and fluid replacement mirror the treatment of burn patients due to protein and fluid loss with an open wound and hypermetabolic state [9].

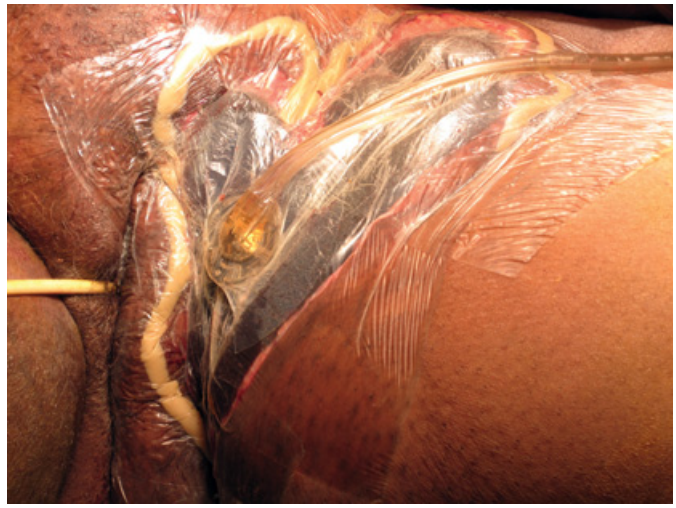

Figure 17.3 Wound after vacuum application.

Hyperbaric oxygen treatment, with its ability to cause neovascularization, inhibit bacterial toxin generation, and reduce tissue edema, has been reported as an adjuvant treatment. Due to cost and limited availability the latest Cochrane review concluded that more randomized studies were needed to determine if hyperbaric oxygen treatment had a significant effect on the outcomes of amount of tissue removed and risk for amputation. They also note the treatment had minimal side effects and the benefits may outweigh the risk of its use [10]. Wound care can be done at the bedside with narcotic pretreatment for pain after all the necrotic tissue is determined to be removed. Once the area is no longer infected, skin grafts may be needed for areas where the skin is on tension or contracting. Alternatively, areas that do reapproximate well can be allowed to heal or a small area can be closed secondarily [10]. While NF is rare, the best outcome starts with a high index of suspension, understanding that superficial skin changes may be minimal at presentation and swift treatment is the key [4, 7, 11].

Key Teaching Points

- Identifying necrotizing fasciitis in the genital area requires a high index for suspicion, especially in patients with diabetes, obesity, and other confounding medical issues
- Necrotizing fasciitis is most often polymicrobial
- The area of tissue involvement cannot be predicted by cutaneous signs alone
- Expedited wide surgical debridement is essential to the best outcome for the patient
- Patients often are in septic shock and will need aggressive supportive measures

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CASE 18 A 14-Year-Old Adolescent with Cyclic Pelvic Pain and Amenorrhea

Geri D. Hewitt

History of Present Illness

A 14-year-old presents to the emergency department with pelvic pain, abdominal distention, and urinary retention. She began having vague abdominal discomfort and cramping several months ago. Recently, the symptoms are much more intense. Her mother reports a similar painful episode about three to four weeks ago, which improved after several days with rest and ibuprofen. They presented to the emergency department now because the patient was unable to void. The patient denies constipation, fever, nausea, vomiting, or sexual activity. She is healthy, taking no medications, and never had surgery. She experienced thelarche at age 10 years and has not yet begun menstruation.

Physical Examination

General appearance: Tearful, but sitting up and communicative

Vital signs:

Temperature: 38.0°C
Pulse: 78 beats/min
Blood pressure: 102/64 mmHg
Respiratory rate: 18 breaths/min
Height: 62 inches
Weight: 120 lb
BMI: 21 kg/m^2

Abdomen: Soft, with normal bowel sounds, palpable midline mass extending to the umbilicus

External genitalia: Normal labia, normal urethra, bulging mass at vaginal introitus

Laboratory studies: Serum pregnancy test: Negative

Imaging: Transabdominal pelvic ultrasound shows distended urinary bladder. Uterus 6.1 × 5.7 × 4.1 cm. The endometrial cavity is distended and filled with mobile echogenic debris. The vagina is also distended, measuring 14 × 9.6 × 7.6 cm, and contains layered debris. Right ovary 3 × 3.2 × 1.8 cm, volume 1.84 mL. Left ovary 3.3 × 3.5 × 2.0 cm, volume 2.01 mL. No free fluid in the pelvis

How Would You Manage This Patient?

This clinical scenario including pain, abdominal mass, and amenorrhea suggests a gynecologic outflow tract obstruction. Transabdominal pelvic ultrasound demonstrated distention of both the vagina (hematocolpos) and uterus (hematometra), which suggests the level of obstruction to be in the distal vagina (Figure 18.1). The findings on physical examination describe imperforate hymen. The patient had a Foley catheter placed in the emergency department to relieve the urinary retention. Once the patient met criteria for NPO status, she was taken to the operating room for a hymenectomy. Postoperatively she voided spontaneously and was discharged to home. She had a follow-up appointment 10 days later and reported no voiding difficulties and resolution of the vaginal bleeding she experienced after surgery. Physical examination confirmed the introitus was well healed.

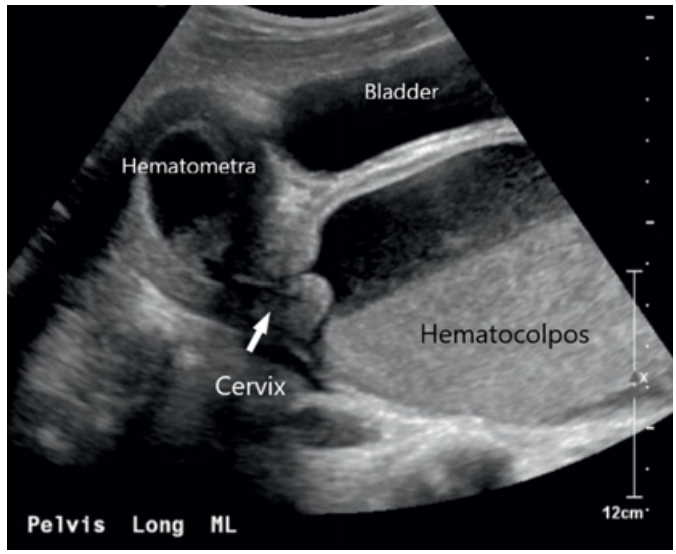

Figure 18.1 Ultrasound showing hematometra and hematocolpos.

Imperforate Hymen

There is a wide range of both normal and abnormal hymenal anatomy. Normal hymenal anatomy includes annular, crescentic, fimbriated, and redundant variants [1]. During development, the squamous epithelium of the urogenital sinus invaginates to meet the longitudinal vagina resulting in complete canalization of the vaginal canal and a small amount of redundant portion of hymenal tissue at the vaginal introitus [2]. Any disruption in this process can impact the resorption of the hymenal tissue leading to abnormal hymen variants including imperforate, microperforate, or septate hymen [1].

Imperforate hymen completely blocks the vaginal introitus making menstrual egress and penetrative sexual activity impossible. Imperforate hymen is the most common vaginal obstructive anomaly with an incidence of 1 in 1000 to 1 in 10 000 [1]. Although unusual, imperforate hymen may present in the newborn period due to mucocolpos secondary to maternal estrogenic effects. Presenting as a bulging, yellow or translucent mass at the introitus, it typically spontaneously resolves with decreasing maternal estrogen effects and no intervention is required. Imperforate hymen presenting in the newborn

period requires surgical intervention only if causing ureteral obstruction [3].

Imperforate hymen may be diagnosed incidentally when examining the perineum of an asymptomatic patient. Once pubertal, a patient with imperforate hymen is more likely to have symptoms of lower abdominal cramping pain (cyclic or acute) and a vaginal bulge of hymenal tissue caused by hematocolpos. The bulge may be more apparent when a patient performs a Valsalva maneuver or when the examiner applied pressure to the abdomen. Other findings associated with imperforate hymen after puberty include constipation, urinary retention, dysuria, dyschezia, and an abdominal mass [2].

Imperforate hymen is more common than other distal causes of outflow tract obstruction including distal vaginal atresia or transverse vaginal septum. Table 18.1 reviews the differenctial diagnosis. When evaluating a patient with suspected imperforate hymen, it is very important to rule out these less common etiologies as they may require referral to a center with experience with these diagnoses as their surgical management is more complex with a higher likelihood of complications. In newborns with an abnormal appearing introitus, etiologies to consider in addition to imperforate hymen include urogenital sinus and labial agglutination.

Imperforate hymen is diagnosed primarily by examining the perineum. Speculum examination is rarely indicated when evaluating patients with any distal vaginal obstruction. The patient is best examined frog-legged or in the dorsal lithotomy position. Using gentle downward labial traction, the labia majora and minora are opened. The urethra appears completely normal. A moist cotton or nasopharyngeal swab can be used to examine the hymenal tissue. Patients with imperforate hymen lack an opening in the hymenal tissue. If the patient is postpubertal and has hematocolpos, a vaginal bulge appears without any hymenal fringe. Patients with distal vaginal atresia have pink vaginal mucosa between the labia with no evidence of a vaginal bulge [2]. Patients with transverse vaginal septum have a normal appearing introitus with hymenal fringe but a shortened vagina with no palpable cervix [2]. In patients with imperforate hymen, a pelvic ultrasound is suggested to confirm the diagnosis. Any diagnostic uncertainty based on physical examination and/or ultrasound findings requires a pelvic MRI to further assess Müllerian anatomy [4].

Table 18.1 Differential diagnoses in patients with abnormal vaginal introitus and/or suspected lower outflow tract obstruction

Imperforate hymen
Labial adhesions
Urogenital sinus
Transverse vaginal septum
Distal vaginal atresia

Hymenectomy

Some patients and families may need education around the hymen and its role in reproductive health reinforcing that hymenal surgery has no impact on virginity [2]. Surgical repair of a hymenal variant is medically indicated to allow for menstrual egress, tampon use, and penetrative vaginal sexual activity. Hymenal variants are isolated conditions which once corrected have no impact on sexual functioning, fertility, or obstetrical outcomes.

Imperforate hymen requires definitive surgical treatment with a hymenectomy. Aspiration and/or drainage alone of the mucocolpos or hematocolpos is associated with ascending infection and therefore not recommended [1]. Unless repair in the newborn period is indicated due to ureteral obstruction, the hymenectomy is performed electively after thelarche (enhanced healing with estrogenized tissue) but before menarche (avoiding symptoms of obstruction) [2]. In pubertal patients presenting with a bulging mass, surgery should be done urgently both to relieve symptoms and minimize further retrograde menstrual flow, which may contribute to endometriosis [3].

While patients with some hymenal variants such as septate or cribiform hymen may safely undergo surgical correction in the office setting, patients with imperforate hymen require hymenectomy in a procedure or operating room with adequate anesthesia. High dorsal lithotomy positioning facilitates visualization. Prophylactic antibiotics are not indicated. Patients require a perineal prep, and insertion of a urethral catheter helps minimize risk of urethral injury. If there is no bulge at the introitus and the hymenal tissue is not easy to identify, apply downward pressure on the uterine fundus. A cruciate or right-side-up U-shaped incision is made in the center portion of the hymenal tissue (Figure 18.2) If the hymenal tissue is not tense and protuberant, stay sutures can be placed to provide tension

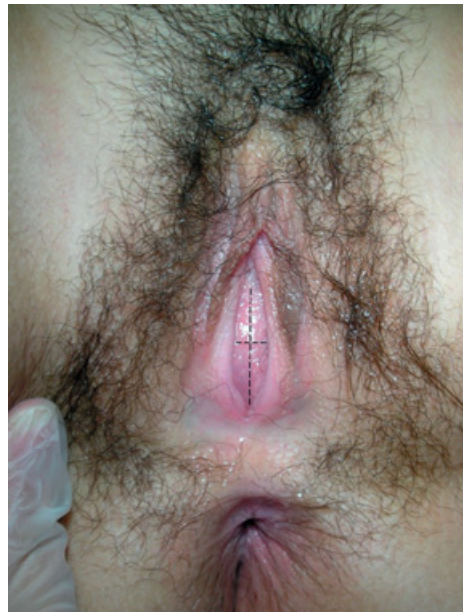

Figure 18.2 Imperforate hymen with marking for incision.

prior to making the incision. The incision can be made either sharply or with needlepoint electrocautery. If the patient has hematocolpos, there may be copious amounts of old blood and having more than one suction device available may be required as the tubing frequently gets clogged. Once the hymen is transected and the vagina is entered, the excess hymenal tissue is excised, as recurrent obstruction has been described when incision alone is performed. The hymenal ring is then sutured open using circumferential, interrupted stitches with 3–0 or 4–0 absorbable suture to achieve hemostasis and prevent scarring. While the vagina is often distended and inflamed after relief of the obstruction, aggressive irrigation of the vagina is discouraged as it may contribute to ascending infection A local anesthetic can be injected in the area to help with postoperative pain relief [1].

Patients should be encouraged to keep the introitus clean and dry postoperatively. A topical emollient can be applied several times a day during recovery [3]. If the procedure is done before thelarche, topical estrogen cream can be applied to facilitate healing and decrease the likelihood of stricture [5]. Postoperative pain is minimal and successfully managed with acetaminophen and/or non-steroidal anti-inflammatory agents. If the patient experienced hematocolpos prior to hymenectomy, bleeding may continue for one to two weeks as the uterus involutes, and these patients are at increased risk of ascending infection and pelvic inflammatory disease and should be instructed to call with increased pain, fever, or prolonged bleeding. Patients should be seen one to two weeks after their hymenectomy to access healing of the introitus. Once healing is confirmed, patients may return to normal athletic activities and use tampons if interested.

Key Teaching Points

- Imperforate hymen is diagnosed with perineal examination and confirmatory transabdominal pelvic ultrasound
- Other vaginal obstructive diagnoses should be ruled out prior to attempts at surgical correction
- Surgical repair is typically performed after thelarche and before menarche
- The most appropriate surgical intervention is performed in the operating room and includes removing the excessive hymenal tissue after the initial cruciate or U-shaped incision

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CASE 19 A 40-Year-Old Woman with a 3 cm Mass Prolapsing through the Cervix

Tara J. Harris

History of Present Illness

A 40-year-old female, gravida 1, para 1, presents to the office with complaints of heavier, longer menstrual cycles and intermenstrual spotting. Her cycles were previously every 28 days, lasting 4 days, and using 3–4 pads per day. Now, her cycles are lasting 9–10 days, and she is soaking 8–9 pads on her heaviest day. She has spotting 2–3 days every week. She reports mild cramping but denies urinary or bowel complaints, dizziness, or weakness. She has had one prior normal pregnancy with spontaneous vaginal delivery, and she has been trying unsuccessfully to conceive for the past year. She has no significant past medical or surgical history, she is taking only prenatal vitamins, and she has no known drug allergies.

Physical Examination

General appearance: Well-developed, obese, no acute distress

Vital signs:

Temperature: 37.1°C
Pulse: 77 beats/min
Blood pressure: 116/63 mmHg
Respiratory rate: 18 breaths/min
BMI: 33.2 kg/m^2

Abdomen: Soft, normal bowel sounds, non-tender, non-distended, no masses

External genitalia: Normal

Vagina: Watery vaginal discharge, no lesions

Cervix: 3 × 2 cm smooth, pale, rubbery mass prolapsing through and palpably separate from the cervix; unable to fully assess stalk size due to patient discomfort. Cervix dilated 3 cm and approximately 50% effaced; smooth, regular contour, no lesions, no cervical motion tenderness

Uterus: 10 weeks, mobile, no masses, non-tender

Adnexa: Small, mobile, non-tender bilaterally

Laboratory studies:

Urine pregnancy test: Negative
Hb: 9.4 g/dL (normal 10.6–14.5 g/dL)
Cervical cytology: Negative for intraepithelial lesion or malignancy
HPV: Not detected
Endometrial biopsy: Secretory endometrium
Surgical pathology: Fragment of leiomyoma with ulcerative surface

Imaging: Transvaginal ultrasound shows 9.5 cm uterus with a 3.2 × 2.8 × 3.0 cm submucosal myoma partially protruding through the external os of the cervix (Figure 19.1). A vascular stalk is noted, extending from the posterior uterine wall. Bilateral ovaries show unremarkable appearance

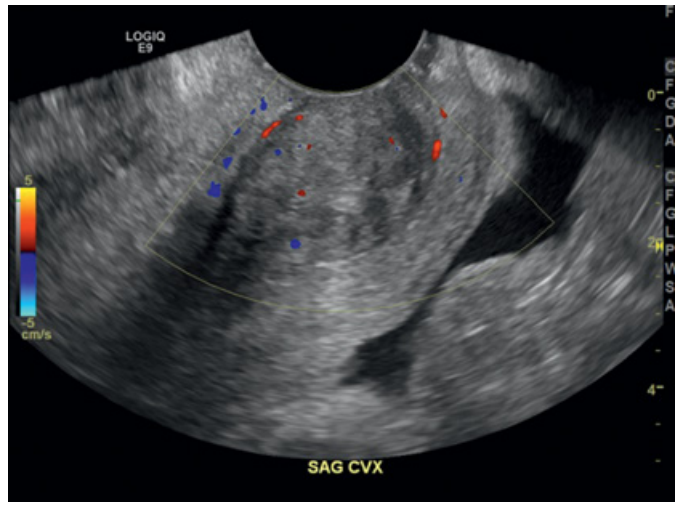

Figure 19.1 Ultrasound of submucosal leiomyoma prolapsed into endocervical canal.

How Would You Manage This Patient?

This patient has a smooth mass distinct from the cervix, consistent with a prolapsed submucosal leiomyoma. Although the visualized mass is an easily identifiable reason for this patient's abnormal bleeding, given her age, obesity, and intermenstrual spotting, endometrial sampling to assess for premalignant lesions or endometrial carcinoma is warranted [1]. Due to the uncertain etiology of the mass, a Pap smear was performed and the mass was biopsied using Tischler forceps, with Monsel's solution applied to control the resulting bleeding. The patient was counseled on her management options. Given her desire for fertility preservation, she elected for conservative surgical management. She was consented and taken to the operating room for vaginal myomectomy followed by hysteroscopy. Following induction of general anesthesia, she was placed in the dorsal lithotomy position in candy cane stirrups. A weighted speculum was placed in the vagina and dilute vasopressin was injected into the mass. A tenaculum was used to apply gentle traction to the mass, and a Heaney clamp was used to grasp the stalk base. The base was doubly ligated with two purse-string stitches, and then the stalk was transected using electrocautery. Hemostasis was noted. Hysteroscopy was then performed and revealed no residual mass or stalk. She was discharged home on the day of surgery. At the time of her postoperative visit, her bleeding had ceased and she was advised to use contraception for three months prior to resuming attempts at conception. Pathologic examination of the mass confirmed submucosal leiomyoma.

Submucosal Leiomyoma

Uterine leiomyomas, or "fibroids," are the most common benign tumor of the female genital tract. They have been

reported in up to 70% of White women and 80% of Black women by age 50 [2–4]. Leiomyomas are typically rubbery tumors consisting of monoclonal smooth muscle cells and fibrous connective tissue. They are estrogen and progesterone sensitive tumors, usually developing during a woman's reproductive years and regressing after menopause. Although most commonly found in the uterus, leiomyomas may also be located within the broad ligament, the cervix, or parasitically attached to surrounding structures. Leiomyomas are classified as either pedunculated, subserosal, intramural, or submucosal depending on their location and direction of growth. Submucosal leiomyomas are further categorized based on their depth of involvement of the myometrium: Type 0 are pedunculated and are located entirely within the endometrial cavity, Type I have less than 50% of the leiomyoma within the myometrium, and Type II have 50% or more of the leiomyoma located within the myometrium [4]. Appropriate imaging of leiomyomas is crucial, as accurate mapping can guide overall treatment and surgical planning. Ultrasound or MRI is used to assess fibroid location. A Cochrane systematic review indicated that saline infused sonography is equivalent to hysteroscopy for the diagnosis of submucosal leiomyomas, and that both are superior to transvaginal ultrasound (TVUS) alone [4]. MRI is also believed to be superior to TVUS in evaluating leiomyoma location and depth of myometrial invasion [4]. Symptomatic patients may present with a range of complaints, including abnormal vaginal bleeding, pelvic pain, abnormal vaginal discharge, infertility, and "bulk" symptoms due to increased pressure on surrounding structures such as bladder and bowel. Symptoms appear to correlate with leiomyoma number, size, and location. For symptomatic women, symptom severity, past medical history, and desire for fertility guide treatment discussions.

Although hysterectomy is an option, vaginal myomectomy is generally the preferred surgical management of a prolapsing uterine leiomyoma as it is usually a straightforward, outpatient procedure with minimal blood loss and rapid postoperative recovery. As with any myomectomy, there are risks of hemorrhage, operative injury, and hysterectomy, which should be carefully addressed during the informed consent process. If the patient is tolerant and the leiomyoma is small with a thin stalk, removal may be accomplished in the office by simply grasping the mass and slowly twisting until the stalk is transected. Otherwise, removal is best performed in the operating room. Conscious sedation or regional anesthesia can be employed, but general anesthesia is preferred when there is a larger stalk present, if significant manipulation is anticipated, or if hysteroscopy is planned [5, 6]. Some sources advocate for preoperative antibiotics given concerns for potential colonization of the upper genital tract [6], while others only advise antibiotics in cases of suspected infection [5].

Intraoperatively, patients are positioned in the dorsal lithotomy position. A weighted speculum is placed in the vagina, with sidewall retractors as needed for visualization. Dilute vasopressin (20 units mixed in 200 mL of normal saline) may be injected into the visible portion of the leiomyoma [6]. The leiomyoma is then grasped with a tenaculum or Lahey clamp, and traction applied to the mass. Care should be taken in the application of traction to avoid avulsion of the stalk or even severing the uterine wall itself. Once the stalk is identified, it should be doubly ligated as close to the base of the pedicle as possible [5, 6]. Laparoscopic endoloops may facilitate ligation high up in the uterine cavity or when the leiomyoma is physically obstructing the surgeon from effective knot tying [5–7]. As in the above case, a Heaney clamp placed on the stalk proximal to the ligation suture provides both control and an opportunity to inspect the stalk stump for hemostasis following transection [5]. The stalk is incised at a point distal to the suture, either sharply or with electrosurgery. Once the clamp is released, the pedicle usually retracts. Of note, some surgeons indicate that ligation may not be necessary for hemostasis, particularly if electrosurgery is employed [4, 5]. Though significant blood loss is uncommon with this procedure, should bleeding occur, intracervical injection of a prostaglandin F2α analog (carboprost) can provide uterine contraction and subsequent hemostasis [4]. Direct pressure can also be applied via an intrauterine Foley balloon inflated with approximately 30 mL of sterile water and left in place up to 24 hours [5, 6]. In the case of uncontrollable hemorrhage, hysterectomy may be indicated. After removal, hysteroscopy can be performed to inspect for and resect any residual tumor, to ensure hemostasis, and to look for other lesions. Though the cervix is dilated, hysteroscopy is still possible if atraumatic clamps are placed on the cervix [6]. Alternatively, a cerclage may be placed to close the cervix enough to achieve uterine distention [7]. If immediate hysteroscopy cannot be performed and there is concern that residual tumor or additional leiomyomas are present, it is reasonable to consider repeating imaging and planning a second procedure, following an appropriate recovery period.

Non-surgical treatment options for submucosal leiomyomas include expectant observation, medical therapy, and uterine artery embolization (UAE). Some submucosal leiomyomas will regress or even expulse spontaneously. The wide variability in growth and shrinkage rates make counseling regarding the outcomes of expectant management challenging [4]. Expectant management may be an appropriate option for women with mild symptoms, not desiring fertility, and nearing menopause. Medical management with combined hormonal contraception, progestin only medications, or tranexamic acid may be reasonable, specifically in treating abnormal bleeding and pain; yet, there is limited data on their effectiveness in resolving symptoms when submucosal leiomyomas are present [2, 4]. gonadotropin-releasing hormone agonists, aromatase inhibitors, and selective progesterone receptor modulators can be used to decrease the size of leiomyomas and typically result in amenorrhea. Unfortunately, these medications are not necessarily intended for long-term treatment and are not universally approved for this indication, limiting their role in medical management of leiomyomas [2, 4]. UAE is a recognized treatment for leiomyomas, particularly for bulk symptoms or abnormal bleeding [2, 4]; however, UAE is controversial in patients with submucosal leiomyomas. Studies indicate that these patients may be at higher risk for post-UAE infections as

well as increased failure rates when abnormal bleeding is the primary symptom [4]. UAE may also adversely affect fertility in patients specifically with submucosal leiomyomas and thus may be inappropriate in cases where that is a consideration, such as this patient [4]. Although MRI-guided focused ultrasound surgery has been approved by the FDA for leiomyoma treatment, there is limited data regarding its role in the treatment of submucosal leiomyomas [2, 4].

Key Teaching Points

- Submucosal leiomyomas may be managed through a variety of methods. Treatment is guided by a patient's symptoms, their severity, and her fertility plans
- Vaginal myomectomy for prolapsed submucosal leiomyoma is a lower risk procedure than hysterectomy, with minimal blood loss, rapid recovery, and is fertility-sparing
- Surgical technique emphasizes proximal ligation of the stalk
- Hysteroscopy following debulking of the leiomyoma may be useful in identifying and resecting any residual stalk as well as ensuring hemostasis
- Strategies to control bleeding include use of a clamp at the base, injection of vasopressin, use of tranexamic acid, or placement of an intrauterine balloon

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CASE 20 A 35-Year-Old Woman with a Fetal Demise at 20 Weeks' Gestation

Elissa T. Serapio

History of Present Illness

A 35-year-old female, gravida 1, para 0, presents to the clinic for her anatomy ultrasound at 20 weeks' gestation. She denies any complaints and has not yet begun feeling fetal movements. Her prenatal course thus far has been unremarkable. She declined aneuploidy screening earlier in her pregnancy. Her past medical history is significant for chronic hypertension, which has been controlled with labetalol. She has no other relevant past medical or surgical history. She has no known allergies.

Physical Examination

General appearance: Healthy appearing female; becomes tearful as the ultrasound results are disclosed

Vital signs:

Temperature: 36.9°C
Pulse: 82 beats/min
Blood pressure: 143/87 mmHg
Oxygen saturation: 98% on room air
BMI: 33 kg/m^2

Abdomen: Soft, non-distended, non-tender

Laboratory studies:

Hb: 11.2 g/dL (normal 10.8–14.7 g/dL)
Fibrinogen: 375 mg/dL (normal range in second trimester: 291–538 mg/dL)
Blood type: A negative

Imaging: Transabdominal ultrasound shows a singleton gestation with no cardiac activity visualized. Femur length 30 mm (corresponding with 19 weeks 2 days). A limited anatomic survey appears normal, with grossly normal amniotic fluid, and an anterior placenta without a retroplacental hematoma

How Would You Manage This Patient?

This patient presents with a newly diagnosed intrauterine fetal demise in the second trimester. When the patient was ready to discuss management, the options of dilation and evacuation (D&E) and induction of labor were discussed. Because she was clinically stable, the patient chose to go home to discuss the options with her family. Two days later, the patient returned to clinic for a D&E. After oral ibuprofen, sublingual lorazepam, and local anesthetic administration in the cervix, the patient underwent placement of nine laminaria. Because a sufficient number of osmotic dilators were placed, adjunctive medications for cervical preparation were not needed. The following day the patient underwent an uncomplicated D&E. She received RhoGAM while under sedation. A sample of the placenta was sent for microarray and footprints were obtained as a memento. The patient was discharged home that day with the plan for a telehealth visit the following week.

Dilation and Evacuation for Fetal Demise in the Second Trimester

Fetal demise occurs in 0.6% of pregnancies [1]. Etiologies include fetal chromosomal and congenital abnormalities, fetal growth restriction, infection, placental and umbilical cord abnormalities, thrombophilia, and uncontrolled maternal illness. Many cases remain unexplained despite a thorough evaluation. Although the diagnosis may be made during an ultrasound or fetal heart rate check during routine prenatal care, patients also may present with evidence of preterm labor, vaginal bleeding, or infection. These symptomatic cases warrant expedited care. In the absence of serious illness, decisions about management can be delayed until the patient feels ready to proceed. However, the risk of spontaneous onset of labor and development of coagulation abnormalities increases if a dead fetus is retained for several weeks [2]. The management options for fetal demise in the second trimester include D&E and the use of medications to induce labor. Studies demonstrate that after counseling about the pros, cons, and different emotional experiences involved, patients express strong preferences for method of uterine evacuation, with some patients preferring D&E and others labor induction. Additionally, patients benefit from choosing the option most concordant with their coping style [3]. Thus, the clinician should counsel the patient about both options. Because patients do express strong preferences for either D&E or labor induction for management of fetal demise, there is a critical need for providers who are trained in D&E procedures.

Both D&E and labor induction are safe and effective with low rates of major complications. The overall complication rate for D&E is between 0.05% and 4% (depending on gestation). Complications include infection, uterine perforation, cervical laceration, and retained products of conception [4]. Hemorrhage is uncommon, but in the setting of fetal demise, heavy bleeding should prompt suspicion of disseminated intravascular coagulation [2, 5]. The additional risk of labor induction in the second trimester is retained placenta, which can occur in approximately 20% of cases [6]. Several reviews conclude that complications – particularly infection and hemorrhage – occur more often in labor induction than in D&E [1, 4]. D&E can be completed in patients with a placenta previa, including the safe use of dilators for cervical preparation.

One significant difference between the two approaches is that after a D&E, a patient may not have an opportunity to see the baby, which is offered with induction. Some patients experience holding and viewing the baby as therapeutic, whereas others find it traumatizing [3]. After most D&Es, footprints or handprints can be made as mementos for the patient and

The surgeon subsequently removes the amniotic fluid using a suction curette and then uses grasping forceps to remove the fetus and placenta. Intraoperative, transabdominal ultrasound guidance has been associated with fewer cases of uterine perforation, with the probe held in the sagittal plane to allow visualization of instruments entering the uterus [6]. The surgeon should extract using the instruments lower in the uterine cavity rather than higher up at the fundus. The procedure concludes with repeat suction and/or gentle use of a sharp curette to check for an empty uterine cavity. The products of conception should be examined to confirm complete evacuation [8]. State law dictates reporting criteria for fetal demise and disposition of products of conception. Patients are instructed to refrain from intercourse and tampon for one to two weeks after the procedure. They are counseled regarding potential lactation and may be offered cabergoline for suppression. Follow-up visits for providing emotional support and discussing the results from the etiology workup are generally conducted in the month following surgery.

Key Teaching Points

- D&E and labor induction are safe and effective approaches to uterine evacuation
- Utilize shared decision-making to help a patient choose between these approaches
- Cervical preparation is recommended for all D&Es and should be individualized
- Steps to minimize complications with D&E include prophylactic antibiotics, ultrasound guidance, adequate cervical dilation, and a vasoconstrictor in the paracervical block

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CASE 21

A 25-Year-Old Woman with Intrauterine Embryonic Demise and Temperature of 39.2°C

Susan Lasch

History of Present Illness

A 25-year-old female last menstrual period approximately eight weeks ago presents to the emergency department with fever and pelvic pain. She is a recent immigrant without health insurance who sought care for a termination of pregnancy from an unknown provider. She took several pills seven days ago and had subsequent heavy bleeding and cramping. She has continued bleeding and worsening cramping. She describes subjective fever for the last 24 hours. She has not obtained pain relief with acetaminophen. She feels light-headed and has not eaten today due to nausea. She denies vomiting, diarrhea, or any urinary symptoms. She is sexually active with one partner for the last six months. Her gynecologic history is significant for one full-term vaginal delivery and a history of chlamydia. She has no significant past medical or surgical history and has no known drug allergies.

Physical Examination

General appearance: Well-developed, well-nourished female, flushed, lying in bed in mild distress

Vital signs:

Temperature: 39.2°C
Pulse: 105 beats/min
Blood pressure: 90/60 mmHg
Respiratory rate: 22 breaths/min
Height: 68 inches
Weight: 140 lb
BMI: 21 kg/m^2

Abdomen: Soft with normal bowel sounds. Tender to palpation in the suprapubic region. No rebound or guarding was noted. No masses palpated

Pelvic: Normal external female genitalia. The vagina has normal rugae. The cervix is open with a small amount of blood noted. Cervical motion tenderness is present. Bimanual examination reveals a midline uterus that is tender to palpation. Mild bilateral adnexal tenderness is noted. No masses are appreciated

Laboratory studies:

Urine pregnancy test: Positive
β-hCG: 3036 IU/L (non-pregnant females less than 5 IU/L)
WBCs: 17 000/μL (normal 4400–11 300/μL)
Hb: 10 g/dL (normal 12.0–16.0 g/dL)
Hct: 29% (normal 36–46%)
Platelets: 369 000/ μL (normal 150 000–450 000/μL)
Creatinine: 0.87 mg/dL (normal 0.5–1.05 mg/dL)
Lactate: 1.0 mmol/L (normal 0.4–2 mmol/L)
ALT: 9 U/L (normal 7–45 U/L)
AST: 34 U/L (normal 9–39 U/L)
PT: 14.0 sec (normal 10.1–13.3 sec)
INR: 1.2 (normal 0.9–1.2)
Blood type: B positive

Imaging: Pelvic ultrasound shows 10.6 × 5.9 × 6.5 cm anteverted uterus with an 18 mm echogenic endometrium present. Vascular flow is present in the endometrial material. The echogenic material is present in the cervix and in the fundus. The cervix canal is dilated. The left ovary measures 4.1 × 2.1 × 2.5 cm and demonstrates intact flow. No adnexal mass is identified. The right ovary measures 5.1 × 3.1 × 3.5 cm and contains a corpus luteum and demonstrates intact flow. Echogenic material is consistent with retained products of conception

How Would You Manage This Patient?

The patient presents with fever and worsening cramping after a medical pregnancy termination. Physical examination reveals cervical motion and uterine tenderness but no masses. Pelvic imaging is consistent with retained products of conception and she has signs and symptoms of infection. The presence of retained products of conception, fever, and cramping suggest a septic abortion. The patient was started on lactated Ringer's at 125 mL/h, ampicillin 2 g IV q 4 hours, clindamycin 900 mg IV q 8 hours, plus gentamicin 5 mg/kg IV q 24 hours, and urgently moved to the operating room for a suction dilatation and curettage (D&C), which revealed malodorous products of conception. She continued IV antibiotics until she was afebrile for 48 hours. At this point, she was discharged home. She was doing well at her follow-up visit one week later. An implantable long-acting reversible contraceptive was placed.

Septic Abortion

Septic abortion is any abortion, spontaneous or induced, that is complicated by upper genital tract infection including endometritis or parametritis [1]. Safe abortions are rarely complicated by infection due to the expertise of healthcare providers, sterile practices, and the routine use of antibiotics. Worldwide, the majority of septic abortions result from unsafe abortion techniques. The World Health Organization defines unsafe abortion as "a procedure for terminating an unintended pregnancy either by an individual without the necessary skills or occurring in an environment that does not conform to minimum medical standards, or both." Worldwide, 20 million unsafe abortions are performed each year. Abortion-related deaths account for 13% of pregnancy-related deaths [2].

Ninety percent of unsafe abortions take place in the developing world. Unsafe abortions may be performed by insertion of an object or a substance (root, twig, catheter, or locally

created preparations), dilatation and curettage performed incorrectly by an unskilled provider, ingestion of abortifacients, or application of external force, such as pummeling the abdomen [2]. Patients may be reluctant to seek care at a traditional outpatient clinic and may eventually seek care in an emergency department. This delay of care can result in devastating consequences such as infertility, septic shock, and death.

Adolescents and young adults have the highest risk for unwanted pregnancies and unsafe abortions. Barriers to abortion, such as parental consent laws, accessibility to a provider, social stigma, cost, and delayed recognition of pregnancy, can increase the risk of an unsafe abortion [3].

In the United States, the death ratio (0.7/100 000 abortions) after spontaneous abortion and induced abortion is roughly the same. Septic abortions can occur with either type of abortion. Increasing gestational age affects the death rate after both spontaneous and induced abortion as the enlarging placenta provides a greater volume of infected tissue [4].

Pathophysiology

Vaginal bacteria invade into the endometrial cavity due to instrumentation. The bacteria spread to the intervillous space and infect the placental tissue. In as little as 6–12 hours, invasion of the decidua and the myometrium can occur. Tissue necrosis of the uterus can follow, which limits the effectiveness of antibiotics.

The bacteria associated with septic abortion are usually polymicrobial. The causative organisms can include normal flora of the vagina and cervix as well as sexually transmitted pathogens. The bacteria may be gram-positive and gram-negative aerobes and facultative or obligate aerobes. *Clostridium* species and group A streptococci can produce toxins that cause an immune response leading to systemic disease and multiorgan failure. Culture of the cervix or products of conception may help isolate toxin-producing organisms or resistant bacteria such as *Staphylococcus aureus* [4].

Maternal bacteremia occurs in 60% of septic abortions. *Peptostreptococcus* is the most common blood isolate, present in about 40% of cases. *Clostridium perfringens* can be identified in up to 5% of septic abortions, and in a higher number of fatal cases [4]. *Clostridium sordellii* infection is rare but has resulted in fatal septic medical abortions [5].

Presentation

Patients with a septic abortion present with fever (100%), vaginal bleeding (57%), abdominopelvic pain (17%), and purulent discharge (2%). Leukocytosis is present in 21% and 2% present with disseminated intravascular coagulation (DIC) [6]. Lactic acid levels can be elevated in cases of sepsis. The ultrasound findings in a septic abortion can be variable, from retained fetal parts to a mass of mixed echogenicity. Prominent vascular flow in the tissue helps make the diagnosis of retained products of conception. The presence of air from a uterine perforation or within the uterine wall should lead to expedited care.

Treatment

The mainstay of therapy for septic abortions is IV antibiotics in combination with surgical evacuation of retained products of conception. In this case, with both retained products and persistent bleeding, urgent operative treatment is imperative. Aerobic and anaerobic cultures of blood should be obtained prior to antimicrobial therapy. Antibiotics should be initiated prior to curettage to reduce the risk of septic shock that can develop from overwhelming bacteremia during the procedure [4].

Antibiotic regimens may include clindamycin 900 mg IV q 8 hours, plus gentamicin 5 mg/kg IV once a day, plus or minus ampicillin 2 g IV q 4 hours. Alternative therapies are ampicillin, gentamicin, and metronidazole 500 mg IV q 8 hours; levofloxacin IV 500 mg daily plus metronidazole; or one of the following: imipenem 500 mg IV q 6 hours, piperacillin-tazobactam 3.375 g IV q 6 hours, ticarcillin-clavulanate (discontinued in the United States) 3.1 g q 4 hours [4].

Rho(D) immune globlulin should be given to Rh-negative women.

Hesitating to evacuate the uterus due to the patient's poor condition can be fatal as a result of profound sepsis. Curettage not only removes infected placental tissue, but also limits the spread to the uterus and systemic circulation. Fetal heart activity should not be a contraindication to uterine evacuation. If no signs of bacteremia are present, vacuum curettage can be performed with local anesthesia or minimal IV sedation. Otherwise, the evacuation should be performed in the operating room in the event that bacteremia and toxin release follows the removal of tissue. A retained fetus from a second-trimester abortion can be a special challenge that requires an experienced practitioner with ultrasound guidance.

Preoperatively, the patient should be counseled that a uterine evacuation can sometimes lead to a hysterectomy, if necessary, to save the life of the patient. Antibiotics should be administered prior to surgery. Surgical pearls include confirming the size and position of the uterus, placing an effective paracervical block with 1% lidocaine administered at either four (3, 5, 7, and 9 o'clock) or two locations (3 and 9 o'clock), and choosing the correct cannula size (one less than the number of weeks of the pregnancy or size of the uterus).

Laparotomy is indicated if there is a suspicion of uterine perforation with bowel or vascular injury. In addition, if there is no response to uterine evacuation and adequate antibiotic therapy, widespread peritonitis, or a pelvic abscess, hysterectomy is indicated. Clostridial myometritis, diagnosed by air in the uterine wall or crepitus, should also lead to immediate hysterectomy. Delay of hysterectomy can quickly lead to worsening clinical status such as septic shock, DIC, or systemic inflammatory response syndrome (SIRS). "The concept of the patient being too sick for surgery needs to be abandoned in these cases, because surgery with hysterectomy can be lifesaving." [4]. The laparotomy incision may need to be vertical, to allow for adequate access. Care should be taken during dissection, as the tissue may be friable and prone to bleeding. Suction drains may need to be placed in the pelvis prior to closure,

especially if portions of an abscess shell cannot be removed due to bleeding.

Postoperative care may need to be managed in an ICU setting for treatment of septic shock. Patients should stay in the ICU until they no longer require invasive ventilation, renal replacement therapies, and aggressive hemodynamic interventions. If post-laparotomy pelvic abscesses develop, they can be drained with radiologic guidance. IV antibiotics are continued until the patient has been afebrile for 24–48 hours. Patients should be discharged home when normal postoperative milestones are met. Oral antibiotics are not necessary. Follow-up should be in one to two weeks.

Septic abortion is a gynecologic surgical emergency. Identifying patients with a septic abortion and promptly initiating intravenous antibiotics and operative management by removal of placental tissue is imperative and can be lifesaving. Close monitoring of patients is indicated for failure to improve or worsening infection after surgical evacuation. If a worsening patient condition occurs, laparotomy and possible hysterectomy should be considered, especially if signs of uterine necrosis are present.

Key Teaching Points

- Septic abortion can follow a spontaneous or induced medical or surgical abortion
- Women with a septic abortion present with fever, vaginal bleeding, and abdominal pain
- Treatment includes broad-spectrum antibiotics and prompt evacuation of the uterus
- Broad-spectrum IV antibiotics should be initiated prior to surgical evacuation
- Delay in surgical evacuation of the uterus due to poor condition of the patient can prove fatal due to sepsis, septic shock, DIC, or SIRS
- Lack of improvement after evacuation of uterus and antibiotics or signs of uterine necrosis should prompt hysterectomy

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CASE 22

A 40-Year-Old G0 Woman with Endometrial Intraepithelial Neoplasia Desiring Hysterectomy

Katherine M. Smith

History of Present Illness

A 40-year-old nulligravid woman last menstrual period 15 weeks ago presents with irregular menstrual bleeding. Upon questioning, she has had irregular cycles for the last 20 years. She has never taken any hormonal medication to regulate her bleeding. She has never been pregnant despite not using contraception since age 21. You perform an endometrial biopsy and the pathologic diagnosis is endometrial intraepithelial neoplasia (EIN). She does not desire future fertility. Her past medical history is significant for hypertension and morbid obesity. She was recently diagnosed with diabetes and has adjusted her diet to try and control her blood sugar. She requests to have a hysterectomy for treatment of her irregular menses. She denies any significant family history of breast, ovarian, or colon cancer. She has no past surgical history. She is currently taking hydrochlorothiazide 25 mg PO daily and has no known drug allergies.

Physical Examination

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

Vital signs:

Temperature: 36.9°C
Pulse: 90 beats/min
Blood pressure: 140/87 mmHg
Respiratory rate: 18 breaths/min
Height: 66 inches
Weight: 259 lb
BMI: 41.8 kg/m^2

Abdomen: Soft, non-tender to palpation, normal bowel sounds, no masses appreciated

Pelvic: Normal external genitalia, labia symmetric and without lesions. Cervix normal appearing without lesions. No cervical motion tenderness. Uterus is anteverted and mobile. Adnexa are not palpable, but no masses appreciated

Laboratory Studies:

HbA1c: 6.7% (normal 4.2–6.1%)
Hb: 11.9 g/dL (normal 12.0–16.0 g/dL)
Urine pregnancy test: Negative
Cervical co-testing: Negative for intraepithelial lesion or malignancy; high-risk human papillomavirus (HPV) negative

Imaging: Pelvic ultrasound shows an anteverted, anteflexed uterus measuring 8.9 × 4.2 × 6.2 cm with an irregular endometrium measuring up to 45 mm in thickness. Cervix appears normal. The right ovary is visualized and has a normal appearance measuring 3.1 × 1.9 × 1.4 cm. The left ovary is visualized and has a normal appearance measuring 2.0 × 1.3 × 0.8 cm. No free fluid is seen. Findings are concerning for uterine malignancy. Clinical correlation is recommended

How Would You Manage This Patient?

This morbidly obese patient presents with long-standing irregular bleeding and risk factors for EIN and endometrial cancer [1]. After ruling out pregnancy, an endometrial biopsy was performed diagnosing EIN. Since she has no desire for childbearing, hysterectomy is the treatment of choice. The patient was counseled on the diagnosis of EIN, risk of endometrial cancer, preferred surgical approach, and the risks of hysterectomy. She undergoes a total laparoscopic hysterectomy and bilateral salpingectomy. She was discharged on postoperative day 1 and had no complications. At her postoperative follow-up visit, she is doing well. Final pathologic evaluation reveals EIN without evidence of invasive cancer.

Endometrial Intraepithelial Neoplasia

Endometrial intraepithelial neoplasia (EIN) is a precursor lesion to adenocarcinoma of the endometrium and has an overall incidence of 133 per 10,000 woman-years. Accurate diagnosis and management of EIN is important given that appropriate treatment can reduce the risk of development of invasive endometrial cancer [2]. While the risk of EIN increases with age, it can occur at any age. Risk factors include diabetes, obesity, nulliparity, and unopposed estrogen; whether exogenous or endogenous. While the differential diagnosis for abnormal uterine bleeding is broad, including anatomic and endocrine-related causes, given the patient's risk factors, cancer must be excluded [1]. As the prevalence of obesity increases worldwide, there is potential for increasing diagnoses of EIN as well as endometrial cancer [3]. Meta-analysis has identified obesity as increasing the odds ratio of endometrial cancer up to 3.33 times in women with a BMI >30 kg/m^2 compared to women with a normal BMI [4].

Estrogen promotes growth of the endometrium and unopposed estrogen can result in altered endometrial histology. The longer the unopposed estrogen effect lasts, whether endogenous or exogenous, the more complex the endometrial glands will become. Estrogen also has effects on the endometrial stroma. Cytologic changes, along with

crowded glands and increased glandular to stromal ratio all contribute to the accurate diagnosis of EIN. There are many benign conditions that mimic the presentation of EIN, including endometrial polyps [5].

EIN is classified using a two-tiered system known as the endometrial intraepithelial neoplasia schema. In most cases this system is preferable to the World Health Organization (WHO) classification system previously used. The EIN schema divides pathologic findings into two categories: either benign endometrial hyperplasia or EIN, which is a true premalignant diagnosis. Diagnostic criteria for EIN include glandular crowding, cytologic alterations, lesion size less than 1 mm and exclusion of endometrial carcinoma as well as mimics such as ciliary or atypical squamous metaplasia [5, 6]. Distinction between benign endometrial hyperplasia and EIN is especially important given up to 40% of patients with EIN have coexisting endometrial cancer [3].

As in this case, most women with EIN present during the perimenopausal or postmenopausal time frame with abnormal uterine bleeding. In some women, suspicion of EIN results from abnormal glandular cells (AGC) or endometrial cells on cervical cytology testing [1]. Endometrial sampling should be performed in women with an AGC cytology result and any risk factor including age over 35 [7]. An office endometrial biopsy using an endometrial sampling device or dilation and curettage (D&C) in the operating room can be used to make the diagnosis of EIN. Transvaginal ultrasound is useful in the evaluation of postmenopausal women with bleeding. In this specific population, an endometrial thickness less than or equal to 4 mm is associated with only a 1% probability of endometrial cancer (Figure 22.1). In premenopausal women, there are no similar ultrasound-derived endometrial thickness cutoffs for exclusion of premalignant lesions [3]. There is no clear benefit of D&C over office sampling as even a D&C will often only sample about half of the uterine cavity. Hysteroscopy along with D&C is felt to improve the accuracy of diagnosis and exclude a coexisting endometrial cancer. Hysteroscopy allows for targeted biopsy of any discrete lesions or abnormalities seen and allows for resection of the entire endometrial cavity if desired. Hysteroscopy has been found to have a diagnostic sensitivity of 98% and positive predictive values of 96% [8]. This may be more important when definitive surgical therapy for treatment is not employed [2, 9].

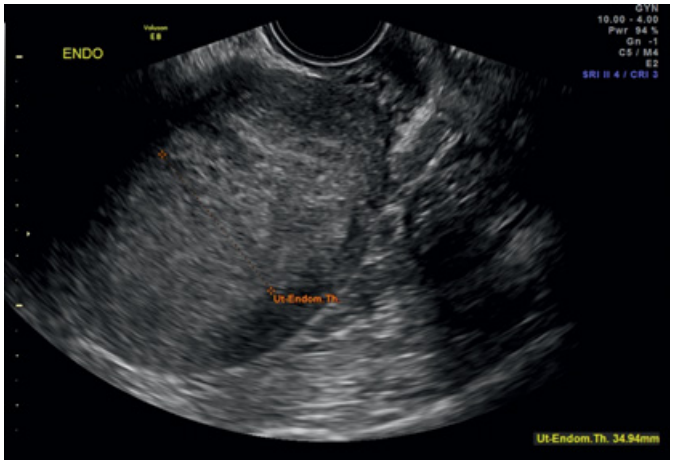

Figure 22.1 Ultrasound image of the uterus with findings concerning for EIN or endometrial cancer.

Patients should be counseled regarding the available surgical and non-surgical treatments for EIN. Non-surgical options are acceptable for those women who desire future fertility or have comorbidities that preclude surgery. These include oral progesterone therapy with megestrol acetate or medroxyprogesterone acetate, which have regression rates of 80–90%. In addition, a levonorgestrel-releasing intrauterine device has also been used in this situation with success [3]. For most women who have completed childbearing and are surgical candidates, hysterectomy is the treatment of choice. Total hysterectomy is a definitive and effective means of treating EIN that allows pathologic assessment of the endometrium for concurrent endometrial cancer. Abdominal, vaginal, laparoscopic, and robotic hysterectomy are appropriate surgical approaches. Removal of the cervix should always occur to prevent leaving residual disease in the case of malignancy. Uterine morcellation is also contraindicated to prevent disease spread and to allow full pathologic evaluation of the specimen [2, 3]. Bilateral salpingo-oophorectomy is not required but women should be counseled that final pathologic diagnosis may require additional surgery to complete staging should an invasive cancer be identified [2].

Ultimately, the decision on route of hysterectomy is dependent on the skill and comfort of the surgeon. A minimally invasive approach will result in decreased pain and faster recovery for the patient. The vaginal approach does not allow for complete surgical staging [3, 9]. It may be beneficial for the surgeon to open the uterine specimen in the operating room to assess for gross evidence of invasive disease. This examination is helpful if frozen section is available, and the scope of the operation can be changed. If available, frozen section may aid in the diagnosis as it correlates well with the final pathologic diagnosis [2, 3]. Correlation between frozen and final pathologic diagnosis has been demonstrated to be 88% to 98%. Frozen section is most helpful if a gynecologic oncologist is available to perform comprehensive surgical staging [2]. Patients who have uterine pathology with a grade 1 or 2 tumor that is 2 cm or less in size and demonstrates less than 50% myometrial invasion do not need complete surgical staging. However, greater than 50% myometrial invasion, high-grade histology and lymph vascular space involvement are associated with a worse prognosis and complete surgical staging with removal of the adnexa and pelvic and para-aortic lymph node dissection as well as pelvic washings is indicated. Review of final pathology for these high-risk features and referral to a gynecologic oncologist, if necessary, is important for postoperative follow-up [10] (Figure 22.2).

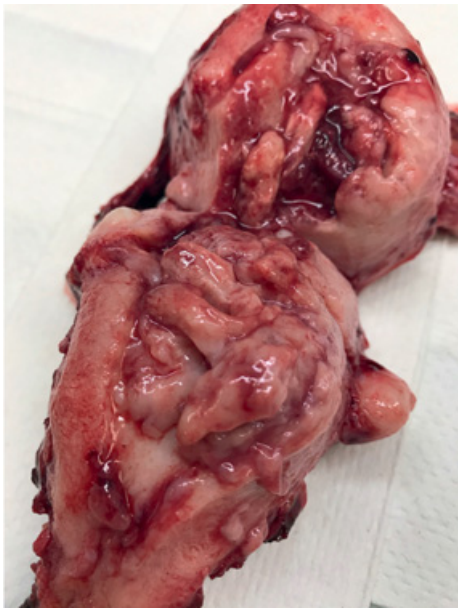

Figure 22.2 Gross pathology hysterectomy specimen in a patient with EIN and grade 1 endometrial cancer.

Key Teaching Points

- For classification, the endometrial intraepithelial neoplasia schema is preferable to the WHO94 classification system
- Risk factors for EIN include diabetes, obesity, nulliparity, and unopposed estrogen; whether exogenous or endogenous
- Office endometrial biopsy or D&C can be used to diagnose EIN; hysteroscopy may provide some advantages but is not required if D&C is performed
- Total hysterectomy is an effective means of treatment; supracervical hysterectomy and morcellation during hysterectomy are contraindicated
- Patients should be counseled that if a coexistent endometrial cancer is identified, they may require additional surgery for complete staging

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CASE 23 A 35-Year-Old G3P3 Woman with a 12-Week Uterus and a Prior Cesarean Section Who Desires Vaginal Hysterectomy

Angelina K. Gangestad

History of Present Illness

A 35-year-old gravida 3, para 3 presents with complaints of heavy menstrual bleeding. Patient reports her menses have been getting progressively heavier over the last year. She has been on oral contraceptive pills for the last six months, and feels they are not helping. She is experiencing heavy flow requiring her to wear a pad and a tampon together for the first two days of her seven-day cycle. She had a cesarean section for her second child followed by a vaginal birth after cesarean (VBAC) of an 8 lb infant. She has no other surgical history and no medical history and has no known drug allergies. She denies any history of sexually transmitted infections (STIs). Her last cervical cytology six months ago was normal. She is currently taking desogestrol 0.15 mg, 0.03 mg ethinyl estradiol contraceptive pills but she has completed her family and desires definitive therapy. After discussing her treatment options, patient requests a hysterectomy.

Physical Examination

General appearance: Well-developed, well-nourished woman who appears comfortable

Vital signs:

Temperature: 37.1°C
Pulse: 89 beats/min
Blood pressure: 128/78 mmHg
Respiratory rate: 18 breaths/min
Height: 65 inches
Weight: 135 lb

Abdomen: Soft, non-tender with a well-healed transverse scar in the suprapubic region. No masses appreciated. No hernias

Pelvic: Normal external female genitalia. Normal vaginal rugae present. Three fingers fit under the pelvic arch. Normal appearing cervix with stage 1 descensus. Anteverted, mobile uterus, 12-week size with a palpable fundal fibroid

Laboratory studies:

Hb: 9.8 g/dL (normal 12.0–15.5 g/dL)
Urine pregnancy test: Negative
Endometrial biopsy: Proliferative endometrium with no evidence of hyperplasia or malignancy

Imaging: Transvaginal ultrasound shows a 12.2 × 6.8 × 7.2 cm uterus with a 4 cm fundal fibroid. The endometrium is homogeneous, and measures 7 mm. Left ovary is 3.2 × 1.4 × 1.7 cm with a 1.3 cm simple cyst. Right ovary is 2.9 × 1.6 × 1.2 cm and appears normal. There is no free fluid

How Would You Manage This Patient?

This patient presents with abnormal uterine bleeding and mild anemia. She has failed medical management, completed her childbearing, and is requesting a hysterectomy. Vaginal arch is adequate, with mild uterine descensus. The uterus is 12-week size with a fundal fibroid. She has no evidence of ovarian or pelvic pathology or cancer. After counseling and shared decision-making, a decision is made to proceed with a vaginal hysterectomy.

The patient underwent vaginal hysterectomy with removal of her fallopian tubes under general anesthesia. In order to complete the hysterectomy, the uterus was bivalved. Blood loss was 400 mL. She was discharged the same day. She was doing well four weeks post-op and returned to work. Pathology confirmed a uterine fibroid and adenomyosis.

Vaginal Hysterectomy

Route of hysterectomy can be influenced by many factors such as size and shape of the vagina and uterus; accessibility and mobility of the uterus; extent of extrauterine disease; the need for concurrent procedures; surgeon training, experience, and comfort with vaginal hysterectomy; and preference of the informed patient. The American College of Obstetricians and Gynecologists (ACOG) recommends vaginal hysterectomy as the approach of choice whenever feasible [1]. Vaginal hysterectomy has a shorter recovery time, shorter procedure time, less blood loss, less febrile morbidity, and fewer wound infections when compared with other routes of hysterectomy [2]. The American Association of Gynecologic Laparoscopists (AAGL) in their position paper on route of hysterectomy states vaginal hysterectomy is both feasible and safe even in the presence of a large uterus [3].

Uterine size and shape is the first factor to take into consideration when deciding on route of hysterectomy. A uterus up to 12-week size (approximately 280 g) with disease confined to the uterus should be able to be removed vaginally in over 90% of cases [4]. With larger uteri, accessibility of the uterosacral and cardinal ligaments should be taken into consideration. A wide uterus that fills the pelvis is more difficult to get appropriate clamp placement. A uterus where the bulk is superior, as in this scenario, allows for clamp placement and mobilization, which provides access to higher pedicles.

The shape of the pelvis and vagina impact ability to perform a hysterectomy vaginally. A narrow vagina or pelvis may not allow for clamp placement or adequate maneuverability and visibility. The pubic arch should be greater than 90 degrees to allow access to the cervix and adequate retraction to visualize the bladder plane. One study showed that an arch less than 90 degrees increased the risk of needing to convert to

abdominal hysterectomy by fourfold [4]. This can be assessed by the ability to fit two fingers under the pubic arch comfortably. The vagina itself needs to be wide enough to allow manipulation of the cervix and uterus. The vagina should be at least two fingerbreadths at the apex to allow adequate access to the cervix and uterus [5].

A laparoscopic or abdominal approach to hysterectomy should be considered in patients with extrauterine disease such as large adnexal masses, concern for extensive adhesions, or endometriosis requiring excision. Laparoscopy allows assessment of the extrauterine disease and mobilization of the uterus. The need for concurrent procedures can also affect the approach to hysterectomy.

Opportunistic removal of the ovaries and fallopian tubes can be completed safely through the vaginal route for most patients. Success rates for vaginal bilateral salpingo-oophorectomy (BSO) range from 65% to 97.5% [1]. In a review by the Society of Gynecologic Surgeons (SGS) Systematic Review Group, they noted no difference in length of stay or perioperative complications with BSO done at the time of vaginal hysterectomy, and the increase in surgical time was 2–23 minutes [6]. Antosh et al., using a standardized technique of single or double clamping across the mesosalpinx and single or double suture-ligating the pedicle after excision of the fallopian tube at the time of vaginal hysterectomy, found that bilateral salpingectomy was successfully performed in 81% of cases, with a mean operating time of 11 minutes and estimated blood loss of 6 mL [7].

For women with larger uteri, an examination under anesthesia can help the surgeon determine the feasibility of vaginal hysterectomy. Once the patient is fully relaxed, the surgeon can evaluate maximum uterine descent and vaginal caliber. Descensus to at least halfway to the introitus allows for access to the uterosacral and cardinal ligaments, allowing the vaginal route for hysterectomy. Schmitt et al. noted that 71.9% of patients in an examination under anesthesia group underwent successful vaginal hysterectomy in their study of a route of hysterectomy decision algorithm [8]. Examination under anesthesia can help the surgeon assess location of uterine fibroids and uterine mobility in patients with previous pelvic surgery.

Previous cesarean or other pelvic surgery should not preclude vaginal hysterectomy. While some women will have dense adhesions to the anterior peritoneum, the majority do not. Nulliparity should also not prevent attempting a vaginal hysterectomy. A study showed that 92% of vaginal hysterectomies planned for a cohort of women with no prior vaginal deliveries were successfully completed with that approach [9].

Previous Cesarean

Vaginal hysterectomy in the patient with a previous cesarean section presents two challenges. The first is entering the anterior peritoneum without injuring the scarred bladder. The second is dense adhesions of the uterus to the abdominal wall. If dense adhesions prevent descent of the uterus, a laparoscopic approach may be necessary to take down adhesions.

Several methods have been proposed for entering the anterior peritoneum. Entry of the posterior peritoneum first can increase uterine mobilization and allow a sound or other instrument to be placed around the fundus into the anterior cul-de-sac to aid in identifying the vesicouterine space. Filling the bladder with a dilute indigo carmine solution to stain the bladder tissues to make the bladder easier to identify has been suggested. The greatest risk of bladder injury occurs during dissection of the bladder off the cervix. The vaginal approach to the vesicouterine space is inferior to the cesarean scar, which facilitates finding the correct plane for dissection. When the cesarean scar is encountered, sharp dissection, instead of blunt dissection, can help reduce the risk of bladder injury [9].

Larger Uteri

Larger uteri and those with leiomyoma can be removed with vaginal hysterectomy using various morcellation techniques. Prior to attempting morcellation, the uterine artery should be secured, the anterior and posterior cul-de-sac should be entered, and rectum and vagina should be protected by appropriate retractor placement. Vaginal hysterectomy morcellation techniques include bivalving, coring, morcellation, and myomectomy [10].

Bivalving involves cutting the uterus in half. The cervix and corpus of the uterus are bisected in the anterior posterior plane with a knife. This allows the surgeon to push one side of the uterus back into the pelvis while securing the pedicles on the opposite side. It can be combined with morcellation and myomectomy to allow easier access to pedicles. Once one side is removed, the remaining side's pedicles are secured, and the rest of the uterus delivered. Leiomyoma which are encountered during bivalving can be removed, allowing easier hysterectomy.

Coring involves removing the center of the uterus in a circumferential manner. The central core pulls down and elongates the uterus allowing for better access to the lateral pedicles. This technique is usually done when there are no large fibroids present. When compared with bivalve and morcellation, coring did have a higher failure rate (25% vs. 0%). Coring failure seemed to occur most frequently in narrower uteri. Coring also was associated with a higher incidence of post-op fever [11].

Myomectomy can be performed to remove a large fibroid allowing better movement of the uterus in the pelvis. This technique is accomplished by opening the uterine serosa overlying the leiomyoma and dissecting the leiomyoma from the uterine wall. Morcellation can also be accomplished by wedge debulking, removing a wedge-shaped piece of the uterus. Both techniques remove uterine bulk allowing better access to the remaining pedicles.

When the uterus is felt to be borderline for a vaginal approach, a short course of medication may lead to a reduced uterine volume allowing vaginal surgery. In a 2017 Cochrane review, it was noted that pretreatment with a gonadotropin-releasing hormone analog (GnRHa) results in decreased uterine volumes and fibroid volumes, along with a higher

preoperative hemoglobin. Surgical times were found to be shorter, blood loss was less, and fewer post-op complications were noted. Selective progesterone receptor modulators have had similar outcomes, although GnRHa appear to have a larger reduction in uterine volume [12].

Key Teaching Points

- Vaginal hysterectomy should be the preferred route of hysterectomy whenever feasible
- Most hysterectomies for disease confined to the uterus can be completed vaginally, including nulliparous patients and patients with previous pelvic surgery
- Examination under anesthesia can help in determining whether a vaginal hysterectomy is appropriate as it allows for pelvic relaxation and a better assessment of the pelvis
- Careful identification of the vesicouterine plane and sharp dissection through the cesarean scar can allow vaginal hysterectomy in patients with a history of previous pelvic surgery
- Techniques such as bivalving, coring, myomectomy, or removing wedges of tissue can facilitate removal of larger uteri vaginally.
- Pre-op treatment with GnRHa or selective progesterone receptor modulators can allow for a vaginal approach to hysterectomy.

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CASE 24

A 42-Year-Old G2P2 Woman Undergoing Vaginal Hysterectomy with Difficulty Entering the Peritoneum

Francine McLeod

History of Present Illness

A 42-year-old woman, gravida 2, para 2, last menstrual period three weeks ago, presents for surgical consultation secondary to heavy menstrual bleeding. She reports persistent, regular monthly bleeding with passage of clots. She was admitted to the hospital for a blood transfusion secondary to anemia, dizziness, and fatigue. She was discharged on a progestational agent and reports initial improvement in her bleeding and symptoms. The heavy vaginal bleeding has recurred and is now associated with constant pelvic pain and cramping. She is sexually active with her husband. She is requesting a hysterectomy. She has no relevant past medical or surgical history. She is currently taking medroxyprogesterone (Provera) 20 mg PO three times daily and has no known drug allergies.

Physical Examination

General appearance: Pale appearing female, comfortable, well-nourished and in no acute distress

Vital signs:

Temperature: 37.1°C
Pulse: 98 beats/min
Blood pressure: 138/70 mmHg
Respiratory rate: 18 breaths/min
Height: 66 inches
Weight: 140 lb
BMI: 22 kg/m^2

Cardiovascular: Regular rate and rhythm, no murmurs appreciated

Abdomen: Normal bowel sounds, soft, non-tender. No masses appreciated. No guarding

Pelvic: Normal external female genitalia noted. A mild amount of blood is present in the vaginal vault. No lesions or lacerations noted. The cervix is parous and descends to 2 cm from the hymen with Valsalva. No lesions noted. The uterus is midplane, mobile, slightly enlarged and boggy. No tenderness appreciated. No uterosacral tenderness or nodularity. No adnexal masses or tenderness appreciated. No rectal masses present. No evidence of a rectocele noted

Laboratory studies:

WBCs: 7000/μL (normal 3100–9500/μL)
Hb: 8.5 g/dL (normal 11.4–14.8 g/dL)
Platelets: 340 000/μL (normal 142 000–346 000/μL)
MCV: 77 fL (normal 78.0–96.0 fL)
Urine pregnancy test: Negative
Endometrial biopsy: Weakly proliferative endometrium. No evidence of hyperplasia, atypia, or malignancy noted
Pap smear: Negative for intraepithelial lesion or malignancy
HPV DNA, high risk negative

Imaging: Pelvic ultrasound shows the uterus is 10.2 × 5.5 × 4.7 cm. The myometrium is diffusely heterogeneous. There is a solitary intramural fibroid measuring 2.3 × 2.2 × 2.5 cm. The endometrial thickness is 10 mm. Ovaries are normal in size and appearance. The right ovary is 2.5 × 1.3 × 2.1 cm. The left measures 3.4 × 1.6 × 2.6 cm. No ovarian or adnexal masses. No significant free fluid noted

How Would You Manage This Patient?

This patient is anemic and experiencing heavy vaginal bleeding despite hormonal therapy. Definitive surgical treatment is indicated and she chooses vaginal hysterectomy. During the operative procedure, difficulty is encountered with the anterior colpotomy. The posterior colpotomy is performed successfully. The uterosacral cardinal ligament complex is transected leading to additional uterine descensus. Entrance into the anterior peritoneum is now achieved and the remainder of the surgery is uneventful. She is discharged home after 24 hours of observation, and she remains stable at her postoperative visit. Pathologic examination of the uterus reveals adenomyosis in addition to leiomyomas.

Vaginal Hysterectomy

Vaginal hysterectomy is the oldest minimally invasive surgical technique for removal of the uterus. Unique to this approach, the surgeon must operate in a narrow space, at times with suboptimal visualization, and have an excellent knowledge of anatomy to be successful. Vaginal hysterectomy results in faster recovery, shorter operating times, and decreased length of stay compared with the abdominal approach. Although laparoscopic hysterectomy is also minimally invasive, vaginal hysterectomy offers lower overall cost [1]. It is the surgical approach of choice for benign disease [2]. Additionally, the majority of patients undergoing a hysterectomy for benign disease will be good candidates for this technique. Success during a vaginal hysterectomy is derived from three important principles: patient selection, knowledge of anatomy, and meticulous surgical technique.

Patient Selection

Every patient undergoing hysterectomy should be evaluated for the potential to utilize the vaginal approach. A shared decision-making model is ideal to align goals and expectations

for an optimal surgical outcome. Opportunistic salpingectomy, adnexal masses, intraoperative hemorrhage, and conversion to open technique should be included in the informed consent process. A thorough history and physical examination will identify patients who are good candidates. A history of successful vaginal deliveries, pelvic prolapse, and absence of previous pelvic surgeries are predictive of a successful vaginal hysterectomy. On examination, the size and mobility of the uterus, pelvic relaxation, uterosacral and pelvic tenderness should be assessed. While there are no absolute contraindications to vaginal hysterectomy for treatment of benign disease, a history of adhesive disease, pelvic infection, or adnexal pathology can be considered relative contraindications and may present unique challenges [3]. Given this patient's physical findings and imaging studies, she is an ideal candidate for a vaginal hysterectomy.

Anterior Peritoneal Entry

The anterior and posterior colpotomy can be two of the most challenging steps in the vaginal hysterectomy. Precise knowledge of the anatomic landmarks is essential in any surgical procedure, but particularly critical during a vaginal hysterectomy. The initial circumferential incision of the cervix is made at the level of the cervicovaginal junction, which is identified by the transition from the smooth cervical mucosa to the rugated mucosa of the vagina. An incision made relatively cephalad or caudad to this point will not permit exposure to the supravaginal septum; the gateway to the vesicocervical space and ultimately the anterior peritoneal reflection. The supravaginal septum is a fibrous band of connective tissue approximately 1–3 cm in length located between the posterior bladder fascia and the anterior cervix [4]. This connective tissue is exposed by elevating the cut edge of the vaginal mucosa and visualizing the tissue cords extending from the anterior cervix [5]. A caudal incision will result in the surgeon dissecting into the cervical stroma where bleeding can occur. A cephalad incision will potentially lead to bladder injury. The average distance between the cervicovaginal incision and the anterior peritoneal reflection is 3.4 cm. However, in cases of cervical elongation, this distance will be significantly greater [6]. Competency with the location of these anatomic landmarks is the foundation for successful peritoneal entry.

In many cases, entry into the anterior peritoneal cavity is challenging. In these situations, there are several fundamental steps to contemplate and alternate approaches the gynecologist should consider. The surgeon should continue the dissection in the midline and avoid the tendency to dissect laterally toward the bladder pillars. Avoid dissection with an open sponge or finger as this technique may inadvertently push the peritoneal fold in the cephalad direction out of the operative field [7]. Best practice is to utilize sharp dissection and maintain a parallel and adjacent position to the anterior cervical stroma. Continuous downward traction on the cervix with upward countertraction by elevation of the bladder will allow for the greatest exposure to the peritoneal reflection while simultaneously displacing the ureters [7]. Four steps, which can be performed in any order, will facilitate anterior peritoneal entry into the abdominal cavity:

1. **Transect the uterosacral cardinal ligament complex.** The traditional approach to a vaginal hysterectomy is to enter the anterior and posterior cul-de-sacs in tandem to gain complete access to the peritoneal cavity. However, in patients with a prior cesarean section, cervical elongation, or nulligravidy, transection of the uterosacral and cardinal ligaments will provide additional uterine descent and "drop" the peritoneal reflection inferiorly [8].
2. **Retrograde filling of the bladder.** Temporary distension of the bladder with sterile milk will provide twofold assistance. It will help delineate the anatomy of the bladder relative to the lower uterine segment and cervix. Second, if an unintentional cystotomy is performed, it will be readily apparent [7].
3. **Place an object through the urethra into the bladder.** Use of a small catheter or blunt instrument inserted into the bladder while a surgeon's hand is placed on the anterior cervix can provide additional knowledge of the bladder edge and thickness of any remaining fibers of the supravaginal septum.
4. **Enter the posterior colpotomy to gain access to the anterior peritoneal reflection.** The surgeon may insert a uterine sound, bent to mimic the shape of a "U," through the posterior peritoneum and over the uterine fundus. The tip can be palpated through the anterior peritoneum with the operator's hand for easy access. In lieu of the sound, if the uterine size permits, the surgeon can insert their second and third digits through the posterior cul-de-sac and flex the fingers around the fundus to provide distention and direction of the peritoneum into the operative field [8].

Posterior Peritoneal Entry

Of the two colpotomies, the posterior technique is more straightforward. After the initial circumferential incision is made through the full thickness of the vaginal mucosa, the cervix is grasped and sharply elevated superiorly. The mucosal fibers of the posterior fornix and peritoneum will be readily apparent with gentle traction on the cut edge of the posterior vagina [7]. However, on occasion, the cul-de-sac of Douglas can be obliterated by endometriosis or colonic disease making identification of the posterior peritoneum arduous. The following three steps will assist with successful peritoneal entry.

1. **Identify the plane of dissection close to the posterior uterus**. This can be located at the level of the uterosacral ligament insertion and should yield promising results.
2. **Begin the hysterectomy in an extraperitoneal manner**. The mucosa can be dissected back 1/8 inch on each lateral side to clearly expose the uterosacral ligaments [9]. Proceed with transecting the uterosacral ligament as mentioned earlier [8].
3. **Proceed in a stepwise fashion with cervical elongation**. This normal variant may not be discovered preoperatively. Both anterior and posterior colpotomies can be difficult as the peritoneal reflection is higher than anticipated. The

surgeon has a few options. One can delay entry and continue the surgery in a stepwise fashion until the uterine vessels have been ligated. At this point, the elongated cervix can be bivalved to improve access to both peritoneal reflections [3]. Alternatively, before transecting the uterosacral ligaments, a V- shaped incision can be made posteriorly to gain access to the posterior cul-de-sac [7].

Regardless of the technique employed to perform the colpotomy, the peritoneum should only be opened under direct visualization. This is the safest approach to avoid injury to adjacent structures such as the bladder, ureters, or bowel. If safe entry into the abdomen cannot be performed, or if intra-abdominal hemorrhage is poorly controlled, the surgeon should abandon this approach and proceed with either abdominal or laparoscopic routes.

Key Teaching Points

- Vaginal hysterectomy is the minimally invasive procedure of choice when it is feasible and agreed upon through a shared decision-making model
- History of cesarean section, large uteri, or pelvic adhesive disease does not preclude the vaginal route, but should prompt the surgeon to prepare for a difficult hysterectomy
- Entry into the anterior and posterior peritoneum can be difficult procedural steps, but alternative approaches are available for consideration
- Proper patient selection, excellent knowledge of anatomy, and meticulous dissection are crucial to achieve success

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CASE 25

A 28-Year-Old PO Woman with Adenocarcinoma In Situ Has Intraoperative Bleeding during a Cold-Knife Conization

Seine Chiang

History of Present Illness

A 28-year-old female para 0, non-smoker, presents to discuss management of adenocarcinoma in situ (AIS) on colposcopic biopsy. She has been in a mutually monogamous relationship for the past four years, has had two lifetime partners, and uses combined oral contraceptive pills (COCs; ethinyl estradiol 20 mcg/norethindrone 1 mg PO daily) for contraception. She has no past surgical history and no known drug allergies. She had a normal wellness examination three months ago and completed the HPV vaccination series at age 26. Her past medical history is significant for abnormal Pap smear. Her cervical cancer screening history is as follows:

- Age 24 – Atypical squamous cells of undetermined significance (ASCUS)
- Age 26 – ASCUS, +HPV 18
  - Colposcopic evaluation was adequate. No ectocervical lesion was seen. Endocervical curettage (ECC) showed cervical intraepithelial neoplasia (CIN) 1
- Age 28 – Atypical glandular cells of undetermined significance (AGc), favoring neoplasia, +HPV 18
  - Colposcopic evaluation was adequate. Biopsy was AIS and CIN 3. ECC showed AIS.

Physical Examination

General appearance: Well-developed, anxious young woman

Vital signs:

Temperature: 37.1°C

Pulse: 90 beats/min

Blood pressure: 120/75 mmHg

Respiratory rate: 15 breaths/min

BMI: 28 kg/m^2

Abdomen: No masses, hernias, or hepatosplenomegaly. No pain

Pelvic: External genitalia and vagina with no lesions. Cervix friable with ectropion. Bimanual examination shows anteverted uterus, normal size, and no adnexal masses

Laboratory studies:

Urine pregnancy test: Negative

Colposcopy: Three biopsies were obtained as noted (Figure 25.1). An endocervical curettage was performed

Pathology: Adenocarcinoma in situ (AIS) and CIN 3 on cervical biopsies; endocervical curettage (ECC) with AIS.

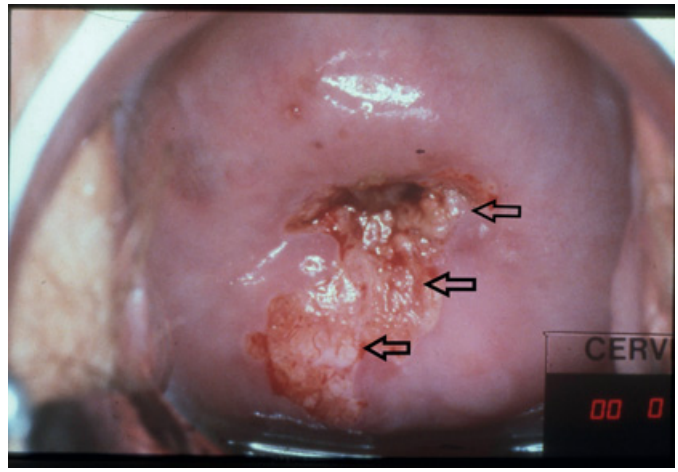

Figure 25.1 Colposcopic examination of the cervix. Arrows depict sites of three cervical biopsies.

How Would You Manage This Patient?

This 28-year-old patient presents with abnormal glandular cells (AGC) and CIN 3 after colposcopic evaluation. Clinical evaluation of AGC requires at least colposcopic-directed cervical biopsies and ECC. Indication for endometrial biopsy should be individualized and based on age and risk factors for endometrial cancer [1]. After counseling, this patient underwent a cold-knife conization (CKC) in the operating room under general anesthesia. The cervix was stained with Lugol's solution, which highlighted the posterior cervical lesion noted on prior colposcopy. A tenaculum was placed on the anterior cervix, away from the planned excision site. The cervical canal sounded to 4 cm. Using a #11 scalpel, an incision was made clockwise, starting at 6 o'clock, 3 mm lateral to the visible posterior lesion and angling toward the endocervical canal for a depth of 1.5 cm. Allis clamp was used to provide countertraction. The base of the 1.5 cm cone specimen was excised with scissors, tagged at 12 o'clock with silk suture, and placed in formalin. ECC was obtained. Continuous brisk bleeding was noted from the cone bed and an Allis clamp was placed across the bleeding area.

Adenocarcinoma In Situ

Recent epidemiologic studies suggest that 55% of women with AGC Pap smears also have a coexisting squamous lesion [1]. Risk factors for AIS include HPV 16 or 18 infection, immunosuppression, smoking, and COC use. HPV 18 infection is associated with 38–50% of all AIS and 50% of all invasive cervical cancers [1]. Since 15% of women with AIS on biopsy will have invasive adenocarcinoma, excisional diagnostic procedure to a depth of at least 10 mm is recommended, including prior to planned hysterectomy for AIS (Figure 25.2) [1].

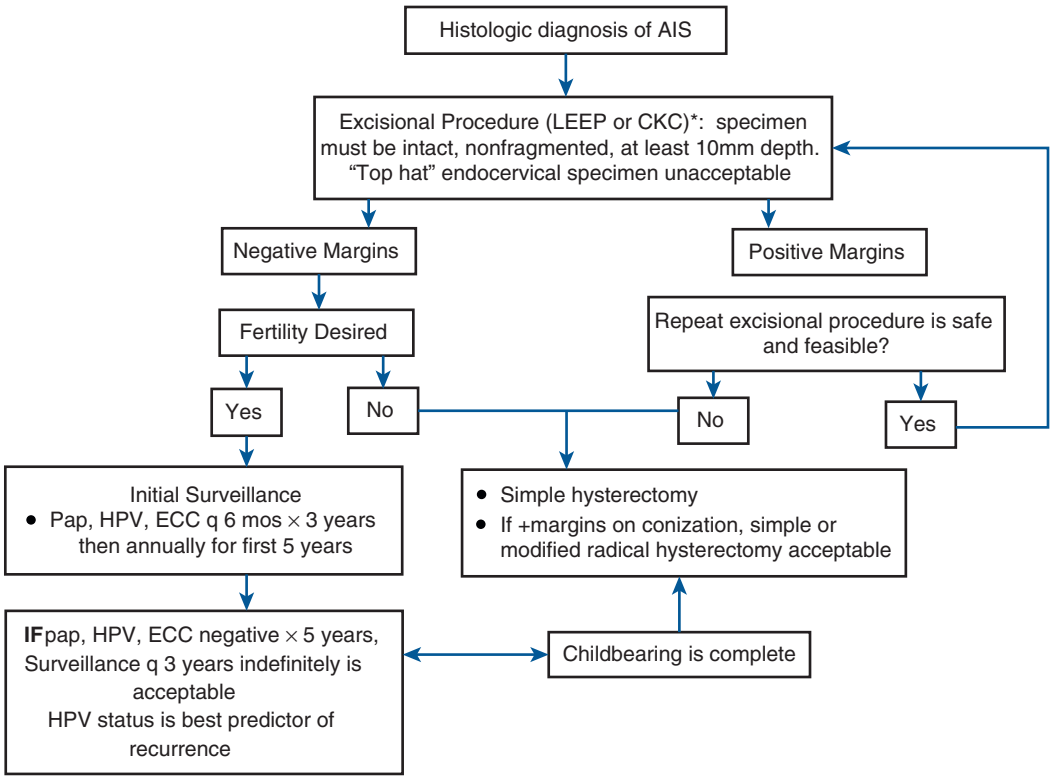

Figure 25.2 Summary of adenocarcinoma in situ SGO management recommendations.

Understanding the anatomy of the cervix including innervation and blood supply is important prior to surgical excision of AIS. The cervical length averages 3.5 cm in premenopausal women with the length visible in the vagina averaging 2.5 cm. The descending branches of the uterine and vaginal arteries provide blood supply to the cervix, entering at the cervicovaginal junction at 3 and 9 o'clock. Cervical innervation is supplied by the uterosacral nerve plexus arising from the inferior hypogastric plexus, which has pressure and temperature receptors but few pain receptors. The ectocervix is covered with multilayered squamous epithelium (30–40 layers) and at the transformation zone transitions to a single cell layered mucous epithelium. AIS involves this one-layer mucous epithelium which lines the folds and clefts of the endocervical canal, projecting 3–6 mm into the underlying stroma [2, 3]. It is important to excise at least 3–5 mm lateral to the abnormal transformation zone and the external os to fully evaluate the endocervical folds and clefts.

Excisional Procedure

While CKC has been the recommended excisional method for women with AIS to minimize cautery artifact at the margins, a recent meta-analysis of 18 retrospective studies showed no difference in residual disease rate (LEEP 9% vs. CKC 11%) or recurrence rate (LEEP 7% vs. CKC 5.6%) between LEEP cone and CKC [1]. Several studies have shown an increased risk of preterm delivery with CKC compared with LEEP, including a large meta-analysis showing an odds ratio for preterm delivery with CKC of 2.8 and 1.7 for LEEP cone [4, 5]. A prospective randomized trial showed a 5% rate of preterm delivery with LEEP cone versus an 11% rate with CKC [6]. Both LEEP and CKC are safe and effective excisional techniques for the conservative management of AIS [4–6], but LEEP cone may be preferred if fertility preservation is important AND if the abnormal area can be removed as one intact specimen with sufficient depth.

How Would You Manage Bleeding Associated with Cold-Knife Conization?

Management of bleeding associated with CKC can be classified into two main strategies: prevention versus management. Combinations of these strategies are often employed, particularly in patients at higher risk for bleeding such as those who are pregnant or anticoagulated (Table 25.1). Hemorrhage following conization is classified as either primary (<24 hours) or secondary hemorrhage (2–3 weeks post-procedure). In a recent Cochrane review of 12 randomized controlled trials on this topic, primary hemorrhage was significantly reduced by the use of dilute vasopressin (compared with placebo) and packing with Monsel's paste (compared with suturing), but no difference in blood loss was noted with Monsel's paste compared with ball fulguration. Tranexamic acid administration significantly decreased the risk of secondary hemorrhage (relative risk 0.23) but not primary hemorrhage [7]. There is no comparative evidence as to whether the other strategies in Table 25.1 are more effective than another due to heterogeneity of outcomes, treatment, comparisons, and small numbers.

With this CKC, primary hemorrhage may have been prevented with subepithelial injection of dilute vasopressin, placement of either lateral deep "stay sutures" (Figure 25.3), prophylactic purse-string suture outside of the planned cut margins, or a combination of vasopressin and suturing. Accurate

Table 25.1 Interventions for minimizing blood loss during cervical conization [7]

Prevention
• Subepithelial injection of vasoconstrictive agent: 10–20 mL of vasopressin (10 units in 50 mL sterile water) or local anesthesia with 1:100 000 epinephrine
• Tranexamic acid (antifibrinolytic agent)
• Deep lateral "stay suture" at 3 o'clock and 9 o'clock to ligate the descending vaginal branches of the uterine vessels
• Use of cautery or laser instead of scalpel
• Prophylactic circumferential purse-string suture outside of planned cut margins
Management of cone bed bleeding
• Inject with vasoconstrictor, pressure, suction to visualize
• Tranexamic acid
• Ball electrode diathermy fulguration of cone bed or direct cautery of bleeding area
• Monsel's paste
• Silver nitrate
• Suturing (figure-of-eight, circumferential around the cut edges, Sturmdorf)
• Gel foam
• Vaginal packing
• Clamp bleeder with polyp forceps, allis clamp, ring forceps, tonsil

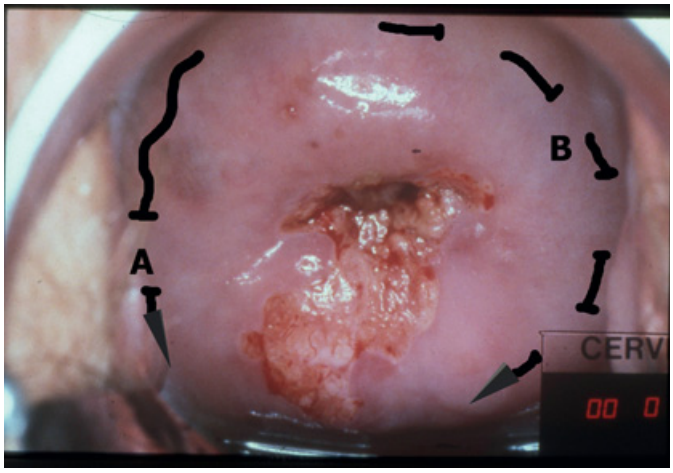

Figure 25.3 A: Placement of deep lateral figure-of-eight sutures at 3 and 9 o'clock to secure the cervical branches of the uterine artery. B: Prophylactic purse-string suture outside of the planned excision site.

placement of "stay sutures" is evident by the amount of immediate bleeding with the initial scalpel incision into the cervix but no comparison studies of efficacy has been performed.

Several strategies can be employed to control brisk continuous bleeding from the cone bed. Adequate visualization and notifying your anesthesiologist regarding blood loss are important.

If there is a specific area that is briskly bleeding, Allis clamp or uterine polyp forceps can be placed over the bleeding site from the cervical os to the ectocervix to compress the area, temporarily control bleeding, and provide traction. Several strategies can now be employed:

- Direct application of electrosurgical energy to the bleeding site
- Directly suturing the bleeding area
- Placement of deep lateral sutures from the anterior ectocervix, through the cervical stroma near the os, and out through the posterior ectocervix. A simple interrupted or a figure-of-eight suture will often slow the bleeding enough to effectively fulgurate the cone bed circumferentially
- Fulguration of the conization bed. Additional vasopressin may be necessary to allow for visualization and effective fulguration
- Placement of Monsel's paste or gel foam in the cone bed after fulguration

Key Teaching Points

- Clinical evaluation: AGC and HPV 16 and 18 are all associated with AIS and require at least colposcopy and ECC
- Diagnostic excisional procedure is recommended (even if hysterectomy is planned) for all patients with AIS histology or AGC-favor neoplasia with negative histology as presence of invasive cervical adenocarcinoma is 2–15%.
- The excised specimen should be intact (not two pieces as with a "top hat" technique) and at least 10 mm in depth (or greater if childbearing is complete) followed by ECC to assess for residual or multifocal disease higher in endocervical canal
- Two main strategies to minimize blood loss during conization: preventative measures (i.e. injection of vasoconstrictive agent, use of cautery, lateral deep "stay" sutures, prophylactic purse-string stitch) and management of bleeding (i.e. fulguration, Monsel's, suturing, gel foam, clamp)
- The most effective strategy for management of bleeding is to prevent bleeding prior to incision using a combination of measures noted

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CASE 26

A 30-Year-Old G1 Woman with Suspected Uterine Perforation during Suction Dilation and Curettage

Michelle M. Isley

History of Present Illness

A 30-year-old female, gravida1, para 0, presents to the office for a suction dilation and curettage (D&C) for management of a six-week missed abortion. Transvaginal ultrasound diagnosed the missed abortion one week ago and it was reconfirmed three days ago. She is taking ibuprofen 400 mg PO q 4 hours PRN and took diazepam 5 mg PO × 1 before arriving. She has no past medical or surgical history and no known drug allergies. On bimanual examination, a small, retroflexed uterus is noted. The cervix is stenotic, but dilation was able to be performed. Near the end of the procedure, the suction cannula passes without resistance deeper than expected. The patient describes a sudden increase in her pain. The procedure is stopped.

Physical Examination

General appearance: Mildly uncomfortable, well-developed female reporting decreased pain since the procedure was discontinued

Vital signs:

Temperature: 37.0°C

Pulse: 92 beats/min

Blood pressure: 110/68 mmHg

Respiratory rate: 18 breaths/min

BMI: 25 kg/m^2

Cardiovascular: Regular rate and rhythm

Abdomen: Soft, non-distended, normal bowel sounds, no guarding or rebound, mildly tender to deep palpation in the lower middle abdomen

Pelvic: Normal external genitalia. Vagina contains a small amount of blood in the vault. Cervix is nulliparous in appearance, 0.5 cm visually dilated. No lacerations are seen. No active bleeding from the cervix noted. Mild cervical motion tenderness noted. No adnexal masses bilaterally

Laboratory studies:

Blood type: O positive; antibody negative

Hb: 12.3 g/dL (normal 11.4–15.2 g/dL)

Imaging: Pelvic ultrasound shows the uterus is normal in appearance, measuring 7.1 × 5.2 × 4.5 cm. The endometrial stripe measures 9 mm. No obvious gestational sac is seen. The right ovary measures 3.2 × 2.8 × 2.6 cm. The left ovary contains a 2 cm simple cyst and measures 4.2 × 3.6 × 3.4 cm. There is a small amount of free fluid in the posterior cul-de-sac

How Would You Manage This Patient?

This is a 30-year-old gravida 1, para 0 patient who has undergone a suction D&C in the office for a six-week missed abortion. During the procedure, she experienced a sudden increase in her pain and the suction cannula passed without resistance farther into the uterine cavity than expected. The gestational sac and decidual tissue were identified by examination of the products of conception. Since the patient's vital signs were normal, she was observed for 2 hours following the procedure. Vital signs, including pulse and blood pressure, were assessed every 15 minutes and remained within normal limits. Regular assessment of the patient's pain utilizing a visual analog scale documented improvement in her pain from a 7/10 to a 1/10. Her abdomen was soft and non-distended, without peritoneal signs, and her vaginal bleeding was minimal. Consideration was given to repeating a hemoglobin level, but because the patient was stable and results would not likely affect decision for discharge, the lab was not repeated. She ambulated to the bathroom without difficulty. After prolonged observation of 2 hours, the patient remained stable and was discharged. The patient was instructed to call or report to the emergency department for increased pain, bleeding, nausea/vomiting, dizziness, or lightheadedness. Follow-up was scheduled for one week. At her follow-up appointment, she was doing well.

Uterine Perforation

Suction D&C is overall a safe procedure with a 0.5% risk for major complications. Recognized uterine perforation during first-trimester suction D&C occurs at a rate of 0.8 to 4.0 per 1000 procedures [1]. The uterus can be perforated during any intrauterine procedure, including sounding, cervical dilation, aspiration, or sharp curettage [2]. The most common location for uterine perforation is the fundus, but perforation can occur at any location. Lateral uterine perforations can be problematic due to bleeding from the uterine arteries. Uterine perforation may be detected at the time of the procedure, but some perforations go unrecognized. Most patients with an undetected perforation have an uncomplicated course with healing of the perforation site and no long-term consequences [2, 3].

Risk factors for uterine perforation include provider inexperience, advancing gestational age, inaccurate assessment of gestational age, significant uterine flexion, a history of prior cervical cone biopsy or uterine surgery, cervical stenosis, adolescent age, and patient parity [1, 4–6]. Procedure-related risk factors for uterine perforation include forced or difficult mechanical dilation and inadequate cervical dilation [2, 3]. In this patient case, a retroverted uterus and a stenotic cervix caused difficult dilation and increased the risk of uterine perforation.

Signs and symptoms of uterine perforation may be subtle. Loss of resistance during dilation, intrauterine instruments passing farther than expected, or an awake patient expressing a sudden increase in pain should raise suspicion for perforation [2, 5]. Also, perforation can result in an increase in vaginal bleeding or, rarely, visualization of intra-abdominal contents, such as fat or bowel.

When perforation is suspected, the procedure should be stopped. If available, an intraoperative pelvic ultrasound can be helpful. Ultrasound can visualize the posterior cul-de-sac to identify the accumulation of free fluid or blood, and it can determine whether the procedure is complete or if intrauterine tissue remains. If perforation occurs prior to suctioning, stop the procedure and observe. If the patient remains stable after observation, the procedure may be reattempted after one week to allow for healing of the perforation. An experienced provider may decide to complete the procedure under ultrasound guidance if appropriate [5].

The majority of outpatient and inpatient cases of uterine perforation can be managed conservatively without the need for additional surgery or hospitalization [5, 7]. Management of uterine perforation or suspected uterine perforation depends on the clinical stability of the patient and the level of suspicion for bowel injury. To assist in management, uterine perforations can be classified as either low or high risk (Figure 26.1). Since most

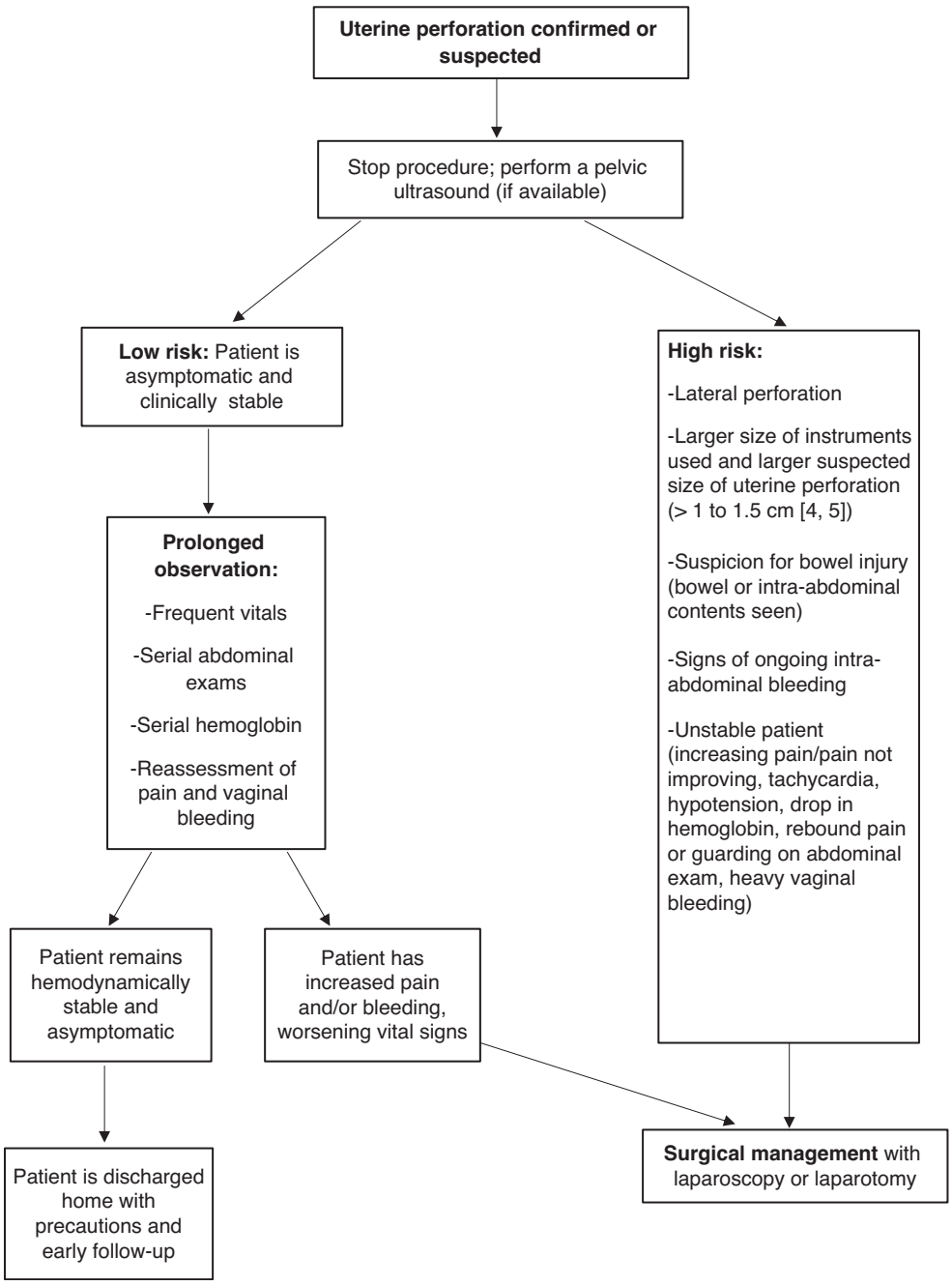

Figure 26.1 Management of uterine perforation.

perforations occur in the avascular midline uterine fundus, observation is appropriate for many patients [2, 5, 7, 8]. Patients who are asymptomatic and have no suspicion of bowel injury or intra-abdominal bleeding are candidates for observation. Conservative management should include patient observation for 2 to 4 hours with close monitoring, every 15- to 30-minute vital signs, frequent reassessment of vaginal bleeding and pain, and serial abdominal examinations. If available, repeat measurement of hemoglobin may also be helpful. Patients who remain clinically stable throughout the observation time can be discharged. Thorough instructions should be given to the patient about when to call the provider or to report to a healthcare facility (fever, increasing pain, dizziness, nausea, and vomiting) and an appointment for early follow-up within one week of the procedure is indicated.

Clinical deterioration of the patient during the observation time, such as development of hypotension, tachycardia, increased pain, rebound or guarding on abdominal examination, increased vaginal bleeding, or a decrease in the hemoglobin level, moves the patient into the high-risk category for perforation. The perforation should also be classified as high risk if the patient displays evidence of intraperitoneal bleeding or visceral injury at the time the perforation is recognized. Findings of intraperitoneal bleeding or visceral injury would include hypotension, tachycardia, increasing abdominal pain, and nausea and vomiting. In both of these high-risk situations, immediate surgical management is the most appropriate action [2, 5, 8]. The decision regarding surgical approach, laparoscopy versus laparotomy, depends on the capabilities of the medical facility, surgical specialists available, and the urgency of the clinical situation. Initial evaluation with laparoscopy may be reasonable to evaluate the damage from perforation and determine whether laparotomy is necessary [6, 8]. For extensive bleeding, laparotomy may be required for prompt control of bleeding and for repair of the uterus or any injured vessels. If there is a high suspicion for a bowel injury, it is important that the full length of the bowel is examined, as injury can be subtle. Some surgeons may be able to accomplish this examination of the bowel via laparoscopy, while others may feel more comfortable performing a laparotomy for this task. The most common viscera injured with uterine perforation is the small bowel. Large bowel injuries have been reported as well, often associated with posterior uterine wall perforations [5]. If not recognized at the time of the suction D&C procedure, patients who suffer a bowel injury as a result of uterine perforation usually present to a healthcare facility within 72 hours, with large bowel injuries resulting in earlier presentation compared with injury to small bowel [5]. A serious but uncommon complication of uterine perforation is small bowel obstruction, which may occur when part of the bowel or omentum is incarcerated within the uterus [3].

Several clinical practices help to increase the safety of suction dilation and curettage procedures and decrease the risk for uterine perforation. Adequate provider training is important. In the case of learners, such as residents in training, appropriate supervision during suction D&C is essential. Use of ultrasound guidance may also be helpful. Ultrasound guidance has been shown to decrease the risk of uterine perforation at the time of second-trimester abortion and to be helpful in certain situations, such as in the case of a stenotic or tortuous cervix [2, 9]. A pelvic examination prior to performance of the procedure is recommended to determine uterine size and position. Accurate gestational dating ensures the use of correct instruments and increases the safety of the suction D&C procedure. Lastly, appropriate use of cervical preparation has been recommended to decrease the risk of uterine perforation [1, 10]. Cervical preparation includes the use of osmotic dilators or pharmacologic agents, such as misoprostol, preoperatively.

Uterine perforation is a rare but potentially serious complication of a suction D&C procedure. High-risk perforations can result in intra-abdominal bleeding and injury to bowel and require surgical intervention. Low-risk perforations can be managed conservatively with observation and close follow-up and do not result in long-term sequelae for the patient.

Key Teaching Points

- Uterine perforation is a rare complication of suction D&C procedures
- Risk factors for uterine perforation include provider inexperience, increasing gestational age, inaccurate assessment of gestational age, adolescent age, greater parity, forced or difficult mechanical dilation, inadequate dilation, history of cone biopsy or prior uterine surgery, and extreme uterine flexion
- Uterine perforation should be suspected if there is a loss of resistance or instruments pass deeper than expected based on gestational age, or if the patient has more pain or bleeding than expected; and is confirmed if fat or bowel is seen on physical examination or on examination of products of conception
- A perforation is classified as low risk if the patient is asymptomatic and remains clinically stable throughout the observation period. Expectant management with early follow-up is acceptable
- A perforation is classified as high risk if the patient is clinically unstable or a bowel injury or bleeding is suspected. A diagnostic surgery is recommended for bowel evaluation and bleeding treatment
- The risk for uterine perforation is decreased with accurate gestational dating, a pelvic examination to determine uterine size and position, the use of ultrasound guidance if dilation is difficult or cervix tortuous, use of osmotic dilators or misoprostol for cervical preparation when appropriate, and adequate training and close supervision of less-experienced providers

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CASE 27 A 39-Year-Old P4 Woman with Recurrent HSIL after LEEP

Mallory Kremer

History of Present Illness

A 39-year-old para 4 cis-woman presents with a history of an office loop electrosurgical procedure (LEEP) one year ago. She was told that they "got everything" during her LEEP. At her one-year follow-up appointment, her cervical cytology and human papillomavirus (HPV) testing were abnormal. She reports that a hysterectomy was recommended for recurrent dysplasia. She desires future fertility. She presents for a second opinion as she did not feel heard at her last doctor's visit. She reports she is otherwise doing well. She is sexually active with male and female partners and uses condoms regularly. Menses are five days long and occur monthly. Her flow is heavy, but this does not bother her. She is a former smoker, with a 10-year pack history, and uses marijuana regularly. She has no other significant past surgical history. She is currently taking cetirizine and is allergic to sulfa antibiotics.

Physical Examination

General appearance: Well-appearing adult female in no apparent distress

Vital signs:

Temperature: 36.6°C

Pulse: 68 beats/min

Blood pressure: 134/87 mmHg

Respiratory rate: 16 breaths/min

BMI: 36 kg/m^2

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

Pelvic: Normal external genitalia. Normal vaginal rugae with physiologic discharge present. Multiparous-appearing cervix without stenosis, Nabothian cysts noted at 7 o'clock, no bleeding or masses present. On bimanual examination, her cervix is mobile and soft. She has a mildly enlarged, 10-week-sized anteverted uterus. No adnexal masses or tenderness was appreciated.

Pathology:

One year ago:

Cervical cytology: Atypical squamous cells – favor high-grade (ASC-H)

HPV testing: HPV 18 positive

Colposcopy: Cervical intraepithelial neoplasia (CIN) 3

Office LEEP: CIN 3, with negative margins, negative endocervical curettage

Two weeks ago:

Cervical cytology: High-grade squamous intraepithelial lesion (HSIL)

HPV testing: HPV 18 positive

How Would You Manage This Patient?

Before entering the room, you review the revised 2019 ASCCP Risk-Based Management Consensus Guidelines [1]. The ASCCP defines CIN 3+ as a useful endpoint when considering an individual's risk for cervical cancer. The definition of CIN 3+ represents CIN 3, adenocarcinoma in situ (AIS), and rare instances of invasive cervical cancer identified in screening programs [2]. HPV-based testing six months after LEEP is preferred. You calculate that her risk of CIN 3+ is intermediate, estimated to be 53%. After reviewing your patient's history and physical examination, you engage in goal setting and discuss that either colposcopy or expedited treatment (with an excisional procedure such as LEEP) is recommended. Hysterectomy is not recommended unless repeat excision is not feasible. Using the principles of shared decision-making, you communicate to your patient that a decision needs to be made, and that you can review the benefits and harms of each option [2]. For this patient, given her desire for future pregnancy, performing office colposcopy first to confirm presence of HSIL (CIN 3) would be reasonable, followed by a LEEP or cold-knife cone if indicated. Figure 27.1 emphasizes that this conversation should incorporate the patient's reproductive history and desires.

Your patient asks if there is ever a time when hysterectomy would be recommended for recurrent CIN 3. In clinical practice, this scenario is most often encountered in postmenopausal patients with severe cervical stenosis and multiple prior excisional procedures. It can be recommended to proceed with hysterectomy if it is felt to be unsafe to attempt a repeat excision. However, repeat colposcopy with endocervical curettage (ECC) to rule out the presence of occult invasive cancer should be performed if possible prior to proceeding with simple (extrafascial) hysterectomy.

Risk of Recurrent High-Grade Dysplasia after Excisional Procedure

The 2019 ASCCP consensus guidelines state that HPV-based testing (HPV alone or co-testing with cervical cytology) is preferred **six months** after excisional procedures for CIN 2–3 [2]. Follow-up with colposcopy and ECC is acceptable. Prior meta-analyses and systematic reviews have shown that HPV positive testing at six months is more predictive of recurrence risk than margin status at the time of excisional procedure. Positive HPV testing at the time of follow-up can predict 91% of recurrent histologic HSIL (CIN 2+) (CI 82–96%) [2].

In the setting of positive margins, planned repeat excision for *residual* disease would be acceptable for certain patients after counseling. Some considerations for repeat excision include patients at high risk for persistence/recurrence of disease (such as postmenopausal, immunocompromised patients with continued tobacco use) or concern regarding ability to

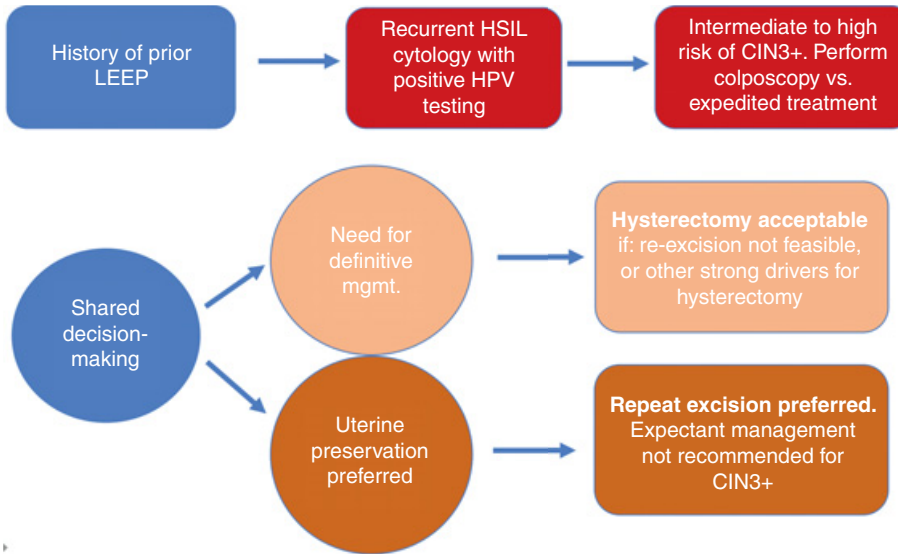

Figure 27.1 Suggested decision pathway for management of recurrent HSIL after prior LEEP. Colposcopy versus repeat excision is preferred. Hysterectomy is acceptable under certain conditions.

commit to regular screening and follow-up. The overall *recurrence risk* of CIN 3 for patients treated with excision varies significantly by age and is estimated to be 11.2% for women >45, compared to 5.6% for women <45 (p = 0.0001) [3]. Whether HPV vaccination affects the rate of HPV clearance after an excisional procedure is an area of continued research.

If the short-term HPV testing following an excisional procedure is negative, an additional three years of negative annual HPV testing or co-testing would be recommended before spacing screening to every three years. A history of CIN 3 necessitates 25 years of follow-up surveillance, regardless of age.

Choosing the Route of Excision: Office versus Intraoperative Management

The "best" route for repeat excisional procedure should be determined for each individual patient. This will vary based on histopathology, as counseling is different for AIS, for example. LEEP is a type of conization that can be performed in the operating room or ambulatory settings, and cold-knife conization is only performed in the operating room. Historically, cold-knife conization was a preferred treatment modality, as it can provide a greater volume or depth of tissue excised and avoids artifact along specimen margins. However, depth of conization may correspond to preterm birth risk and is associated with increased morbidity [4]. Current guidance suggests that LEEP and cold-knife conization are equally effective at treating CIN 3, and the route of excision is not thought to greatly predict recurrence rates [5, 6].

Requisite factors for office management include adequate provider experience with office LEEP, office-based LEEP equipment, and a procedure room. Querying patients on the tolerability of past experiences with office colposcopy can be helpful when setting expectations for analgesia in office-based settings. In well-selected patients, office LEEP can be performed with an intracervical block and oral ibuprofen. Addition of a preprocedure oral anxiolytic and/or an opioid can be considered for additional comfort. Potential benefits of office-based procedures include lower procedure cost and avoidance of general anesthesia. Practical considerations, such as needing a designated driver, available time off from work, or childcare needs, can also drive patient decision-making in favor of office management.

Physical examination findings are particularly helpful for appropriate patient selection for office procedures. If cervical visualization is challenging due to postmenopausal changes, patient habitus or anatomy, or limited patient mobility, an intraoperative excisional procedure can provide more adequate visualization, lighting, and positioning under anesthesia. Patients with bleeding disorders or those on anticoagulant medications may benefit from operative settings (Figure 27.2).

Surgical Considerations for Hysterectomy

Repeat excision or hysterectomy for dysplasia or cervical cancer has traditionally been recommended to be performed either **<48 hours** or **>6 weeks** following the initial excisional procedure to allow for adequate healing. This dogma stems from concerns regarding increased surgical febrile morbidity from parametrial inflammation, described in studies from the 1950 to 1970s. One retrospective review found no significant increase in mean operative time or blood transfusion rates for patients undergoing simple abdominal hysterectomy following a LEEP within the "early" (<6 week) time window, although length of hospital stays was longer [7]. Conversely, a similar study conducted by Sullivan et al. in 2017 of 138 patients undergoing definitive, minimally invasive hysterectomy for cervical cancer diagnosed by LEEP was more supportive of traditional recommendations [8]. Sullivan found an increased risk of composite 30-day perioperative complications (including postoperative fever, abscess, or cuff dehiscence) in patients with "early" surgery

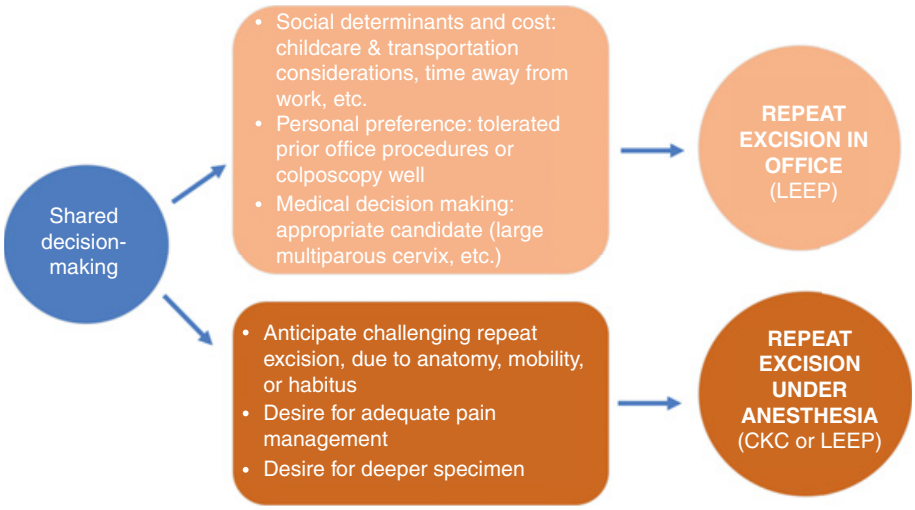

Figure 27.2 Suggested decision pathway for the type and location of repeat excisional procedure. LEEP, loop electrosurgical excision procedure; CKC, cold-knife conization.

less than six weeks after an excisional procedure (p = 0.02). Regardless, both authors suggested there is no absolute contraindication to early surgery in cancer care, and patients may receive a definitive hysterectomy when deemed clinically necessary.

Cervical stenosis is rare after conization, and most likely to occur in postmenopausal or amenorrheic women. Stenosis from prior excisional procedures can make minimally invasive hysterectomy challenging secondary to difficulty placing the uterine manipulator. Techniques such as using microdilators, injecting dilute vasopressin into the cervical stroma, using small scissors or forceps to snip or "push and spread" scar tissue covering the external os, or performing a small LEEP to access the cervical canal have been described [9]. If there is concern for causing uterine perforation when placing the manipulator, it can be placed while watching from above laparoscopically. Pre-procedure vaginal estrogen is often prescribed for patients with postmenopausal atrophic changes prior to colposcopy. Vaginal estrogen can be given prior to hysterectomy in patients with cervical stenosis as well.

Understandably, patients with a history of cervical dysplasia often express a desire to never have a colposcopy again. It is important to counsel patients that even after definitive surgery for CIN 2–3, there is a 1–7% risk of post-hysterectomy vaginal or vulvar dysplasia, and that post-treatment surveillance should continue for 25 years [10].

Key Teaching Points

- 2019 ASCCP guidelines recommend HPV-based screening six months after excisional procedure for CIN 3
- Recurrence risk of HSIL after an excisional procedure for CIN 3 is approximately 6% and varies by age
- Recurrence risks are similar for office-based LEEP versus intraoperative conization procedures
- Office LEEP is an acceptable alternative for many patients undergoing repeat excision of dysplasia
- Hysterectomy is acceptable for recurrent HSIL after LEEP if repeat excision is not feasible, or if other gynecologic factors lead to this decision
- A repeat excision or hysterectomy has traditionally been performed at least six weeks after the initial excisional procedure, although there is heterogeneity in studies evaluating this recommendation

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CASE 28

A 34-Year-Old G2P1 Woman with Elevated β-hCG (>250 000 mIU/mL) and Concern for Molar Gestation

Maria Shaker

History of Present Illness

A healthy 34-year-old woman, gravida 2, para 1001, last menstrual period (LMP) approximately nine weeks ago presents with vaginal spotting. She reports nausea and vomiting for three weeks. Her menstrual cycles are normal in length, and she is sure of her LMP. She reports a history of a normal pregnancy that resulted in an uncomplicated spontaneous vaginal delivery two years ago. She has no relevant past medical or surgical history. She is currently taking prenatal vitamins and has no known drug allergies.

Physical Examination

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

Vital signs:

Temperature: 37.0°C

Pulse: 80 beats/min

Blood pressure: 116/70 mmHg

Respiratory rate: 16 breaths/min

Abdomen: Soft, non-tender throughout all four quadrants. No rebound or guarding noted

Pelvic: Normal external female genitalia. Vagina appears normal except for a scant amount of blood. Cervical os is closed. No cervical motion tenderness present. Bimanual examination reveals a 12-week anteverted uterus. No adnexal tenderness

Laboratory studies:

Hb: 11.7 g/dL

Blood type: A negative

Electrolytes: Within normal limits

Liver function tests: Within normal limits

TSH: 2.5 mIU/L

Urine pregnancy test: Positive

Serum β-hCG: >250 000 mIU/mL

Imaging:

Pelvic ultrasound: Enlarged 12 × 10 × 7 cm uterus with a normal appearing myometrium. The endometrial cavity is thickened, heterogeneous, and hyperechoic with multiple cystic areas of various sizes. No gestational sac or fetal pole noted. The right ovary is 3.4 × 3.2 × 2.8 cm. The left ovary is enlarged measuring 6.4 × 5.2 × 3.8 cm and contains multiple simple cysts. No free fluid is noted

Chest x-ray: No evidence of acute cardiopulmonary process

How Would You Manage This Patient?

This 34-year-old female presents in early pregnancy with vaginal bleeding and an elevated quantitative β-hCG. The ultrasound indicates at least an anembryonic pregnancy but is suspicious for gestational trophoblastic disease (GTD) based on the presence of heterogeneous-appearing cystic structures. Based on the constellation of findings, the patient is counseled on the possibility of GTD. The recommendation is made for dilation and suction curettage under ultrasound guidance in the operating room, with 2 units of packed red blood cells on hold. The procedure is performed with monitored anesthesia care and an intracervical block with 4 units of vasopressin in 20 mL of 1% lidocaine. The endometrial stripe appears thin at the end of the procedure. Blood loss is minimal. She receives Rh-immune globulin following the procedure. The patient opts for combined oral contraceptive pills while pathology results are pending. Pathology is consistent with a complete hydatidiform mole. At the postoperative visit, a plan is made for post-evacuation surveillance.

Molar Pregnancy

Gestational trophoblastic disease (GTD) defines a heterogeneous group of uncommon disorders associated with pregnancy. GTD arises from the abnormal proliferation of the placental villous trophoblast. Complete and partial hydatidiform moles exist at the benign end of the spectrum, while invasive moles, choriocarcinoma, placental site trophoblastic tumor, and epithelioid trophoblastic tumor constitute the malignant forms, commonly referred to as gestational trophoblastic neoplasia (GTN). Complete molar pregnancies affect approximately 1 in 2000 pregnancies, while partial moles have a slightly higher incidence of 1 in 700 pregnancies [1]. Trophoblastic sequelae (invasive mole or choriocarcinoma) follow 15–20% of complete moles and 1–5% of partial moles [2]. Extremes of age and history of prior molar pregnancy are risk factors for GTD.

Complete hydatidiform mole (CHM) results from the fertilization of an empty ovum by two different sperm or by a haploid sperm which subsequently duplicates its genome, resulting in 46, XX (mainly) or 46, XY karyotype [2]. There is no identifiable embryo or fetus (Figure 28.1). Conversely, a partial hydatidiform mole (PHM) arises from the fertilization of a normal haploid ovum with two sperm, yielding a triploid karyotype (69, XXY; 69, XYY; or 69, XXX) [2]. Partial moles are associated with the presence of embryonic or fetal tissue (Figure 28.2). Rarely, twin pregnancies consisting of a complete mole and a normal fetus affect 1 in 22 000–100 000 pregnancies [2].

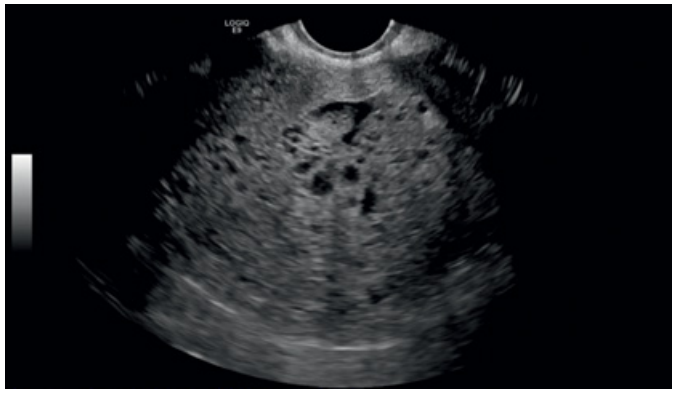

Figure 28.1 Transvaginal ultrasound of a complete hydatidiform mole.

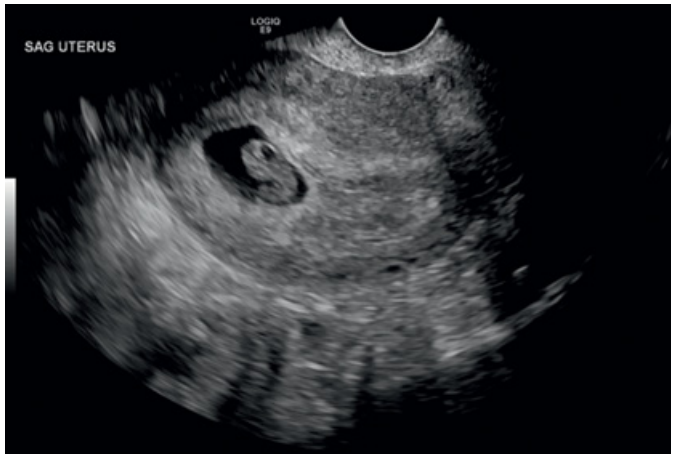

Figure 28.2 Transvaginal ultrasound of a partial hydatidiform mole.

Presenting symptoms of CHM and PHM can vary. Complete moles most commonly present with vaginal bleeding in 80–90% of cases [2]. Widespread availability of ultrasound has contributed to the earlier diagnosis of molar pregnancies, and as a result, has decreased the frequency of other presenting symptoms such as excessive uterine enlargement, hyperemesis gravidarum, hyperthyroidism, or preeclampsia. Serum hCG levels can be >100 000 mIU/mL in CHM, and the hydropic swelling of the chorionic villi projects as multiple echoes, or the typical "snowstorm" appearance on ultrasound. Partial moles most often present as an incomplete or missed abortion, and pathologic evaluation is required to confirm the diagnosis.

If GTD is suspected after obtaining the history and physical examination, it is important to conduct a preoperative workup to exclude medical complications. Evaluation for conditions such as anemia, preeclampsia, hyperthyroidism, and extrauterine disease can be assessed by way of vital signs, laboratory tests, and chest x-ray. Additional preoperative preparation includes obtaining a type and crossmatch in case of hemorrhage.

Preoperative counseling should address the patient's reproductive life plans. While suction curettage under ultrasound guidance is the preferred method of evacuation, a minimally invasive approach to hysterectomy is an alternative treatment for those patients who have completed childbearing. Suction curettage is preferred over sharp curettage to reduce the risk of uterine perforation. Manual vacuum aspiration appears to be equivalent to electric vacuum aspiration if the latter is not available [3]. Adequate dilation of the cervix must be obtained to facilitate the passage of a larger-bore cannula, such as a 10–12 mm curette. Once the cannula is within the lower uterine segment, suction should be activated, and the cannula rotated until the uterine contents have been evacuated. Expert opinion has traditionally recommended oxytocin administration during and after evacuation, but no data exist to support this practice. Hysterectomy may prevent local invasion, but this does not eliminate the risk of metastatic disease; therefore, surveillance is still required. Ovarian conservation is recommended even in the presence of overwhelmingly large theca lutein cysts, which will resolve with normalization of the β-hCG level. Medical methods of uterine evacuation are not supported due to the increased risk of bleeding and incomplete evacuation.

Hemorrhage during or immediately post-evacuation is a known complication. Surgeons should be prepared to address bleeding at the time of evacuation. The usual obstetric techniques to manage hemorrhage can be employed: from bimanual massage, administration of uterotonics such as methergine and misoprostol, to more invasive interventions such as insertion of a uterine balloon to tamponade, uterine artery embolization, or hysterectomy.

Other post-evacuation complications have been more commonly associated with second-trimester molar gestations. Trophoblastic embolization is thought to precipitate cardiopulmonary symptoms such as chest pain, dyspnea, tachypnea, and tachycardia in 2% of patients treated in the second trimester [4]. Physical examination reveals diffuse rales, and chest x-ray is consistent with bilateral pulmonary infiltrates, which can be confused with pulmonary metastases. Thyroid storm is a possible sequela of hyperthyroidism associated with GTD. The hyperthyroidism resolves with management of the molar pregnancy and normalization of the β-hCG value. In symptomatic patients, a perioperative beta-blocker should be administered. Lastly, large theca lutein cysts may cause physical discomfort for patients, but spontaneous regression is the norm; therefore, observation is recommended. If the patient is uncomfortable enough to warrant intervention, the cysts can be decompressed under ultrasound guidance [4].

Idiosyncratic to GTD follow-up is post-evacuation β-hCG surveillance to monitor for evidence of GTN. Yet, duration of β-hCG surveillance has been an area of uncertainty. The International Federation of Gynecology and Obstetrics (FIGO) currently recommends two consecutive undetectable β-hCG levels one month apart after partial mole and consecutive undetectable levels obtained monthly for six months after complete mole [5]. The New England Trophoblastic Disease Center follows weekly β-hCG levels, requiring at least a 10% decline in levels over a three-week period (e.g. on days 1, 7, 14, and 21). Then, weekly β-hCG values are obtained until undetectable for three weeks. With CHM, the β-hCG is monitored monthly for an additional three months. After a partial mole,

a confirmatory negative value one month after normalization is enough to complete monitoring [4].

During β-hCG surveillance, patients should be encouraged to use a reliable method of contraception. A systematic review conducted by Gaffield et al. [6] found no effect on the development of postmolar GTN in women who used combined oral contraceptives. These authors analyzed the data surrounding intrauterine device (IUD) use, which are limited, but the data do not suggest an effect on the risk of invasive trophoblastic disease or the time for β-hCG normalization. The World Health Organization's Medical Eligibility Criteria for Contraceptive Use and similarly, the Centers for Disease Control's US Medical Eligibility Criteria for Contraceptive Use support the use of copper or levonorgestrel IUDs in the setting of GTD. However, if there is concern for intrauterine postmolar GTN, IUDs should be avoided due to the theoretical risk of perforation, hemorrhage, and infection as well as in patients at higher risk of disease progression [7, 8].

Criteria for postmolar GTN include: a plateau (β-hCG level remains within +/−10% over a three-week period) over four measurements during a period of three weeks or longer (i.e. days 1, 7, 14, and 21); a rise in β-hCG for three consecutive weekly measurements over at least a period of two weeks or more; or more simply, histologic confirmation of GTN [5]. Further workup and management of postmolar trophoblastic neoplasia relies on FIGO staging and risk stratification, and management of GTN lies beyond the scope of this summary.

For patients who desire fertility preservation, subsequent pregnancies are frequently a point of concern. Patients can be assured the likelihood of a subsequent normal pregnancy is extremely high. Repeat molar pregnancy risk hovers around 1%, but this does increase to 15–18% after two prior molar pregnancies [9]. Pregnancy planning can commence as soon as the patient has graduated from β-hCG surveillance [9]. First-trimester ultrasound is recommended in subsequent pregnancies to ensure the developing pregnancy appears normal. Additionally, tissue (i.e. products of conception or the placenta) from any subsequent pregnancy event should be sent for histologic evaluation, and a β-hCG should be sent six weeks postpartum to exclude GTN [4].

Key Teaching Points

- Complete and partial molar pregnancies comprise the benign end of the gestational trophoblastic disease spectrum, affecting 1 in 2000 to 1 in 700 pregnancies, respectively. Extremes of age and history of molar pregnancy are known risk factors
- Preoperative workup should assess for any associated medical conditions and extrauterine disease. The patient's reproductive life plans should be addressed, and short-term use of a reliable method of contraception should be encouraged during surveillance, if fertility is desired
- Suction curettage under ultrasound guidance is the preferred approach for management. Surgeons should anticipate the possibility of hemorrhage at the time of evacuation
- Recommendations regarding the length of post-evacuation surveillance vary between experts and societies. Data exist to support shorter surveillance periods than previously recommended

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CASE 29 A 35-Year-Old G3P2 Woman with Persistent Bleeding after Suction D&C

Katherine Rivlin

History of Present Illness

A 35-year-old woman, gravida 3, para 2, last menstrual period 11 weeks ago, presents with an undesired pregnancy. Her prior pregnancies were uncomplicated vaginal deliveries. Her ultrasound confirms an 11-week intrauterine pregnancy. She has no relevant past medical or surgical history. She is currently taking prenatal vitamins and has no known drug allergies. After counseling, she chooses to proceed with a surgical abortion. After the administration of 200 mg of oral doxycycline, a suction dilation and curettage (D&C) is performed under moderate sedation. After the procedure, she has persistent heavy vaginal bleeding.

Physical Examination

General appearance: Well-developed female, sleepy from moderate sedation, in mild discomfort

Vital signs:

Temperature: 36.8°C

Pulse: 105 beats/min

Blood pressure: 100/60 mmHg

Respiratory rate: 20 breaths/min

Oxygen saturation: 99% on room air

Height: 64 inches

Weight: 140 lb

BMI: 24.0 kg/m^2

Cardiovascular: Tachycardia with regular rhythm

Abdomen: Soft, non-tender and non-distended, normal bowel sounds. No rebound or guarding

Pelvic: Normal external genitalia. Speculum examination reveals brisk bleeding from the cervical os. Vagina appears normal and intact. Cervix is visually 1 cm dilated and intact. Bimanual examination demonstrates a fundus with poor tone, but no tenderness. Adnexa are non-palpable and non-tender

Laboratory studies:

Hb: 12.2 g/dL (normal 12.0–15.5 g/dL)

Platelets: 212 000/μL (normal 150 000–450 000/μL)

WBCs: 8200/μL (normal 4500– 11 000/μL)

Imaging: Transvaginal ultrasound shows an anteverted uterus, 9.2 × 6 × 3.5 cm. The endometrium contains a scant amount of heterogeneous material. The myometrium is without abnormality. No adnexal masses are seen. No free fluid is noted in the posterior cul-de-sac

How Would You Manage This Patient?

This patient underwent a suction D&C for pregnancy termination. Following her procedure, she was noted to have persistent vaginal bleeding, poor uterine tone, and mild tachycardia. Bimanual massage was performed with concomitant intramuscular administration of 0.2 mg methylergonovine maleate. On repeat bimanual examination, the uterine fundus was still poorly contracted. Given the patient's tachycardia and continued bleeding, additional staff were called to the procedure room. Fluid resuscitation with lactated Ringer's at 500 mL/h was initiated, and a second IV line was placed.

An intraoperative hemoglobin and coagulation parameters were collected. Misoprostol 800 mcg was administered sublingually. A second ultrasound confirmed no reaccumulation of blood in the endometrial cavity. A rigid suction cannula was placed to the uterine fundus under abdominal ultrasound guidance. The endometrial cavity was gently explored and no uterine defect was present. Suction was applied to remove any residual tissue and to confirm a gritty texture throughout the uterus. Minimal tissue was removed. Products of conception were inspected and noted to be complete and consistent with 11 weeks of gestation. Bimanual massage continued and uterine tone returned. On speculum examination, the patient's bleeding had slowed. The estimated blood loss was 800 mL. The patient was taken to the recovery room for monitoring and continued fluid resuscitation. Her intraoperative laboratory studies returned with a hemoglobin of 10.8 g/dL, platelets of 210 000/μL, and an INR of 0.9 (normal <1.1).

In the recovery room, her tachycardia improved, and her vaginal bleeding was light. She was discharged to home on oral iron and given anemia precautions. She initiated oral contraceptive pills the following day for pregnancy prevention. She was recommended to return as needed for worsening bleeding, pain, or clinical signs of anemia, or for routine gynecologic care.

Postabortion Hemorrhage

Postabortion hemorrhage occurs in less than 1% of abortions and is rare in first-trimester abortions. Estimations of hemorrhage following first-trimester aspiration range from 0 to 3 per 1000 cases [1]. Definitions of postabortion hemorrhage vary between studies and this lack of a standard definition makes calculating incidence challenging. Because of the low incidence of hemorrhage in the first trimester and inconsistent standards in the literature, there is little data on relative frequencies of each cause for hemorrhage.

In the Society of Family Planning's (SFP) guidelines for management of postabortion hemorrhage, the recommended clinically relevant definition "include[s] both a clinical response to excessive bleeding, such as transfusion or admission, and/or bleeding in excess of 500 mL" [1].

Common causes of postabortion hemorrhage include (1) uterine atony, (2) retained pregnancy tissue, (3) cervical laceration, (4) uterine perforation, (5) abnormal placentation, and (6) disseminated intravascular coagulation (DIC). Uterine perforation is discussed in Case 26. Uterine atony, or inadequate contraction of the uterine fundus and corpus after removal of the pregnancy and placenta, can lead to postabortion hemorrhage. Endometrial spiral arteries dilate in early pregnancy limiting their ability to contract and reduce bleeding; therefore, myometrial contraction is necessary for hemostasis. Risk factors for postabortion atony include greater gestational ages, older maternal age, prior cesarean section (as scarring may impair uterine contraction), and the use of halogenated anesthetic agents (which can lead to uterine relaxation) [1].

Retained pregnancy tissue following abortion can lead to both postabortion pain and hemorrhage. Risk factors for retained pregnancy tissue include provider inexperience and not utilizing intraoperative ultrasound guidance [1].

Cervical lacerations are rare in the first trimester (0.2 per 1000) [2] but can occur in up to 3% of second-trimester abortions [1]. In most cases, cervical lacerations do not lead to hemorrhage. External cervical tears usually occur from grasping the anterior lip of the cervix with a tenaculum. Higher cervical tears can occur when removing larger fetal parts. These lacerations can traumatize cervical branches of the uterine artery or vein. Because the uterine vasculature lies in the retroperitoneum, these lacerations can lead to concealed hematomas, which may make diagnosis more challenging. Risk factors for cervical lacerations include provider inexperience, inadequate cervical dilation, prior cesarean section, nulliparity, and gestational ages of more than 20 weeks [1, 3, 4].

Abnormal placentation includes placenta previa and placenta accreta spectrum (PAS). Second-trimester placenta previa occurs in 2–6% of pregnancies, and usually does not complicate abortion care or necessitate hospital-based care. However, in the setting of PAS, when the placenta fails to detach from the uterine wall, severe and life-threatening hemorrhage can occur. Among second-trimester abortions, the estimated prevalence of placenta accreta is 0.4 per 1000 operations [4] and has increased as cesarean section delivery has become more common. Uterine scarring is the most common risk factor for abnormal placentation, but other independent risk factors include advanced maternal age, multiparity, smoking, uterine anomalies (such as fibroids), and hypertensive disorders [5].

If a clinician is concerned for PAS based on history or imaging, the patient should be referred to a skilled sonographer to better evaluate placental anatomy. When the concern for PAS is high, procedures should be performed in a hospital setting with blood bank capabilities. The patient should be informed of the risk of a hysterectomy, and the surgeon should be prepared to perform one if needed.

DIC is a rare cause of postabortion bleeding. It can occur as a result of either prolonged heavy bleeding or infection. DIC is characterized by a massive activation of the coagulation system leading to an imbalance of bleeding and clotting factors, which ultimately results in a hypocoagulable state. In these cases, massive hemorrhage can occur. Risk factors for DIC include advancing gestational age, prolonged fetal death, placental abruption, abnormal placentation, amniotic fluid embolus, or massive blood loss.

When assessing persistent bleeding following a surgical abortion, the SFP recommends an organized and systematic approach. The clinician should begin with a physical examination to (1) visually and digitally assess the cervix for lacerations or perforation, (2) assess uterine tone with a bimanual examination, and (3) utilize ultrasound to assess for retained pregnancy tissue, or reaccumulated blood. Findings from this assessment will often dictate next steps [1].

In the setting of a cervical laceration, the surgeon should ensure adequate visualization. If needed, the surgeon should ask for extra operative assistants, better lighting, and additional retractors. Small external cervical lacerations may be treated with observation or compression using direct pressure or a ring forceps, or by applying silver nitrate or ferric subsulfate. When lacerations are larger, surgical repair with absorbable suture such as polyglactin 910 or chromic suture may be needed. For internal tears or when bleeding persists, the surgeon may consider balloon tamponade, the administration of vasopressin, transfer to Interventional Radiology for uterine artery embolization (UAE), or to the operating room for vaginal or abdominal repair. Cervical lacerations are best prevented by adequate cervical preparation prior to second-trimester abortion [6].

If a cervical laceration is not diagnosed, the clinician should initiate bimanual uterine massage. Either sequentially or concomitantly, uterotonic therapy should be administered. While little evidence exists to support starting with a particular agent, methylergonovine maleate and misoprostol are commonly used medications for postabortion hemorrhage [7, 8]. Other agents include oxytocin, carboprost, and vasopressin. If initial doses of uterotonics fail, consider additional agents, or repeat dosing.

The surgeon should also evaluate the endometrium with a bedside ultrasound. If retained tissue is noted, re-aspiration should be performed under ultrasound guidance. Additionally, the surgeon may gently probe the uterine cavity with a metal dilator or rigid cannula under ultrasound guidance to assess for a uterine perforation. If no uterine defect or retained tissue is noted, a Foley catheter or Bakri balloon (Cook Medical) can be inflated within the uterus to compress the endometrium and lower uterine segment. These devices may stay in place while observing the patient and awaiting hemodynamic stability.

When bleeding is refractory to these interventions, the clinician should quickly initiate resuscitative measures by establishing adequate IV access and initiating fluid resuscitation. Laboratory assessment should occur when available. If hemorrhage is severe or there is concern for hemodynamic instability, a blood transfusion may be required. If the clinician is concerned for DIC, transfusion of fresh frozen plasma may also be necessary. If blood products are not available, the clinician should resuscitate and transfer to a hospital with transfusion capabilities.

Should conservative therapies fail, more invasive interventions such as UAE, laparoscopy, laparotomy, and hysterectomy

may be necessary. UAE is fertility sparing and a safe alternative to hysterectomy and laparotomy and should always be considered when immediately available [9]. Laparoscopy can be used to assess for perforation and to better visualize the pelvic cavity. Laparotomy is required in the setting of hemodynamic instability. Hysterectomy should only be considered after other treatments have failed or when a patient is hemodynamically unstable. The need for hysterectomy is rare, occurring in 1.4 out of every 10 000 abortions in the United States [10].

Key Teaching Points

- Postabortion hemorrhage is rare, occurring in less than 1% of cases
- Clinicians should approach the evaluation and treatment of postabortion hemorrhage in an organized and systematic manner, including a thorough physical examination and intraoperative ultrasound
- First-line therapies include repair of any identified cervical or vaginal laceration, bimanual massage, and administration of uterotonic agents either sequentially or concomitantly
- Second-line therapies include resuscitative measures, laboratory evaluation, re-aspiration of retained pregnancy tissue, and balloon tamponade
- When first- and second-line therapies fail, more invasive interventions such as uterine artery embolization, laparoscopy, laparotomy, and hysterectomy may be required

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CASE 30 A 70-Year-Old G0 Woman with Postmenopausal Bleeding and Severe Vaginal Atrophy

Renee R. Eger

History of Present Illness

A 70-year-old nulligravid woman presents with a three-month history of intermittent, painless vaginal spotting. The patient denies any vaginal bleeding or spotting since her last menstrual period 20 years ago. She initially noticed brown staining on her underwear. Currently, she wears a pad which she changes daily. She reports regular bowel movements with no blood in her stools. She had her second colonoscopy four years ago. No abnormalities were noted. She denies any urinary complaints and has not noticed any hematuria. The patient was last sexually active 15 years ago. She denies any prior history of sexually transmitted infections. Her last Pap smear with co-testing was normal at age 65. She has no history of abnormal Pap smears. She has never taken hormone therapy. Her past medical history is significant for hypertension, hyperlipidemia, and diabetes mellitus. Her past surgical history is significant for laparoscopic cholecystectomy. She is currently taking lisinopril, atorvastatin, and glyburide and she has no known drug allergies.

Physical Examination

General appearance: Well-developed, morbidly obese female in no apparent distress

Vital signs:

Temperature: 36.7°C

Pulse: 82 beats/min

Blood pressure: 142/92 mmHg

Respiratory rate: 20 breaths/min

Weight: 240 lb

Height: 63 inches

BMI: 42.5 kg/m^2

Abdomen: Soft, non-tender and non-distended. No rebound or guarding noted. No masses appreciated

Pelvic: External genitalia with loss of labial fat pad and fusion of labia minora and majora bilaterally. Vagina with loss of rugae, pallor noted with friable tissue evident. Vaginal apex narrowed and with minimal blood present. Cervix small, smooth, non-tender with no masses. Uterus difficult to assess size due to habitus. Right and left adnexa without masses or tenderness

Laboratory studies:

WBCs: 5600/μL (normal 4000–11 000/μL)

Hb: 11.5 g/dL (normal 11.7–16.0 g/dL)

Platelets: 205 000/μL (normal 150 000–440 000/μL)

Urine dip: Negative for blood, nitrates, and leukocytes

Imaging: Transabdominal pelvic ultrasound shows an anteverted, anteflexed 6.1 × 4.9 × 4.0 cm uterus with endometrial thickness of 6 mm. A heterogeneous lesion in the endometrium measuring 1.0 × 0.7 × 1.5 cm is noted at the fundus. One 1.1 × 1.2 × 2.4 cm intramural solid mass with smooth borders noted in the posterior wall. Right ovary 2.4 × 0.9 × 0.9 cm appears normal. Left ovary 2.4 × 1.0 × 1.6 cm appears normal. No free fluid is noted

How Would You Manage This Patient?

This case involves a 70-year-old woman with postmenopausal bleeding, a physical examination noteworthy for severe vaginal atrophy, transabdominal imaging showing a thickened endometrial stripe, and a 1 cm heterogeneous mass in the endometrial cavity. The patient has genitourinary syndrome of menopause based on her pelvic examination findings and is at risk for endometrial pathology based on her BMI and medical history. The patient is unable to tolerate an examination with a speculum or subsequent endometrial sampling and transvaginal ultrasound. She undergoes office vaginoscopy and hysteroscopy with directed biopsies. An endometrial polyp is identified and removed with a loop snare instrument. The patient tolerates the procedure with minimal discomfort. Pathology from the polyp was benign. The patient returns at six weeks and denies further vaginal bleeding.

Clinical Approaches to Postmenopausal Bleeding

Postmenopausal bleeding (PMB) is the presence of vaginal bleeding in a woman after permanent cessation of menses, demonstrated by at least 12 months of amenorrhea. It is important to recognize and evaluate PMB promptly. Approximately 10% of women with PMB have underlying endometrial cancer [1]. In 2019, the United States recorded 61 880 new cases of endometrial cancer with 12 160 deaths [2]. The differential diagnosis of PMB includes vaginal wall or endometrial bleeding from atrophic changes, cervical or endometrial polyps, uterine fibroids, benign endometrial hyperplasia, endometrial intraepithelial neoplasia (EIN), or endometrial, cervical, ovarian, vaginal, or vulvar neoplasias.

Transvaginal ultrasound can be used to precisely assess this patient's endometrial thickness, particularly given her Class III obesity. Transvaginal ultrasound is a simple, non-invasive technique with high diagnostic value in excluding endometrial abnormalities. As a screening tool for intrauterine abnormalities, ultrasound has a sensitivity and specificity of approximately 80% and 45% respectively [3]. An ultrasound evaluation showing a uniform endometrium

with a thickness less than or equal to 4 mm has a 98–99% negative predictive value for endometrial cancer [4]. An endometrial stripe that is not clearly delineated or is greater than 4 mm in thickness requires further evaluation. Saline infusion sonography (SIS) provides an adjunct to transvaginal ultrasound when indistinct or irregular endometrial contours are identified. The sensitivity of SIS for the detection of focal intrauterine abnormalities approaches 80% [3]. Given this patient's severe vaginal atrophy, she was unable to tolerate an in-office transvaginal ultrasound.

If the endometrial thickness is irregular or greater than 4 mm or the ultrasound results are inconclusive, endometrial sampling is required to further evaluate the etiology of the bleeding. Blind sampling of the endometrial cavity, performed with mechanical suction or curettage, often requires tenaculum placement on the cervix. Limitations include patient discomfort, inability to pass the biopsy instrument, and inadequate sampling. A systematic review and meta-analysis of 12 studies of endometrial sampling in women with PMB, comparing blind endometrial sampling with D&C with endometrial sampling or hysteroscopy, demonstrated failure rates of endometrial sampling (mostly due to cervical stenosis) between 1% and 53% with a weighted failure rate of 11%. The fraction of women with insufficient material at histology was between 7% and 76% with a weighted insufficient rate of 31%. The weighted percentage of women with endometrial cancer among those with failed or insufficient sampling was 7% [5].

Hysteroscopy is the gold standard for direct visualization and evaluation of the endometrial cavity. Its value in the workup of abnormal uterine bleeding or PMB in the outpatient setting has been well established [6]. One of the most common reasons for hysteroscopy failure is pain, especially during introduction of the hysteroscope through the cervix. There is a paucity of data supporting the use of topical, intravenous, or oral anesthetics to reduce pain during traditional hysteroscopy with 4–5 mm hysteroscopes. Use of narrow (<4 mm) hysteroscopes has shown lower rates of pain, lower failure rates, and less vasovagal reactions compared with standard 4 mm hysteroscopes [7].

Patients who experience PMB in the setting of vulvovaginal atrophy present unique clinical challenges. Patient discomfort associated with speculum examinations and transvaginal ultrasound often limits the necessary evaluation. Outpatient vaginoscopy or "no touch" hysteroscopy is a minimally invasive way to evaluate patients presenting with PMB [7]. This technique allows direct visualization of the endometrial cavity without using a speculum, analgesia, or anesthesia. Visualization is achieved by inserting a small, typically <4 mm, 30-degree rigid microhysteroscope into the vagina. The vagina is distended by holding the labia minora together, thereby allowing for identification of and entry into the cervix. Improved visualization of the cervix can be obtained by placing the patient in Trendelenburg position. The hysteroscope descends into the posterior fornix, and by pulling back to visualize the upper third of the vagina, the external cervical os can be visualized. The hysteroscope can then be inserted into the cervical canal and endometrial cavity [8].

Since vaginoscopy is an atraumatic approach, it significantly decreases the pain associated with a speculum and a tenaculum, as well as the pain caused by manipulating the hysteroscope within the cervical canal [6]. The "no touch" introduction of the hysteroscope, when compared with traditional hysteroscopy with the use of a tenaculum, is better tolerated with improved visual analog pain scale reports. A randomized controlled multicenter trial showed pain to be the reason for procedural failure in 0.6% of patients undergoing vaginoscopy versus 4% in patients undergoing traditional hysteroscopy. Procedure times for vaginoscopy typically range from 2 to 10 minutes, significantly shorter than traditional hysteroscopy [9].

While data is limited on distention media for vaginoscopy, both normal saline and carbon dioxide gas have been shown to be safe media for hysteroscopy [6]. An analysis of six studies comparing normal saline with carbon dioxide gas during outpatient hysteroscopy showed no statistically significant difference in pain scores. There were fewer vasovagal episodes and shorter operative times with the use of normal saline. When compared with carbon dioxide, saline affords the same visualization and provides better visualization when biopsies or excisions are performed [10].

Visually directed endometrial sampling can be performed through a 5-French operative channel, allowing simultaneous diagnosis and treatment of intrauterine pathologies. Mechanical instruments or bipolar electrosurgical equipment can be used safely and effectively in an office setting. A "see and treat" technique has been shown to be safe, effective, and feasible with decreased anesthesia time, analgesia time, personal expense, and facility operating costs [6].

Patients should be counseled on the low risks of the procedure. Complications of vaginoscopy include uterine perforation (0.12–1.61% of cases), vasovagal reactions (up to 2% of patients), fluid overload (0.01–1.42% of cases), pelvic infection (3% of cases), and clinically significant air or gas embolism (up to 0.09% of cases). The risk of infection can be lowered by preprocedural application of povidone-iodine or chlorhexidine to the vaginal walls. An active genital infection, identified by patient history of foul-smelling and/or purulent discharge with wet mount evaluation suggestive of infection, abdominal and pelvic pain, or a positive DNA probe testing or culture, is a contraindication to the procedure [6, 8, 9].

The number of failed procedures when performing vaginoscopy is equal to or less than the numbers associated with traditional hysteroscopy. A randomized controlled trial of 1600 women comparing vaginoscopy with traditional hysteroscopy defined procedural success as completion of the hysteroscopy with an acceptable level of pain for the patient without intraoperative complications or postoperative infections. In this study, vaginoscopy was successful in 89% of cases. This was significantly more successful than traditional hysteroscopy (85% of cases). In subgroup analysis, vaginoscopy was more successful than traditional hysteroscopy in nulliparous and premenopausal women; however, no difference in success rates was noted in postmenopausal women [9].

Vaginal atrophy, as the underlying cause of PMB, is a diagnosis of exclusion. The use of vaginoscopy for the evaluation of PMB is an ideal option for nulliparous patients with

atrophic vaginal changes. Vaginoscopy in the office results in less patient discomfort and improved maneuverability of the hysteroscope for diagnostic and operative purposes.

Key Teaching Points

- Use of traditional hysteroscopy for the evaluation of postmenopausal bleeding may be associated with significant pain and is often a reason for failure to complete the procedure
- Postmenopausal patients, particularly nulliparous patients with atrophic vaginal changes, benefit from "no-touch" diagnostic approaches
- Vaginoscopy allows direct visualization of the endometrial cavity without using a speculum, analgesia, or anesthesia
- Vaginoscopy can be performed with less pain and visualization comparable to traditional hysteroscopy with success rates of approximately 90%
- Risks of the procedure include vasovagal reactions, pelvic infections, uterine perforation, fluid overload, and air or gas embolism
- Both normal saline and carbon dioxide gas are safe media for vaginoscopy

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CASE 31

A 28-Year-Old G3P2 Woman Presents at Eight Weeks with a Cervical Ectopic Pregnancy

Jessica E. Murphy

History of Present Illness

A 28-year-old woman, gravida 3, para 2, last menstrual period eight weeks ago, presents for confirmation of pregnancy. She reports mild nausea and fatigue. She has regular menses and reports that she and her partner have been trying to conceive. Her obstetric history is significant for a full-term cesarean delivery for malpresentation and a first-trimester abortion requiring dilation and curettage. She has no past medical history. She is currently taking prenatal vitamins and she is allergic to penicillin.

Physical Examination

General appearance: Comfortable adult woman in no apparent distress

Vital signs:

Temperature: 37.0°C

Pulse: 86 beats/min

Blood pressure: 115/73 mmHg

Respiratory rate: 18 breaths/min

Height: 67 inches

Weight: 155 lb

BMI: 24.3 kg/m^2

Abdomen: Soft, non-tender, non-distended abdomen with normal bowel sounds. No guarding or rebound noted

Pelvic: Normal external genitalia noted. The vagina is well-rugated. The cervix is soft, enlarged, bulging, and hyperemic with a closed external os. No active bleeding noted. Anteverted, mobile, and non-tender uterus with no palpable adnexal masses

Laboratory studies:

Urine β-hCG: Positive

Blood type and screen: O positive, antibody screen negative

Hb: 12.2 g/dL

WBCs: 13 000/μL

Creatinine: 0.6 mg/dL

AST: 14 U/L

ALT: 17 U/L

β-hCG: 37 240 mIU/mL

Imaging: Transvaginal ultrasound shows an anteverted 8.4 × 4.4 × 4.0 cm uterus with thickened (15 mm) endometrium. The cervix is ballooned outward and a 26 mm gestational sac is visualized in the endocervical canal, with fetal pole and cardiac activity present. Color Doppler demonstrates peritrophoblastic blood flow. Cervical canal is visualized between the gestational sac and endometrium. The right ovary measures 3.0 × 3.4 × 2.8 cm. The left ovary contains a 2.5 cm simple cyst and measures 4.5 × 3.2 × 3.0 cm. Sliding sign is negative

How Would You Manage This Patient?

Based on the history, physical examination, and ultrasound findings, this patient was diagnosed with a cervical ectopic pregnancy. Though clinically stable, because of the risk of hemorrhage, she was admitted for inpatient management. The patient was counseled regarding her management options, and she decided to proceed with intra-amniotic injection of potassium chloride (KCl) under ultrasound guidance in combination with multi-dose systemic methotrexate (MTX). The patient was consented for potential additional procedures including blood transfusion, uterine artery embolization (UAE), suction curettage, and hysterectomy. The patient was crossmatched and taken to the operating room for the procedure under monitored anesthesia care. Under ultrasound guidance, KCl (2 meq/mL) was injected into the gestational sac. Fetal cardiac activity cessation was confirmed by ultrasound. She received MTX (1 mg/kg) and leucovorin (0.1 mg/kg) on alternating days. Serial beta human chorionic gonadotropin (β-hCG) levels were obtained on the days she received MTX. Her β-hCG declined 12% to 32 771 mIU/mL from day 1 to day 3 of treatment, and treatment continued. On day 5, her β-hCG declined to 26 544 mIU/mL, representing a 19% decrease. Treatment was stopped and she was discharged home with strict bleeding and pelvic rest precautions, and instructions to continue serial β-hCG measurements weekly until negative.

Cervical Ectopic Pregnancy

Cervical pregnancy (CP) occurs when the trophoblast implants in the mucosal lining of the endocervical canal. CP represents less than 1% of all ectopic pregnancies, with an incidence of 1 in 10 000–18 000 births and may occur more commonly in pregnancies resulting from assisted reproductive technologies [1]. Early diagnosis is key due to the risk of catastrophic hemorrhage and its associated morbidity and mortality. Risk factors for CP include those associated with all ectopic pregnancies, with special consideration to history of cervical or uterine surgery including curettage or cesarean delivery.

Asymptomatic patients may be diagnosed at the time of early first-trimester ultrasound. Symptomatic patients usually present with profuse, painless vaginal bleeding, which makes differentiation of CP from incomplete abortion difficult. Ectopic pregnancy including CP must be part of the

differential diagnosis for all patients with vaginal bleeding in early pregnancy.

Diagnosis of CP may be confirmed by ultrasound examination or by histopathologic specimen. In 1978, Raskin described criteria for ultrasound diagnosis as cervical enlargement, uterine enlargement, absence of intrauterine pregnancy, and diffuse amorphous intrauterine echoes. These criteria have been subsequently refined to include presence of placenta and the entire chorionic sac containing the pregnancy completely within the cervical canal, presence of a barrel-shaped cervix, the absence of a "sliding sign," and peritrophoblastic blood flow to the cervix identified by Doppler [2]. The "sliding sign" involves exerting gentle pressure to the cervix with the vaginal ultrasound transducer, and a miscarrying pregnancy slides along the endocervical canal whereas a CP does not. Histopathologic diagnosis determined at the time of hysterectomy was initially outlined by Rubin in 1911. Criteria include presence of cervical glands opposite the placental attachment, intimate attachment of the placenta to the cervix, placenta situated inferior to the level of the uterine vessels or below the peritoneal reflection of the anterior and posterior surfaces of the uterus, and lack of fetal elements in the uterine corpus [3].

Management

There are no consensus guidelines for management of CP. Treatment depends on the patient's hemodynamic stability, desire for future fertility, gestational age, and comorbidities and may include systemic or intra-amniotic MTX, evacuation or resection procedures with or without UAE or balloon tamponade, and hysterectomy.

Medical Management

As in other ectopic pregnancies, single- or multi-dose systemic MTX may be used for treatment of CP. The protocols for systemic MTX are well established (Table 31.1) [4]. Additional options include intra-amniotic injection of MTX or KCl under ultrasound guidance (Table 31.2) [5]. Frequently, treatment with the combination of local injection and systemic methotrexate is utilized. Subsequently, the patient is followed with weekly serum β-hCG levels until resolution. Potential risks of MTX include adverse reactions such as conjunctivitis and stomatitis, as well as more uncommon reactions such as transaminitis and bone marrow suppression. Factors associated with failure of primary MTX for patients with CP include: crown–rump length >10 mm, presence of fetal cardiac activity, gestational age ≥9 weeks, or serum β-hCG ≥10 000 mIU/mL [6].

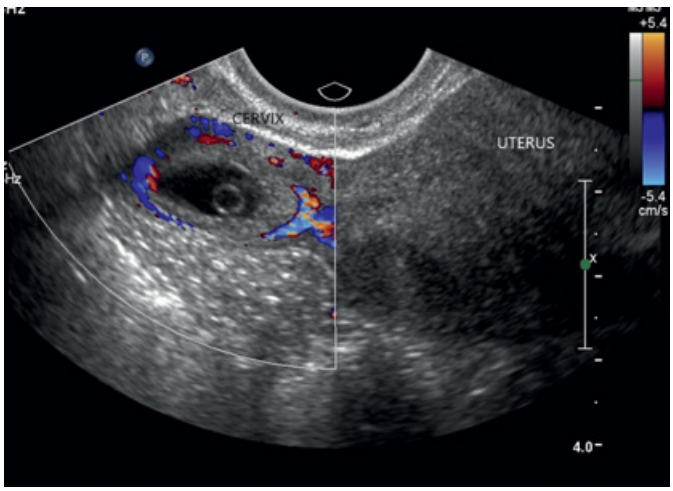

Figure 31.1 Ultrasound image of a cervical pregnancy. (Image kindly provided by Dr. Timothy Canavan, MD MSc – Chair, ETSU Quillen College of Medicine Department of Obstetrics and Gynecology.)

Surgical Management

Options for surgical management of CP include endocervical curettage, hysteroscopic resection, and hysterectomy. When surgical management is considered, providers should be prepared for the possibility of massive hemorrhage requiring transfusion and/or conversion to hysterectomy, and patients should be counseled and consented for these possibilities. In cases of more advanced gestational age, consideration should be given to preoperative blockade of the uterine arteries via UAE or laparoscopic uterine artery ligation (Table 31.3). In earlier gestational ages, or in settings where UAE is not possible, other options to minimize bleeding include:

- Circumferential injection of 20 mL intracervical dilute vasopressin (0.05 U/mL or 20 units in 50 mL normal saline) into cervical stroma at a depth of 1.5 cm
- Transvaginal ligation of the cervical branches of the uterine arteries by deviation of the cervix away from the vaginal sidewall bilaterally and placement of sutures in the cervix at 3 and 9 o'clock with dissolvable suture (e.g. 1–0 or 2–0 polyglactin 910)

Followed by postoperative direct compression of the cervix for 24–48 hours by:

- Placement of a double balloon transcervical catheter
- Intracervical placement of a size 26 Foley catheter or gastric tube followed by purse-string suture closure of external cervix for retention

Following arterial blockade or cervical preparation, suction curettage may be performed. Dilation is not necessary as the cervical canal is already dilated by the expanding pregnancy [7]. Since the cervix is capable of only minimal fibromuscular contraction, uncontrolled hemorrhage can occur with introduction of mechanical dilators, performance of suction curettage or hysteroscopic resection without uterine or cervical artery blockade, and therefore is not recommended. Hysteroscopic resection is generally feasible under eight weeks' gestation [8]. The resectoscope is gently introduced into the endocervical canal under direct visualization. A complete survey of the endocervical canal is performed, with notation of location of the gestational sac implantation site and extent of placentation. Directed injection of dilute vasopressin around the implantation site can be considered, followed by excision or hydrodissection, and bipolar cauterization if needed.

For more advanced gestations (12+ weeks), a multistage treatment methodology such as UAE followed by systemic or local MTX, and suction curettage after a short interval may be

to the urinary tract, and preoperative placement of ureteral stents for aid in identification may be useful. Vaginal hysterectomy has the added benefit of immediate control of the uterine vasculature. If non-abdominal route is chosen, blood and laparotomy set-up should be readily available [10].

Key Teaching Points

- Cervical ectopic pregnancy occurs in less than 1% of pregnancies and is often identified on early pregnancy ultrasound or in patients presenting with profuse and often painless vaginal bleeding. Differentiation between low implantation of a viable intrauterine pregnancy, abortion in progress, and CP is critical
- Key sonographic findings include an enlarged or ballooned cervix greater than uterine size, absence of intrauterine pregnancy, presence of gestational sac completely within the cervical canal below the level of the internal os, absent "sliding sign," and peritrophoblastic blood flow identified on Doppler
- Treatment is dependent on clinical status and gestational age. Fertility-sparing treatment with local or systemic MTX with or without surgical resection is the mainstay of treatment in hemodynamically stable patients. If hysterectomy is required and patient's clinical status can support it, consider a minimally invasive route
- Hemorrhage is a significant cause of morbidity and mortality for CP patients. Blood loss may be reduced by uterine or cervical artery ligation or embolization, local injection of vasopressin, or direct tamponade

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CASE 32 A 45-Year-Old Woman with Leg Weakness following a Vaginal Hysterectomy

Genevieve A. Wolpert

History of Present Illness

A 45-year-old woman, gravida 2, para 2, postoperative day 0 following a vaginal hysterectomy for menorrhagia due to uterine fibroids calls for assistance after falling when attempting to ambulate. At the completion of her procedure, her Foley catheter was removed. She attempted to ambulate to the bathroom but experienced a fall onto the bed when she attempted to bear weight on her left leg. She describes numbness of the left thigh. Her surgery was difficult due to the presence of multiple uterine fibroids but had no unusual complications. Estimated blood loss was 315 mL and operative time was 2.5 hours. She has a medical history of diabetes and tobacco abuse and a past surgical history of vaginal hysterectomy. She is currently taking metformin and has no known drug allergies.

Physical Examination

General appearance: Alert, oriented, well-developed female in no acute distress

Vital signs:

Temperature: 37.0°C

Pulse: 95 beats/min

Blood pressure: 137/88 mmHg

Respiratory rate: 20 breaths/min

Oxygen saturation: 99% on room air

Height: 66 inches

Weight: 135 lb

BMI: 21.8 kg/m^2

Abdomen: Soft, non-tender, no masses, rebound, or guarding is appreciated

Pelvic: Deferred, no blood noted on pad

Extremities: No evidence of trauma, ecchymosis, erythema, or skin changes. Right lower extremity examination unremarkable with normal sensory and motor function. Left lower extremity examination notable for mildly decreased touch sensation over left anterior thigh, decreased hip flexion, and decreased ability to extend left lower leg against resistance. Patellar reflex 1+ on left, 2+ on right

Laboratory studies:

Preoperative holding:

WBCs: 7500/μL

Hb: 11.2 g/dL

Platelets: 278 000/μL

Creatinine: 0.9 mg/dL

Eight hours postoperative:

WBCs: 12 300/μL

Hb: 9.8 g/dL

Platelets: 265 000/μL

Creatinine: 0.9 mg/dL

How Would You Manage This Patient?

This patient presents with new-onset left lower extremity motor and sensory loss following vaginal hysterectomy. Physical examination localizes her deficits to the distribution of the femoral nerve. Her surgery was uncomplicated, and her examination and vital signs are stable, making nerve compression from an acute hematoma or retained item less likely. The leading diagnosis is neuropathy from compression of the femoral nerve in lithotomy position. Consultations were obtained from Neurology and Physical Therapy. Neurology confirmed no additional deficits; given her overall stability, imaging studies were deferred. Physical Therapy recommended strengthening exercises and a four-wheeled walker for support. She was discharged home on postoperative day 1. She was seen one week postoperatively and was no longer requiring a walker. By two weeks postoperatively, she was ambulating without issue. She saw Neurology for outpatient follow-up and nerve conduction studies were deferred given her improvement. She ultimately recovered within weeks of surgery without residual deficits.

Lower Neuropathies in Gynecologic Surgery

Neurologic injury following gynecologic surgery is not common, but it does represent a potential complication of any gynecologic surgery, regardless of approach. Postoperative neuropathy following gynecologic surgery has been reported to occur at a rate of less than 2% [1]. The lumbosacral plexus and branching nerves are at risk of injury during gynecologic surgery [2]. The most common lower neuropathies are summarized in Table 32.1.

Mechanisms of injury include prolonged compression, stretch, crush, laceration, suture entrapment, and thermal injury [2]. Stretching of the nerve can cause disruption of the nerve's vascular supply, leading to ischemia, and tearing of the connective tissue within the nerve leading to bleeding and necrosis [3]. Compression of the nerve causes venous congestion and edema that compresses arterial blood flow, leading to neuron ischemia. Excess pressure can cause direct damage to the Schwann cells and lead to demyelination, axonal damage, and Wallerian degeneration. If axonal loss occurs, recovery relies on regeneration of the axon, which progresses at approximately 1 mm/day [3]. If the nerve is completely transected, axonal regeneration will not occur.

Several risk factors have been identified for neuropathic injury during gynecologic surgery. Greater incidence of nerve injury has been associated with thin body habitus, prolonged

carbamazepine, and amitriptyline) may improve neuropathic pain and help with neuron stabilization during recovery. Electrical stimulation and stabilizing orthotic braces may help [4]. Recovery varies by severity of the injury; most will spontaneously resolve. Mild injury can recover in days to weeks, while more significant injury may take months to years, with the majority recovering by six months. In women who do not achieve a tolerable degree of recovery, surgical release or resection of entrapped nerves may be necessary [7].

Femoral Nerve

Femoral neuropathy is the most common postoperative neuropathy following gynecologic surgery [8]. The femoral nerve arises from L2 to L4 nerve roots and courses under the psoas muscle, over the iliacus muscle, and through the inguinal canal. The anterior branch supplies the anterior thigh including the sartorius and the intermediate and medial cutaneous nerves. The posterior branch supplies the quadriceps, articularis genus, and saphenous nerves [6]. In abdominal surgery, the most common injury site is along the psoas muscle from deep placement of self-retaining retractors [7]. During vaginal surgery, the femoral nerve is most commonly injured through prolonged patient positioning in lithotomy. Candy cane stirrups present a higher risk for positional neuropathy [4]. Hip flexion, abduction, and external rotation compress and stretch the femoral nerve as it passes beneath the inguinal ligament (Figure 32.1) [1]. Femoral neuropathy may present with motor or sensory symptoms. Motor loss includes weakness in any of the distributions supplied, classically quadriceps weakness, loss of patellar reflex, and weakened hip flexion. Sensory loss includes pain in the inguinal region and numbness/paresthesia of the anterior thigh, the anteromedial leg, and the medial foot [1].

Ilioinguinal and Iliohypogastric Nerves

The ilioinguinal and iliohypogastric nerves arise from T12 to L1 and pass through the psoas major muscle, through the transversus abdominis, and to the pelvis. The ilioinguinal nerve supplies sensation to the mons pubis, labia majora, and inner thigh. The iliohypogastric nerve supplies sensation to the lateral gluteal region and hypogastric region, and motor function to the transversus abdominis and internal oblique muscles. These nerves can be injured with transverse abdominal incisions, lateral abdominal port placement, or via nerve entrapment or constriction with incision closure or scar formation [7]. Injuries present with pain or paresthesia to the groin or gluteal region.

Genitofemoral Nerve

The genitofemoral nerve arises from L1 to L2 and courses along the psoas muscle. It supplies sensation to the mons, labia majora, and femoral triangle, and injury presents as paresthesia to these areas [2]. It is most commonly injured during pelvic sidewall dissection and external iliac lymph node excision [9].

Lateral Femoral Cutaneous Nerve

The lateral femoral cutaneous nerve arises from L2 to L3 and runs along the border of the psoas, crosses the iliac fossa, and passes posterior to the inguinal ligament. It supplies sensation to the anterolateral thigh and injury presents as pain and paresthesia in the anterior and lateral thigh. It may be injured from self-retaining retractor use during abdominal surgery or lithotomy positioning [2].

Obturator Nerve

The obturator nerve arises from L2 to L4 and passes behind the psoas, over the pelvic brim, behind the common iliac vessels, and through the obturator foramen [9]. It supplies motor function to the hip abductors and sensation to the upper thigh, and injury presents with loss of hip abduction and paresthesia of the upper medial thigh [2]. Injury may occur during retroperitoneal dissection in oncologic or endometriosis surgery; avoiding unnecessary dissection of the retroperitoneal space can decrease the chance of injury. Nerve injury recognized intraoperatively should be repaired [7].

Common Peroneal and Tibial Nerves

The common peroneal and tibial nerves arise from the sciatic nerve from L4 to S3, and the common peroneal and tibial nerves branch off in the thigh [9]. The peroneal passes around the head of the fibula and down the lateral calf while the tibial passes through the popliteal fossa and into the posterior leg. The peroneal supplies motor function for foot flexion and sensation to the lateral lower leg; injury presents as foot drop and lower lateral leg paresthesia [2]. The tibial supplies foot dorsiflexion and toe extension [1]. Both may be injured via compression from stirrups in lithotomy position; padding the calf and knee can help avoid this complication [2].

Pudendal Nerve

The pudendal nerve arises from S2 to S4 and passes through the greater sciatic foramen, behind the lateral third of the sacrospinous ligament and ischial spine next to the internal pudendal artery. It may be entrapped during sacrospinous ligament fixation, and presents as gluteal, perineal, and vulvar pain [9].

Key Teaching Points

- Neuropathic injury during gynecologic surgery is rare, but the gynecologic surgeon must be familiar with the most common mechanisms of and sites for injury
- Injury prevention includes familiarity with retractor blade placement (with self-retaining retractors, including padding blades and attention to deep placement), attention to proper lithotomy positioning (avoiding extreme hip flexion, abduction, external rotation, and calf/knee pressure on stirrups), and limiting operative time
- Recognition of nerve injury can help direct treatment and avoid long-term loss of motor and sensory function. Excluding correctable complications such as hematoma,

foreign body retention, or complete nerve transection is important. Neurologic consultation may be helpful

- Most injuries will resolve spontaneously, and physical therapy is the mainstay for recovery

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CASE 33 A 45-Year-Old Woman Undergoes a Transvaginal Midurethral Sling and Is Unable to Void after the Procedure

Rachel A. Maassen

History of Present Illness

A 45-year-old female is awaiting discharge from the post-anesthesia recovery unit but is unable to void. She is two hours post-completion of a transobturator tension-free vaginal tape procedure for stress urinary incontinence. The procedure was uncomplicated with minimal blood loss. It was performed under spinal anesthesia. Post-procedure cystoscopy was normal. She is in minimal pain after taking ibuprofen and oxycodone. She is tolerating a general diet without nausea. She reports the sensation of a full bladder. She has no significant past medical or surgical history. She is currently taking multivitamins (one tablet PO daily) and has no known drug allergies.

Physical Examination

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

Vital signs:

Temperature: 36.9°C

Pulse: 75 beats/min

Blood pressure: 135/80 mmHg

Respiratory rate: 12 breaths/min

Oxygen saturation: 99% on room air

BMI: 19 kg/m^2

Abdomen: Soft, non-distended, bowel sounds are present

Pelvic: Incisions clean, dry, and intact. No vaginal hematoma or perineal induration, no cervical lesions. No cervical motion tenderness. Uterus and ovaries normal size and shape without tenderness. Normal rectal examination

Laboratory studies: Urinalysis was negative for blood, nitrates, and leukocyte esterase

Imaging: Bladder scan: 500 mL

How Would You Manage This Patient?

This patient presents with postoperative urinary retention (POUR), which is a frequent consequence of gynecologic surgery. A straight catheterization is performed with 500 mL of clear urine returned. The patient was taught how to perform clean intermittent catheterization (CIC) at home four to six times per day after attempting to void. She is asked to record how much she voided as well as the post-void residual (PVR) with each attempt. Return visit is scheduled in two weeks.

The patient returns for her scheduled appointment and reports urinating on her own with less than 100 mL PVR. Physical examination demonstrated well-healed vaginal incisions and a normal urethra and vagina. A retrograde fill voiding trial was performed with 300 mL of normal saline. The patient was able to void 250 mL with a 50 mL PVR. CIC was discontinued. The patient was cautioned to avoid bladder overdistention by voiding four to six times a day over the next two weeks.

Postoperative Urinary Retention (POUR)

Postoperative urinary retention (POUR) is estimated to occur in 2.5–24% of incontinence and prolapse surgeries and as often as 43% in tension-free transvaginal mesh sling procedures [1]. POUR is defined as impaired bladder emptying with an elevation in the volume of retained urine. POUR can be immediate or delayed, partial or complete, symptomatic or asymptomatic, acute or chronic, obstructive or non-obstructive, and transient or prolonged. Typical bladder capacity ranges from 400 to 700 mL with normal bladder sensation beginning around 150 mL and first urge at 250 mL. Strong urge occurs around 400 mL. Post-surgical changes that lead to edema, inflammation, damage to nerve endings, as well as the effects of anesthesia, scopolamine patch [2], narcotics, postoperative pain, and psychosocial distress can affect bladder sensation and the micturition pathway leading to POUR [1]. Persistent POUR may be a result of excessive tensioning of the sling, but could also be secondary to pelvic prolapse, postoperative urinary tract infection, preexisting impaired detrusor contractility, or as a result of habitual use of abdominal muscles to void, which results in excessive resistance after sling placement. Patient risk factors for POUR include age >50, lower BMI, advanced pelvic organ prolapse, baseline bladder dysfunction, and previous incontinence surgeries. Surgical risk factors include all pelvic surgeries but specifically prolapse and incontinence surgeries, spinal anesthesia, intraoperative fluid administration >750 mL, estimated blood loss >100 mL, postoperative opioid use, and postoperative urinary tract infection. In this case, the patient's initial POUR was likely multifactorial but certainly could have been related to her low BMI and spinal anesthesia.

Early recognition is the key to management of POUR. According to the International Urogynecological Association, all incontinence surgery patients should undergo voiding function evaluation prior to discharge [3]. Most commonly this is achieved with a voiding trial and the measurement of PVR with catheterization. A PVR of less than 100 mL is considered successful [4]. Adequate bladder volume (300 mL) prior to voiding is essential to avoid a false-negative test. Many surgeons use a retrograde fill of 300 mL as opposed to waiting for spontaneous fill prior to the voiding trial. Bladder scanning, using a transabdominal ultrasound, can be used to determine the PVR. Older studies found this method to be less accurate; however, with the improvement of ultrasound technology and

technique, better correlation has been demonstrated [1, 5]. In addition to the recognition of early POUR, patients should be counseled to watch for symptoms of delayed partial or complete urinary retention. Urinary hesitance, slow stream, the need to lean forward, strain, double void, the feeling of incomplete emptying, or overflow incontinence should prompt an office visit.

In addition to a voiding trial, a physical examination should be performed regardless of time of onset of POUR. The examination should include inspection of the urethra and the vagina and evaluation for hematoma, retained surgical laps, induration or abscess, a full rectum, pelvic floor spasm, or specific sites of tenderness. A urinalysis with culture should also be considered depending on preoperative screening and timing of onset of symptoms.

The goal in management of POUR is to drain the bladder to prevent long-term damage to the bladder integrity and function by overdistension and compression. The first step is always catheterization, which may be performed with in and out drainage or placement of an indwelling Foley catheter. If total retention is noted, bladder rest for 24–36 hours with an indwelling catheter, indwelling catheter with clamp release every 3–4 hours, or with CIC is indicated [3]. Several studies have demonstrated CIC to be associated with fewer infections and shorter catheterization time when compared with an indwelling catheter. The continual assessment of the PVR allows for earlier discontinuation and possibly fewer infections [1, 6]. A decision to discontinue catheterization can be made when the PVR is less than 100 mL on at least two occasions or the patient passes an office retrograde fill voiding trial. It is still important to caution patients to avoid bladder overdistension in the weeks to come as decreased sensation is still possible.

Transvaginal Midurethral Slings

The midurethral sling (MUS) was developed in the mid-1990s as a minimally invasive treatment for stress urinary incontinence (SUI). Compared with a traditional pubovaginal sling, the MUS is placed more distally to act as a "backboard" for the mid-urethra. Continence is maintained by allowing compression against the sling when intra-abdominal pressure increases. Multiple commercially available kits with polypropylene mesh are now available, each with slight variations in surgical technique. These variations include retropubic bottom-to-top and top-to-bottom, as well as transobturator medial-to-lateral and lateral-to-medial approaches. Multiple studies have shown the short-, medium-, and long-term effectiveness of MUS regardless of technique [7]. A 2017 Cochrane meta-analysis that included 55 trials concluded that postoperative voiding dysfunction was less frequent following the transobturator route (RR 0.53, 95% CI 0.43–0.65) compared with the retropubic route [8].

Regardless of surgical technique, adjusting the sling tension is very subjective. Many surgeons adjust sling tension with a surgical instrument such as a no. 8 Hagar dilator or by inserting a right-angle clamp between the posterior urethra and the sling. Additionally, some surgeons prefer to use the "cough test" with the patient under local anesthesia. The goal is to have enough laxity in the mesh to avoid direct contact with the underside of the urethra while still moving back toward the urethra if pulled on vaginally [7].

Persistent Postoperative Urinary Retention with Midurethral Slings

Most cases of postoperative urinary retention are self-limited and do not require surgical intervention. The rate of sling revision or removal for a population-based cohort of 188 454 women who underwent MUS between 2001 and 2010 was 1.3% [3]. If conservative measures fail, surgical options should be considered. Urethral dilatation is not endorsed by the International Urogynecological Association, citing a lack of evidence to support its efficacy as well as the complications of urinary infections and higher rates of mesh erosion [3, 9]. Acceptable surgical options include sling mobilization (loosening), sling incision (midline, unilateral, or bilateral), partial or complete excision, and urethrolysis. The timing of surgical options is lacking consensus; however, consideration of the length of time from surgery and the severity of symptoms is important. For mobilization, earlier intervention before scar formation occurs has been reported to be more successful. Moksnes et al. demonstrated that early sling mobilization was more successful when compared with CIC followed by later sling incision in a Norwegian study of 585 women [10]. No consensus exists on which type of incision nor whether partial excision of the sling is best; therefore, the decision should be individualized. If more than three months has passed since the original sling placement, partial excision may be the only option because of scar formation and tissue integration around the sling. Incision, when appropriate, has a short recovery time, low morbidity, and is associated with a 90% cure of postoperative voiding dysfunction. A major concern for surgical intervention is the risk of recurrent SUI, which ranges from 9% to 61%. Results are conflicting on the effect of time elapsed to intervention and the type of sling revision on SUI recurrence [3]. Urethrolysis, which involves entering the retropubic space and completely dissecting the urethra anteriorly and posteriorly to the bladder neck, should be reserved for complex patients who have undergone multiple surgeries and is best performed by a surgeon with the appropriate skills and expertise, such as a fellowship-trained urogynecologist or urologist [10].

Key Teaching Points

- Postoperative urinary retention is common after MUS and is often self-limited if recognized and managed appropriately
- Postoperative voiding evaluation should be performed prior to discharge with assessment of the PVR, which should be less than 100 mL
- Postoperative urinary retention can be early or delayed in onset and should be evaluated with a physical examination, PVR, and consideration of urinary tract infection

- Bladder drainage with indwelling catheter or CIC should continue until the PVR is consistently less than 100 mL or the patient passes a retrograde voiding trial
- Early mobilization is associated with the highest rate of resolution of urinary retention with the lowest risk of recurrent SUI
- If postoperative urinary retention persists, reoperation should be considered with sling incision versus excision. No evidence-based consensus exists to favor one method over the other for relief of voiding dysfunction

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CASE 34 A 65-Year-Old Woman Presents with a Symptomatic Stage 2 Rectocele

Christopher M. Morosky

History of Present Illness

A 65-year-old woman, gravida 4, para 4, presents with a worsening bulge in her vagina. She describes a dragging sensation in the vagina that is worse at the end of the day. She has increased the fiber in her diet to help with constipation. Despite this, over the past three months, she has had increased straining with bowel movements. Now, she must digitally place pressure on the bulge in the vagina to evacuate the rectum.

She denies urinary incontinence, frequency, or incomplete emptying of the bladder. She describes an increase in pain with intercourse and incontinence of flatus and occasional stool during sex. Her past obstetrical history includes a forceps-assisted vaginal delivery with a midline episiotomy and third-degree extension for her first child. She subsequently had three term spontaneous vaginal deliveries without complications. She worked for 30 years as a machinist on an assembly line. Her medical history is significant for and hypertension. Her past surgical history is significant for right breast mass excisional biopsy. She is currently taking labetalol and she has no known drug allergies.

Physical Examination

General appearance: Alert and oriented obese female in no apparent distress

Vital signs:

Temperature: 36.9°C

Pulse: 88 beats/min

Blood pressure: 142/86 mmHg

Respiratory rate: 18 breaths/min

Oxygen saturation: 98% on room air

Height: 67 inches

Weight: 210 lb

BMI: 32.9 kg/m^2

Abdomen: Soft and non-distended. No scars. No mass or hernia present

Pelvic: Perineum with well-healed midline scar. Slightly widened genital hiatus. A bulge in the vagina was present just inside the hymenal ring. Speculum examination reveals mild atrophic changes to the vaginal epithelium. Using half of the speculum, the bulge was confirmed to arise from the posterior vagina. Bimanual examination demonstrates a normal-sized anteverted uterus that was non-tender. The strength of her pelvic floor muscle tone was weak. Rectal examination demonstrates a normal sphincter tone. Herniation of the anterior rectum into the posterior vagina was confirmed

POP-Q examination: With the patient in the lithotomy position and using a combination of Valsalva and at rest, the following measurements were obtained using a cotton-tipped applicator and paper measuring tape: Aa = -3, Ba = -3, C = -8, gh = 3.5, pb = 4, tvl = 10, Ap = -0.5, Bp = -0.5, and D = -10

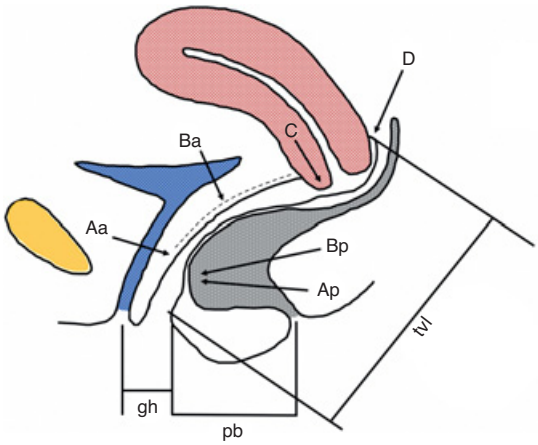
How Would You Manage This Patient?

The patient has a symptomatic stage 2 rectocele. Her physical examination and POP-Q assessment (Figure 34.1) confirm a posterior vaginal wall herniation with normal support of the anterior vaginal wall and vaginal apex, including the uterus and cervix. The patient has taken the first step in conservative management of her defecatory dysfunction by increasing the fiber in her diet. Non-surgical management options for a rectocele such as pelvic floor physical therapy including electrical stimulation and biofeedback, lifestyle modifications including avoiding heavy lifting and losing weight, and vaginal pessaries were reviewed in detail with the patient. After discussing the various surgical treatment options, including their risks and benefits, the patient undergoes a transvaginal posterior colporrhaphy with perineorrhaphy. She does well postoperatively and was discharged on postoperative day 1. At a six-month postoperative visit, she notes significant improvement in her pelvic pressure, defecatory dysfunction, and mild improvement of her dyspareunia.

Rectocele

While pelvic organ prolapse is identified on physical examination in up to 40–60% of parous women, only 3–6% of women report symptomatic prolapse [1, 2]. In the United States, the incidence of surgery for pelvic organ prolapse is 1.5–1.8 surgeries per 1000-woman years, with approximately 300,000 surgeries performed each year [1]. Rectocele is caused by defects in the rectovaginal septum, also referred to as Denonvillier's fascia, with herniation of the rectal wall into the vaginal lumen [3]. These defects may be located distally near the introitus, in the middle of the septum, or proximally near the vaginal apex. Risk factors for rectocele include parity, operative and spontaneous vaginal delivery, episiotomy and obstetric perineal trauma, menopause, constipation, obesity, connective tissue disorders, and chronically elevated intraperitoneal pressure [1–3].

Patients with symptomatic rectoceles have a variety of complaints. Bulge symptoms include perineal or vaginal pressure, pelvic heaviness, or a sensation of a protrusion coming from the vagina [1–4]. Dyssynergic and obstructed defecation are most commonly seen with rectocele [4, 5]. Defecatory symptoms related to rectocele include straining for bowel movements, incomplete emptying, flatus and fecal incontinence, splinting (placing pressure on the vaginal bulge to accomplish rectal evacuation), or digitation (using a finger to directly evacuate the stool from the rectum). Sexual



Anterior wall	Anterior wall	Cervix or cuff
Aa = –3	Ba = –3	C = –8
Genital hiatus	Perineal body	Total vaginal length
gh = 3.5	pb = 4	tvl = 10
Posterior wall	Posterior wall	Posterior fornix
Ap = –0.5	Bp = –0.5	D = –10

Figure 34.1 Pelvic Organ Prolapse Quantification (POP-Q) assessment of a patient with a stage 2 rectocele.

dysfunction is commonly present and includes dyspareunia, vaginal looseness, decreased sensation during intercourse, and coital flatus or stool incontinence [1, 3]. Patients should be asked about the frequency and intensity of symptoms, as well as how much they interfere with physical activity or sexual function.

The physical examination of patients with a symptomatic rectocele includes an abdominal examination, inspection of the external genitalia, speculum examination, bimanual examination, and rectal examination. The Pelvic Organ Prolapse Quantification (POP-Q) examination can be performed to identify the location and degree of the pelvic organ prolapse. As can be seen in Figure 34.1, nine specified points are measured in relation to the hymen during maximum Valsalva, except for tvl, which is done at rest. These points are defined as follows: Aa – 3 cm proximal to the urethral meatus; Ba – the most prolapsed portion of the anterior vaginal wall; C – the leading edge of the cervix or vaginal cuff; gh – the middle of the urethra to the posterior hymen; pb – the posterior hymen to the middle of the anus; tvl – the maximum length of the vagina with the prolapse reduced; Ap – 3 cm proximal to the posterior hymen; Bp – the most prolapsed portion of the posterior vaginal wall; D – the posterior fornix in patients with a cervix [1].

POP-Q measurements can be used to stage the prolapsed portion of the vagina as follows: stage 0 – the anterior and posterior points are all -3 cm, and C or D is between -tvl and -(tvl – 2) cm; stage 1 – stage 0 criteria are not met, however, the most distal prolapse is more than 1 cm above the hymen; stage 2 – the most distal prolapse is between 1 cm above and 1 cm below the hymen; stage 3 – the most distal prolapse is more than 1 cm below the hymen but no more than 2 cm less than tvl; stage 4 – the most distal prolapse extends to at least tvl – 2 cm.

Evaluation of pelvic floor muscle tone on bimanual examination and anal sphincter tone on rectal examination is important in planning further workup and treatment. The strength of these muscle groups can be described as absent, weak, normal, or strong [1]. Rectal examination can confirm the extent of the rectocele, as well as the possible absence or weakness of the muscles of the perineal body consistent with a perineocele.

For most patients with symptomatic rectocele, history and physical examination alone are sufficient to plan treatment. When defecatory dysfunction is the primary complaint or when pelvic floor or anal sphincter muscle tone is weak or absent, consultation with an anorectal disorders specialist may be advisable. Defecography is the gold standard in the workup of rectocele. This involves filling the rectum with radiopaque barium paste and using dynamic fluoroscopy to observe the squeeze and evacuation of the barium. Findings consistent with rectocele include large rectocele diameter, barium retention within the rectocele, and increased perineal descent. Defecography can also be helpful in diagnosing conditions that are not improved with treatment of rectocele such as rectoanal intussusception, paradoxical puborectalis contraction, or sigmoidocele [3].

Conservative management of rectocele includes initial treatment of constipation with increased fiber and osmotic laxatives. Lifestyle modifications such as weight loss, sitting with feet elevated, and avoiding heavy lifting can also be recommended. A recent Cochrane review identified that pelvic floor muscle therapy (PMFT) improved the stage of prolapse by 17% compared with no PMFT, including improvement in bowel symptoms [6]. A separate Cochrane review noted that ring and Gelhorn pessaries were both effective in treating pelvic organ prolapse in approximately 60% of women [7]. For patients with symptomatic rectoceles that continue with symptoms despite conservative treatment or who decline conservative treatment, surgical management is appropriate.

The International Federation of Gynecology and Obstetrics (FIGO), the Society for Gynecologic Surgeons (SGS), and jointly both the American College of Obstetricians and Gynecologists (ACOG) and the American Urogynecologic Society (AUGS) have published reviews and recommendations for the surgical repair of the symptomatic rectocele with the transvaginal approach preferred over other approaches [1, 4, 8]. The most effective procedure is the posterior colporrhaphy, which is commonly performed with a perineorrhaphy. Many surgeons begin this procedure by infiltrating the posterior

vaginal epithelium and perineal body with either lidocaine with epinephrine or a dilute solution of vasopressin in order to facilitate dissection and decrease bleeding. Next, a triangular-shaped incision is made over the perineal body. In the midline, this incision is extended in the posterior vagina over the rectocele. Sharp and blunt dissection of the vaginal epithelium away from the underlying rectovaginal septum is carried out laterally to the lateral vaginal sulcus, and superiorly past the margin of the rectocele. Plication of the rectovaginal fascia is performed in the midline using interrupted fine absorbable suture (ex. 2–0 polyglycolic acid). The bulbocavernosus and transverse perineal muscles are similarly reapproximated to complete the perineorrhaphy. Excess vaginal epithelium is trimmed. The vaginal epithelium and perineal skin are reapproximated again with fine absorbable suture.

Rectocele has been addressed surgically by transvaginal, transrectal, transperineal, laparoscopic, and abdominal approaches. However, numerous reviews by national organizations all support posterior colporrhaphy as having the highest success rates in improving anatomy and obstructed defecatory symptoms with the lowest risk of side effects, such as dyspareunia [1, 4, 8]. Avoiding complete plication of the levator ani muscles greatly reduces the incidence of postoperative dyspareunia. Several reviews have found that posterior colporrhaphy has a significantly lower recurrence rate (4% versus 11%, $p = 0.02$) compared with transvaginal site-specific repair, where discrete defects in the rectovaginal septum are repaired over the surgeon's finger [1, 4, 8]. Furthermore, when compared with transanal repair, where a U- or T-shaped incision is made through the rectal mucosa just above the dentate line and the rectovaginal septum is plicated from the rectal side, posterior colporrhaphy has better anatomic and symptomatic improvement with less recurrence [1, 2, 4, 8]. Other surgical procedures more commonly performed by colorectal surgeons and proctologists such as abdominal and laparoscopic mesh repair, stapled transanal rectal resection, and transperineal repair for rectocele are less well studied and are likely to be inferior to posterior colporrhaphy [4, 8]. Finally, in 2019, the FDA ordered the removal of vaginally placed synthetic surgical mesh for the treatment of pelvic organ prolapse from the market. Previous research has shown that both synthetic and biologic grafts provide no improvement in symptoms or recurrence compared with native tissue repair and therefore should be avoided [1, 2, 4, 8].

Key Teaching Points

- Pelvic organ prolapse is common on physical examination; however, symptomatic presentation is less common. Treatment of rectocele should be limited to patients with bothersome bulge symptoms, defecatory dysfunction, or sexual dysfunction
- Conservative treatment with fiber, osmotic laxatives, lifestyle modifications, pelvic floor muscle therapy and/or pessary should be offered initially to patients with symptomatic rectocele
- Transvaginal posterior colporrhaphy with or without perineorrhaphy provides the most success in terms of anatomic and symptomatic improvement with less recurrence compared with site-specific or transanal repair
- Biologic and synthetic surgical mesh offers no improvement in anatomy or symptoms and should be avoided when surgically correcting a rectocele

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CASE 35 A 55-Year-Old Woman with Stress Urinary Incontinence without Uterine Prolapse

J. Chris Franka

History of Present Illness

A 55-year-old woman presents reporting two years of bothersome episodes of leaking urine. The episodes of incontinence have become more frequent over that time and now occur daily. The urine loss is provoked by laughing, coughing, and standing from a sitting position. The symptoms are significant enough to require the regular use of sanitary pads. The embarrassment associated with these episodes has caused the patient to limit her normal physical and social activities in recent months. She denies symptoms of urgency or frequency associated with the incontinence episodes, and she denies hematuria, dysuria, or nocturia. She has no other gynecologic complaints. Obstetric history is significant for three term spontaneous vaginal deliveries without complications. She has no past medical or surgical history. She is not taking any medications and has no known drug allergies.

Physical Examination

General appearance: 55-year-old female in no apparent distress

Vital signs:

Temperature: 36.9°C

Pulse: 82 beats/min

Blood pressure: 134/80 mmHg

Respiratory rate: 18 breaths/min

Height: 64 inches

Weight: 182 lb

BMI: 31.2 kg/m^2

Abdomen: Soft, non-distended, non-tender abdomen with no rebound or guarding

Pelvic: Normal external female genitalia. Normal vaginal mucosa present. No significant cystocele or rectocele noted. Well-suspended parous cervix with no visible lesions. Normal size, anteverted, mobile uterus that is non-tender and has a smooth contour. No adnexal masses palpated

Laboratory studies: Urinalysis negative for protein, leukocyte esterase, blood, or nitrites

How Would You Manage This Patient?

This patient has symptoms that are strongly suggestive of female stress urinary incontinence (SUI). In these patients, urine leakage is frequently provoked by activities associated with rapid increases in intra-abdominal pressure. Options for conservative treatment and the role of surgical management were reviewed with the patient. The patient desired to try pelvic floor muscle exercises at home and return to reassess her symptoms.

After six weeks, the patient returned and reported only minimal improvement of her incontinence. After a discussion of relevant risks and benefits, the patient expressed desire to proceed with surgical treatment. Preoperative office examination revealed minimal post-void residual, normal bladder capacity, and visible leak from the urethra with cough after filling the bladder with sterile water. The patient underwent an elective retropubic midurethral sling (MUS) placement in an outpatient surgical center. At her six-week follow-up appointment, the surgical incisions were well healed, and the patient reported nearly complete relief of her SUI symptoms.

Stress Urinary Incontinence

Female stress urinary incontinence (SUI) is the "complaint of involuntary loss of urine on effort or physical exertion . . . or on sneezing or coughing" [1]. The mechanisms by which urinary continence is normally maintained are complex and are affected by intrinsic urethral muscle tone, detrusor activity, and the anatomic relationship of the urethra to the bladder and pelvic floor musculature.

The prevalence of female urinary incontinence varies based on the population surveyed and the frequency or severity of symptoms used to define the condition, with estimates ranging from 16% to 51% of the US population [2]. SUI is the most common subtype of urinary incontinence in US women, with 33% of incontinent women reporting isolated stress symptoms and an additional 50% reporting stress symptoms in combination with urgency (mixed incontinence) [3]. Risk factors for the development of female SUI include advancing age, obesity, and parity [4].

Evaluation of patients with SUI should begin with a detailed history. The provider should assess the duration of the condition, changes in severity of symptoms over time, and symptoms that provoke the episodes of urine loss, especially activities involving a rapid change in intra-abdominal pressure such as coughing, laughing, sneezing, or position changes. The patient history should also include the presence or absence of urinary frequency, dysuria, hematuria, nocturia, incomplete emptying, the need to strain or splint to void, and any sensation of prolapse, as these may indicate other causes of bladder dysfunction such as urinary tract infection, interstitial cystitis, or urinary outlet obstruction. Establishing the degree to which symptoms interfere with desired physical activity, social pursuits, intimacy, and maintenance of hygiene is particularly important, as the success of any treatment will likely depend on whether the intervention reduces the patient's bother in these areas.

A pelvic examination in these patients should document urethral mobility, presence of vaginal atrophy, and degree of prolapse of other pelvic structures. Assessment of bladder capacity, post-void residual, and confirmation of stress-provoked

urine loss with a comfortably full bladder are also important before planning surgical treatment, as abnormal findings may indicate the presence of conditions requiring additional evaluation with urodynamic testing or specific surgical interventions to achieve desired outcomes. When this examination is consistent with the diagnosis of SUI, however, additional urodynamic testing is usually unnecessary. Finally, a complete urinalysis should be performed as part of the initial evaluation to evaluate for possible urinary tract infection or isolated hematuria that might warrant upper tract imaging and cystoscopy.

The initial approach to management of SUI should include a thorough discussion of non-surgical management options. Not only is a review of conservative alternatives an important part of any surgical informed consent process, but these options are associated with lower expense and fewer risks and side effects than surgery and therefore may be more appealing to or more medically appropriate for many patients. Moderation of daily fluid consumption, restriction of caffeine intake, and cessation of smoking are lifestyle modifications commonly recommended for patients with SUI. Weight loss in overweight and obese women is another lifestyle change that effectively reduces frequency of SUI episodes [5]. Pelvic floor muscle exercises have also been shown to improve incontinence and are recommended as first-line non-surgical management by several professional organizations. However, many patients have difficulty identifying or correctly isolating their pelvic floor muscles and may require feedback from a provider during a pelvic examination to perform these exercises effectively.

Medications can also be considered for patients seeking alternatives to surgery for management of SUI symptoms. Exogenous estrogen is among the most widely studied and prescribed of these agents in postmenopausal women due to the presence of estrogen receptors in urinary tract and pelvic tissues as well as the high prevalence of stress incontinence around the typical age of natural menopause. A 2012 Cochrane review suggests that topical vaginal estrogen therapy (ET) appears to be of benefit in this population, with a relative risk of 0.74 (95% CI 0.64–0.86, 4 studies, 213 women) for any patient-reported urinary incontinence among local ET users compared with placebo. However, systemic hormone replacement may actually exacerbate symptoms, with a relative risk of 1.32 (95% CI 1.17–1.48) of worsened incontinence among systemic ET users compared with placebo noted in the same review [6]. Multiple other pharmacologic agents have been studied as possible treatments for stress incontinence, but most are limited by duration of required use for symptom relief, poor efficacy, and undesirable side effects. As a result, no medications currently have FDA approval for the treatment of SUI.

Finally, mechanical devices such as vaginal pessaries or urethral plugs may be considered for patients who do not desire or cannot tolerate surgery. Satisfaction with the use of these inserts is generally highest among patients who have episodic and predictable incontinence episodes such as during exercise. However, pessaries and plugs often require removal and reinsertion to permit voiding and thus may be unacceptable for patients who find this manipulation unpleasant or difficult.

For women with SUI who do not obtain symptom relief with these conservative measures or who do not wish to consider them, surgery can be an appropriate and effective treatment. Currently, the most widely utilized surgical treatment for symptomatic stress incontinence is the synthetic MUS. This procedure involves the placement of a thin strip of non-absorbable polypropylene mesh loosely under the inferior portion of the midurethra and suspending it to surrounding supportive tissues. Trocars attached to each end of the mesh are used to carefully guide the implant either behind the pubic bone or through the nearby obturator membranes. The implanted mesh then acts as a scaffolding upon which collagen is deposited during the healing process. This band of collagen forms a new bridge of supportive tissue under the urethra and reduces its descent when subjected to increased intra-abdominal pressure. This pressure can then compress the urethra against the collagen and mesh support, increasing urethral closure pressure and restoring urinary continence (Figures 35.1 and 35.2).

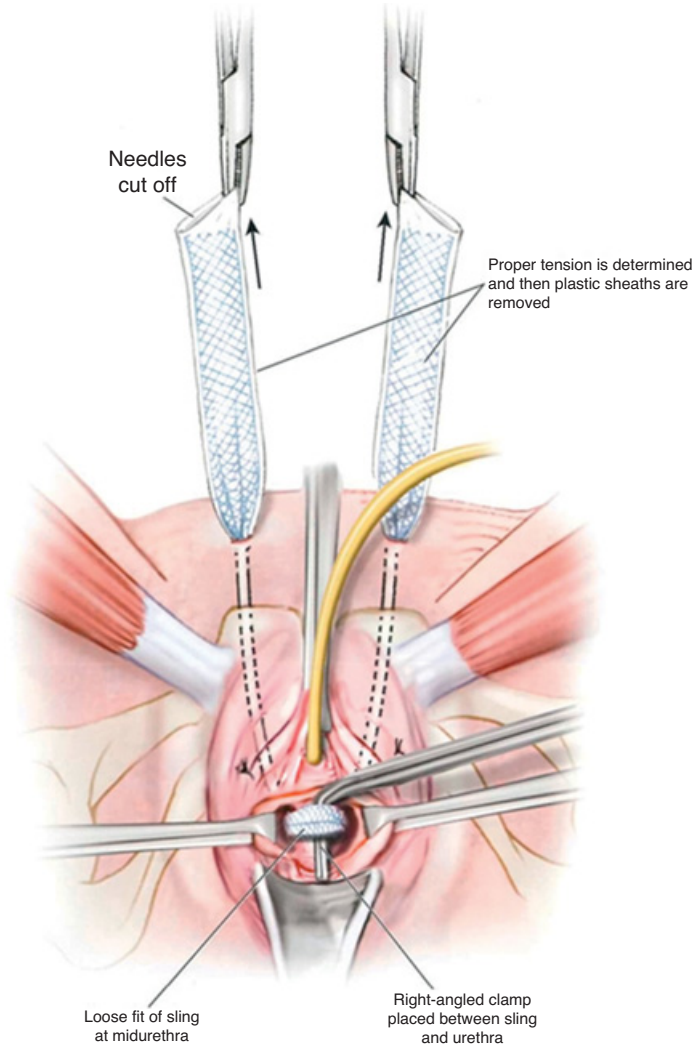

Figure 35.1 Placement of synthetic retropubic midurethral sling. (From *Urogynecology and Reconstructive Pelvic Surgery*. 4th ed. By Mark D. Walters, Mickey M. Karram. Philadelphia: Saunders; 2014. Used with permission.)

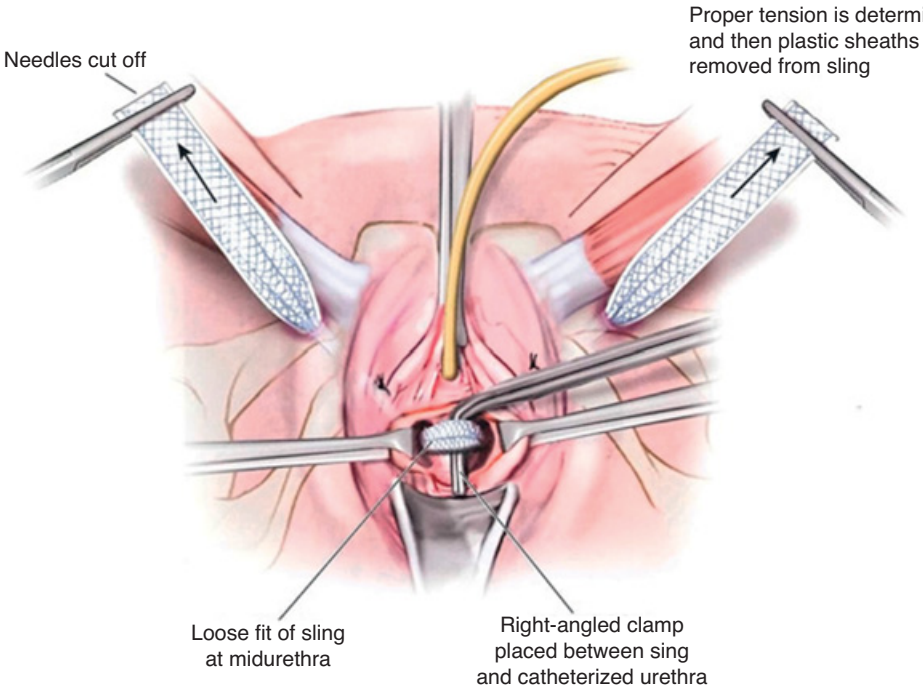

Figure 35.2 Placement of synthetic transobturator midurethral sling. (From *Urogynecology and Reconstructive Pelvic Surgery*. 4th ed. By Mark D. Walters, Mickey M. Karram. Philadelphia: Saunders; 2014. Used with permission.)

Synthetic MUS are highly effective, with cure rates equal to or better than other surgical techniques. Retropubic and transobturator slings appear equally effective, with patient-reported rates of symptom relief ranging from 62% to 98% at one year following retropubic MUS and 71% to 97% at one year following transobturator MUS. These benefits appear to persist five years or longer after surgery, although data for long-term outcomes are more limited [7]. Cure rates appear equivalent for the two possible directions of retropubic MUS trocar passage (often described as the "top-down" and "bottom-up" approaches). Similar outcomes are also seen for the "outside-in" and "inside-out" transobturator techniques. As a result, the American Urological Association supports offering any of the above methods of retropubic or transobturator sling placement to an otherwise healthy patient with SUI without prior SUI surgery, with the choice of approach dependent primarily on surgeon comfort and experience [8]. However, in an SUI patient that is diagnosed with intrinsic sphincter deficiency during their preoperative evaluation, a retropubic MUS approach is associated with higher rates of success than a transobturator approach [9].

Midurethral slings also carry the benefit of reduced morbidity and faster recovery compared with surgical techniques requiring larger incisions such as open retropubic colposuspension and autologous fascial bladder neck slings. However, these latter procedures are reasonable alternatives when synthetic mesh use is contraindicated, such as in women undergoing concurrent urethral surgery [8].

Adverse events related to MUS placement are rare. Bladder perforation during trocar placement is more common with retropubic slings (4.5%) than transobturator slings (0.6%, 95% CI 0.08–0.20) [7]. However, this complication can be recognized by performing intraoperative cystoscopy and is easily managed in most cases with removal and careful reinsertion of the trocar. Mesh erosion or extrusion is another rare complication following MUS placement, with equivalent rates for both retropubic (2.1%) and transobturator approaches (2.4%, 95% CI 0.78–1.65) [7]. Conservative treatments include topical estrogen therapy and pelvic rest. If this is unsuccessful, reoperation to mobilize and reapproximate the edges of the mucosal defect, excision of the exposed mesh only, or complete removal of the entire suburethral mesh may be necessary. Finally, injury to pelvic vessels and nerves, persistent pain, new-onset urge incontinence, and the risk of recurrent SUI symptoms are additional uncommon risks that should be discussed with a patient during the informed consent process.

Some patients warrant special consideration when considering treatment options for stress incontinence. Although some studies have shown similar outcomes among obese women compared to normal weight women following MUS procedures, others have demonstrated lower subjective and objective cure rates among obese patients undergoing MUS placement [10], providing additional support for recommending weight loss as a conservative intervention in this patient population. Additionally, the role of surgical intervention in women desiring future pregnancy is unclear. Concerns about mesh displacement and SUI recurrence following vaginal delivery have led some experts to advise either cesarean delivery following MUS placement or delay of any surgical intervention until childbearing is completed. However, there is little published information to support or contradict these recommendations, so management in these situations is generally individualized between each patient and provider.

Key Teaching Points

- Stress incontinence is a common condition diagnosed primarily based on patient symptoms. However, a thorough physical examination and bladder assessment are important to evaluate for other conditions such as prolapse or urinary tract infection
- Non-surgical treatments should be discussed with patients and encouraged due to their associated low cost and risk profile
- The synthetic MUS is the most commonly performed surgical treatment for SUI due to its high rate of success, ability to be performed in outpatient settings, low risk of adverse events, and persistent long-term benefit

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CASE 36 A 45-Year-Old P2 Woman Undergoing Vaginal Hysterectomy Who Desires Opportunistic Salpingectomy

Amy Markese

History of Present Illness

A 45-year-old woman, gravida 2, para 2, presents for preoperative consultation for hysterectomy. She has a long-standing history of abnormal uterine bleeding and has failed medical management with combined hormonal contraceptive pills and a levonorgestrel intrauterine device (IUD). She has completed childbearing and desires definitive surgical management with hysterectomy. Her family history is notable for breast cancer in her maternal grandmother. She denies history of abnormal Pap smears. She has no history of sexually transmitted infections. She has two prior spontaneous vaginal deliveries at term. Her medical history is significant for hypertension and she has no past surgical history. She is currently taking lisinopril and she has no known drug allergies.

Physical Examination

General appearance: Alert and oriented female in no acute distress

Vital signs:

Temperature: 36.8°C
Pulse: 82 beats/min
Blood pressure: 129/82 mmHg
Respiratory rate: 16 breaths/min
Oxygen saturation: 99% on room air
BMI: 25 kg/m^2

Abdomen: Soft, non-tender, non-distended without mass

Pelvic: Normal female external genitalia. The vaginal walls are pink and rugated. The cervix is smooth and without lesions. On bimanual examination, the uterus is small, anteverted, and mobile with descent to 1 cm above the introitus. No adnexal masses appreciated

Laboratory studies:

Hb: 11.5 g/dL

Urine pregnancy test: Negative

Cervical cytology: Negative for intraepithelial lesion or malignancy (NILM), HPV negative

Endometrial biopsy: Proliferative endometrium, negative for hyperplasia or malignancy

Imaging: Pelvic ultrasound shows the uterus measures 6.5 × 5.0 × 4.5 cm and is anteverted with a normal contour. Endometrium measures 8 mm in thickness. Right ovary measures 2.4 × 2.5 × 1.8 cm and demonstrates physiologic follicles. Left ovary measures 2.2 × 2.3 × 1.6 cm and demonstrates physiologic follicles

How Would You Manage This Patient?

This patient presents with abnormal uterine bleeding that has not responded to medical management. Given her small, mobile uterus, negative surgical history, and two prior vaginal deliveries, she is scheduled for a vaginal hysterectomy. Preoperatively, she is counseled on risk-reducing bilateral salpingectomy at the time of hysterectomy. She undergoes an uncomplicated vaginal hysterectomy with bilateral salpingectomy and is discharged the same day. She is seen back in the office at four weeks for a postoperative visit and is recovering well.

Opportunistic Salpingectomy

At the time of hysterectomy in average risk women, both the American College of Obstetricians and Gynecologists (ACOG) and the Society for Gynecologic Oncology (SGO) recommend that the surgeon and patient discuss the potential benefits of an opportunistic bilateral salpingectomy. The leading theory of epithelial ovarian carcinogenesis suggests that many serous, endometrioid, and clear cell carcinomas are derived from the fallopian tube and endometrium, rather than the ovary itself [1, 2]. Studies of *BRCA* mutation carriers undergoing risk-reducing bilateral salpingo-oophorectomy have shown that 1–5% of women had a preinvasive serous tubal intraepithelial carcinoma in the distal fallopian tube at the time of surgery, thought to be a precursor lesion to ovarian cancer. Ovarian cancer is the fifth leading cause of cancer death among women, with a poor survival rate due in part to lack of effective screening tests and few reliable symptoms of early-stage disease. Studies suggest that bilateral salpingectomy reduces the risk of ovarian cancer, and though this data was initially derived from *BRCA* mutation carriers, this risk reduction holds even among women at general population risk of the disease. A meta-analysis of three studies of women undergoing hysterectomy for benign indications demonstrated a lower risk of ovarian cancer among women who also underwent bilateral salpingectomy compared with those who did not [3]. A decision-analysis model demonstrates that salpingectomy at the time of vaginal hysterectomy could prevent ovarian cancer in 1 in 225 women having surgery and death in 1 in 450 of these women [4]. Salpingectomy at the time of hysterectomy is also a cost-effective strategy [4].

Salpingectomy at the time of hysterectomy has been shown to be both safe and feasible, with no significant increased risk of major complications such as blood transfusion, hospital readmission, or postoperative infection compared with hysterectomy alone. Short-term data also indicate there is no decrease or change in ovarian function following a bilateral salpingectomy [1]. This same data holds specifically when

hysterectomy is performed via the vaginal route. A multicenter, prospective study of patients undergoing planned vaginal hysterectomy found that bilateral salpingectomy resulted in an additional mean estimated blood loss of only 6 mL, with no significant increase in surgical complications [5]. Further, salpingectomy can be accomplished in the majority of vaginal hysterectomy cases, with completion rates reported between 75% and 88%. When salpingectomy could not be completed, adhesions or lack of tube accessibility were the most commonly cited reasons [1]. Factors that predict non-completion of salpingectomy at time of vaginal hysterectomy include prior adnexal surgery, fibroids, pelvic adhesions, and older patient age [5, 6]. BMI and history of sexually transmitted infection were not found to significantly impact ability to complete salpingectomy at the time of vaginal hysterectomy [6]. Given the safety and feasibility of performing salpingectomy at the time of vaginal hysterectomy, ACOG recommends that the planned route of hysterectomy not be modified simply for the purpose of salpingectomy [1].

Surgical Technique

When performing a salpingectomy, the fallopian tube should ideally be removed from the fimbriated end to the cornua; however, ovarian cancer risk reduction is thought to persist even in the setting of partial salpingectomy [1]. Various surgical techniques have been proposed to best facilitate salpingectomy.

The most common technique for performing transvaginal salpingectomy is referred to as the "mesosalpinx – mesovarium technique" [7]. In this technique, completion of the hysterectomy is performed as the round ligament–fallopian tube–utero-ovarian ligament complex is divided and ligated. The fallopian tube is grasped with a Babcock or Allis clamp and placed on gentle traction (Figure 36.1). A large clamp, such as a curved Heaney clamp, is placed across the mesosalpinx parallel and inferior to the fallopian tube and transects the tube at its most proximal location. Alternately, monopolar cautery can be used to divide the mesosalpinx, isolating the fallopian tube and allowing a clamp to be placed transecting the proximal tube. Once the tube is grasped and clamped, it is cut, and the pedicle tied off or suture ligated, typically using a braided absorbable suture such as 0 polyglactin.

When visualization is difficult, mini-laparotomy sponges or a sponge-stick can be used to retract the bowel. Trendelenburg positioning can also help the bowel to retract into the upper abdomen. If the ovary but not tube is identified, the ovary can be grasped with a Babcock clamp and gently retracted to allow exposure of the tube. The use of a pre-tied ligature loop can facilitate tubal ligation and removal, particularly if exposure or anatomy limits space for placing clamps and tying down pedicles. The technique begins the same as above, by grasping the tube with a Babcock or Allis clamp. The ligature loop is then threaded over the clamp and pressed down around the proximal tube, to form a knot. The suture is cut, and the tube is transected (Figure 36.2).

Giraudet et al. described an additional technique that involves tubal removal prior to completion of the hysterectomy [8]. In this technique, the posterior peritoneum is entered, and the vaginal hysterectomy is performed up to and through transection of the uterine arteries. The anterior peritoneum is then entered. The uterus is rotated 180 degrees, exposing the posterior uterus. The fallopian tubes are identified, coagulated, and cut from the mesosalpinx leaving the tubes attached at the

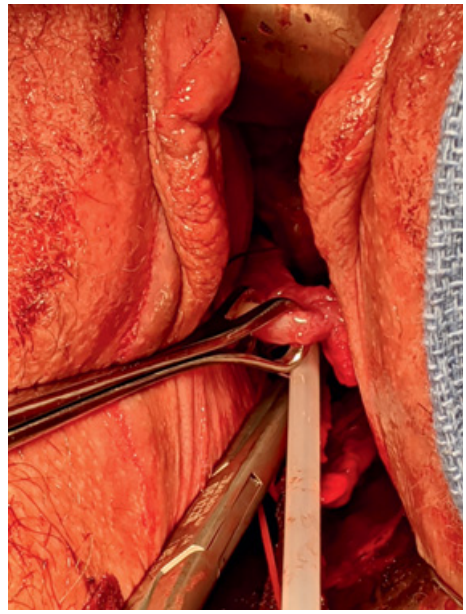

Figure 36.1 After completion of the hysterectomy, the fallopian tube is grasped with a Babcock clamp and placed on gentle traction. Bowel is packed out of the way with a mini-laparotomy sponge.

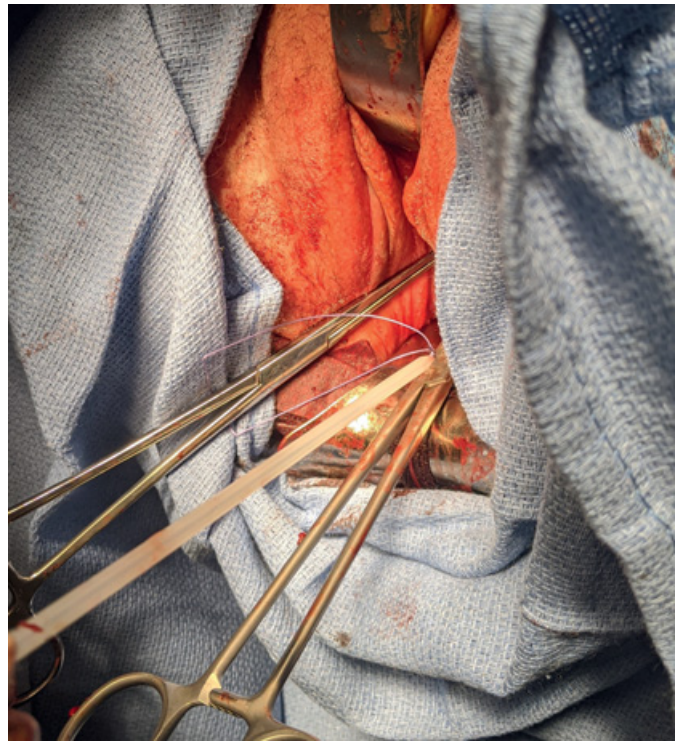

Figure 36.2 An endoloop ligature is placed around the Babcock clamp and tied down, allowing transection and removal of the fallopian tube.

cornua. The hysterectomy is completed by dividing and ligating the utero-ovarian and round ligaments. The fallopian tubes are removed with the hysterectomy specimen.

Finally, Kho et al. describe a "round ligament technique" for removal of the fallopian tubes, which allows removal of the entire tube including the very most proximal portion and may be a consideration for patients at higher risk of ovarian cancer [9]. In this technique, the vaginal hysterectomy is first completed and the round ligament–fallopian tube–utero-ovarian ligament complex is suture ligated as usual. Vaginal packing is placed to retract the bowel, and a Deaver retractor is used on the vaginal sidewall peritoneum to allow visualization of the fallopian tube. The fallopian tube is grasped with an Allis clamp and placed on gentle traction. With the tube on traction, monopolar cautery is used to divide the round ligament, allowing the adnexa to drop away from the pelvic sidewall and into the surgical field. A window is then created in the mesosalpinx, and a Heaney or similar clamp is placed on the distal utero-ovarian pedicle, near the ovary. The fallopian tube–utero-ovarian complex is recut, releasing the most proximal portion of the tube. A bipolar cautery device is then used to serially seal and divide the mesosalpinx until the fimbria is reached. The utero-ovarian complex is religated with a tie or suture ligation.

Video description of both the mesosalpinx–mesovarium technique and the round ligament technique can be found at DOI:https://doi.org/10.1016/j.jmig.2017.06.012.

Summary

Salpingectomy can be feasible and safely performed the majority of the time during a vaginal hysterectomy. Given that bilateral salpingectomy can reduce risk of ovarian cancer in patients at population risk of disease, an opportunistic salpingectomy should be discussed with the patient prior to surgery. Various surgical techniques have been proposed to facilitate salpingectomy at the time of vaginal hysterectomy, and salpingectomy has not been shown to increase the risk of surgical complications.

Key Teaching Points

- Prior to hysterectomy, both ACOG and SGO recommend that the surgeon and patient discuss bilateral salpingectomy as a means of risk reduction for ovarian cancer
- Salpingectomy at the time of vaginal hysterectomy has been shown to be both safe and feasible
- Factors that may impact ability to complete transvaginal salpingectomy include prior adnexal surgery, fibroids, pelvic adhesions, and older patient age
- The mesosalpinx–mesovarium technique, round ligament technique, and posterior rotation of the uterus have all been proposed to facilitate transvaginal salpingectomy
- Route of hysterectomy should not be modified simply for the purpose of salpingectomy

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CASE 37 A 32-Year-Old G2P2 with Bleeding from a 5 cm Vaginal Laceration after Sexual Assault

Robyn Gray-Puleo

History of Present Illness

A 32-year-old woman, gravida 2, para 2, presents to the emergency department by ambulance with heavy vaginal bleeding and severe abdominal and pelvic pain after physical and sexual assault by her ex-husband.

She reports being hit in her lower abdomen with a bat and punched in the face. She recalls heavy vaginal bleeding and profound abdominal pain following forced penetrative intercourse. She does not recall if a foreign body/object was used, but she admits to not remembering much once he started sexually assaulting her.

She denies fevers but reports some nausea and an episode of vomiting in the ambulance. Her pain is currently 8/10 constant, sharp across the abdomen, worse with movement and breathing.

She is divorced and not currently sexually active. She denies history of sexually transmitted infections. She had a tubal ligation after her last delivery. She has no significant medical or other surgical history; she is not taking medications and has no known drug allergies.

Physical Examination

General appearance: Uncomfortable appearing female, in moderate distress, tearful, mild ecchymosis along the left cheekbone

Vital signs:

Temperature: 37.5°C

Pulse: 130 beats/min

Blood pressure: 110/60 mmHg

Respiratory rate: 22 breaths/min

Oxygen saturation: 98% on room air

Chest: Clear to auscultation bilaterally

Cardiovascular: Tachycardic with regular rhythm

Abdomen: Diffusely tender to palpation, with rebound and guarding in lower quadrants. Ecchymosis is visible along the right flank and extending to the pelvis

Pelvic: External genitalia with bilateral ecchymosis along the labia majora and mons pubis, no lacerations or hematoma noted. Sterile speculum examination demonstrated moderate amount of blood and clot in the vaginal vault. The cervix appears closed, no lesions or lacerations or avulsions. Right posterior fornix had a deep 5 cm laceration, with small amount of active bleeding

Extremities: Bilateral ecchymosis of inner thighs, no lacerations. Non-tender, no edema

Neurologic: Alert and oriented; anxious

Laboratory studies:

WBCs: 12 800/μL (normal 4000–9500/μL)

Platelets: 150 000/μL (normal 145 000–357 000/μL)

Hb: 10.6 g/dL (normal 11.7–15.5 g/dL)

Coagulation studies:

INR: 1.0 (normal 0.91–1.16)

PT: 10 sec (normal 9.4–12.5 sec)

PTT: 32 sec (normal 25–37 sec)

Fibrinogen: 200 mg/dL (normal 200–393 mg/dL)

Urinalysis: Negative

Urine pregnancy test: Negative

Imaging:

Abdominal and pelvic CT: Hematoma distending the endometrium and vaginal vault. Concern for vaginal extravasation or torn/heaped up vaginal wall/mucosa. Hyperdense material contiguous from endometrial cavity through fundus into peritoneal cavity. Pelvic fractures involving left iliac bone and bilateral pelvic rami (Figures 37.1 and 37.2)

Cystogram: Intact bladder; remote from hyperdense intraperitoneal material

How Would You Manage This Patient?

This patient presents with mild active vaginal bleeding in the setting of physical and sexual assault. She is currently hemodynamically stable, but has clinical findings concerning for peritonitis with rebound and guarding on clinical examination. With her presenting history and obvious trauma to her abdomen and pelvis, she had immediate imaging with CT scan of abdomen and pelvis. Additionally, gynecology and general surgery/trauma were consulted.

This patient remained stable and CT scan revealed extensive vaginal laceration suspicious for peritoneal cavity perforation as evidenced by presence of hemoperitoneum. Additionally, bilateral pelvic rami and left iliac bone fractures were identified. Cystogram was performed and bladder appeared normal.

She was taken to the operating room for examination under anesthesia and exploratory laparoscopy. At time of surgery, she was found to have hemoperitoneum that was evacuated without evidence of perforation of uterus or vaginal vault, and no evidence of solid organ injury. General surgery was present to run the bowel and no injuries were identified. The 5 cm posterior fornix vaginal laceration was repaired using interrupted 3.0 vicryl suture. She was managed by the orthopedic surgeon for

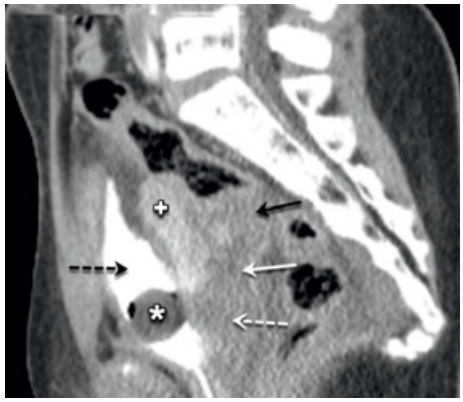

Figure 37.1 Sagittal contrast-enhanced CT pelvis demonstrating hyperdense material distending the vagina (hatched white arrow). Uterus (white +), bladder (black hatched arrow) with Foley catheter (white star). Discontinuous vaginal apex (white arrow) with peritoneal extravasation of hyperdense material (black arrow). (Image courtesy of Anne Silas, MD, ABR Radiology Department: Dartmouth Hitchcock Medical Center, Lebanon, NH, Associate Professor of Radiology, Geisel School of Medicine, Dartmouth.)

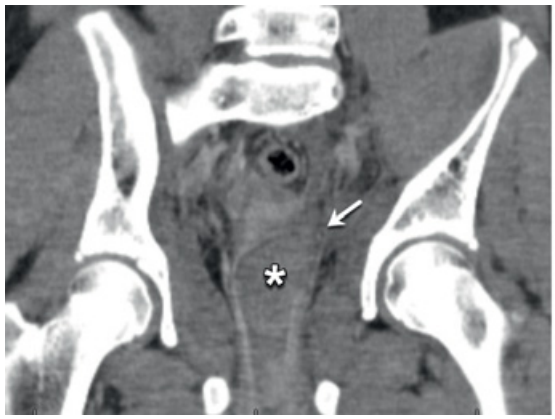

Figure 37.2 Coronal contrast-enhanced CT pelvis demonstrating hyperdense material consistent with thrombus and blood products distending the vaginal vault (white star). Discontinuous left apical vaginal wall (white arrow) with extravasation of blood products into the pelvis. (Image courtesy of Anne Silas, MD, ABR Radiology Department: Dartmouth Hitchcock Medical Center, Lebanon, NH, Associate Professor of Radiology, Geisel School of Medicine, Dartmouth.)

stabilization of the pelvic fracture. Postoperatively, she was given a tetanus shot, given high suspicion for foreign object penetration, as well as sexually transmitted infection prophylaxis. She had additional care from the sexual assault nurse examiner during her hospitalization. The patient was referred for outpatient counseling and follow-up in two to four weeks for post-surgical care with the gynecology team.

Vaginal Laceration from Sexual Assault

Sexual assault is estimated to occur in 13–39% of women over their lifetime and visually, ano-genital injuries are recognized in 30% of victims rising to 84% with use of colposcopy or toluidine blue [1]. Populations at risk of sexual assault include those with physical or mental disability, institutionalized or homeless persons, gay, lesbian, bisexual, or transgendered persons, users of illicit drugs, college students, and history of intimate partner violence. Most injuries are minor and commonly include fourchette tears, labial abrasions, and vaginal lacerations [2]. More serious and potentially life-threatening injuries including extensive vaginal lacerations with or without cuff rupture, cervical laceration, rectal mucosa lacerations, and air embolism are reported with penetrative penile intercourse or use of foreign body. Women at extreme ages of life (the very young and elderly) are at particular risk of significant injuries. Other risk factors for extensive injuries include use of foreign body, history of vaginal surgery or radiation, and presence of ano-genital lesions [3, 4].

Surgical evaluation should include prompt assessment of blood loss and hemodynamic stability. If unstable hemodynamically, resuscitative efforts should include use of plasma expanders and blood products as necessary. Examination under anesthesia allows for rapid evaluation of extent of ano-genital injuries including thorough evaluation of the vulva, urethra, vagina, cervix, and bimanual palpation. Rectal examination should note any fecal soilage, anal tear, sphincter tone, and integrity. Further evaluation may include cystoscopy in the presence of hematuria, and proctoscopy for suspected anal injuries. Diagnostic laparoscopy or laparotomy is indicated if there are signs of peritoneal irritation. If the patient is stable, preoperative imaging with CT scan may allow for determination of the extent of injuries and exclude presence of a retained foreign body or intra-abdominal bleeding.

Minor perineal lacerations and vulvar hematoma can be treated conservatively with use of non-steroidal anti-inflammatory agents, cold packs, and compression bandage. Larger and rapidly expanding vulva hematoma will require incision, drainage, and packing under general anesthesia. Secondary, third- and fourth-degree lacerations should be debrided and repaired in a manner identical to equivalent obstetric laceration. Injuries to the rectum proximal to the sphincter require proctoscopy with appropriate expertise; diverting colostomy may be needed for more extensive injuries.

Vaginal lacerations typically occur posteriorly and frequently on the right. The depth of the injury should be carefully assessed to assure the integrity of the cuff; any suspicion of peritoneal breach or presence of foreign body should prompt diagnostic laparoscopy and careful evaluation of bowel integrity. Otherwise, vaginal lacerations can be repaired with an absorbable suture in continuous locking fashion. Although evidence for use of preoperative antibiotics is lacking, it would seem prudent to administer a single dose of broad-spectrum antibiotics to those requiring surgical repair. Antibiotic therapy is mandatory for human bites to prevent aerobic and anaerobic infections.

Postoperative surgical wound management should be consistent with normal practice. Pain relief should be adequate and prophylaxis against gonorrhea, chlamydia, trichomoniasis, hepatitis B, HIV and tetanus booster should be administered. Hormonal or non-hormonal emergency (copper intrauterine device) contraceptive should be offered. Psychological support should be offered for acute emotional reactions of embarrassment, self-blame, and self-doubt with

expertise from a sexual assault nurse examiner, social worker, and sexual assault response team if available. Because sexual assault victims are at lifetime risk for development of post-traumatic stress disorder, major depression, suicide attempt, and suicide, it is imperative that sexual assault crisis counselors create a plan for long-term psychological support prior to dismissal.

Key Teaching Points

- Sexual assault is reported in 13–39% of women over their lifetime; most episodes are un-reported. Prompt assessment should include estimates of blood loss and hemodynamic stability
- Imaging with CT scan, cystoscopy and proctoscopy may assist in determining extent of injuries and presence of intra-abdominal blood loss
- Exploratory laparotomy and/or laparoscopy is indicated in a hemodynamically unstable patient and/or suspicion for peritoneal cavity entry
- Substantial perineal and vaginal lacerations must be repaired in the usual fashion; rectal injuries require additional multidisciplinary collaboration
- Prophylaxis against sexually transmitted infection, tetanus, and pregnancy are mandatory
- Long-term psychological support is required to reduce risk of mood disorders and threat to life

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CASE 38 A 50-Year-Old Woman Loses Consciousness during an Office Hysteroscopy

Isabel C. Green

History of Present Illness

A 50-year-old woman is seen in the office for the evaluation of postmenopausal bleeding. Pelvic ultrasound demonstrated an 11 mm endometrial lining. She has a history of diabetes and well-controlled hypertension. She has no known drug allergies. She has a history of prior cesarean sections. After review of technical aspects and risks, consent is obtained. She is placed in dorsal lithotomy position and the vagina is prepped with povidone-iodine. Vaginoscopy is performed using a 3 mm flexible hysteroscope. The vaginal mucosa and endocervical canal appear normal. She reports to the nurse that she is feeling lightheaded and warm. She subsequently states that her vision is blurred and loses consciousness.

Physical Examination

General appearance: Facial pallor and diaphoresis, skin is cool and clammy to the touch

Vital signs:

Temperature: 37.6°C

Pulse: 56 beats/min

Blood pressure: 90/60 mmHg

Respiratory rate: 18 breaths/min

Oxygen saturation: 97% on room air

Chest: Clear to auscultation, shallow respirations bilaterally

Cardiovascular: Bradycardia with regular rhythm

Abdomen: Soft, non-distended

Pelvic: No bleeding from the cervical os

How Would You Manage This Patient?

The patient presents with loss of consciousness during office hysteroscopy. Preceding symptoms included lightheadedness, feeling warm, and blurred vision. These symptoms are frequently part of the prodrome associated with vasovagal reflex syncope, which is the most common complication of office hysteroscopy. However, other causes should be considered in the initial evaluation, particularly in patients with preexisting medical conditions such as in this patient with diabetes and hypertension. The differential diagnosis would include hypoglycemia, anaphylaxis, cardiogenic syncope, or local anesthetic systemic toxicity (LAST) if a local block had been used. A point of care (fingerstick) glucose was also performed in this patient to rule out hypoglycemia.

Treatment was targeted at improving cerebral perfusion while monitoring vital signs (blood pressure, heart rate, respiratory status, and oxygenation). The procedure was discontinued and the head of the bed lowered. Her legs were elevated to improve cerebral perfusion. Smelling salts and stimulation were administered to assist her in regaining consciousness. As occurs in most cases, this patient recovered consciousness rapidly, within 20–30 seconds, with subsequent normalization of her vital signs. Residual symptoms of nausea, pallor, lightheadedness, and diaphoresis may continue. In the event that she did not respond to these supportive measures, her refractory episode may require intravascular resuscitation (IV) and oxygen support. In the rare event, the above are not sufficient, atropine can be administered to increase cardiac output. After this vasovagal episode, clinic observation was recommended, as she may subsequently experience recurrent syncope when moving from the horizontal to vertical position, and this should be done gradually.

Complications of Office Hysteroscopy

Complications in office hysteroscopy are infrequent (0.22–0.28%) [1–3]. The office setting confers unique risks due to the awake patient and interventions targeted at managing patient comfort such as a paracervical block. Those complications more unique to the office include vasovagal reflex syncope as experienced with this patient, anaphylaxis, and LAST [4].

The vasovagal reflex is characterized by vagally mediated vasodilation and decreases in heart rate in response to a trigger. Office procedure triggers include stress, emotional stimulation, noxious stimuli, medical instrumentation, and fear. Although typically self-limited, the combination of hypotension and bradycardia lead to central nervous system hypoperfusion and possibly syncope. In a patient with significant cardiac morbidity such as aortic stenosis or other obstructive heart disease, bradycardia may lead to cardiogenic syncope and additional morbidity. Vasovagal symptoms can occur during a procedure, or be delayed and occur following a procedure when the patient is in a vertical or standing position. Isometric muscle tensing (patient using arms to "give themselves a hug" or gripping a ball) may help abort an episode and can be utilized in patients with prior history of vasovagal episodes at the first signs of the vasovagal reflex [5].

Anaphylaxis

Anaphylaxis is a systemic, immediate hypersensitivity reaction that may be immunologic, non-immunologic, or idiopathic in etiology. The subsequent global inflammatory response may result in a range of symptoms [6]. Potential exposures include povidone-iodine, latex, non-steroidal anti-inflammatory medications, or injections. Cutaneous symptoms include urticaria, angioedema, flushing, and pruritus, and may be present in 45–90% of patients. Respiratory symptoms include dyspnea, wheezing, upper airway angioedema, and rhinitis, and may be present in 15–50% of patients. Systemic symptoms such as hypotension, dizziness, syncope, and diaphoresis may be present in 30–35% of patients. Abdominal symptoms including

nausea, vomiting, diarrhea, and pain may be present in 25–30% of patients.

During the initial evaluation, it is important to assess for possible inciting exposures or incidents and to maintain a wide differential diagnosis [6]. These symptoms can also be seen with organic and non-organic causes such as carcinoid tumor, hyperthyroidism, hereditary angioedema, paradoxical pheochromocytoma, panic attacks, vasovagal reactions, or vocal cord dysfunction. In contrast to vasovagal symptoms, anaphylaxis early on is associated with tachycardia and hypotension in contrast to bradycardia, and as facial redness in contrast to cool clammy skin.

The first step is to remove the inciting agent if possible [6], such as swabbing povidone-iodine from the vagina. Next is evaluation of the airway, breathing, circulation, and mentation of the patient and to call for help. If there is evidence of a severe reaction, emergency medical services should be called. In the event of cardiopulmonary arrest, resuscitative measures should be initiated [6].

Regardless of severity of signs and symptoms, if there is concern for anaphylaxis, epinephrine should be swiftly administered as delay in this intervention is thought to be a major contributing factor to fatalities. Intramuscular administration is preferred, typically with an auto-injector for ease and speed of administration. When drawn from a 1 mg/mL ampule vial, a 1 mL syringe is used to draw up 0.5 mg (0.5 mL) for patients over 50 kg. The patient should be placed in the supine position while monitoring vital signs at frequent, regular intervals during resuscitation. In addition to epinephrine, supplemental oxygen and intravenous access should be obtained. Hypotension refractory to intramuscular epinephrine may be treated with rapid fluid resuscitation. For signs of bronchospasm (wheezing, dyspnea, coughing) that has not responded to epinephrine, nebulized albuterol may be given [6].

Patients on beta-adrenergic antagonists may have severe or refractory anaphylaxis, possibly due to a blunted response to treatment with epinephrine. These patients may require treatment with glucagon in order to treat bronchospasm and hypotension via a mechanism that bypasses the beta-adrenergic receptors.

In the setting of moderate to severe anaphylaxis, the minimum recommended observation time is 4–8 hours. Longer observation and possible admission should be considered if the patient has risk factors for severe anaphylaxis, if the allergens have been ingested, if more than one dose of epinephrine was required, or if prolonged symptoms are present. Patients should be counseled on the future avoidance of possible triggers [6]. A prescription for auto-injectable epinephrine should be given promptly as up to 23% of patients with anaphylaxis can have a biphasic reaction with return of symptoms within 10 hours after the initial event.

Local Anesthetic Systemic Toxicity

Local anesthetics are frequently utilized for paracervical blocks. Local anesthetic systemic toxicity (LAST) refers to the manifestation of toxic levels of local anesthetics, typically characterized by symptoms in the cardiac and central nervous systems. It can occur when these agents are inadvertently injected intravascularly or when high doses are used. There is significant variability in the presentation of LAST described in the literature. The typical cascade of signs and symptoms of LAST starts with central nervous system excitement. This may manifest with auditory changes such as tinnitus, circumoral numbness, metallic taste, and abrupt onset of psychiatric symptoms such as agitation or anxiety. Excitatory symptoms may then progress to seizures. Following seizures, the patient may exhibit central nervous system depression characterized by drowsiness, coma, or respiratory depression [7].

Cardiac signs and symptoms typically follow neurologic evidence of LAST. Similar to central nervous system effects, the cardiac system initially exhibits evidence of excitation (hypertension, tachycardia, and/or ventricular arrhythmias) possibly followed by depression (bradycardia, decreased contractility, hypotension, and/or asystole). Cardiac toxicity may be present in LAST without central nervous system toxicity or simultaneously [7].

Timing of signs and symptoms of LAST also varies. Immediate LAST occurs less than 60 seconds after the injection and is suggestive of intravascular administration of the drug. Delayed LAST occurs between 1 and 5 minutes after the injection and is suggestive of intermittent intravascular injection or delayed tissue absorption. LAST can also present more than 15 minutes later.

LAST is associated in patients with underlying disease in cardiovascular, neurologic, pulmonary, renal, and hepatic systems. Patients with metabolic disorders may also be more likely to experience toxicity. LAST is also associated with extremes of age and use of larger doses of local anesthetics in areas of the body with higher vascularity [7].

Isolated minor effects in LAST such as tinnitus or metallic taste can be observed without medical intervention as they typically resolve with time and **withholding any additional local anesthetic administration**. While frequently considered side effects of anesthetic administration, these minor symptoms represent nervous system excitation due to anesthetic absorption and toxicity. If significant symptoms develop, airway management is the initial priority to prevent hypoxia and acidosis, both of which potentiate LAST. Additional resources and resuscitative team support should be quickly engaged. If seizures occur, the primary treatment is benzodiazepines. If cardiac toxicity occurs resulting in arrest, advanced cardiac life support measures should be initiated. Epinephrine is the preferred agent in this setting. Ventricular arrhythmias should be preferentially managed with amiodarone instead of local anesthetics such as lidocaine or procainamide.

Should initial resuscitative measures fail, lipid emulsion therapy should be initiated. If all these interventions are unsuccessful, cardiopulmonary bypass is warranted.

The risk of LAST can be minimized by using the lowest effective dose of local anesthetic for a given procedure and avoiding high doses. Aspirating the needle and watching for a flash of blood in the syringe may aid in early detection of intravascular needle placement. Use of incremental injections

may also allow providers to detect evidence of early toxicity prior to administering a significant dose of the drug.

Patient Safety

Patients should expect the same level of safety in the office as they would in the operating room. Office protocols and policies should address appropriate patient selection, provider credentialing, equipment maintenance, transfer plans, and evacuation plans [8]. Each office setting is unique. What is most appropriate for a practice located within a hospital likely will not apply to a stand-alone clinical facility without immediate access to emergency services.

Simulation is a well-studied proven tool for the acquisition of team-based skills and can prepare and refresh office staff in the management of these infrequent complications [4, 8]. As our patient population ages and develops more chronic medical conditions, the pool of patients undergoing office-based procedures also increases in complexity and complication risk [8]. Thoughtful consideration of the safest and most appropriate setting for a procedure should be included in procedural planning. While rare, office emergencies have the potential for significant morbidity and mortality if the team is caught unprepared.

Key Teaching Points

- While rare, complications include vasovagal reflex syncope, anaphylaxis, and local anesthetic systemic toxicity (LAST)
- The vasovagal reflex is characterized by vagally mediated vasodilation and decreases in heart rate and resulting cerebral hypoperfusion
- Syncope is frequently preceded by a 30- to 60-second prodrome including nausea, pallor, diaphoresis, blurred vision, and feeling hot or cold
- Treatment is targeted at improving cerebral perfusion by lowering the head of the bed and if possible, elevating the lower extremities. Patients typically recover consciousness rapidly (20–30 seconds)
- Refractory episodes may require intravascular resuscitation (IV) and oxygen support, and rarely the administration of atropine to increase cardiac output

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CASE 39 A 44-Year-Old Woman with Intermenstrual Spotting

Dana Marie Scott

History of Present Illness

A 44-year-old woman, gravida 2, para 2, presents for evaluation of a four-month history of intermenstrual bleeding. Menses occur at regular, 28-day intervals, and last 4–5 days with recently heavy flow. For the past four months she has had painless intermenstrual bleeding at unpredictable times throughout her cycle. Intermenstrual bleeding ranges from spotting to moderate flow and lasts one to two days. Her last menstrual period was three weeks ago. She is up to date on cervical cancer screening and routine gynecologic care. Medical history is significant for hypothyroidism, two prior cesarean deliveries, and bilateral tubal ligation. She is on levothyroxine and denies any medication allergies. She is sexually active with one male partner and denies any history of sexually transmitted infections or recent exposures.

Physical Examination

General appearance: Well-appearing

Vital signs:

Temperature: 36.8°C

Pulse: 74 beats/min

Blood pressure: 118/65 mmHg

Respiratory rate: 16 breaths/min

Height: 64 inches

Weight: 125 lb

BMI: 21.5 kg/m^2

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

Pelvic: Normal external genitalia. Vagina with scant dark red blood. Cervix with mild ectropion, but no other visible abnormalities. Uterus anteverted, non-tender, mobile, slightly enlarged without appreciable masses. Bilateral adnexa without palpable masses or tenderness

Laboratory studies:

Urine pregnancy test: Negative

TSH: 2.1 mIU/L (normal 0.35–4.94 mIU/L)

Hb: 11.1 g/dL (normal 12.0–16.0 g/dL)

Cervical gonorrhea and chlamydia NAAT swab: Negative

Imaging: Transvaginal ultrasound shows an anteverted uterus measuring 9.1 × 5.3 × 4.2 cm with a 2 cm subserosal anterior fundal fibroid. Endometrium 12 mm with focal thickening at the fundus. Left ovary measures 3.4 × 3.1 × 2.6 cm without visible abnormalities. Right ovary measures 3.7 × 3.2 × 2.7 cm with a 1.5 cm simple cyst

How Would You Manage This Patient?

This patient presents with recent-onset intermenstrual bleeding. She underwent transvaginal ultrasound (TVUS). TVUS is a common first-line imaging modality for abnormal uterine bleeding (AUB), and is indicated in cases of an enlarged uterus, pelvic pain, suspected adenomyosis, or patient preference [1]. This patient's focally thickened endometrium on pelvic ultrasound raises suspicion for an endometrial polyp. She underwent a diagnostic office hysteroscopy during the follicular phase of her next menstrual cycle, which revealed an endometrial polyp. Hysteroscopic polypectomy and hysteroscopic-guided endometrial biopsies were performed in the office under paracervical block. Pathology revealed a benign endometrial polyp and normal proliferative endometrium. Her intermenstrual bleeding resolved after the procedure.

Evaluation of Intermenstrual Bleeding and Office Hysteroscopy

Abnormal uterine bleeding is among the most common causes for gynecologic referrals, and intermenstrual bleeding is a common complaint among this population [2]. Both structural and non-structural etiologies of AUB should be considered. The International Federation of Gynecology and Obstetrics (FIGO) and American College of Obstetricians and Gynecologists (ACOG) have adopted the acronym PALM-COEIN to classify AUB by etiology. PALM refers to structural causes (polyp, adenomyosis, leiomyoma, malignancy/hyperplasia) and COEIN refers to non-structural causes (coagulopathy, ovulatory dysfunction, endometrial, iatrogenic, not yet classified) [3].

Intrauterine pathology, such as polyps and myomas, is identified in up to 40% of women presenting with AUB [2]. Accurate evaluation of the uterine body and cavity is, therefore, a critical part of the diagnostic evaluation. Non-structural etiologies of intermenstrual bleeding should be evaluated as well, and basic laboratory evaluation with pregnancy test, complete blood count, gonorrhea and chlamydia screening, and thyroid function tests should be considered [3].

Endometrial polyps are a common cause of AUB, occurring in 10–40% of reproductive-aged women undergoing evaluation [4]. Such bleeding is classified as AUB-P by the PALM-COIEN system [3]. Symptomatic endometrial polyps are typically removed for resolution of AUB. Even among asymptomatic women, endometrial polyps are often removed due to concerns of malignancy and/or hyperplasia. A recent systematic review and meta-analysis identified an overall 2.73% risk of malignancy among all endometrial polyps, but a higher risk of malignancy (5.14%) was noted among symptomatic patients regardless of menopausal status [4].

Outpatient hysteroscopy can be offered as the first-line diagnostic test when intrauterine pathology is the suspected

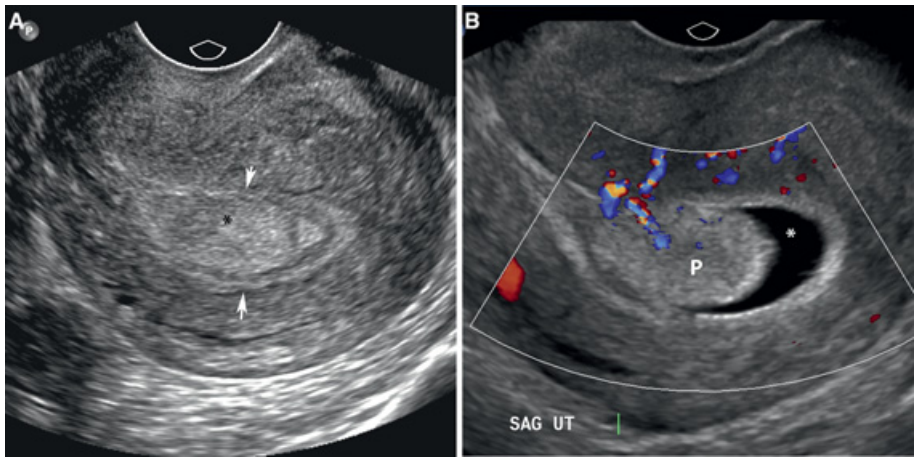

Figure 39.1 Endometrial polyp on TVUS (A) and SIS (B). (A) Echogenic intracavitary mass with hyperechoic rim. (B) Polyp margins outlined by intracavitary fluid. (Reprinted from *Canadian Association of Radiologists Journal*, Vol 67 Issue 3, Sadro C, Imaging the endometrium: a pictorial essay. Pp. 254–262, Copyright 2016, with permission from Elselvier.)

source of AUB [1]. TVUS should be used if the uterus is enlarged or extracavitary pathology is suspected but is less accurate than other methods for identifying intracavitary lesions. Endometrial polyps may appear with non-specific endometrial thickening rather than the classic hyperechoic intracavitary lesion, which can be difficult to differentiate from polypoid endometrium, particularly among premenopausal women [5]. Sensitivity and specificity for intracavitary lesions is significantly improved with the addition of saline infusion sonography (SIS) (see Figure 39.1) [6].

Many studies show similar detection rates of endometrial polyps between SIS and hysteroscopy [3, 5]. SIS does not offer removal of the visualized intracavitary lesion or pathologic diagnosis.

Hysteroscopy is an important option in the evaluation of AUB. Compared with TVUS or SIS, hysteroscopy allows direct visualization of the endometrial cavity, as well as the option to resect intracavitary lesions immediately if identified (Figure 39.2). Hysteroscopy is more accurate for identifying intracavitary pathology than TVUS or SIS, with excellent sensitivity and specificity for both endometrial polyps (sensitivity 94%, specificity 92%) and submucous myomas (sensitivity 87%, specificity 95%) [2].

In-office hysteroscopy has emerged as a convenient option for patients undergoing AUB evaluation. Office hysteroscopy is cost-effective, avoids general anesthesia, and is associated with higher patient satisfaction and faster recovery compared with hysteroscopy performed in the operating room [7]. In particular, patients appreciate the ability to "see and treat" their condition at the same time. Importantly, a randomized controlled non-inferiority study showed office operative hysteroscopy is as effective as hospital-based procedures for treatment of AUB caused by endometrial polyps [8]. Office-based procedures were, however, associated with higher rates of incomplete polyp resection and slightly lower acceptability by patients [8].

An office procedure can be considered for most patients requiring hysteroscopy for evaluation of AUB. If operative hysteroscopy for an intracavitary lesion is planned, the provider should be aware of the size and location of the target pathology and consider the likelihood of successful resection in the office. Patients with significant procedural anxiety or those with difficulty tolerating prior office-based procedures may benefit from a procedure in the operating room. Significant medical comorbidities, such as obstructive sleep apnea or cardiac or pulmonary disease, are not a contraindication to an office procedure, but may preclude the use of intravenous sedation if available [7].

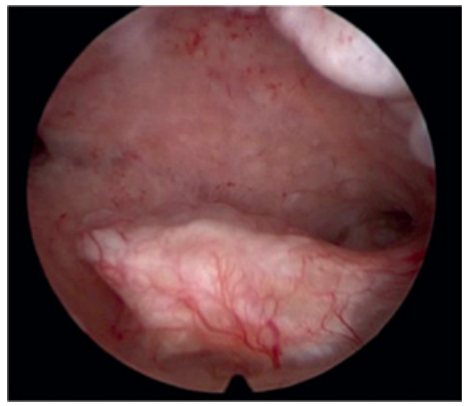

Figure 39.2 Endometrial polyp visualized on hysteroscopy. (Reprinted from *Journal of Minimally Invasive Gynecology*, Vol 25 Issue 2, Salazar CA, Isaacson KB, Office operative hysteroscopy: An update. pp 199–208, Copyright 2018, with permission from Elselvier.)

The optimal timing of diagnostic hysteroscopy in premenopausal women is during the follicular phase of the menstrual cycle after completion of menstruation, when the endometrium is at its thinnest [7, 9]. Routine preparation of the cervix prior to office hysteroscopy is not recommended but should be considered in patients suspected to have cervical stenosis. If cervical preparation is indicated, a synthetic prostaglandin E1 (such as misoprostol 400–800 mcg) can be administered vaginally 12 hours prior to the procedure [9]. Such preparation is associated with decreased procedural pain in those with cervical stenosis, but increased side effects such as nausea, pelvic pain, and vaginal bleeding [9].

Adequate pain control is an important component of office hysteroscopy. Poor pain control is the most common cause of procedure discontinuation [9]. Many different options for pain control are described in the literature, including intracervical

or paracervical block and pre-procedural non-steroidal anti-inflammatory medication, benzodiazepines, and opiates (most commonly buprenorphine and tramadol). A recent Cochrane systematic review and meta-analysis showed no significant difference between the most common pain control options, though analysis was limited by study heterogeneity and low-quality evidence [10]. Mean pain scores were fairly low among all pain control options.

Procedure technique can also affect patient tolerance of office hysteroscopy. Smaller diagnostic scopes (≤3.5 mm diameter) may be better tolerated than larger diameter operative hysteroscopes (typically 4–5 mm) [1, 9]. Both flexible and rigid diagnostic hysteroscopes are available in these sizes. A smaller hysteroscope can be used for initial evaluation of the uterine cavity, followed by the larger operative hysteroscope if necessary.

Another option to reduce procedural pain is vaginoscopy, which is associated with decreased procedural pain compared with traditional hysteroscopy with speculum and tenaculum [7, 9]. A vaginoscopic approach involves gently placing the hysteroscope into the vagina and distending the vagina with fluid. The cervix is then identified and the hysteroscope is guided into the endocervical canal.

Principles of fluid management for office hysteroscopy are identical to hysteroscopy performed in the operating room. Fluid deficit should be continuously monitored with either a fluid management system or careful observation of fluid input and output. Isotonic fluid mediums, such as normal saline, are most commonly used and are appropriate for diagnostic and operative hysteroscopy without use of a monopolar device. Rarely in the outpatient setting, a hypotonic fluid medium may be used, primarily for use of monopolar cautery. The maximum fluid deficit is 2500 mL for isotonic solution and 1000 mL for hypotonic solution [7]. Lower maximums should be used if the patient has medical comorbidities increasing her risk of fluid overload.

Risks of office hysteroscopy are similar to those performed in the operating room, including uterine perforation, fluid overload, air embolism, and hemorrhage. Of particular importance in the office setting is the risk of vasovagal reaction. Vasovagal reactions are caused by parasympathetic nerve activation during the manipulation of the cervix and uterus [7]. Vasovagal reactions typically resolve within a few minutes and should be managed by removing the inciting stimulus and repositioning into reverse Trendelenburg position [9].

Key Teaching Points

- Intracavitary lesions, such as endometrial polyps and submucous myomas, are common causes of intermenstrual bleeding
- Hysteroscopy is a reliable and accurate method to fully evaluate the endometrial cavity, and has higher sensitivity and specificity than TVUS and SIS
- In-office hysteroscopy provides a convenient diagnostic and therapeutic option for patients that minimizes risk of anesthesia, recovery, and cost
- Vaginoscopy is associated with decreased pain compared with use of a speculum and tenaculum
- Procedural risks and fluid management for office hysteroscopy is similar to hysteroscopy performed in the operating room

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CASE 40

A 71-Year-Old G2P2 Woman with Postmenopausal Bleeding and Severe Cervical Stenosis

Daniel Breitkopf

History of Present Illness

A 71-year-old woman, gravida 2, para 2, presents with vaginal bleeding for one week. The bleeding has been light and dark red in color. She has not been on hormone replacement therapy. She denies pelvic pain, or changes in bowel or bladder function. Her medical and surgical history are non-contributory. There is no family history of breast, uterus, ovarian, or colon cancers. She is not taking medications and has no history of drug allergy.

Physical Examination

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

Vital signs:

Temperature: 36.5°C
Pulse: 80 beats/min
Blood pressure: 103/75 mmHg
Respiratory rate: 16 breaths/min
Height: 62 inches
Weight: 150 lb
BMI: 27.4 kg/m^2

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

Pelvic: The external genitalia are normal appearing. Cervix appears stenotic, with a dimple at the external os. The uterus is anteverted, non-tender, mobile, and normal sized without appreciable masses. Bilateral adnexa are without palpable masses or tenderness

Imaging: Transvaginal ultrasound shows an anteverted uterus measuring 7 × 4 × 4 cm. The endometrium is 9 mm in thickness without increased Doppler flow. Both ovaries appear small and without adnexal masses. No fluid is noted in the posterior cul-de-sac

How Would You Manage This Patient?

In the presence of postmenopausal bleeding, and a thickened endometrium on ultrasound, endometrial sampling is required. Given the patient's cervical stenosis, a paracervical block was placed in the outpatient setting and dilation was attempted with half-size Hegar dilators. Because the cervix could not be dilated due to stenosis of the external os, a size 11 scalpel was used to make an opening at the dimple. Once the cervix was successfully dilated, an endometrial biopsy was obtained using a plastic suction piston device.

Evaluation of Postmenopausal Bleeding in the Setting of Cervical Stenosis

Postmenopausal bleeding is a common condition and a warning symptom for endometrial malignancy. Any bleeding after menopause is considered abnormal and requires evaluation. The most common causes of postmenopausal bleeding include atrophic vaginitis, endometrial polyps, submucosal fibroids, endometrial hyperplasia, and endometrial carcinoma. Evaluation of the endometrium is paramount and can be accomplished by either direct endometrial sampling/biopsy, or indirectly via ultrasound imaging. The optimal strategy for endometrial evaluation has not been clearly defined in a patient with postmenopausal bleeding, thus either starting with an endometrial biopsy or pelvic ultrasound is considered acceptable practice. The American College of Obstetricians and Gynecologists recommends transvaginal sonography as a first approach in evaluation of postmenopausal patients with an initial episode of bleeding [1]. However, endometrial biopsy should be performed first in patients at increased risk of malignancy, such as those with recurrent or persistent bleeding, obesity, family history of uterine cancer, type 2 diabetes mellitus, and atypical glandular cells on cervical cytology.

Endometrial biopsy is 90% sensitive for detection of malignancy [2]. However, up to 11% of endometrial biopsy specimens from postmenopausal patients are non-diagnostic (tissue insufficient for diagnosis, TIFD). In cases of TIFD, further evaluation of the uterine cavity is needed to be sure that representative sampling has been accomplished, and to evaluate for focal pathology. Further evaluation usually includes either transvaginal ultrasound with or without intrauterine fluid infusion (sonohysterography) or hysteroscopy. Hysteroscopy should be attempted whenever possible in an office setting for patient convenience and efficiency of evaluation [3].

Uterine cervical stenosis is common after menopause, with an incidence of as much as 70% [4]. Cervical stenosis is often defined as a narrowing of the cervical opening preventing insertion of a 2.5 mm dilator [5]. Stenosis is usually the result of lack of estrogen and resultant cervical atrophy, leading to contraction of the cervical canal and internal os. Other factors can increase the risk of cervical stenosis, such as prior cervical conization, nulliparity, pelvic radiation, and congenital anomalies. Stenosis can lead to fluid entrapment in the uterine cavity, as the fluid transudate from the endometrium has no natural path of drainage. Most postmenopausal patients with cervical stenosis are asymptomatic. Some question the importance of evaluating the endometrium in a patient with cervical stenosis and bleeding, as the blood is less likely to originate from a cavity that cannot drain vaginally.

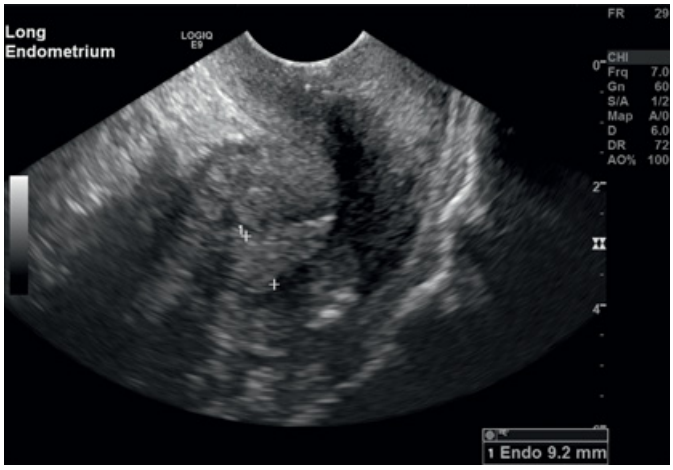

Figure 40.1 Transvaginal ultrasound image of a postmenopausal patient with a thickened endometrium.

Patients with cervical stenosis and postmenopausal bleeding should be evaluated first with transvaginal ultrasound. If the endometrial thickness is normal by ultrasound, further uterine evaluation is not necessary. While a thickness of 4 mm or less is highly effective in excluding endometrial malignancy, cases of serous endometrial carcinoma have been described in patients with thin endometrial echoes. If the patient is significantly symptomatic from the bleeding, use of vaginal estrogen may alleviate the bleeding from urogenital atrophy. If the endometrial thickness is abnormal, further evaluation is needed and attempts to overcome the cervical stenosis should be undertaken to biopsy the endometrium and image the uterine cavity (Figure 40.1).

Techniques to overcome cervical stenosis involve mechanical dilation of the cervix, pharmacologic treatments to effect dilation, and surgical manipulations to create a cervical opening. There are no published data demonstrating superiority of one technique over another. It seems reasonable to choose the least invasive method first, and also utilize methods readily available in the office before resorting to utilizing the operating room. Patient comfort and acceptance are also important factors to consider, including availability of local anesthetics and parenteral sedation.

Pharmacologic aids to overcome stenosis include vaginal estrogen, vasopressin, and prostaglandin agonists. Exposure of the cervix to vaginal estrogen may result in softening of the tissue over the course of several weeks. Prostaglandins, used vaginally or orally, cause biochemical changes in the cervical stroma and uterine contractions, which may make cervical dilation easier. The evidence for improvement in cervical stenosis by prostaglandin use in postmenopausal patients is mixed [4]. Misoprostol appears to be less effective in a hypoestrogenic environment and takes longer to be effective in postmenopausal versus premenopausal patients. Pretreatment with vaginal estrogen for two weeks may increase the effectiveness of misoprostol. Vaginal dinoprostone may be used instead of misoprostol and appears to be equally effective. Osmotic dilators such as laminaria appear to be more effective than prostaglandin therapy but are less convenient to use [6]. Dilute vasopressin injected into the stroma of the cervix may reduce the force required to dilate the cervix. Vasopressin causes smooth muscle contraction, and the resultant reduction in blood flow may decrease tissue resistance. Since vasopressin can result in significant cardiovascular complications, use should be limited to the operating room [4].

Mechanical dilation of the cervix may be accomplished with several types of instruments. Tapered plastic dilators can be useful to open the internal cervical os. Additionally, Hegar cervical dilators are available in sizes starting at 1 mm and also may be utilized to open the internal os. If cervical dilation is attempted in the office, consideration should be given to placing a paracervical block with local anesthetic for patient comfort. Care must be taken not to create a false tract in the cervix, as uterine perforation may result. Utilizing gentle pressure and adjusting the angle of the dilator may help in avoiding false tracts into the cervical stroma. Furthermore, real-time transabdominal ultrasound may be used to guide the dilator through the internal os. Filling the bladder with saline facilitates visualization of the cervix and uterus.

Hysteroscopic examination of the cervical canal may also be helpful in dilating the cervix. The hysteroscope itself along with the distention fluid may be used to visually dilate the cervix. Additionally, visualization of the cervical canal can aid the clinician in determining the exact axis of the cervix to the uterus, which may also aid in placing dilators. Hysteroscopy may be performed via the "no-touch" or vaginoscopic technique, where the hysteroscope is placed directly through the introitus without a speculum and guided into the cervical os while distending the vagina with saline [3]. For postmenopausal women with advanced vulvovaginal atrophy, this technique may be significantly more comfortable than the traditional use of a vaginal speculum. Use of coaxial or balloon-tipped catheters to guide the hysteroscope through the stenotic cervix have also been described [4]. Bettocchi et al. used a variety of hysteroscopic instruments including micro scissors, graspers, and bipolar electrodes to relieve a stenotic cervix, achieving success in 98.5% of cases [7].

In some cases, the external os may also be stenotic. A scalpel may be used to create a cruciate incision at the external os to facilitate further dilation and exploration of the cervix. Resection techniques to open a stenotic cervix with a cutting electrode, mechanical morcellator, or carbon dioxide laser have also been reported [4].

Attempts to dilate a stenotic cervix can lead to an increased risk of surgical complications. Complications of dilation attempts include cervical lacerations, creation of a false passage with resultant uterine perforation and bleeding. Cervical lacerations may require suturing to achieve hemostasis. The uterine perforation rate is 0.2% in postmenopausal patients undergoing diagnostic hysteroscopy. Most uterine perforations will not require further intervention if bleeding is not observed. If the perforation occurred with a sharp instrument or while electrosurgical energy was applied, laparoscopic evaluation of the gastrointestinal and urinary tracts may be required to evaluate for viscus injury.

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CASE 41

A 34-Year-Old G2P2 Woman with a 4 cm Type 1 Submucosal Myoma Undergoing a Hysteroscopic Myomectomy

Shannon K. Laughlin-Tommaso

History of Present Illness

A 34-year-old woman, gravida 2, para 2, presents to the gynecology clinic for increasingly heavy menstrual bleeding over the past year. Periods occur every 28–29 days and are predictable. Bleeding lasts for seven days with the heaviest bleeding occurring on days 2 and 3. On those days, she uses super tampons and maxi pads, changing them every 2 hours, and at night is using night-time pads. She has to leave long meetings at work to change protection and has menstrual accidents. She passes large clots and describes "gushing" type bleeding when on the toilet. She has tried non-steroidal anti-inflammatory drugs and tranexamic acid for bleeding with only slight improvement in heaviness; oral contraceptive pills have not worked in the past and she is not using them now. She has no relevant past medical or surgical history and denies any drug allergy.

Physical Examination

General appearance: Alert woman in no acute distress

Vital signs:

Pulse: 72 beats/min
Blood pressure: 110/70 mmHg
Respiratory rate: 16 breaths/min
BMI: 24 kg/m^2

Pelvic:

External genitalia: Normal
Vagina: Normal rugae, normal discharge
Cervix: Ectropion present, no bleeding noted, no cervical motion tenderness
Uterus: Anteverted, non-tender, mobile, 10 weeks' size
Adnexa: No palpable masses

Laboratory studies:

Hb: 10.3 g/dL (normal 11.6–15.0 g/dL)
Ferritin: 7 ng/mL (normal 11.0–307.0 ng/mL)

Imaging: Pelvic ultrasound shows uterus 9.2 × 5.8 × 4.6 cm and 4 cm myoma that abuts and may distort the endometrium (Figure 41.1). Endometrial stripe measures 7 mm. Normal ovaries bilaterally.

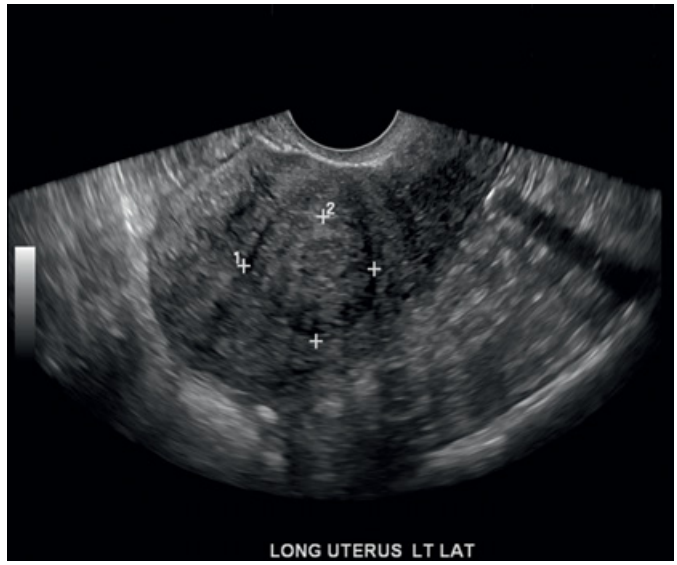

Figure 41.1 Pelvic ultrasound image showing an anteverted uterus (longitudinal view) with a 4 cm myoma that abuts and may distort the endometrium (markers show periphery).

How Would You Manage This Patient?

Heavy menstrual bleeding is a common concern for women presenting to the gynecologic clinic. When evaluating heavy bleeding, the PALM-COEIN method can be an excellent classification tool [1]. Imaging in this case reveals a leiomyoma (L1) but no evidence of polyp (P0) or adenomyosis (A0). At 34 years old with regular cycles and no other known risk factors, she is at very low risk for malignancy (M0) so an endometrial biopsy is not necessary. History of the present illness helps to rule out several of the COEIN causes of bleeding as well. She does not indicate a coagulopathy (no prior blood transfusions or nose bleeds), ovulatory dysfunction (regular cycles), iatrogenic (not on hormones), or not classified causes. Endometrial disorder is possible, but unclear in this case. Thus, the myoma should be considered as the significant contributor to bleeding and addressed.

Next best steps in evaluation would be either office hysteroscopy or sonohysterogram to determine the extent that the myoma is in the uterine cavity. Sonohysterogram performed by a skilled clinician can reveal the depth of the myoma into the myometrium. Office hysteroscopy can also help to estimate the extent of intracavitary myoma and is more specific when the overall size of the myoma is known by ultrasound. Office hysteroscopy revealed a 4 cm type 1 myoma with 80% in the cavity (Figure 41.2). Endometrium appeared proliferative. The patient was counseled on treatment options and elected to undergo hysteroscopic myomectomy.

In the preoperative area, the patient received 200 mcg of misoprostol orally for cervical ripening. Without significant anemia and a type 1 myoma with the majority in the cavity, leuprolide was not *previously* administered *Dilute*. Vasopressin was injected into the cervix at 12, 3, 6, and 9 o'clock positions (3–5 mL each) and the bipolar resectoscope was used for resection. The myoma was 100% removed during the procedure with a blood loss of 50 mL and fluid deficit

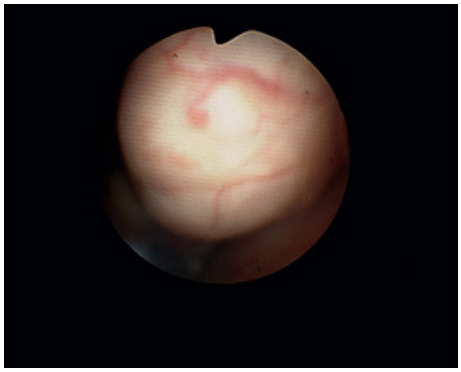

Figure 41.2 Office hysteroscopy demonstrates a 4 cm type 1 myoma with 80% in the cavity.

of 1800 mL normal saline. Her bleeding improved; she no longer has menstrual accidents, is not leaving work meetings, and realized that her social calendar is less impacted by scheduling around her periods.

Uterine Myomas and Heavy Menstrual Bleeding

Not all myomas are associated with heavy menstrual bleeding or have symptoms at all. Myomas are common and appear in up to 80% of women by age 50. They may develop in young women in their mid-20s to mid-30s. Approximately 15% of women with heavy menstrual bleeding have a submucosal myoma [2].

The definition of heavy menstrual bleeding has recently been changed to "excessive menstrual blood loss, which interferes with a woman's physical, social, emotional and/or material quality of life" [1]. Heavy bleeding associated with myomas has a significant impact on physical, social, and work life; in a national survey 24% reported that they were unable to live up to their full potential at work and 15% reported not being able to travel for work [3]. Anemia has been associated with submucosal myomas so her anemia may already be a clue that this is not strictly intramural [2].

Hysteroscopic Myomectomy

The surgery can be performed by either mechanical morcellation or bipolar resectoscope. There are risks and benefits to both that may influence the decision and may be influenced by size and type of myoma[4]. The mechanical morcellation of intracavitary myomas may be quicker and allows for removal of morcellated myoma pieces during the procedure. However, the intramural portion of type 1 and type 2 myomas may be difficult to remove with morcellation [4]. Resectoscopes have both a cutting current (130–170 W) and a coagulation current (70–100 W) that offers the ability to coagulate blood vessels at the base [4]. The creation of myoma chips can inhibit visualization though and require removal via forceps or curettage. There are newer vaporization techniques available as well; similar to morcellators, these reduce the number of insertions of the scope and allow easier removal of myoma tissue. The outer sheaths of most bipolar resectoscopes and morcellators are between 6 and 9 mm so that dilatation will be needed. Preoperative preparation of the cervix can reduce risks of cervical injury or uterine perforation. Misoprotol is one option, though doses and delivery routes vary.

The resectoscopes are commonly bipolar devices that can utilize isotonic solution as the distending medium; monopolar devices require the distending media to be hypotonic solutions such as 1.5% glycine and 3% sorbitol. Because of the elevated risks of hyponatremia, hypoproteinemia, and cerebral edema associated with hypotonic solution, the use of isotonic solutions and bipolar resectoscope devices is common.

Fluid absorption must be carefully monitored throughout the procedure even with isotonic solutions as described in the American Association of Gynecologic Laparoscopists (AAGL) guidelines [5]. Although simple gravity flow may provide enough distension for the procedure, monitoring the fluid deficit is more accurate and easier with a pump system. There are a variety of fluid management systems available that can monitor the fluid ins and outs or can also regulate the intrauterine pressure. These are important to determine the extent of the fluid deficit and prevent fluid overload and intravasation. The risks of pulmonary edema and left-sided heart failure are estimated between 0.1% and 0.2% and increase with length of the procedure and extent of the resection [5]. A fluid management plan should be in place in collaboration with the anesthesia team to determine when the procedure should be terminated and if diuretics should be given in the case of fluid overload.

Intracervical injection of dilute vasopressin (20 U in 100 mL normal saline) can reduce fluid absorption and intravasation. Vasopressin can be injected into the cervical stroma and care must be taken to avoid systemic injection of vasopressin as this can cause bradycardia and even death. Direct injection of vasopressin through the scope and into the myoma has also been reported.

Preoperative leuprolide acetate may also help in cases of large myomas to reduce size, fluid absorption, and blood loss. Although leuprolide acetate is reported to shrink myomas up to 50%, this has not been shown to improve complete resection. To reduce anemia, the leuprolide acetate may be given about one to three months before surgery.

In this case, a bipolar resectoscope was used with saline as the distending medium. After inspection of the uterine cavity, the resection begins at area of the myoma closest to fundus and using the cutting current. The telescoping feature of the device allows for long strips of myoma to be removed at once in a continuous fashion. This size myoma may require simultaneous withdrawal of the scope to remove longer pieces for efficiency. The scope should not be advanced toward the fundus while activating the device as this can cause perforation. Perforation with an activated resectoscope should prompt immediate abdominal exploration to ensure that there is no bowel or bladder injury. There should be resection of as much of the myoma as possible before removing chips as more intravasation and bleeding occurs after removing chips, as well as an increase in risk of gas embolism [4]. During the procedure, monitor the fluid deficit and troubleshoot any losses outside the system (leaking from the scope or the cervix, fluid not captured in the bag, etc.) so that true intravasation can be recorded. Fluid deficit should be reported starting at

1000–1500 mL and every 500 mL to the anesthesia team so that they can determine if there are signs of fluid overload.

Once near the myometrium, it is important to identify the base of the myoma. Reduction in intracavitary pressure will allow the intramural portion to deliver into the cavity. Myomectomy is complete when no further white myoma tissue is seen. Also, after myoma chips are removed, check the base and ensure that no further myoma has delivered. If visualization is blocked due to chips, withdraw the scope and using curette or forceps, remove the chips. Removal of all chips will prevent postoperative passage of tissue or the potential for parasitic myomas. If there is bleeding, visualize the vessel and coagulate. Moving the scope to the fundus will allow for some clearing of the blood and improved visualization.

Once the myomectomy is completed, insert the resectoscope to check that the base is hemostatic and no myoma chips remain. Document the fluid deficit as recorded by the fluid management system. If the fluid deficits have reached 2500 mL and the myomectomy is incomplete, it is important to pause to determine (1) whether the fluid deficit is correct, (2) if there is a chance of completion with minimal additional fluid absorption, and (3) that the anesthesia team is not seeing signs of fluid overload. In some cases, a second procedure may be needed to completely remove the myoma if the patient is still symptomatic.

Postoperatively, if bleeding remains heavy, a repeat office hysteroscopy or sonohysterogram may be performed to check for remnant myoma. If additional myoma is seen, repeat myomectomy may be needed. If there is no remnant, medical therapy can be started. Even with incomplete myoma resection, success rates are high and regression of the remaining myoma has been seen. Hysteroscopic myomectomy is a low-risk procedure with short-term recovery that has shown to be very successful in both reducing bleeding and surprisingly, bulk symptoms [6].

Key Teaching Points

- Using the PALM-COEIN system for evaluation of abnormal uterine bleeding is an effective tool to determine testing and treatment options
- Hysteroscopic myomectomy is the gold-standard treatment for submucosal myomas
- It offers a low-risk and successful procedure to reduce heavy menstrual bleeding associated with myomas
- Both bipolar resectoscopes and morcellators are effective in removing myomas
- Fluid deficit must be actively managed during the procedure to minimize fluid absorption and complications

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CASE 42 A 50-Year-Old Woman with a Retained IUD

Corinne A. Bazella

History of Present Illness

A 50-year-old woman, gravida 3, para 3, presents to the office requesting removal of an intrauterine device (IUD). She had a levonorgestrel IUD placed six years ago for contraceptive purposes and now that she is menopausal wishes removal. Last menstrual period was two years ago, and she has experienced vasomotor symptoms and vaginal dryness. She was never able to palpate the IUD strings nor were they visible on pelvic examinations. She is currently sexually active with a long-standing monogamous partner and has never been exposed to a sexually transmitted disease. She has a family history of breast cancer in first-degree relatives, and no significant past medical or surgical history. She is not taking medications and has no drug allergies.

Physical Examination

General appearance: Comfortable, not in distress

Vital signs:

Temperature: 37.0°C
Pulse: 65 beats/min
Blood pressure: 115/77 mmHg
Respiratory rate: 16 breaths/min
Height: 64 inches
Weight: 137 lb
BMI: 23 kg/m^2

Abdomen: Normal bowel sounds, soft, non-distended and non-tender

External genitalia: Normal

Vagina: Normal rugae, normal discharge

Cervix: Normal, IUD string not visualized at the external os

Uterus: Anteverted, non-tender, mobile, normal in size

Adnexa: No palpable masses

Imaging: Transvaginal ultrasound shows an anteverted normal-sized uterus with endometrial thickness of 3 mm, IUD at the uterine fundus. Normal left ovary and a normal right ovary. There is no free fluid in the cul-de-sac

How Would You Manage This Patient?

The patient presents with a retained IUD. In the office there are several techniques that can be used to identify the IUD location and removal. When the IUD string is unable to be visualized and its presence is uncertain, the patient's pregnancy status should be identified by menstrual history and pregnancy test. In this patient, menopause was assumed because of her two-year history of amenorrhea accompanied by vasomotor symptoms and vaginal dryness; therefore, a pregnancy test was not obtained.

Ultrasound images from the radiology department showed intrauterine IUD location; therefore, attempts to locate the IUD string in the cervix with the endocervical brush were made by gently rotating the brush in the cervical canal while extracting it from the cervical os. This was not successful. An alligator grasper was used within the cervix to blindly grasp the string but was also unsuccessful. She agreed to an ultrasound-guided IUD removal with a cervical block. The cervical block was placed, and ultrasound was used to identify the intrauterine IUD transabdominally. An alligator grasper was introduced into the intrauterine cavity guided by ultrasound and the IUD was easily grasped by the body and removed completely without complication. The patient had minimal discomfort throughout the procedure and expressed satisfaction with the outcome.

Retained IUD

Removal of IUDs when the string is visualized is generally easy, only requiring gentle traction on the string to remove the IUD. IUD strings not visualized at the external cervical os are a common occurrence during IUD surveillance with an incidence estimated between 5% and 18% [1]. The differential diagnosis for missing IUD strings includes unnoticed IUD expulsion, IUD perforation with the IUD outside of the uterine cavity, damaged or shortened IUD strings, and IUD strings that have retracted into the cervix or uterine cavity. Pregnancy should be excluded with history and urine pregnancy test.

The first step of in-office retained IUD removal is to attempt to sweep the endocervical canal with a cervical cytology brush. If unable to see the IUD string the next step is to use a small-tipped forceps, an alligator, uterine, or Kelly forceps to grasp the IUD string in the cervical canal. If the string is unable to be grasped by this technique, then ultrasound guidance is recommended to identify the location of the IUD. A double bar sign below the body of the IUD will be visible on abdominal or transvaginal ultrasound (Figure 42.1) [2].

If unable to visualize the IUD on ultrasound, plain film of the abdominal cavity with full view of both the superior upper quadrants including the diaphragm and the entire pelvis should be performed to identify the presence of an intra-abdominal IUD or confirm IUD expulsion.

In-office removal of a retained IUD is safe, convenient, cost-effective, and well accepted by most patients. Intrauterine removal in the office can be painful, and the following analgesia can be used singly or in combination: a paracervical block, oral non-steroidal anti-inflammatory medication, anxiolytics, abdominal heating pad, or intrauterine lidocaine [3].

After patient comfort with analgesia is achieved, intrauterine exploration for the IUD can be performed. Several devices

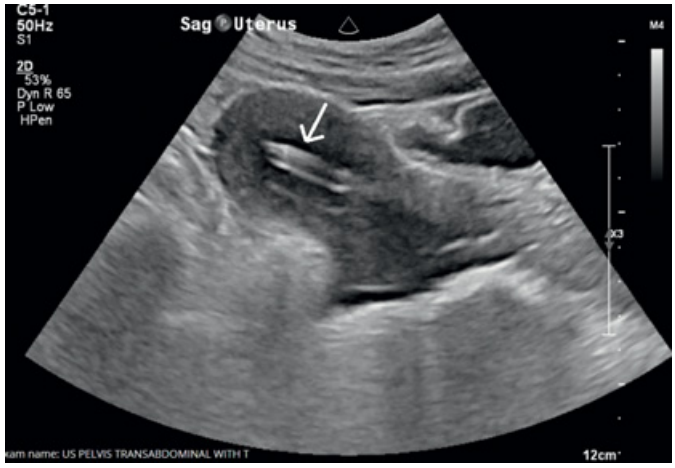

Figure 42.1 Ultrasound image of intrauterine IUD. Arrows indicates double bar sign from shadowing of the body of the IUD in the endometrium.

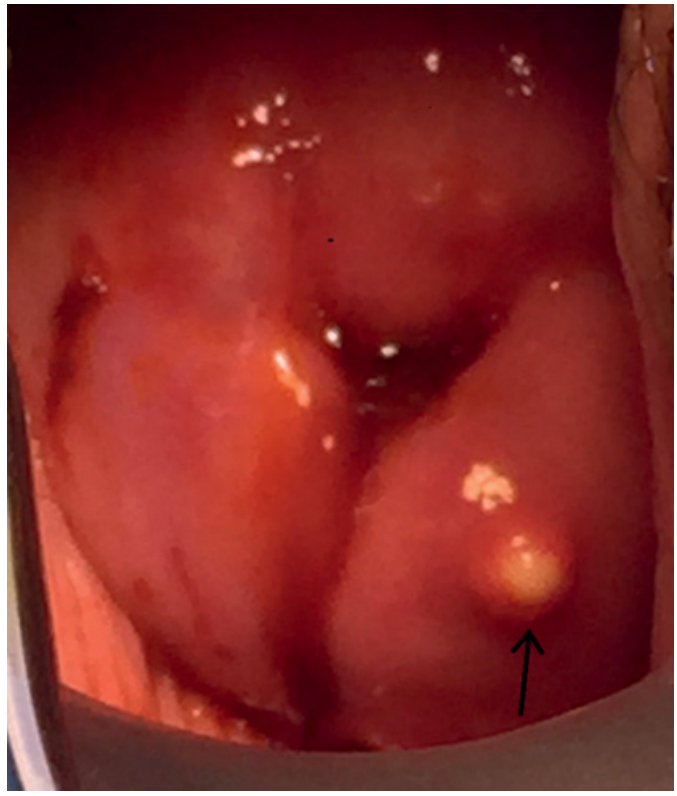

Figure 42.2 Picture of cervix with body of the IUD (arrow) perforating through the stroma of the cervix. (Photo by Lisa Perriera MD.)

can be used to extract a retained IUD. For T-shaped IUDs, grasping forceps are the most successful. Thread retrievers, hook devices, and suction curettes can also be used, but are generally more useful for ring or loop IUDs. The slim design of alligator forceps allows the device to be fully opened within the cavity of the uterus without cervical dilation. The body of the IUD or the IUD string can then be grasped easily and removed. The alligator forceps is available in several lengths; however, 20 cm length is necessary to reach the fundus of most uteri [2]. Cervical dilatation is generally needed for a polyp forceps in order to open the forceps enough to grasp the IUD. Hook devices are inserted to the fundus and can grasp either the arm of the IUD or the string into the cervix as they are withdrawn. Suction devices such as the Karman cannula, Novak curette, or manual vacuum aspiration device with a small curette are helpful for the removal of ring and loop IUDs. The instrument is inserted to the fundus, suction is applied, and the instrument is brought out of the uterine cavity. The string or IUD is usually brought into the cervix with the use of these instruments and can then be removed.

Intra-procedural use of abdominal ultrasound guidance will increase the likelihood of successful office retrieval; in a case series of a referral clinic for retained IUDs, office removal with ultrasound guidance was successful in 83% and hysteroscopy was required only in a minority of patients [4].

If in-office retrieval with these techniques is not successful, patients should be offered hysteroscopic removal. Risks of hysteroscopy are small but include uterine perforation, fluid overload from distention fluid, infection, and uterine bleeding. Direct visualization of the intracavitary IUD with hysteroscopy is helpful by identifying cavity distortion from fibroids, embedded IUDs, and malrotated IUDs.

For in-office hysteroscopy, cervical preparation with misoprostol or hygroscopic agents may minimize patient discomfort. In addition, pain may be lessened by using minimal distention media for visualization and rotating the light source of 30 degree angled scopes to minimize cervical manipulation or movement. A 5 mm rigid hysteroscope with an operating channel for 5 French semi-rigid biopsy or grasping forceps allows for missing strings or IUD to be grasped and gently retrieved by withdrawing the hysteroscope and IUD through the cervix.

These methods can be successfully used to retrieve ultrasound confirmed embedded IUD [5–8]. The embedded IUD arm is grasped with micro-forceps, and traction is applied in the opposite direction of the embedded arm away from the myometrium (Figure 42.2).

Ultrasound guidance can be used during these techniques to prevent perforation. If imaging suspects the IUD to be completely perforated through the myometrium, concurrent laparoscopy should be planned.

During the removal of embedded IUDs, it is a common complication for a portion of the IUD to be retained or an arm to be broken from the body. A manual vacuum aspiration device can successfully remove the retained fragment in the office setting. If unsuccessful, ultrasound-guided hysteroscopy in the operating room is suggested if the patient is symptomatic with bleeding or desires fertility. If the patient does not desire fertility and is asymptomatic with no change in bleeding patterns, the fragment can be left in situ with the patient's consent.

The choice of procedural setting should be guided by patient's tolerance for in-office procedure, presence and severity of myometrial embedment, and the surgeon's skills. Patients should be fully counseled on risks including the need for concomitant laparoscopy.

Key Teaching Points

- Retained IUDs are a common finding in women using IUDs
- Pregnancy status should be evaluated in the setting of lost or retained IUD strings in reproductive age women
- In-office intrauterine exploration and removal with Alligator forceps with or without ultrasound guidance is the most successful technique for removal of T-shaped IUDs
- In-office hysteroscopy offers a successful, safe, convenient, cost-effective approach for removal of retained IUDs, and is well accepted by most patients

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CASE 43 A 30-Year-Old Woman Seeking Pregnancy Who Has Intrauterine Synechiae

Zaraq Khan

History of Present Illness

A 30-year-old woman, gravida 2, para 1011, presents with 15 months of secondary infertility. She notes a change in her menstrual pattern with light menstrual bleeding consisting of menstrual spotting for 1 day every 31 days. She reports significant cyclic pain with spotting. She had normal menstrual cycles with four days of flow prior to her last pregnancy two years ago that ended in a miscarriage at nine weeks. She failed medical management of first-trimester loss and underwent a dilation and curettage (D&C) for evacuation of products of conception. The procedure was uneventful; however, she did require a course of antibiotics afterward for postoperative endometritis. The couple did not report any issues with conceiving their previous pregnancies. She denies any significant past medical or surgical history other than the D&C.

Physical Examination

General appearance: Well-developed, healthy adult female who appears comfortable sitting upright

Vital signs:

Temperature: 37.2°C
Pulse: 78 beats/min
Blood pressure: 110/69 mmHg

Abdomen: Soft, no tenderness to superficial or deep palpation. No organomegaly noted

Pelvic: Skin and morphology of vulva within normal limits. On speculum examination a well-supported normal appearing cervix and well-estrogenized vaginal sidewalls were noted. On bimanual examination a normal-sized mobile uterus was palpated. No cervical or uterine motion tenderness or palpable adnexal masses was noted

Laboratory studies: Urine pregnancy test: Negative

Imaging: Transvaginal ultrasound shows a normal-sized uterus with indistinct thin endometrial lining of 2 mm. Both ovaries were normal on appearance. A dominant follicle measuring 1.8 cm noted on the patient's left ovary. No free fluid in the cul-de-sac noted

How Would You Manage This Patient?

This patient presented with change in menstrual pattern and secondary infertility after D&C two years ago. The differential diagnoses in the setting of a secondary infertility, light menstrual bleeding, and negative pregnancy includes Asherman's syndrome or intrauterine synechiae, ovulation dysfunction, and hypothalamic/pituitary or ovarian insufficiency. She underwent further bloodwork that included a normal antimüllerian hormone level at 2.8 ng/mL (0.9–9.5 ng/mL), an appropriate follicle stimulating hormone and serum estradiol level drawn the day after spotting noted at 7.2 IU/mL (2.9–14.6 IU/mL) and 75 pg/mL (15–350 pg/mL) respectively. Normal hormonal assessment ruled out hypothalamic/pituitary and ovarian dysfunction. A saline infusion sonohysterogram was next performed which revealed significant intrauterine scar tissue consistent with the diagnosis of Asherman's syndrome.

The patient was subsequently listed for an operative hysteroscopy for lysis of intrauterine adhesions. The endometrial cavity was anatomically restored after the procedure. An intrauterine stent was temporarily placed in the uteru after the surgery and the patient received postoperative hormonal therapy in form of high-dose oral estrogen (2 mg twice a day of estrace) for 30 days with progestin added for the last 10 days (medroxyprogesterone acetate [Provera] 10 mg at night) to induce a withdrawal bleed. An office hysteroscopy was scheduled soon after the withdrawal bleed where filmy recurrent adhesions were taken down and a normal cavity was noted. The patient subsequently achieved a spontaneous pregnancy five months after the surgical correction. She was induced at 36 weeks of gestation for intrauterine growth restriction (IUGR) and delivered a healthy baby girl vaginally.

Asherman's Syndrome/Intrauterine Synechiae

The terms Asherman's syndrome and intrauterine synechiae are used interchangeably, although Asherman's syndrome typically requires a triad of symptoms that include menstrual disturbances, cyclic pain, and sub/infertility [1]. Additionally, intrauterine scar tissue formed around a pregnant state such as first-trimester loss, retained placenta after delivery, etc. is classically called Asherman's syndrome. Alternatively, scar tissue formed after extensive hysteroscopic myomectomy or endometrial ablation procedure is usually referred to as intrauterine synechiae. Though the true incidence of Asherman's syndrome is unknown, improvements in imaging and widespread use of office hysteroscopy have led to higher case identification. The most common cause of the disease in the developed world is iatrogenic. Vigorous curettage leading to traumatic denudation of the endometrial basalis layer to raw myometrium may result in permanent scarring. Additionally, a hypoestrogenic state (especially postpartum) and an ongoing sub-chronic endometrial infection (especially during a first-trimester loss) could further augment the chances of scar formation. Extensive hysteroscopic surgeries in non-pregnant states continue to be a major reason for development of intrauterine synechiae.

These surgeries can include septoplasty, myomectomy, and endometrial ablation. Finally, in the developing world infection of the endometrium with *Mycobacterium tuberculosis* is a common cause for intrauterine synechiae [2].

The classic clinical symptoms are similar to the case presentation in this chapter with menstrual disorders typically absent or light menses being the most common. Women can also have pain with bleeding and the condition usually results in uterine factor infertility. Uterine imaging with transvaginal sonography (2D or 3D) or saline infusion sonohysterogram is typically used for diagnosis but office hysteroscopy can also be utilized depending on the clinical set-up and resource availability [3]. Hysteroscopy is needed to classify the extent of the disease. Classification and detailed description of the disease is important as severity of the disease can dictate prognosis. Several classifications systems have been proposed [1], but the lack of a standard method makes treatment comparisons and multicenter research challenging.

Older data have shown limited role of expectant management for Asherman's syndrome with resumption of menses reported as high as 78% in 1–7 years [4]. Surgery with hysteroscopic lysis of scar tissue is, however, considered the standard of care therapy with no role of medical management [5]. Prior to advances in hysteroscopy equipment and optics, blind cervical probing and/or blind D&C was used for taking down intrauterine scar tissue. Lysis of adhesions under direct hysteroscopic guidance is now the treatment of choice. The basic principle involves adhesiolysis in a caudad to cephalad manner. The dissection is carried out cephalad to the uterine fundus and laterally to each respective corneal region till a tubal ostium is identified on each side. Concurrent diagnostic laparoscopy may also be used to serve as a guide for the hysteroscopic procedure and to avoid uterine perforation. Moreover, laparoscopy aids in completion of a chromopertubation dye study. The study can be performed at the end of the surgery to confirm a connection between the fallopian tubes and the uterine cavity.

A surgeon has a choice of several modalities for performing lysis of adhesions. These include the use of hysteroscopic scissors, monopolar and bipolar electrosurgery instruments, and lasers such as neodymium-doped yittrium aluminum garnet (YAG) laser [1]. There are no data to show superiority of one particular modality. Availability of resources and surgeon's preference typically drive the choice of instruments used for the surgery. The ultimate goal is to have an anatomically restored cavity with at least one if not both tubal ostia identified.

The biggest challenge of disease management is prevention of recurrent adhesions after surgery. A third of all cases with mild scar tissue and two-thirds of all severe cases can have recurrence of adhesions. Several methods are used for prevention of this scar tissue; however, there is no consensus regarding the ideal methods to prevent postoperative scar tissue formation. Physical barriers such as intrauterine stents, intrauterine devices, or Foley balloon; semi-solid barriers such as auto-crosslinked hyaluronic acid gel and fresh and dry amniotic membranes; and postoperative hormonal supplementation with high-dose estrogen are some methods commonly used in the absence of high-quality data [6].

Patient outcomes after surgery are challenging to study. These difficulties arise because of a lack of standardized classification of disease severity, differences in surgeon's experience, small case numbers, and lack of randomized controlled trials. Return of menstrual function is reported to be as high as 92–96% [5], whereas pregnancy rates can be up to 60–70% [7]. Pregnancy after correction of intrauterine scar tissue is not without risks. A higher miscarriage rate and placentation issues leading to IUGR, preterm labor, and postpartum hemorrhage has been reported in these patients [4]. These data highlight the importance of involving a high-risk obstetrician for such pregnancies from the beginning.

The future of therapy for Asherman's syndrome is driven toward the use of stem cell therapy to help regenerate the endometrium. The current challenge with disease management is restoration of the anatomy of the uterine cavity without revival of physiologic function due to absent endometrial lining. Stem cell therapy may be the answer to the challenging situation. Though preliminary reports on animals and humans are promising, larger studies in a randomized blinded setting are needed [8]. Finally, as newer advancements in uterus transplantation are made and safety of the procedure is increased, it may serve as a method of providing women with a functional uterus for childbearing in the future [9]. This could be an alternative to the use of a gestational carrier, which is associated with significant cost and resource.

Key Teaching Points

- Menstrual changes most commonly absent or lighter menses, cyclic pain, and infertility are the most common presenting features of Asherman's syndrome
- Most cases are iatrogenic after a D&C in the setting of a first-trimester loss or retained placenta after mid-trimester or full-term delivery
- Imaging, ideally with saline sonohysterogram or diagnostic hysteroscopy are most helpful in diagnosing the disease
- Surgical approach with hysteroscopic lysis of adhesions is the standard of care for management
- Prevention of postoperative scar tissue reformation is key to successful treatment
- Outcomes including return of menses and pregnancy rates are overall reassuring but could depend on the extent and severity of the initial disease
- Obstetrical risks such as higher first-trimester loss, IUGR, preterm labor, and postpartum hemorrhage are reported in women after correction of intrauterine scar tissue
- The use of stem cells for regeneration of the endometrial lining holds a lot of promise for the future treatment of this disease process

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CASE 44

A 42-Year-Old Woman with Abnormal Uterine Bleeding Who Desires In-Office Ablation

Alessandra J. Ainsworth

History of Present Illness

A 42-year-old multiparous woman with heavy menstrual bleeding desires in-office endometrial ablation. She has regular but heavy menses that lasts 10 days and occurs every 28 days. Menses are so heavy that she passes large clots and has missed work on occasions. She denies any dysmenorrhea or intermenstrual bleeding. She has had a complete evaluation and no cause of abnormal uterine bleeding was identified. She denies fatigue, shortness of breath, or lightheadedness. She has intolerable side effects with systemic contraceptives and has previously trialed tranexamic acid and a levonorgestrel intrauterine device without success. She would like to avoid hysterectomy and requests in-office endometrial ablation. She has no history of chronic pain, anxiety, or intolerance of office procedures or anesthesia. Her partner has had a vasectomy. She has no medical comorbidities and does not take any daily medications.

Physical Examination

General appearance: Alert, comfortable, in no acute distress

Vital signs:

Temperature: 37.2°C
Pulse: 68 beats/min
Blood pressure: 112/72 mmHg
Respiratory rate: 12 breaths/min
BMI: 21.1 kg/m^2

Laboratory studies:

Hb: 12 g/dL (normal 11.6–15.0 g/dL)
Platelets: 235 000/μL (normal 157 000–371 000/μL)
WBCs: 4500/μL (normal 3400–9900/μL)
MCV: 94.4 fL (normal 78.2–97.5 fL)
Ferritin: 24 mcg/L (normal 11–347 mcg/L)
Urine pregnancy test: Negative
Endometrial biopsy: Disordered proliferative endometrium

Imaging: Transvaginal ultrasound shows a normal-sized uterus with an endometrial thickness of 5 mm and unremarkable adnexa

How Would You Manage This Patient?

This patient is an ideal candidate for an endometrial ablation as she has regular, heavy menstrual bleeding and no dysmenorrhea, a risk factor for ablation failure and subsequent hysterectomy. Importantly, she has no absolute contraindications to endometrial ablation including desired future pregnancy or endometrial malignancy. She has no anatomic barriers that may impair procedural completion including cervical stenosis, Müllerian anomaly, or large uterine size (≤10 cm for most devices). Specific to procedural completion in the office setting, she has no history of chronic pain, anxiety, or intolerance of office procedures or anesthesia.

The patient is counseled on the anticipated success rates and complications of endometrial ablation. The procedure is a safe alternative to hysterectomy with fewer serious complications. Procedural complications of endometrial ablation range from endometritis to uterine perforation with risk of bowel and bladder injury. Uterine perforation may require additional surgical intervention, and when this occurs in the outpatient setting, requires transition to the operating room and potentially inpatient management.

The patient underwent in-office endometrial ablation using a bipolar radiofrequency device. She tolerated the procedure well using a combined approach of conscious sedation and local analgesia. She reports amenorrhea postoperatively and high satisfaction with this treatment choice.

In-Office Endometrial Ablation Devices

Endometrial ablation devices destroy the endometrial decidua, preventing future proliferation and menstrual shedding. First-generation devices utilize laser destruction, endometrial resection, or roller-ball ablation but are accompanied with risk of fluid overload. Second-generation, global ablation, devices use balloon ablation or bipolar radiofrequency ablation to achieve similar success with decreased operative time and risk for fluid overload. To date, five second-generation devices have been approved by the FDA and all have been successfully used in the office setting [1].

When compared directly, the radiofrequency device has shown superior outcomes to the balloon ablation device on rates of patient satisfaction and amenorrhea. Multiple randomized controlled trials have compared these two devices in the office setting and found similar rates of patient tolerance and satisfaction, with increased rates of amenorrhea and improvement in quality of life with use of the radiofrequency device.

Procedural Preparation

Patient preparation aimed at minimizing anxiety and pain has not been formally evaluated for in-office endometrial ablation. Efforts to mitigate patient anxiety may be extrapolated from findings in other office gynecologic procedures where studies have shown a positive impact of music therapy [2]. Cervical pretreatment with misoprostol, to minimize the need and difficulty of cervical dilation, has shown mixed results when

provided with local injection or systemic administration of non-steroidal anti-inflammatories or opioids. All drugs should be titrated in small and incremental doses to prevent profound respiratory depression and other unwanted side effects. Titration should occur only after sufficient time has passed to allow adequate assessment of full pharmacologic effect.

Finally, successful completion of conscious sedation requires post-procedural monitoring until the patient has returned to baseline consciousness, no longer at risk for hypoxemia.

Pain Management for Office Procedures

Local analgesia may be used as an adjunct, and at times an alternative, to conscious sedation in gynecologic procedures. Local analgesics allow for pain control that may minimize or avoid the need for additional anesthesia. The most commonly used medications for local analgesia in gynecology, amides, include lidocaine, mepivacaine, bupivacaine, prilocaine, and ropivacaine. Allergic reactions to amides are uncommon and are most likely a result of allergic response to the preservatives found in multiuse vials. Patients may present with rash, urticaria, laryngeal edema, and rarely bronchospasm and hypotension. Systemic toxicity is unlikely and most often results from inadvertent intravascular injection. The addition of epinephrine to the local anesthetic provides local vasoconstriction which decreases the chance of systemic toxicity and prolongs the duration of effect. Signs of systemic toxicity include lightheadedness, dizziness, circumoral numbness, tinnitus, slurred speech, and restlessness. Severe systemic toxicity induces central nervous system depression leading to decreased consciousness and respiratory arrest.

When used safely, local anesthetics provide a key role in patient comfort and successful procedural completion in the office setting. Providers should be aware of the total dose administered and check for potential intravascular injection location by drawing back on the syringe before injecting.

One systematic review, evaluating use of intrauterine anesthesia for gynecologic procedures found that cervical injection of lidocaine reduced pain for several, but not all, gynecologic procedures when compared with injection of placebo [8]. Additional factors that may make local analgesia less likely to be successful include nulliparity, prior cesarean delivery, history of chronic pain or anxiety, and postmenopausal status [9].

In addition to local analgesics, providers may consider use of non-steroidal anti-inflammatories or oral narcotics. However, there remains insufficient evidence for routine use of analgesics before office hysteroscopy. Small differences have been found in visual analog scales for pain assessment but most studies were small and pain scores low at baseline [10].

Key Teaching Points

- Endometrial ablation provides a safe alternative to hysterectomy in carefully selected patients
- Bipolar radiofrequency ablation is superior to balloon ablation and has been evaluated specifically in the office setting
- Safe and successful completion of conscious sedation begins with a thorough pre-procedural evaluation of patient history with specific focus on preexisting conditions, surgical and family history, and current medications
- Providers performing conscious sedation should monitor the patient's level of consciousness, oxygenation, and hemodynamic stability through the procedure
- Providers performing conscious sedation should be trained in emergency response and ready to intervene for decreased respiratory drive, airway obstruction, or cardiovascular collapse
- Patients may also benefit from use of systemic or local administration of analgesics for pain control during office procedures, although evidence is limited

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CASE 45

A 55-Year-Old G1P1 Woman with New-Onset Vaginal Bleeding after Prior Endometrial Ablation

Colleen M. Miller

History of Present Illness

A 55-year-old woman, gravida 1, para 1001, presents to the office with complaints of new-onset vaginal bleeding. She has not had a menstrual period since undergoing an endometrial ablation (EA) seven years ago. The vaginal bleeding started five days ago and is intermittent. She has been bleeding through three to four regular maxi-pads per day. Review of systems is negative for dizziness, fatigue, shortness of breath, and pelvic pain. She is currently sexually active with her husband who underwent a vasectomy after the birth of their child. Her past medical history is significant for regular, heavy menstrual cycles. She denies a history of bleeding disorders, diabetes, or hypertension. She has no other pertinent surgical history. She has no family history of endometrial cancer. She is not taking any medications and has no drug allergies.

Physical Examination

General appearance: Alert, oriented, well-appearing. She is in no acute distress

Vital signs:

Temperature: 36.9°C
Pulse: 75 beats/min
Blood pressure: 128/82 mmHg
Respiratory rate: 16 breaths/min
Height: 66 inches
Weight: 192 lb
BMI: 31.0 kg/m^2

Skin: Warm, well-perfused

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

Pelvic: Evidence of mild vulvar atrophy, otherwise normal external female genitalia. Minimal bright red blood in the vaginal vault noted. No cervical motion tenderness. No abnormal cervical or vaginal discharge. Uterus is anteverted, approximately 8 cm in size with normal contour, mobile. No palpable adnexal masses. No adnexal tenderness to palpation

Laboratory studies:

Hb: 12.7 g/dL (normal 11.6–15.0 g/dL)
Platelets: 285 000/μL (normal 151 000–371 000/μL)
WBCs: 9400/μL (normal 3400–9600/μL)
Urine pregnancy test: Negative
Pathology: Endometrial biopsy demonstrates benign endometrium with small fragments of polypoid tissue consistent with benign endometrial polyp

Imaging: Transvaginal ultrasound shows an anteverted uterus measuring 8.1 × 5.0 × 4.6 cm with endometrial lining of 3 mm. There is a 2.1 cm lesion in the anterior fundus abutting the endometrial cavity, suspicious for endometrial polyp or fibroid. No free fluid in the cul-de-sac. Normal bilateral ovaries with blood flow via Doppler

How Would You Manage This Patient?

This patient presents with new-onset intermittent vaginal bleeding years following an EA. In patients with a history of bleeding remote from an ablation, the differential diagnosis includes pregnancy, resumption of normal menses, uterine structural abnormalities such as polyps or fibroids, and endometrial cancer.

As this patient is likely postmenopausal and her partner is status post vasectomy, pregnancy is an unlikely cause of her bleeding. However, pregnancy should always be reliably excluded, and, in this case, a urine pregnancy test was negative.

A complete set of vitals was reassuring for hemodynamic stability. Physical examination was performed to determine the source of bleeding and assess for palpable uterine abnormalities. No abnormalities were discovered on examination, with bleeding appearing to originate from the uterine cavity. A complete blood count was drawn without evidence of anemia or infection.

Transvaginal ultrasonography was performed to identify pelvic pathology. Structural anomalies such as fibroids, polyps, adenomyosis, or a thickened endometrial lining could lead to the development of abnormal bleeding. Additionally, the presence of ovarian cysts would indicate ongoing follicular development and the resumption of menses. In this patient, the ovaries were normal in appearance, but there was a 2 cm fundal lesion suspicious for a fibroid or polyp. A saline infusion sonohysterogram could be considered to further delineate the structural abnormality. However, post-ablation scarring and anatomical changes can make this difficult to perform and was not attempted in this patient.

Abnormal bleeding, especially in postmenopausal women, warrants a biopsy to rule out endometrial malignancy. An in-office endometrial biopsy can be difficult to perform due to intracavitary adhesions, with the failure rate estimated to be as high as 40%. To ensure an adequate specimen is obtained, the biopsy may be performed under ultrasound guidance or in the operating room at the time of a hysteroscopy.

The patient was counseled on her options for treatment including in-office endometrial biopsy followed by expectant management versus surgical removal. She agreed to proceed with operative hysteroscopy and polypectomy. Surgery was successfully performed under ultrasound guidance, and a small fundal polyp was removed. The remainder of the cavity

effective and reliable birth control. Although rare, conception occurs in about 0.7% of patients after EA, and pregnancies have been diagnosed even up to 13 years postoperatively. Women who conceive are at risk for ectopic pregnancies and miscarriages, as well as preterm delivery, malpresentation, and abnormal placentation [5].

Treatment Options for Ablation Failure

Overall, approximately 85% of patients will be satisfied with the reduction in bleeding at one year post-ablation. However, the failure rate of EA is estimated to be 10–29%. For women who experience benign, bothersome bleeding, both medical and surgical treatment options are available.

Medical management: Progesterone supplementation – in the form of pills, injections, and intrauterine devices (IUDs) – has been used to prevent and treat ablation failure. Studies show that adding progesterone postoperatively leads to higher rates of amenorrhea and lower risks of repeat ablation and hysterectomy. IUDs also provide effective contraception and are particularly effective in treating women with adenomyosis.

Operative management: Performing a repeat ablation is generally not recommended. A second procedure is risky due to the distorted endometrial cavity and the increased risks of uterine perforation, visceral thermal damage, fluid overload, and genital tract burns [5].

In one study, in-office operative hysteroscopy was shown to be an effective treatment for EA failure. Tissue was resected to a depth of at least 4 mm beneath the basal layer of the endometrium and the myometrium was then coagulated. In the study of 50 patients, 89.9% did not require a second surgery [6].

Ultimately, definitive surgery via a hysterectomy may be warranted. Indications for a hysterectomy include irregular, heavy, or persistent bleeding; a high risk for endometrial cancer; or the inability to obtain an endometrial biopsy specimen. Hysterectomy can also be offered to symptomatic patients who report bothersome bleeding or associated pain. Additionally, patients undergoing surgery for other gynecologic abnormalities such as pelvic organ prolapse or cervical dysplasia could consider a concurrent hysterectomy. The probability of post-ablation hysterectomy is about 26%, with the majority performed within two to three years of the EA. In a study of hysterectomy specimens after failed ablation, hematometra was found in 26% of women who underwent hysterectomy due to pain; fibroids were found in 44% of women whose main complaint was abnormal bleeding. Age at the time of EA has been shown to be the most significant risk factor for undergoing a hysterectomy, with a 40% probability in women less than 40 years old [7, 8].

Key Teaching Points

- Endometrial ablation should be reserved for women who have benign heavy menstrual bleeding and a desire to lighten their monthly menses
- Risk factors for ablation failure include a history of dysmenorrhea, a prior tubal ligation, or age <45 at the time of the procedure
- If postoperative bleeding is irregular, heavy, or prolonged, a full workup should be completed. Evaluation should include uterine imaging and endometrial sampling
- The differential diagnosis of post-ablation bleeding may be narrowed down by time of onset after surgery. The most common cause of new-onset bleeding years after EA is the development of new uterine pathology
- Hyperplasia and malignancy should always be suspected, particularly in women who are postmenopausal or who have risk factors including diabetes, obesity, hypertension, or a history of endometrial intraepithelial neoplasia
- Recurrence of benign, heavy menstrual bleeding after EA may be treated with supplemental progesterone or hysterectomy

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CASE 46 A 22-Year-Old G3P0030 Woman with Recurrent Pregnancy Loss and Uterine Septum

Tana Kim

History of Present Illness

A 22-year-old woman, gravida 3, para 0, presents to the office for evaluation of recurrent pregnancy loss. Her obstetric history is significant for three prior first-trimester losses, all managed expectantly. She has regular menstrual cycles and has not had difficulty with conceiving in the past. She has been in a relationship with her partner for four years and they desire to conceive at this time. She has no significant past medical or family history and has not had prior surgery. She takes no medications and has no allergies.

Physical Examination

General appearance: Well groomed, healthy appearing woman, comfortable sitting upright

Vital signs:

Temperature: 37.0°C
Pulse: 74 beats/min
Blood pressure: 110/68 mmHg
Respiratory rate: 14 breaths/min
Height: 62 inches
Weight: 115 lb
BMI: 20 kg/m^2

Abdomen: Normal bowel sounds, soft, non-distended

Vagina: Normal rugae, no septum or lesions

Cervix: Normal appearing cervix without bleeding

Uterus: Anteverted, six weeks in size, mobile, non-tender

Adnexa: No palpable masses, non-tender

Laboratory studies:

Maternal karyotype: 46, XX
Paternal karyotype: 46, XY
Lupus anticoagulant: Negative
Anti-beta 2-glycoprotein IgM and IgG: <40 units
Anticardiolipin IgM and IgG: <40 units
Prolactin: 12.8 ng/mL (normal 0.0–20 ng/mL)
TSH: 1.7 mIU/L (normal 0.3–4.2 mIU/L)
HbA1c: 5.2% (normal 4–5.6%)

Imaging: Transvaginal ultrasound shows a normal-sized uterus with demonstration of two endometrial cavity horns. Three-dimensional rendered imaging demonstrates a smooth fundal contour and a uterine septum measuring 1.7 cm in length (Figure 46.1)

How Would You Manage This Patient?

This patient has a uterine septum on imaging, and no other obvious explanation for her pregnancy losses. Her uterine anomaly is the likely cause of her recurrent pregnancy loss. She was counseled regarding surgical resection. The patient agreed to a hysteroscopic septoplasty, which was completed without any complications. Approximately three months following the procedure, the patient successfully conceived a single intrauterine pregnancy. The pregnancy was uncomplicated and was managed routinely. A viable healthy term infant was delivered vaginally.

Uterine Septum

While the incidence of congenital Müllerian anomaly in the general population is approximately 4.3%, the incidence is approximately 13% in women with recurrent pregnancy loss [1]. A septate uterus is the most common uterine anomaly, representing approximately 34.9% of all congenital Müllerian anomalies [1]. Embryologically, a septate uterus results from the failure of midline tissue resorption following fusion of the two Müllerian ducts. The size of the septum can vary depending on the extent of resorption failure, at times extending down to the level of the cervix. Despite a significant association between Müllerian anomalies and renal malformations, a uterine septum is not typically associated with concurrent renal abnormalities as the septum resorption occurs after the mesonephros has already differentiated into the renal system.

Imaging studies can aid in identifying Müllerian anomalies. Correctly diagnosing a septum requires evaluation of both the intrauterine cavity and the external contour of the uterine fundus. Prior to the advent of sophisticated imaging modalities, the diagnostic gold standard was a combination of laparoscopy and hysteroscopy. Non-invasive imaging techniques including three-dimensional ultrasonography with or without saline and magnetic resonance imaging are now preferred over surgical diagnosis (Figure 46.2) [2]. Hysterosalpingography

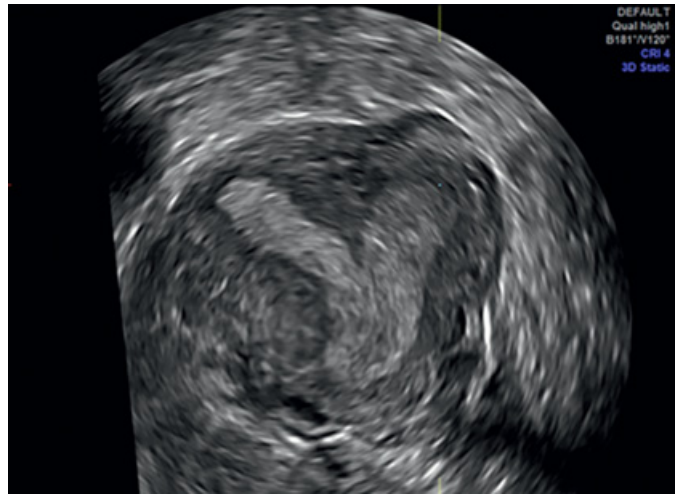

Figure 46.1 Three-dimensional ultrasound image of uterine septum.

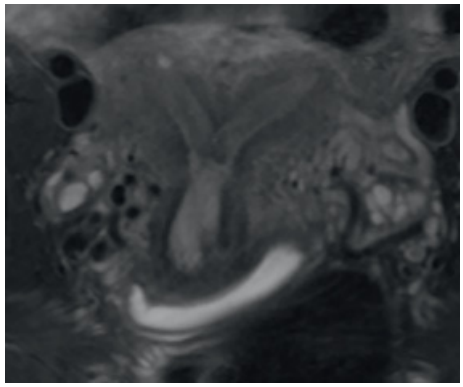

Figure 46.2 Magnetic resonance imaging of uterine septum.

alone is not adequate for correctly differentiating the type of Müllerian anomaly as it only assesses the intrauterine cavity. Findings suggestive of a Müllerian anomaly on hysterosalpingography require further investigation with additional imaging studies. Furthermore, a septum cannot be accurately diagnosed on a gravid uterus as uterine distention distorts the normal anatomy.

The diagnostic criteria for uterine septum are not uniform. The European Society of Human Reproduction and Embryology (ESHRE) defines uterine septum as an internal indentation of >50% of the uterine wall thickness with a straight external fundal contour [3]. On the other hand, the American Society for Reproductive Medicine (ASRM) defines uterine septum as a septum depth greater than 1.5 cm with an indentation angle less than 90 degrees. The contour of the external uterine fundus is typically smooth and if an indent is present, it should be less than 1 cm in depth [2].

Compared with other types of uterine malformations, a septate uterus is more likely to be associated with adverse pregnancy outcomes. The risk of spontaneous abortion can be as high as 41.1% in the presence of an uncorrected septum [4]. Predisposition to pregnancy loss is thought to result from implantation on a poorly vascularized septum. Pregnancy complications including preterm labor (20%) and malpresentation (25–30%) are also more frequent with septate uterus than with a normal uterine cavity [5]. Additionally, studies have found an increased risk of low birth weight and more than twofold increase in perinatal mortality in pregnancies complicated by an uncorrected uterine septum [6]. Although larger uterine septa may preferentially be managed surgically, there is insufficient evidence as to whether the size and extent of the septum correlates with increased risk of adverse outcomes [7]. Fortunately, these adverse pregnancy outcomes can be mitigated by surgical resection.

Uterine septum is treated by resecting the residual tissue under hysteroscopic visualization. As the fibrous septum is typically avascular, it can be successfully incised using hysteroscopic cold scissors. Bipolar electrosurgery or laser can also be used. To aid in visualization, the procedure is best performed during the early follicular phase or following pretreatment with combination estrogen/progestin contraceptive to thin the endometrium. The goal of the resection is to minimize the septum. Prior to incising the septum, a global evaluation should be performed soon after the hysteroscope is inserted into the cavity. Each uterine horn should be explored, and the tubal ostia identified bilaterally. Once the layout of the cavity is recognized, the hysteroscope should be retracted until the leading edge of the septum is in view. Resection of the septum should start at the distal edge and carried through until the base of the septum is reached. The septum can be taken down with serial cuts using the hysteroscopic scissors. The cuts should be aimed at the midplane of the septum. As the septum is cut, the avascular septal tissue will retract. The septum should be serially incised at the mid anterior/posterior plane, starting from the center then moving left and right, focusing on leveling the horizontal plane as the tissue retracts. The tubal ostia should be visualized at all times to avoid inadvertent cuts, which can potentially lead to perforation. Increased vascularity is suggestive of myometrium. Thus, visualization of bilateral tubal ostia in a single view, along with increased bleeding, likely indicates adequate resection. Although not required, concurrent laparoscopy or intraoperative transabdominal ultrasound can be considered to supplement visualization and help decrease the uterine perforation risk.

Post-surgical intrauterine adhesion formation is uncommon following hysteroscopic septoplasty. Preventative interventions against adhesion formation are likely not helpful and generally not recommended. Randomized studies have not demonstrated significant differences in adhesion formation following estrogen/progestin therapy, placement of an intrauterine device, or intrauterine balloon in the postoperative period compared with expectant management alone [8, 9]. There is no consensus on the length of postoperative recovery prior to conception. However, retrospective cohort studies suggest that the endometrium is healed by two months following surgery [2].

There are no randomized studies comparing pregnancy outcomes between septoplasty and expectant management, but several observational studies suggest improvement in pregnancy and live birth rates following surgical correction. A large retrospective study reported a decrease in the miscarriage rate from 94.3% to 16.1% and an increase in the live birth rate from 2.4% to 75% following septoplasty among women with recurrent pregnancy loss [10]. A meta-analysis also found a significant decrease in spontaneous abortion following septoplasty compared with women who did not undergo surgical resection (RR 0.37, 95% CI 0.25–0.55); however, the rate of preterm labor did not significantly differ following surgery. Not all septate uterus results in pregnancy loss. However, given its association with adverse pregnancy events and significant improvement following surgical correction, resection should be considered in women with history of recurrent pregnancy loss.

Key Teaching Points

- Uterine septum is associated with poor obstetrical outcomes, including recurrent pregnancy loss
- Diagnosis can be made on magnetic resonance imaging or three-dimensional ultrasound and requires evaluation of both the intrauterine cavity and the external fundal contour
- Surgical management should be offered to women with history of recurrent pregnancy loss as it is associated with decrease in miscarriage rates and improved live birth rates
- Hysteroscopic septoplasty is the gold standard with septum resection performed using hysteroscopic scissors down to the myometrium
- Hormone therapy or intrauterine balloon placement to decrease postoperative adhesion formation is likely unhelpful and is not recommended
- There is no consensus on the required length of postoperative recovery prior to conception; however, studies suggest normal endometrium is restored by two months

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CASE 47

A 33-Year-Old G2P2 Woman with Persistent Irregular Vaginal Bleeding after Cesarean Delivery

Jonathan D. Emery

History of Present Illness

A 33-year-old woman, gravida 2, para 2, presents with irregular intermenstrual bleeding occurring each month since undergoing her second cesarean delivery 15 months ago. Since finishing breastfeeding, she has experienced light intermenstrual bleeding episodes following menses. She denies any change in bowel or bladder symptoms. She is sexually active with one partner using condoms and denies pain or bleeding with intercourse. She denies any history of sexually transmitted diseases or abnormal Pap test that required treatment. Her past medical and surgical histories are non-contributory. She is not taking any medications and denies medication allergy.

Physical Examination

General appearance: Well-developed, well-nourished female, sitting comfortably

Vital signs:

Temperature: 36.8°C
Pulse: 76 beats/min
Blood pressure: 124/72 mmHg
BMI: 26 kg/m^2

Abdomen: Well-healed Pfannenstiel skin incision with mild skin retraction along the scar. Normal bowel sounds in all quadrants, soft, non-distended, no guarding or rebound

External genitalia: Normal vulva and introitus without lesions

Vagina: Normal without lesions, mild brown mucoid discharge present

Cervix: Mild ectropion present without lesions

Pelvic: Retroverted, non-tender uterus, without abnormalities or enlargement. Adnexae with no enlargement or tenderness

Laboratory studies:

β-hCG: <5 mU/ml (normal <5.0 mU/ml)
TSH: 2.670 mIU/L (normal 0.270–4.200 mIU/L)
Prolactin: 16.8 ng/mL (normal 4.5–26.8 ng/mL)

Imaging: Transvaginal ultrasound shows retroverted uterus measuring 9.4 × 6.5 × 5.2 cm with a uniform endometrial thickness of 12 mm. The myometrium is homogeneous and without evidence of leiomyomas. The anterior lower uterine segment contains a hypoechoic defect of the myometrium with a triangular appearance. The defect appears to be in communication with the endometrium

How Would You Manage This Patient?

This woman presented with persistent intermenstrual spotting and bleeding after cesarean delivery. Abnormal uterine bleeding (AUB) has a wide differential diagnosis which includes endometrial structural lesions (polyps or submucosal fibroids), endometritis, endometrial hyperplasia, cervicitis, or retained products of conception. Non-gynecologic disorders include coagulopathy or other endocrine disorders. In this patient, the clinical history of an ultrasound finding of a defect in the lower uterine segment with a history of cesarean section points to isthmocele as the primary diagnostic consideration. The next step was to confirm the diagnosis with a sonohysterography (SHG), which confirmed the cesarean scar notch with only 3 mm residual myometrium over the defect. Once the diagnosis was confirmed, she was counseled on initial conservative medical options including hormonal management with combination oral contraceptive pills or a levonorgestrel intrauterine device, both of which she declined. Discussion of her goals for treatment led to an evaluation for surgery as she desired a cessation of the intermenstrual bleeding and correction of the scar in consideration of future childbearing. After a review of vaginal, hysteroscopic, and laparoscopic surgical approaches, she chose a laparoscopic repair, which was performed with hysteroscopic assistance. The surgery was uncomplicated and the cesarean scar defect (CSD) was completely excised and repaired in two layers. She was discharged home with a Foley catheter for one week. Her postoperative course was uneventful and menses resumed with no intermenstrual spotting or bleeding. Subsequently, she underwent a repeat SHG four months after surgery which showed an increase in myometrial thickness of the scar from 3 mm preoperatively to 12 mm.

Isthmocele: Evaluation and Surgical Treatment

Isthmocele was reported in detail in 1995 by Morris who described the myometrial thinning and widening of the cesarean scar combined with the inflammatory process with the scar itself [1]. There is no standardized classification system and studies define a defect, sometimes called a niche, of at least 2 mm depth and 4 mm width. The primary factor in development is improper healing after one or multiple cesarean sections. In the majority of cases, patients are without symptoms and the isthmocele is found incidentally on imaging. The presence of the defect can cause AUB, postmenstrual spotting, pelvic pain, and dysmenorrhea. The prevalence of isthmocele varies from 6.9% to 70% depending on presence or absence of symptoms and imaging modality used for diagnosis, which can include

transvaginal ultrasound (TVUS), SHG, hysterosalpingography, pelvic MR, and hysteroscopy. The prevalence of isthmocele is 24–70% with TVUS and increases to 56–84% with SHG [2].

Decision to Operate

The decision to operate should be based on the patient's objectives and desires. If the patient is asymptomatic and the defect is found on pelvic imaging, no specific treatment is warranted. If the patient is symptomatic, then discussion of medical versus surgical management should take place. Medical treatment with oral contraceptive pills, oral progesterone therapy, or the levonorgestrel intrauterine device (IUD) can be considered while gonadotropin-releasing hormone agonists are associated with greater side effects [3]. It should be noted that IUD placement may be more difficult as the scar defect may interfere with advancement of the IUD applicator; IUD insertion with ultrasound guidance should be considered. Finally, if the patient fails medical management, counseling on appropriate surgical options is acceptable.

If the patient desires future childbearing and the defect is not corrected, then the patient is at risk for a cesarean scar pregnancy as well as potential risk of uterine scar rupture and should be counseled accordingly. There is a lack of evidence correlating isthmocele with these events [4]; therefore, clinical judgment about the size of the scar and the depth of the overlying myometrial thickness should guide therapy.

Surgical Techniques

Once the decision for surgical correction has been made, choice of appropriate surgical technique is required. This will depend primarily on the surgeon's experience as well as the goal of surgery, whether for resolution of symptoms or restoration of fertility. The critical step of each procedure is to modify the CSD so as to resect or ablate the endometrial tissue within the scar as well as to excise the fibrous scar tissue and repair the myometrial defect.

While the vaginal approach is the least studied, it does have favorable outcomes in the hands of a skilled vaginal surgeon using a step-by-step approach as documented by Luo et al. [3]. Once the patient is appropriately positioned for surgery, the vesicovaginal space is injected with a hemostatic solution such as vasopressin. This is followed by dissecting the vesicovaginal space sharply, similar to vaginal hysterectomy, with careful attention to scarring from the antecedent cesarean section.

Once the bladder is dissected, identification of the isthmocele may be accomplished by palpation either manually or with the use of a cervical dilator or hysteroscope. The CSD is then opened sharply and surrounding fibrotic scar tissue is excised. The defect is closed in two layers, using interrupted delayed absorbable suture. The vaginal tissue and bladder peritoneum are reapproximated to minimize dead space. A Foley catheter is also used to decompress the bladder postoperatively. The vaginal approach has been noted to have improvement in AUB symptoms in 89–94% but it is noted to be longer and is associated with more blood loss [3].

The hysteroscopic approach has been the most described in the literature [5, 6] and has been described with multiple techniques with a wider range of improvement of AUB (59–100%) with a pregnancy rate greater than 75%. The primary goals of the hysteroscopic approach are to resect and remodel the scar tissue around the defect, and to ablate or remove any aberrant endometrial tissue that contributes to irregular bleeding. This surgery requires preoperative knowledge of the depth of the residual myometrial scar with imaging (SHG or MRI) over the defect as depths less than 3 mm have been associated with increased risk of perforation. Hysteroscopic surgery is performed in the operating room using a local hemostatic agent on the cervix. Cervical dilation is accomplished in standard fashion enough to accommodate an operative hysteroscope, typically a 16 French Pratt dilator. The hysteroscope is then advanced through the internal os to identify the isthmocele. Most described hysteroscopic techniques utilize a cutting wire loop with resection of the edges of the defect accomplished to provide continuity with the lower uterine segment and removal of any fibrotic tissue defects, which allows for improved menstrual flow. Also, ablation or fulguration of any aberrant endometrial tissue or blood vessels surrounding the scar is also done. Care should be taken to avoid the apex of the scar at its thinnest point.

This patient ultimately underwent a laparoscopic repair with hysteroscopic assistance. This combined approach has been shown to be associated with greater improvements in decreasing the duration of abnormal bleeding and in reducing the depth of the diverticulum [7, 8].The initial step of the procedure is to locate and define the CSD laparoscopically, which can be aided by hysteroscopy or small intrauterine Foley catheter as indicated. Once the defect is identified (Figure 47.1), the bladder is dissected off the lower uterine segment and cervix to allow exposure to the defect with attention to bladder and/or peritoneal scarring. The isthmocele is excised sharply with appropriate surgical energy. Care must be taken to remove all the fibrotic scar tissue. Closure of the defect is done with laparoscopic suturing, in at least two layers, using either vicryl or PDS suture (Figure 47.2).

A Hegar dilator may be placed in the cervix after the excision to maintain integrity of the cervical canal during suturing. Closure of the overlying peritoneum and/or use of an adhesion barrier can be considered. The integrity of the repair can be evaluated hysteroscopically. In cases where the

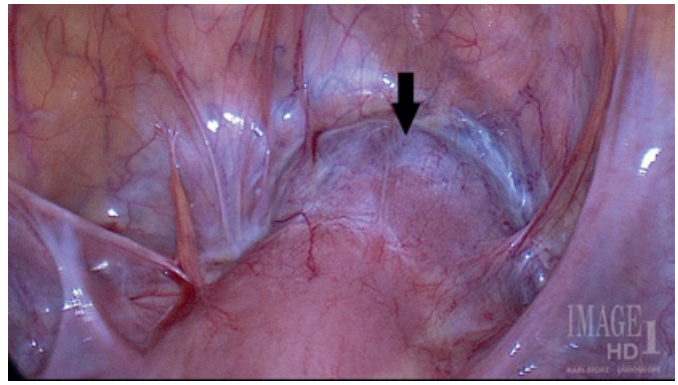

Figure 47.1 Pelvic anatomy with black arrow identifying the isthmocele.

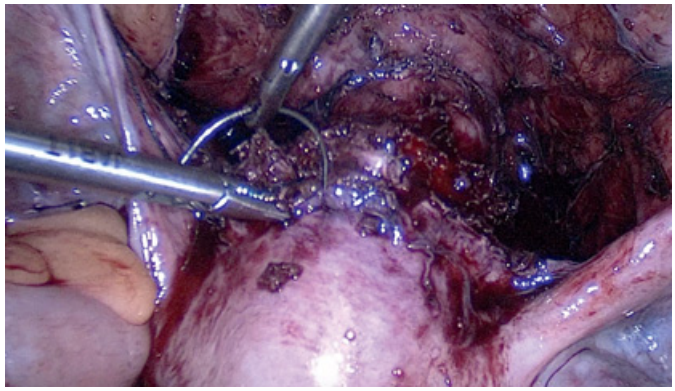

Figure 47.2 Completed laparoscopic repair of isthmocele.

uterus is retroflexed, laparoscopic shortening of the round ligaments can be performed to lessen the potential anatomic forces on the repair that may impede wound healing. The stand-alone laparoscopic approach is noted to improve AUB symptoms in over 85% of patients and has a post-procedure pregnancy rate of 55%.

Risks associated with the vaginal approach include bleeding and injury to the bladder. Hysteroscopic techniques are associated with uterine perforation and injury to surrounding viscera, especially if the overlying myometrial thickness is <3 mm. Fluid management is mandatory to prevent pulmonary edema. Laparoscopic complications include injury to pelvic viscera as well as bleeding encountered during dissection and in identifying the defect. Postoperatively, patients should be advised to use contraception for at least six months to allow for complete healing of the scar before attempting a pregnancy. The decision about route of delivery should be individualized as there is no evidence supporting vaginal delivery over cesarean delivery or vice versa.

Key Teaching Points

- Isthmocele is an increasingly recognized cause of abnormal uterine bleeding in women with a history of cesarean delivery
- Sonohysterography is the best diagnostic imaging modality
- Surgery may be indicated in symptomatic women who have failed initial medical treatment
- Choice of surgical approach is dictated by the gynecologist's preferred approach

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CASE 48 A 38-Year-Old G3P2 Woman with Pelvic Pain following Endometrial Ablation

Amber Bondurant-Sullivan

History of Present Illness

A 38-year-old gravida 3, para 2 female presents to the office with an eight-month history of severe recurrent cyclic pelvic pain. The patient had a long history of heavy menstrual cycles and dysmenorrhea for which she had undergone an uncomplicated endometrial ablation using radiofrequency device two years ago. As a result of the procedure, she has become amenorrheic. Eight months ago she began to experience severe bilateral lower pelvic cramping that occurs monthly and lasts for five to seven days. She has had minimal improvement with non-steroidal anti-inflammatory agents. She has no past medical history. Her past surgical history is significant for postpartum tubal sterilization five years ago. She is a non-smoker and has no significant family history. She is sexually active with one male partner and has no history of sexually transmitted infections. She is not taking any medications and has no drug allergies.

Physical Examination

General Appearance: Healthy adult woman in no distress
Vital signs:

Pulse: 70 beats/min
Blood pressure 114/62 mmHg
BMI: 29 kg/m^2

Abdomen: Soft, non-tender, and non-distended
External genitalia: Normal
Vagina: Normal rugae, normal discharge
Cervix: Normal without bleeding. No cervical motion tenderness
Uterus: Anteverted, non-tender, mobile, normal in size
Adnexa: No palpable masses, non-tender bilaterally
Laboratory Studies:

Urine pregnancy test: Negative
Urinalysis: Normal

Imaging: Transvaginal ultrasound shows a normal sized uterus, normal myometrium, and distorted endometrial stripe, with only small measurable segment at 4 mm in thickness. Adnexa are normal in appearance. There is no free fluid

How Would You Manage This Patient?

Differential diagnosis for this patient included post-ablation tubal sterilization syndrome, ovarian cysts, urinary tract infection, constipation, and pelvic floor dysfunction. Another ultrasound was obtained during an episode of pain which demonstrated small bilateral cornual hematometra. The patient initially desired medical management and was started on an extended cycle combined oral contraceptive for presumed post-ablation tubal sterilization syndrome. Due to incomplete control of her pain, she opted for hysterectomy. During the laparoscopic hysterectomy small bilateral hydrosalpinx were seen. The uterus and ovaries were normal in appearance. The specimen pathology demonstrated uterine adenomyosis and sterile hydrosalpinx bilaterally. The patient recovered well and had complete resolution of her symptoms.

Risks of Endometrial Ablation Failure

Endometrial ablation has become a commonly used minimally invasive alternative to hysterectomy for the treatment of heavy menstrual bleeding. Overall satisfaction rates for these procedures are high at 80–90%. Despite this, about 10–20% of women who undergo endometrial ablation develop symptoms of bleeding and pain that ultimately require additional treatment [1]. Endometrial ablation failure is defined by the need for re-intervention after an ablation procedure and includes hysterectomy, repeat ablation, synechiolysis, or use of a gonadotropin-releasing hormone (GnRH) analog for post-ablation pain or bleeding. Prognostic factors that have been associated with endometrial ablation failure are younger age less than 45 years old, prior tubal ligation, and preexisting dysmenorrhea. Obesity and the presence of large submucosal myomas are also associated with failure. Preexisting dysmenorrhea is strongly associated with endometrial ablation failure, as the common underlying causes of dysmenorrhea – adenomyosis and endometriosis – are not treated with endometrial ablation. Changes to the intrauterine architecture after endometrial ablation can exacerbate prior pain-related conditions, as well as cause new sources of pain that may require re-intervention.

Diagnosis of Post-ablation Pain Syndrome

Post-ablation pain syndrome includes a number of conditions that result from obstructed menstrual bleeding after endometrial ablation. Thermal injury to the endometrium from the ablation results in intrauterine scarring and contracture that leads to obstruction of outflow. Although the goal of endometrial ablation is to destroy the entire endometrium to prevent ongoing bleeding, this is rarely attained as evidenced by the less than 50% amenorrhea rate achieved by these procedures [2]. Persistent or regenerating endometrium has been reported in follow-up post-ablation MRI examinations in up to 95% of patients, suggesting the presence of persistent endometrial glands in most cases [3]. Post-ablation pain syndrome occurs when persistent or regenerating endometrial cells bleed resulting in trapped blood behind intrauterine scar. This bleeding can result in hematometra at the cornual region, as seen in post-ablation tubal sterilization syndrome (PATSS) or within the body of the uterus (central hematometra). Women with this syndrome generally present with severe cyclic pelvic pain,

with or without vaginal bleeding, after endometrial ablation. These conditions can occur months to years after the ablation procedure was performed.

Post-ablation Tubal Sterilization Syndrome (PATSS) and Cornual Hematometra (CH)

Post-ablation tubal sterilization syndrome was initially reported in 1993 after a case report of six patients who presented with unilateral or bilateral pelvic pain and spotting after undergoing endometrial ablation and tubal sterilization [4]. These patients were found to have endometrial scarring and proximal edema of one or both fallopian tubes. The mechanism of pain in PATSS is thought to be due to the presence of persistent or regenerated endometrial cells in the cornua that shed monthly, resulting in cornual hematometra (CH). The trapped blood is subsequently pushed retrograde through the proximal portion of the fallopian tube, where it is confined by the patient's prior tubal occlusion. This blood causes distension of the proximal fallopian tube, which results in pain. In CH, confined blood due to intrauterine scarring causes distension of the cornual region with resultant pain. The incidence of PATSS and CH is approximately 6–8% and typically develops two to three years after endometrial ablation [5].

The diagnosis of PATSS/CH is made clinically and should be suspected in any woman with a history of endometrial ablation, with or without tubal sterilization, who presents with cyclic pelvic pain. The pain occurs during the time of expected menses, although the patient may be amenorrheic. These patients will have a normal complete blood count and negative pregnancy test. Most often an ultrasound scan will demonstrate a normal uterus, and normal adnexa bilaterally, as the hematosalpinx or CH associated with these conditions is generally too small to be visualized with ultrasound. Imaging by ultrasound or MRI can visualize the obstructed cornual blood, but must be obtained during times of symptomatic cramping, as the blood may resolve between episodes. CT scans are generally non-diagnostic.

Central Hematometra

Central hematometra occurs when there are regenerating or residual endometrial cells that cause bleeding proximal to cervical or lower uterine segment stenosis (Figure 48.1). This stenosis is typically caused by damage to the upper endocervical canal at the time of the endometrial ablation. This results in menses being obstructed at the level of the cervix. These patients will present with cyclic pain during the time of menses. They are generally amenorrheic but can have some menstrual flow. The symptoms typically start weeks to months after surgery with an incidence of 1–3% of all ablations independent of type of ablation device. Unlike PATSS, an ultrasound completed at the time of a patient's symptoms is generally diagnostic for the condition. Pelvic MRI can be performed to better define the uterine anatomy, which often is distorted, and to confirm the presence of blood products in challenging cases.

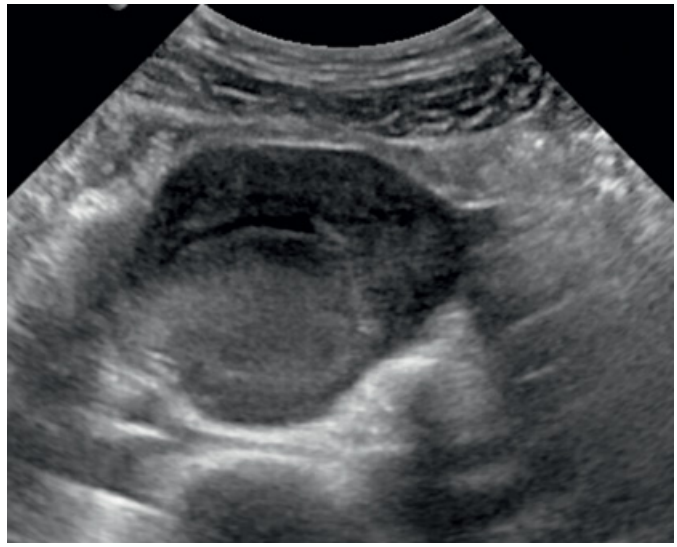

Figure 48.1 Transverse view of uterus with central hematometra.

Treatment Options for Post-ablation Pain Syndrome

Treatment strategies for post-ablation pain syndrome include both non-surgical and surgical options. While central hematometra has shown successful treatment with minimally invasive treatment, hysterectomy has been shown to have the best long-term success in the treatment of pain associated with PATSS and CH. Salpingectomy with or without cornuectomy have also been shown to be viable options for appropriate patients.

Non-surgical Treatment

Non-surgical treatment strategies for post-ablation pain syndrome include medical therapies that induce menstrual suppression and endometrial atrophy. They should only be considered in women who can be ruled out for other significant endometrial or myometrial pathology. Often women who have undergone endometrial ablation have previously failed medical management or have contraindications to its use; therefore, use of these therapies is generally limited. Gonadotrophin-releasing hormone agonists have been shown to provide temporary relief of pain secondary to obstructed bleeding. However, patients may have difficulty tolerating the adverse effects related to its use and pain symptoms are likely to recur within months of discontinuation. Generally definitive management of post-ablation pain syndrome requires a form of surgical intervention.

Surgical Treatment

Minimally invasive and non-minimally invasive surgical techniques have been used in the treatment of post-ablation pain syndrome. These include reoperative hysteroscopic techniques, salpingectomy, and hysterectomy. Central hematometra can be successfully treated with cervical dilation and decompression of the hematometra without the need additional surgery.

Unlike central hematometra, PATSS and CH are more difficult to treat. The formation of intrauterine scarring and contracture make hysteroscopic adhesiolysis or endometrial resection and drainage of the blood collection challenging. There is a high risk of uterine wall perforation in the central cavity as well as cornual region after ablation due to myometrial thinning. The use of ultrasound guidance can improve outcome but success often requires expertise in complex hysteroscopic techniques [6]. If drainage is successful, the tract created to drain the obstructed blood can reclose, leading to a recurrence of symptoms. Additionally, 25% of patients will have persistent endometrium in the intramural oviduct after endometrial resection. This endometrium also has the potential to bleed, leading to symptom recurrence [7]. The placement of a levonorgestrel-releasing intrauterine device (LNG-IUS) immediately after endometrial resection has been reported to improve pain in women with dysmenorrhea or adenomyosis. Thus, concurrent placement of LNG-IUS at the time of hysteroscopic adhesiolysis can be considered as a strategy to reduce symptom recurrence for PATSS.

Laparoscopic salpingectomy has shown success in alleviating pain only when the blood collection is wholly intratubal, as it will not address pain caused by concurrent CH that is often present in women with PATSS [5]. Women treated with salpingectomy alone will often develop recurrent pain due to a persistent CH from residual endometrial cells in the cornua and intramural oviduct. They also have the potential to develop endosalpingiosis because of reactivation of cells within the intramural oviduct. Hysterectomy with proximal salpingectomy is the definitive treatment for PATSS and CH and has been shown to have the best long-term results over all other treatment options [5]. Determination of the best course of management for patients with post-ablation pain syndrome are dependent on multiple factors including patient medical comorbidities, patient age, past surgical history, availability of minimally invasive techniques, and surgeon comfort.

Key Teaching Points

- Approximately 20% of women who undergo endometrial ablation will develop endometrial failure. Factors associated with endometrial ablation failure are younger age less than 45 years old, prior tubal ligation, and preexisting dysmenorrhea
- This is a clinical diagnosis that should be suspected in any woman with a history of endometrial ablation, with or without tubal sterilization, who presents with cyclic pelvic pain
- Imaging by ultrasound or MRI can visualize the obstructed cornual blood, but must be obtained during times of symptomatic cramping, as the blood may resolve between episodes
- Medical and surgical treatments are available. Treatment choice depends on patient factors as well as surgeon comfort with complex minimally invasive techniques

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CASE 49 A 33-Year-Old Woman with Acute Hypoxia during Hysteroscopic Myomectomy

Aakriti R. Carrubba

History of Present Illness

A 33-year-old nulligravid woman is undergoing hysteroscopic removal of a 5 cm FIGO type 1 submucosal myoma due to heavy menstrual bleeding and mild anemia. She is otherwise in good health and has no significant medical or surgical history. She is not on any medications and denies drug allergy. The patient receives general anesthesia without difficulty. The procedure commences with use of a fluid management system and a bipolar resectoscope to remove myoma fragments. Approximately 30 minutes into the surgery, the anesthesiologist becomes concerned due to sudden decrease of oxygen saturation to 87%. The total fluid deficit is approaching 2300 mL. The anesthesiologist administers intravenous (IV) furosemide and asks the surgeon to terminate the procedure. Several minutes later, oxygen saturations increase to 92%. The patient is awakened from anesthesia and proceeds to the recovery room in a stable condition.

Physical Examination

General appearance: Well-developed, well-nourished female; currently intubated with endotracheal tube and under general anesthesia

Vital signs:

Temperature: 35.9°C
Pulse: 90 beats/min
Blood pressure: 126/76 mmHg
Respiratory rate: 28 breaths/min
Oxygen saturation: Initially 87%

Chest: Bilateral basilar crackles

Cardiovascular: Regular rate and rhythm; no murmurs or arrhythmias noted

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

Pelvic: Normal external female genitalia. Normal nulliparous cervix with no masses or lesions. Slightly enlarged eight-week-sized anteverted uterus. No adnexal masses

Extremities: No cyanosis, clubbing, or edema. Sequential compression devices present on bilateral lower extremities

Neurologic: Intubated and sedated; unable to assess mental status

Laboratory studies:

WBCs: 7200/μL (normal 3400–9600/μL)
Platelets: 312 000/μL (normal 157 000–371 000/μL)
Hb: 10.2 g/dL (normal 11.7–15.0 g/dL)
Sodium: 139 mmol/L (normal 135–145 mmol/L)
Potassium: 3.9 mmol/L (normal 3.6–5.2 mmol/L)
Creatinine: 0.81 mg/dL (normal 0.59–1.04 mg/dL)
Urine pregnancy test: Negative

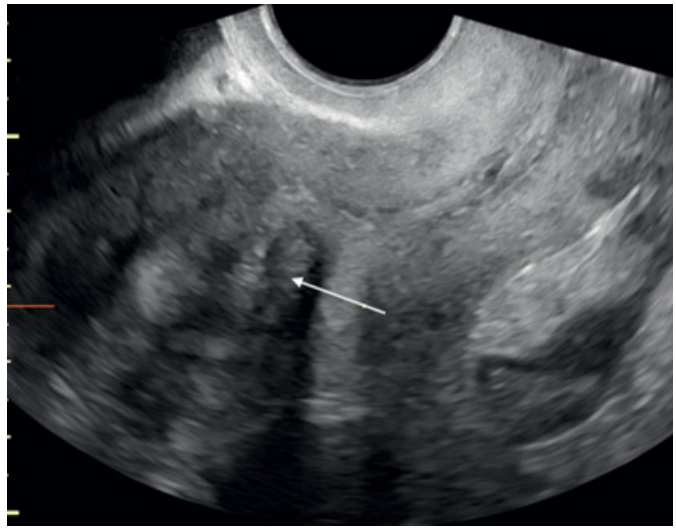

Figure 49.1 Transvaginal ultrasound of FIGO I myoma, white arrow indicating fibroid.

Imaging: Pelvic ultrasound shows an anteverted uterus measuring 8.5 × 4.1 × 4.7 cm with multiple intramural fibroids, all less than 2 cm in diameter. The endometrial thickness is 3 mm in most areas. There is a 5.1 × 3.2 × 4.2 cm submucosal fibroid arising from the lower uterine segment, FIGO stage I (Figure 49.1). The cervix has several small nabothian cysts. The left ovary measures 2.1 × 3.5 × 3.7 cm and the right ovary measures 3.2 × 3.5 × 3.0 cm; there are no adnexal masses noted. There is no free fluid in the pelvis

How Would You Manage This Patient?

This patient is undergoing a hysteroscopic myomectomy of a large intracavitary fibroid. The procedure required extensive resection using a bipolar device due to the large size and density of the fibroid. To provide adequate visualization throughout the procedure, the surgeon utilizes fluid to distend the uterine cavity. As the surgery progresses, fluid absorption occurs both through vascular influx from disrupted venous sinuses in the myometrium and into the peritoneal cavity by way of the fallopian tubal ostia ("third spacing"). At a certain threshold, the patient develops symptoms of fluid overload which can result in acute hypoxia and difficulty with ventilation due to pulmonary edema.

In this case, the surgery was terminated to decrease additional pulmonary edema; operative hysteroscopy cannot continue without use of a distention medium. Administration of IV furosemide dramatically improved this scenario by increasing renal clearance of the excess fluid. She was monitored postoperatively for cardiopulmonary ramifications in the post-anesthesia recovery room and did not require

admission to the intensive care unit. There was still a significant portion of her myoma that needed to be resected, so she can undergo a second "staged" hysteroscopic procedure in the future.

Fluid Overload

Uterine distention is required for visualization of the endometrial cavity during hysteroscopy, and distention media can result in fluid overload related to excess absorption. Consequences of fluid overload include hyponatremia, right heart failure, pulmonary edema, cerebral edema, and rarely death [1, 2]. Technology to accurately measure fluid absorption consists of media delivery and management systems. They can be used to determine the amount of fluid delivered, the amount collected via a perineal drape, and a fluid deficit, the excess amount that has been absorbed by the patient [1]. It is important to limit fluid spilled on the floor or absorbed by the drapes to improve accuracy of this measurement. Additionally, surgeons should be able to manually track the amount of fluid used and returned during the procedure in the event that the management system has an erroneous result. The goals of accurate fluid management include prevention of excess absorption, early recognition of excess absorption, and choosing distention medium that is least likely to cause complications if fluid overload is to occur [3].

Factors that can increase risk for fluid overload include use of a large diameter hysteroscope, high intrauterine distention pressure, low mean arterial pressure (MAP), deep myometrial penetration of the resection, prolonged operative time, a large uterine cavity, and use of general anesthesia [4]. During surgery, the intrauterine pressure should be kept below the patient's MAP to decrease risk of systemic intravasation. Furthermore, pressures greater than 75 mmHg increase the volume of media passing through the fallopian tubes [4]. Intrauterine pressures can be transiently increased if visualization is poor, but in general they should be lowered to 50 to 80 mmHg when possible. Methods to reduce risk include preoperative administration of gonadotropin-releasing hormone (GnRH) analogs to reduce fluid absorption, paracervical injection of dilute vasopressin to create vasoconstriction of the cervix, and preoperative administration of misoprostol to facilitate cervical dilation and vasoconstriction [1, 5]. Preoperative patient counseling regarding the possibility of a staged approach with two hysteroscopy procedures is warranted to make patients aware of this condition. Additionally, it is critical to communicate risks of fluid overload with the anesthesiology and operating room staff to act quickly and prevent additional harm to the patient.

There are several types of distention media which can be used during operative hysteroscopy (Table 49.1). Distention media should be selected based on the properties of the solution, energy source, and goals of the procedure. Fluid deficit thresholds vary based on the type of media; for example, a maximum fluid deficit threshold ranges from 750 to 1000 mL for electrolyte-free media and 1500 to 2500 mL for normal saline, with more conservative measures for patients with baseline cardiopulmonary disease [1]. Patients with kidney disease or congestive heart failure should have a cutoff of 750 mL regardless of media type [7].

The differential diagnosis of hypoxia during hysteroscopy includes pulmonary embolism, gas embolism, anaphylaxis, cerebrovascular accident, and cardiac arrhythmia. Recognition is critical, and the surgical team needs to communicate effectively in order to minimize additional fluid absorption to prevent cerebral edema and death.

Physical examination findings that are consistent with fluid overload include bibasilar crackles and muffled lung sounds due to pulmonary edema. Patients may also have edema in the upper extremities or face. Management includes expeditious termination of the procedure, measurement of serum electrolytes, and treatment with IV furosemide. If a patient develops symptoms of cardiac failure or pulmonary edema, an echocardiogram and chest x-ray should be performed. In patients who develop symptomatic hyponatremia, admission to an intensive care unit for appropriate electrolyte correction is warranted. This is performed with administration of 3% hypertonic sodium chloride solution via a 100 mL bolus over 10 minutes followed by an infusion of 1–2 mmol/L/h [4]. It is critical to correct sodium values slowly to avoid central pontine myelinolysis, a neurological disorder consisting of demyelination at the base of the pons and pseudobulbar paralysis [8]. The goal is an increase in sodium of 6 mmol/L over 24 hours until a value of 130 mmol/L is reached [4].

It is important for the surgeon and anesthesiology team to also be familiar with the concept of gas embolism, another condition on the differential diagnosis of acute hypoxia during hysteroscopy. This occurs when air enters the uterine cavity from insertion in the scope, air bubbles in the fluid if the tubing is not primed prior to insertion, and gases generated from the electrical current of the hysteroscope which are forced into the venous system [4]. Although gas entry into the cardiovascular system is common, large amounts can rarely collect in the right heart and can result in cardiovascular collapse. Signs include decreased end-tidal carbon dioxide, tachycardia, hypoxia, hypotension, and arrhythmias including a pill-wheel murmur [7]. Diagnosis can be confirmed with transesophageal echocardiography. Treatment includes termination of the procedure and provision of supportive care, including 100% oxygen administration, administration of intravenous fluids, administration of vasopressors, and cardiopulmonary resuscitation if indicated [9].

Key Teaching Points

- Operative hysteroscopy requires the use of distention media, which can result in fluid overload once a certain threshold is reached
- The mechanism of fluid overload is excess absorption through bleeding sinuses in the myometrium or intraperitoneal absorption

CASE 50 A 40-Year-Old Woman Desires Endometrial Ablation for Heavy Menstrual Bleeding

Denise De Los Santos

History of Presenting Illness

A 40-year-old female, gravida 2, para 2, presents to the office for preoperative consultation regarding endometrial ablation for heavy menstrual bleeding. Her last menstrual period was two weeks ago.

The patient's menstrual bleeding history is regular, occurring every month without dysmenorrhea and lasts for five days. Her flow is heaviest on days 1–3, when she soaks through one pad every 2 hours. There have been no changes in her flow since the delivery of her most recent child seven years ago. She has no history of sexually transmitted infections or abnormal Pap smears. She has been treated with oral contraceptive pills in the past, which has helped minimally with the bleeding over the past few months. She tends to forget to take the medication and suffers from occasional breakthrough bleeding as a result. The heavy bleeding is affecting her lifestyle, and she would like to discuss endometrial ablation.

Her past medical history is significant for iron deficiency anemia and she is taking supplemental iron sulfate twice a day. Her past surgical history is significant for laparoscopic cholecystectomy five years ago. She is sexually active with one partner, her husband, and had a bilateral tubal ligation after her last delivery. She has no drug allergy.

Physical Examination

General appearance: Pleasant, obese adult woman, sitting upright on the examining table

Vital signs:

Temperature: 36.9°C
Pulse: 82 beats/min
Blood pressure: 110/72 mmHg
Respiratory rate: 16 breaths/min
Height: 65 inches
Weight: 180 lb
BMI: 30 kg/m^2

Cardiovascular: Regular rate and rhythm, no murmurs, rubs or gallops

Respiratory: Clear to auscultation bilaterally, no rhonchi or wheezes

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

Pelvic:

Vulva: Normal appearing external female genitalia. No lesions or masses noted
Vagina: pink rugae, physiologic discharge present. No lesions or masses noted
Uterus: Anteverted, 8 weeks' size. Mobile. Non-tender to palpation. No masses palpated
Adnexa: No masses palpated, non-tender

Laboratory studies:

Urine pregnancy test: Negative.
Hb: 10.4 g/dL (normal: 12–15 g/dL)
Gonorrhea and chlamydia: Negative
Cervical cancer screening: Negative
High-risk HPV testing: Negative

Imaging: Transvaginal ultrasound shows a uterus measuring approximately 8.2 × 5.1 × 3.2 cm in size. Endometrial stripe is homogeneous appearing and measures 5 mm. Both ovaries appear non-enlarged with no abnormalities. There are no adnexal masses noted. No free fluid is present in the cul-de-sac

How Would You Manage This Patient?

This patient presented with heavy menstrual bleeding refractory to treatment with combined hormonal therapy. A transvaginal ultrasound was performed and did not demonstrate structural intrauterine pathology, such as a leiomyoma or endometrial polyp. An endometrial biopsy was performed to rule out hyperplasia or malignancy and was negative.

The differential diagnosis of abnormal uterine bleeding can be narrowed down as in this case to ovulatory menorrhagia, since she has regular cycles that are heavy.

If this patient were having symptoms of irregular heavy menses, other causes, such as infection, pregnancy, and anovulation, could be considered. The patient was not currently experiencing any symptoms of vaginitis or systemic signs of infection. Pregnancy test was negative, and she has already had a tubal ligation for permanent sterilization.

The patient had a hydrothermal endometrial ablation in an outpatient surgical center under general anesthesia due to pain intolerance encountered during the endometrial biopsy in the office. The heavy menstrual bleeding has resolved since the procedure.

Endometrial Ablation

Endometrial ablation broadly describes a group of procedures that destroys or resects the endometrium with the goal of achieving eumenorrhea in women who present with cyclical heavy menstrual bleeding [1]. Preoperative counseling involves appropriate patient selection to optimize success and minimize immediate and long-term complications from the procedure. Patients that are ≤35 years old, have a history of previous tubal ligation, or have preexisting dysmenorrhea have a higher risk of requiring surgical re-intervention [2, 3]. Alternatives to endometrial ablation in order from least to most invasive include oral combined hormonal or progesterone-only medications, tranexamic acid, intrauterine levonorgestrel-containing devices, and hysterectomy.

Endometrial ablation is not considered as a sterilization procedure, and pregnancy is not recommended after an ablation is performed. An acceptable form of contraception or permanent sterilization is recommended. Patients with anovulatory bleeding considering endometrial ablation were previously counseled that re-evaluation of the endometrium at a later date would not be feasible because of resultant intrauterine adhesions. For women who present with bleeding post-ablation, endometrial tissue *can* be properly accessed with hysteroscopy, transvaginal sonography, and endometrial biopsy [2]. Furthermore, endometrial ablation artifact does not appear to hinder evaluation and treatment planning in the presence of endometrial cancer [4].

Up to 20% of premenopausal women with an endometrial thickness of 5 mm or less may still have a polyp or myoma, so performing a hysteroscopy or saline infusion sonography should be considered as the initial evaluation tool [5]. The endometrial ablation method utilized for this patient involved hysteroscopy and confirmed that no intrauterine pathology was identified.

Using an ultrasound is also important for measuring uterine length if the provider is considering performing an endometrial ablation at a later date – as most of the ablative techniques have a minimum or maximum uterine cavity length requirement. This measurement can also be performed using a uterine sound at the time of endometrial sampling.

Complications of endometrial ablation include uterine perforation (0.26%), endometritis (2%), and hematometra (1.67%) [6]; longer term, 20–25% of women develop post-ablation pain syndrome and this accounts for one in five hysterectomies performed for endometrial ablation failure [5]. The majority of hysterectomy after endometrial ablation occurs between 6 and 10 years post-procedure, for common indications including fibroids, ovarian cysts, and uterine prolapse [7].

Endometrial ablation technologies are classified as first- and second-generation methods. First-generation methods require hysteroscopic guidance and include endometrial vaporization with the neodymium:yttrium-aluminum-garnet (Nd-YAG) laser, rollerball electrosurgical desiccation, or endometrial resection by resectoscope. They are also known as resectoscopic techniques. Second-generation methods do not require hysteroscopic guidance and utilize various energy forms. However, some methods do utilize hysteroscopy in their technique or recommend pre or postoperative hysteroscopy. They are referred to as non-resectoscopic techniques. Currently in the United States, bipolar radiofrequency (NovaSure), cryotherapy (Her Option), circulating hot water (Hydro ThermAblator), combined thermal and bipolar radiofrequency (Minerva), and more recently vapor ablation (Mara) are available techniques. One technology has not been proven to be more effective than another. Surgeon training and experience play a part in selecting which technique for endometrial ablation is performed.

Endometrial ablations can be performed either in the office or outpatient surgery center. Selecting the right patient is important for any in-office gynecologic procedure. Some known patient contraindications include personal or family history of adverse reaction to local anesthetic, low pain threshold (history of failed analgesia from local anesthesia administration), substance abuse, abnormal blood sugars, and American Society of Anesthesiology (ASA) Class >2. The office should be equipped with adequate equipment for the level of anesthesia that will be given. Staff should be trained in basic life support or advanced cardiac life support in case emergency resuscitation is required. Safety protocols should be readily available. An excellent resource which outlines all the necessary considerations in office-based gynecologic procedures is the American College of Obstetricians and Gynecologists (ACOG) Report of the Presidential Task Force on Patient Safety in the Office Setting [8].

Scheduling the procedure during the early proliferative phase of the menstrual cycle can be helpful. Pharmacologic treatment of the endometrium which utilizes gonadotropin-releasing hormone (GnRH) analogs, danazol, and progestogens can also help achieve a thin endometrial lining but is not necessary for non-resectoscopic techniques.

A thin myometrium that results from multiple cesarean sections or other uterine surgeries may cause an increased risk of injury to adjacent organs, such as the bowel or bladder. Despite this concern there is no specific myometrial thickness threshold identified that decreases this risk.

Most manufacturers do not recommend performing the procedure if type 0 or 1 submucosal myomas are present as they can cause cavity distortion. Second-generation devices are less effective when intracavitary fibroids are present. Hysteroscopic myomectomy followed by endometrial ablation does help increase control of heavy menstrual bleeding [9].

Key Teaching Points

- Ideal candidates for an endometrial ablation are usually between 40 and 45 years of age
- Patients should have an endometrial biopsy performed either in the office or in the hospital outpatient setting prior to ablation to rule out hyperplasia or malignancy
- Endometrial ablation is not recommended for those patients that desire future fertility, so reliable contraception or permanent sterilization should be considered for those patients
- Eighty percent of patients who have an endometrial ablation with the ideal characteristics are satisfied with the method and do not require later surgical re-intervention
- Although complications are rare, the most common complication is post-ablation pain syndrome and pain is the most common reason for hysterectomy after endometrial ablation

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CASE 51

A 24-Year-Old G0 Woman with Suspected Endometriosis Who Has Failed Medical Management

Megan M. Quimper

History of Present Illness

A 24-year-old female, gravida 0, presents to the office for follow-up of suspected endometriosis. Her last menstrual period started two days ago. She reports a three-year history of chronic pelvic pain that is worse during menses, is moderate to severe in intensity, and crampy in nature. She has tried combined oral contraceptive pills without symptomatic improvement. She denies fever, changes in bowel or bladder habits, or dyspareunia. She is sexually active with one male partner. She uses condoms regularly. She has no history of sexually transmitted infections. She has no significant past medical or surgical history.

Physical Examination

General appearance: Well-nourished adult woman in no acute distress

Vital signs:

Temperature: 36.8°C
Pulse: 80 beats/min
Blood pressure: 112/76 mmHg
Respiratory rate: 16 breaths/min
Height: 63 inches
Weight: 130 lb
BMI: 23 kg/m^2

Abdomen: Normal bowel sounds, soft, non-tender, non-distended, no guarding or rebound
External genitalia: Normal
Vagina: Normal rugae, small amount of blood in vault. No lesions visualized. Mild tenderness to palpation of right uterosacral ligament, no nodules appreciated
Cervix: No active bleeding from os, no lesions, no cervical motion tenderness
Uterus: Anteverted, mildly tender, mobile, normal in size
Adnexa: No palpable masses, bilateral adnexa mildly tender to palpation
Rectovaginal examination: No palpable masses in rectovaginal septum
Laboratory studies: Urine pregnancy test: Negative
Imaging: Transvaginal ultrasound shows a normal-sized uterus with endometrial thickness of 7 mm and normal ovaries bilaterally. There is a physiologic amount of free fluid in the cul-de-sac

How Would You Manage This Patient?

The clinical scenario of chronic pelvic pain with suspected endometriosis is often initially treated with medical management. The differential diagnosis for chronic pelvic pain is broad and includes adenomyosis, pelvic inflammatory disease and its sequelae, pelvic floor myalgia, as well as gastrointestinal and genitourinary disorders. When medical management of suspected endometriosis fails, and other causes of pelvic pain are unlikely, an appropriate next step is diagnostic and operative laparoscopy. This patient presents with suspected endometriosis given worsening pelvic pain during menses that is refractory to medical management. No structural pathology is noted on her transvaginal ultrasound and she has no history of pelvic infection. She is counseled on different medical treatment options including use of a levonorgestrel intrauterine device, which she declines. She ultimately elects to proceed with surgical management for diagnosis and treatment of suspected endometriosis. Informed consent is obtained after discussion of risks and benefits of surgery. Risks of surgery reviewed include injury to surrounding structures, inability to obtain a diagnosis, incomplete resolution of symptoms, and need for future surgery. Benefits of surgery reviewed include the ability to confirm the diagnosis, improvement in symptoms, and improved fertility outcomes.

Laparoscopy is notable for multiple superficial endometriotic lesions located in both ovarian fossa and on the right uterosacral ligament. The lesions range in size from 2 mm to 5 mm and are blue in appearance. The largest lesion on the right uterosacral ligament is excised by elevating the lesion and surrounding peritoneum from underlying structures, and implant is removed using cold scissors. This tissue is sent to pathology for confirmation of endometriosis. The remaining lesions are ablated utilizing monopolar cautery with careful attention to surrounding structures to avoid injury. She has an uncomplicated postoperative course and reports improvement in her pelvic pain and dysmenorrhea. She is considering pregnancy and declines postoperative medical management of endometriosis.

Management of Superficial Endometriosis

Endometriosis is an estrogen-dependent inflammatory condition characterized by endometrial-like tissue outside of the uterus and is associated with pelvic pain, dysmenorrhea, and infertility. Endometriosis is estimated to affect 10% of reproductive age women and as many as 25–40% of women with subfertility [1]. However, the true prevalence is unknown, as definitive diagnosis requires surgical visualization. Endometriosis has a wide range of surgical findings including superficial peritoneal lesions, ovarian cysts (endometrioma), deep endometriosis nodules (classified as

For deep endometriosis, excision is the most appropriate surgical technique [7]. Endometriomas are best managed with cystectomy as this provides improved pain relief and decreased recurrence risk compared with ablation [8]. Hysterectomy with bilateral salpingo-oophorectomy is considered definitive surgical management for endometriosis and may be considered in patients who have completed childbearing. In this clinical scenario, a preoperative discussion of the implications of premature surgical menopause and its effects on bone and cardiovascular health is necessary. Hormone replacement therapy is recommended for these patients postoperatively and is not associated with endometriosis recurrence.

Postoperatively, patients should be counseled on medical management to prolong symptom relief and suppress recurrent endometriosis. Approximately 50% of patients with confirmed endometriosis will have recurrent symptoms regardless of treatment modality [9]. Surgical treatment of superficial endometriosis in women with subfertility may improve rates of spontaneous pregnancy [4]. In the case of endometrioma excision, the ovarian follicular reserve may be diminished especially if electrocautery is used, and this should be considered preoperatively in women desiring pregnancy [8].

Decisions regarding the management of superficial endometriosis should be made in conjunction with the patient taking into consideration the prior treatment history, symptom severity, and desire for pregnancy. Operative laparoscopy with either excision or ablation of superficial endometriosis may improve pain and fertility outcomes.

Key Teaching Points

- Endometriosis is a working diagnosis that may be confirmed with laparoscopic surgery
- Superficial endometriosis managed with either surgical excision or ablation has similar outcomes
- Postoperative medical therapy may prolong symptom relief and suppress recurrent endometriosis
- Pregnancy rates may improve following surgical management of endometriosis

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CASE 52

A 35-Year-Old G0 Woman with Chronic Pain and Multiple Prior Surgeries Undergoing Diagnostic Laparoscopy

Megan N. Wasson

History of Present Illness

A 35-year-old nulligravid woman is scheduled to undergo diagnostic laparoscopy for evaluation of chronic pelvic pain. She describes her pain as sharp and stabbing that does wax and wane throughout the month but is always present. It is located in the pelvis and does not seem to be affected by bowel or bladder function. Her medical history is significant for ulcerative colitis and endometriosis. Her surgical history is significant for laparoscopic cholecystectomy, coloproctectomy with ileo J pouch creation, laparoscopic ablation of endometriosis, and total laparoscopic hysterectomy. Her coloproctectomy was complicated by postoperative peritonitis that necessitated a prolonged course of intravenous antibiotics. She is not currently on any medications and has no known allergies.

Physical Examination

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

Abdomen: Multiple scars consistent with prior surgical history. Soft, mild tenderness to palpation in the bilateral lower quadrants that resolves with recruitment of the abdominal wall musculature. No guarding or rebound. No masses

Pelvic: Normal external female genitalia. Q-tip test is negative. No myofascial dysfunction. Vagina with physiologic discharge. Vaginal apex intact. Moderate tenderness with palpation of the vaginal apex and right adnexa. Right adnexal fullness

Imaging: Pelvic ultrasound shows surgically absent uterus. There is right adnexal simple cyst measuring up to 8.6 cm favoring ovarian origin (Figure 52.1). Peritoneal inclusion cyst much less likely given the appearance. No abnormal free fluid

How Would You Manage This Patient?

This patient presents preoperatively with a complicated medical and surgical history resulting in likely intra-abdominal adhesive disease. In this premenopausal patient with a simple appearing ovarian cyst, the most likely diagnoses included physiologic cyst or peritoneal inclusion cyst. Additional evaluation, including CA-125 or other tumor markers, was not needed as her history and ultrasound findings were not concerning for underlying malignancy. Given her chronic pelvic pain and history of endometriosis with prior ablation, the patient declined expectant or medical management. Decision was made to proceed with surgical exploration to further evaluate her adnexal mass and excise endometriosis.

When planning her laparoscopic procedure, it is essential to consider the likely location of adhesions and utilize strategies intraoperatively to avoid injury. This patient underwent diagnostic laparoscopy with primary entry at Palmer's point using an open technique. Significant pelvic adhesive disease and endometriosis was encountered (Figure 52.2). Adhesiolysis, excision of endometriosis, and ovarian cystectomy were performed. The patient was discharged later that day. Pathology confirmed endometriosis and a serous cystadenoma. The patient's postoperative course was uncomplicated and she reported significant improvement in her pelvic pain.

Abdominal Entry

Thoughtful abdominal entry is of utmost importance as up to one-third of all injuries during laparoscopy occur at the time of entry and can involve major blood vessels, large or small intestine, stomach, liver, bladder, or spleen. These injuries have been reported to occur in 0.3–1% of laparoscopic surgeries with a mortality rate of up to 7/100 000 [1]. Abdominal entry can be achieved via a closed or open technique. Systematic reviews have shown that there is no advantage of any one entry technique for reduction in mortality or complications related to vascular or visceral injury. However, open entry is associated with a reduced incidence of entry failure and extraperitoneal insufflation when compared with a closed-entry technique [2].

Closed-entry techniques include use of a Veress needle or direct trocar entry. With use of a Veress needle, the needle is placed followed by insufflation and laparoscopy. In contrast, when using a direct trocar entry, the trocar is

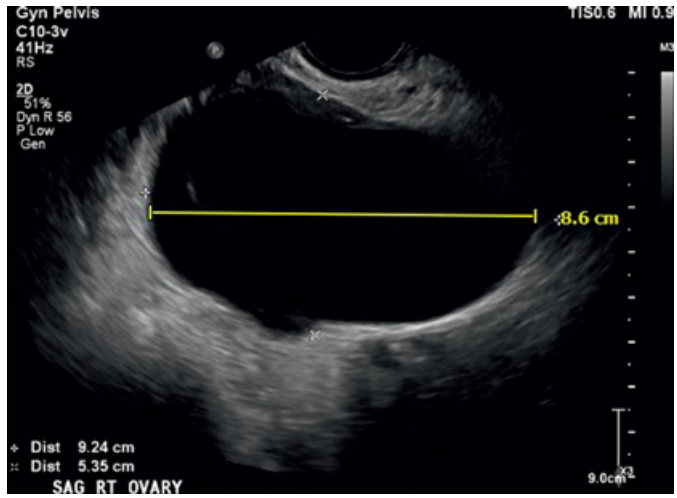

Figure 52.1 Ultrasound showing right adnexal simple cyst measuring up to 8.6 cm favoring ovarian origin.

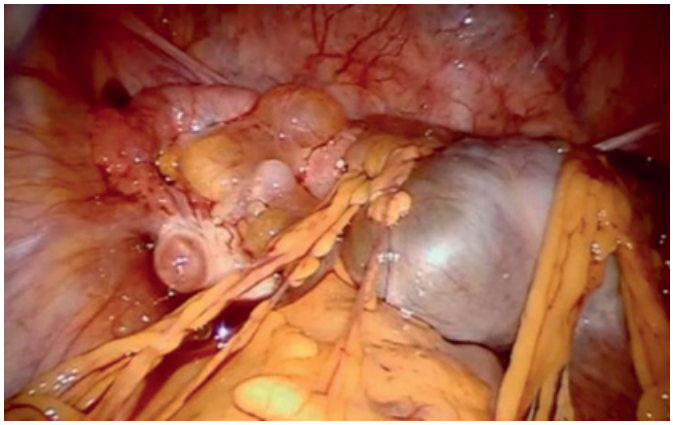

Figure 52.2 Laparoscopic view of significant adhesive disease and obliteration of the posterior cul-de-sac.

placed followed first by the laparoscope and then insufflation. Direct trocar entry can also utilize an optical trocar. Alternatively, an open-entry technique, commonly referred to as Hasson entry, can be employed. This involves cut down through the peritoneum, visualization of the peritoneal cavity, and trocar placement followed by insufflation and laparoscopy.

Anticipated Difficult Initial Port Placement

The umbilicus is the thinnest area of the abdominal wall and does not contain any subcutaneous fat, blood vessels, or nerves. These characteristics make it an ideal location for the main point of entry into the abdominal cavity during laparoscopy. This holds true for women with a history of abdominoplasty and an artificially created umbilicus. However, in patients with a high likelihood of periumbilical adhesions, this area should be avoided. Risk factors known to be associated with adhesions in this area include prior umbilical surgery, laparotomy incision, and abdominal mesh. Performing ultrasound examination with a visceral slide test preoperatively can help detect periumbilical adhesions. If with an exaggerated inhalation and exhalation, the bowel or omentum underlying the umbilicus moves less than 1 cm, adhesions can be predicted with a sensitivity of 86% and specificity of 91% [3]. Additionally, an alternative entry point should also be considered in patients with an umbilical hernia, large pelvic mass, or pregnancy in the second or third trimester to decrease risk of injury or complication.

Alternative entry sites include Palmer's point and Lee-Huang point. These sites are both in the upper abdomen and offer the advantage of avoiding any adhesive disease at the umbilicus. Palmer's point is located in the left upper quadrant, 3 cm below the left subcostal margin in the midclavicular line. Prior to entry in this area, it is imperative to ensure the stomach has been decompressed with a nasogastric tube. This area should be avoided in patients with prior surgery or altered anatomy in this area, such as in the case of prior splenectomy or hepatomegaly. Lee-Huang point lies in the midline of the upper abdomen between the xiphoid process and the umbilicus. It should also be avoided in the case of hepatomegaly. When compared with Palmer's point, use of Lee-Huang point affords the benefit of central vision rather than lateral vision with a left upper quadrant entry [4].

Surgical Principles of Adhesiolysis, Risks, and Prevention

Intraperitoneal adhesive disease can occur as a result of prior surgery, peritonitis, or intra-abdominal infection or pathology. In the development of adhesions, peritoneal damage or tissue trauma first occurs inducing an inflammatory response. Fibroblast migration is promoted and fibrinolysis is inhibited. Collagen subsequently forms followed by adhesion formation [5, 6]. Adhesions are associated with increased complexity for obtaining intra-abdominal access, but can also cause infertility, bowel obstruction, and pain. Intraoperatively, they can make identification of normal tissue planes and anatomy more challenging.

When adhesions are encountered, they can be lysed (adhesiolysis or enterolysis) to facilitate exposure and safe completion of the surgical procedure. The goal of adhesiolysis should be to return tissue to its normal anatomic position and avoid creation of new tissue planes. Prior to proceeding with adhesiolysis, it is vital to have a firm understanding of the visceral and vascular structures involved in and in close proximity to the scar tissue. Thorough inspection is essential to avoid inadvertently causing or not recognizing an iatrogenic injury. More than half of intestinal injuries that occur during laparoscopy are not recognized. The delay in diagnosis leads to intra-abdominal sepsis and oftentimes death [1].

Adhesiolysis can be performed using blunt or sharp dissection and electrosurgery can be utilized as necessary. The method employed for adhesiolysis is dependent on the adhesion characteristics. Thin, filmy, avascular adhesions can be isolated by first using blunt dissection with a "push and spread" technique. The remaining adhesive bands can then be fully lysed using sharp dissection. Use of sharp dissection without use of electrosurgery is ideal when performing adhesiolysis in close proximity to visceral structures, such as the large or small intestine, to avoid thermal spread and inadvertent injury.

Electrosurgery should be considered if the adhesions involve vessels or are thick and dense. Blunt dissection should be avoided in these cases as this can result in tearing and trauma to the surrounding structures. Application of monopolar electrosurgery should be precise and deliberate to decrease the risk of a delayed thermal injury and resultant morbidity. Use of advanced bipolar electrosurgery can also be used for adhesiolysis but is associated with significant thermal spread. When using advanced bipolar electrosurgery, an adequate distance between the device and visceral structures must be maintained. Compared with monopolar and bipolar electrosurgery, ultrasonic energy has the least amount of thermal spread, but the instrument does maintain heat following activation. Therefore, the instrument must be given time to cool after use and surrounding tissue must not be touched to avoid unintentional injury.

Adhesions frequently reform following adhesiolysis and it is therefore best to prevent initial adhesion formation by following key surgical principles. When completing a surgical procedure, laparoscopic approach is preferred and trauma and injury to the tissue remaining in the abdomen and pelvis should be minimized. Moisture should be maintained in the surgical field with frequent irrigation as well as use of humidified and warmed carbon dioxide gas during laparoscopy. Closing the parietal peritoneum is not necessary, but application of a physical barrier, such as hyaluronic acid sheets, can assist in reduction of adhesion formation. Use of intraperitoneal crystalloid solutions or systemic anti-inflammatory agents has not been shown to be effective [5–9].

Key Teaching Points

- Up to one-third of injuries during laparoscopy occur at the time of entry
- There is no advantage of any one entry technique regarding mortality or complications related to vascular or visceral injury
- Visceral slide test can help detect periumbilical adhesions with a sensitivity of 86% and specificity of 91%
- Alternative entry sites include Palmer's point and Lee-Huang point
- Formation of adhesions can be minimized by using a laparoscopic approach, minimizing tissue trauma, maintaining adequate moisture, and considering placement of a hyaluronic acid sheet in laparotomy

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CASE 53 A 25-Year-Old Woman with Sudden Cardiovascular Collapse after Creation of Pneumoperitoneum

Emily S. Barrows

History of Present Illness

A 25-year-old female, gravida 0, with chronic pelvic pain presents for a scheduled diagnostic laparoscopy. Her medical and surgical history is otherwise unremarkable. She relies on depot medroxyprogesterone acetate for contraception and has no known drug allergies. Anesthetic induction and intubation proceeded without complication. Laparoscopic entry is attempted using the Veress needle. Following two unsuccessful attempts at sub-umbilical insufflation, insertion of the Veress is attempted at Palmer's point, 3 cm below the costal margin in the left midclavicular line. Opening pressure at Palmer's point is 14 mmHg. The needle is retracted slightly, the pressure decreases appropriately to 5 mmHg, and abdominal insufflation proceeds. Upon placement of the initial trocar and visualization of the abdominal cavity with the laparoscope, a 2.5 cm laceration is noted along the inferior border of the left hepatic lobe. Bleeding is minimal and pressure is applied. Approximately 2 minutes later, the anesthesiologist alerts the surgeon of acute-onset tachycardia, hypotension, and hypoxia.

Physical Examination

General appearance: Intubated, sedated

Vital signs:

Blood pressure: 54/38 mmHg
Pulse: 107 beats/min
SpO_2: 88%
$EtCO_2$: 18 mmHg (normal 35–45 mmHg)

Chest: Bilateral breath sounds present, diminished

Cardiovascular: Loud, harsh murmur, tachycardia, regular rhythm

Intraoperative field: 150 mL estimated blood loss from liver laceration, no other apparent injury

Imaging:

ECG: Sinus tachycardia, ST depression
TEE: Right atrium and right ventricle containing large volume coalesced echogenic foci, intra-atrial septal bowing toward the left atrium

How Would You Manage This Patient?

This patient demonstrates cardiovascular collapse in the setting of a laparoscopic surgery. The initial differential diagnosis is broad and includes hemorrhage, anaphylaxis, pneumothorax, coronary events, and cerebrovascular compromise [1]. In this case, the patient is experiencing a large volume carbon dioxide venous embolus caused by insufflation of the hepatic parenchyma. This is rare but can be fatal; therefore, the surgeon's index of suspicion for this condition must be high.

Management of this case proceeds with the surgeon immediately turning off the insufflation and opening all ports wide to remove as much insufflated air as possible. The anesthesiologist transitions the patient to 100% oxygen and hyperventilates the patient. The patient is placed in the left lateral decubitus position with a steep Trendelenburg. A TEE is performed with findings as above, and the anesthesiology team places a central line to facilitate aspiration of the visualized air embolism within the right heart. Aspiration attempts yield successful removal of approximately 10 mL of air. Cardiothoracic surgery is called in anticipation of possible cardiopulmonary bypass, and while awaiting their arrival, fluids and vasopressors are given to maintain mean arterial pressure above 60 mmHg. The patient's vital signs and echocardiogram normalize over the following 10 minutes prior to the arrival of the cardiothoracic surgeon. The abdomen is carefully re-insufflated and the liver laceration is noted to be hemostatic. The procedure is completed and the patient is discharged home later that day with no lasting sequelae.

Carbon Dioxide Embolism

Carbon dioxide gas (CO_2) is utilized for abdominal insufflation in laparoscopic surgery given its high solubility in blood. This solubility decreases the risk of significant venous embolism but does not eliminate it. In this rare event, CO_2 becomes entrapped within a vein or parenchymal organ and travels to the right heart and pulmonary arteries resulting in the possibility of total cardiovascular collapse [2]. While these catastrophic events are rare, small volume gas embolisms are remarkably common in laparoscopic surgery. A 2009 study used routine transesophageal echocardiography (TEE) to screen for emboli during laparoscopic hysterectomies and found CO_2 emboli in all 40 of the observed cases [3]. The incidence of subclinical embolism found among other similar studies ranges from 6% to 69% [2], but clinically significant CO_2 embolism is rarer. A 2009 meta-analysis of 489,335 laparoscopic cases found an incidence of clinically significant CO_2 embolism in only 7 cases (0.001%), and the maximum incidence found in any large population study is 0.59% [1, 2, 4, 5]. While rare, the mortality associated with severe CO_2 embolus is approximately 28.5% [1].

Large volume CO_2 embolism can occur under any circumstances in which CO_2 is introduced into the body. Greater than 60% of clinically significant CO_2 emboli occur during initial abdominal entry and are attributed to inadvertent placement of the Veress needle within a vessel or abdominal organ [5]. Reports of CO_2 embolism taking place well into a procedure or following the conclusion of a case exist, but these are rare.

Animal models show much greater effect from CO_2 bolus placed directly into the vein than from intraoperative laceration of a vein [2, 6]. Severity of the embolism is dependent predominantly on the volume of embolized gas. Other risk factors include proximity of the gaseous entry point to the heart, the gravitational gradient present when a patient is in Trendelenburg position, and the patient's comorbidities [4, 7]. Due to the solubility of CO_2 in blood, the mean lethal volume of CO_2 for a 70 kg human is much higher than that of air; 600–1750 mL compared with 375 mL [1, 2]. Porcine studies show that a 1.2 mL/kg/min infusion of CO_2 has 60% mortality [2, 4]. For an average weight human, this is between 5% and 10% of the volume of CO_2 that is infused through a Veress needle over one minute on the low flow setting; therefore, continuous infusion is much more dangerous than a relatively large one-time bolus [6].

Once a large volume of CO_2 has entered a patient's venous system it travels to the right heart and initiates a cascade of physiologic events. Initially, a "gas-lock" effect develops as CO_2 gas bubbles collect in the right heart and pulmonary outflow trunk. This increases the pulmonary artery pressure and right ventricular outflow resistance and decreases pulmonary venous return. Right heart failure develops quickly and subsequently arrhythmias. Decreased left ventricular preload and ineffective cardiac contractions profoundly decrease cardiac output leading to hypotension, asystole, and systemic cardiovascular collapse [1, 2, 5]. Simultaneously, in the setting of increasing pulmonary vessel resistance a ventilation-perfusion (V/Q) mismatch develops with increased alveolar dead space and right to left intrapulmonary shunting, causing arterial hypoxia and hypercapnia [1]. Variably, this insult to the lung can lead to bronchospasm, pulmonary edema, and acute respiratory distress syndrome [6]. Paradoxical embolism can develop in the setting of a patent foramen ovale with subsequent neurologic deficits and stroke [4]. Paradoxical emboli can also develop when massive gas burden overwhelms the normal filtering mechanisms of the pulmonary microvasculature, allowing gas diffusion into the arterial system [8].

Diagnosis of CO_2 embolism can be a challenge given the broad differential diagnosis in the setting of sudden intraoperative decompensation; therefore, a high index of clinical suspicion must be maintained. Initial signs in a sedated patient include systemic hypotension, hypoxemia, cyanosis, tachycardia or bradycardia, increasing pulmonary venous pressure and central venous pressure (CVP), and arrhythmia [2, 4]. Effects on end-tidal CO_2 are variable. Often, an initial increase in end-tidal CO_2 gives way to a marked decrease when pulmonary dead space expands and gas exchange begins to fail [2]. The classic sign of a CO_2 embolism is the "mill-wheel" murmur, a harsh, splashing, metallic sound caused by air in the right heart; however, this is not reliable, and when present, typically coincides with cardiovascular collapse [2]. The gold-standard test for diagnosis of CO_2 embolism is the TEE which visualizes the echogenic CO_2 bubbles in the right heart and can detect a 0.0007 mL/kg CO_2 bolus (Figure 53.1) [2]. The precordial Doppler is the most sensitive non-invasive diagnostic tool, with the ability to detect 0.25 mL of air [5]. If a patient is awake prior to developing a CO_2 embolism, typical symptoms include chest pain, nausea, dyspnea, and altered mental status. Focal neurologic deficits can arise in the case of paradoxical embolism [4].

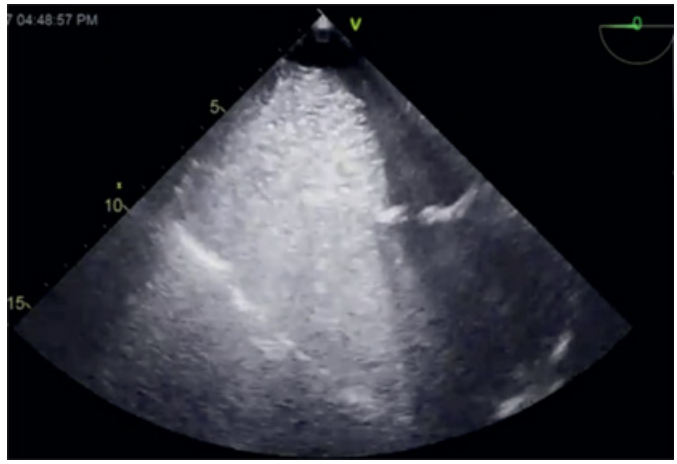

Figure 53.1 Transesophageal echocardiogram (TEE) image demonstrating coalescing echogenic foci filling the right atrium and ventricle, consistent with a CO_2 embolism [9].

Once a CO_2 embolism has been identified, insufflation should be immediately discontinued and pneumoperitoneum should be released [2]. Some investigators recommend flooding the operative field with fluid to prevent further embolism [3]. The patient should be hyperventilated and given 100% oxygen to washout the CO_2, decrease the V/Q mismatch, and increase oxygenation [4]. Placement of the patient in steep Trendelenburg and left lateral decubitus – Durant's maneuver – will sequester gas bubbles within the right heart and facilitate aspiration of the embolized gas using a central venous catheter [2]. Volume expansion with a rapid fluid bolus will increase CVP, which decreases further embolism development. Following these steps, vasopressors should be given as needed to maintain coronary perfusion, and if indicated, chest compressions, cardiac massage, cardiopulmonary bypass, and extracorporeal membrane oxygenation can successfully resuscitate these patients [1–3, 5]. After initial resuscitative efforts, hyperbaric oxygen should be considered within 3–48 hours of embolism for alleviation of any neurologic deficits from paradoxical embolism [5].

Given the profound morbidity and mortality associated with severe CO_2 embolism, prevention is key; this can be achieved through confirmation testing of Veress needle placement with aspiration, hanging drop test, and observation of low opening pressure prior to initiation of high CO_2 flow [2, 4]. Intraoperatively, lowering insufflation pressure from 15 mmHg to 12 mmHg has been shown to decrease subclinical embolism from 13.3% to 6.5%; therefore, it can be extrapolated that maintaining the lowest insufflation pressure possible is beneficial for preventing clinical CO_2 embolism [10]. Finally, minimizing the gravitational gradient by using the minimum necessary degree of Trendelenburg position can help in preventing embolism [7]. TEE should not be used routinely given the associated expense and invasiveness, but it can be

considered for high-risk patients with complex cardiac history undergoing laparoscopic procedures.

Key Teaching Points

- Subclinical CO_2 embolism is common in laparoscopic surgery, occurring in virtually all cases; however, clinically significant embolism is rare, with a prevalence of 0.001–0.59% of cases
- The most common cause for clinically significant CO_2 embolism is direct insufflation of CO_2 gas within a vessel or parenchymal organ at the time of insufflation
- Clinically significant CO_2 embolism causes hypotension, changes in heart rate, hypoxia, hypercarbia, increased pulmonary artery pressure, increased central venous pressure, arrhythmia, asystole, and rarely death
- TEE is the gold-standard test for diagnosis of CO_2 embolism
- Immediate treatment includes discontinuation of insufflation and release of pneumoperitoneum, Durant's maneuver, hyperventilation with 100% oxygen, fluid bolus, and aspiration of emboli via a central line

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CASE 54

A 30-Year-Old G0 Woman with 6 cm Complex Ovarian Cyst Suspicious for Borderline Ovarian Tumor

Adela G. Cope

History of Present Illness

A 30-year-old nulligravid woman presents for Gynecology consultation after an incidental finding of left adnexal mass on pelvic ultrasound (US). She initially presented to her primary care provider with increased heaviness and duration of menstrual periods following copper intrauterine device (IUD) placement. Pelvic US was obtained to assess the IUD, which was appropriately placed. However, she was noted to have a left-sided, complex ovarian cyst measuring 6 cm. Pelvic magnetic resonance imaging (MRI) was obtained for further assessment of the indeterminate adnexal mass. She has no pelvic pain, early satiety, abdominal bloating or distention, changes in bowel or bladder function. She desires future fertility. Last menstrual period was in the week prior to consultation. She is healthy with no past medical or surgical history and no known drug allergies. Family history is negative for any malignancies, specifically ovarian, uterine, colon, or breast cancers.

Physical Examination

General appearance: Well-developed and in no acute distress

Vital signs:

Temperature: 36.9°C
Pulse: 80 beats/min
Blood Pressure: 126/78 mmHg
Respiratory Rate: 12 breaths/min
Oxygen saturation: 100% on room air

HEENT: Normocephalic, atraumatic. No hirsutism noted. No lymphadenopathy

Cardiovascular: Regular rate and rhythm. No murmurs appreciated

Lungs: Clear to auscultation bilaterally

Abdomen: Soft, non-distended, and non-tender to palpation. No masses appreciated

Pelvic: External genitalia are within normal limits. Urethra is midline and without lesions. No pelvic floor tension myalgia or bladder tenderness on single digit exam. Vagina is well-estrogenized with no abnormal discharge present. Cervix is visualized and normal with IUD strings noted and of normal length. On bimanual examination there is fullness in the left adnexa, with no tenderness. Uterus and right adnexa are without abnormalities. No cervical motion tenderness

Extremities: Well perfused. No calf tenderness or edema

Neurologic: Alert and oriented

Laboratory studies:

Hb: 13.9 g/dL (normal 11.6–15.0 g/dL)
Hct: 42.4% (normal 35.5–44.9%)
Platelets: 247 000/μL (normal 157 000–371 000/μL)
Leukocytes: 6800/μL (normal 3400–9600/μL)
TSH: 1.0 mIU/L (normal 0.3–4.2 mIU/L)
CA-125: 32 U/mL (normal <46 U/mL)
Urine pregnancy test: Negative

Imaging:

Pelvic US: Normal anteverted uterus with IUD in good position and normal, uniform endometrium. Right ovary is normal. Left ovary contains a unilocular cyst with a few small avascular nodules. The margins of the cyst are smooth. Diffuse low-level internal echoes are present, consistent with possible endometrioma or mucinous debris. No free fluid. Evaluation with MRI or follow-up US in 8–12 weeks is recommended

Pelvic MRI: Uterus, cervix, vagina, and right ovary are all normal in appearance. IUD is appropriately positioned. Arising from the left ovary is a T2 hyperintense cystic lesion with indeterminate T1 signal with three to four enhancing nodules with restricted diffusion. No lymphadenopathy or enhancing bone lesions. Overall features are suggestive of a benign neoplasm such as mucinous cystadenoma or, less likely, a borderline neoplasm.

How Would You Manage This Patient?

This patient presented with a left-sided complex adnexal mass found incidentally on pelvic ultrasound. She was asymptomatic with normal laboratory tests results and had no family history of breast or ovarian cancer. Imaging was suggestive of benign neoplasm, possibly a borderline tumor. In addition to borderline tumor, differential diagnosis included serous or mucinous cystadenoma and less likely endometrioma. The results were reviewed with the patient and options were reviewed including observation with repeat imaging and surgical intervention. With the possibility of borderline tumor on pelvic MRI, surgical intervention was recommended. Given the patient's young age, desire for future fertility, and imaging supportive of a likely benign process, both unilateral oophorectomy and ovarian cystectomy were reviewed as options. Risk of cyst rupture at time of cystectomy was reviewed with spread of cells from within the neoplasm. After discussion of these options, the patient elected to undergo ovarian cystectomy.

This patient underwent operative laparoscopy with ovarian cystectomy in a contained bag without cyst rupture. Pelvic washings were performed prior to starting the procedure and were negative. Intraoperative frozen pathology of the ovarian

cyst was suggestive of a mucinous borderline ovarian tumor without evidence of invasion. Peritoneal biopsies and appendectomy were performed and negative. She was discharged the same day as the procedure and was doing well at her six-week postoperative appointment. Final pathology was concordant with intraoperative frozen assessment. Given the finding of borderline tumor, she was referred to Gynecologic Oncology for consultation. Given the complete excision of disease at time of her procedure, her young age, and no indication that complete surgical staging improves survival in these tumors, decision was made to proceed with continued close surveillance to monitor for evidence of recurrence.

Borderline Ovarian Tumor (BOT)

Borderline ovarian tumors (BOT) are epithelial ovarian neoplasms that are considered to be intermediate between benign and malignant ovarian neoplasms. As a group, they comprise an estimated 10–20% of all ovarian neoplasms and are made up of six histologic subtypes including serous (50%), mucinous (45%), endometrioid, clear cell, seromucinous, and borderline Brenner tumor [1, 2]. While presenting symptoms may include abdominal pain or discomfort, bloating, abnormal bleeding, pain with intercourse, and bowel or bladder dysfunction, 13–32% of BOT are asymptomatic [3]. Compared with ovarian carcinomas, BOT present at a younger age, at an earlier stage, and with better survival [4]. The majority are limited to the ovaries at diagnosis, but they can be associated with microinvasion, intraepithelial carcinoma, lymph node involvement, and non-invasive peritoneal implants [3].

Preoperative assessment of adnexal masses with imaging and tumor markers can be helpful for differentiating benign ovarian neoplasms from malignant neoplasms. These tools have also been evaluated for use in preoperative identification of BOT. Features of BOT that have been described on pelvic US include presence of papillae (as shown in Figure 54.1A) with or without blood flow and multiple septa. Reported specificity of these features is as high as 96% in ovarian cysts with papillae, 93% in ovarian cysts with papillae or multiple septa, and 100% in ovarian cysts with papillae and intra-papillae blood flow. However, reported sensitivity is low for each of these characteristics: 48%, 68%, and 27% respectively. BOT may also present as unilocular, smooth-walled ovarian cysts on US, similar to benign ovarian cysts [5]. Pelvic MRI may also help characterize adnexal masses. Reported appearances of BOT on MRI include unilocular cysts with or without nodularity (as shown in Figure 54.1B), minimally septate cysts with papillae, markedly septate lesions with excrescences, and solid lesions with exophytic projections. Similar to US, reported specificity of MRI in detecting BOT is high (93.3–96.1%) while sensitivity is low (33.3–45.5%). Computerized tomography (CT) has relatively poor soft tissue contrast and is less helpful in the characterization of BOT. CA-125 has limited diagnostic utility due to overlap with both benign and malignant tumors; however, in the setting of BOT recurrence, risk is higher in those with CA-125 greater than 150 U/mL at time of presentation [3, 6].

Surgery is the mainstay of treatment for BOT. Patients with BOT should be referred to Gynecologic Oncology if strongly suspected preoperatively or identified on pathology intraoperatively or postoperatively [4]. Frozen section diagnosis of BOT has a reported correlation with final pathology diagnosis of 90.6% with no difference between academic and community hospital settings with or without gynecologic pathologists [7]. When comparing open versus laparoscopic approach for management of BOT, those undergoing laparoscopic resection have significantly shorter operative time, reduced blood loss, less need for blood transfusion, shorter length of hospital stay, and quicker return of bowel function with no difference in residual tumor volume or disease-free survival after adjusting for stage and histologic subtype [8]. Laparoscopic visualization of an ovary enlarged with BOT is demonstrated in Figure 54.2.

In young patients and those desiring future fertility, conservative surgery in the form of ovarian cystectomy (unilateral or bilateral) and/or unilateral salpingo-oophorectomy with resection of residual disease is reasonable. Pooled recurrence rate is higher with cystectomy compared to oophorectomy (25.3% as compared to 12.5%) though pregnancy rate may also be higher following cystectomy [9]. Pelvic washings should be performed to

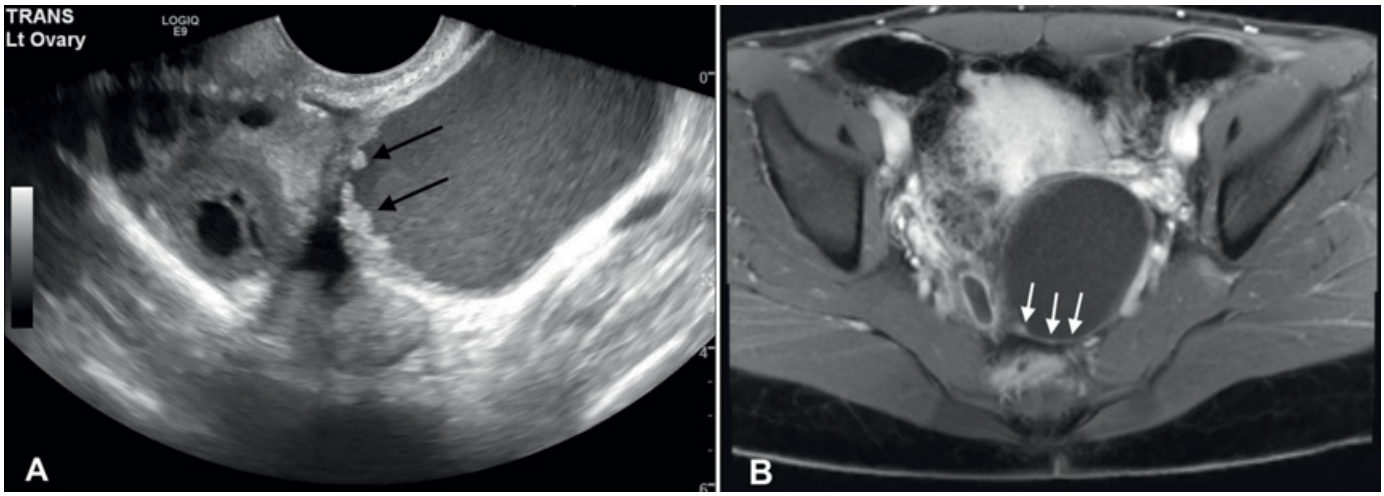

Figure 54.1 (A) Pelvic US demonstrating cystic ovarian lesion with papillae (black arrows). (B) Pelvic MRI demonstrating cystic ovarian lesion with tiny enhancing nodules (white arrows). Pathology demonstrated mucinous borderline tumor.

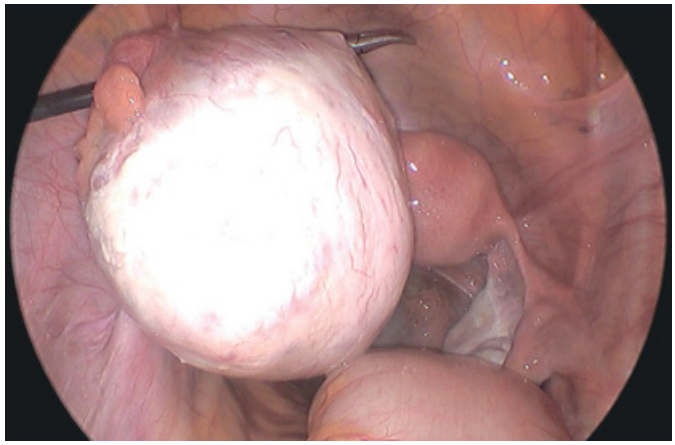

Figure 54.2 Laparoscopic visualization of left ovary enlarged with borderline ovarian tumor.

assess for presence of atypical cells prior to starting the procedure. If rupture of BOT occurs at time of surgery, this may also increase risk of recurrence. Data are lacking regarding appropriate next steps to reduce this risk of rupture occurring. In patients where surgical resection is complete and no invasive implants are present, observation is the recommended next step in management. If surgical resection and staging is incomplete, assessment for residual disease with CT scan of chest, abdomen, and pelvis with contrast is warranted. Standard complete staging would include pelvic washings, total hysterectomy with bilateral salpingo-oophorectomy, and debulking of additional disease as needed [4]. While lymphadenectomy and omentectomy may result in upstaging, no survival benefit has been demonstrated [4]. In mucinous BOT, appendectomy is typically included in surgical treatment to rule out a primary appendiceal neoplasm with spread to the ovary, though rate of primary appendiceal mucinous malignancy in this population is low [10].

If invasive implants are present, chemotherapy may be warranted. If observation is recommended, surveillance for recurrent disease is performed with clinic evaluations every three to six months for up to five years then annually ongoing. These evaluations include pelvic examination with imaging studies as clinically indicated. Ultrasound is indicated for those with fertility-sparing surgery. If CA-125 was elevated at presentation, this should be included in ongoing evaluations to signal recurrent disease. Once childbearing is completed, completion surgery with hysterectomy and bilateral salpingo-oophorectomy may be considered. If relapse occurs, surgical evaluation and debulking are typically recommended [4].

Key Teaching Points

- BOT are intermediate epithelial ovarian neoplasms of six different subtypes (serous [50%], mucinous [45%], endometrioid, clear cell, seromucinous, and borderline Brenner tumor) that comprise 10–20% of all ovarian neoplasms
- While up to a third of patients with BOT are asymptomatic, they may present with abdominal pain or discomfort, bloating, abnormal bleeding, pain with intercourse, and bowel or bladder dysfunction
- The majority of BOT are limited to the ovaries at diagnosis, but they can be associated with microinvasion, intraepithelial carcinoma, lymph node involvement, and non-invasive peritoneal implants
- Pelvic US and MRI may help aid in preoperative diagnosis of BOT, though sensitivity is low for both imaging modalities
- Surgery is the mainstay of treatment of BOT and may include unilateral salpingo-oophorectomy or cystectomy if diagnosed in premenopausal women or complete staging with pelvic washings, total hysterectomy, and bilateral salpingo-oophorectomy. Appendectomy should be considered in patients with mucinous BOT
- If BOT is suspected or incidentally found, referral to Gynecologic Oncology is warranted. Clinical surveillance for recurrent disease is essential for ongoing care

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CASE 55

A 32-Year-Old G4P4 Woman with Through-and-Through Small Bowel Penetration on Placement of Umbilical Port

Aaron Goldberg

History of Present Illness

A 32-year-old gravida 4, para 4 woman presents to the clinic with a history of increasingly painful menses over the past 18 months. She also reports mild daily right lower pelvic pain that is increased during menses. She typically misses one to two days of work each month due to this pain but struggles to maintain normal work and personal activities for a total of five to six days each month. Her bowel and bladder function are normal other than occasional constipation. She has tried oral contraceptive pills for six months and over-the-counter non-steroidal anti-inflammatory medications without improvement.

She is otherwise healthy. Her surgical history includes two prior cesarean deliveries, a laparoscopic appendectomy, and a laparoscopic cholecystectomy. She is not currently taking any medication and has no known drug allergies.

Physical Examination

General appearance: Well-developed female adult in no acute distress

Vital signs:

Temperature: Afebrile
Pulse: 75 beats/min
Blood pressure: 118/74 mmHg
Respiratory rate: 15 breaths/min
BMI: 27 kg/m^2

Chest: Clear to auscultation, normal breath sounds bilaterally

Cardiovascular: Regular rate and rhythm

Abdomen: Soft with mild diffuse tenderness in lower abdomen right side greater than left with no rebound or guarding. Well-healed incisions from her prior surgeries are noted

Pelvic: Normal external genitalia, vagina, and cervix. Mild tenderness of uterus and right adnexa. Some fullness of right adnexa. Normal size uterus. Examination limited by mild guarding

Neurologic: Awake and oriented, somewhat distressed during discussion of symptoms

Imaging: Pelvic ultrasound shows an anteverted uterus measuring 9.0 × 5.5 × 5.2 cm with a normal endometrial stripe of 9 mm. Left ovary normal. Right ovary is enlarged with a complex cyst. The cyst measures 6.0 × 4.6 × 5.0 cm and includes a heterogeneous appearance but without abnormal vasculature or solid areas. Trace pelvic free fluid is noted. The radiologist's impression is suggestive of an endometrioma

How Would You Manage This Patient?

This patient has worsening chronic pain and dysmenorrhea refractory to medical therapy. Her differential diagnosis includes endometrioma, benign ovarian mass (e.g. mature teratoma), functional ovarian cyst, tubo-ovarian abscess, pedunculated uterine fibroid, ovarian malignancy, and non-gynecologic neoplasm (e.g. bowel mass). The patient's age, symptoms, physical examination findings, and ultrasound results are strongly suggestive of endometriosis with a right-sided ovarian endometrioma. Alternative treatment options, including expectant management and continued medical therapy, are discussed with the patient and she is scheduled for a laparoscopic ovarian cystectomy. A review of the risks of surgery, including the potential for unanticipated organ injury and the possible need for a laparotomy, are included as part of the informed consent discussion.

In the operating room, the patient successfully undergoes general anesthesia and is prepped and draped in the routine fashion. In order to gain intraperitoneal access, a Veress needle is passed through the base of the umbilicus. After an initial unsuccessful attempt, the second attempt is followed by an opening pressure of 5 mmHg and a reassuring saline drop test. After pneumoperitoneum is achieved, the needle is removed, and a 5 mm optical laparoscopic trocar is placed with a zero-degree laparoscope under direct visualization. Intraperitoneal placement is confirmed, and two additional 5 mm trocars are placed in both lower quadrants under direct visualization. The laparoscope is then placed through one of the lower ports and visualization of the primary trocar site reveals a through-and-through penetration of a loop of small bowel that was adherent to the umbilicus. No spillage of bowel contents is apparent, and the primary trocar remains in place without further manipulation to avoid worsening the injury. Broad-spectrum antibiotics are administered to reduce the risk of infection.

Recognizing the injury and the need for immediate repair, a general surgeon is consulted to help with the repair. A mini-laparotomy at the level of the umbilicus is performed, again leaving the primary trocar in place to mark the site of injury. Adhesiolysis of the small bowel from the anterior abdominal wall and umbilicus helps to mobilize and isolate the injured portion of bowel, carefully avoiding making the injury larger. The injured portion of small bowel is inspected and a through-and-through puncture wound from the 5 mm trocar is confirmed without evidence of significant bleeding or spillage of bowel contents. The general surgeon performs a small bowel resection including the affected area with primary reanastamosis. A thorough inspection of the rest of the bowel confirms that there are no other injuries. The incision is then closed and pneumoperitoneum is re-established. Using one of the

accessory ports to provide direct visualization, a 5 mm laparoscopic trocar is placed superior to the umbilicus with adequate visualization of the pelvis confirmed. A right-sided ovarian endometrioma is removed without further complication. The patient is monitored for 24 hours and discharged in stable condition.

Prevention and Recognition of Bowel Injury

Bowel injury during laparoscopy is an uncommon but significant complication of laparoscopic surgery. Incidence of bowel injury during gynecologic laparoscopic surgery is 0.13–0.54%, with nearly 75% of injuries occurring to the small bowel. Approximately half of these injuries occur during entry [1, 2].

Risk factors for bowel injury during laparoscopic surgery are similar to those for open surgery. These include prior abdominal or pelvic surgery, intra-abdominal adhesions, endometriosis, history of intra-abdominal or pelvic infection, and prior abdominal or pelvic radiation.

While some bowel injuries are unavoidable, prevention and recognition of this complication remains essential to reducing the risk of morbidity and mortality on the patient. Intraoperative recognition significantly reduces the risks of morbidity and mortality to the patient. A delay in diagnosis of over one day occurs in over 40% of such injuries and is associated with significantly increased mortality risk compared with intraoperative recognition [3, 4].

Injuries are more common with complex surgeries, for example those involving bowel adhesions, prior myomectomies, history of radiation, multiple prior abdominal surgeries, and endometriosis. Efforts to prevent bowel injuries include careful peritoneal entry, gentle tissue handling, meticulous anatomic dissection, and caution with thermal energy sources [3, 4]. Preoperative mechanical bowel preparation provides no benefits in routine gynecologic surgery [5, 6]. Careful inspection of area near trocar sites for bleeding, hematomas, or bowel spillage is helpful to identify bowel injuries.

While bowel injuries during laparoscopic surgery most often occur during primary trocar placement, no one method of peritoneal entry has been shown to be optimal at reducing bowel injuries. Use of open versus closed techniques of obtaining laparoscopic entry show similar rates of bowel injury [6–8]. Alternative entry sites, such as the left upper quadrant ("Palmer's point"), should be considered in patients with prior umbilical hernias, prior midline laparotomy, and extensive past pelvic or abdominal surgery or suspected adhesions. In addition, multiple prior attempts using the Veress needle should prompt use of alternative entry techniques. Use of optical entry trocars may help detect bowel injuries; they are not associated with a lower risk of injury [8].

Observation is reasonable for isolated simple Veress needle injuries. This patient has experienced a full thickness small bowel injury and requires immediate repair. Upon recognition, the trocar should be left in place to aid in identification and avoid worsening the injury. Sutures may be placed at the site of injury to help with later identification and to minimize spillage of bowel contents.

Although experienced benign gynecologic surgeons may be competent in repairing minor bowel injuries, consultation with a gynecologic oncologist or general surgeon is required for any complex repairs or if the primary surgeon does not have experience with bowel injury repair.

The majority of bowel injuries during laparoscopy are managed by conversion to laparotomy in an effort to facilitate exposure and repair of the injured area of bowel. Laparoscopic repair can be used by surgeons experienced in complex bowel surgery using laparoscopic instruments [4]. A mini-laparotomy can be used to isolate the injured bowel and facilitate appropriate repairs provided the injured area of small bowel can be identified and mobilized. Use of a small self-retaining retractor may be helpful.

The technique required for repair of a small bowel injury depends on the extent of the injury and blood supply affected. Superficial and partial thickness injuries to the serosa or muscular layer of the bowel can be repaired by primary repair using 3–0 interrupted absorbable sutures to over sew the affected area. Full thickness small bowel injuries less than 1 cm can usually be repaired with a simple two-layer closure. Delayed absorbable 2–0 or 3–0 sutures may be used with the first layer avoiding the mucosa and the second layer performed as an imbricating layer over the first. The repair should be perpendicular to the length of the bowel to reduce the risk of subsequent stenosis or obstruction.

Full thickness small bowel injuries measuring greater than 1 cm or involving interrupted blood supply, necrotic tissue, or other complicated injuries likely require resection of the injured segment of bowel and primary anastomosis. Diverting ostomy may be needed in rare cases involving complex injuries or significant spillage of bowel contents. Closed intra-abdominal drains may be considered and broad-spectrum antibiotics should be given to help reduce the risk of infectious complications and anastomotic leak. Routine nasogastric tube decompression is rarely needed. A regular diet may be offered for small injuries, but a clear liquid diet should be maintained until bowel function resumes for large or complex injuries [1, 9].

Key Teaching Points

- Small bowel injury is an uncommon serious complication of laparoscopic surgery
- Risk factors include prior surgery and suspected intra-abdominal adhesions that distort normal anatomy
- Intraoperative recognition and repair is crucial to improving patient outcomes. Delayed recognition is associated with significant morbidity, an increased risk of mortality, increased healthcare costs, and liability claims
- Timely repair and recognition are key to reducing morbidity and mortality as well as healthcare costs and medical liability claims
- Repair by a surgeon experienced in bowel surgery is essential for a good outcome, so appropriate consultation must be considered by a surgeon without adequate training for complex bowel injury repairs

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CASE 56 A 43-Year-Old G3P3 *BRCA1* Carrier Desiring Risk-Reducing Salpingo-oophorectomy

Emily R. Rosen

History of Present Illness

A 43-year-old, gravida 3, para 3, with a known *BRCA1* gene mutation presents to the office to discuss risk-reducing surgery. Her family history is significant for breast cancer diagnosed in her mother at age 42 years, ovarian cancer in a maternal aunt at age 53 years, and ovarian cancer in her maternal grandmother at age 49 years. Last month, she underwent genetic counseling and testing revealed a *BRCA1* mutation. She is otherwise healthy with no significant past medical history or surgical history. She had three uncomplicated vaginal deliveries and has regular monthly periods. She used oral contraceptive pills for birth control for 15 years prior to her husband's vasectomy. She denies any recent weight change, fever or chills, bowel or bladder dysfunction, nausea, early satiety, or abdominal or pelvic pain. She had a normal mammogram last week. She is not taking medications and has no known drug allergies.

Physical Examination

General appearance: Alert, well-appearing, in no distress

Vital signs:

Temperature: 36.8°C
Pulse: 86 beats/min
Blood pressure: 126/78 mmHg
Respiratory rate: 18 breaths/min
BMI: 32 kg/m²

Abdomen: Soft, non-tender, non-distended, no masses or organomegaly, normal bowel sounds

Pelvic: Normal appearing external female genitalia. Vagina with normal color, physiologic discharge, and no lesions. Normal cervix. Anteverted, 9-week-sized, mobile, non-tender uterus. Adnexa with no palpable masses and non-tender

Extremities: No edema or calf tenderness

Laboratory studies: None ordered

Imaging: Transvaginal ultrasound demonstrates an anteverted uterus measuring 9.3 × 5.6 × 4.9 cm with an endometrial thickness of 12 mm. Normal ovaries without lesions. No free fluid is noted.

How Would You Manage This Patient?

With the advancement of genetic testing and subsequent identification of *BRCA* mutation carriers, the clinical scenario of *BRCA*-positive patients presenting for risk-reducing management is increasing. This patient presents with a high-risk family history and a known *BRCA1* mutation. The patient expressed that she was done with childbearing and desired the most effective ovarian cancer risk-reduction strategy. The different management strategies for risk reduction, as well as their advantages and limitations, were discussed including screening, risk-reducing agents, and surgical risk reduction. The patient was counseled on the rare potential for occult invasive or intraepithelial neoplasms identified on surgical pathology. She elected to proceed with surgical management. Preoperative testing included a negative pregnancy test, normal complete blood count, and type and screen.

The patient underwent a laparoscopic bilateral salpingo-oophorectomy and pelvic washings. A thorough evaluation of the abdomen and pelvis during her surgery revealed no evidence of macroscopic disease. Specimens were sent to pathology for complete, serial, sectioning of both ovaries and fallopian tubes. The patient was discharged home that evening in stable condition. Pathology returned with normal bilateral ovaries, one fallopian tube with serous tubal intraepithelial carcinoma, and the other fallopian tube with endometriosis (see Figure 56.1). Cytology was benign. She was referred to Gynecologic Oncology for further evaluation and management.

Risk-Reducing Bilateral Salpingo-oophorectomy

Women who have germline mutations in the *BRCA1* or *BRCA2* genes have a significantly increased lifetime risk of breast and ovarian cancer. The *BRCA* genes are tumor suppressor genes that play a role in the DNA repair process, and a defective allele increases the chance of cancer development. The carrier frequency in the general population ranges from 1 in 300 to 1 in 800 [1]. However, certain ethnic groups have a higher incidence. Most notably, 1 in 40 Ashkenazi Jews are *BRCA* mutation carriers. The risk of breast cancer ranges from 45% to 85% by age 70 in patients with either *BRCA* mutation. The risk of ovarian cancer is dependent on the specific mutation and ranges from 39% to 46% by age 70 in *BRCA1* patients versus 10–27% in *BRCA2* patients [1]. Ovarian cancer in this population is frequently high grade and often has a serous or endometrioid histologic phenotype.

Different non-surgical risk-reducing strategies for breast and ovarian cancer have been studied; chemoprevention with oral contraceptive pills has shown 33–80% reduction in ovarian cancer risk [2]. Screening with serum CA-125 and transvaginal ultrasound may be recommended as an option for women delaying definitive surgery. Risk-reducing salpingo-oophorectomy (RRSO) is the most effective strategy to decrease the risk of ovarian cancer. Initial work by Domchek et al., in a prospective study with short-term follow-up, showed that RRSO in *BRCA*-positive patients was associated with a significant reduction in breast cancer-specific, ovarian cancer-specific, and overall mortality [3]. A subsequent meta-analysis suggested that RRSO resulted in an 80% reduction in ovarian

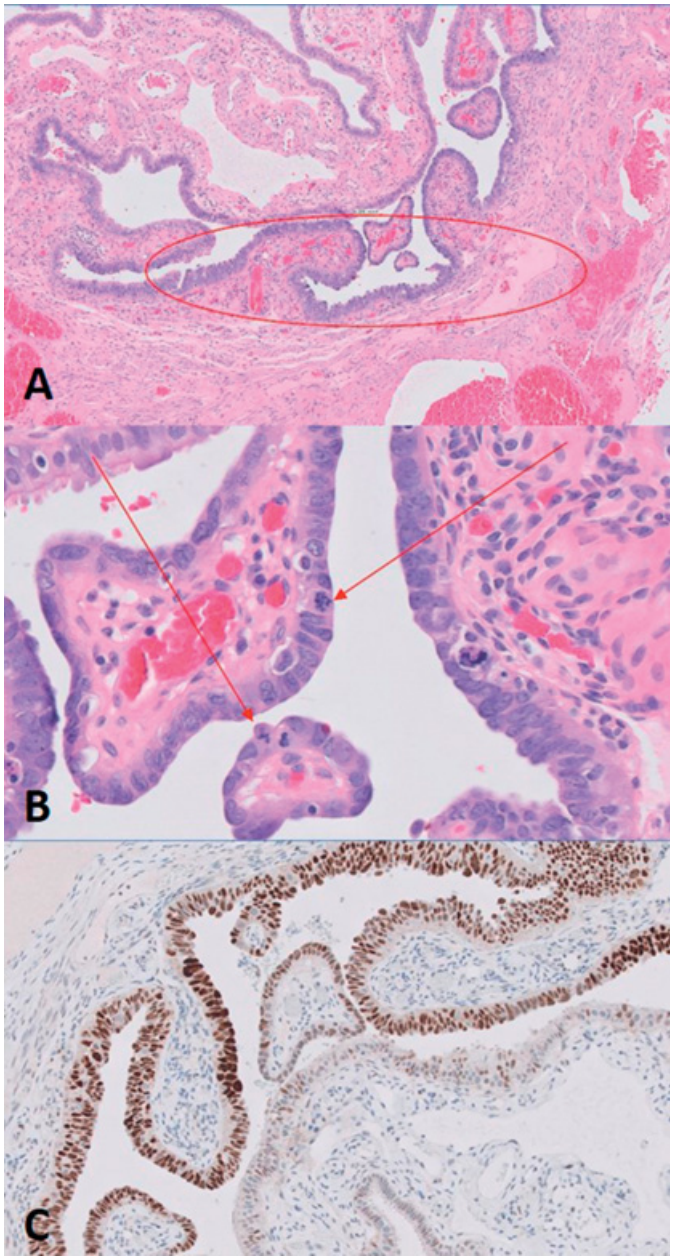

Figure 56.1 Serous tubal intraepithelial carcinoma (STIC) identified in a non-fimbriated region. Low power examination showed an area of hyperchromasia (circled) compared with neighboring non-neoplastic tubal mucosa (A). On high power there is marked nuclear pleomorphism and mitotic activity including abnormal figures (arrows) (B). Immunohistochemistry for p53 demonstrated a mutated pattern with intense nuclear staining of virtually all morphologically abnormal nuclei, compared with neighboring non-neoplastic mucosa (right lower corner) (C). Image courtesy of Adrián Suárez, M.D. Director of Surgical Pathology at James Comprehensive Cancer Center.

and fallopian tube cancer risk and a 50% reduction in breast cancer risk [4]. Additional studies have shown a decrease in all-cause mortality associated with RRSO [5], and a 2018 Cochrane review emphasized the increase in overall survival and decrease in ovarian and breast cancer mortality [6].

Due to the absence of effective screening for ovarian cancer and consistent evidence of benefit from RRSO, women with *BRCA* mutations should be offered RRSO. When a patient presents to discuss RRSO, a complete medical history including family history should be ascertained. A preoperative examination is performed with emphasis on the abdominal and pelvic examination. Preoperative counseling includes a discussion of the timing of surgery, surgery details, expected recovery, and unique pathology evaluation with possible findings of occult malignancy. The timing of surgery is individualized based on the patient's specific *BRCA* mutation and their desire for future fertility. Current recommendations are to perform a RRSO at age 35–40 in *BRCA1* patients, and at age 40–45 in *BRCA2* patients given the later onset of ovarian cancer presentation [1]. Additionally, it is important to discuss potential adverse effects of the surgery including early menopause with associated vasomotor and genitourinary symptoms and possible long-term health consequences of heart disease and bone loss. Although current literature shows that hormone replacement therapy (HRT) does not change breast cancer risk reduction following RRSO, more long-term studies are needed on HRT risks, benefits, and duration of use in this high-risk population. Routine preoperative testing is indicated.

Performing a RRSO is distinct from a bilateral salpingo-oophorectomy in a low-risk patient (see Table 56.1). After laparoscopic entry into the abdominal cavity, pelvic washings are collected and sent for cytologic evaluation. A thorough evaluation of the abdominal structures, pelvic structures, and peritoneal surfaces is performed. Evaluation includes examination of the diaphragm, liver, omentum, bowel, paracolic gutters, appendix, ovaries, fallopian tubes, uterus, bladder serosa, and posterior cul-de-sac. If there are any abnormal findings, a biopsy should be performed. When removing the adnexa, it is crucial that all ovarian and fallopian tissue is removed. This is accomplished by ligating and transecting the infundibulopelvic ligaments approximately 2 cm proximal to visible ovarian tissue, ligating the fallopian tube at the uterine cornua, and transecting the utero-ovarian ligaments as close to the uterus as possible (see Figure 56.2). Retroperitoneal dissection may be necessary to assure a 2cm portion is excised, in particular, in the presence of peri-ovarian adhesions. Adjacent peritoneal tissue and adhesions should be excised. Rarely, unexpected macroscopic evidence of cancer is found during surgery. The decision to perform surgical staging at the time of RRSO, as opposed to awaiting final pathology results, should be discussed preoperatively. Placing the specimen in a laparoscopic bag to preserve the tissue can be considered. It is imperative to label the pathology for serial sectioning in the setting of *BRCA* mutation.

Occult ovarian, fallopian tube, and peritoneal malignancies have been reported at the time of RRSO in *BRCA* mutation carriers. The introduction of strict pathologic protocols has led to an increase in the detection of invasive and intraepithelial neoplasms. A multicenter retrospective analysis found almost a sevenfold higher detection rate with a rigorous pathology examination that included serial sectioning [7]. Data from the

Table 56.1 Surgical recommendations during a RRSO

- Collect pelvic washing
- Perform a thorough evaluation of abdomen, pelvis, and peritoneal surfaces: inspect the diaphragm, liver, omentum, bowel, paracolic gutters, appendix, ovaries, fallopian tubes, uterus, bladder serosa, and cul-de-sac
- Biopsy any abnormal areas
- Ligate the ovarian vessels approximately 2 cm proximal to the end of visible ovarian tissue
- Transect the fallopian tube at its insertion into the uterine cornua
- Ligate the utero-ovarian ligament as close to the uterus as possible to remove the ovary
- Send pathology for complete, serial sectioning

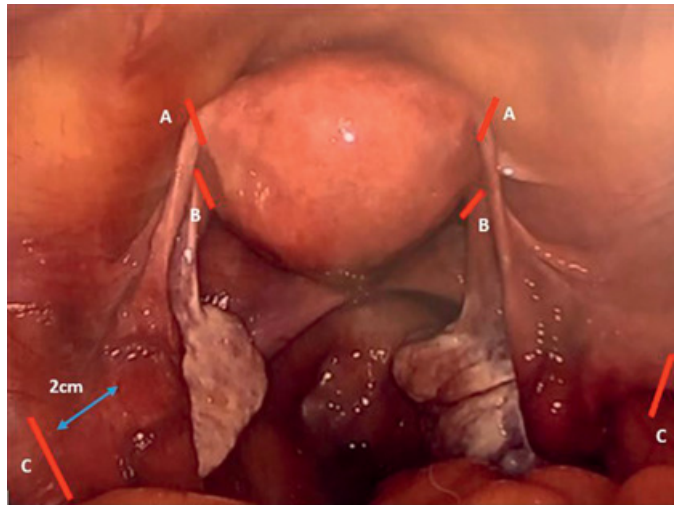

Figure 56.2 Surgically remove all adnexal tissue by (A) transecting the fallopian tube at the uterine cornua, (B) transecting the utero-ovarian ligament close to the uterus, and (C) transecting the ovarian vessels at least 2 cm proximal to ovarian tissue.

Gynecologic Oncology Group Trial GOG-0199 found a detection rate of occult gynecologic neoplasm of 4.6% in *BRCA1* and 3.5% in *BRCA2* mutation carriers [8], and a recent systematic review showed a pooled prevalence of 1.2% for occult tubal carcinoma in *BRCA* and other high-risk patients [9]. Given that most malignancies identified at the time of RRSO are occult, routine intraoperative frozen section is not recommended [10]. If occult malignancy is identified on final pathology, referral to Gynecologic Oncology is recommended.

RRSO decreases cancer incidence and overall mortality in *BRCA* mutation carriers. In this population, unique surgical considerations and a thorough pathologic evaluation are necessary for appropriate risk reduction and identification of occult malignancy.

Key Teaching Points

- Women with *BRCA* mutations have a significantly increased lifetime risk of breast and ovarian cancer
- RRSO is the most effective strategy to decrease the risk of ovarian cancer
- The goal to remove all ovarian and fallopian tube tissue during RRSO for patients with *BRCA* mutations is unique to the procedure
- Surgical specimens should be sent to pathology for serial sectioning to evaluate for occult malignancy

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CASE 57 A 34-Year-Old G3P3 Is Undergoing an Interval Bilateral Salpingectomy. During Initial Trocar Insertion, Bright Red Blood Is Noted to Be Filling the Pelvis

Matthew R. Hopkins

History of Present Illness

A 34-year-old gravida 3, para 3 is undergoing an interval bilateral salpingectomy for permanent sterilization. She is currently using combined oral contraceptive pills (containing ethinyl estradiol/norethindrone) for contraception. Because of side effects associated with the pill, she has opted for permanent sterilization. She understands sterilization is a permanent procedure and is certain she has completed her family. Her pre-procedure pregnancy test was negative. All her deliveries were spontaneous vaginal deliveries. She has no history of easy bleeding or bruising. She has no past medical or surgical history. She is not taking any other medications and she has no known drug allergies.

Physical Examination

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

Vital signs:

Temperature: 37.1°C
Pulse: 78 beats/min
Blood pressure: 118/76 mmHg
Respiratory rate: 16 breaths/min
BMI: 20 kg/m^2

How Would You Manage This Patient?

The patient reported to the outpatient procedure center for her planned procedure – a laparoscopic bilateral salpingectomy. After induction of general anesthesia, the patient was placed in the dorsal lithotomy position using yellowfin stirrups. After appropriate sterile preparation and draping, a presurgical pause was performed. A Foley catheter and a uterine manipulator were placed. Laparoscopic entry was performed through an infraumbilical incision using a closed technique with initial insertion of a Veress needle. Upon insertion of the Veress needle there was no return on aspiration and opening intra-abdominal pressures were <7 mmHg. The abdomen was insufflated to 15 mmHg and a 5 mm blunt trocar was placed through this incision and the laparoscope was inserted. The patient was then placed in Trendelenburg position. A 5 mm accessory trocar was placed in the left lower quadrant under direct visualization. Routine anatomic survey was initiated by sweeping the bowel out of the pelvis at which point bright red blood was noted to be filling the pelvis. Laparoscopic survey demonstrated bleeding appearing to originate from the right common iliac artery. At the same time anesthesia begins to notice changes in the patient's blood pressure and pulse.

Management

Immediately upon recognition of this vascular injury, the surgeon notified anesthesia and nursing teams. Anesthesia began administering crystalloids and started a second large bore IV. The blood bank was notified of the potential need for blood products and the massive transfusion protocol was activated. The nursing team prepared for laparotomy and requested the presence of vascular surgery team on call from the adjacent hospital. Meanwhile, the surgeon provided compression to the area bleeding until the equipment necessary to perform an emergent low midline laparotomy was available.

A low midline laparotomy was then performed and compression to the area of bleeding was applied with lap sponges to slow the bleeding. Anesthesia followed labs and administered blood products per protocol. The patient had a warming device applied to her upper torso. The room temperature was adjusted as appropriate to prevent hypothermia. Upon arrival of the vascular surgeon, the injured area was evaluated, and adequate exposure was ensured. Evaluation demonstrated a 3 mm laceration in the right common iliac vein which was then primarily repaired.

Intraoperative Hemorrhage

Vascular injuries at the time of laparoscopic surgery are a rare but potentially life-threatening complication. Vascular injuries (including injury to major and minor vessels) are estimated to occur at a frequency of 1.0–6.4%. This is likely an underestimate as injuries to minor vessels are likely underreported. A large percentage of these injuries occur at the time of initial access to the abdomen as in this case. Injuries to the large retroperitoneal vessels are the most potentially catastrophic and are thought to occur in 0.3–1.0%. Despite the relatively rare incidence of these injuries, they are associated with a high mortality rate [1, 2]. With an umbilical point of entry, the vessels most commonly injured are the terminal aorta, the terminal vena cava, common iliac arteries (R>L), and the common iliac veins. This is intuitive given the anatomic location of these vessels in the area of the umbilicus. Body habitus may impact the relationship between the umbilicus and the underlying vessels [3]. While much speculation exists about the safest mode of entry, a recent Cochrane review found insufficient evidence to demonstrate any difference in the rates of vascular injury among abdominal entry techniques [4].

Injury to blood vessels and subsequent intra-abdominal bleeding can also occur during insertion of secondary trocars. The vessels injured during secondary trocar insertion tend to be abdominal wall vessels – specifically the inferior epigastric vessels. Since these trocars are being inserted under visualization in an insufflated abdomen, injury to the large

vascular structures, blind grasping/clamping of vessels in the mesentery could potentially result in devascularization of bowel segments and subsequent ischemia.

If the surgeon possesses the necessary skills and the site of the bleeding is clearly identified, appropriate cases can be managed laparoscopically. In general, massive bleeding from the large retroperitoneal vessels, bleeding of unknown origin, or significant bleeding in unstable patients is best managed by emergent low midline laparotomy. A midline incision allows for improved exposure to the pelvis and large retroperitoneal vessels, and the incision can be extended if necessary. At this point compression can be performed to slow the bleeding allowing anesthesia to resuscitate and stabilize the patient. If possible, compression proximal and distal to the injury will yield the best results. This can be performed until a surgeon skilled in vascular injury repair is available. In cases where a surgeon capable of vascular repair is not available, the abdomen should be packed and once the patient is stabilized/resuscitated the patient should be transferred to a facility with the necessary resources available to manage this complication [1]. Massive transfusion protocols should ensure appropriate blood product replacement to prevent coagulopathy and metabolic acidosis. Protocols should also include measures to prevent hypothermia. This lethal trauma triad has long been known to negatively impact survival [10].

Key Teaching Points

- Vascular injury is a relatively rare but potentially fatal complication of laparoscopic surgery
- Injury to the great vessels is most common during primary entry and can occur with any of the reported entry techniques
- Prompt recognition of vascular injury is paramount
- Surgical teams should develop protocols for intraoperative bleeding that take into consideration the local resources available

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CASE 58 A 28-Year-Old G0 Woman with Stage IV Endometriosis and an Obliterated Posterior Cul-de-sac

Megan Billow

History of Present Illness

A 28-year-old nulligravid woman presents reporting severe dysmenorrhea, deep dyspareunia, and dyschezia that worsens with menses. She states she has always had painful periods, but they have worsened over the past year. She describes it as sharp, twisting, and feels that something is "stabbing her from the inside out." She is in a long-term relationship and desires future fertility. She has tried several different combined oral contraceptive pills, which mildly improved her pain. She has also tried non-steroidal anti-inflammatory drugs, medroxyprogesterone acetate, and a gonadotropin-releasing hormone agonist without relief. She states the dyspareunia and constipation have worsened over time. She underwent a diagnostic laparoscopy at age 26 and was told she had stage IV endometriosis. She continues to have debilitating pain that significantly impacts her quality of life. She would like to proceed with fertility-sparing surgical management. She has no other relevant relevant past medical or surgical history. She is currently taking oral contraceptives (ethinyl estradiol/norethindrone) and has no known drug allergies.

Physical Examination

General appearance: Tearful, well-developed female in moderate distress

Vital signs:

Temperature: 37.1°C
Pulse: 83 beats/min
Blood pressure: 120/70 mmHg
Respiratory rate: 16 breaths/min
BMI: 21 kg/m^2

Abdomen: Soft, tender to deep palpation, no guarding or rebound tenderness

Pelvic: Normal external female genitalia. Vagina with physiologic discharge. Cervix is normal without any cervical motion tenderness. Uterus is retroverted, fixed, and tender to palpation. A 2 cm, painful nodule is palpated on the left uterosacral ligament. Right adnexa has fullness and tenderness. Left adnexa is non-tender and no fullness. Rectovaginal examination reveals induration in the rectovaginal septum

Laboratory studies:

Urine pregnancy test: Negative
WBCs: 10 200/μL
Hb: 12.0 g/dL
Platelets: 406 000/μL

Imaging:

Pelvic ultrasound: Uterus measuring 8.2 × 5.3 × 4.8 cm with a symmetric endometrial thickness of 8 mm. The left ovary measures 2.6 × 3.3 × 2.8 cm and is without abnormalities. The right ovary is enlarged and measures 8.2 × 5.5 × 5.8 cm and is completely replaced by a unilocular cyst that measures 6.9 × 4.9 × 5.5 cm with homogeneous low-level echogenicity. Doppler flow is present in both ovaries

MRI: Normal-sized uterus with large right ovarian endometrioma. Tethering of the posterior uterus/cervix and the anterior rectum, concern for endometriosis

How Would You Manage This Patient?

This patient has chronic pelvic pain that is worsening and significantly impacting her quality of life. She has surgically diagnosed endometriosis and has failed multiple medical management options. The symptoms of deep dyspareunia and dyschezia that worsens with menses are concerning for deep infiltrating endometriosis (DIE). Furthermore, the MRI suggests the presence of a right endometrioma and tethering of the rectum to the posterior uterus. Given the severity of the patient's symptoms and that she has failed multiple medical management options, the decision was made to proceed with fertility-sparing surgical management.

The patient underwent a diagnostic laparoscopy that revealed an obliterated posterior cul-de-sac, right ovarian endometrioma, 3 cm left uterosacral ligament nodule, and the rectosigmoid adhered to the posterior uterine wall. She underwent a laparoscopic excision of endometriosis, right ovarian cystectomy, and superficial excision (shaving) of endometriosis on the rectosigmoid. The patient was discharged home the same day as the surgery. She was doing well at her two-week postoperative visit and the pathology confirmed endometriosis.

Endometriosis

Endometriosis is the presence of endometrial-like tissue containing endometrial glands and stroma outside of the uterus. It affects 6–10% of reproductive-aged women, up to 47% of patients with subfertility [1], and up to 87% of women with chronic pelvic pain [2]. The types of endometriosis include endometrioma (involving the ovary), superficial (involving the peritoneum), and DIE (invasion into >5 mm of the peritoneum). Common presenting symptoms include dysmenorrhea, dyspareunia, dyschezia, and non-menstrual pelvic pain. A patient may not have any clinical examination findings; however, nodularity of the uterosacral ligament, adnexal fullness, induration of the rectovaginal septum, and a fixed, retroverted uterus may be present with advanced disease.

Deep infiltrating endometriosis occurs when the endometriotic lesion extends >5 mm past the peritoneal surface. These lesions contain smooth muscle and active glandular epithelium, causing fibrosis and nodularity. Advanced stage endometriosis commonly affects the posterior cul-de-sac and involves tethering of the anterior rectum to the posterior uterus, vagina, and cervix while extending laterally to the uterosacral ligaments. Fibrosis and inflammation lead to obliteration of normal anatomy and tissue planes causing severe pain (Figure 58.1). While some patients may respond to medical management, surgery is often necessary to improve pain symptoms. Due to the significant distortion of anatomy, these surgeries are challenging and often require referral to advanced laparoscopic surgeons.

Pelvic ultrasound and MRI can be helpful for diagnosis and facilitate preoperative surgical planning. Transvaginal pelvic ultrasound is the imaging modality of choice for chronic pelvic pain. It has the highest sensitivity in diagnosing an endometrioma, with a sensitivity of 93% and specificity of 96% [3]. Protocols utilizing transvaginal ultrasound with bowel preparation and MRI with rectal contrast can be helpful in evaluating DIE; however, sensitivity and specificity are dependent on operator experience. Abrão et al. demonstrated the use of transvaginal ultrasound with bowel preparation to have a sensitivity and specificity of 95% when locating DIE at the rectocervical or rectosigmoid level [4]. MRI has a sensitivity of 84% when diagnosing DIE in uterosacral ligaments and 88% when diagnosing rectosigmoid lesions [5]. Given that transvaginal ultrasound with bowel preparation is dependent on operator experience, many surgeons utilize MRI for preoperative surgical planning when DIE is suspected. This aids in determining the need for referrals to advanced laparoscopic pelvic surgeons and surgical specialists to optimize surgical and patient outcomes.

When patients with advanced stage endometriosis do not respond to medical management, laparoscopic or robotic-assisted laparoscopic surgery is recommended. Both surgical routes have similar outcomes without any difference in perioperative complications [6]. When comparing ablation and excisional surgery, a systematic review of three randomized, controlled trials demonstrated that excisional surgery had a significantly greater reduction in visual analog scale scores pertaining to dysmenorrhea and dyschezia [7]. Furthermore, excisional surgery is recommended in advanced stage endometriosis in order to avoid injury to vital structures. Since DIE penetrates the peritoneum, ablation surgery will not completely remove the endometriotic implants.

Surgical Technique

The laparoscopic procedure is approached in a systematic fashion: release the rectosigmoid colon from the sidewall, perform a bilateral ureterolysis, restore normal adnexal anatomy, approach the rectovaginal septum laterally via the perirectal space, release the rectum from the posterior uterus, excise endometriosis lesions, and perform bowel surgery, when needed.

In addition to traditional instruments and energy devices, a uterine manipulator with colpotomy cup is used to delineate the posterior vaginal fornix and the rectum. Rectal probes or EEA sizers assist in further delineation of anatomical and surgical planes.

After pneumoperitoneum is achieved and a complete survey of the upper abdomen and pelvis is performed, adhesiolysis of the rectosigmoid from the sidewall is often needed to expose the left adnexa and gain access into the retroperitoneal space. The combination of cold scissors, quick bursts of monopolar energy, and blunt dissection are used to safely reflect the rectosigmoid to the midline.

Next, the retroperitoneal space is entered via the pelvic triangle that consists of the external iliac artery, round ligament, and infundibulopelvic ligament. The pararectal and paravesical spaces are developed to identify and completely lateralize the ureter (Figure 58.2). This is completed using blunt dissection, short bursts of monopolar energy, and the "push and spread" technique, which will aid in avoidance of injury to the ureter. If any fibrotic nodules or implants are identified within the retroperitoneal space, they should be excised at this time.

The next step is to restore normal anatomy of the adnexa. Blunt dissection can be used to mobilize the ovaries away from the posterior uterus. If endometriomas are present, an ovarian cystectomy with excision of the endometrioma is performed. When compared with drainage and ablation of an

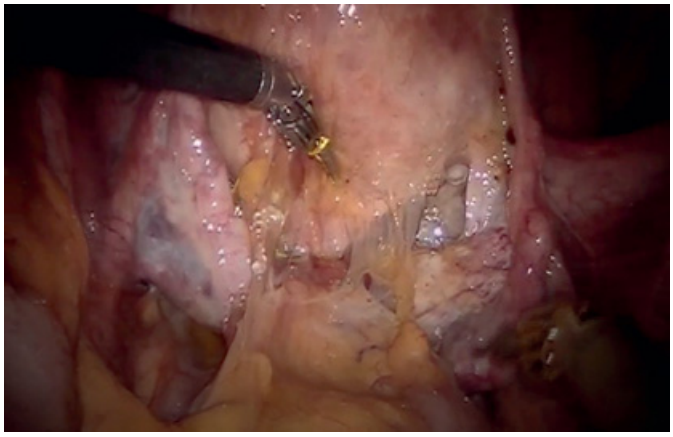

Figure 58.1 Classic appearance of obliterated posterior cul-de-sac due to endometriosis.

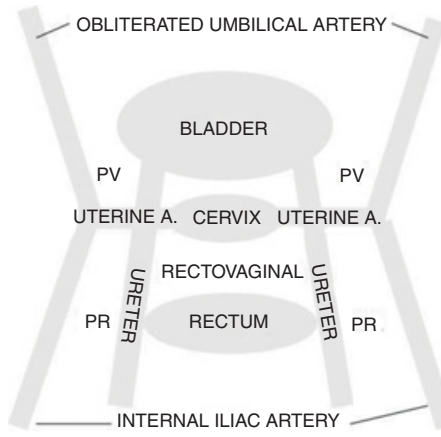

Figure 58.2 Diagram of pelvic anatomy and spaces. PV, paravesical space; PR, pararectal space.

endometrioma, a 2008 Cochrane review demonstrated that excision of an endometrioma is associated with a reduced rate of recurrence and pain symptoms with an increased rate of spontaneous pregnancies (OR 5.1, CI 2.04–13.29). [8]

The perirectal spaces are entered lateral to the rectum in order to enter the rectovaginal space. The ureters can be further lateralized during this step. The colpotomy cup and rectal probes are useful during this step to aid in identification of the posterior vaginal fornix and rectum.

The rectum is mobilized away from the uterus. Gentle traction is placed on the rectum and cold scissors are used to release adhesions. Once the rectum is released and the rectovaginal space is visualized, the rectum is inspected for endometriosis implants and nodules. The surgeon decides if further surgery such as shaving, discoid excision, or segmental resection is necessary [4]. Due to the risk of iatrogenic injury, a thorough inspection of bowel integrity is completed with the air leak test (ALT) prior to closure. The pelvis is filled with saline, the distal part of the large bowel is occluded, and air is instilled through the rectum. Lower rates of postoperative colorectal anastomotic leakage were seen in patients undergoing an intraoperative ALT and thus, it should be considered in patients with severe endometriosis in the posterior cul-de-sac [9].

Key Teaching Points

- Common presenting symptoms of endometriosis include dysmenorrhea, dyspareunia, and dyschezia
- If a patient fails medical management, surgical management is recommended
- Deep infiltrating endometriosis (DIE) is challenging to diagnose and treat. Transvaginal ultrasound and MRI can be helpful with diagnosis, facilitating preoperative surgical planning and referral to advanced laparoscopic pelvic and surgical specialists
- Surgical management of an obliterated posterior cul-de-sac is a challenging procedure and should be performed with a minimally invasive approach with careful attention to the avascular pelvic spaces and vital anatomic structures

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CASE 59 A 40-Year-Old G3P3 Woman with 20 cm Unilateral Simple Cyst

Bryan K. Rone

History of Present Illness

A 40-year-old woman, gravida 3, para 3, with last menstrual period two weeks ago presents for evaluation of a palpable pelvic mass. She reports noticing a slow increase in her abdominal distention over the last four months; however, she denies abdominal pain. She denies any bowel or bladder dysfunction. She is sexually active and denies dyspareunia. Her sexual partner has had a vasectomy. She denies a personal history of breast cancer and denies any family history of breast, ovarian, or colon cancer. Her medical history is significant for anxiety. She has no past surgical history. She is currently taking citalopram. She has no known drug allergies.

Physical Examination

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

Vital signs:

Temperature: 36.9°C
Pulse: 95 beats/min
Blood pressure: 125/65 mmHg
Respiratory rate: 18 breaths/min
Height: 64 inches
Weight: 170 lb
BMI: 29 kg/m^2

Abdomen: Large, palpable, mobile mass filling the lower abdomen extending to 2 cm above the umbilicus. Abdomen is non-tender with no guarding or rebound

Pelvic: Normal external genitalia. Normal vaginal mucosa. Normal cervix. Unable to assess uterine size due to large pelvic mass. Mobile mass present that extends above the umbilicus and is non-tender. Unable to localize the side of mass origin

Laboratory studies:

Complete blood count:

WBCs: 9800/μL (normal 3700–10 300/μL)
RBCs: 4.5 M/μL (normal 3.9–5.2 M/μL)
Hb: 12.5 g/dL (normal 11.2–15.7 g/dL)
Hct: 37% (normal 34–45%)
Platelets: 357 000/μL (normal 155 000–369 000/μL)

Basic metabolic panel:

Glucose: 110 mg/dL (normal 74–99 mg/dL)
Creatinine: 0.70 mg/dL (normal 0.60–1.10 mg/dL)
Sodium: 141 mmol/L (normal136–145 mmol/L)
Potassium: 3.9 mmol/L (normal 3.7–4.8 mmol/L)
Chloride: 106 mmol/L (normal 97–107 mmol/L)
CO_2: 24 mmol/L (normal 22–29 mmol/L)
Calcium: 9.1 mg/dL (normal 8.9–10.2 mg/dL)
Urine pregnancy test: Negative

Risk of ovarian malignancy algorithm (ROMA):

CA-125: 25 U/mL
HE4: 30 pmol/L
ROMA score: Premenopausal 1.00, low risk

Imaging: CT abdomen/pelvis shows large adnexal mass measuring 21 × 17 cm arising from the right ovary comprised of a unilocular, homogeneous cyst. No solid components noted. Normal uterus and normal left ovary present. Normal small bowel and colon observed. Normal kidneys. The bladder is compressed. No ascites or omental lesions. No peritoneal lesions noted

How Would You Manage This Patient?

This patient presents with findings of a large pelvic mass noted on physical examination. She reports that her spouse has had a vasectomy; however, pregnancy must be ruled out. A gynecologic cause is most likely when a large, asymptomatic pelvic mass is encountered. This patient had a large adnexal mass confirmed on her CT scan (Figure 59.1). The next step in the evaluation is to perform a risk assessment to try to determine whether or not the adnexal mass is benign or malignant. This patient is premenopausal with a benign personal and family history related to gynecologic malignancies. The ROMA score was low risk. The CT imaging showed a simple appearing but large ovarian cyst without other abdominal findings such as ascites, omental lesions, or peritoneal lesions suggestive of malignancy.

This patient's adnexal mass was determined to most likely be a benign ovarian neoplasm after a reasonable risk assessment. Surgical removal of the mass is indicated given its large size, abdominal distention, and need for definitive pathologic evaluation. This patient had a single-incision laparoscopic right salpingo-oophorectomy. Pathology showed a benign serous cystadenoma. The patient was discharged the same day and was back to work on postoperative day 5.

Large, Simple Ovarian Mass

Gynecologists frequently evaluate patients with pelvic masses. In the United States, 5–10% of women undergo a surgical procedure for an ovarian mass in their lifetime [1]. A large pelvic mass is impressive on physical examination and imaging; however, the evaluation and management of a large pelvic mass is similar whether it is 7 cm or 30 cm. The first step in the evaluation of an adnexal mass should always be ovarian cancer risk assessment. Ovarian cancer occurred in 11.1 out of 100 000 females from 2012 to 2016 with a combined stage five-year survival of 48% from a cohort of cases between 2009 and 2015 [2].

The patient's age is the most important independent risk factor for ovarian cancer with increasing risk after

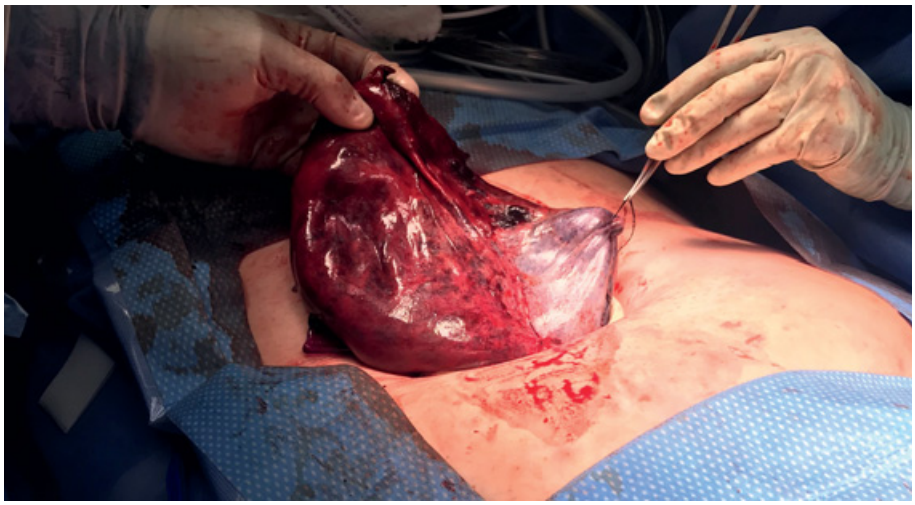

Figure 59.3 Exteriorization of decompressed large, simple ovarian cyst to perform ovarian cystectomy through a mini-laparotomy umbilical incision.

performed in case an unexpected malignancy is encountered. The large cyst should first be drained with a needle aspirator to avoid or minimize spillage. After initial decompression, the cyst should be opened to complete the fluid drainage and inspect the cyst wall for solid components or papillary excrescences. A cystectomy can be performed through the mini-laparotomy incision if the large ovary can be exteriorized (Figure 59.3). If not, the cystectomy should be performed laparoscopically. The single-incision port system is placed within the umbilical mini-laparotomy incision. Laparoscopy allows great visualization of the abdominal and pelvic organs and surfaces to further assess for malignancy. The laparoscopic views allow identification of the ureter and other anatomical landmarks when oophorectomy or salpingectomy are indicated. Accessory laparoscopic ports should be placed as needed to facilitate the completion of the procedure.

Intraoperative pathology should be performed on the specimen if there is any concern for an unexpected malignancy. It is prudent to discuss this possible outcome with the patient prior to surgery. Surgical staging for an ovarian cancer includes hysterectomy, bilateral salpingo-oophorectomy, omentectomy, and a complete evaluation with biopsies of abnormal abdominopelvic organ surfaces or abnormal peritoneal surfaces.

Key Teaching Points

- Malignancy risk assessment should be performed using patient history, family history, physical examination, imaging findings, and serum marker testing
- Large adnexal masses that are low risk of malignancy can be managed in a minimally invasive fashion
- Single-incision laparoscopic techniques combine the benefits of a mini-laparotomy incision and laparoscopy to manage large, simple adnexal masses
- Adnexal masses with high risk of malignancy should be referred to a gynecologist oncologist

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CASE 60 A 16-Year-Old Female G0 Adolescent with Acute Pelvic Pain

Sarah Hagood Milton

History of Present Illness

A 16-year-old nulligravid female presents to the emergency department with abdominal pain. She reports the pain started suddenly two hours prior to arrival and is associated with nausea and vomiting. The pain comes and goes, is located in the right lower quadrant, and is described as sharp and stabbing. She rates the pain as nine out of ten. She denies fever, chills, urinary symptoms, diarrhea, and constipation. She reports never having been sexually active. She has no past medical or surgical history. She is not taking any medications and she has no known drug allergies.

Physical Examination

General appearance: Well-nourished adolescent in mild distress with movement on examination table

Vital signs:

Temperature: 37.1°C
Pulse: 112 beats/min
Blood pressure: 108/76 mmHg
Respiratory rate: 18 breaths/min
Oxygen saturation: 99% on room air

Cardiovascular: Tachycardic with regular rhythm

Abdomen: Soft, tender to palpation in bilateral lower quadrants, no rebound or guarding, no masses palpable

Pelvic: Deferred

Laboratory studies:

WBCs: 5200/μL (normal 3400–9600/μL)
Hb: 12.8 g/dL (normal 11.6–15.0 g/dL)
Urinalysis:

Color: Yellow
pH: 5.0
Specific gravity: 1.010
Glucose: 70–80 mg/dL
Ketones: Negative
Nitrites: Negative
Leukocyte esterase: Negative
Bilirubin: Negative
Blood: Negative
Protein: Negative
WBCs: 1 WBC/hpf
RBCs: 1 RBC/hpf
Bacteria: None
Urine pregnancy test: Negative

Imaging: Abdominal ultrasound shows uterus 6.4 × 4.2 × 4.0 cm with a normal endometrium and myometrium. Normal cervix visualized. The right ovary contains a 6 cm complex mass with cystic and solid components. There is enlarged ovarian parenchyma with hyperechogenic stroma and peripherally displaced follicles. The left ovary is 3.2 × 2.8 × 3.0 cm without masses. No free fluid noted

How Would You Manage This Patient?

This adolescent patient presents with acute pelvic pain. With the clinical presentation of acute pain, associated nausea and vomiting, negative pregnancy test, and pelvic ultrasound showing a complex adnexal mass, ovarian torsion is the most likely diagnosis. She is taken to the operating room for an emergent diagnostic laparoscopy where ovarian torsion is confirmed. Following an uncomplicated detorsion and right ovarian cystectomy, she recovers well. Pathology confirms intraoperative suspicion for mature cystic teratoma.

Ovarian Torsion

Ovarian torsion occurs when the ovary rotates on its vascular pedicle resulting in complete or intermittent obstruction of blood flow in the ovarian vessels as they traverse the infundibulopelvic ligament. Although torsion is relatively uncommon in adolescent patients with an incidence of 5 in 100,000, prompt diagnosis is critical to ovarian preservation [1, 2].

Risk factors for ovarian torsion include a history of prior torsion, polycystic ovarian syndrome, presence of an ovarian mass, ovulation induction, ovarian hyperstimulation syndrome, history of tubal ligation, and pregnancy [2, 3].

Ovarian torsion can occur at any age, but it is more common after puberty when the ovary is more hormonally active and the incidence of benign ovarian pathology increases. While the majority of cases are associated with a pathologic ovarian mass or ovarian enlargement, up to 46% of pediatric cases occur in patients with normal ovaries [3]. Several anatomic circumstances contribute to vulnerability of the pediatric or adolescent ovary to torsion. Compared to adult patients, adolescents have increased laxity of pelvic ligaments and smaller uteri, both of which facilitate freedom of movement of the ovary and the adnexa thereby increasing the chances of torsion. Congenitally long ovarian ligaments are also associated with a higher risk of ovarian torsion and recurrent torsion [2]. Regardless of age, torsion occurs more commonly (60%) on the right due to the stabilizing impact of the descending colon on the left adnexa (Figure 60.1) [4, 5].

Providers who care for both pediatric and adult patients should maintain a high index of suspicion for torsion in patients who present with acute pain. There are no specific clinical, laboratory, or imaging findings that are clearly diagnostic of ovarian torsion. Therefore, providers should have

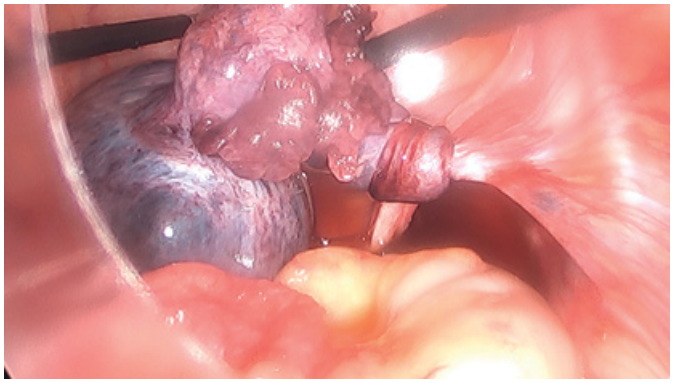

Figure 60.1 Laparoscopic visualization of right ovarian torsion.

a low threshold for surgical exploration in patients presenting with acute pain. The classic presentation, physical examination, and imaging findings outlined below can be useful to guide a provider's level of clinical suspicion regarding torsion and threshold for surgical intervention.

The most common clinical presentation of ovarian torsion is acute onset, intermittent sharp or stabbing abdominal pain [2, 5]. Nausea and vomiting are present in 60–70% of patients [2]. Intermittent pain is the result of incomplete or transient episodes of torsion. For many patients, retrospective assessment reveals intermittent pain for days to weeks leading up to the acute event that led them to seek care [3]. Physical examination is classically notable for abdominal tenderness (88%) without peritoneal signs. A palpable adnexal mass is common in adults with torsion (60–90%) but is an uncommon finding in the pediatric and adolescent population (24%) [2, 5]. Given the variation in this finding by age and habitus, palpation of a mass should not be used to exclude the diagnosis of torsion. Further, pelvic examination is not necessary or recommended as part of the diagnostic workup in a pediatric or adolescent patient with concern for torsion [5]. There are no specific laboratory derangements associated with torsion; however, labs should be obtained to rule out alternative diagnoses [5, 6]. The differential diagnosis for an adolescent with acute pain is broad and includes appendicitis, pelvic inflammatory disease, pyelonephritis, nephrolithiasis, gastroenteritis, ectopic pregnancy, ruptured ovarian cyst, and ovarian torsion. Exclusion of pregnancy with a urine pregnancy test should universally be performed.

In patients with acute-onset pelvic pain, imaging is often warranted. Abdominal ultrasound is the modality of choice for evaluation of ovarian torsion in adolescents [2, 5]. In adults, vaginal ultrasound may facilitate better visualization of the pelvic vessels and more specifically characterize adnexal pathology [3]. Once an ovary undergoes torsion, venous congestion occurs and there is resultant edema in the ovary. Ultrasonographically, this manifests as a unilateral enlarged ovary with hyperechogenic ovarian stroma with peripherally displaced follicles. The presence of an ovarian mass in this scenario would further substantiate the diagnosis of ovarian torsion [3, 5].

The assessment of color Doppler flow in the ovary may aid in diagnosis. In a patient with symptoms consistent with torsion, absence of Doppler flow to the ovary on ultrasound is highly concerning for torsion with a positive predictive value of 94% [7]. Notably, the presence of Doppler flow does not reliably exclude torsion as flow is documented in as many as 60% of cases of surgically confirmed torsion [3, 7].

When significant clinical concern exists for ovarian torsion, emergent surgical exploration is indicated [5]. A minimally invasive approach should be undertaken in pediatric, adolescent, and adult patients with concern for torsion. Surgical goals should prioritize prompt detorsion and ovarian preservation. Historically, oophorectomy was recommended when the ovary appeared dusky, blue, or edematous. Multiple studies have proven that despite these intraoperative findings, visibly devascularized ovaries return to normal function. Resumption of normal post-surgical ovarian function has been proven sonographically, grossly with reoperation, biochemically, and histologically [2, 3]. Oophorectomy should be reserved for postmenopausal patients, patients with clear signs of malignancy, or in circumstances where necrosis is profound and tissue sloughing occurs with ovarian manipulation [5].

While prompt detorsion and ovarian preservation are key elements in management of torsion, performing a cystectomy for an ovarian mass is more controversial. Minimizing handling of the enlarged/edematous/friable adnexa is associated with improved long-term ovarian hormonal functionality [2]. This finding is the basis for management strategies that emphasize detorsion without cystectomy. With this approach, interval reassessment of the adnexa is performed and, if an ovarian mass persists, a laparoscopic ovarian cystectomy is preformed weeks to months after detorsion allowing for tissue edema from torsion to resolve [2, 5]. Further studies are required to clarify the role of cystectomy at the time of detorsion and current management should emphasize shared decision-making when weighing risks and benefits of both approaches.

The most common ovarian pathologies discovered at the time of surgical management of ovarian torsion are benign ovarian cysts. Mature cystic teratomas and functional cysts are the two most common pathologic diagnoses. Malignant ovarian neoplasms are very rare in reproductive-aged women with torsion [2, 5]. Obtaining a pathologic diagnosis at the time of initial surgery should be more strongly considered in premenarchal and postmenopausal patients as ovarian masses are more likely to be malignant in these age groups.

Recurrence of ovarian torsion is rare (8%) if the initial episode of torsion was associated with an ovarian mass. Conversely, recurrence is common in patients who undergo torsion of a normally sized ovary (63%) [4]. Surgeons managing ovarian torsion of the normal ovary should give consideration to this recurrence risk and consider oophoropexy at the time of detorsion. Oophoropexy could also be considered when a subjectively congenitally long ovarian ligament is encountered, in cases of recurrent torsion, and torsion with absence of contralateral ovary. Several techniques for

oophoropexy have been described in the literature. Techniques focus on fixation of the ovary to a static structure within the pelvis versus shortening of the ovarian ligament. For fixation, the ovary can be sutured through the cortex and fixed to the posterior side of the abdominal wall, the pelvic sidewall, or the posterior uterus [2, 8]. For the later procedure, the ovarian ligament can be plicated with suture to shorten it. One author described this technique: "Permanent suture [is] passed through the utero-ovarian ligament at the ovarian insertion, through the midportion of the ligament in the opposite direction, and then back through the ligament at its uterine origin [and then tied]" [9]. The utero-ovarian ligament can also be shortened by creation of a "knuckle" of ligament that is secured in place with an endoloop [8]. These techniques have been described using both absorbable and non-absorbable suture [2]. Currently, there are insufficient data to suggest superiority of a particular suture type. Overall, data on the benefit and long-term reproductive outcomes of oophoropexy are sparse and more quality studies are needed to give firm guidance on this topic.

Key Teaching Points

- There are no specific clinical, laboratory, or imaging findings that are specific for ovarian torsion and providers must maintain a high index of suspicion in female patients presenting with acute pain
- Ovarian torsion is a surgical emergency. Laparoscopic approach should be utilized whenever possible
- Prompt detorsion with or without cystectomy and ovarian preservation is standard of care in reproductive-aged women
- Dusky, blue, or otherwise devascularized appearance of the ovary should not preclude ovarian preservation. These findings do not correlate with long-term postoperative ovarian function
- Oophoropexy is controversial but can be considered in patients who have torsion of a normally sized adnexa, have congenitally long ovarian ligaments, have recurrent episodes of torsion, or have torsion and absence of the contralateral ovary

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CASE 61 A 29-Year-Old G2P0 Woman with Symptomatic Ectopic Pregnancy and History of Prior Salpingectomy

Loriana Soma

History of Present Illness

A 29-year-old, gravida 2, para 0, 0, 1, 0, presents to the emergency room with left lower quadrant pain and vaginal bleeding. Her last menstrual period was six weeks ago. Her pain was acute in onset but now is intermittent and crampy in nature. She denies dizziness, nausea, vomiting, urinary, and gastrointestinal symptoms. She has a past medical history of pelvic inflammatory disease and past surgical history of laparoscopic right salpingectomy for ectopic pregnancy. She is taking oral contraceptive pills and has no know drug allergies.

Physical Examination

General appearance: Well-developed female, tearful, sitting upright, appears uncomfortable

Vital signs:

Temperature: 36.7°C
Pulse: 80 beats/min
Blood pressure: 116/76 mmHg
Height: 65 inches
Weight: 160lb
BMI: 26.6 kg/m^2

Abdomen: Normal bowel sounds, soft, non-distended, moderate tenderness on palpation of left lower quadrant, no rebound or guarding

Pelvic: Normal external genitalia, normal vagina with small amount of dark blood in vault. Normal cervix, no active bleeding. Bimanual examination with small, mobile, anteverted uterus. No cervical motion tenderness. Tender on palpation of left adnexa. No palpable masses

Laboratory studies:

Urine pregnancy test: Positive
β-hCG: 3200 mIU/mL
Hb: 12.4 g/dL (normal 11.4–15.2 g/dL)
Hct: 37% (normal 34.9–44.3%)

Imaging: Transvaginal ultrasound shows a normal-sized uterus with no intrauterine gestational sac visualized. Within the left adnexa adjacent to the left ovary there is a thick-walled cystic structure measuring 2.38 × 1.93 × 2.82 cm containing a fetal pole compatible with an ectopic pregnancy (Figure 61.1). Crown–rump length measures 1.65 cm. No fetal heart tones

How Would You Manage This Patient?

This patient was counseled on treatment options and decided to proceed with laparoscopic salpingostomy. She desired future fertility and conservation of her remaining tube if possible. She was taken to surgery where laparoscopic salpingostomy of the left tube was achieved. She recovered from surgery without complications. Her quantitative β-hCG level was drawn weekly and followed until it was negative.

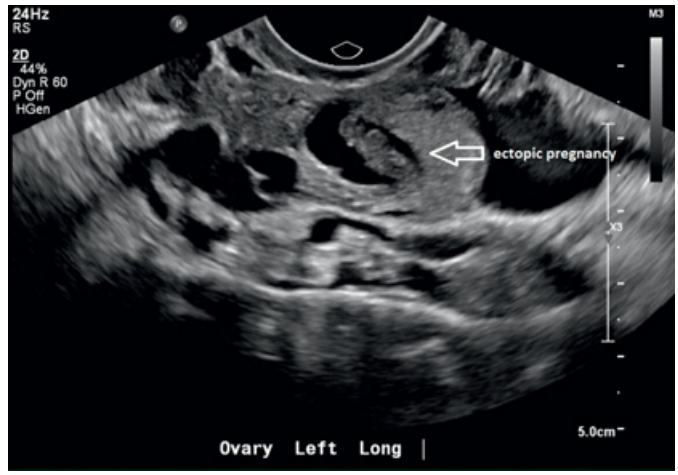

Figure 61.1 Left ectopic pregnancy in fallopian tube.

Discussion

Ectopic pregnancy is a pregnancy that implants outside of the endometrium of the uterine cavity. It occurs in about 2% of all reported pregnancies, though this number may be higher [1]. The most common location of an ectopic pregnancy is the fallopian tube. Risk factors for ectopic pregnancy include prior ectopic pregnancy, history of pelvic or tubal surgery, damage to fallopian tubes, pelvic infection, infertility, assisted reproductive technology, cigarette smoking, and age greater than 35 [1]. The diagnosis is made with transvaginal ultrasound and a pregnancy test. In many cases, serial ultrasound, and quantitative β-hCG levels over time are necessary to confirm the diagnosis. Surgical management with diagnostic laparoscopy or dilation and curettage can also be used for confirmation of the diagnosis.

Management options for ectopic pregnancy include surgery, medical treatment with methotrexate, and observation. The decision for management will depend on the patient's preference after reviewing her clinical presentation, past medical history, past surgical history, and specifics of her obstetric and gynecologic history. The patient's desire for future fertility will be particularly important if she has had damage to or previous removal of the contralateral tube, as in this case. The future intrauterine pregnancy rate is comparable when comparing surgery, medical management, and expectant management in women with a normal contralateral tube [2].

A meta-analysis of two randomized controlled trials and eight cohort studies (a total of 1229 patients) found no significant difference in subsequent intrauterine pregnancy rates after laparoscopic salpingectomy or salpingostomy (RR = 1.04, 95% CI 0.89–1.21, $p = 0.61$) [3]. An analysis of 35 randomized controlled trials found that a single dose of methotrexate is less successful at treating ectopic pregnancy, but a variable dose or fixed multi-dose regimen shows no significant difference in effectiveness when compared with laparoscopic salpingostomy. In addition, no significant difference was found in tubal preservation, tubal patency, future pregnancy, or repeat ectopic rate when comparing systemic methotrexate with laparoscopic salpingostomy [4]. Thus, if future fertility is desired and the contralateral tube is injured or absent, salpingostomy or methotrexate can be offered. Patients receiving systemic methotrexate report worse health-related quality of life compared with surgical patients. Women treated with methotrexate reported more limitations in physical, role, and social functioning; less energy; more physical symptoms and pain; more depression; and worse overall quality of life than women treated with surgery [5].

Expectant management can be offered if the patient is hemodynamically stable without concern for rupture, the quantitative β-hCG level is less than 1500 IU/L, and the patient understands the necessary surveillance. Repeat β-hCG is repeated after 48 hours and, if falling, weekly until undetectable. This method can be successful in 50–70% of women who meet the above criteria, and possibly more when the β-hCG level is low [6]. A study done at an inner-city teaching hospital evaluated 179 tubal ectopic pregnancies, 107 of them were managed expectantly. In 70%, the pregnancy resolved spontaneously. In women with β-hCG levels of 175 IU/L or less, expectant management was successful in 96% of cases. When the β-hCG level was 175–1500 IU/L, expectant management was effective only 66% of the time [7]. The patient must understand that treatment with methotrexate or surgery may be necessary if the β-hCG level does not fall appropriately.

Medical management with methotrexate can be offered if there is no evidence of rupture, the quantitative β-hCG is less than 5000, lab evaluation is normal, and the patient will be compliant with long-term surveillance. Medical contraindications include hepatic, renal, or hematologic dysfunction; immunodeficiency; alcoholism or chronic liver disease; blood dyscrasias; active pulmonary disease; peptic ulcer disease; and heterotopic pregnancy [1]. Side effects of methotrexate include nausea, vomiting, stomatitis, transient pneumonitis, bone marrow suppression, and abdominal pain. More serious side effects such as severe neutropenia and alopecia are rare [6]. Success rate is high, 90–95%, and is no different from surgical management when subsequent doses are given when clinically indicated [8].

Indications for surgical management include hemodynamic instability, inability to comply with methotrexate follow-up, suspected heterotopic pregnancy, failure of medical therapy, and desire for permanent sterilization. Laparoscopy can be used as a diagnostic tool as well as treatment when an ectopic pregnancy is suspected [9]. Surgery is preferred when there are signs of cardiac activity within the ectopic pregnancy, when the quantitative β-hCG level is greater than 5000, when there is an adnexal mass greater than 4 cm, and when free fluid is present in the pelvis [6]. Contraindications to surgery include any past medical or surgical history that would place the patient at undue risk.

Salpingectomy is preferred if the tubal pregnancy has ruptured, an ectopic has occurred after sterilization or prior salpingostomy, or if there is uncontrolled bleeding after attempted salpingostomy. In addition, salpingectomy may be preferred when the operating surgeon does not have the experience or equipment for salpingostomy [10]. The patient should be counseled that salpingostomy requires long-term follow-up of β-hCG levels and that persistent trophoblastic tissue may be present 3–20% of the time [9]. Risk factors for persistent ectopic tissue include small ectopic pregnancy (<2 cm), early surgical intervention (<42 days from last menstrual period), and β-hCG >3000 IU/L [6]. Weekly quantitative β-hCG levels are followed until undetectable. If the β-hCG level plateaus or increases, the provider and patient will need to consider re-treatment with methotrexate or surgery (salpingectomy). The patient will need to use reliable contraception until the pregnancy has completely resolved.

Surgical management should be performed laparoscopically if the patient is hemodynamically stable. For laparoscopic salpingostomy, first the mesosalpinx should be infiltrated with dilute vasopressin to help with hemostasis. Next, the distal end of the tube is held on gentle traction with blunt forceps [9]. A linear incision is made along the superior aspect of the fallopian tube that overlies the largest diameter, correlating with the location of the ectopic pregnancy (Figure 61.2). This can be performed with laser, monopolar or bipolar energy, or sharp dissection. The incision should be long enough to remove the entire ectopic pregnancy [9].

The pregnancy tissue should be removed in one piece using forceps, hydrodissection, suction, or compression lateral to the incision. It should be immediately removed from the peritoneal cavity with a laparoscopic bag, or by drawing the tissue into the port with a grasper and removing the entire port [10]. The tube is then irrigated, evaluated for bleeding, and cauterized as needed. Bipolar electrosurgical devices limit risk of damage to adjacent tissues and combine electrosurgical energy with compression to create a tissue seal. Persistent bleeding can be managed with occlusion of vessels below the implantation site in the mesosalpinx. Topical hemostatic agents can also be used on bleeding surfaces. It is not necessary to close the tubal defect with suture as this can increase adhesion formation and provides no benefit for closure or patency rate [10].

To perform a laparoscopic salpingectomy, multifunction electrosurgical instruments that grasp, coagulate, and cut are typically used. First, the distal end of the tube is grasped. Bipolar electrosurgery is then used to desiccate and divide the mesosalpinx beginning from the fimbriated end of the tube and proceeding along the tube to the cornua until the complete tube is removed. Salpingectomy can also be achieved by encircling the ectopic pregnancy with a preformed suture loop and excising the tube and mesosalpinx with scissors [10]. The specimen is then removed through the port or with a laparoscopic bag.

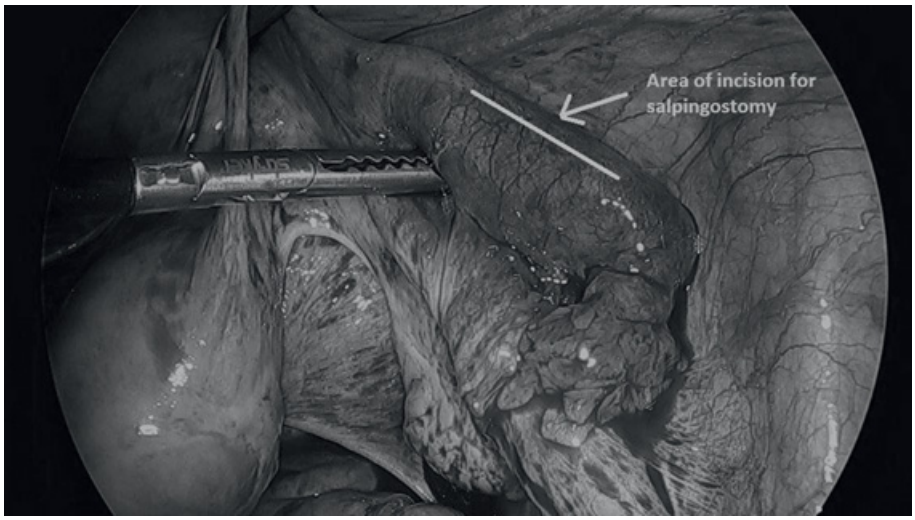

Figure 61.2 Laparoscopic view of ectopic pregnancy and location of salpingostomy.

Regardless of type of surgery performed, patients should be counseled of the increased risk of future ectopic pregnancy, which is as high as 18% for salpingostomy [6]. Patients should be aware to notify their provider early in a future pregnancy for monitoring of β-hCG levels and early ultrasound to evaluate for repeat ectopic pregnancy.

Key Teaching Points

- Surgical treatment with salpingostomy is recommended for patients who desire future fertility, especially in those who have damage or prior removal of the contralateral tube
- Both salpingostomy and methotrexate confer similar risk of repeat ectopic pregnancy, and there is no difference in the rate of tubal patency or future intrauterine pregnancy
- If salpingostomy is performed, quantitative β-hCG levels must be followed until undetectable. If a plateau or increase occurs, further treatment with methotrexate or salpingectomy is warranted

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CASE 62 A 35-Year-Old P2 Woman with Preperitoneal Insufflation at Time of Laparoscopy

Frances Burgan

History of Present Illness

A 38-year-old para 2 presents for scheduled total laparoscopic hysterectomy for heavy menstrual bleeding. She has no past medical history. Her past surgical history is significant for two low transverse cesarean sections. She is not taking any medications and she has no known drug allergies. Laparoscopic entry is started with a Veress needle inserted through a small incision in the skin of the umbilicus until two popping sounds are heard. Aspiration in the space is negative. A hanging drop test is slow but the saline flows in. The gas source is connected and the pressure at the tip of the Veress needle reads 10 mmHg. Insufflation is begun at 1 L/min and a sharp trocar is inserted once the pressure becomes 20 mmHg. Upon entry of the laparoscope, distended fat is visualized instead of intraperitoneal contents.

Physical Examination

General appearance: Well-developed, no distress

Vital signs:

Temperature: 36.6°C
Pulse: 77 beats/min
Blood pressure: 125/78 mmHg
BMI: 32.2 kg/m^2

Abdomen: Deep umbilicus, no masses appreciated, Pfannenstiel scar

Pelvic: Normal external female genitalia. Normal vagina and cervix. Twelve-week size anteverted uterus. No adnexal fullness or masses

Laboratory studies: Hb: 12.5 g/dL (normal 11.3–15.2 g/dL)

How Would You Manage This Patient?

Once preperitoneal insufflation was identified, insufflation was stopped, and the laparoscope and trocar were removed. Entry was switched to an open technique that allowed for direct visualization of the tissue planes and assured placement of a 12 mm blunt-tipped trocar into the peritoneal space. The laparoscope was inserted, intraperitoneal contents confirmed correct placement, and insufflation was restarted at higher flow. After a second lateral port was placed, the anterior abdominal wall was carefully inspected at the umbilical site of entry and a small amount of preperitoneal air was noted. Since the amount of air was small, it did not impede completion of the remainder of the case.

Discussion

More than half of all laparoscopic surgery complications are related to entry. In a study of 25 764 laparoscopic gynecologic cases, complications related to entry had an incidence of 0.3% [1]. The most dangerous of these complications include vascular and bowel injury, particularly if not immediately recognized and repaired. Complications, such as preperitoneal insufflation as mentioned in the above case, are more common with closed (Veress and direct) entry techniques. A Cochrane review from 2019 compared different entry techniques and rates of complications. When comparing open entry versus closed entry there was insufficient evidence to determine a difference in rates of vascular injury, visceral injury, or failed entry. The only significant difference was a reduction in failed entry between direct trocar and Veress needle. The authors concluded that there is insufficient evidence to support the use of one technique over another [2]. Retrospective reviews have noted that there are reduced rates of major complications with open or direct visualization techniques compared with blind entry [3, 4].

The site of initial entry should be decided based on the patient's history and risk factors. There are no society recommendations or consensus statements to guide practice. Instead, surgeons should be equipped and knowledgeable in several methods and tailor them to the appropriate case.

Many gynecologic surgeons prefer a closed or Veress needle entry technique. With this technique the skin within the umbilicus is incised to 5–12 mm. The Veress needle is grasped along the shaft (holding like a dart) and inserted into the incision. In thinner patients, the angle ought to be close to 45 degrees toward the pelvis to avoid vascular injury to the aorta, which can be as close as 2 cm below the umbilicus. In obese patients, the angle of the Veress will be closer to 90 degrees. During insertion, two clicks or pops will be felt as the tip traverses the fascia and the parietal peritoneum. There are several tests to confirm peritoneal placement of the Veress including aspiration, injection of saline, withdrawal of saline, hanging drop test, and measuring pressure at the tip of the Veress needle. If initial aspiration reveals blood or bowel contents, the Veress needle should be left in place and preparations made for general or vascular surgery to repair a presumed injury. Injection of saline should flow easily without resistance in the peritoneal cavity. Aspiration of the injected saline should not yield any fluid, as it would freely float away from the needle tip in the peritoneal cavity. However, if saline is re-aspirated after injection, this may suggest that the needle is in an enclosed space and should be repositioned. The hanging drop test involves putting a few drops of saline in the open end of the Veress needle with an open stopcock and upon elevating the anterior abdominal wall, the saline should visually flow quickly down into the shaft of the needle. If flow is slow or not at all, the needle may be in the preperitoneal space. Lastly, the pressure at the tip of the Veress needle is assessed when starting insufflation. Pressures at or less than 5 mmHg are consistent with intraperitoneal placement. Pressure greater than 12 mmHg is consistent with inappropriate placement (preperitoneal, intra-adhesion, intra-organ) [5, 6]. Once insufflated, the primary port can be placed either with

a sharp trocar or with the assistance of a polymeric sleeve that allows for a blunt trocar. Advantages of a closed technique include speed, a smaller fascial defect, and less risk of air leakage around the port.

General surgeons tend to prefer an open entry. For this technique, the skin is incised 10–12 mm vertically within the umbilicus. The fascia in the midline is grasped with two clamps (e.g. curved hemostats, small Kochers), elevated, and the area between clamps incised. The lateral aspects of the fascia are tagged with a stay suture for closure if desired. The peritoneum can be entered similar to the fascia or can be entered bluntly with a hemostat. Confirmation of peritoneal entry can be made visually, by palpation, or by allowing an S-retractor to swing freely circumferentially. A blunt-tipped Hasson port is inserted in the incision toward the pelvis. Once a laparoscope confirms correct placement, high flow insufflation can be given. Advantages of this technique include the ability to visualize all layers of the abdominal wall directly and lower rates of vascular injury [3].

The direct entry technique is another option. Here, the skin within the umbilicus is incised and the abdominal wall is elevated with towel hooks placed lateral to the umbilicus. The surgeon then holds an empty trocar with their index finger alongside the trocar, positioned a few centimeters from the tip to safeguard against uncontrolled movement into the abdomen. At a 90-degree angle, the trocar is inserted in a controlled fashion while twisting in a semicircle shape. The surgeon confirms an intraperitoneal location with the laparoscope and can begin high flow insufflation [7]. Advantages include faster access to the peritoneal cavity and fewer failed entries when compared with the Veress needle technique [2, 8]. This same technique can be used with an optical trocar, where the laparoscope along with a clear plastic port are inserted together through the incision. Advantages include visualization of the layers of the anterior abdominal wall during entry.

Each of these techniques can be used in non-umbilical sites of entry, but most surgeons will use the Veress needle or an optical trocar in sites outside of the umbilicus. The most common non-umbilical site of entry is in the left upper quadrant at Palmer's point. This site is described as 3 cm below the left costal margin in the midclavicular line [9]. A nasogastric or orogastric tube should be in place to decompress the stomach prior to starting this technique. Other non-umbilical sites include the midline abdomen and the lateral flank, although these are not commonly used by gynecologic surgeons. Surgeons should consider a non-umbilical primary port in patients with significant adhesions, umbilical hernias, a large pelvic mass, a pregnant uterus, or periumbilical mesh. Advantages include a low complication and failure rate [10].

This case describes preperitoneal insufflation. Once identified insufflation should be stopped, all instruments removed, and the patient and scenario should be reassessed. Anesthesia should be notified for assessment of crepitus or hypercapnia. A large bore needle may be used to allow the gas to escape the preperitoneum. Veress needle placement can be reattempted in the same location, the surgeon can convert to an open entry technique, as described in this case, or choose a non-umbilical site. A potential space has been created above the parietal peritoneum and the normal entry planes will be distorted. Complications of preperitoneal insufflation are minimal but include crepitus around the incision that can spread throughout the subcutaneous tissues. Should this complication produce unstable cardiopulmonary function, the laparoscopic approach should be abandoned [3, 4]. The expanded preperitoneal space may distort anatomy and make it difficult to visualize the pelvis laparoscopically. Rapid identification and stopping insufflation will help minimize or prevent these complications.

Key Teaching Points

- Preperitoneal insufflation is a common and relatively benign complication of laparoscopic entry
- Early recognition of this and other laparoscopic entry complications leads to the best patient outcomes
- No one laparoscopic entry technique is preferred over another and surgeons should be skilled in more than one
- Non-umbilical sites of entry should be used for patients with risk factors that make entry at the umbilicus unsafe

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CASE 63 A 38-Year-Old Woman Who Desires Device Removal after Hysteroscopic Sterilization

Julia F. Switzer

History of Present Illness

A 38-year-old female, gravida 2, para 2, presents with pelvic pain for several years. Pain is localized to the bilateral lower abdomen and pelvis. She describes it as dull, achy, constant, and of mild intensity. Pain occurs most days and is unrelated to menses. She has been reading on the internet that hysteroscopic sterilization devices have been removed from the market and she is concerned that her implants may be causing her symptoms. She reports fatigue but no nausea, vomiting, diarrhea, constipation, irregular bleeding, vaginal discharge, or bladder symptoms. She has no past medical history. Her surgical history is significant for Essure hysteroscopic sterilization 5 years ago. She is not taking any medication and has no known allergies.

Physical Examination

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

Vital signs:

Temperature: 36.7°C
Pulse: 72 beats/min
Blood pressure: 110/70 mmHg
BMI: 25 kg/m^2

Abdomen: Normal active bowel sounds, soft, non-distended, mildly tender on deep palpation of bilateral lower quadrants, no rebound or guarding

Pelvic: Normal external female genitalia. Vagina with physiologic discharge, normal appearing cervix with no cervical motion tenderness. No pelvic floor tenderness. Anteverted, non-tender, mobile uterus. Minimal right and left adnexal tenderness. No palpable masses

Imaging: Transvaginal ultrasound shows normal-sized uterus with endometrial thickness of 6 mm, presence of bilateral Essure devices in the proximal fallopian tubes, normal ovaries, and a small amount of physiologic free fluid in the cul-de-sac

How Would You Manage This Patient?

A careful history and systematic physical examination with attention to all possible sources of pelvic pain was performed. The patient was educated about Essure devices and the events that led to their removal from the market. Through shared decision-making, the patient and provider ultimately decided on hysterectomy for removal of Essure devices and treatment of pelvic pain. The patient was counseled that pain may persist despite surgery. Total laparoscopic hysterectomy with bilateral salpingectomy was performed. The laparoscopic approach was selected to permit visualization of the entire peritoneal cavity and ensure en bloc removal of bilateral fallopian tubes with Essure devices in situ (Figure 63.1). The patient reported improvement in her symptoms and improved quality of life at her six-week postoperative visit.

Discussion

Chronic pelvic pain, pain of greater than six months and localized to the lower abdomen and pelvis, has a long differential diagnosis and is often multifactorial [1]. Evaluation begins with careful history and physical examination. In this case the patient was concerned that her previous hysteroscopic sterilization was the cause. It is important to address the patient's concerns regarding the sterilization devices and discuss the messaging she has received from the media. Asymptomatic patients can be reassured about the safety of the devices and educated about the history and controversy around hysteroscopic sterilization procedures. In these cases, the benefits of the devices likely outweigh the risks of retention or removal and they can remain in place. When history, physical examination, and imaging suggest that the hysteroscopic devices may be playing a role in the patient's pain, surgical removal is reasonable [2].

The Essure System for Permanent Birth Control [3] was composed of a stainless steel inner coil wrapped in polyethylene terephthalate (PET) fibers surrounded by an outer expandable coil made of nickel and titanium alloy which was FDA approved in 2002. The devices were inserted into the proximal portion of the fallopian tubes under

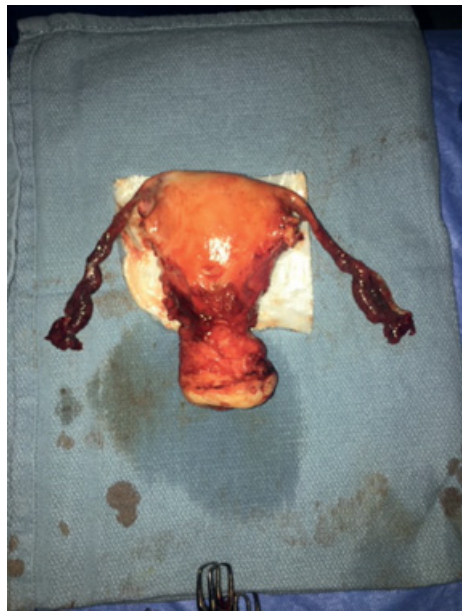

Figure 63.1 Photo of en bloc removal of uterus and bilateral fallopian tubes with Essure devices.

hysteroscopic guidance. After insertion, fibroblastic proliferation and ingrowth around the coils led to tubal occlusion. By 2016, reports of chronic pelvic pain, tubal perforation, device migration and concerns about hypersensitivities to nickel and PET led the FDA to recommend a black box warning on the devices. In 2018, Essure was voluntarily removed from the market due to a decrease in sales. Many women have presented for device removal due to new-onset symptoms or concerns about the safety of the devices. The most common complaints attributed to the Essure devices were pelvic pain, abnormal uterine bleeding, allergic reaction, and fatigue although as many as 120 unique symptoms have been reported [4]. Women may continue to present for removal due to device-attributed symptoms or may require surgery for other reasons and therefore understanding the surgical technique for removal of Essure remains relevant.

Prior to planned removal, pelvic imaging is recommended to confirm location of devices. Transvaginal ultrasound allows for evaluation for other gynecologic sources of pain such as adenomyosis, adnexal masses, or fibroids. Ultrasound may demonstrate perforation of the devices through the uterus or fallopian tubes. If implants are not seen with ultrasound, it is reasonable to consider an abdominal x-ray to identify and localize perforated or migrated devices. Hysterosalpingogram may also be used.

Many patients report symptom improvement after device removal and symptoms may continue to improve over time up to at least 24 months postoperatively. One retrospective cohort study of 90 women found major improvement in symptoms for 46.7% of women at one month and for 83.3% of women when reassessed at two years [5]. An observational case series of 95 women seeking Essure removal demonstrated a lower quality of life as measured by the SF-36 and a mental health scale compared with the general population, and an improvement in scores following Essure removal with 71% of patients showing an improvement of at least 10% in both scores [6]. Despite these promising studies, patients should be counseled that symptoms might persist even after device removal. Patients should also be clearly informed that removal of fallopian tubes and/or the uterus would result in infertility so goals for future fertility should be reviewed.

Surgical approaches to removal of Essure devices include laparoscopic device removal with salpingectomy, laparoscopic salpingectomy with cornual resection, and hysterectomy with en bloc bilateral salpingectomy. To date no method has been proven superior for treating Essure-related symptoms and therefore selection of technique should be individualized to provider skill and patient needs [7]. A procedure for removal of devices with reimplantation of the tubal remnant has been described for women seeking reversal of the procedure for fertility purposes; however, it is unclear that successful intrauterine pregnancies have occurred as a result.

The laparoscopic approach begins with an abdominopelvic survey to evaluate for other sources of pain. Once the device location has been established an incision can be made in the tubal wall on the antimesenteric surface to enter the tubal lumen. Using a fine tip forceps or scissors in each hand, the tube is dissected to uncover the Essure device. The device is held with a grasper and gentle traction is applied in a hand-over-hand technique to remove it from the lumen. Both internal and external coils should be removed. It is common for the devices to uncoil with traction. If a device breaks, hysteroscopy may be necessary to remove remaining portions of the device embedded in the tubal ostia. Following removal of the device, salpingectomy is completed [8]. The devices should be inspected following removal from the body to ensure that they were completely removed.

Salpingectomy with cornuectomy can be performed to reduce the likelihood of leaving PET fibers behind which may be a source of systemic symptoms. Wedge resection of the cornua begins with injection of a dilute solution of vasopressin into the myometrium of the cornual region of the uterus. Sharp dissection and electrocautery is used to dissect the tube to the level of the endometrium. The tubes are then removed from the body and inspected to confirm complete removal of the Essure devices. The uterine defect is then closed with delayed absorbable suture or delayed absorbable barbed suture in multiple layers [9]. Published data looking at postoperative x-rays have demonstrated a metal residue following removal in approximately 15% of women after salpingectomies and therefore patients may potentially require another surgery in the future if symptoms do not resolve. One study reported 5 of 35 women undergoing salpingectomy for Essure removal went on to have a hysterectomy to ensure complete removal [5].

Hysterectomy offers the additional advantage of treating other potential sources of pain and bleeding such as adenomyosis and fibroids. Vaginal, laparoscopic, or abdominal hysterectomy with en bloc removal of fallopian tubes is an effective method of removal of Essure devices and reduces the likelihood of leaving any Essure fragments behind. No modifications in technique are necessary if performing abdominal or laparoscopic hysterectomy as long as routine removal of fallopian tubes is performed. In these cases, salpingectomy should be performed en bloc to avoid transection of the devices and distributing PET fibers.

Vaginal hysterectomy requires modification in technique. Traditional techniques for salpingectomy require transection of the fallopian tubes at the level of the uterine attachment followed by dissection from the round and uterine ovarian ligaments prior to removal from the mesosalpinx. This technique should be modified to avoid transection of the Essure coil during the hysterectomy. One technique suggests bivalving the uterus to allow en-bloc removal of the tubes with each hemi-uterus. Following transection of broad ligaments and ligation of uterine arteries the uterus is bivalved. One hemi-uterus is gently pushed into the pelvic cavity to allow the surgeon to visualize the other hemi-uterus and adnexal structures. The fallopian tube is then isolated from the other structures and the round and utero-ovarian ligaments are clamped and cut. The tube is then dissected from the mesosalpinx. This procedure is then repeated on the contralateral side [10]. One disadvantage of the vaginal route is that it does not allow for systematic evaluation of the abdominal and pelvic cavities for other sources of pain. In addition, it is critical to review preoperative imaging to ensure that devices are located in the fallopian tubes as visualization will be limited.

Hysteroscopic removal is effective in the initial weeks after placement of Essure devices by simply grasping the coils under hysteroscopic visualization and applying gentle traction. This is not a recommended method currently because the patients presenting for Essure removal have had the devices in place for years and it should be assumed that significant fibrosis has already occurred.

Key Teaching Points

- Hysteroscopic sterilization procedures were withdrawn from the market after decreasing sales following reports of chronic pain and other symptoms
- Asymptomatic women with Essure coils in place should be counseled that their contraceptive method is safe and effective and can be left in place
- Women with pelvic pain and Essure coils in place should undergo comprehensive evaluation for sources of chronic pelvic pain and if no alternative etiology is uncovered can be offered removal of devices
- Surgical technique should be selected based on individual patient needs and surgeon skill. Care should be taken to remove the entire implant

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CASE 64 A 28-Year-Old Woman with a 6 cm Complex Mass Adherent to the Pelvic Sidewall

Megan Billow and Michael T. Breen

History of Present Illness

A 28-year-old gravida 2, para 2 presents to the office complaining of a six-month history of constant right lower quadrant pelvic pain, worsening over the past two months. She describes the pain as a constant dull ache that becomes sharp and stabbing, and rates it as an 8 out of 10. She has tried non-steroidal anti-inflammatory drugs and heat with some relief. She states intercourse and increased physical activity worsen the pain. She has regular menses with mild dysmenorrhea, and her last menstrual period was one week ago. Her past medical history is significant for chlamydia and past surgical history is significant for laparoscopic appendectomy. She has a history of cocaine and marijuana use and had intercourse with multiple male partners in exchange for drugs. She is currently safe, living with her cousin, and attending an outpatient rehabilitation program.

Physical Examination

General appearance: Well-developed, well-nourished female in mild distress

Vital signs:

Temperature: 37.1°C
Pulse: 82 beats/min
Blood pressure: 110/64 mmHg
BMI: 22 kg/m^2

Abdomen: Soft, tender to moderate palpation; no distention; no guarding or rebound tenderness. No masses noted

Pelvic: Normal external female genitalia. Vagina with physiologic discharge, mild cervical motion tenderness. Anteverted uterus without abnormalities. Left adnexa without mass or tenderness. Right adnexal fullness with a tender, non-mobile palpable mass

Laboratory studies:

WBCs: 12 100/μL
Hb: 12.4 g/dL
Platelets: 192 000/μL
Urine pregnancy test: Negative

Imaging: Pelvic ultrasound shows an anteverted, anteflexed uterus measuring 8.2 × 4.3 × 3 cm with an endometrial stripe of 11 mm. The left ovary measures 2.8 × 3.3 × 3.9 cm without abnormalities. There is a large, unilocular complex cystic structure within the right adnexa measuring 6.8 × 6.0 × 5.9 cm with homogeneous low-level internal echoes, a fluid-filled level, and smooth walls. Color Doppler imaging demonstrated vascular flow in the periphery of the cystic mass

How Would You Manage This Patient?

The patient presents with chronic pelvic pain that is worsening and a tender, palpable adnexal mass. Once pregnancy has been ruled out, the differential diagnosis of a patient with an adnexal mass includes dermoid cyst, endometrioma, hemorrhagic cyst, benign epithelial serous or mucinous cystadenoma, tubo-ovarian abscess, and malignant neoplasm. Due to the nature of the patient's pain, physical examination, and ultrasound findings, endometrioma and chronic tubo-ovarian abscess were the primary concerns.

Given the patient's worsening pain and no evidence of active infection, she underwent a diagnostic laparoscopy. Intraoperative findings revealed a right tubo-ovarian abscess adherent to the pelvic sidewall. Drainage of the purulent fluid, ovarian cystectomy, and complete excision of the tubo-ovarian abscess was performed. The patient was discharged home with a 14-day course of oral antibiotics. She was doing well at her two-week postoperative visit and the pathology confirmed a chronic tubo-ovarian abscess.

Discussion

Adnexal masses are a common reason for gynecologic evaluation in premenopausal and postmenopausal women and approximately 10% of women will undergo surgical evaluation due to an adnexal mass [1]. They can be gynecologic or non-gynecologic in origin. Benign gynecologic etiologies of pelvic mass include functional or hemorrhagic cyst, endometrioma, dermoid cyst, tubo-ovarian abscess, and serous or mucinous cystadenoma. Malignant gynecologic etiologies include epithelial carcinoma, germ cell tumor, sex-cord tumor, or metastatic cancer. Age, family history, clinical presentation, and imaging aid in diagnosis. The American College of Obstetrics and Gynecology emphasizes that while most adnexal masses are benign, the diagnostic evaluation should focus on excluding malignancy [2]. Age is the most important independent risk factor for epithelial ovarian cancer; it is rare in women less than 40 years old with an increased frequency after menopause with the median age at diagnosis of 63 [3]. The most important personal risk factor for ovarian cancer is a family history of breast or ovarian cancer. It is important to discern a familial ovarian cancer syndrome to accurately assess risk. The clinical presentation also aids in the diagnosis. The acute onset of pelvic pain may indicate a hemorrhagic cyst or ectopic pregnancy compared with chronic, worsening pain, which is more consistent with a dermoid cyst or chronic tubo-ovarian abscess. Symptoms of intermittent, worsening pain may indicate an ovarian torsion, while a history of dysmenorrhea and dyspareunia suggest an endometrioma. A pelvic examination

should evaluate for mobility, laterality, size, and location of the mass. Findings concerning for malignancy include fixed, firm, and nodular masses with associated ascites. However, these findings can also be seen in benign conditions such as endometrioma, chronic pelvic infection, and hemorrhagic corpus luteal cyst [4].

Imaging modalities further elucidate the diagnosis and risk for malignancy. Transvaginal pelvic ultrasound evaluating the morphology and color Doppler of the adnexal mass has a sensitivity of 0.86 (0.79–0.91) and specificity of 0.91 (0.8–0.97) for the diagnosis of malignancy [5]. The size and composition of the mass (cystic, solid, mixed); laterality; and presence or absence of septations, mural nodules, and papillary excrescences are useful to stratify risk. Ultrasound findings of thin, smooth walls with absence of solid and papillary components are most consistent with low risk [5]. Common ultrasound characteristics of endometriomas include a round, homogeneous cyst with low-level echoes within the ovary. Dermoid cysts typically have a hypoechoic attenuating component with multiple small homogeneous interfaces.

Other imaging modalities such as MRI and CT scan are not indicated for the initial evaluation of an adnexal mass; however, MRI may be helpful in differentiating the origin of the mass or determining the risk of malignancy [6].

Laboratory testing including a pregnancy test in reproductive-aged women, a complete blood count, and testing for gonorrhea and chlamydia may be helpful in determining the etiology of the adnexal mass. Serum markers can be used in conjunction with imaging findings to assess malignancy risk. Cancer antigen 125 (CA-125) is most useful in postmenopausal women due to a higher pretest probability and better specificity. In premenopausal women, CA-125 can be elevated in several benign conditions such as endometriosis, pelvic inflammatory disease, and pregnancy [7]. Other serum markers such as β-hCG, lactate dehydrogenase, alpha-fetoprotein, and inhibin should be considered if less common malignant tumors are suspected based on the patient's risk factors and symptoms.

Management of adnexal masses includes observation and surgery. Observation is appropriate in asymptomatic women with low-risk findings on ultrasound and/or when the diagnosis is unclear. There are no data to guide recommendations for timing of follow-up imaging [2]. When simple, even very large cysts can be expected to resolve spontaneously in most patients and observation is recommended. For cysts larger than 10 cm, concerning ultrasound findings, or persistent symptoms, surgical exploration is warranted [5].

Laparoscopy is recommended as a diagnostic and therapeutic approach to the management of a presumed benign adnexal mass in symptomatic women. Several randomized trials comparing laparoscopy and laparotomy for the treatment of benign adnexal masses determined laparoscopy is safe and feasible [8]. Fertility preservation is important in reproductive-aged women who have not completed childbearing.

After insertion of the primary trocar, pneumoperitoneum is achieved, and secondary trocars are inserted, a complete survey of the upper abdomen and pelvis is completed. A history of prior surgery, infection, and endometriosis may cause extensive pelvic adhesions and a subsequent adherent adnexal mass to the pelvic sidewall. The surgical approach is to restore normal anatomy, perform adhesiolysis and/or ureterolysis, and then proceed with an ovarian cystectomy or oophorectomy. In this case, the adnexal mass was found to be a chronic tubo-ovarian abscess adhered to the right pelvic sidewall without bowel involvement. In order to mobilize the mass away from the sidewall, the peritoneum is incised at the level of the pelvic brim, lateral and parallel to the infundibulopelvic (IP) ligament, and the retroperitoneal space is entered. The ureter is identified as it courses medial on the pelvic brim and ureterolysis is performed by retracting the peritoneum medially and using blunt dissection and cold scissors to completely release the ureter from surrounding tissue. The ovary can now be safely released from the ovarian fossa utilizing blunt dissection, monopolar electroenergy, and traction. Once the ovary is released from the ovarian fossa and posterior cul-de-sac, decision is made to proceed with ovarian cystectomy or oophorectomy. In this case, the patient had not completed childbearing and complete excision of the tubo-ovarian abscess was possible. Drainage of purulent material was performed, and the abscess wall was identified. To complete the cystectomy, an incision is made using monopolar electrocautery on the ovarian capsule near the base of the cyst. The cyst wall is separated from the ovary using blunt dissection, traction, and short bursts of energy. In this patient, after the cyst was removed, excision of remaining abscess and the ipsilateral fallopian tube was completed using bipolar electroenergy, leaving healthy ovarian tissue.

In cases where ovarian preservation is not preferred or possible, the IP ligament should be identified and isolated. Bipolar energy is then used to cauterize the IP ligament and it can be transected. Next the utero-ovarian ligament is identified and similarly cauterized and transected, along with the fallopian tube. After completion of the excision, whether oophorectomy or cystectomy, hemostasis should be achieved, and the excised tissue can be placed in a bag and removed.

Postoperatively, patients do not need specific follow-up to watch for recurrence of an adnexal mass. Recurrence risk is dependent on the type of mass that was excised but in most cases is low. For this patient, safe sex practices and screening for sexually transmitted infections are recommended to help prevent recurrence of a tubo-ovarian abscess.

Key Teaching Points

- Adnexal masses are a common reason for gynecologic evaluation in premenopausal and postmenopausal women and approximately 10% of women will undergo surgical evaluation due to an adnexal mass
- Most adnexal masses are benign, and the diagnostic evaluation should focus on excluding malignancy
- Transabdominal/transvaginal ultrasound can help stratify malignancy risk and is recommended as the first-line imaging modality
- Laparoscopy is recommended as a diagnostic and therapeutic approach to the management of a presumed benign adnexal mass in symptomatic women

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CASE 65 A 21-Year-Old Woman with an 8 cm Adnexal Mass Presumed to Be a Dermoid Tumor

Stephanie M. Lee

History of Present Illness

A 21-year-old nulligravid woman presents to the office reporting three months of dull and aching right lower quadrant pain. She rates the pain a 4 out of 10. She denies any associated nausea, vomiting, or changes in bowel or bladder function. She is sexually active with one male partner and uses condoms for contraception. She has no significant past medical or surgical history. She is not taking medications and she has no known drug allergies.

Physical Examination

General appearance: Well-developed female, sitting comfortably in no distress

Vital signs:

Temperature: 37.1°C
Pulse: 77 beats/min
Blood pressure: 114/64 mmHg
Height: 65 inches
Weight: 145 lb
BMI: 24 kg/m^2

Abdomen: Normal bowel sounds, soft, non-distended, no guarding or rebound, mild tenderness on palpation of the right lower quadrant

Pelvic: Normal external genitalia. Vagina with normal rugae and physiologic discharge. Cervix with ectropion, no bleeding or friability, no cervical motion tenderness. Uterus is small, anteverted, non-tender, mobile. Left adnexa without tenderness or mass. Right adnexa with smooth, mobile mass and tenderness

Laboratory studies:

WBCs: 8500/μL (normal 3900–11 700/μL)
Platelets: 220 000/μL (normal 172 000–440 000/μL)
Hb: 12.6 g/dL (normal 12.0–15.0 g/dL)
Hct: 38% (normal 34.8–45%)
Urine pregnancy test: Negative
Urine gonorrhea and chlamydia: Negative

Imaging: Transvaginal ultrasound reveals an anteverted, anteflexed uterus measuring 6.2 × 5.3 × 4.9 cm with an endometrial thickness of 9 mm. The left ovary measures 2.9 × 3.2 × 3.4 cm without any abnormality. The right ovary is enlarged, and abnormal appearing with a complex, cystic mass measuring 8.2 × 6.3 × 7.4 cm. The mass is composed of a heterogeneous echotexture and contains both solid and cystic components as well as a hyperechoic mural nodule. Doppler flow is present in both ovaries. No free fluid is noted in the cul-de-sac

How Would You Manage This Patient?

The differential diagnosis of a patient with an adnexal mass is broad and includes an ovarian cyst, ectopic pregnancy, tubo-ovarian abscess, or fibroid. This patient's ultrasound reveals classic characteristics of a dermoid tumor. She underwent a diagnostic laparoscopy and right ovarian cystectomy. The left ovary was thoroughly inspected and found to be normal. Gross examination of the right ovarian cyst revealed tufts of hair, copious sebum, and small pieces of bone. Pathologic evaluation of the ovarian cyst confirmed a mature cystic teratoma. The patient did well postoperatively and was discharged that evening.

Discussion

Dermoid tumors, also known as mature cystic teratomas, comprise 10–25% of all ovarian neoplasms and up to 60% of all benign ovarian neoplasms [1]. They are most common in women of reproductive age, particularly in adolescents and women under age 30 [2]. Dermoids arise from a single totipotent germ cell and can contain all three layers of tissue (ectoderm, mesoderm, and endoderm) [2]. Ectodermal tissue is most common, often containing hair, teeth, and sebaceous tissue [3, 4].

Due to their slow growth rates, dermoids are usually asymptomatic and are often incidentally found on imaging or during a routine pelvic examination [3, 5]. Larger cysts may present with dull pelvic pain or dyspareunia. Fifteen to thirty percent of dermoids, especially those larger than 5 cm, undergo torsion which can lead to an acute abdomen and subsequent loss of ovarian function [4]. Rarely dermoid cysts can undergo spontaneous rupture or slow leak which seeds the abdomen, causing a chemical peritonitis that may appear as carcinomatosis on imaging [1].

Dermoids have a pathognomonic appearance on ultrasound due to various echotextures (Figure 65.1). They commonly contain a densely echogenic tubercle with distal acoustic shadowing [6]. This nodule is often referred to as a Rokitansky protuberance or tubercle, dermoid plug, or mural nodule [1, 3, 7]. Echogenic, thin, band-like echoes or accentuated lines and dots represent hair and sebaceous contents [1, 3]. Distinct demarcation of cystic components is prominent due to fat–fluid or hair–fluid levels [1, 2].

The choice between surgical and expectant management is often driven by the patient's degree of symptomatology. Expectant management is an option in patients who are premenopausal and asymptomatic with cysts <6 cm [1, 6, 7]. If expectant management is elected, patients should be followed with a pelvic examination and transvaginal ultrasound every 6–12 months [1]. The optimal length of follow-up has not been

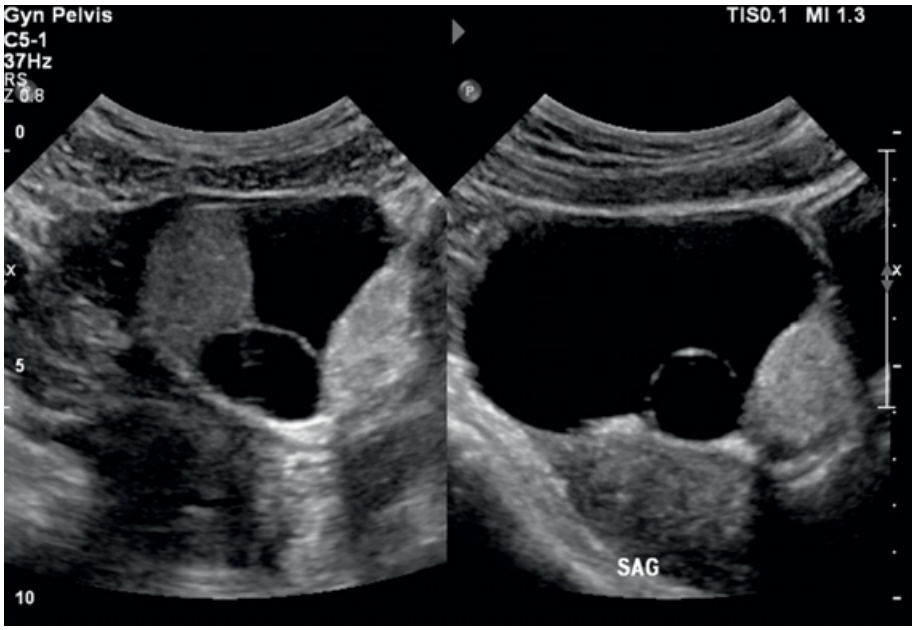

Figure 65.1 Typical ultrasound appearance of a dermoid tumor.

established and up to 26% of patients will ultimately need surgical management [6].

Dermoid cysts are slow-growing tumors with a reported growth rate of 1.8 mm/yr in premenopausal women [2, 8]. Rapid cyst growth or change in appearance on ultrasound, especially those larger than 6 cm or with multiple solid components, warrant surgical examination [7]. Incidence of malignant transformation is reported to be 0.17–2% [2]. Malignant transformation is more common in women over age 40 and in cysts greater than 10 cm [2]. Up to 85% of these transformations are to squamous cell carcinomas [8].

Additional factors in favor of surgical management include bilateral cysts, large cyst size, atypical appearance on ultrasound, and patient age [8]. Increased rates of surgical intervention in adolescents and younger women may also be driven by concern for development of torsion and its effects on future fertility [2]. In the case above, the patient was symptomatic with pelvic pain and dyspareunia and was found to have an 8 cm right ovarian dermoid, therefore the patient was not a candidate for expectant management and underwent ovarian cystectomy.

Ovarian cystectomy is the preferred surgical management technique over oophorectomy. Conservative cystectomy approaches aim to conserve fertility and remaining ovarian function. Studies show that in reproductive-age women each 1 mm^2 of ovarian surface tissue contains 35 primordial follicles, thus it is imperative to preserve as much of the viable ovarian stroma as possible [2].

A 2009 Cochrane review of trials comparing laparoscopic cystectomy with laparotomy for benign ovarian tumors supports the laparoscopic approach as the preferred method. Laparoscopic cystectomies are associated with fewer surgical injuries and postoperative complications (including fever and urinary tract infection), and lower postoperative pain [9]. Benefits of minimally invasive cystectomy also include reduced blood loss, improved cosmesis, and faster recovery [3, 5, 6]. Additionally, laparoscopy is associated with shorter hospital stay and lower total cost [9]. There has been concern for higher rates of intraoperative cyst spillage during laparoscopic cystectomy [4]. Current data show spillage rates of 15–100% in laparoscopic cystectomies compared to 4–13% in laparotomy [10]. Use of laparoscopic bag removal systems shows a significantly reduced spillage rate approaching that of laparotomy [10]. Spill of dermoid contents carries a theoretical risk of tissue irritation and future adhesion formation, as well as exposure to malignant cells with the potential to upstage a malignancy [4]. Postoperative adhesions may result in mechanical infertility [2]. Dermoid cyst spillage should be managed with copious irrigation and removal of all visible particles as the most worrisome sequelae of cyst spillage is creation of a chemical peritonitis. Chemical peritonitis is characterized by a severe inflammatory response caused by a granulomatous reaction. This inflammation can also lead to ascites, peritoneal adhesions, and need for repeated abdominal washout [4]. Current evidence reveals a 0.2% incidence of chemical peritonitis following laparoscopic removal of dermoid cysts [10]. Due to the low incidence of peritonitis should the cyst rupture occur, laparoscopic cystectomy is the preferred management of dermoid cysts.

When performing a laparoscopic cystectomy, standard laparoscopic entry, port placement, and thorough exploration of the pelvis is performed. The affected ovary is then grasped with an atraumatic grasper, either at its hilum or at the utero-ovarian ligament. Laparoscopic scissors are used to create a small incision over the cyst wall. A cleavage plane is created between the cyst wall and ovarian stroma using atraumatic dissection, taking care to avoid cyst rupture [3, 10]. The cyst incision is extended using laparoscopic scissors [3]. Using

grasping forceps at the incision margins, hydrodissection with a laparoscopic suction-irrigator device can be utilized to further advance the cleavage plane until the cyst is enucleated [3, 10].

Older management techniques include aspiration of the cyst contents using a laparoscopic suction-irrigator needle or removing the enucleated cyst through a posterior colpotomy [10]. However, current evidence strongly supports use of impermeable bag removal systems to reduce intraoperative spillage of cyst contents. With this method, the enucleated cyst is placed into the bag laparoscopically and drawn up through one of the laparoscopic trocars [10]. The laparoscopic bag edges are then everted and grasped with Kelly clamps. Cyst contents are then morcellated within the bag using Kocher clamps, Kelly clamps, or scissors, and cyst fluid is aspirated until the bag and cyst can be removed through the laparoscopic port [3].

The remaining ovarian cortex is then investigated. Electrocautery can be used sparingly to obtain hemostasis. Alternatively, large defects can be closed with laparoscopic suturing [7, 10]. If cyst spillage is encountered, copious peritoneal lavage using at least two liters of fluid should be performed and all visible cyst particles removed [7]. Lavage works both to prevent cyst contents from adhering to peritoneal surfaces as well as to perform dilution of chemical irritants [3].

Teratomas are bilateral in 10–15% of cases [3, 10]. As such, both ovaries require careful examination at the time of operation. Previous instructions to perform wedge biopsy or bivalve the non-affected ovary have been replaced with current evidence to support thorough survey of gross appearance [1]. Histologic evaluation of normal appearing contralateral ovaries leads to identification of a teratoma in only 1.1% of cases [2].

In recent years, robotic-assisted laparoscopy has been employed to perform ovarian cystectomies. Robotic assistance brings a three-dimensional perspective with active wrist movement at the console that improves dexterity and precision and may decrease the likelihood of dermoid spillage [7]. Further studies are needed to compare surgical outcomes and complications of laparoscopic versus robotic-assisted cystectomies for dermoid tumors. The laparoscopic approach is currently preferred due to its shorter operative time [6].

Recurrence rates of dermoids following laparoscopic ovarian cystectomy are seen in 4.2% of adults and 3–20% of adolescents [4]. Risk factors for recurrence include young age, cyst size >8 cm, and bilateral cysts. Given the benign nature, routine ultrasound surveillance for recurrence is not warranted [4].

Key Teaching Points

- Dermoid cysts have a pathognomonic appearance on ultrasound due to their various echotextures including fat–fluid levels and echogenic nodules
- Expectant management of a dermoid cyst is an option in an asymptomatic, premenopausal woman with a cyst <6 cm
- The preferred surgical management of dermoid cysts is ovarian cystectomy over oophorectomy in order to conserve fertility and ovarian function
- Laparoscopic cystectomy is preferred over laparotomy as it is associated with fewer postoperative complications, reduced blood loss, faster recovery, and improved cosmesis
- Intraoperative rupture of a dermoid cyst can cause a chemical peritonitis and should be managed with copious irrigation and removal of all solid components

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CASE 66 A 24-Year-Old G2P1 Woman with an Eight-Week Interstitial Ectopic Pregnancy

Frances E. Casey

History of Present Illness

A 24-year-old gravida 2, para 1001 with a last menstrual period eight weeks ago presents to the emergency department complaining of vaginal spotting and cramping pain for the past three days that is increasing in intensity. She took a pregnancy test two weeks ago that was positive. She denies any significant past medical or surgical history, is not currently taking any medications and has no known medication allergies.

Physical Examination

General appearance: Well-nourished female in moderate distress and anxious appearing

Vital signs:

Temperature: 36.7°C
Pulse: 100 beats/min
Blood pressure: 115/75 mmHg
Respiratory rate: 23 breaths/min
BMI: 23.0 kg/m^2

Chest: Clear to auscultation bilaterally, symmetric expansion

Abdomen: No distension, rebound, or mass appreciated

Pelvic: Normal external female genitalia. Physiologic discharge from vagina and cervix. No cervical motion tenderness. Anteverted uterus eight-week size. Adnexa without mass or tenderness

Laboratory studies:

WBCs: 10 500/μL with 80% neutrophils (normal 3900–11 700/μL)
Platelets: 305 000/μL (normal 172 000–440 000/μL)
Hb: 11.3 g/dL (normal 12.0–15.0 g/dL)
Hct: 32.4 % (normal 34.8–45.0%)
Creatinine: 1.2 mg/dL (normal 0.50–1.00 mg/dL)
AST: 24 U/L (normal 0–50 U/L)
Urinalysis: Trace protein
β-hCG: 35 200 mIU/mL

Imaging: Pelvic ultrasound shows an anteverted uterus measuring 10.4 × 5.4 × 5.3 cm with an endometrial echo measuring 5 mm pointing to a gestational sac with crown–rump length measuring 17 mm, positive cardiac activity noted. 1 mm myometrium noted around superolateral boundary of gestational sac. No adnexal masses. Left ovary measures 3.4 × 3.2 × 2.8 cm and right ovary measures 2.9 × 3.1 × 3.4 cm. No free fluid is noted (Figure 66.1).

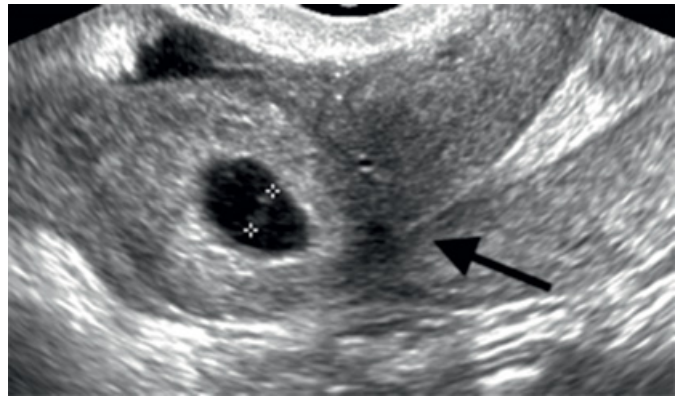

Figure 66.1 Endometrial echo appears to be "pointing" to the gestational sac on ultrasound.

How Would You Manage This Patient?

This patient presents with abdominal pain and spotting with a positive pregnancy test. The differential diagnosis includes ectopic pregnancy, viable intrauterine pregnancy, or threatened abortion. Given the lateral displacement of the gestational sac with a paucity of myometrium on sonogram, there is concern for an interstitial pregnancy (Figure 66.2). The patient was counseled about the dangerous location of the pregnancy and options for management. Due to her abdominal pain and concerns for rupture, the patient was taken to the operating room for surgical management. She underwent a laparoscopic cornual resection (Figure 66.3) and was discharged from the hospital the following day.

Discussion

An interstitial pregnancy denotes the ectopic implantation of the embryo in the interstitial portion of the fallopian tube. Interstitial pregnancies are often referred to as cornual pregnancies, although the strict definition of cornual pregnancy refers to a pregnancy in one horn of a bicornuate uterus. True cornual pregnancies have varying outcomes dependent upon the expandable ability of the horn whereas an interstitial pregnancy is not associated with pregnancy continuation.

Interstitial pregnancies account for up to 4% of ectopic pregnancies but have mortality rates as high as 2.5% [1]. The interstitial portion of the fallopian tube has a greater capacity to expand than the distal fallopian tube, leading to larger ectopic pregnancies which can cause catastrophic uterine rupture. Risk factors include a history of pelvic inflammatory disease, Müllerian anomalies, ipsilateral salpingectomy, and the use of assisted reproductive technologies [1].

Early diagnosis is possible with the use of transvaginal ultrasonography and β-hCG levels. Diagnosis based on transvaginal ultrasonography requires (1) an empty uterine cavity, (2) a gestational sac >1 cm from the endometrial echo, and (3) a paucity of myometrium (typically <5–8 mm)

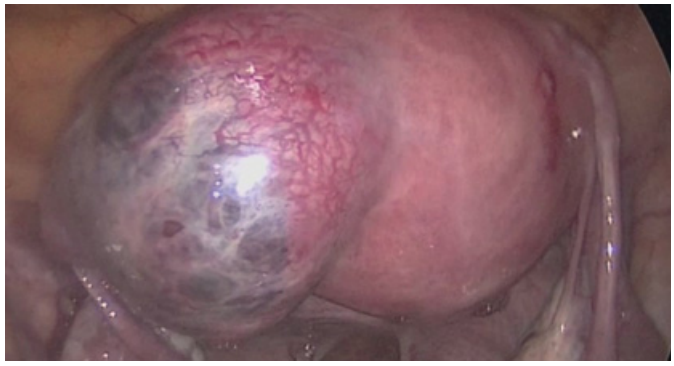

Figure 66.2 Laparoscopic view of interstitial pregnancy. (Image courtesy of Dr. Mireille Truong.)

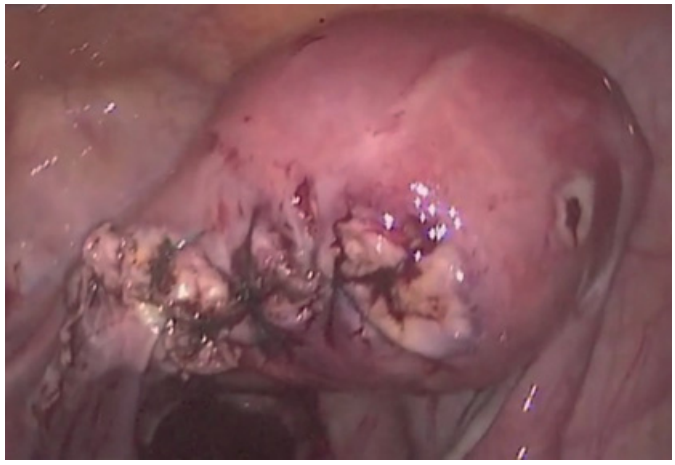

Figure 66.3 Laparoscopic view following cornual resection. (Image courtesy of Dr. Mireille Truong.)

particularly at the superolateral border of the gestational sac (as opposed to an intrauterine angular pregnancy, which is surrounded on all sides by at least 5 mm of myometrium). Often, the endometrial echo can be seen "pointing" to the gestational sac and has been referred to as the "interstitial line sign" [2]. If a clear delineation cannot be made with transvaginal sonography, magnetic resonance imaging may be employed [1].

There are several different medical and surgical options available for management of interstitial pregnancies. Expectant management has been described but requires a decline in β-hCG in an asymptomatic patient and very close follow-up given the concern for maternal morbidity and possibly death [1].

Medical management success rates are as high as 80–90% and may include (1) ultrasound-guided injection of potassium chloride (KCl) or methotrexate (MTX) into the gestational sac using ultrasonographic, laparoscopic, or hysteroscopic guidance or (2) systemic administration of single- or multi-dose MTX. Side effects of MTX include abdominal pain and gastric distress. Aspartate aminotransferase (AST) and creatinine levels must be obtained prior to initiation with medical management as hepatic or renal dysfunction is an absolute contraindication to MTX. β-hCG levels must be followed to ensure resolution as persistent elevations in β-hCG may require surgical treatment or can lead to rupture and associated catastrophic hemorrhage. Resolution to normal values can take weeks to months of follow-up [1, 3, 4].

Single-dose systemic MTX (typically 50 mg/m^2) may be successful in cases of β-hCG levels <5000 mIU/mL. Following medical treatment, β-hCG levels should be followed, evaluating on day 0 or 1, day 4 and day 7. For higher starting β-hCG levels or with the presence of an identifiable embryonic pole, a second dose of MTX on day 7 is associated with higher success rates (94% compared to 75% with single-dose protocols). Some studies have evaluated multi-dose regimens with 1 mg/kg/day MTX given on days 1, 3, 5, 7 but this type of dosing can be associated with pancytopenia, renal or liver dysfunction and thus requires folinic acid rescue [1].

Some studies have reported higher success rates (91–100%) for a single local injection directly under sonogram guidance compared with single-dose systemic administration [5]. The needle is introduced into the gestational sac directly under sonogram guidance with either aspiration followed by injection of agent or injection of agent directly into the gestational sac. If a heterotopic pregnancy is present, KCl is the preferred agent to resolve the interstitial pregnancy [5, 6].

Surgical treatment is indicated when a patient demonstrates hemodynamic instability or concern for rupture including pain or signs of hemoperitoneum on imaging. Surgical treatment may also be appropriate for recurrent interstitial pregnancies, failed medical therapy, patient preference, or when a patient is not able to continue follow-up to ensure β-hCG resolution.

Surgical methods that have been most often described include laparoscopic cornuostomy/salpingotomy (best for interstitial pregnancies <4 cm in diameter) or cornual wedge resection or excision (best for interstitial pregnancies >4 cm in diameter), and hysterectomy. Many surgeons with experience in minimally invasive techniques will choose laparoscopic management. Laparotomy is required in cases of hemodynamic instability that preclude expeditious laparoscopy.

A cornuostomy or salpingotomy involves a linear incision directly over the interstitial pregnancy. In cases where visualization of the implantation site is limited, the incision can also be made over the tube where it inserts into the fundus. This approach maintains uterine architecture and preserves fertility. Prior to incision, the surgeon injects diluted vasopressin directly into the myometrium under the pregnancy (typically 10 units diluted in 10–100 mL of normal saline solution). The surgeon then incises directly over the pregnancy, extracts the pregnancy tissue with a combination of blunt, sharp, and hydrodissection, cauterizes the base, and closes with interrupted, continuous absorbable suture or suture loops. β-hCG levels must be followed after conservative surgical treatment. Intramuscular injection of MTX at the time of cornuostomy or salpingotomy may help ensure β-hCG resolution [1, 6, 7].

Laparoscopic cornual resection also begins with injection of diluted vasopressin into the myometrium surrounding the pregnancy. The surgeon then makes a circumferential incision at the

junction of the interstitial pregnancy to the uterus. Next, the cornual region is excised using a scalpel, scissors, and bipolar or monopolar energy. The tube and mesosalpinx are then cauterized and transected adjacent to the pregnancy. Monopolar and/or bipolar energy is then used to cauterize the area of excision to achieve hemostasis. The defect should then be closed using a running barbed suture or interrupted absorbable sutures in several layers if necessary [1, 6].

When laparoscopic expertise is not available, cornual wedge resection via laparotomy may be used in which the interstitial pregnancy and surrounding myometrium are removed en bloc followed by suture repair of the myometrial defect [1].

Given the morbidity and permanent sterilization of a hysterectomy, this approach is reserved as a last resort in the setting of uncontrolled bleeding, very large interstitial pregnancies, or in the setting of significant uterine pathology in women who do not desire further fertility [1].

Rates of subsequent intrauterine pregnancy are similar for both minimally invasive surgical management and medical management. It is difficult to know the effect of surgical management regarding the tensile strength of the myometrium but subsequent pregnancy outcomes following surgical management have demonstrated low rates of uterine rupture. Nevertheless, interstitial pregnancies managed with cornual resections compared with cornuostomy are associated with an increased rate of planned cesarean deliveries prior to the onset of labor due to concern for uterine rupture. Careful observation of thinning in the area of prior cornual excision at the time of cesarean section is warranted as repair may be necessary [1].

Key Teaching Points

- Interstitial pregnancies account for up to 4% of ectopic pregnancies but have mortality rates as high as 2.5%
- Risk factors include a history of pelvic inflammatory disease, Müllerian anomalies, ipsilateral salpingectomy, and use of assisted reproductive technologies
- The most common presenting symptoms are abdominal pain and vaginal bleeding
- Medical or surgical management or a combination of both may be required for treatment. Surgical management is necessary if there is concern for uterine rupture
- Pregnancy outcomes appear to be similar for medical and minimally invasive surgical management

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CASE 67 A 16-Year-Old G0 Adolescent with Acute Psychosis and 3 cm Ovarian Dermoid Cyst

Kim Hoover

History of Present Illness

The gynecology service is consulted on a 16-year-old gravida 0 admitted to the inpatient psychiatric service to rule out physiologic concerns of acute psychosis. On day 2 of her admission, she had a witnessed grand mal seizure. EEG was performed and demonstrated slow delta waves in the frontal temporal area. An MRI showed no abnormalities and a lumbar puncture revealed lymphocytic pleocytosis and was positive for *N*-methyl-D-aspartate receptor (NMDAR) antibodies. Her last menstrual period was two weeks ago. She has never been sexually active. She has no past medical or surgical history. Her parents deny concern for alcohol, drug use or ingestion, or tobacco use. She is not taking any medications and has no known drug allergies.

Physical Examination

General appearance: Well-developed and well-nourished, lying on her hospital bed. She is alert but non-responsive to questions asked to her by nursing staff or providers

Vital signs:

Temperature: 37.9°C
Pulse: 115 beats/min
Blood pressure: 116/72 mmHg
Respiratory rate: 22 breaths/min
Oxygen saturation: 98% on room air
BMI: 25 kg/m^2

Chest: Clear to auscultation bilaterally. She has no retractions noted

Cardiovascular: Mildly tachycardic with a regular rhythm. No murmurs or arrhythmias are noted

Abdomen: Soft, non-tender, normal bowel sounds. No masses appreciated

Neurologic: Poor eye contact though her extraocular eye movements appear intact. Pupils equal and responsive to light reflex bilaterally. She is in an uncooperative state. Cranial nerves were not able to be completely evaluated. Normal reflexes

Laboratory studies:

Complete blood count:

WBCs: 9800/μL (normal 4000–11 000/μL)
Hb: 11.9 (normal 5–20 g/dL)
Hct: 35% (normal 33–45%)
Platelets: 202 000/μL
Neutrophils: 67% (normal 35–73%)
Lymphocytes: 24% (normal 15–52%)
Monocytes: 7% (normal 4–13%)
Eosinophil: 1% (normal 0–5%)
Basophils: 0% (normal 0–2%)

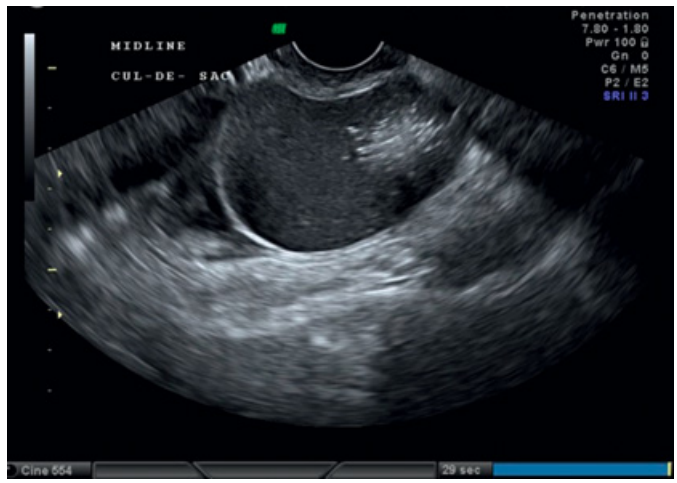

Figure 67.1 Ultrasound image of classic benign ovarian teratoma with homogeneous element and hyperechoic areas consistent with calcification. (Photo courtesy of Dr. Ashley Wright.)

Complete metabolic panel:

Sodium: 135 mmol/L (normal 133–145 mmol/L)
Potassium: 4.1 mmol/L (normal 3.1–5.1 mmol/L)
Chloride: 101 mmol/L (normal 97–108 mmol/L)
Bicarbonate: 25 mmol/L (normal 22–32 mmol/L)
Glucose: 100 mmol/L (normal 70–110 mmol/L)
BUN: 16 mg/dL (normal 5–22 mg/dL)
Creatinine: 0.7 mg/dL (normal 0.4–1.2 mg/dL)
Magnesium: 1.9 mg/dL (normal 1.7–2.5 mg/dL)
Calcium: 9.7 mg/dL (normal 8.4–10.4 mg/dL)
Urine pregnancy test: Negative
Urine drug screen: Negative
Urine culture and blood culture: Negative

Imaging: Pelvic ultrasound revealed a uterus measuring 4.1 × 3.2 × 2.8 cm and a complex cystic mass noted on left ovary measuring approximately 5 × 3 cm noted. Mass contains hyperechoic area consistent with fine calcifications and dot dash patterning consistent with an ovarian teratoma (Figure 67.1). Right adnexa not visualized

How Would You Manage This Patient?

The clinical scenario of acute altered mental status changes in a reproductive-aged woman in whom autoantibodies to the *N*-methyl-D-aspartate receptor (NMDAR) are identified is known as anti-NMDAR encephalitis. The identified ovarian mass is consistent with a dermoid cyst, or teratoma (Figures 67.2 and 67.3), and the likely source of antibodies. The patient was taken for removal of the ovarian teratoma and underwent a laparoscopic cystectomy. Postoperatively she began to show significant clinical improvement after several weeks.

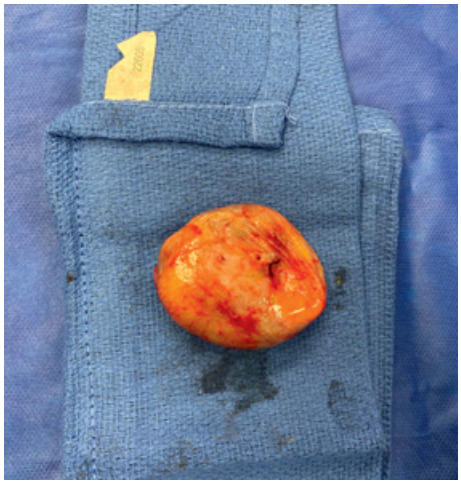

Figure 67.2 Gross specimen of smooth-walled dermoid cyst after cystectomy. (Photo courtesy of Dr. Kim Hoover.)

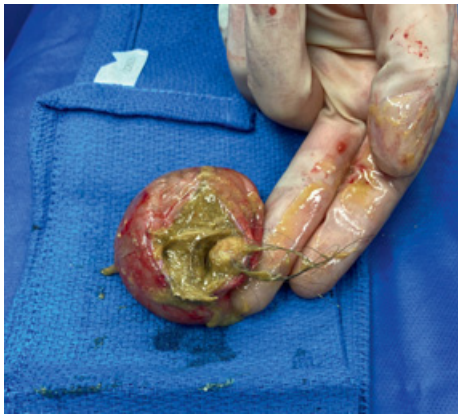

Figure 67.3 Gross specimen of internal contents of teratoma with hair, sebum, and calcifications. (Photo courtesy of Dr. Kim Hoover.)

Discussion

Diagnosis of anti-NMDAR encephalitis is often delayed and clinically presents with non-specific symptoms such as headache, fever, nausea, and vomiting. After a prodromal phase, days to weeks later, an acute psychiatric episode typically presents. This phase may present as paranoia, anxiety, agitation, mutism, and catatonia [1, 2]. Episodes such as these will be severe enough to warrant presentation to an emergency department. Once altered mental status occurs, an encephalopathic presentation may rapidly ensue. This may include epileptic seizures, speech disorder, and involuntary abnormal movements [1]. Symptoms may deteriorate to dysautonomia disorder with the patient experiencing hyperthermia, tachycardia, bradycardia, hypo/hypertension, and hypoventilation [1, 3]. If the clinical scenario worsens, these patients will require admission to an intensive care unit capable of resuscitative efforts.

Hypoventilation requiring respiratory support may occur during any portion of psychiatric disturbance requiring mechanical ventilation. During the stage of autonomic dysregulation, patients are commonly managed in an intensive care setting as decompensation can manifest rapidly while diagnostic testing is performed to rule out infectious etiology.

Once evaluation has eliminated infectious etiology for encephalopathy, focus then becomes on causes of autoimmune encephalopathy. Currently anti-NMDAR antibodies are the leading cause of non-infectious encephalitis in females [2]. These antibodies are often found in central cerebrospinal fluid on lumbar puncture and can also be present in the serum when the encephalopathic picture presents itself [1–4]. If patients have already undergone plasma exchange or IV immunoglobulin therapy, antibodies may not be detected in serum and may only be found in cerebrospinal fluid. Presence of anti-NMDAR antibodies during evaluation for encephalopathy on lumbar puncture is the gold standard for diagnosis [2, 4, 5].

Diagnostic testing with brain MRI may be unremarkable in half of patients and follow-up MRI may only show minimal changes despite the severity of the symptoms [1, 2, 4]. EEGs are abnormal in most patients showing non-specific, slow, disorganized activity [2, 5].

Up to 80% of patients with anti-NMDAR encephalitis are women and are frequently of reproductive age [2, 4]. Approximately half of females presenting with autoimmune encephalitis will have an ovarian tumor consistent with a teratoma [2, 5]. The majority will be mature teratomas, but symptoms may also be found with immature teratomas [6]. Gynecology services may be requested for surgical intervention. Ovarian tumor markers are not helpful if imaging renders findings consistent with a benign mass [1]. Removal of the ovarian teratoma in this clinical scenario can significantly improve clinical outcome [2, 7]. Management of the encephalitis focuses on immunotherapy with most patients receiving corticosteroid therapy, IV immunoglobin, or plasma exchange as first line of therapy.

Clinical improvement is seen in most of these patients when resection occurs once a teratoma is identified. There is no consensus for the optimal surgical procedure, cystectomy versus oophorectomy. The laparoscopic route has been studied and is safe in patients with anti-NMDAR encephalitis [7]. Laparoscopic cystectomy has been associated with an increased risk of dermoid cyst rupture and recurrence in patients without anti-NMDAR encephalitis. The recurrence rate of teratomas can approach 4.2% if incomplete cystectomy is performed and though rare, there is the possibility for chemical peritonitis if spillage or rupture of the cyst occurs during dissection [8]. Careful surgical technique, use of laparoscopic bags for cyst removal, and copious irrigation if cyst rupture occurs can significantly reduce these risks. There are several case reports describing varying techniques for cystectomy as severe symptoms can be seen with small teratomas sub-centimeter in size. In instances where the teratoma may be embedded within the ovary and not visualized laparoscopically, case reports utilizing intraoperative vaginal ultrasound to identify the teratoma while performing concomitant laparoscopic ovarian wedge resection have proven beneficial [1, 9]. In scenarios where a very small teratoma is identified on imaging, discussion of

oophorectomy should be conducted before surgery as cystectomy may not be plausible. Surgical decision planning should involve shared decision-making with the patient, or their medical caregiver if non-responsive, when considering oophorectomy versus cystectomy [1, 7]. There is no clinical indication for hysterectomy for teratoma.

Continued medical management with a multi subspecialty team will be necessary despite removal of an identified mass or if a mass is not identified. Bliateral oophorectomy without teratoma noted on imaging is not indicated; however, there are case reports using this technique as a desperate measure [9]. If there is no mass noted, second-line medical therapy with rituximab or cyclophosphamide can be initiated.

Approximately 75% of these patients with anti-NMDAR antibodies will recover and have mild sequelae [1]. Neurologic improvement is a slow, multistage process occurring in reverse order of the initial symptoms [1, 2, 5, 7]. Initially, patients will usually awaken from their comatose state and then experience autonomic dysfunction as respiration recovers spontaneously on its own. Following autonomic dysfunction recovery, patients then may become agitated and psychotic, requiring close observation until they can respond to verbal commands. The total time for recovery may take three to four months.

There have been case reports of anti-NMDAR encephalitis during pregnancy with ovarian teratomas noted at that time. During pregnancy, patients can be safely treated with methylprednisolone, IV immunoglobulin, or plasma exchange and immediate removal of ovarian mass if identified in second trimester or at the time of delivery if identified later in pregnancy [2, 6].

Key Teaching Points

- Anti-NMDAR antibodies are the leading cause of non-infectious encephalitis in females, most of whom are of reproductive age
- When a patient presents with symptoms consistent with non-infectious autoimmune encephalitis, screening for an ovarian teratoma should be high on differential
- Gynecology services may be requested for surgical intervention if an ovarian mass is identified during the evaluation
- Cystectomy and oophorectomy are equivalent options for treatment and consideration of future fertility should be addressed thoroughly prior to surgical intervention

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CASE 68

A 23-Year-Old Woman with Cyclic Pelvic Pain and Suspected Obstructed Rudimentary Uterine Horn

Tara A. Nielsen

History of Present Illness

A 23-year-old nulligravid woman presents to your office with worsening cyclic pelvic pain for the past four years. The pain occurs a few days prior to the onset of menses and continues for five to seven days after menses commences. She describes the pain as constant, cramping, worse on the right and unrelenting. She has associated nausea and low back pain. Occasionally she can get partial relief with non-steroidal anti-inflammatory drugs, but these have become less effective over time. She is sexually active but has most recently been unable to tolerate intercourse due to deep pain. She has never used any form of hormonal contraception. She has no past medical or surgical history. She takes ibuprofen as needed and is allergic to penicillin (rash).

Physical Examination

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

Vital signs:

Temperature: 36.7°C
Pulse: 86 beats/min
Blood pressure: 110/76 mmHg
BMI: 23 kg/m^2
Last menstrual period: 10 days ago

Chest: Clear to auscultation bilaterally

Cardiovascular: Regular rate and rhythm

Abdomen: Soft, non-distended, mildly tender in right lower quadrant with deep palpation, no rebound or guarding, normal bowel sounds

Pelvic: Normal appearing external genitalia without lesions, vagina well estrogenized, cervix small, uterus midline deviated to the left, mobile tender mass in the right adnexa

Laboratory studies:

Urine pregnancy test: Negative
PCR *Chlamydia trachomatis*/*Neisseria gonorrhea*: Negative

Imaging:

Pelvic ultrasound: A 5.5 × 4 × 4.5 cm uterus, endometrial stripe 8 mm, left ovary 3.1 × 2.0 × 1.5 cm with 1.2 cm dominant follicle, right ovary 2.7 × 3.1 × 1.5 cm. Adjacent to the right ovary there is a 4.5 × 5.0 × 3.4 cm mass with central heterogeneous echogenicity consistent with blood products

Pelvic MRI: A left unicornuate uterus with a distended rudimentary horn on the right measuring 5.2 × 4.1 × 4.2 cm with adjacent hydrosalpinx, T1 bright and T2 intermediate fluid consistent with blood products. Ovaries normal appearance. Right renal agenesis

How Would You Manage This Patient?

This patient was started on continuous combination oral contraceptive pills for menstrual suppression. She was taken to the operating room for diagnostic laparoscopy and resection of a suspected rudimentary horn. A distended right-sided non-communicating separate rudimentary horn was identified and resected laparoscopically using bipolar cautery. An ipsilateral salpingectomy was completed, the normal appearing right ovary remained in situ. She did well postoperatively and was discharged home the same day.

Discussion

Uterine anomalies have been reported in 7% of females [1], with 20% of these being unicornuate or class II Müllerian duct anomalies as classified by the widely accepted classification from the American Fertility Society [2, 3, 4]. The fallopian tubes, uterus, cervix, and upper two-thirds of the vagina arise from the Müllerian (paramesonephric) ducts. Class II Müllerian duct anomalies result from arrested development of one of the two Müllerian ducts during the three stages of development: organogenesis, fusion, or septal reabsorption. Approximately 65–74% of class II Müllerian duct anomalies are associated with a rudimentary uterine horn [2, 5]. These are often diagnosed after puberty in patients presenting with severe dysmenorrhea or during an evaluation for infertility. Rudimentary uterine horns can be further categorized as non-cavitary or cavitary with functional endometrium, communicating or non-communicating, separate or non-separate from the unicornuate uterus (Figure 68.1). Approximately 66–92% have been reported as non-communicating, separate from the primary unicornuate horn. Functional endometrium has been observed to be present in up to 50% of rudimentary horns [2, 3, 5]. It is proposed that non-cavitary horns may be underdiagnosed due to the absence of symptoms.

The differential diagnosis for a sexually active nulliparous female with dysmenorrhea includes primary dysmenorrhea, endometriosis, adnexal mass, fibroids, ectopic pregnancy, pelvic inflammatory disease, and less commonly an obstructed uterine anomaly.

A careful history and physical examination, which can often take place in the outpatient setting, can determine the most appropriate next steps. It is important to first rule out pregnancy and pelvic inflammatory disease. The most appropriate next step is to obtain imaging with pelvic ultrasound to evaluate for structural causes including adnexal masses,

women with obstructive Müllerian duct anomalies have been shown to have a higher incidence of endometriosis and are frequently found to have a higher stage at time of diagnosis. Surgical correction has been shown, in some cases, to improve dysmenorrhea and fertility outcomes, but has been inconsistent across studies [6, 7].

While this is a very rare entity, with few centers having more than a handful of cases annually, the majority of these cases can be successfully completed with a minimally invasive approach and optimal surgical planning under the care of an experienced laparoscopist. It is important to remember that due to wide variations and rarity of class II Müllerian duct anomalies, there is not a standardized approach to surgical management. Each surgical case must be individualized to meet the needs of that individual patient's anatomic variation.

Diagnostic survey of the pelvic anatomy is paramount to orient to altered anatomy and, if indicated, excise endometriosis implants. It is good practice to identify the ipsilateral ureter at the pelvic brim and trace it inferiorly as it crosses the bifurcation of the common iliac artery and passes under the uterine artery. When preoperative imaging suggests renal agenesis or renal anomalies, it may be helpful to start with diagnostic cystoscopy to rule out or identify duplicate, ectopic, or aberrant ureters to prevent unintended urologic injury.

Resection of a non-communicating separate rudimentary horn can be completed using bipolar cautery to maintain hemostasis and develop surgical planes in a retrograde fashion. The blood supply is primarily found within the broad and utero-ovarian ligaments. The blood supply in a non-separate horn can be identified within or below the connection with the unicornuate uterus as well as within the utero-ovarian ligament.

When resecting a non-separate rudimentary horn, some surgeons have found myometrial injection of a dilute vasopressin solution to be beneficial. Non-separate rudimentary horns involving more than a thin fibrous band may require concomitant hysteroscopy for transillumination of the unicornuate uterine cavity and myometrial connection to minimize damage to the contralateral horn. Laparoscopic closure and reconstruction of the remaining myometrial defect may be accomplished with laparoscopically placed delayed absorbable sutures. Many surgeons will opt to place an adhesion barrier over the defect. Successful removal of the horn from the peritoneal cavity can be achieved by extending one of the laparoscopic ports. Larger specimens can be morcellated within a bag and successfully removed through a laparoscopic port. Hysteroscopic septum resection and hematometra evacuation of a non-communicating, non-separate horn has been reported in the literature [5].

It is recommended that an ipsilateral salpingectomy be performed at time of surgery for risk reduction as well as to avoid an ectopic pregnancy from transperitoneal fertilization [8]. The ipsilateral ovary, if normal appearing, can be left in situ. If surgical resection of a non-separate horn involves the myometrium of the unicornuate uterus, cesarean delivery is recommended for all future live births.

Key Teaching Points

- Cavitary rudimentary uterine horns should be surgically excised to prevent a rare but often fatal rudimentary uterine horn pregnancy
- Rudimentary horn characterization can be accomplished with the use of three-dimensional ultrasonography or MRI
- Preoperative evaluation of the kidneys and ureters is recommended given the large percentage of concomitant renal anomalies in patients with Müllerian anomalies
- Given the association with significant endometriosis and disruption of normal anatomy, rudimentary uterine horn excision is best completed by an experienced laparoscopist and should include an ipsilateral salpingectomy

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CASE 69 A 31-Year-Old Woman with Cesarean Scar Pregnancy

Diane A. Christopher

History of Present Illness

A 31-year-old gravida 3, para 1011 at 7 weeks' gestation presents with vaginal spotting. She complains of no pain but reports mild uterine cramping. Her obstetric history is notable for a term cesarean delivery two years ago for non-reassuring fetal heart tones. Her first pregnancy was a fallopian tube ectopic pregnancy treated with methotrexate and complicated by a gastrointestinal hemorrhage. On review of systems, she reports nausea, vomiting, and fatigue. Her past medical history is significant for gastric ulcers and her past surgical history is significant for tonsillectomy. She is currently taking a proton pump inhibitor and prenatal vitamins. She has no known allergies.

Physical Examination

General appearance: No acute distress, well-appearing

Vital signs:

Temperature: 36.5°C
Pulse: 68 beats/min
Blood pressure: 110/70 mmHg
BMI: 27.7 kg/m^2

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

Pelvic: Normal external female genitalia, normal urethra and bladder, cervix is closed with no blood in the vault. Bimanual examination is non-tender with no palpable adnexal masses

Laboratory studies:

WBCs: 8000/μL (normal 4000–11 200/μL)
Hb: 13.5 g/L (normal 12.1–16.3 g/L)
Platelets: 345 000 (normal 150 000–400 000/μL)
β-hCG: 67 000 mIU/mL
Blood type: A positive, antibody screen negative

Imaging: Transvaginal ultrasound shows the uterus is anteverted with a gestational sac measuring 1.1 × 0.5 cm present at the level of the cesarean scar (Figure 69.1). No fetal pole is visualized. The cervical canal is normal, and the uterine fundus is empty. Right ovary shows corpus luteum cyst and measures 3.5 × 4.5 × 2.1 cm. Left ovary measures 1.5 × 2 × 2.5 cm.

How Would You Manage This Patient?

The differential diagnosis includes a normal intrauterine pregnancy, cervical ectopic pregnancy, and an ongoing spontaneous abortion. The ultrasound features demonstrate a gestational sac implanted at the cesarean scar, thinning of the myometrium at the same level of the gestational sac, and increased vascularity along the uterine scar that appears to be growing towards the cervicoisthmus space. These findings confirm the diagnosis of type 1, endogenic cesarean scar pregnancy. Her history of peptic ulcers and gastrointestinal

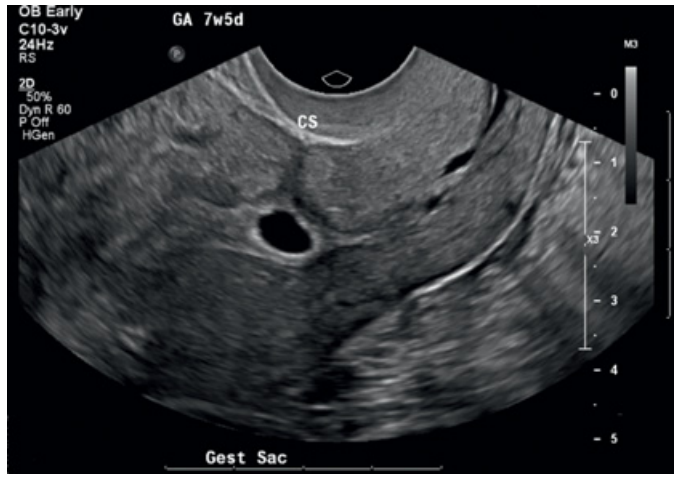

Figure 69.1 Ultrasound showing gestational sac implanted at the level of the cesarean scar and thinning of the myometrial tissue. (Image courtesy of University of Colorado School of Medicine Department of Radiology.)

hemorrhage exclude her from being a candidate for methotrexate. She underwent a hysteroscopic guided suction curettage. During hysteroscopy, the location of the pregnancy was confirmed, suction curettage was used to remove the pregnancy and visually aided electrosurgery and resection devices were used to excise the remainder of the pregnancy tissue. Following the procedure, the patient experienced ongoing bleeding from the implantation site. An intrauterine Foley balloon was placed for the purposes of tamponade. The patient was observed inpatient for 24 hours at which time the balloon was deflated, and no further bleeding was noted. The patient was discharged to home in stable condition.

Discussion

Cesarean scar pregnancies (CSPs) have increased substantially since the condition was first reported in 1978. Both a rising rate of cesarean deliveries and improvements in ultrasound technology explain the increase in reporting of CSP. While the true rate of CSP is unknown, it is estimated to be 1 in 1800 to 2216 pregnancies or 0.15% [1]. Recurrence risk of CSP has been reported between 4% and 40% and patients should be counseled on the high probability of recurrence. Evidence is not available to determine which treatment method produces the highest chance of a subsequent normal pregnancy.

The diagnosis is established by a positive pregnancy test and a transvaginal ultrasound (TVUS) demonstrating these key features: (1) gestational sac implanted at the site of uterine scar; (2) thinning myometrial tissue between the gestational sac and the bladder; (3) absence of gestational sac in the endometrial cavity and the cervical canal; and (4) increased

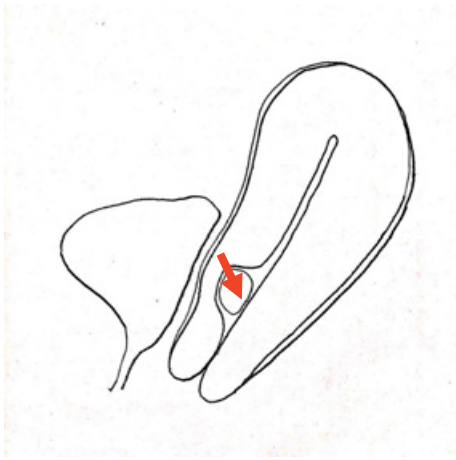

Figure 69.2 Cesarean scar pregnancy type 1: endogenic. Gestational sac grows inward toward the cervical isthmus space.

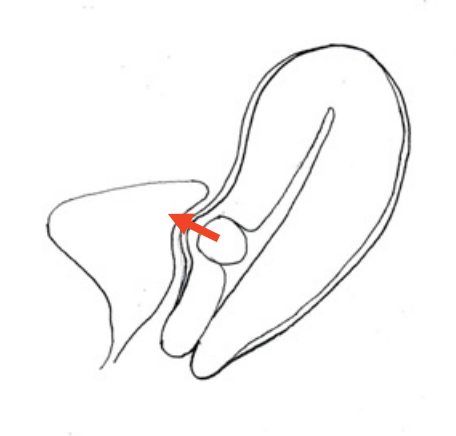

Figure 69.3 Cesarean scar pregnancy type 2: exogenic. Gestational sac grows outward towards the bladder.

vascularity at the site of the uterine scar [2]. Furthermore, CSP has two types: type 1, endogenic – growing inwards towards the cervicoisthmus space, and type 2, exogenic – growing outwards towards the bladder (Figures 69.2 and 69.3). Type 1 is more likely to result in an abnormally adherent placenta, while type 2 is more likely to result in uterine rupture [3].

TVUS is the preferred method to diagnose CSP. While most CSPs can be diagnosed with TVUS using color Doppler and grayscale, magnetic resonance imaging (MRI) can be helpful when the diagnosis is unclear. In cases of uncertainty, it is recommended to proceed with MRI rather than serial TVUS to confirm the diagnosis [1].

No consensus exists on the optimal treatment method and rarely is one intervention sufficient to resolve the pregnancy. Expectant management can lead to significant morbidity and mortality including uterine rupture, hemorrhagic shock, disseminated intravascular coagulation, hysterectomy, and death. One meta-analysis evaluated 69 patients where CSP was managed expectantly. Fifty-two women had a pregnancy with positive cardiac activity. Of this group, 12 pregnancies ended in the first or second trimester and 40 patients progressed to the third trimester. Of the third-trimester pregnancies, 75% were diagnosed with an abnormally invasive placenta, 57.5% required a hysterectomy, and 58.6% were diagnosed with placenta percreta. Of the first- and second-trimester pregnancies, 20% experienced a miscarriage with complications requiring medical or surgical intervention, 9.9% experienced uterine rupture, and 15.2% required a hysterectomy [4]. Expectant management with cardiac activity requires extensive patient counseling, serial imaging, and preparation for an abnormally invasive placenta at time of delivery. The physician, patient, and their facility should be prepared for a cesarean hysterectomy and massive transfusion.

Methotrexate is the primary medication used to treat a CSP. Methods of administration include local injection of the gestational sac or systemic administration. A systematic review showed that systemic methotrexate as a sole treatment was successful in 75% of 339 cases, while local administration of methotrexate had a success rate of 64.9% in 74 cases. Studies which evaluated local and systemic administration simultaneously had a success rate of 76.5% (34 cases). Needle aspiration of the gestational sac followed by injection of methotrexate or potassium chloride showed efficacy at 84.5% when evaluating 148 cases [5]. Studies did not exclude patients with positive fetal cardiac activity, or a β-hCG greater than 5000 mIU/mL. Use of methotrexate requires a hemodynamically stable patient who is capable of repeat office visits, without contraindications to methotrexate, and an understanding that a single treatment might not be curative.

Surgical approaches to remove CSP include dilation and curettage, hysteroscopy, laparoscopy, a transvaginal approach, and laparotomy. Adjunct procedures combined with surgery include high intensity focused ablation (HIFA), uterine artery embolization (UAE), and insertion of a cervical Foley balloon.

Dilation and curettage with or without ultrasound guidance has a 48% success rate as a single treatment, but is associated with a high chance of excessive bleeding, and incomplete removal of the gestational sac. Therefore, it is not a first-line recommended treatment for CSP [1]. Adding hysteroscopy to suction curettage has been used with greater success (83.3%) possibly due to direct visualization of the gestational sac, and opportunity for focused application of suction. When performing hysteroscopy, first the location of gestational tissue should be confirmed through the hysteroscope. If abundant blood supply is noted, the vessels can be electrocoagulated by means of bipolar hysteroscopic rolling ball before starting suction curettage. Once curettage is completed, the hysteroscope is once again inserted to check for residual gestational tissue, which can then be removed under direct visualization if necessary. The hysteroscopic rolling ball is then used for hemostasis. In a single-center study, all type 1 (endogenic) CSPs were treated in this way and achieved a 96% success rate which suggests proper case selection improves outcomes [6]. As in this case, hysteroscopy can also be followed by placement of an intrauterine Foley balloon to achieve hemostasis.

Laparoscopic excision of a cesarean scar ectopic has been reported in 7 studies totaling 69 patients with a success rate of 97.1% [2]. After achieving intraperitoneal insufflation, the vesicouterine peritoneum and bladder are dissected from the uterus. The myometrium is then incised using electrocautery along the defect, and the gestational sac is removed using graspers and suction. The pregnancy can be placed into a laparoscopic bag and removed through one of the port sites, or if small enough, removed directly. Bipolar cautery can be used to achieve hemostasis and then the defect is closed using an absorbable suture.

The transvaginal approach also has a high success rate at 99.2% in 6 studies totaling 118 cases [2]. To remove the pregnancy vaginally, the surgeon starts by creating an anterior colpotomy. Then, the bladder is dissected from the uterus, and the myometrium is incised vaginally to excise the gestational sac. The myometrium is repaired vaginally, and the vaginal mucosa is closed. While the grouped data did not detail which type of CSPs were included, in a one-site study, only type 2 (ectogenic) cases were included and the success rate was 100% for vaginal surgery and 89.5% for laparoscopic surgery [6]. To achieve this success, patients must be hemodynamically stable, and surgeons should be comfortable with advanced vaginal and laparoscopic skills. Laparotomy is another surgical method which is fertility sparing and highly effective. It should be used in patients who are hemodynamically unstable or when other therapies are not possible [6].

Adjunct therapies such as HIFA and UAE have also been used to treat CSP. In HIFA, ultrasonic energy is applied to the gestational sac which results in tissue necrosis and in one small case series a success rate of 100% was noted [2]. For UAE, the uterine arteries are catheterized and filled with gelatin sponge particles to temporarily occlude blood flow to the uterus. UAE is then followed by evacuation of the uterus with or without hysteroscopy and has published success rates of 93.5% and 95.4%, respectively [2]. Alternatively, after catheterizing the uterine arteries methotrexate is injected, the arteries are embolized, and a suction curettage is performed 24 hours later. In a review of 14 studies involving 427 cases, this method had a success rate of 68.6% [2]. These procedures can be considered in the stable patient where interventional radiology is available.

Small case series have shown success with placement of a double-balloon cervical ripening catheter inside the uterus. After placing the catheter inside the uterus, the upper balloon is inflated with a maximum of 30 mL of saline and the lower balloon is positioned at the level of internal os and inflated with 20 mL of saline. The system is left in place for 72 hours before removal, and patients are then monitored with serial β-hCG levels and ultrasound until resolution. A combined case series showed a 97.7% success rate when evaluating 2 studies with a total of 48 cases [1].

While there are many different options, early identification and treatment is associated with a higher rate of success and less need for multiple interventions [7]. For this reason, it has been recommended that patients with history of cesarean delivery undergo an early TVUS in their subsequent pregnancies [8].

Key Teaching Points

- Expectant management is not recommended for CSP due to the potential for significant maternal morbidity and mortality
- Multiple treatments are typically necessary to resolve a CSP and there is no single best treatment
- Early TVUS in women who have history of cesarean section should be considered

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CASE 70 A 35-Year-Old Woman with Bleeding from a Right Lower Abdominal Trocar Site

Shivika Trivedi Kapadia

History of Present Illness

A 35-year-old multiparous woman is taken to the operating room after appropriate counseling and consent for surgical sterilization via bilateral salpingectomy. Her medical history is significant for class II obesity. Her past surgical history is significant for two cesarean sections. She is not taking any medications and has no allergies. A 5 mm trocar was placed using direct entry via an optical trocar in the umbilicus. Two additional laparoscopic trocars were placed in bilateral lower quadrants under direct visualization. Standard abdominal survey was performed and within normal limits. The left tube was resected and removed through the trocar. Attention was turned to the right tube and approximately 250 mL of blood was noted in the right lower quadrant. Suction irrigation was used to remove the blood from the right lower quadrant. There was no further bleeding. The right salpingectomy was completed, and the specimen removed. Intra-abdominal pressure was decreased and an abdominal survey was repeated. All surgical sites were noted to be hemostatic; however, when the right trocar was removed, bleeding from the right trocar site was identified.

Preoperative Physical Examination

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

Vital signs:

Temperature: 36.4°C
Pulse: 90 beats/min
Blood pressure: 125/73 mmHg
BMI: 38 kg/m^2

Abdomen: Obese abdomen with low transverse surgical scar

Laboratory studies:

Hb: 10.4 g/dL (normal 11.6–15 g/dL)
Hct: 31% (normal 35.5–44.9%)

How Would You Manage This Patient?

The anesthesia and operating room staff were informed of the suspected inferior epigastric artery injury. Pneumoperitoneum was re-established and a 14Fr Foley catheter was passed through the right trocar site. The balloon was inflated with 30 mL of normal saline and tension applied to pull the balloon taut against the anterior abdominal wall. Hemostasis was achieved. Tension was maintained for 5 minutes at which time half of the fluid was removed from the balloon. Hemostasis continued. The Foley catheter was completely deflated and removed with continued hemostasis. The intra-abdominal pressure was decreased to less than 10 mmHg. After 2–5 minutes, pneumoperitoneum was reestablished and hemostasis was confirmed. All instruments and the remaining trocar were removed, and the abdomen was desufflated. The port sites were closed with subcuticular sutures and the patient was admitted for overnight observation with serial abdominal examinations and hemoglobin/hematocrit checks. The patient had an unchanged abdominal examination and stable labs overnight and was discharged to home the following day.

Discussion

Injury to the inferior epigastric artery (IEA) occurs in 0.2–2% of laparoscopic cases [1, 2] Bleeding from the right trocar site can be due to injury to superficial perforating vessels, to the rectus muscle, or to inferior epigastric vessels. Injury to superficial vessels and the rectus muscle generally resolves with the tamponade created by the intraperitoneal insufflation and the trocar itself. Injury to the IEA may be immediately detected intraoperatively at time of abdominal entry, may be detected once insufflation is decreased and the tamponade effect diminishes as demonstrated in this case, or may be detected in the postoperative setting.

Understanding the anatomic course of the IEA is imperative to avoid injury and essential prior to any laparoscopic surgery. The IEA originates from the external iliac artery, just above the inguinal ligament. The IEA courses superiorly and medially toward the umbilicus. It lies medial to the round ligament passing into the deep inguinal ring and lateral to the obliterated umbilical (medial) ligaments. The IEA pierces the transversalis fascia, passes in front of the arcuate line, and then ascends behind the rectus muscle (Figure 70.1) [3].

The patient should be supine to allow for anatomic evaluation to guide placement of all trocars, then placed in Trendelenburg if desired. Trocars must be placed perpendicular to the abdominal wall with care taken to not change direction until the peritoneum has been tented or even pierced. Intraperitoneal visualization of the IEA is the most reliable way to avoid injury, although this becomes increasingly difficult with increasing body weight [4]. Transillumination is not helpful in visualizing the IEA, although it can be used to avoid injury to superficial vessels including the superficial epigastric vessels [4, 5]. If the IEA is unable to be identified intraperitoneally, cadaveric and imaging studies deduced that an entry point 5 cm superior to the pubic symphysis and 8 cm lateral to the midline will avoid injury to the IEA [2, 4]. When the anterior superior iliac spine (ASIS) is used as the surface landmark, entry should be above this level and at least 6 cm from the midline (Figure 70.2) [6]. If surface anatomy is not reliable due to obesity and/or previous abdominal surgery, use of a safe zone known as the "yellow island" avoided injury in over 3400 laparoscopic procedures [7]. The "yellow island" is a macroscopic intraperitoneal collection of adipose tissue

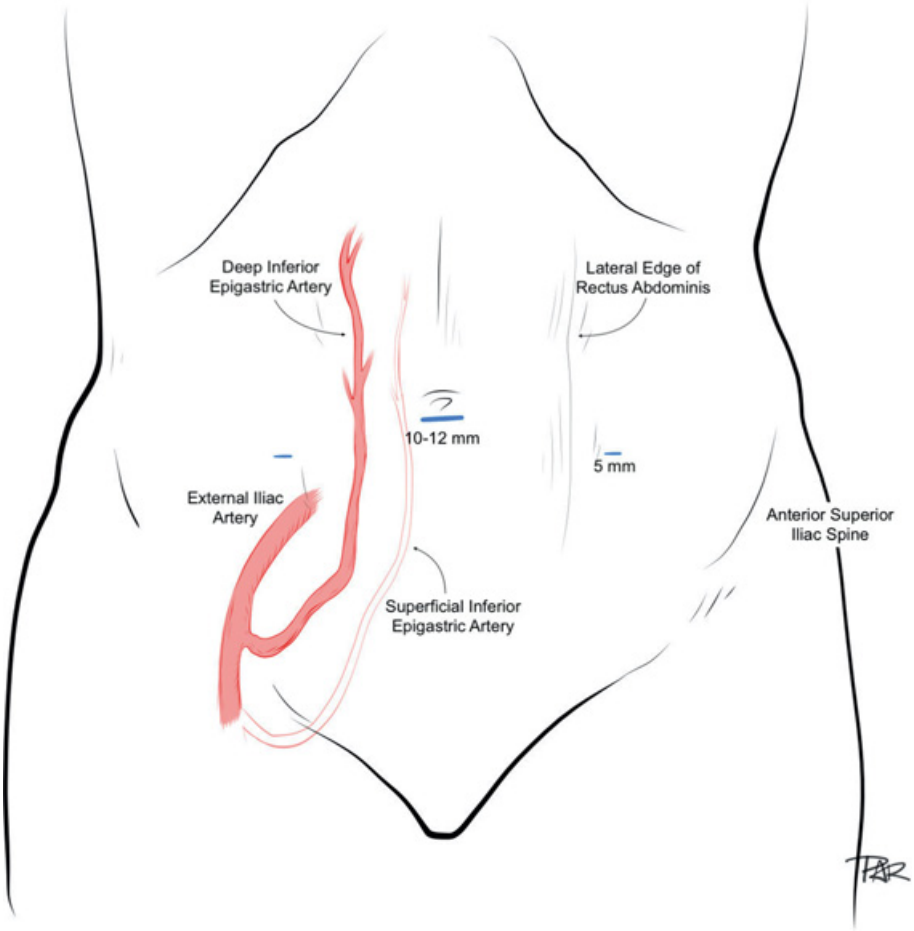

Figure 70.1 External view of the anterior abdominal landmarks and corresponding vascular anatomy. (Illustration by Dr. Priya Rajdev MD, University of Arizona College of Medicine, Phoenix, AZ.)

that is at the lateral third of a line between the ASIS and the umbilicus, and is especially evident in obese patients [7, 8].

Management of such injuries varies depending on the extent of the injury and the timing of detection. As soon as an injury is detected, the surgeon should alert the anesthesia and operating room team to coordinate resuscitation and appropriate response in this time-sensitive situation. Immediately detected injuries can be managed with direct bipolar cautery devices inserted into the contralateral port. Cautery should be performed above and below the level of injury [1]. However, in the case of complete vessel transection, the vessel may retract on either side making this technique more difficult with excess cautery causing necrosis to the abdominal wall.

An easier and safer technique is to perform immediate tamponade with a Foley catheter. A 5 mm port site should be able to accommodate a 14Fr Foley catheter that can be inserted into the port site and the balloon inflated with 15–30 mL of normal saline. The balloon can then be pulled against the abdominal wall and a hemostatic clamp used to secure the balloon externally at the level of the skin (Figure 70.3) [1]. The balloon can be left inflated for several minutes and then released and the site can be examined for hemostasis without abdominal insufflation. If there is persistent bleeding, the catheter can be left in place for 24 hours and removed in a delayed fashion. However, this presents the risk of delayed hematoma formation, skin necrosis, and possible inability to deflate the Foley balloon due to damage to the fluid port by the clamp [9].

Definitive management of persistent bleeding is best achieved with suture ligation. In the intracorporeal approach, these sutures are placed intramurally above and below the level of injury to encircle and ligate the vessels. This technique requires dexterity with complex laparoscopic suturing; tools such as a laparoscopic suture passer or port closure device can be used to assist the operator. Transmural permanent sutures can be passed through the skin and abdominal wall then tied externally; however, these must be removed in approximately 24 hours to prevent the risk of abdominal wall necrosis [10].

If the surgeon is uncomfortable with advanced laparoscopic suturing in the event of persistent bleeding with hemodynamic instability and unavailability of immediate assistance from a minimally invasive trained surgeon, laparotomy must be performed to directly address the bleeding vessel and obtain hemostasis. This would generally require a midline vertical incision to access the vessel

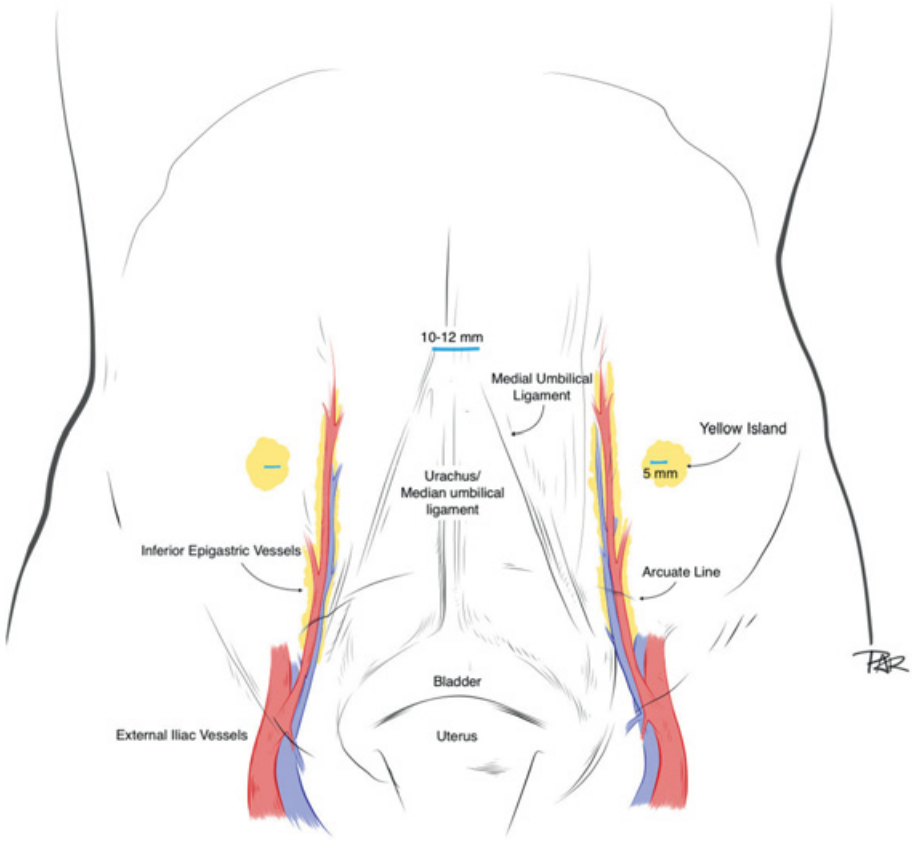

Figure 70.2 Internal view of the anterior abdominal wall. (Illustration by Dr. Priya Rajdev MD, University of Arizona College of Medicine, Phoenix, AZ.)

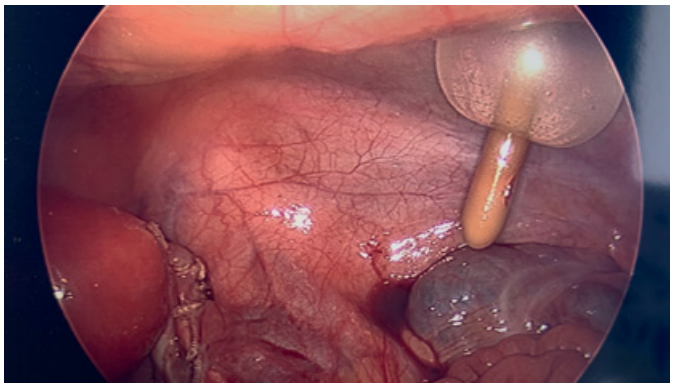

Figure 70.3 Intraperitoneal laparoscopic view of Foley balloon providing tamponade of injury to inferior epigastric vessels.

above and below the level of injury. The vessel can then be ligated in the standard fashion.

Management of an IEA injury that is not detected until the postoperative setting will depend on the stability of the patient and availability of resources. An unstable patient should be taken to the operating room for laparotomy and immediate ligation of the affected vessels with transfusion of blood products as needed for resuscitation. If the patient is stable, some institutions have resources available for minimally invasive angiography with subsequent coil embolization of the injured vessel. This endovascular approach is also effective in cases of delayed recurrent hematoma. Otherwise, if these services are unavailable, the surgeon can return to the operating room and attempt laparoscopic ligation of the vessel or proceed to laparotomy.

Postoperative care of IEA injuries detected at the time of surgery requires vigilance to identify and address any ongoing or recurrent bleeding. In this event, the patient may require blood transfusion and/or additional procedural intervention as mentioned above. After hemostasis has been achieved, most residual hematoma will resorb. In some instances, a hematoma may develop into an abdominal wall abscess that will require drainage in the postoperative phase.

It is imperative to document injury and ligation of the epigastric vessels in operative reports because these vessels are routinely used in breast reconstruction and vascular bypass. Of note, due to significant collateral blood supply, ligation of a unilateral epigastric vessel is generally well tolerated.

Key Teaching Points

- Injury to the inferior epigastric artery can present at the time of trocar placement, when insufflation is decreased at the end of the case, on port removal, or in the postoperative setting

- Management of an injury to the inferior epigastric artery is dependent on injury severity, timing of detection, and laparoscopic skill
- Inferior epigastric artery injury can be managed using bipolar cautery, tamponade via Foley catheter, or suture ligation
- Inferior epigastric artery injury can be prevented via knowledge of the anatomical course and variations of the vessel, as well as use of techniques to place accessory trocars in safe zones that will avoid injury to the vessel when it is unable to be visualized

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CASE 71 A 21-Year-Old Woman with an Intra-abdominal IUD

Jordan Hylton

History of Present Illness

A 21-year-old gravida 2, para 1011 presents to the outpatient office for missing intrauterine device (IUD) strings following IUD insertion. The patient had an IUD placed at her six-week postpartum visit. She noted increased discomfort with this IUD placement compared with the one she had prior to the pregnancy. She also noted increased bleeding immediately following the procedure. Since placement she has had unprovoked intermittent abdominal discomfort that is sharp in nature and self resolves. She denies changes in her bowel or bladder habits and reports her menstrual cycles are short, one to three days, occurring monthly. Her past medical history is significant for depression and postpartum endometritis. Her past surgical history is significant for right anterior cruciate ligament repair. She is not taking any medications and she has no allergies.

Physical Examination

General appearance: Well-appearing, no acute distress

Vital signs:

Temperature: 36.3°C
Pulse: 64 beats/min
Blood pressure: 104/64 mmHg
Respiratory rate: 16 breaths/min
BMI: 26 kg/m^2

Abdomen: Soft, non-tender abdomen to palpation without rebound or guarding. No masses appreciated. Audible bowel sounds

Pelvic: Normal external female genitalia. Vagina with physiologic vaginal discharge, no evidence of IUD strings. No cervical motion tenderness, adnexal masses, or tenderness on bimanual examination

Laboratory studies:

Hb: 12.1 g/dL (normal 120–15.0 g/dL)
Hct: 35.0% (normal 24.8–45.0%)
Urine pregnancy test: Negative

Imaging:

Pelvic ultrasound: Anteverted uterus measuring 3.6 × 3.2 × 3.7 cm. Normal appearing bilateral ovaries, right measuring 3.4 × 1.6 × 1.9 cm and left 2.6 × 1.4 × 1.8 cm. Free fluid visualized in cul-de-sac, largest pool 24.8 × 12.2 × 10.4 mm. No IUD can be seen
Abdominal AP x-ray: IUD projects over the left upper quadrant of the abdomen, likely extrauterine given the appearance of the uterus on recent ultrasound. Non obstructive bowel pattern. IUD most suspicious for intraperitoneal migration (Figure 71.1)

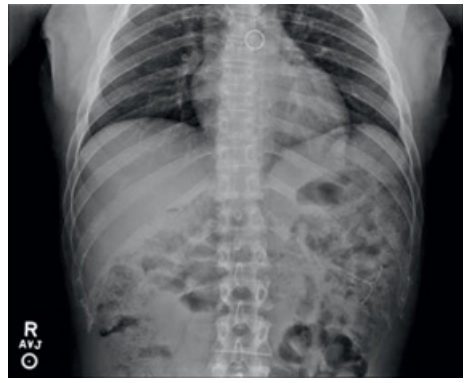

Figure 71.1 AP radiograph indicating the extrauterine presence of a radiopaque IUD device in the left upper quadrant.

How Would You Manage This Patient?

This patient presents with missing IUD strings following insertion. Pregnancy was ruled out on initial presentation and the patient was offered alternative contraception methods. The patient was taken for a diagnostic laparoscopy with planned removal of the IUD. Intraoperative findings confirmed that the IUD was embedded within the omentum. The IUD was dissected from the omentum using laparoscopic monopolar shears and was removed intact through a 5 mm laparoscopic port. She was discharged home later that day and did well postoperatively.

Discussion

Fourteen percent of women worldwide choose an IUD as their primary source of contraception [1]. Original devices were a variety of shapes and materials and multiple modifications have led to the typical T-shaped devices that are common within our practice today. Most IUDs today consist of a polyethylene frame to which a copper wire or a levonorgestrel-containing collar attaches [2]. The IUD is a reliable form of contraception and a popular choice among women and adolescents.

Intrauterine device perforation is a recognized, although uncommon, complication of IUD insertion occurring with an incidence of 1 in 1000 insertions [1]. The type of perforation can be described based on relation of the device to the uterus. For example, an IUD that is completely perforated, as in this case, is observed outside of the uterine wall. For partial perforations, a classification system described by Zakin et al. has been detailed in the literature. This classification is relevant for description as well as approach to removal. The IUD is described in relation to the uterine cavity, myometrium, or peritoneal cavity. Type A IUD perforations are described as one or two arms within the myometrial compartment, A1 and A2, respectively, with the stem within the endometrial cavity.

Type B are difficult to evaluate given their location entirely within the myometrium. Type C have migrated into the peritoneum, but the stem remains fixed within the myometrium. The final classification, Types D1 and D2, describes one or two arms that remain anchored within the myometrial compartment with the stem protruding into the peritoneal cavity [3].

Two mechanisms of uterine perforation have been noted in the literature, including immediate or primary perforation at the time of insertion and secondary perforation which results from gradual myometrial erosion [1]. While there are many theories on the reason a uterine perforation occurs, risk factors are not as clear. It is thought to occur most frequently at the time of insertion [4]. Multiple studies have evaluated the risk of lactation and postpartum status on the risk of IUD perforation. A large European cohort study of 61 448 women noted a sixfold increase in women who were breastfeeding. Women who delivered ≤36 weeks had an incidence of 5.6 (95% CI: 3.9–7.9) compared to 1.6 (95% CI: 0.0–9.1) per 1000 women who had delivered >36 weeks prior to IUD insertion [1]. This is thought to be secondary to decreased estrogen levels and uterine contraction which occur in this period. Uterine abnormalities as well as clinician inexperience are also likely to contribute to perforation rates [1, 5]. Factors that have not been associated with increased risk of perforation include patient age, history of dilation and curettage, history of cesarean section and immediate placement of an IUD following surgical abortion [5].

Earlier versions of IUDs had a rigid insertion instrument and following the conversion to a more flexible inserter in use today, there was a reduction in perforation rate. As an example, the Birnberg bow had a uterine perforation rate of 1 in 200 compared to the rate of more current IUDs of 1 in 1000 [1]. Uterine perforation has been noted using all intrauterine device types and the frame type does not appear to increase perforation rates. In addition, there are no differences in rates of perforation with the copper and the Mirena levonorgestrel device [5].

The most common perforation site is secondary to the flexion and position of the uterus at time of placement. For an anteverted uterus, the uterorectal pouch, or pouch of Douglas, is common, whereas the vesicouterine pouch is more common with a retroverted uterus. Case reports have noted expulsion from a wide variety of sites including the uterosacral and broad ligaments, cervix, fallopian tube, and ovary [1]. For complete perforation, devices are most commonly located in the peritoneal cavity, but may form adhesions to surrounding bowel or omentum [6]. In a systematic review, IUD locations at the time of surgical management for perforation were categorized by anatomical locations. Of the 74.9% located within the abdominal cavity, most were embedded in the omentum (26.7%) (Figure 71.2) [6].

Perforations into the large and small bowel, appendix, rectum, and urinary tract have all been described. Approximately 70 case reports demonstrate involvement of the urinary tract [1]. Colonic perforation was noted in 10.4% of perforations outside of the uterus, 11.1% involving mesentery and bowel serosa [6]. Suspicion should be heightened in women who describe pain, fever, diarrhea, urinary complaints, and rectal bleeding.

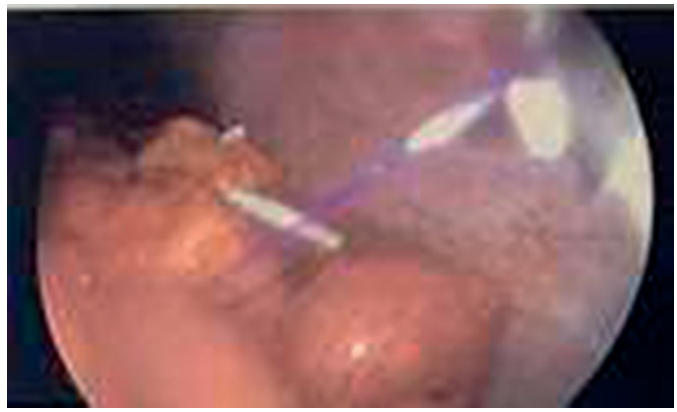

Figure 71.2 Classic laparoscopic finding of IUD in the abdominal cavity embedded within the omentum.

The diagnosis of uterine perforation is commonly made following a stepwise approach. Ninety percent of IUD perforations are not recognized at the time of insertion and half of perforations are diagnosed more than one year following insertion [6]. The most common patient concern at time of perforation is absent IUD strings. More urgent symptoms can also occur including severe abdominal discomfort, vaginal bleeding, diarrhea, hematuria, or hematochezia. While there is a wide range of presentations, it is important to note that some women may still experience the amenorrheic or contraceptive effects if the perforated IUD is in close proximity to the uterus [1].

An initial evaluation includes pelvic examination and pregnancy test; however, once the device strings are unable to be located, an ultrasound is the preferred imaging modality. It is important to note that three-dimensional ultrasound is superior at describing malpositioned or partially perforated intrauterine devices. In a study of 66 women, three-dimensional ultrasound added value to 15 (23%) patients, and in 5 of the 15 (33%) three-dimensional imaging captured information not seen on two-dimensional imaging [7]. If an IUD is unable to be located using ultrasound, this should be followed with abdominal anteroposterior and lateral radiography. This imaging is required for a diagnosis of IUD expulsion. CT is the best modality in the scenario where a visceral perforation, abscess, or bowel obstruction is suspected [1].

Several studies have evaluated the risk of peritoneal adhesion formation in different forms of IUDs. While there are conflicting data, complications associated with current IUD types appear rare. Localized adhesions were noted 37.7% of the time in successful laparoscopic surgery, and 75% of the time, when a laparotomy was required for removal [6]. This should be considered in addition to symptomatology, surgical candidacy, and potential risks of a surgical procedure. The World Health Organization recommends removal of all intra-abdominal IUDs due to risk of adhesive disease and potential long-term consequences [8]. For women who choose expectant management, alternative forms of contraception should be

offered in addition to counseling on the risks, and signs and symptoms of perforation complications.

A minimally invasive approach to IUD removal is preferred. A 2012 systematic review noted a 64% success rate of laparoscopic surgery, with 35% of procedures being converted to laparotomy [6]. Consideration of the use of x-ray imaging at the time of surgery has been suggested for device location. Previously, laparotomy was recommended for women with suspected colonic or bowel involvement; however, given the advances of minimally invasive surgery, laparoscopy remains a viable option for a myriad of IUD locations. In addition to laparoscopy, the use of cystoscopy, proctoscopy, and hysteroscopy have been described. The hysteroscopic approach may be particularly necessary for partially perforated or embedded IUDs.

A varying degree of lysis of adhesions may be necessary prior to retrieval. This can be accomplished using monopolar shears for careful dissection of overlying tissue remaining proximate to the device. The use of a vessel sealing device may also be required. Collaboration with respective surgical specialists for IUDs involving adjacent structures such as the bowel or bladder is advised as this may require resection. Once located, the operator grasps the IUD strings or base, allowing for the arms of the device to extend. This action condenses the diameter allowing for removal through a 5 mm port. For older IUD types, including the Lippes Loop or Daikon Shield, a specimen bag may be warranted for intact removal. If the procedure is unable to be completed laparoscopically, consideration of a laparotomy should be made.

Key Teaching Points

- The risk of IUD perforation is less than 1% and highest at the time of insertion
- Management should be based on a shared decision model; however, a minimally invasive approach is recommended if proceeding with surgical management
- Additional approaches may be warranted to locate the IUD at time of removal including radiography, cystoscopy, hysteroscopy, proctoscopy, and fluoroscopy
- Alternative and/or emergency contraceptive options should be offered to women undergoing evaluation and management of a suspected or confirmed malpositioned IUD

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CASE 72

A 32-Year-Old G2P1 Woman with Ovarian Pregnancy Noted at Time of Surgery for Presumed Tubal Ectopic

Debra A. Taubel

History of Present Illness

A 32-year-old female, gravida 2, para 1, presents to the emergency department for evaluation of acute-onset low abdominal pain that began several hours ago. Her last menstrual period was approximately six weeks ago and her urine pregnancy test in the emergency department is positive. She denies gastrointestinal symptoms, dizziness, or fever. Her past obstetric history is significant for one uncomplicated normal spontaneous vaginal delivery three years ago. Her past medical history is significant for chlamydia diagnosed and treated in the last year and endometriosis. Her past surgical history is significant for diagnostic laparoscopy.

Physical Examination

General appearance: Appears stated age, well-developed, no distress

Vital signs:

Temperature: 37.2°C
Pulse: 96 beats/min
Blood pressure: 128/84 mmHg
Height: 64 inches
Weight: 168 lb
BMI: 28.8 kg/m^2

Chest: Clear to auscultation bilaterally

Heart: Regular rate and rhythm

Abdomen: Non-distended, tender in both lower quadrants, left greater than right, no guarding or rebound, normal bowel sounds in all four quadrants

Pelvic: External genitalia are normal, no lesions. Vagina with normal rugae, small amount of dark brown discharge at os. Uterus is anteverted, small, mobile. Cervical motion tenderness present making it difficult to assess adnexa, some fullness appreciated in left adnexa, tenderness greater in left than right

Laboratory studies:

Urine pregnancy test: positive
Serum quantitative β-hCG: 7825 mIU/mL (non-pregnant value <5 mIU/mL)
Hct: 32% (normal 36–48%)
Hb: 10.3 g/dL (normal 11.6–15 g/dL)
WBCs: 4600/μL (normal 4500–11 000/μL)
Blood type: A positive

Imaging: Transvaginal ultrasound demonstrates a thickened uterine lining without evidence of an intrauterine pregnancy. There is a thick-walled cystic mass in the left adnexa measuring 3.6 × 3.5 × 3.1 cm which appears to contain a fetal pole measuring 0.5 cm. Within the fetal pole is a measurable heart rate of 120 beats/min. There is trace free fluid in the cul-de-sac

How Would You Manage This Patient?

This patient presents with amenorrhea, a positive pregnancy test, and no evidence of an intrauterine pregnancy. These findings, when considered with her physical examination, laboratory results, and imaging are consistent with an ectopic pregnancy. Given the finding of a fetal pole with a fetal heart rate surgical treatment was elected.

After informed consent for laparoscopic salpingostomy and blood transfusion was obtained, including the possibility of salpingectomy and salpingo-oophorectomy, the patient was urgently taken to the operating room. Entry into the abdominopelvic cavity was uncomplicated, and the uterus and bilateral adnexa were visualized. The left adnexa was enlarged with the presence of a 3 cm hyperemic mass on the ovary consistent with an ovarian implantation of the ectopic pregnancy. The left fallopian tube and right adnexa were grossly normal. Approximately 100 mL of blood were appreciated in the cul-de-sac. Using a bipolar sealing and ligating device, the pregnancy was separated from the remaining normal ovarian tissue and removed from the abdominal cavity. Small amounts of bleeding at the surgical site were cauterized with monopolar cautery to achieve hemostasis. The procedure was completed in routine fashion and estimated blood loss from the procedure was 30 mL. The patient was transferred to the post-anesthesia care unit in stable condition.

Discussion

Ectopic pregnancy, defined by a pregnancy that has implanted outside of the uterine body, occurs in approximately 2% of all pregnancies [1]. The fallopian tube is the most common site of extrauterine implantation, at more than 90% [1, 2]. Other sites are rare, with ovarian implantation estimated at 1–3% [1].

The early events that result in a fertilized egg implanted on the ovary have been hypothesized, and two different theories have emerged. The first is of fertilization of an egg that has not fully ruptured from the follicle. The second theory is of retrograde travel of a fertilized egg through the fimbriated end of the tube and implantation on the ovarian epithelium [3]. There is no mechanism to determine if these are indeed the events that result in an ovarian pregnancy either during diagnosis or in analysis of risk factors. Recognized risk factors for ovarian ectopic pregnancy are advanced maternal age, ovarian stimulation, assisted reproduction, and endometriosis [2, 3].

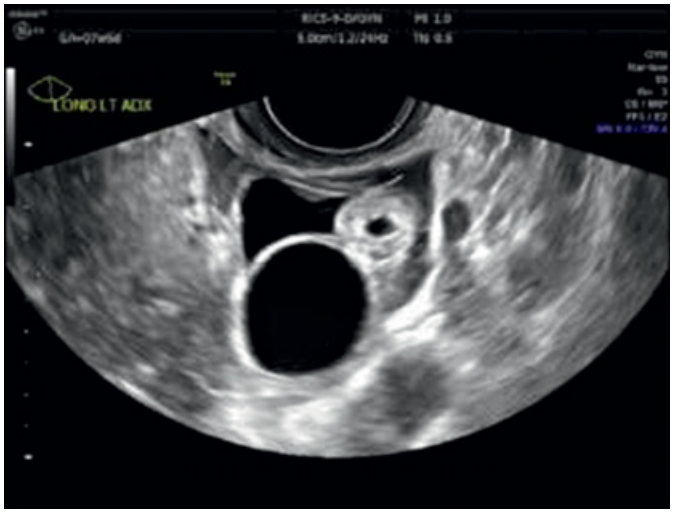

Figure 72.1 Sonographic image of ovarian ectopic. Transvaginal grayscale image of left ovary showing a corpus luteum cyst and adjacent echogenic mass [2]. (Reprinted by permission of SAGE Publications, Inc.)

The evaluation of a pregnancy that is not located in the uterus follows accepted criteria. A serum beta-human chorionic gonadotropin (β-hCG) level that would expect to correlate with a visualized intrauterine gestation on transvaginal ultrasound is still the cornerstone of the diagnostic process [4]. Once it is established that the pregnancy is not viable nor in the uterus, a more accurate diagnosis should be sought. Ultrasound of the adnexa may indicate the location of a lesion consistent with an ectopic pregnancy. The level of β-hCG in most cases does not reflect the size or location of an ectopic pregnancy [4]. Once a suspected ectopic is seen in the adnexa, steps can be taken to determine if the pregnancy is on the ovary, and demonstration of a negative "sliding organ sign" (Figure 72.1) is helpful [2, 4]. This is a technique where pressure is applied to the ovary while performing the ultrasound, allowing visualization of tissue separation to determine if the pregnancy is attached to the ovary or not. Duplex Doppler imaging has not been shown to be of value in determining extrauterine pregnancy location, as both corpus luteum cysts and ovarian ectopic pregnancies can have similar vascularity [2]. Definitive ovarian tissue immediately adjacent to the ectopic or surrounding the ectopic has a high correlation with the diagnosis of ovarian ectopic pregnancy. There is no consensus regarding ultrasound criteria for diagnosis of ovarian ectopic pregnancy [3, 5].

Implantation of a fertilized egg on the ovary has been associated with a longer time to diagnosis than traditional tubal ectopic pregnancies. The lack of a limiting structure such as a tubal lumen and the established blood supply of the ovary providing a stable implantation site allows unimpeded growth of an embryo without risk of rupture until later in the gestation [6]. The growth of the embryo on a free-floating ovarian epithelial surface may only be symptomatic at time of rupture and hemoperitoneum [6]. Delays in diagnosis can also be attributed to imaging studies which poorly differentiate ovarian pregnancy from other common structures such as a hemorrhagic cyst or a corpus luteum cyst [2, 3]. Ovarian ectopic pregnancies are associated with higher rates of morbidity and mortality and higher complication rates during treatment presumably due to a diagnosis at a later gestational age [7]. A case series of 12 confirmed ovarian pregnancies reported an average gestational age of 44.8 days at time of diagnosis and all but one had hemoperitoneum of 100 mL or greater at time of initial presentation [8].

Description of ovarian pregnancy was recorded as early as the 1600s, and in 1878 Dr. Otto Spiegelberg defined criteria for diagnosis, which are still used today [2, 3]. His four criteria, which are based on pathologic evaluation of the adnexa, are as follows: the fallopian tube with its fimbriae must be intact and separate from the ovary, the gestational sac must occupy the normal position of the ovary, the gestational sac should be connected to the uterus by the utero-ovarian ligament, and the histologically proven ovarian tissue should be located in the sac wall. These criteria have come under criticism as we continue to advance our diagnostic capability using imaging and histologic analysis to confirm diagnosis. The first criterion is of particular concern as an embryonic sac is not found in tubal pregnancies nor miscarriages in up to 80% of specimens [3]. The remaining criteria are still valid and are helpful when confirming true site of implantation. However, pathologists using the Spiegelberg criteria may underdiagnose the condition if all criteria must be met [3].

The accepted standard for diagnosis of ovarian pregnancy is surgical, and laparoscopy is the technique of choice [6]. Direct visualization of the implantation site on the ovary is often easily identified; however, in cases of rupture this may not be an obvious finding. Previous failed treatment with systemic methotrexate may also disrupt the implanted pregnancy so that the location is not readily identified [1, 3].

There have been case reports of using systemic methotrexate to successfully treat ovarian ectopic pregnancies as well as local injection of various agents to treat non-tubal ectopic pregnancies [4, 6]. There are no dedicated studies done to confirm the safety or efficacy of this method of treatment. Surgery is considered the treatment of choice. In this case, the presence of fetal cardiac activity is a strong relative contraindication to the use of methotrexate in any regimen, and surgical treatment was indicated [1].

Removal of the implantation site from the remaining viable ovarian tissue is the goal of surgical treatment for ovarian ectopic pregnancy [2, 4]. Identification of the entire lesion on the ovary is critical to remove the pregnancy while conserving normal ovarian tissue. Using bipolar electrocautery or ultrasound energy sources dissection of the lesion can be performed while maintaining hemostasis [4]. Other options for control of bleeding include sutures, monopolar energy, and topical hemostatic agents [4, 7]. Consent should always include the possibility of removal of the entire ovary in the event of uncontrolled bleeding or other conditions, such as dense adhesions, that would make resection difficult. If there is concern for incomplete removal of the ectopic pregnancy, serum β-hCG levels should be followed postoperatively until they are undetectable. There have been cases described where β-hCG levels declined appropriately even after residual ectopic tissue

was left on the ovarian stroma [4, 8]. Other studies cite successful yet limited data on novel medical treatment options such as injection of methotrexate or etoposide directly into the ovarian ectopic site [4, 6].

Key Teaching Points

- The ovary is an uncommon site of ectopic pregnancy implantation, which is often misdiagnosed on ultrasound as a tubal ectopic or corpus luteum cyst
- Definitive diagnosis is most often achieved by direct visualization of the ovarian pregnancy during surgery
- There are no accepted protocols for medical management of ovarian ectopic pregnancy. Surgery is considered the treatment of choice
- Ovarian conservation is the goal of surgical treatment of ovarian ectopic pregnancy, with oophorectomy reserved for cases of uncontrolled bleeding or other surgical complication

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CASE 73 A 32-Year-Old P0 Woman with Persistent Pain after LAVH/BSO for Endometriosis

James N. Casey

History of Present Illness

A 32-year-old para 0 presents with persistent pain after laparoscopic assisted vaginal hysterectomy/bilateral salpingo-oophorectomy (LAVH/BSO) for endometriosis. Her surgery was notable for bilateral endometriomas with scarring of the ovaries to each respective ovarian fossa and adhesions of the rectosigmoid colon to the left ovary. She had an uneventful recovery from surgery and was started on estrogen-only therapy for skeletal and cardiovascular protection. Three months following surgery, she reports the onset of an intense intermittent left lower quadrant pain. This began cyclically though it has progressed to pain for at least two weeks of each month. She has no past medical history. Her past surgical history is significant for three laparoscopic endometriosis surgeries, LAVH/BSO. She is taking estradiol (Estrace) 1 mg PO daily. She has no allergies.

Physical Examination

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

Vital signs:

Temperature: 37.0°C
Pulse: 97 beats/min
Blood pressure: 137/84 mmHg
Height: 64 inches
Weight: 170 lb
BMI: 29.2 kg/m^2

Abdomen: Soft, mildly tender in left lower quadrant, non-distended

Pelvic: Normal external genitalia, well-healed vaginal cuff, non-tender, no lesions. Cervix and uterus are surgically absent, tenderness in adnexa recreating her described left lower quadrant pain with internal palpation, no fullness or mass appreciated

Laboratory studies:

WBCs: 6200/μL (normal 4000–10 500/μL)
Hb: 13.7 g/dL (normal 12.0–16.0 g/dL)
Hct: 39.1% (normal 36–46%)
BUN/Cr: 10.5/0.7 (BUN 6–20 mg/dL, Cr 0.5–1.2 mg/dL)
Urinalysis: Negative (mid-cycle peak 3.1–17.7 mIU/mL, luteal phase 1.5–9.1 mIU/mL, postmenopausal 23.0–116.3 mIU/mL)

Imaging: Transvaginal ultrasound reveals a surgically absent uterus, cervix, and right ovary. In the left adnexa, a 2.1 cm complex adnexal cyst is present

How Would You Manage This Patient?

The finding of a new adnexal cyst in a presumed surgically menopausal female with a history of endometriosis is most consistent with ovarian remnant syndrome (ORS). Her estrogen was discontinued and follicle-stimulating hormone (FSH) checked >10 days from the time of discontinuation and returned consistent with premenopausal status. Initial suppressive efforts were made with combined oral contraceptives for three months without benefit. The patient was taken for a laparoscopic removal of a left ovarian remnant and adhesiolysis. The retroperitoneal space was dissected and the left infundibulopelvic (IP) vessels isolated with identification of the left ureteric course and removal of the left ovarian remnant. Her pain resolved postoperatively.

Discussion

Ovarian remnant syndrome (ORS) is an uncommon condition in which a portion of ovarian parenchyma remains in place despite a prior oophorectomy. ORS should be considered in women with the presence of an adnexal mass in the setting of prior oophorectomy. The differential also includes peritoneal inclusion cysts and tubal remnants. ORS should be distinguished from other less common processes as well. These include supernumerary ovary syndrome, which is the development of an additional embryologic ovary, and seeding of ovarian tissue within port sites during tissue extraction. These scenarios are rare in comparison to ORS [1]. The incidence of ORS itself has no population-based assessment to date, but within the specific subset of women with cyclic/chronic pain after hysterectomy with bilateral oophorectomy, 22% (26/119) were found to have a newly diagnosed ovarian remnant intraoperatively [2].

Risk factors for an ovarian remnant include processes that obscure or obliterate traditional pelvic tissue planes and inhibit dissection at the time of oophorectomy including endometriosis, prior pelvic surgery, pelvic adhesive disease, pelvic inflammatory disease, inflammatory bowel disease, limited visibility, poor surgical technique, and anatomic variation [1]. Ovarian remnants are described more commonly with the left ovary, potentially due to the adjacent location of the rectosigmoid colon in the setting of adhesive disease, and difficulty isolating the left IP vessels for complete ovarian removal [3].

The largest review to date of presenting symptoms in 186 patients with ORS included chronic pelvic pain (84%), dyspareunia (26%), cyclic pelvic pain (9%), dysuria (7%), and tenesmus (6%) [4]. Ovarian remnants themselves are often present in the setting of endometriosis and this is the most common prior medical condition associated with ORS. The remnant itself may become painful, and the circulating hormonal response from the ovarian remnant may also stimulate additional surrounding endometriotic implants. Suspicion for ORS should also be raised in patients with complex surgical histories and adnexal pain

who do not experience vasomotor symptoms after bilateral oophorectomy.

The diagnosis of ORS requires a multifaceted approach with laboratory and imaging support. It is important to know that most, though not all cases of ovarian remnants, will be hormonally active. Following bilateral oophorectomy, most patients will be placed on hormonal supplementation with estrogen for protection of both skeletal and cardiovascular health as well as treatment of vasomotor symptoms. For hormonal evaluation of an ovarian remnant, supplemental estrogen should be discontinued for at least 10 days prior to testing of FSH and estradiol. When tested off hormonal support, premenopausal levels of FSH and estradiol are highly correlated with the presence of an ovarian remnant; however, postmenopausal levels of FSH and estradiol (FSH >30 mIU/mL, estradiol <20 pg/mL) should not completely exclude the diagnosis. In patients undergoing treatment for confirmed ORS, only 63% and 69% of patients exhibited premenopausal levels of estradiol and FSH, respectively [4].

Imaging studies are often one of the first steps taken to alert the physician to the presence of ORS. In the largest ORS study to date (186 patients), a pelvic mass was present in 93% of ORS patients on ultrasound, 92% on computed tomography, and 78% on magnetic resonance imaging [4]. This has been correlated with an additional smaller study demonstrating a visible pelvic mass on transvaginal ultrasound in 90% of pathologically confirmed ORS patients [5].

Ovarian stimulation may be required for further assessment in patients with suspected ORS without a visible pelvic mass on imaging. Ovarian stimulation with clomiphene citrate can stimulate cystic ovarian follicles for re-imaging or be employed prior to surgery to help delineate the remnant itself. Clomiphene citrate regimens include 100 mg daily (in single or divided dose) for 10 days. It is important to remember that not all ovarian remnants will develop cystic activity in response to clomiphene citrate and in the limited study data available, 66% (4/6) of ORS patients with premenopausal FSH and estradiol levels produced new visible cysts on ultrasound with clomiphene citrate [6].

Primary treatment options for ORS include medical and surgical interventions. Medical suppressive therapies are directed at ovulatory suppression. These include continuous combined contraceptives, progesterone-only options, and gonadotropin-releasing hormone (GnRH) analogs. Small longitudinal studies looking at treatment with GnRH analogs have shown promise in patients with anticipated difficult surgical courses or contraindications to surgical management, though their limited duration of use makes these less attractive for long-term treatment [7]. Attempts with pelvic radiotherapy were limited by adjacent structural radiation damage and is not recommended [1]. Ovarian malignancy has been described within ovarian remnants. In one small series, 10% of women (2 of 20) with ORS developed ovarian adenocarcinoma, though there is no definitive evidence that patients with ORS exhibit a higher rate of ovarian malignancy than the general population [8].

Care should be taken with surgical interventions to avoid the same limitations and pitfalls which led to the initial formation of the ovarian remnant itself. For most patients, it should be expected that tissue planes will be distorted (Figures 73.1–73.4). Intraoperative descriptions of ORS in patients include 90% requiring enterolysis, 93% requiring ureterolysis, and 23% needing bowel repair or resection [5]. Supportive surgical

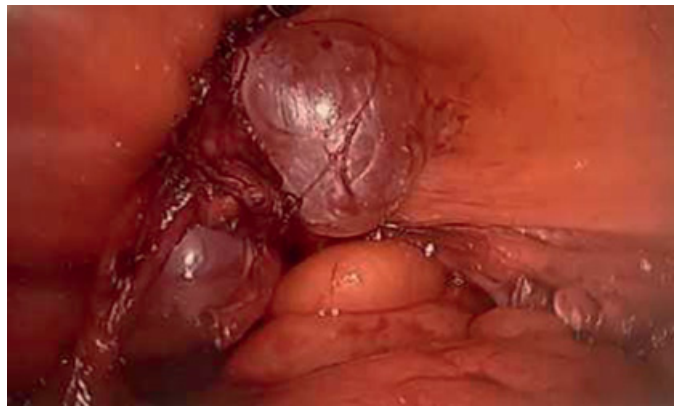

Figure 73.1 Ovarian remnant adjacent to bladder.

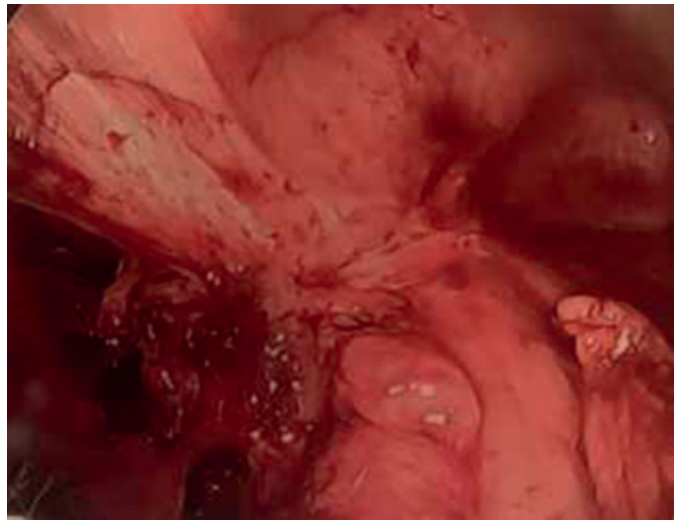

Figure 73.2 Ovarian remnant with endometriosis and bowel involvement.

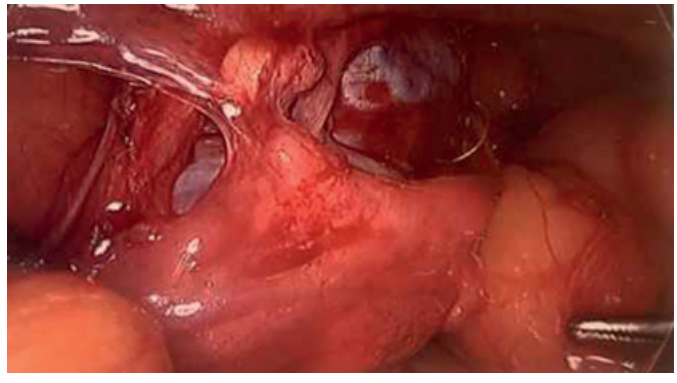

Figure 73.3 Retroperitoneal dissection of ovarian remnant.

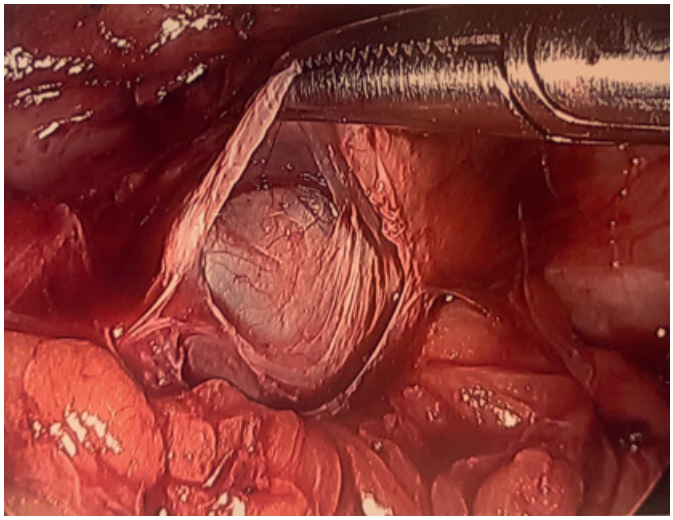

Figure 73.4 Ovarian remnant within the rectovaginal space.

services may be required including colorectal and urologic surgery and should be contacted and involved prior to surgery. All routes of approach (laparoscopic, open, robotic-assisted, vaginal) have been described [1]. The evidence to safely complete the procedure for ORS laparoscopically suggests this as the preferred approach [5]. This should include referral to a surgical subspecialist within minimally invasive gynecologic surgery or to a high-volume surgical center.

Prior to the procedure, the patient should be counseled on the high incidence of bowel and bladder injury with potential need for bowel resection, ureteral stenting, reanastomosis surgery, and complications associated with these surgeries. Injury to the bowel or bladder were reported in 9.6–20.6% of ORS surgical patients, with simultaneous bowel resection with a general surgeon required in 10.3% of patients [4, 5]. Preoperative antibiotics and mechanical bowel preparation should be administered under recommendations by the American Society of Colon and Rectal Surgeons.

Initial dissection seeks to restore normal anatomic position to adherent or distorted structures. Dissection should begin in a region of normal anatomic position and extend in the direction of the pathology, dissecting from "known to unknown." A common location for retroperitoneal entry is parallel and lateral to the IP vessels, often at the level of the pelvic brim. A defect is made in the posterior leaf of the broad ligament, inferior to the IP and superior to the ureter. The ureter itself should be identified, mobilized with dissection parallel to its course along the medial leaf of the posterior peritoneum, and lateralized away from the ovarian remnant. Complete desero-salization of the ureteric vessels should be avoided to minimize the chance of localized ureteric ischemia. With inability to locate the ureteric course, temporary ureteral stent placement should be considered. In one small study, the ovarian stroma was found to extend 0.2–1.4 cm within the IP ligament, and this may represent a useful benchmark for the minimal IP truncation distance required [9].

While medical outcome research is limited, surgical outcomes of this complicated procedure are robust when complete excision is performed. Resolution or improvement of pain symptoms postoperatively has been reported in 87–91% of ORS patients undergoing surgical excision [4, 5].

Key Teaching Points

- Ovarian remnant syndrome should be considered in patients with prior oophorectomy and the classic presentation of prior adhesions, a new pelvic mass, and pain
- Premenopausal hormonal levels of FSH and estradiol are highly suggestive of ORS in this setting, although menopausal levels do not rule out the diagnosis
- Surgical excision is the mainstay of treatment for ORS. Advanced adhesiolysis and retroperitoneal dissection should be the anticipated intervention with these cases and surgical teams should plan accordingly

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CASE 74

A 50-Year-Old Woman with Bleeding with Intercourse Four Weeks after Robotic Hysterectomy

Stephen M. Wagner

History of Present Illness

A 50-year-old gravida 2, para 1 presents to the emergency department with vaginal bleeding. She underwent a robotic-assisted total laparoscopic hysterectomy with bilateral salpingectomy and cystoscopy 29 days ago for symptomatic uterine fibroids. The patient reports experiencing a "popping" sensation during her first episode of intercourse following surgery. Subsequently she developed 8/10 abdominal pain, vaginal bleeding, and vaginal pressure. She has no past medical history. Her past surgical history is significant for hysterectomy and bilateral salpingectomy. Her social history is significant for 20 pack-year history of tobacco use. She is not taking any medications and has no allergies.

Physical Examination

General appearance: Well-developed, well-nourished female in moderate distress

Vital signs:

Temperature: 37.0°C
Pulse: 102 beats/min
Blood pressure 133/88 mmHg
Respiratory rate: 20 breaths/min
BMI 28 kg/m^2

Cardiac: Mild tachycardia with regular rhythm. No murmurs or arrhythmias

Pulmonary: Diminished breath sounds in the bases bilaterally

Abdomen: Hyperactive bowel sounds, no guarding or rebound, tender to palpation in the lower quadrants bilaterally

Pelvic: Eternal genitalia are normal, vagina has normal rugae, scant blood in the posterior cul-de-sac, a pink mass with visible peristalsis at apex of the vagina, vaginal cuff not visualized

Laboratory studies:

Hb: 12.4g/dL (normal 12.0–15.5g/dL)
Hct: 36.9% (normal 35.5–44.9%)
WBCs: 10 500/μL (normal 4500–11 000/μL)
Platelets: 251 000/μL (normal 150 000–400 000/μL)

Imaging: CT scan: Liver, gallbladder/biliary, pancreas, adrenals, and spleen visualized without abnormalities. Kidneys and ureters visualized with contrast noted from the renal pelvis into the bladder. No defect, spillage, or hydronephrosis noted. Aorta and retroperitoneum without adenopathy or aneurysm noted. Bladder is non-distended and contrast is visualized without extravasation. Uterus is surgically absent. Ovaries visualized bilaterally. Right ovary measures 3.0 × 2.0 × 3.0 cm without masses or abnormalities. Left ovary measures 3.8 × 3.1 × 3.1 cm without masses or abnormalities. There is free air with a fluid collection adjacent to the vaginal cuff and small bowel herniation into the vagina

How Would You Manage This Patient?

The patient presents with abdominal pain and vaginal bleeding four weeks postoperatively. The differential diagnosis for this patient includes pelvic organ prolapse and postoperative complications such as vaginal cuff hematoma, cellulitis, granulation tissue formation, and dehiscence with or without evisceration. The CT finding of free air suggests vaginal cuff dehiscence, and the visualization of peristalsis on physical examination supports evisceration with small bowel prolapsing into the vaginal vault. She underwent a diagnostic laparoscopy and repair of the vaginal cuff. After copious irrigation, the bowel was replaced, and the vaginal cuff was sutured with a vaginal approach utilizing figure-of-eight 0-polyglactin 910 sutures. The bowel was evaluated laparoscopically and no injury or ischemia was noted. She was discharged home postoperative day 1 following 24 hours of IV antibiotics.

Discussion

A cuff dehiscence is the separation of the closed incision of the anterior and posterior vaginal edges post-hysterectomy and may be complete or partial (Figures 74.1 and 74.2). Over 600 000 hysterectomies are performed in the United States each year with 0.1–4.7% having the complication of a cuff dehiscence [1, 2]. Historically, the rate of cuff dehiscence was reported as between 0.1% and 0.3% in single-center reports [1]. Over the past two decades the rate has been increasing and was initially attributed to the rise in laparoscopic surgery. The increasing rate of cuff dehiscence correlated with the increase in laparoscopic hysterectomy, first performed in 1989, and subsequent FDA approval of robotic surgery for hysterectomy in 2005. It was hypothesized that laparoscopic surgery resulted in smaller tissue purchases while suturing and was therefore inferior to an open or vaginal closure [3]. This was negated in 2018 when a randomized controlled trial with 1395 patients showed a significant decrease in overall vaginal cuff complications (4.7% vs. 9.8%), including dehiscence (1.0% vs. 2.7%), with laparoscopic cuff closure when compared with a transvaginal approach [2].

Smoking has been consistently shown to be a risk factor for vaginal cuff dehiscence. Additional proposed risk factors include use of electrosurgical devices for the colpotomy, vaginal cuff hematoma, a history of pelvic radiation, chronic

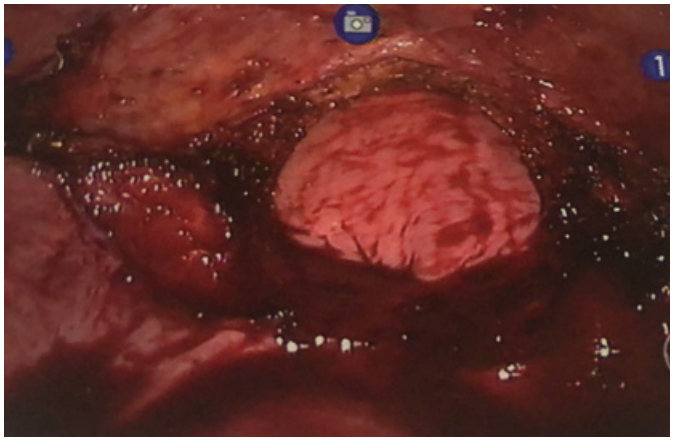

Figure 74.1 Laparoscopic view of open vaginal colpotomy prior to closure.

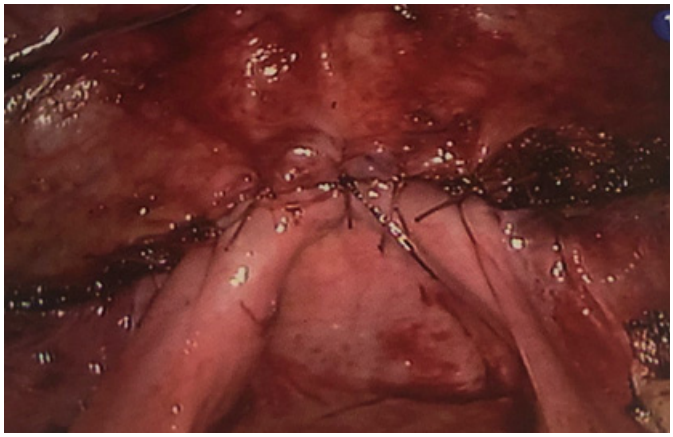

Figure 74.2 Laparoscopic view of closed vaginal cuff.

medical conditions including anemia and diabetes, and immunosuppressive medications; however, the data on these are based on single-center studies and are at times conflicting [1, 4, 5]. Vaginal cuff dehiscence typically presents 2–18 weeks postoperatively, with one study reporting a median time to presentation of 43 days [6]. In postmenopausal women there are reports of a vaginal cuff dehiscence occurring years after surgery. While coitus is the most common identified precipitating event (8–48%), the majority (up to 70%) of vaginal cuff dehiscences appear to occur spontaneously [1, 6].

Modification of risk factors including quitting smoking and controlling diabetes would intuitively decrease the risk of vaginal cuff dehiscence, as they have been shown to decrease wound separation in other surgical specialties. A randomized trial by Vesna and Neli showed use of estrogen in patients with vaginal atrophy improved re-epithelization (95% vs. 83%). Rates of full cuff dehiscence were not reported in this study [7].

Surgical technique also affects rates of dehiscence. Minimization of electrocautery along the colpotomy and suturing the cuff in two layers with at least 5 mm of tissue per stitch appears to lower the rate of dehiscence. Hemostasis of the surgical bed should be ensured, as cuff hematomas and abscesses are associated with dehiscence.

One month postoperatively the rapidly absorbable sutures commonly used in vaginal cuff closures have lost greater than 75% of their stability and the scar tissue has only obtained 40% of its final strength. Therefore, it is imperative that patients be counseled to maintain avoidance of vaginal intercourse until cuff inspection by a medical provider, typically six to eight weeks postoperatively.

Patients with a vaginal cuff dehiscence often present with the sudden onset of vaginal pain or pressure. Additional symptoms include vaginal bleeding or discharge [6]. Some patients will report experiencing a "popping" sensation immediately prior to the onset of symptoms. Fever along with nausea and vomiting may indicate peritonitis, and changes in bowel habits may occur with bowel evisceration.

While a clinical diagnosis, it is not uncommon for patients to having imaging studies performed in a triage setting prior to consultation of the gynecologic specialist. On CT imaging, a vaginal cuff dehiscence will demonstrate free air in the abdomen [8]. There may also be a fluid collection near the vaginal cuff. On abdominal examination there is often suprapubic tenderness and occasionally rebound and guarding. A speculum examination is mandatory to diagnose a vaginal cuff dehiscence. The separation of the vaginal edges will be seen on examination and intra-abdominal contents might also be visualized. Based on limited studies it appears 33–64% of complete vaginal cuff dehiscences are complicated by evisceration of peritoneal organs including the ileum, omentum, and fallopian tubes [2, 9]. In the majority of cases, vaginal cuff dehiscence is treated surgically, and the presence of evisceration constitutes a surgical emergency.

If evisceration is noted on examination a moist towel should be placed over the peritoneal contents that are exposed to air. Intravenous fluids and broad-spectrum antibiotics (e.g. ampicillin, gentamicin, and clindamycin) should be started [10]. In cases of dehiscence without evisceration a single dose of cefazolin can be given perioperatively. Once in the operating room the eviscerated organ should be inspected for injury. If evisceration is noted, both a transvaginal and transabdominal approach is indicated. Up to one-third of cases with evisceration may have bowel injury, so thorough inspection is imperative. Historically, evisceration was an indication for a laparotomy to allow complete inspection of the bowel and intraperitoneal structures. As skill and comfort with laparoscopy has increased, this has become an alternative to laparotomy in many cases.

Inspection of the vaginal cuff may demonstrate necrotic tissue edges which should be debrided until healthy edges are present circumferentially. In patients without evisceration or evidence of infection a vaginal route without abdominal exploration is reasonable. Following irrigation and inspection the vaginal cuff can be reapproximated either transabdominally, laparoscopically, or vaginally [10]. In one case series, 50% of cuff dehiscences, all without evisceration, were closed vaginally. There is no standard repair of a cuff dehiscence [5], but reported suture

choices include polyglactin 910, poliglecaprone 25, and polydioxanone. Closure may be continuous or interrupted, but should include the vaginal epithelium, vaginal muscularis, and the parietal peritoneum.

Many surgeons will also place a vaginal drain if there is concern for an infection or abscess, but there is limited evidence for or against placement. Additionally, in patients with evisceration, antibiotic therapy for 24 hours should be considered due to risk of peritonitis and sepsis. Following hospital discharge, patients should be encouraged to avoid vaginal intercourse. No optimal follow-up protocol has been identified for these patients. It is reasonable to see these patients three times in the office over 12 weeks. If the physical examination is reassuring at 12 weeks vaginal intercourse can be resumed.

Key Teaching Points

- Vaginal cuff dehiscence complicates approximately 1% of all hysterectomies
- Patients who have recently undergone a hysterectomy and are reporting vaginal bleeding or pressure should be evaluated for vaginal cuff dehiscence
- Vaginal cuff dehiscence is a clinical diagnosis made on speculum or bimanual examination. Imaging studies are not a substitute for a clinical examination
- If evisceration is present this should be considered a surgical emergency. Thorough inspection of the bowel is mandatory due to the high injury rate
- There is no repair technique for a vaginal cuff dehiscence that has been shown to be superior

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CASE 75

A 42-Year-Old Woman Who Desires Minimally Invasive Surgery for a 20-Week-Sized Uterus

Patrick Teefey

History of Present Illness

A 42-year-old nullipara presents with abdominopelvic and bladder pressure, low back pain, and heavy menstrual periods. Menses are regular, lasting five to seven days with heavy flow and no intermenstrual bleeding. She does not desire future childbearing and would like definitive management but is worried about missing work. She has no past medical or surgical history. She is not taking medications and has no known drug allergies.

Physical Examination

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

Vital signs:

Pulse: 90 beats/min

Blood pressure: 110/70 mmHg

BMI: 30.0 kg/m^2

Abdomen: Soft, non-distended, visible bulge in lower abdomen appreciated when laying supine. Mass extends from pelvis to umbilicus, excellent lateral mobilization

Pelvic: Normal external female genitalia. Vagina and cervix unremarkable in appearance. Narrow pubic arch appreciated. The uterus could be disengaged from the pelvis and demonstrated excellent mobility. Inability to appreciate adnexa due to enlarged uterus

Laboratory studies:

Hb: 11.4 g/dL (normal 11.7–15.5 g/dL)

Hct: 38.9% (normal 35–45%)

Platelets: 357 000/μL (normal 140 000–400 000/μL)

Urine pregnancy test: Negative

Pap: Negative for intraepithelial lesion

Endometrial biopsy: Proliferative phase endometrium

Imaging:

Transvaginal ultrasound: Enlarged fibroid uterus measuring 21 × 11 × 16 cm with multiple fibroids, the largest measuring 14 cm. Unable to appreciate endometrial lining due to fibroids. Right ovary shows corpus luteum cyst and measures 3.5 × 4.5 × 2.1 cm. Left ovary measures 1.5 × 2 × 2.5 cm

CT abdomen/pelvis (Figure 75.1): Enlarged fibroid uterus measuring 20 × 12 × 16 cm including a 13 cm anterior intramural myoma with mass effect on the endometrium. Normal adnexa. Bilateral proximal mild hydroureter without hydronephrosis. Otherwise normal upper abdomen, retroperitoneum

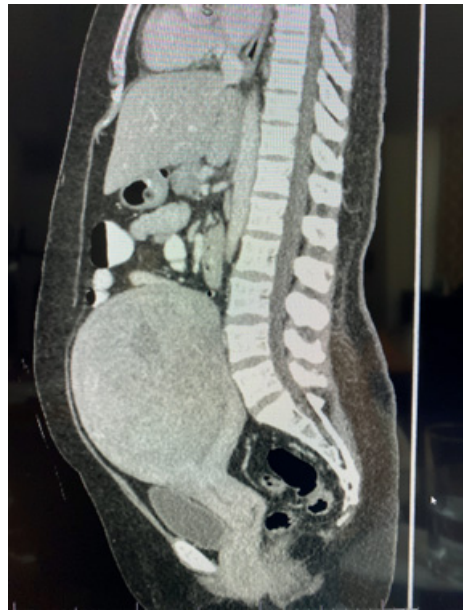

Figure 75.1 CT scan sagittal view of 20-week-sized uterus.

How Would You Manage This Patient?

This patient presents with a 20-week-size uterus complaining of bleeding and bulk symptoms secondary to uterine fibroids. She expressed desire for definitive surgical management and prefers a minimally invasive approach to allow a reduced return-to-work time. She was noted to have uterine mobility suggesting feasibility of a minimally invasive approach.

She underwent a total laparoscopic hysterectomy, bilateral salpingectomy, and cystoscopy without complication. The uterus was removed through the umbilicus using contained tissue extraction. She was discharged on postoperative day 0 and returned to work in two weeks. Estimated blood loss was 50 mL. Pathologic assessment was consistent with an unremarkable cervix, endometrium, fallopian tube, and leiomyoma with cystic degeneration, weighing 1785 g.

Discussion

Hysterectomy is the most common gynecologic procedure performed in the United States, with uterine fibroids as the most common indication [1]. The procedure can be done vaginally, laparoscopically, and abdominally. Minimally invasive surgery (vaginal or laparoscopic) should be utilized when feasible given the well-documented benefits over laparotomy [2]. Vaginal hysterectomy is the preferred approach among major societies but may present certain challenges such as limited vaginal access, uterine enlargement, and the management of concomitant abdominopelvic pathology [3].

Laparoscopy can overcome these limitations; however, it also has procedural related challenges including lack of training, technical difficulty, and increased operating time [4]. Despite recommendations for minimally invasive surgery as the standard of care, many hysterectomies are still performed abdominally. Tertiary healthcare systems have reported minimally invasive approaches surpassing laparotomy, likely the result of an increasing prevalence of high-volume subspecialists and technologic advancements including the introduction of robotics.

Although major complications are rare, the composite rate of complication during a laparoscopic hysterectomy has been reported as high as 14%, with a statistically significant relationship between preoperative predicted uterine weight and odds of complication [5]. There is, however, an inverse relationship between surgeon volume and patient outcomes/complication rates [6]. The balance between personal experience and anticipated case complexity most certainly plays a role in the decision to choose a procedural route.

While there are many variations to the laparoscopic hysterectomy, in this case, we will focus on the skills and techniques needed for performance of a conventional total laparoscopic hysterectomy (TLH) for the enlarged uterus. It is important to acknowledge that while these techniques can serve as an aid, performing a 20-week TLH is a technically challenging procedure. The decision to proceed should be a gradual progression based on the surgeon's personal experience and skill. Surgical videos and mentorship from an experienced surgeon can be of added value in the preparation for a challenging case.

For the large uterus, physical examination should evaluate disengagement from the pelvis and lateral mobility of the abdominal component. A 20-week-uterus comprised of a large fundal myoma will often have preserved anatomical landmarks of the deep pelvis, contrary to a large broad ligament myoma. Anticipation of concomitant pathology and risk factors for injury and/or conversion should be considered [7]. Review of imaging can aid in treatment planning, surgical approach, and patient expectations through the identification of concomitant pelvic pathology. Pelvic ultrasound is widely accepted as the initial study for gynecologic pathology; however, it may be limited in the evaluation of women with a massively enlarged uterus. Although CT and MRI can provide the surgeon with preoperative insight regarding the relationship of the uterus to the bony pelvis and adjacent structures, additional imaging is not necessary. MRI is preferred to CT when endometriosis or sarcoma is suspected. Appropriate screening for gynecologic malignancies should be performed, and the risk of occult malignancy discussed. The balance between this risk and the preservation of a minimally invasive approach can be positively influenced through the utilization of tissue extraction techniques.

A key to a successful laparoscopic hysterectomy is the use of a uterine manipulator, of which many types are available. For the large uterus, it is important to select a model with a firm shaft that can tolerate high levels of torque, and a colpotomy cup for designation of the amputation margin. A sterile drape placed over the manipulator can allow the surgeon to redirect or self-manipulate in critical parts of the case. In addition to basic movements, a subtle twist of the handle away from the operative side drastically improves visualization and maintains tissue tension.

Most methods for initial trocar insertion can be utilized. Many surgeons, including the author, favor an open technique at the umbilicus because it minimizes the risk of injury to the underlying bulky uterus, facilities use of a 10 mm camera (superior light/visualization), and can be later extended for tissue extraction with minimal visible scarring. Use of a balloon blunt-tip trocar can maximize the working space and provide stable pneumoperitoneum during tissue extraction. Furthermore, with uterine manipulation and Trendelenburg positioning, the bulk of the enlarged fibroid uterus will often fall cephalad to the umbilicus resulting in adequate visualization. For the bulky uterus, 5 mm trocars are placed bilaterally at the level of the umbilicus to allow contralateral access. Lastly, a tertiary 5 mm trocar is placed 2 cm superomedial to the anterior superior iliac spine on the side of the primary surgeon. Alternatively, a suprapubic trocar can be used as it provides an exchangeable secondary operating hand.

A 10 mm, 30-degree, or 0-degree camera can be used. A 30-degree camera is preferred by some surgeons because it facilitates visualization of pelvic structures despite obscuring pathology (Figure 75.2). At case initiation, reviewing rotational effects of the light cord, and standardized terminology to improve communication (i.e. light cord to 2 o'clock), especially when using a 30-degree camera, is helpful. A 5 mm camera is also made available which can be interchangeable between all trocars when challenging viewpoints are encountered.

To preserve clear visualization of the retroperitoneum, the utero-ovarian ligament and fallopian tube can be transected prior to the round ligament. This minimizes the risk of bleeding from the venous plexus of the mesosalpinx into the opened retroperitoneum. Additionally, the lateralized adnexa will not obscure visualization during the remainder of the case. The adnexa can then be addressed after removal of the uterus from the pelvis.

The round ligament should be transected halfway between the insertion of the sidewall and cornua. This minimizes the risk of bleeding from the ascending uterine

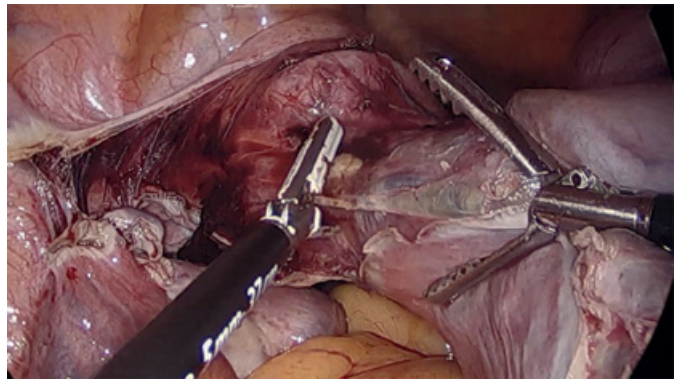

Figure 75.2 When utilizing a 30-degree scope and appropriately placed trocars, visualization is optimized.

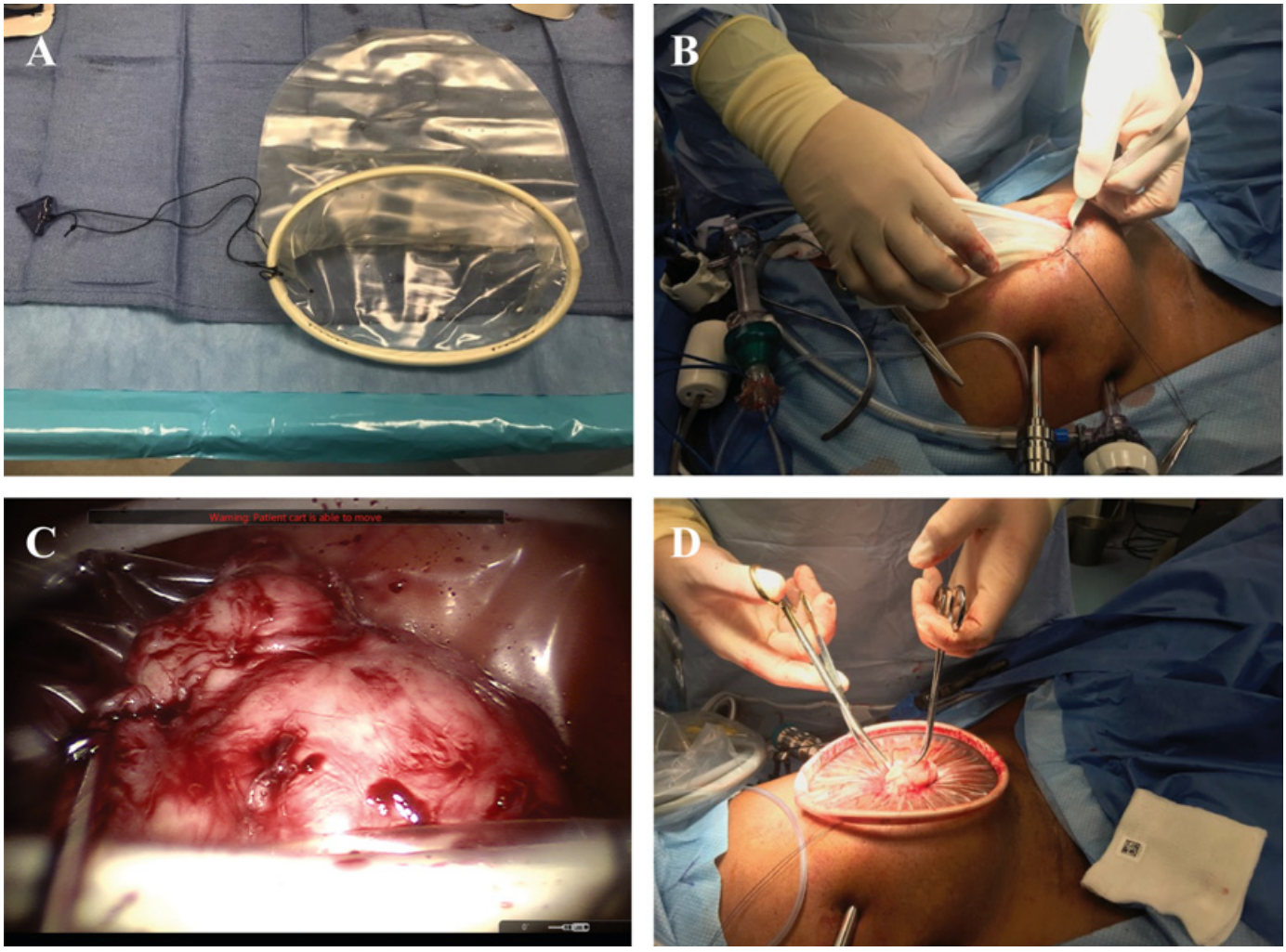

Figure 75.3 (A) Tissue extraction bag; (B) passage of bag through extraction site; (C) specimen within collection bag; (D) initiation of manual morcellation.

vessels and initiates the approach toward the colpotomy cup. The areolar tissues of the retroperitoneum can be bluntly developed, isolating the anterior and posterior leaves which are then taken down separately. The bladder flap is developed along the anterior cup of the manipulator. If mild venous bleeding is encountered, excessive thermal energy should be avoided given the proximity of the ureter. When needed, a 4 × 4 sponge can be placed into the pelvis for compression.

After ligation of the first uterine pedicle, transection can be deferred until the contralateral pedicle is safely accessed. This reduces the potential for back-bleeding during dissection of the contralateral side. When the contralateral side is reached, it is ligated, then each are individually transected and mobilized away from the colpotomy cup.

Monopolar energy is used to amputate the specimen over the colpotomy cup. An atraumatic grasper can be used to mobilize or compress the rectosigmoid during the posterior colpotomy to reduce the risk of thermal injury. The freed specimen is mobilized to the upper abdomen to facilitate hemostatic survey, adnexal intervention, and vaginal cuff closure (pending extraction site).

Tissue extraction is a necessary skill for removal of the large uterus and is often a source of reluctance when considering minimally invasive surgery. Since the FDA discouraged the use of power morcellation in 2014, many techniques have been developed as alternatives [8]. Common tissue extraction sites include the colpotomy, or a mini-laparotomy (often utilizing the umbilicus). Selection is determined by numerous factors including specimen size, vaginal access, patient habitus, surgeon preference, and procedural limitations (supracervical hysterectomy or myomectomy). Use of a tissue-extraction bag is encouraged to eliminate the risk of tissue dissemination. The author favors a bag that is FDA approved for this indication and simultaneously serves as a wound retractor (Figure 75.3).

First, the malleable ring of the bag is collapsed to facilitate passage through the extraction site. Maintenance of pneumoperitoneum is achieved using a balloon trocar and/or vaginal occlusion. The bag is then positioned within the pelvis for tissue collection. Reducing the angle of Trendelenburg can assist in bringing a heavy specimen toward the pelvis. Once collected, the attached string facilitates retrieval. When using a mini-laparotomy, it is extended to 2–4 cm to aid in

extraction. Insufflation is continued to increase the distance from the bowel and the extraction site. The tissue is stabilized with a penetrating grasper and morcellation is initiated with heavy scissors or a scalpel. The author favors the C-incision technique to remove the specimen in long strips [9].

Key Teaching Points

- Minimally invasive surgery for hysterectomy has well-established benefits over laparotomy
- The threshold of feasibility for performing a minimally invasive hysterectomy is surgeon dependent but influenced by many factors
- Physical examination and preoperative imaging can predict anticipated success
- Screening for gynecologic malignancies should be performed preoperatively
- Familiarity with tissue extraction techniques is essential for performing advanced minimally invasive gynecologic surgery

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CASE 76

A 40-Year-Old Woman with No Spill from Her Left Ureter on Postoperative Cystoscopy after Total Laparoscopic Hysterectomy with Bilateral Salpingectomy

Juan J. Diaz Quinones

History of Present Illness

A 40-year-old female, gravida 1, para 1, presents for follow-up with history of heavy menses and uterine leiomyomas. She tried hormonal treatment to control her bleeding but was not successful. For the past two years she bleeds monthly for seven days, and changes pads every 2 hours. She requested definitive treatment and underwent a total laparoscopic hysterectomy (TLH), and bilateral salpingectomy. Intraoperatively, the cul-de-sac was observed to be partially obliterated due to the presence of dense adhesions, which limited the visualization of the left ureter. Multiple intramural and subserosal fibroids were visualized. At the end of the procedure a cystoscopy was performed, the bladder mucosa was intact without lesions. Right ureteral jet was visualized with clear urine, no spill or peristalsis was visualized from the left side. Her past medical history is significant for pelvic inflammatory disease. Her past surgical history is non-contributory. She is not taking medications and has no known allergies.

Preoperative Physical Examination

General appearance: Well-developed, no acute distress

Vital signs:

Temperature: 36.8°C
Pulse: 90 beats/min
Blood pressure: 120/80 mmHg
BMI: 26 kg/m^2

Abdomen: Soft, non-tender, enlarged and irregular uterus

Pelvic: Normal external genitalia. Normal vagina and cervix with physiologic discharge. No cervical motion tenderness noted. Uterus is retroverted, irregular, extending to 2 cm below the umbilicus. Adnexa without masses or tenderness

Laboratory studies:

WBCs: 6500/μL (normal 3800–10 800/μL)
Platelets: 290 000/μL (normal 140 000–400 000/μL)
Hb: 10.1 g/dL (normal 11.7–15.5 g/dL)
Hct: 30.0% (normal 35–45%)
Urine pregnancy test: Negative
Pap smear: Negative for intraepithelial lesion or malignancy and HPV negative
Endometrial biopsy: proliferative endometrium

Imaging: Pelvic ultrasound shows retroverted uterus measuring 15.8 × 4.8 × 6.3 cm. There two intramural leiomyomas measuring 2.4 × 1.8 × 2.5 cm and 6.8 × 4.9 × 4.8 cm. There multiple subserosal leiomyomas, ranging in size from 2 to 5 cm. The endometrial complex is without focal lesion or abnormal vascularity. Right and left ovary appear normal

How Would You Manage This Patient?

The lack of efflux from the ureter and the complexity of the case raised suspicion for a ureteral injury. A urology consult was called and a retrograde pyelography (RPG) to assess for any signs of injury was performed. It revealed medial extravasation of the contrast dye and a lack of opacity proximal to the injury site (Figure 76.1). The urologist repaired the ureter performing an ureteroneocystostomy. An indwelling catheter and a ureteral stent were left in place. On postoperative day 7 a cystogram was performed and no leaks were observed, this allowed the removal of the indwelling catheter. Six weeks later the stent was removed, and an RPG was performed, which documented healing of the ureter without leakage or stenosis.

Discussion

Ureteral injury is a rare complication of hysterectomy occurring at a rate of 1.61%, 0.46%, and 0.46% for abdominal, laparoscopic/robotic, and vaginal hysterectomy, respectively [1]. Six out of 10 ureteral injuries are unrecognized intraoperatively. In addition to a higher readmission rate, unrecognized injuries also contribute to an increased risk of placement of nephrostomy tubes, sepsis, urinary fistula, acute renal insufficiency, and death [2].

Ureters are injured during gynecologic procedures given the close anatomical location to the ovarian vessels, uterine artery, and cervix. The ureter is at greatest risk of injury where it courses beneath the uterine vessels, approximately 2.3 cm anterolateral to the cervix [3].

The patient in the case presented with dense adhesions, a known risk factor for ureteral injury. Others risk factors are prior abdominal and pelvic surgery, endometriosis, broad ligament leiomyomas, and low-volume surgeons [3].

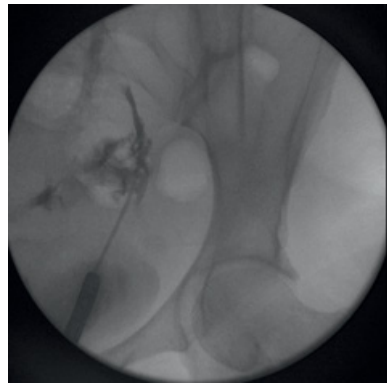

Figure 76.1 Retrograde pyelography (RPG) with fluoroscopy showing medial extravasation of the contrast at the site of a left ureteral injury.

The best approach to preventing injuries during hysterectomy is a clear understanding of the anatomy. Ureterolysis is prudent when there is significant distortion of the anatomy. If the ureter is not clearly visualized, a superficial incision parallel to the infundibulopelvic ligament is made which allows access to the pararectal space; subsequent blunt dissection will identify the ureter. If the left ureter is not visualized the rectosigmoid can be mobilized medially after lysis of the physiologic adhesions [4].

It is important to note that identification of the ureter at the pelvic brim is not enough in cases involving significant deep pelvic adhesions. In the presented case, ureterolysis needed to be carried down to the cardinal ligament to avoid an injury of the ureter. The anatomy at the level of the cul-de-sac was distorted pulling the ureter medially, putting the ureter at risk of injury [4].

When performing a hysterectomy, sufficient skeletonization of the uterine vasculature will ensure that any peritoneal attachments involving the ureter are released. Additionally, it is important to maintain cranial deviation of the uterus with firm upward pressure to protect the ureters [4]. When there is significant distortion of the anatomy, ureteral stents may be placed to aid in the identification of the course of the ureter [3]. Preoperative ureteral stenting has not been shown to result in a statistically significant decrease in ureteral injury rate.

Data suggest that the sensitivity of cystoscopy for detecting ureteral trauma is 80–90%. The American Association of Gynecologic Laparoscopists (AAGL) advocates the use of routine cystoscopy for TLH. They reason that the elevated rate of bladder and ureter injuries and the number of undiagnosed injuries along with their complications supports this guidance [5]. Dissenters argue that the available evidence shows that its use is not cost-effective, and that cystoscopy should instead be performed during cases where the risk of injury is above average or for cases done by low-volume surgeons (selective cystoscopy) [1, 6].

A systematic review of 79 studies found that routine cystoscopy increased the intraoperative detection rate by fivefold but did not decrease the number of undetected injuries diagnosed postoperatively. The postoperative detection rates for ureteric injury were 1.6/1000 without routine cystoscopy and 0.7/1000 with routine cystoscopy. For bladder injury detection, rates were 0.8/1000 without routine cystoscopy and 1.0/1000 with routine cystoscopy. Possible explanations for these differences are that intraoperative cystoscopy was detecting a small number of injuries that would otherwise have spontaneously resolved [7].

Cadish et al. concluded that selective cystoscopy during high-risk cases had a lower cost increase than routine cystoscopy ($13.20–26.13 versus $51.39–57.86, respectively). For routine cystoscopy to be cost saving, the risk of bladder and ureteral injury rate would need to exceed 20.59–47.24% and 27.22–37.72%, respectively. For selective cystoscopy to be cost saving the rate must exceed 4.48–11.44% for bladder injury and 3.96–8.95% for ureteral injury [1]. Overall, any increase in risk of injury should prompt the surgeon to perform a cystoscopy at the time of TLH. In our case presentation, a cystoscopy was indicated due to the presence of adhesions putting the bladder and ureters at risk of injury.

To help assess the ureteral patency during cystoscopy surgeons have historically used indigo carmine solution; a shortage of this solution obligated surgeons to assess other options such as phenazopyridine and IV sodium fluorescein. A randomized control trial showed that 10% dextrose and sodium fluorescein compared with saline and oral phenazopyridine resulted in improved visibility and provider's satisfaction [8]. To hasten excretion from the ureteral jets, some surgeons give 5 mg of furosemide. Jets are usually seen within 5–10 minutes; however, if not seen within 30 minutes, further investigation should be explored.

If an injury is suspected during a hysterectomy, urology consultation followed by an RPG with simultaneous imaging using dynamic fluoroscopy, and stenting can be performed while the patient is still in the operating room. In this case, the RPG showed a complete transection at the level of the uterine arteries. Because the lesion was located 2 cm from the uterovesical junction a ureteroneocystostomy was preferred. If the lesion is located 3–4 cm proximal to the ureterovesical junction, a ureteroureterostomy is performed [9].

Kinking of the ureter should be managed by removing the offending sutures. If the ureter is suture ligated, the sutures or clips should first be removed followed by placement of a ureteral stent. Stenting may be sufficient for minor damage after ligation or crushing, whereas resection may be required for more extensive injuries [3].

Thermal injury or ischemia to the ureter from adventitial dissection can result in scar tissue formation and stricture. When minimal thermal damage has occurred or the ureter is partially transected, it is usually managed by stent placement. Sometimes partial lacerations can be sutured. If more than half the diameter is affected a repair is performed. [3].

Maintaining adequate drainage of the urinary system with a Foley catheter and ureteral stent are critical to allow healing of ureteral injuries. The indwelling catheter is maintained for one to two weeks followed by a cystogram to rule out leakage. Ureteric stents are removed one to two months postoperatively. Stent removal must be followed by an RGP to assess the anastomotic site. At 3–6 months, and again at 12 months the anastomotic site should be assessed [3].

Key Teaching Points

- Ureters are at risk for injury during gynecologic procedures given the close anatomical location to the ovarian vessels, uterine artery, and cervix
- Ureterolysis is prudent when there is scarring or significant distortion of the anatomy
- While some experienced surgeons prefer selective cystoscopy, national guidelines recommend routine cystoscopy for all hysterectomies

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CASE 77 A 40-Year-Old G1P1 Woman with Endometriosis Desiring Definitive Management

Heather O'Connor Greer

History of Present Illness

A 40-year-old gravida 1, para 1001 presents with worsening pelvic pain. Her symptoms have been present for over 15 years and are progressing. Most recently, she has daily symptoms described as sharp, stabbing, intermittent pelvic pain. Her menstrual cycle exacerbates the pain. In addition to dysmenorrhea, she reports deep dyspareunia and a history of infertility. She denies any bowel or bladder dysfunction. Menarche was early at age 10. Menses occur every 25 days, with an 8- to 10-day duration with heavy bleeding and dysmenorrhea. Past treatments include combined oral contraceptive pills, gonadotropin-releasing hormone (GnRH) agonist following laparoscopy-proven endometriosis, and she is currently in her fourth year of a levonorgestrel-containing intrauterine device (IUD). She has no significant past medical history. Her past surgical history is significant for operative laparoscopy 12 years ago with excision of endometriosis (pathology confirmed) and adhesiolysis to improve fertility. She is not taking any medications and is allergic to sulfa (rash). She is a nonsmoker, drinks alcohol socially. She is happily married and works for a nonprofit organization. Her daughter is 10 years old and healthy. Due to her increasing pelvic pain she now requests hysterectomy.

Physical examination

General appearance: No acute distress

Vital signs:

Temperature: 36.8°C
Pulse: 72 beats/min
Blood pressure: 124/76 mmHg
BMI: 21 kg/m^2

Cardiovascular: Regular rate and rhythm

Pulmonary: Clear to auscultation bilaterally

Abdomen: Soft, non-tender, non-distended, no rebound or guarding, negative Carnett test

Genitourinary: Normal external genitalia, normal vagina and cervix. Bimanual examination demonstrated a fixed, retroverted 12-week uterus with right adnexal fullness and tenderness. No pelvic floor tenderness or hypertonicity. Rectovaginal examination confirms and notes uterosacral nodularity

Laboratory studies:

Hb 12.6 g/dL (normal 12–15 g/dL)
Hct 38% (normal 34.8–45.0%)
Creatinine 0.6 mg/dL (normal 0.4–0.7 mg/dL)
Urine pregnancy test: Negative
Chlamydia and gonorrhea cultures: Negative

Imaging: A pelvic ultrasound is obtained demonstrating a 12 cm retroverted uterus, heterogeneous myometrium, endometrium obscured by IUD. Right ovary measures 4 × 3 × 4 cm containing a stable, complex 3 × 3 × 2 cm cyst, likely endometrioma. Left ovary measures 3 × 2 × 2 cm with a normal appearance

How Would You Manage This Patient?

This patient has recurrence of her endometriosis, which is refractory to medical management. She desires definitive surgical management. Ultimately, she proceeded with total laparoscopic hysterectomy, bilateral salpingo-oophorectomy (BSO), excision of endometriosis, extensive ureterolysis, lysis of adhesions, and cystoscopy (Figure 77.1).

Discussion

Endometriosis is a chronic inflammatory condition characterized by ectopic endometrial glands and stroma that grow in response to estrogen. It commonly involves the fallopian tubes, ovaries, and pelvic peritoneum including the pouch of Douglas. Endometriosis has a polygenic, multifactorial pathogenesis leading to a wide array of clinical presentations. The pathogenesis of endometriosis is thought to occur via retrograde menstruation, vascular or lymphatic dissemination, coelomic metaplasia, or stem cell differentiation [1]. Implantation and dissemination of endometriosis is a complex, heterogeneous disorder involving stem cells, dysfunctional immune response, genetic susceptibility, central neurologic sensitization, and an aberrant peritoneal environment. Manifestations can include dysmenorrhea, dyspareunia, noncyclic chronic pelvic pain, dysuria, dyschezia, and infertility. Women suffering from endometriosis typically fall into one of three phenotypes: superficial peritoneal endometriosis (SUP), ovarian endometrioma (OMA), or deeply infiltrating endometriosis (DIE). Endometriosis occurs in 6–10% of reproductive-age

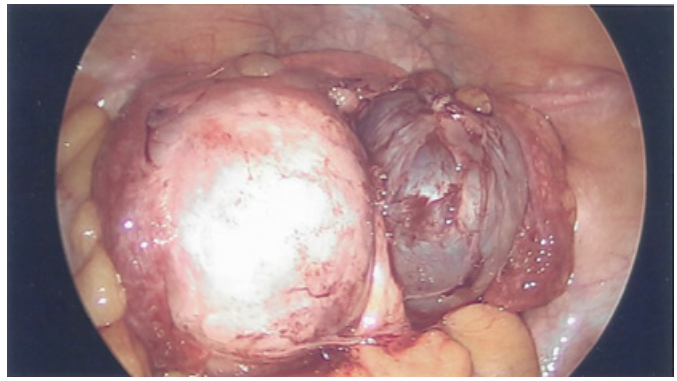

Figure 77.1 Laparoscopic visualization of bilateral endometriomas and associated adhesions. (Photo courtesy of James Casey MD.)

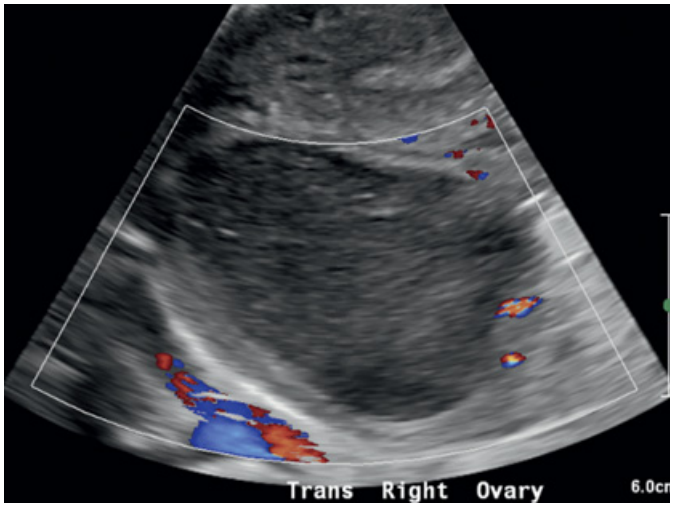

Figure 77.2 Characteristic ultrasound appearance of endometrioma with diffuse homogeneous ground-glass echotexture due to hemorrhagic debris. (Photo courtesy of Thomas Stoecker MD.)

women, with a prevalence of 38% (range 20–50%) in infertile women, and 71–87% in women with chronic pelvic pain. Risk factors for endometriosis include early menarche, frequent menstrual cycles (less than every 27 days), and prolonged menstrual duration with heavy bleeding. Physical examination findings may include uterosacral nodularity, a fixed uterus, or adnexal mass suggestive of endometrioma [1].

Thorough preoperative evaluation includes an individualized surgical plan, discussion of risks and benefits of oophorectomy, as well as the need for post-surgical medical suppression to mitigate recurrence of microscopic endometriosis. While endometrial implants are often diagnosed via direct visualization through laparoscopy, preoperative diagnosis may occur when an endometrioma is present, which can be visualized with pelvic ultrasound (Figure 77.2). Current literature has demonstrated 83% sensitivity and 89% specificity of ultrasound to delineate endometriomas from other ovarian cysts [2].

Ultrasound is the most common imaging modality in the evaluation of endometriosis; however, preoperative MRI can be helpful in identifying the presence and extent of deep infiltrating endometriosis. This may be done in patients with neuropathic pain, change in stool caliber, and/or otherwise unexplained renal insufficiency. Preoperative knowledge of deep lesions can assist with surgical planning and may prompt referral to a multidisciplinary center of expertise if the surgeon is not comfortable with the clinical picture of a technically challenging surgery.

The patient in this case was instructed that she should continue the progesterone IUD preoperatively for hormonal suppression, as this can reduce inflammation and make surgical dissection and excision technically more feasible, particularly for DIE [3]. Consider gastroenterology referral for colonoscopy if bowel dysfunction is present. If bowel involvement is suspected on imaging or colonoscopy, having a colorectal surgeon available during the case should be considered. The patient should be extensively counseled regarding surgical management, including the option for ovarian preservation. A thorough discussion entailing risks and benefits of postoperative hormone replacement therapy should take place. She should be made aware of the need for earlier bone scans and cardiovascular screening in the setting of bilateral oophorectomy.

Definitive surgical management should be considered for patients with severe refractory pain, or those who no longer desire fertility. The goal of definitive surgical management is complete destruction or removal of endometriotic tissue and adhesions. Success in achieving this aim may largely depend on the severity of disease and skill of the surgeon [4]. Whenever possible, laparoscopic surgery should be undertaken in preference to laparotomy [5]. Hysterectomy is a common treatment and endometriosis-associated pain is the leading indication for hysterectomy among women 30–34 years of age, accounting for 18% of all hysterectomies in the United States [4]. If removal of the uterus is indicated, a total hysterectomy is favored rather than a supracervical approach. This rationale is supported by evidence of abnormally increased nerve density in the endometrial implants in the cervix. Up to 25% of patients will subsequently require trachelectomy due to pelvic pain, dyspareunia, or bleeding after supracervical hysterectomy [3].

The best surgical approach for the treatment of superficial endometriosis is controversial. A meta-analysis including 335 women demonstrated that excision of endometriosis was superior to coagulation in reducing dysmenorrhea, dyschezia, and chronic pelvic pain 12 months after surgery. In another study, laser ablation with a layered approach to vaporization of superficial endometriosis lesions was 65% effective in reducing pain, compared with only 22% reduction of symptoms when diagnostic laparoscopy alone was performed [3]. The evidence supporting surgical treatment of superficial endometriosis for pain relief is sparse and currently under debate [4]. Surgical technique will likely depend on individual surgeon preference.

Evidence is also still lacking to guide the best surgical management of deep endometriosis [5]. Incomplete resection may reduce symptomatic outcomes, but radical interventions increase the risk of major complications such as ureteral and rectal injuries, especially in the setting of retroperitoneal fibrosis. Although current randomized controlled trials have not confirmed that excision is superior to ablation, it is generally recommended to excise lesions when possible, especially deep endometriotic lesions. Careful surgical technique should be used to excise all the affected tissue while avoiding healthy tissue.

This patient underwent ureterolysis to aid in complete excision of her endometriotic lesions. The ability to perform ureterolysis is an important tool for endometriosis surgeons and requires expertise and training to do safely. This is typically done via either a medial (transperitoneal) or lateral (retroperitoneal) approach, working from a disease-free area toward the endometriosis, and taking care to not devascularize the ureter.

Significant improvements in dysmenorrhea, nonmenstrual pelvic pain, dyspareunia, dyschezia, and quality of

life for a period of up to five years after surgical treatment of endometriosis have been demonstrated [2]. This improvement in symptoms and quality of life continues long after surgery regardless of the stage of endometriosis [6]. It is, however, important to counsel patients that not all women will have long-term improvement in pain. Past studies have reported a 62% risk of recurrent pain and 31% need for reoperation in women undergoing hysterectomy without oophorectomy. In those undergoing hysterectomy with bilateral oophorectomy, 10% had recurrent pain and 3.7% required reoperation [2]. It is recognized that the stage/extent of disease may not correlate with recurrence risk [5].

It is important to discuss menopausal side effects, the most common of which include early–onset cardiovascular disease, loss of bone density, and urogenital atrophy [3]. Surgical menopause from BSO accounts for approximately half of the 60% elevated risk of cardiovascular disease among women with endometriosis [4]. Estrogen alone may potentiate residual endometriosis and must be balanced with progesterone, thus patients undergoing oophorectomy should not have absolute contraindications to combined hormonal therapy.

This patient underwent hysterectomy with BSO and excision of endometriosis and hormone therapy was initiated following surgery. Patients treated with combined estrogen and progesterone hormone therapy were found to have a 4% risk of recurrence. On the contrary, recurrence ranges from 5% to 15% when progesterone is not used [3]. An estrogen dose of 0.625 mg of conjugated equine estrogens can help to alleviate the impacts of bone loss, vasomotor symptoms, and mood changes. It has been reported that in patients undergoing ovarian suppression with GnRH analogs and hormonal add-back therapy, recurrence of pain does not begin until an estradiol (E2) level of 40 pg/mL. Low-dose estrogen replacement will not elevate E2 levels beyond this threshold and helps to minimize pain recurrence [2]. However, given the concern of possible malignant transformation of residual endometriotic lesions, some providers recommend routine progesterone in conjunction with estrogen [1].

Key Teaching Points

- In women with treatment-resistant endometriosis pain and/or those who have completed childbearing, definitive surgery should be discussed
- If surgery is indicated, laparoscopy should be performed when possible, rather than laparotomy
- When feasible, excision of endometriosis is superior to electrosurgical coagulation
- If bilateral salpingo-oophorectomy is completed, age-appropriate estrogen hormone replacement therapy is necessary postoperatively to treat surgical menopause sequelae; the addition of progesterone may be used to protect against recurrence and potential malignant transformation of residual endometrial implants

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CASE 78

A 40-Year-Old G4P4 Woman with 16-Week-Size Fibroid Uterus and Abnormal Uterine Bleeding Desiring Hysterectomy

C. Nathan Webb

History of Present Illness

A 40-year-old gravida 4, para 4 woman presents to the office for heavy menstrual bleeding and bulk symptoms secondary to uterine leiomyoma. She reports regular menses with heavier bleeding over the past year and more recently has developed episodic intermenstrual bleeding. She notes bulk symptoms of dull pelvic pain, urinary frequency, occasional constipation, and dyspareunia. Attempts have been made to manage her symptoms with combined oral contraceptive tablets and nonsteroidal anti-inflammatory drugs for several months; however, neither provided significant relief. During this visit she requests hysterectomy. Her past obstetrical history is significant for two term vaginal deliveries, the largest fetus weighing 3700 g at birth, and two cesarean deliveries at term, the latter with concomitant bilateral tubal ligation. She has no past medical or surgical history.

Physical Examination

General appearance: Well-appearing, no acute distress

Vital signs:

Temperature: 37.1°C
Pulse: 80 beats/min
Blood pressure: 123/74 mmHg
Height: 62 inches
Weight: 180 lb
BMI: 32.9 kg/m^2

Abdomen: Soft, non-distended, non-tender, uterine fundus palpable a few centimeters below the umbilicus

Pelvic: External genitalia are normal. Vagina with normal rugae, normal discharge. Parous cervix, no bleeding or cervical motion tenderness. Uterus is bulky, with irregular contour mobile, 18-week-sized on bimanual examination with moderate descensus. No adnexal masses or tenderness

Laboratory studies:

Hb: 8.5 g/dL (normal 12.0–15.0 g/dL)
Hct: 25.5% (normal 34.8–45 %)
MCV: 80 fL (normal 78.5–96.4 fL)
Urine pregnancy test: Negative
Endometrial biopsy: Benign, secretory endometrium
Cervical cancer screen: Normal cervical cytology, negative for high-risk human papilloma virus

Imaging: Transvaginal/transabdominal ultrasound shows an enlarged, myomatous uterus measuring approximately 16 cm in total length, with multiple ~3–4 cm leiomyomas, some transmural with submucosal and subserosal involvement. The adnexal structures are unremarkable

How Would You Manage This Patient?

This patient has a symptomatic fibroid uterus and abnormal uterine bleeding, two of the most common indications for hysterectomy. She has undergone attempts at managing her symptoms with medical therapies and had an inadequate response as suggested by her persistent bulk symptoms and microcytic anemia. She has completed childbearing, has no additional comorbidities to explain her symptoms or contraindicate surgery, and has had a reasonable evaluation to rule out gynecologic malignancy. She underwent a total laparoscopic hysterectomy with bilateral salpingectomy with minimal intraoperative blood loss and she was discharged home the same day. At the time of her postoperative visit, she noted complete resolution of her bleeding and bulk symptoms. Final pathology results revealed a 575 g uterus with benign endometrium and myometrium, along with numerous benign uterine leiomyomas.

Discussion

Multiple options exist for the management of this patient's symptoms including myomectomy, uterine fibroid embolization, and hysterectomy. Myomectomy, via an open or laparoscopic approach based on her ultrasound findings of transmural myomas, could have been considered; however, this procedure carries higher risks of perioperative blood loss, adhesion formation, and recurrence of fibroids and has typically been reserved for patients who desire preservation of fertility. Uterine fibroid embolization is a suitable alternative to hysterectomy in select circumstances and, when resources are available, consultation with an interventional radiologist should be offered. This patient, however, had a stated preference for hysterectomy.

Annual rates of hysterectomy approach 500 000 per year in the United States, representing the most common non-obstetric surgery performed on women [1–3]. Hysterectomy may be accomplished vaginally, laparoscopically (both conventional and robotic), and via laparotomy, or a combination of these. A Cochrane review from 2015 evaluated the pooled outcomes of over 5000 patients from 47 randomized controlled trials comparing the different routes of hysterectomy and found vaginal hysterectomy offered faster return to normal activity and shorter duration of hospital admission compared with abdominal hysterectomy [4]. When compared with abdominal hysterectomy, laparoscopic hysterectomy has a similarly favorable profile to vaginal hysterectomy albeit with longer operative times and higher cost. Position statements from the American College of Obstetrics and Gynecology and the American Association of Gynecologic Laparoscopists recommend vaginal hysterectomy over other

approaches when feasible [5, 6]. When the vaginal approach is not practical, the laparoscopic approach is recommended over abdominal hysterectomy. Recent data examining both inpatient and outpatient hysterectomy admissions reveal laparoscopic hysterectomy (both conventional and robotic) has become the most common approach, now accounting for roughly 48% of hysterectomies, followed by abdominal hysterectomy (37%) and vaginal hysterectomy (15%) [2, 3]. Although the trend toward less invasive approaches is heartening, the data still show vaginal hysterectomy is widely underutilized. Several validated algorithms have been applied to the decision-making process for selection of hysterectomy route and have been shown to increase the rate of vaginal hysterectomy when used. Most notably, Kovac prospectively employed an algorithm based on guidelines for selecting the route of hysterectomy established by the Society for Pelvic Reconstructive Surgeons. Applied to over 400 patients over the course of five years, he demonstrated a shift in the ratio of abdominal and vaginal hysterectomy from 3:1 to 1:11 [7]. Clinical considerations during the preoperative evaluation should be to determine if the vaginal approach is appropriate and if not, alternate methods must be justified in ways that best meet the needs of the patient and clinical scenario.

Uterine sizes of up to 20 weeks can be accomplished in the hands of an experienced vaginal surgeon, however, a uterus that is 12–14 weeks size is a common threshold for abandoning vaginal hysterectomy for other approaches. This correlates to a uterine weight of 280 g. Size can be readily determined in most patients with a bimanual examination. In patients whose habitus render such assessments ambiguous, size and weight can be determined with ultrasound (width × length × fundal anteroposterior diameter × 0.56) [7]. Typically, larger uteri, as in this case, will require a laparoscopic or abdominal approach or some method of size reduction to allow for the vaginal route. Size reduction may be in the form of preoperative medical debulking or surgical debulking. Use of GnRH agonists three months in advance of surgery has been shown to reduce uterine volume by up to 60% and may allow for vaginal hysterectomy of uteri 14–18 weeks in size [8]. Sharp surgical debulking methods include wedge morcellation, intramyometrial coring, and bisection of the uterus. Before initiating any surgical debulking vaginally, it is essential that the uterosacral, cardinal ligaments, and uterine vessels are ligated. Care must be taken to avoid inadvertent injury to bowel and vaginal surfaces. When the laparoscopic approach is chosen, similar care must be taken with respect to removal of the specimen. Given the risk of peritoneal seeding from occult malignancy with open power morcellation, it is preferred to perform enclosed debulking within an endoscopic bag either through one of the laparoscopic port sites or vaginally.

Presence of fibroids within the cervix or lateral aspects of the lower uterine segment may render safe vaginal ligation of uterine vessels impossible, posing risk of injury to the ureters. The angle between the lateral border of the cervix and ascending uterine wall, or uterocervical angle, is typically 140 degrees in a normal-sized uterus. With increasing bulk this angle is reduced and a threshold of 90 degrees is suggested as a contraindication to the vaginal approach [9]. In these instances, laparoscopic or abdominal approaches are preferred.

Uterine mobility and descent are also determined with bimanual examination. Limited mobility may suggest presence of adhesive disease. Similarly, limited descent of the uterus with patient Valsalva or fundal pressure on bimanual examination may indicate adhesive disease or uterine bulk. Although classically offered as relative contraindications to vaginal hysterectomy, lack of either may not impede this approach if there is adequate exposure of the posterior fornix. Digital massage of the uterosacral ligaments while the cervix is under traction and transection of the uterosacral and cardinal ligaments often will afford adequate descent for safe completion of the procedure. A reasonable approach may include laparoscopic assessment of the pelvis and, if appropriate, completion of the procedure vaginally.

Parity may give some indication of the adequacy of the pelvis but nulliparity should not be used as a de facto contraindication to vaginal hysterectomy. Of more importance is the surgeon's assessment of the bony pelvis and vaginal caliber. A narrow pubic arch (<90 degrees) or a narrow vaginal apex (<2 fingerbreadths) that limits exposure and safe access to the vaginal fornices suggest a vaginal approach may be technically challenging and a laparoscopic approach may be more appropriate.

Obese patients are at higher risk for intra and postoperative morbidity including wound infection and thromboembolic events. In these patients, abdominal hysterectomy should be avoided when possible. Patients with coexisting super-obesity (BMI >50 kg/m^2), or cardiovascular and pulmonary diseases such as congestive heart failure, chronic obstructive pulmonary disease, or pulmonary hypertension may not tolerate the increased intra-abdominal pressures and Trendelenburg positioning that accompany laparoscopic surgery. These patients should be counseled of the possible need for conversion to an abdominal approach. If a vaginal approach is chosen for the obese patient, particular attention must be paid to positioning and use of assistants for retraction.

Prior history of intra-abdominal or pelvic infection, including ruptured appendicitis, ruptured diverticula, pelvic inflammatory disease, or tubo-ovarian abscess, or history of endometriosis raises concerns for adhesive disease and mandates laparoscopic assessment for scarring. A history of abdominal surgery must also be considered. Prior cesarean delivery is not a contra-indication to the vaginal approach, but multiple cesareans or additional abdominal surgery may predispose the patient to scarring and adhesion formation. In some patients this may manifest as marked cephalad retraction of the cervix, making it difficult to expose on speculum examination, and an elevation of the uterine fundus incongruous to its size, suggesting severe scarring of the uterus to the anterior abdominal wall [9]. This is considered a contraindication to vaginal hysterectomy and alternate approaches are recommended.

Any condition that requires a survey of the pelvis or abdomen should preclude a vaginal approach as it would not afford adequate exposure. This may include endometriosis, pelvic pain, and extrauterine or adnexal pathology. For suspected

endometriosis, assessment of the cul-de-sac for adhesive disease must be performed either via rectovaginal examination or transvaginal ultrasound to assess for visceral slide. Any suggestion of an obliterated cul-de-sac contraindicates a vaginal approach.

Additional procedures, that is for repair of pelvic organ prolapse, should dictate the approach best suited for their safe completion. Opportunistic salpingectomy or prophylactic oophorectomy are not indications for a laparoscopic approach, however, as both can be safely accomplished vaginally [10].

Practice style remains an important determinant for route selection. Factors such as surgeon comfort formed by adequacy of training and subsequent surgical practice volume, personal experiences with each approach, and availability of more senior partners for assistance each impact the decision. When a patient is deemed suitable for a minimally invasive approach it is incumbent upon the physician to assess their own limitations and, if necessary, consult with a specialist or recruit them as a mentor to provide operative assistance and guidance.

Finally, patient preference must be honored. Adequate counseling regarding non-surgical options, a clear recommendation for a given surgical approach, and transparency about risks and possible need for conversion to a different approach are vital to shared decision-making.

Key Teaching Points

- Vaginal approach to hysterectomy is preferred above other methods
- When vaginal hysterectomy is impractical, laparoscopy is preferred over laparotomy
- Factors such as anatomy, surgeon experience, and medical and surgical history must be considered during surgical planning
- Decision for and route of hysterectomy should be a shared decision between the physician and the patient

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CASE 79 A 45-Year-Old Woman with Vaginal Bleeding and Fever to 38.3°C after Hysterectomy

Julie Zemaitis DeCesare

History of Present Illness

A 45-year-old women presents to the emergency room complaining of vaginal bleeding and fevers at home to 38.3°C. She is six days post-op from a robotic hysterectomy, bilateral salpingectomy. The patient had normal return of bowel and bladder function and has been taking ibuprofen 600 mg every 6 hours alternating with oxycodone/acetaminophen 5/325 mg every 6 hours as needed for pain relief. She states that she really felt good for the first few days with only some light spotting since the procedure. Over the last 24 hours, she has noticed an increase in the discharge and stated it is now foul smelling. Her pain level and fatigue have increased over the last 12 hours, and she rates the pain in her abdomen as a 5 out of 10.

Physical Examination

General appearance: Well-nourished, well-developed, looking mildly uncomfortable and ill appearing

Vital signs:

Temperature: 38.3°C
Pulse: 105 beats/min
Blood pressure: 120/80 mmHg
Respiratory rate: 16 breaths/min
Height 64 inches
Weight 181 lb
BMI: 30.0 kg/m^2

Chest: Clear to auscultation bilaterally

Abdomen: Tender diffusely without rebound or guarding, robotic ports intact without erythema or drainage, good bowel sounds

Pelvic: Normal external female genitalia. Speculum placed with purulent bloody drainage with a fluctuant mass noted at the top of the vaginal cuff. Sutures noted to be intact and when the cuff was probed with a q tip additional drainage was expressed

Extremities: No edema, erythema, or tenderness

Laboratory studies:

WBCs: 13 000/μL with 92 neutrophils (normal 3800–10 800/μL)
Neutrophils (ANC): 15/μL (normal 1.5–8 neutrophils/μL)
Platelets: 275 000/μL (normal 140 000–400 000/μL)
Hb: 11.0 g/dL (normal 11.7–15.5 g/dL)
Hct: 33.0% (normal 35–45%)
Urinalysis: Plus one blood, moderate ketones

Imaging: CT scan: Chest, lungs, liver, gallbladder/biliary, pancreas, adrenals, and spleen visualized with abnormalities. Kidneys and ureters visualized with contrast noted from the renal pelvis into the bladder; no defect, spillage, or hydronephrosis noted. The bowel and peritoneum were noted without dilation or evidence of obstruction. The appendix was negative, and there is no inflammatory change or free fluid noted. Aorta and retroperitoneum without adenopathy or aneurysm noted. Bladder is non-distended and contrast is visualized without extravasation. Uterus surgically absent. Ovaries visualized bilaterally. Right ovary measures 3.0 × 2.0 × 3.0 cm without masses or abnormalities. Left ovary measures 3.8 × 3.1 ×3.1 cm without masses or abnormalities. Round, multiloculated partially cystic mass measuring 8.2 × 4.3 × 5.5 cm with hypodense fluid collection noted deep in the pelvis adjacent to the vaginal cuff. The bladder does not appear to be impacted by the fluid collection

How Would You Manage This Patient?

This patient presents with postoperative abdominal pain, fevers, and a mass noted on CT scan. The differential diagnosis of this clinical presentation includes post-surgical abscess, hematoma, pelvic inflammatory disease, inflammatory bowel disease, urinoma, and diverticulitis. Given her postoperative status, pelvic abscess is top on the differential diagnosis.

The patient was admitted to the inpatient gynecology service for further management. She was started on parenteral piperacillin-tazobactam. The patient was brought to the gynecologic procedure room and given IV sedation and pain medications. A speculum was placed, and a Malecot catheter was placed in her vaginal cuff to facilitate drainage. Daily complete blood count and chemistry panels were followed. After 48 hours of remaining afebrile, she was switched to an oral regiment of trimethoprim-sulfamethoxazole and metronidazole. She was discharged home to complete a total of 14 days of antibiotic therapy. The Malecot catheter was removed prior to discharge. The patient was instructed to follow up seven days after discharge, and to notify the surgeon with additional fevers, pain, or an increase in vaginal discharge.

Vaginal Cuff Abscess

The most common presentation of a vaginal cuff abscess after hysterectomy is a patient presenting with fever, tachycardia, and abdominal pain. This is a rare complication of surgery, as less than 1% of patients undergoing major obstetric or gynecologic surgery develop an abscess [1]. An abscess occurs as a direct result of a post-surgical infection. Risk factors for infection included smoking, elevated glucose preoperatively, poor nutritional status, coexisting infection (including pelvic

inflammatory disease or bacterial vaginosis), MRSA (methicillin-resistant *Staphylococcus aureus*) status, and immunodeficiency [1, 2].

The vagina is entered during the surgery and the surgical site is exposed to the anaerobic and aerobic polymicrobial flora found in the cavity. This type of wound is considered clean contaminated according to the Centers for Disease Control and Prevention (CDC) classification system [3]. Prevention strategies are important to minimize the morbidity of an abscess. Antibiotic prophylaxis is critical for the prevention of postoperative abscess and is indicated for all hysterectomies, regardless of the surgical approach. A broad-spectrum antibiotic (i.e. cefazolin) is dosed using a weight-based regiment given within 1 hour of the procedure [3]. If a patient has an allergy to a penicillin-based regiment, she will require one of the multi-dose regimens for prophylaxis. These include clindamycin or metronidazole plus gentamicin or aztreonam [3]. Antibiotic prophylaxis should be repeated if the patient's procedure lasts more than 4 hours, and greater than 1500 mL of blood is lost during a case.

Postoperative risk factors that predispose to pelvic abscess include hematoma formation. Intraoperatively, close attention to bleeding and meticulous surgical technique should be employed to minimize the risk.

Other considerations to minimize post-surgical abscess include maintenance of glycemic control in diabetic patients as well as treatments of remote infection (i.e. urinary tract) prior to the surgical procedure [4]. Bacterial vaginosis is also a risk factor for postoperative infection as it causes an alteration in the normal vaginal flora. Anerobic microorganisms and genital mycoplasma as well as the *Gardnerella vaginalis* organism predominate in women with bacterial vaginosis. Prior to the initiation of prophylactic antibiotics, screening for bacterial vaginosis before hysterectomy was recommended. However, as testing is low risk and easily available, considerations for testing and treating preoperatively should be entertained [3, 5]. Surgical skin preparation is recommended preoperatively. An alcohol-based agent is recommended for abdominal prep during a hysterectomy. Chlorhexidine-alcohol is the most endorsed agent. Chlorhexidine demonstrates superiority over povidone-iodine, as it is not inactivated by blood or serum proteins and has a higher reduction in skin microbes. The polymicrobial environment found in the vaginal cavity may contaminate the abdominal cavity thus preoperative prep of the vagina is recommended. Chlorhexidine gluconate has better antimicrobial activity then povidone-iodine, however, it is not FDA approved for vaginal site prophylaxis. The CDC does recommend chlorhexidine gluconate-based surgical prep for external skin cleansing and the American College of Obstetricians and Gynecologists (ACOG) does support the use vaginally. Many institutions do use it off label, and it is the author's preference [6]. If chlorhexidine is used, one should select asolution with 4% alcohol to minimize vaginal irritation, as the solutions with higher alcohol concentrations (up to 70%) can be extremely irritating to sensitive vaginal tissue [3].

The initial workup includes a history and physical examination with the focus on risk factors for post-surgical abscess. Laboratory evaluation includes complete blood count, urinalysis, and a basic chemistry panel. If the patient is febrile, a blood culture should be considered. Computed tomography scan with contrast is the imaging modality of choice; however, ultrasound can also be performed as a practical alternative.

Management

Principles of management include drainage and antibiotic therapy. As the mass in the presented case is visible on speculum examination, opening up the cuff to allow for drainage is a good first step. Placement of a drain (such as a Malecot catheter) into the vaginal cuff can further facilitate drainage. This can easily be performed in a procedure room under minimal sedation and pain medication. General anesthesia and/or the operating room may be utilized for drain placement depending on the patient's level of discomfort and the availability for adequate equipment, lighting, and a bed capable of providing the lithotomy position.

If the abscess is not visualized at the vaginal cuff, parameters for abdominal drainage are less clear. Many advocate draining of the mass if it is greater than 8 cm; however, emerging evidence suggests primary drainage may be of benefit in abscesses of a smaller size [7]. Note that this study only included tubo-ovarian abscesses, not those that occur post-hysterectomy, and this does represent an area in which further study is needed [7]. Abdominal drainage can be accomplished with the assistance of interventional radiology. Alternately, laparoscopic drainage with placement of a drain is an option if interventional radiology services are not available.

It is recommended to drain any abscess over 8 cm; however, if drainage is not performed primarily, it should definitely be performed with clinical failure. This is defined by the following parameters: hemodynamic instability, continued fever, enlarging abscess/fluid collection, lack of reduction in size of the fluid collection (<50%), worsening sepsis, increasing pain, or suspected abscess rupture [4]. Abscess at the vaginal cuff can be drained as previously described (i.e. opening the vaginal cuff); however, abscess in the upper pelvis should be drained via percutaneous interventional radiology techniques if possible. In a 2014 study that looked at over 240 patients with a postoperative abscess over 80% were treated successfully with antibiotics alone. It is important to note that the average-sized mass in those successfully treated with antibiotics was 5.9 cm compared to 8.5 cm in the antibiotic failure group [8].

Patients with pelvic abscess need to be treated with broad-spectrum antibiotics. Most postoperative abscesses are multi-organism and include enterococci, streptococci, and anaerobic bacteria. An empiric broad-spectrum penicillin-based regiment (i.e. piperacillin-tazobactam) is a good first choice for mild infections. Alternative regimens include ceftriaxone plus either

clindamycin or metronidazole. Moderate or severe infections should be treated with piperacillin-tazobactam plus gentamicin or ampicillin, or clindamycin plus gentamicin [9]. Change in therapy is indicated based on culture and sensitivity of the offending organism. Antibiotics are continued IV until the patient is stabilized, which includes maintaining afebrile status for 48–72 hours, decreasing white blood cell count and/or evidence of decreasing size on imaging. Parenteral antibiotics should then be converted to oral for a total of 14 days of therapy.

Key Teaching Points

- Postoperative cuff and pelvic abscess is one of the most common postoperative complications of hysterectomy
- The most common presentation for a postoperative abscess is abdominal pain, fevers, and a mass
- Risk factors for postoperative abscess should be identified preoperatively and addressed if possible, to minimize postoperative complications
- Treatment includes antibiotic therapy and drainage. Drainage should be performed primarily if the abscess is greater than 8 cm or if the patient fails medical management. Drainage methods include opening the vaginal cuff, CT-guided drainage, laparoscopic draining, or open drainage
- Antibiotic therapy should be continued for 14 days of therapy and should be changed based on culture and sensitivities

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CASE 80 A 45-Year-Old Woman with Decreased Urine Output on POD#1 after Robotic-Assisted Total Laparoscopic Hysterectomy

Timothy E. Klatt

History of Present Illness

A 45-year-old woman, gravida 4, para 4, is postoperative day 1 from a robotic-assisted total laparoscopic hysterectomy. By 02:00, she had produced only 10 mL of urine output over the prior 2 hours and a total of 50 mL over the past 7 hours. The surgery began at 15:00 yesterday and required 4.5 hours, the majority of which was spent dissecting the bladder free of the uterus and cervix. There was difficulty with the left uterine artery, leading to an estimated blood loss of 1500 mL. The patient was briefly hypotensive and responded to a large fluid bolus. At the end of the surgery, the operative field was dry and cystoscopy revealed vigorous jets from both ureters. Her starting hemoglobin was 11.2 g/dL. A repeat hemoglobin was planned for 02:30. Her urine has been blood tinged since the surgery. The patient has no medical problems and has had four previous cesarean deliveries. She takes no medications.

Physical Examination

General appearance: Well-developed, well-nourished female who appears pale and is breathing shallowly

Vital signs:

Temperature: 36.8°C
Pulse: 108 beats/min
Blood pressure: 90/50 mmHg. Preoperative pressures were 120–130/70–75 mmHg
Respiratory rate: 24 breaths/minute
Oxygen saturation: 93% on room air

Chest: Rales noted in the bottom third of both lung fields. Equal, shallow respirations

Cardiovascular: Tachycardia. Regular rhythm. No murmurs

Abdomen: Slightly firm. More tender than expected to gentle palpation. No guarding or rebound tenderness. Some blood staining on the dressings

Pelvic: Minimal blood on her pad. Bimanual deferred

Extremities: Normal. IV sites hemostatic

Neurologic: Sleepy and somewhat difficult to arouse

Urine: Urine in the Foley bag is concentrated and blood tinged. Urine in the tubing is clear. The course of the tubing is unobstructed

How Would You Manage This Patient?

The patient has oliguria in the setting of recent complicated surgery. Complete blood count, basic chemistry panel, and blood type and crossmatch were sent STAT. White blood cell count was 9500/μL, hemoglobin was 6.3 g/dL, platelets were 175 000/μL, and creatinine was 1.0 mg/dL. The lung examination suggested pulmonary edema, so furosemide was administered to correct presumed fluid overload, with 40 mL of urine output over the subsequent 2 hours. Chest x-ray was not obtained as the physical findings were felt adequate for the diagnosis. Bedside transabdominal ultrasound, with the Foley catheter clamped after 200 mL of normal saline had been instilled, was negative for free intraperitoneal fluid. As the patient was tachycardic with hemoglobin below 7.0 g/dL, a single unit of packed red blood cells was transfused. Nonsteroidal anti-inflammatory drugs (NSAIDs) were discontinued. Serial hemoglobin levels showed an increase to 7.4 g/dL 4 hours after the transfusion was completed and were stable afterward. Consultation was obtained from a hospitalist medicine specialist for guidance with the management of presumed acute kidney injury. Diuresis resolved her pulmonary edema and improved her oxygen saturation. Her vitals normalized. Serial serum creatinine assessments showed an increase to 1.75 mg/dL over the next 12 hours and a maximum of 2.5 mg/dL on postoperative day 2. She was discharged on postoperative day 3 after her creatinine exhibited a downward trend. After seven days, her serum creatinine decreased to 0.7 mg/dL.

Postoperative Oliguria

Oliguria is defined as urine production less than 0.5 mL/kg/h. Although most patients weigh more than 60 kg, many surgeons begin diagnostic evaluation when the urine output is less than 30 mL/h. The differential diagnosis includes urinary tract injury, inadequate fluid resuscitation, ongoing bleeding, volume overload, and acute kidney injury.

Urinary tract injury: Decreased urine output and ongoing blood-tinged urine in the Foley bag are suggestive of a urinary tract injury. The normal intraoperative cystoscopy combined with the urine clearing as indicated by no visible hematuria in the catheter tubing makes this much less likely. (Please see Cases 76 and 84 for discussions of evaluation and management of urinary tract injuries.)

Hypovolemia: The wide implementation of enhanced recovery after surgery (ERAS) programs [1], which encourage clear liquid intake until 2 hours prior to surgery, should decrease iatrogenic hypovolemia, especially for cases that start in the afternoon. Hypovolemia can be caused by both inadequate intraoperative fluid replacement and ongoing blood loss. The presence of concentrated urine in the Foley bag and a hemoglobin higher than expected are consistent with hypovolemia. An increase in urine output in response to a fluid bolus is expected when fluid replacement has been inadequate. This patient's pulmonary edema makes inadequate replacement unlikely and administration of a fluid bolus inappropriate.

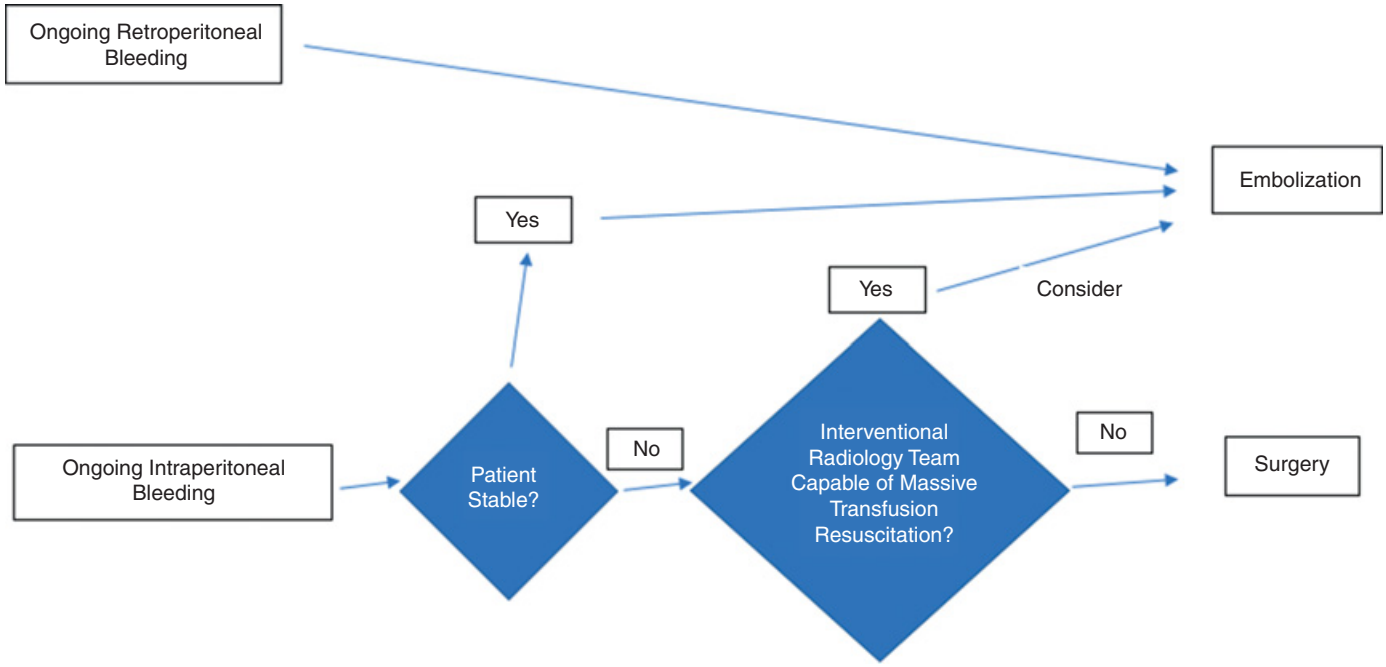

Figure 80.1 Management of postoperative bleeding.

Ongoing bleeding: The evaluation and treatment of postoperative hemorrhage is based on expert opinion, not quality evidence. This patient is clearly volume overloaded. However, her intraoperative bleeding, tenderness on abdominal examination, and low hemoglobin also makes continued bleeding a possibility. Her hemoglobin of 6.3 g/dL is consistent with her intraoperative blood loss. Significant bleeding can frequently be diagnosed on examination and lab findings alone, and management should not be delayed by imaging. When available, a bedside ultrasound can be used to approximate the focused assessment with sonography for trauma (FAST) evaluation for injury. In the FAST protocol, ultrasound is used to rapidly evaluate the thorax, right and left flanks, and pelvis for anechoic fluid. Since the pelvis is the most likely source of bleeding and is the most dependent portion of this supine patient, this view is key, and the other views may be omitted. Only a transabdominal probe is necessary. An empty bladder is the major reason pelvic free fluid is missed, so the bladder should be backfilled before scanning. The scan is performed systematically across the entire bladder looking for a fluid collection. The examination is considered positive if it reveals anechoic fluid. Free fluid, including unclotted blood, is typically anechoic. Clotted blood is more likely to be echogenic.

When the diagnosis is uncertain, CT of the abdomen and pelvis with contrast is generally preferred to ultrasound as it can detect blood in areas not seen by ultrasound, such as retroperitoneal hemorrhage. At times, it can localize active bleeding [2]. In patients like this with an elevated creatinine, consultation with a radiologist or renal specialist may be necessary to determine the safety and necessity of contrast administration. Ultrasound may be more appropriate in patients with impaired renal function.

This patient was unlikely to have ongoing bleeding. Management of continued bleeding is summarized in Figure 80.1. If the patient's condition can be stabilized outside of the operating room, embolization is preferred because it is associated with lower morbidity than reoperation [2, 3]. The source of the bleeding can be accurately identified with fluoroscopy, even at rates of 2–3 mL/min. Selective angiographic arterial embolization for post-surgical hemorrhage has demonstrated success rates of more than 90% [3]. Even large retroperitoneal hemorrhages are usually suitable for embolization as the patients are often adequately stable because the bleeding is relatively constrained. Unstable patients should be taken to the operating room immediately.

Volume overload: Volume overload may lead to pulmonary edema and cardiac dysfunction, especially among patients with a history of cardiovascular problems. It can occur in otherwise healthy patients. Volume overload can cause decreased perfusion of the kidneys and oliguria. Volume overload is treated with diuresis. This patient had clear findings of pulmonary edema on physical examination, which was recognized and immediately treated with diuresis.

Acute kidney injury: Acute kidney injury (AKI) is diagnosed by serum creatinine elevation. There is no standard definition. The American College of Surgeon's National Surgical Quality Improvement Project (NSQIP) defines AKI as an increase in serum creatinine of 2 mg/dL from baseline or the need for renal replacement therapy, while other organizations variously use increases of 3.5 and 4 mg/dL [4]. *Harrison's Principles of Internal Medicine* defines AKI as a rise in serum creatinine of at least 0.3 mg/dL above baseline within 48 hours or a reduction in urine output to <0.5 mL/kg/h for longer than 6 hours [5].

Table 80.1 Management of acute kidney injury

Management of acute kidney injury

1. Consider consultation with a specialist with appropriate expertise in managing AKI such as a nephrologist or intensivist
2. Where possible, stop or reduce nephrotoxic agents including NSAIDs, aminoglycosides, vancomycin, IV contrast, angiotensin-converting-enzyme inhibitors, and angiotensin receptor blockers
3. Adjust the dosing and administration frequency of medications for the degree of renal compromise
4. Optimize systemic and renal hemodynamics by maintaining appropriate volume status:
   - Maintain adequate hydration without overload
   - Manage hypotension with vasopressors as necessary
   - Treat fluid overload with diuretics and fluid restriction
5. Serially assess renal function
6. Initiate renal replacement therapy and dialysis if necessary

Percentage changes in serum creatinine after severe AKI are dependent on baseline kidney function. With normal baseline kidney function, the serum creatinine could increase by 50% within 4 hours and as much as 246% after 24 hours. Poorer baseline function is associated with smaller percentage increases. The absolute increase after 24 hours was nearly identical (1.8 to 2.0 mg/dL) across the spectrum of baseline function [6].

Postoperative AKI can be caused by intraoperative hypotension. One study analyzed 57 000 surgeries and reported that even a few minutes of intraoperative hypotension increased the risk for AKI. A mean arterial pressure (MAP) less than 65 mmHg for at least 13 minutes was associated with higher odds of myocardial and kidney injury. Injury was more common with prolonged hypotension. If MAP dropped to 50 mmHg for just one minute, the odds for both myocardial and kidney injury increased [7]. Cardiovascular disease, diabetes, chronic kidney disease, advanced age, sepsis, and obesity are risk factors for AKI [8]. Venous congestion due to volume overload can also cause AKI. Since kidneys are encapsulated organs, elevated central venous pressure can increase pressure along the renal vascular tree, causing renal congestion with compression of tubules and a decrease in the net pressure gradient across the glomerulus, decreasing the glomerular filtration rate [4].

From the acute rise in her creatinine, this patient appears to have AKI caused by her blood loss and intraoperative hypotension, likely compounded by her volume overload. Once the precipitating factors are corrected, the treatment of AKI is supportive (Table 80.1). Recovery of renal function is typical, even when AKI is severe enough to require dialysis [5].

Key Teaching Points

- Oliguria should be promptly evaluated as a patient can initially appear well and then suddenly decompensate. This is especially true for younger patients without comorbidities
- A bedside abdominal ultrasound, with a partially filled bladder, can rapidly evaluate for intraperitoneal fluid
- For stable patients with normal renal function, CT scan of the abdomen and pelvis with contrast is preferred over ultrasound for the radiologic evaluation of postoperative bleeding
- Acute kidney injury can result from even a few minutes of intraoperative hypotension and is treated through supportive therapy
- A diuretic such as furosemide should be administered if fluid overload is suspected

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CASE 81 A 38-Year-Old G0 Woman with a 4 Cm Umbilical Mass

Jessica Kingston

History of Present Illness

A 38-year-old nulligravid woman presents to the office with a painful umbilical mass present for one year. She describes near daily pain, worse just prior to and during menses. She also reports a one- to two-year history of dysmenorrhea and intermittent dyspareunia. Currently her pain is 3 out of 10, and during menses it increases to 6 out of 10. Menses occur at 24-day intervals with up to 7 days of bleeding, heavy on days 1 to 3. She is not currently sexually active and has no history of sexually transmitted infections. She denies any past medical or surgical history. Her medications include a combination oral contraceptive pill and ibuprofen as needed for pain. She has no known drug allergies. Family history is unremarkable.

Physical examination

General appearance: Well-developed female, appears comfortable

Vital signs:

Temperature: 36.8°C
Pulse: 76 beats/min
Blood pressure: 118/76 mmHg
Respiratory rate: 16 breaths/min
Height: 65 inches
Weight: 186 lb
BMI: 30.9 kg/m^2

Abdomen: Soft, non-distended. Well-circumscribed 3–4 cm non-reducible mass palpable at the inferior umbilicus with mild tenderness

External genitalia: Normal female, no lesions

Vagina: Normal rugae, no mucosal lesions

Cervix: No gross lesions, no cervical motion tenderness

Uterus: Retroverted, non-tender, mobile, slightly enlarged

Adnexa: No palpable masses, non-tender

Laboratory studies:

WBCs: 7400/μL
Hb: 12.9 g/dL
Platelets: 194 000/μL
TSH: 2.01 mIU/L
Electrolytes: Normal

How Would You Manage This Patient?

This patient presents with a mass causing chronic cyclic pain worse just prior to and during menses. An MRI was ordered, which showed:

> Cystic soft tissue thickening measuring 2.8 × 1.6 cm with foci of intrinsic T1 hyperintensity. Junctional zone thickening noted in the posterior uterus up to 2.5 cm compatible with adenomyosis. Abdomen and pelvis were otherwise unremarkable.

Based on the cyclic nature of her symptoms, physical examination findings, and imaging, a presumptive diagnosis of primary umbilical endometriosis was made.

The patient was scheduled for diagnostic laparoscopy with open excision of the umbilical mass and placement of levonorgestrel intrauterine device. After orogastric tube placement, a left upper quadrant primary port was introduced at Palmer's point. A secondary port was placed in the right lower quadrant to aid in manipulation of the adnexae. Survey of the abdomen revealed normal peritoneum and no evidence of umbilical hernia. Pelvic findings included a mobile slightly enlarged globular uterus, normal adnexae, and no evidence of peritoneal endometriosis. A circumferential incision was made with a scalpel around the umbilical mass. The mass was grasped with an Allis clamp, elevated, and dissected free from the surrounding subcutaneous tissue and fascia ensuring adequate margins (Figure 81.1). A 2 cm fascial defect was closed with 0 vicryl suture under direct laparoscopic visualization. The skin at the umbilicus was closed with 4–0 Monocryl. To address her dysmenorrhea, dyspareunia, and the finding of adenomyosis on MRI, a levonorgestrel intrauterine device was placed. She was discharged home the same day and was recovering well at postoperative visit two weeks later. Pathologic evaluation of the mass confirmed benign endometrioma. At follow-up one year later she reported decreased dysmenorrhea and dyspareunia, and her abdominal and pelvic examinations were normal.

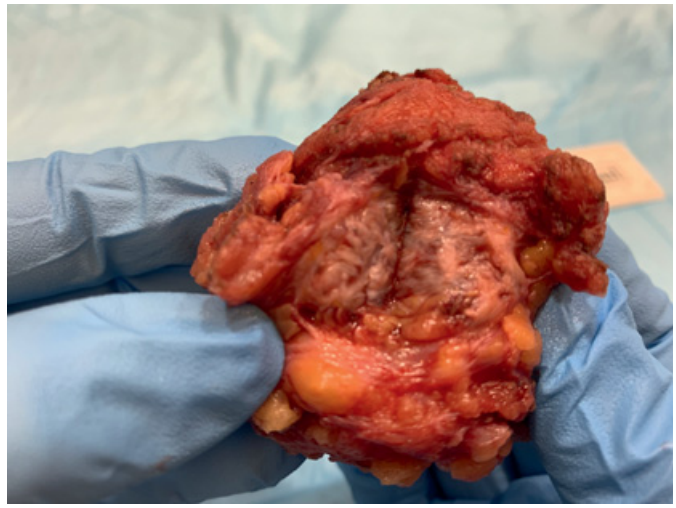

Figure 81.1 Gross appearance of excised abdominal wall endometrioma.

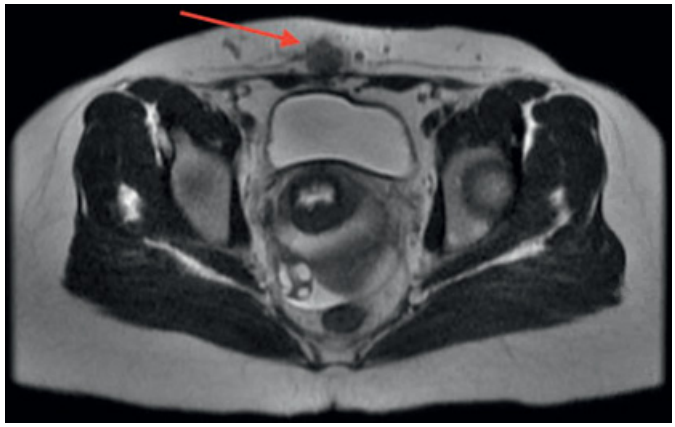

Figure 81.3 Magnetic resonance image transverse view of pelvis demonstrating endometrioma in cesarean incision.

performed to ensure complete removal. If the patient has additional symptoms or imaging suggesting pelvic endometriosis, as this patient did, laparoscopic diagnosis and treatment can be done at the same surgery. When the disease involves the abdominal wall fascia, complete excision can result in a defect, which may require mesh for adequate closure. Patients with lesions greater than 4 cm in size, or those with imaging demonstrating fascial involvement may benefit from a procedure done jointly with a general surgeon.

Recurrence after surgical excision occurs rarely, in contrast to medical treatment [2]. Pathologic confirmation of the diagnosis is an additional advantage of surgery. Incisional carcinoma of Müllerian origin is very unlikely in women with secondary abdominal wall endometriosis. The median tumor size in women diagnosed with incisional carcinoma was 8 cm, and median time from initial surgery to diagnosis was 18 years. A 2020 review noted 46 cases of incisional carcinoma published in the English language literature to date [5].

Interventional alternatives to surgery in treating abdominal wall endometriosis include high-intensity focused ultrasound (HIFU) and cryoablation. HIFU has been used as an ablative therapy with some success to treat leiomyomas and adenomyosis. A retrospective study done in China compared outcomes between HIFU and surgical excision [6]. At one year of follow-up, both had low complication rates and no recurrence. HIFU had advantages of shorter hospital stay, no blood loss, no surgical scar, and no need for anesthesia with lower immediate pain scores. Cryoablation has been used successfully for treating lesions up to 7 cm. A few studies have demonstrated a significant decrease in lesion size, improvement in pain scores, and low rates of recurrence sustained up to 42 months after treatment [7, 8]. Cryoablation complication rates were comparable to or even lower than those for surgical excision.

Key Teaching Points

- Primary umbilical endometriosis is rare and represents 75% of cases of abdominal wall endometriosis at this site
- Most cases of abdominal wall endometriosis occur in women with a history of cesarean section or pelvic laparoscopy and can present from 1 to 30 years after the initial surgery
- The most common presenting symptom for abdominal wall endometriosis is focal cyclic pain localized to a palpable abdominal mass
- Malignancy within secondary abdominal wall endometriosis is rare
- Abdominal wall endometriosis is primarily treated surgically. Lesions larger than 4 cm can involve the fascia, and complete removal may require mesh closure of the resulting defect
- High-intensity focused ultrasound and cryoablation are emerging treatment options that appear to be safe and effective alternatives to surgery

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CASE 82 A 26-Year-Old G0 Woman with Large Multifibroid Uterus Desiring Myomectomy

Michelle Meglin

History of Present Illness

A 26-year-old nulligravid woman presents with concerns of heavy menses and pelvic pain. Her last menstrual period was one week ago. She describes a long history of cyclic heavy menses which were initially improved on combination oral contraceptive pills but have worsened in the last two years. On her heaviest days, she soaks through a tampon in 1 hour and has soiled her clothes. She notes worsening pelvic pain which was previously limited to her menses but now feels like a constant fullness in her lower abdomen. She reports urinary frequency and denies dysuria or malodorous urine. She is not sexually active and denies a history of pelvic infections. She had a negative Pap test last year. She has a history of anemia, but no other medical problems. She has never had surgery. She desires future childbearing. She takes no medications other than her contraceptive pills.

Physical Examination

General appearance: Well-developed, no distress

Vital signs:

Temperature: 36.9°C
Pulse: 90 beats/min
Blood pressure: 125/78 mmHg
Oxygen saturation: 99% on room air

Chest: Clear to auscultation bilaterally

Cardiovascular: Regular rate and rhythm

Abdomen: Soft, non-distended. Non-tender in upper quadrants. Irregular pelvic mass palpable in the lower abdomen to 4 cm above the umbilicus which is mildly tender to palpation

Pelvic: Normal external genitalia. Physiologic vaginal discharge. Cervix is high in the vagina and normal appearing. Uterus is enlarged, irregular, 24-week size, mobile, with no descent. No adnexal masses

Laboratory studies:

WBCs: 8000/μL
Hb: 9.6 g/dL
Platelets: 210 000/μL
Ferritin: 8 ng/mL
Urine pregnancy test: Negative
Urinalysis: Negative for leukocytes, blood, and nitrites

Imaging: Pelvic ultrasound shows enlarged uterus measuring 20.5 cm × 15.1 cm × 14.6 cm with multiple fibroids. Endometrial thickness 6.1 mm. Fibroids: posterior intramural 9.8 × 7.4 × 7.9 cm, right fundal subserosal 7.5 × 6.4 cm × 6.8 cm, anterior intramural 6.6 × 5.5 × 4.5 cm, left fundal subserosal 4.5 × 3.3 × 3.3 cm, left lateral subserosal 6.2 × 5.5 × 6.6 cm, posterior abutting endometrium 3.3 × 2.7 × 2.5 cm

How Would You Manage This Patient?

This patient presented with chronic heavy menstrual bleeding and pelvic pain and had an enlarged uterus on examination. She was anemic and ultrasound confirmed multiple leiomyomas. She failed medical therapy with combination oral contraceptive pills, has bulk symptoms, and desires fertility preservation. She was scheduled for an abdominal myomectomy. Because of her anemia, the case was scheduled in three months, a single intramuscular injection of depot leuprolide acetate 11.25 mg was administered for menstrual suppression, and she was directed to take oral ferrous sulfate 325 mg daily. She returned to clinic two weeks prior to surgery with minimal decrease in fibroid size, but her hemoglobin increased to 12.5 g/dL. Misoprostol 400 mcg was administered vaginally 1 hour prior to surgery. She underwent an abdominal myomectomy with removal of multiple large leiomyomas. The endometrial cavity was entered during fibroid excision. She had an uncomplicated postoperative course and was discharged on the second postoperative day. She was counseled that she will need cesarean delivery.

Abdominal Myomectomy

Procedural or surgical management is warranted for women with fibroids who fail medical therapy or who have large fibroid uteri at the time of diagnosis. Procedural options include uterine artery embolization, leiomyoma ablation, endometrial ablation, myomectomy, and hysterectomy. Only myomectomy is recommended for patients who desire future childbearing [1]. Removal of multiple submucosal, intramural, or subserosal fibroids can be performed by laparoscopic, robotic-assisted laparoscopic, and open myomectomy (laparotomy) [2]. Abdominal myomectomy was most appropriate in this case due to the large number and size of uterine fibroids. Pelvic ultrasound and MRI can be useful in characterizing uterine fibroids to aid in preoperative planning (Figure 82.1). If minimally invasive myomectomy is being considered, MRI allows the surgeon to plan the number and expected depth of uterine incisions. In this case, the uterine fibroids were clearly visualized by ultrasound and minimally invasive myomectomy was not feasible, so MRI was not necessary.

Patients with bleeding from leiomyoma significant enough to require surgery often have iron deficiency anemia and require optimization prior to surgery. Rarely, excessive intraoperative bleeding during myomectomy may require conversion to hysterectomy and patients should be counseled

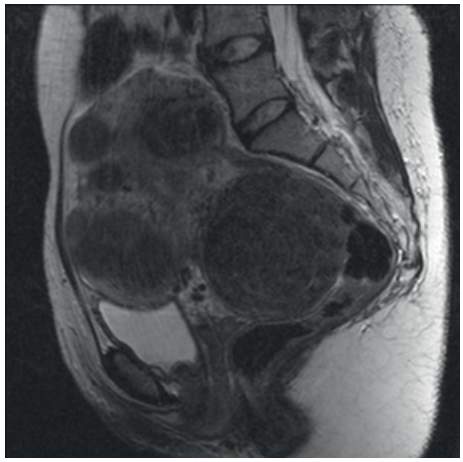

Figure 82.1 MRI image demonstrating an enlarged uterus with multiple fibroids.

regarding a <1% risk of hysterectomy. Administration of gonadotropin-releasing hormone (GnRH) agonists, such as leuprolide acetate, for two to three months preoperatively induces amenorrhea, reduces uterine volume (mean difference −175 mL) and increases hemoglobin (mean difference 0.88 g/dL). Preoperative GnRH agonist decreases intraoperative blood loss (−21 to 157 mL) during abdominal myomectomy but may be associated with higher blood loss during laparoscopic myomectomy (82 mL) [3]. Preoperative GnRH agonist therapy may make fibroids softer and the enucleation plane less distinct, which may increase operative time for minimally invasive myomectomy, but is unlikely to significantly impact abdominal myomectomy [3]. Preoperative iron supplementation may also increase the starting hemoglobin [1]. A randomized control trial comparing leuprolide and oral iron supplementation versus oral iron alone for three months demonstrated an improvement in hemoglobin from 8.2 to 12.7 g/dL and 8.0 to 11.5 g/dL, respectively [4]. This patient had significant iron deficiency anemia, which responded well to a three-month course of GnRH analog and supplemental iron.

There are several preoperative and intraoperative interventions to reduce blood loss at the time of myomectomy (Table 82.1) [5–7]. These interventions include administration of uterotonics, pharmacologic and mechanical vasoconstriction, and pharmacologic manipulation of the coagulation cascade. Preoperative administration of 400 mcg misoprostol vaginally reduces blood loss (mean −201 mL) and rates of transfusion, is low cost, and can be easily administered in preoperative holding. Intramyometrial injection of dilute vasopressin reduces blood loss (mean −245 mL) and transfusion risk (Figure 82.2) [5]. A recent meta-analysis found that a combination of vasopressin and preoperative rectal misoprostol was the most effective pharmacologic intervention to reduce blood loss (mean −652 mL) and transfusion and outperformed tourniquets [6, 7]. Intravenous tranexamic acid 10 mg/kg (max 1 g) administered prior to uterine incision also improves blood loss (mean −261 mL). Cervical tourniquets and infundibulopelvic ligament tourniquets or clamping are frequently used to reduce blood loss; however, there are few studies comparing tourniquets with placebo and no studies combining tourniquets with administration of misoprostol, vasopressin, or tranexamic acid [5].

Abdominal myomectomy is often feasible via a transverse incision; however, patients with very large fibroids or prior abdominal surgeries may require midline laparotomy. Myoma excision is accomplished by incising the overlying myometrium followed by blunt and sharp dissection of the myoma from the pseudocapsule. When planning uterine incisions, the surgeon should avoid the cornua and uterine vessels, incise the thinnest portion of the myometrium overlying the myoma, and remove as many fibroids as possible through each myometrial incision. Following fibroid removal, the uterine defect should be repaired in a multilayer closure with 2–0 to 0 delayed absorbable suture. If the endometrium is entered, it can be repaired with 4–0 or 5–0 delayed absorbable suture. Incomplete myometrial reapproximation may increase the risk of uterine rupture in a subsequent pregnancy. Limited data suggest that rate of uterine rupture following open or minimally invasive myomectomy is low; however, many obstetricians treat prior myomectomy similarly to prior classical uterine incision [1]. The American College of Obstetricians and Gynecologists identifies previous myomectomy entering the endometrial cavity as a contraindication to vaginal delivery [8].

The complex dissection of myomas, multilayer closure of myometrium, and need for tissue extraction makes minimally invasive myomectomy technically challenging. Minimally invasive myomectomy is associated with decreased blood loss, transfusion, postoperative pain, fever, shorter hospitalization, and longer operative time compared with open myomectomy [9, 10]. Several studies demonstrate feasibility of minimally invasive myomectomy with multiple (3–5) or large myomas (largest fibroid up to 6–12 cm). However, these procedures were performed by high-volume minimally invasive gynecologic surgeons and may not be generalizable to the typical specialist in obstetrics and gynecology [9, 10]. This patient was not a candidate for minimally invasive myomectomy due to having six fibroids, four of which were large (6–10 cm), and a large total uterine size (24 weeks).

Up to 93% of women will have improvement in heavy menstrual bleeding and pelvic pressure following myomectomy. Recurrence of symptomatic fibroids occurs in 11–84% of women depending on the duration of time from their myomectomy. Eleven to twenty-six percent of women may ultimately require hysterectomy [1].

Key Teaching Points

- Myomectomy is the only procedural or surgical treatment option recommended in women with symptomatic leiomyoma who desire future childbearing

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CASE 83 A 45-Year-Old Woman with a Foul-Smelling Pfannenstiel Incision on POD 7

Jade Stafford

History of Present Illness

A 45-year-old female, gravida 2, para 2, presents to the office on postoperative day 7 after an uncomplicated total abdominal hysterectomy for abnormal uterine bleeding caused by a 20-week-sized fibroid uterus. She was discharged home on postoperative day 2 after a postoperative course complicated by some challenges managing her blood glucose. She called your office after noting foul-smelling yellow discharge from her Pfannenstiel incision site beginning last night. She also reports intermittent low-grade fevers for the past two to three days. She is still taking ibuprofen and acetaminophen (Tylenol) for pain relief. She took her last ibuprofen dose this morning with breakfast. She rates her pain as 7–8/10. She has pain at and around the incision site and can express discharge from the wound when pressing on surrounding areas. She denies urinary or gastrointestinal symptoms. Her past medical history is significant for well-controlled hypertension and poorly controlled and long-standing diabetes. She takes hydrochlorothiazide, metformin, and long-acting insulin. Her surgical history is significant for two cesarean deliveries. She has no known drug allergies.

Physical Examination

General appearance: Overall well-appearing, mild distress noted on ambulation

Vital signs:

Temp: 37.7°C
Pulse: 112 beats/min
Blood pressure: 139/89 mmHg
Respiratory rate: 22 breaths/min
Oxygen saturation: 99% on room air
Height: 67 inches
Weight: 268 lb
BMI: 42 kg/m^2

Respiratory: Clear to auscultation bilaterally, no rales or rhonchi

Cardiovascular: Regular rhythm, tachycardic, no murmurs, rubs, or gallops

Abdomen: Obese, soft, non-distended. Erythematous, warm, and tender around incision. Induration around incision. Purulent appearing yellow drainage from the left lateral aspect of the incision. Increased drainage from wound when expressed. No crepitus noted. Wound probed with cotton swab and incision noted to have defect 3 cm in depth and 4 cm in length with fascia intact

Pelvic: Deferred

Neurologic: Alert and oriented × 3

Laboratory studies:

WBCs: 14 000/μL
Hb: 9.0 g/dL
Hct: 27.0%
Platelets: 225 000/μL

How Would You Manage This Patient?

This patient presented seven days after total abdominal hysterectomy with subjective low-grade fevers and new onset of foul-smelling drainage from her wound. On examination, her low-grade fever was confirmed, and her incision was erythematous, tender, and had purulent discharge coming from a skin defect. The differential diagnosis for drainage from a postoperative wound includes surgical site infection, wound seroma, wound hematoma, fascial dehiscence, and necrotizing fasciitis. Given this patient's low-grade fever, foul-smelling purulent drainage, erythema, induration, and skin defect, the suspicion for a superficial wound infection was high.

The patient's labs revealed a leukocytosis. A wound culture was sent. Results returned two days later showing *Staphylococcus aureus*. Her wound was irrigated, debrided, probed in the office, and the fascia confirmed intact. There was not crepitus present. She was able to tolerate food by mouth without nausea and vomiting, so was a good candidate for outpatient management. The patient was started on a course of oral antibiotics with cephalexin (500 mg PO QID) for 14 days. Her partner was instructed on how to change wet-to-dry dressings twice daily and she was advised to return weekly until the wound completely healed. She returned weekly for four weeks until the wound was closed.

Superficial Surgical Site Infections

Surgical site infections (SSIs) are defined by the Centers for Disease Control as an infection related to an operative procedure that occurs near the surgical site within 30 days after the procedure. SSIs are further classified as follows:

Superficial: Involving the skin and subcutaneous tissues

Deep: Involving deeper soft tissues of the incision including the muscle or fascia

Organ/space: Involving anatomy deeper to the incised layers [1]

In this case, the patient presented complaining of a foul-smelling and painful incision on postoperative day 7. On examination, her infection is limited to the skin and subcutaneous tissues, meeting the criteria for superficial SSI.

SSIs complicate approximately 2% of hysterectomies. They are a significant cause of morbidity and mortality. They are a leading cause of hospital readmission with mortality rate as high as 3% [2]. Patient-specific risk factors include obesity, smoking, immunosuppression, diabetes mellitus, cardiovascular disease, depth of subcutaneous tissue ≥3 cm, Group B streptococcus vaginal colonization, history of methicillin-resistant *Staphylococcus aureus* (MRSA), and poor nutrition [3]. Preoperative risk factors include the route of hysterectomy (abdominal conferring the greatest risk), skin cleansing and washing, glycemic control, and hair removal. Intraoperative factors include prophylactic antibiotics, abdominal and vaginal prep, wound closures, supplemental oxygen, temperature, operator experience, and increased operative time. Postoperative factors include glycemic control, supplemental oxygen, wound dressing, and blood transfusion [4, 5]. The patient had several risk factors for a wound infection including obesity, history of two prior surgeries at the incision site, and diabetes.

Total abdominal hysterectomies are clean-contaminated procedures. Pathogens originate from the flora in the patient's skin or vagina. The incision in the abdomen exposes the internal surfaces to these bacteria. Organisms include aerobic gram-positive cocci such as staphylococci. When the colpotomy is performed, the abdomen is exposed to vaginal flora. These organisms are polymicrobial and include aerobes and anaerobes. Bacterial vaginosis infection changes the flora of the vagina and increases the risk of infection with anaerobic bacteria [3]. Early-onset infections are most commonly caused by group A β-hemolytic streptococcus or group B β-hemolytic streptococcus. Late-onset infections are due to *S. aureus* [6].

Evidence-based measures should be routinely used to reduce SSI risk. Preoperatively, bacterial vaginosis should be treated, the incision site should be clipped (not shaved), the patient should have an antimicrobial bath or shower, skin should be prepared with an alcohol-based agent (unless contraindicated), and the vagina prepared with a povidone-iodine solution. During the case, aseptic technique should be maintained, and operating room traffic minimized. Good surgical technique should include achieving hemostasis, preventing hypothermia, closing dead space, and removing devascularized tissues. The appropriate choice and dose of an antibiotic should be given before the start of the case. Prophylactic antibiotics should be repeated for prolonged cases (>3 hours if cefazolin is used for prophylaxis) or high blood loss (>1500 mL). Obese women require increased doses of some antibiotics [3]. Euglycemia should be maintained throughout the perioperative period, particularly important in a patient like this one with diabetes [4]. Safety bundles have been widely adopted to decrease SSIs. Safety bundles are collections of evidence-informed practices aimed to improve patient care outcomes in the surgical setting. Enhanced recovery after surgery (ERAS) programs are comprehensive evidence-based practices with the goal of decreasing surgical stress to expedite healing and recovery [3].

Presence, extent, and type of infection is generally determined by history and physical examination. Relevant history for superficial surgical site infection can include the spontaneous passage of fluid from the incision. Fever and leukocytosis may be present but can also reflect other postoperative complications. The wound may have purulent drainage, skin erythema, or induration. Fascial integrity should be confirmed whenever the wound is open. A complete blood count can be helpful, and other labs drawn as necessary to ensure other infections are not present. A wound culture is important to rule out *Pseudomonas* or MRSA [6]. Based on the physical examination, the need for imaging can be determined. Pelvic ultrasound or CT may be helpful to evaluate the extent of SSI, and other imaging may be necessary to assess for other infection sources [6].

The management of all superficial wound infections includes evacuation of the purulent material, debridement of necrotic tissue, and initiating appropriate antibiotics. Debridement at the bedside may be uncomfortable for the patient and local anesthetics should be used as necessary. If the patient is unable to tolerate bedside debridement or the wound has significant depth or may involve the fascia, then exploration in the operating room should be considered. Once the wound has been drained and debrided, the patient should have wet-to-dry dressing changes once to twice daily. The patient or a home care provider will need to be instructed on how to manage these dressing changes. The patient should return for in-office evaluations to assess wound healing progress. Weekly visits until the wound has closed are reasonable. This patient's wound closed after approximately four weeks, but this can be variable.

Cephalexin (500 mg PO QID) or dicloxacillin (500 mg PO QID) can be used for outpatient management of superficial SSI with a low suspicion for MRSA. If MRSA is suspected, trimethoprim-sulfamethoxazole (DS PO BID), doxycycline (100 mg PO BID), or clindamycin (300 mg PO TID) can be administered [7].

Most patients with superficial SSIs will not require hospital admission. If temperature is greater than 38.3°C and there is evidence of peritonitis, intra-abdominal or pelvic abscess, hypotension, or other lab indicators of sepsis, then inpatient admission is appropriate. If the patient requires admission, parenteral antibiotics should be administered. Choices include cefazolin (1–2 g IV q 6 h), ceftriaxone (1–2 g IV q 24 h), cefoxitin (2 g IV q 6 h), ampicillin-sulbactam (3 g IV q 6 h), or piperacillin-tazobactam (3.375 g IV q 6 h) [7].

Negative pressure wound therapy may be beneficial for obese patients with significant wound depth. If used, it should be changed two to three times per week [8]. Delayed primary closure can be performed four days after resolution of the subcutaneous infection either at the bedside under local anesthesia or in the operating room. Delayed absorbable suture should be used to reapproximate the edges of the tissue. This technique helps to decrease healing time and the number of postoperative visits. It is not usually performed for superficial SSI as it requires an additional surgical procedure.

Key Teaching Points

- The wound should be probed to ensure fascial integrity as fascial dehiscence is a surgical emergency
- Outpatient management of superficial SSI usually includes oral antibiotic therapy and incision and drainage of the wound at the bedside or in the operating room. The wound is allowed to heal by secondary intention with wet-to-dry dressing changes or reapproximated using delayed primary closure
- Inpatient admission is appropriate when temperature is greater than 38.3°C, there is evidence of peritonitis, intra-abdominal or pelvic abscess, hypotension, or other lab indicators of sepsis
- Negative pressure wound therapy can be considered in patients with significant wound depth
- Patients should be followed closely until wound closure is complete

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CASE 84 A 45-Year-Old Woman with Watery Vaginal Discharge Six Weeks after Hysterectomy

Zineb Mashak

History of Present Illness

A 45-year-old female, gravida 3, para 3, presents to the office for a postoperative visit complaining of watery vaginal discharge. She underwent a hysterectomy six weeks ago for abnormal uterine bleeding. Two weeks ago, she first noticed intermittent watery vaginal discharge, which has become persistent. She describes the discharge as yellow and sometimes blood tinged. She also reports pain in her vagina and an abnormal urinary stream. She denies dysuria, fevers, chills, nausea, or vomiting. She has regular bowel movements and denies hematochezia. She underwent a laparoscopic assisted vaginal hysterectomy with bilateral salpingectomy. The procedure was difficult due to dense adhesive disease in the vesicouterine space. She has not resumed sexual activity and plans on returning to work next week.

Her past medical history is significant for obesity and hypertension. Her past surgical history is significant for three cesarean deliveries and a laparoscopic cholecystectomy. She takes no medications.

Physical Examination

General appearance: Alert and oriented, comfortable

Vital signs:

Temperature: 37.3°C
Pulse: 92 beats/min
Blood pressure: 130/94 mmHg
Respiratory rate: 18 breaths/min
Height: 63 inches
Weight: 247 lb
BMI: 43 kg/m^2

Abdomen: Non-distended, bowel sounds present, soft, nontender, no rebound or guarding, no masses. All incisions appear clean, dry, and well healed

External genitalia: Normal appearing vulva, introitus is intact, no prolapse noted

Vagina: Vaginal mucosa is pink and moist, vaginal cuff appears intact, watery discharge with urine odor. No defects noted on speculum examination

Bimanual examination: No masses or tenderness

How Would You Manage This Patient?

This patient presented with watery vaginal discharge six weeks after a hysterectomy. A speculum examination was performed, which noted fluid, but could not identify the source. A sample of the fluid was sent for creatinine measurement, which returned 133 mg/dL. The patient returned to the office for a tampon test. Her bladder was filled with methylene blue through a urinary catheter to maximum capacity. A tampon was placed in the vagina and turned blue. Serum creatinine (0.6 mg/dL) and urine culture (no growth) were sent. An indwelling urinary catheter was placed to divert urine from the fistula tract. Cystogram showed a defect in the posterior wall of the bladder consistent with vesicovaginal fistula (Figure 84.1).

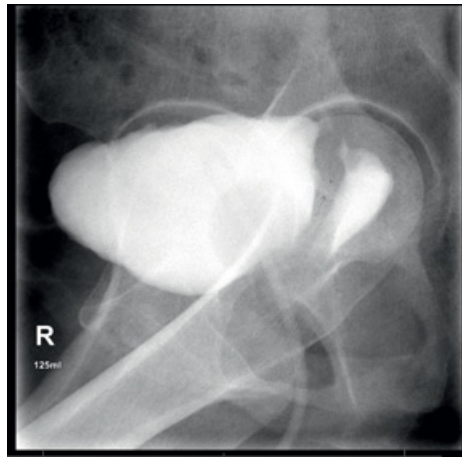

Figure 84.1 Cystogram with contrast extravasation from bladder to vagina. Arrows indicate fistulous tract.

The patient was referred to a urogynecologist, who performed office cystourethroscopy, confirming a vesicovaginal fistula. She did not have any evidence of inflammation or infection. Options discussed with the patient included expectant management, extended Foley catheter diversion, or surgical closure. The patient elected surgical management. Repair of the vesicovaginal fistula was performed via a vaginal approach. The fistulous tract was excised, and the defect closed in several layers. Her surgery was uncomplicated. She was discharged home with a Foley catheter and was instructed to use vaginal estrogen cream. She followed up one week after surgery for a voiding cystourethrogram, which revealed no extravasation of contrast from the bladder. She passed an in-office voiding trial and the catheter was removed. At her six-week postoperative visit she was voiding without difficulty and was able to resume usual activities.

Genitourinary Fistula

Bladder injury is the most commonly reported urologic complication of gynecologic surgery because of the bladder's close proximity to the upper vagina and lower uterus. The dome is the most commonly injured portion. The ureter is also at risk of injury because of its close proximity to the cervix, uterine arteries, and the ovarian vessels near the pelvic brim [1]. The

overall incidence of urinary tract injuries during gynecologic surgery is reported to be approximately 0.33%, which includes a 0.08% incidence of ureter injury and 0.24% incidence of bladder injury [2]. The incidence of vesicovaginal fistula is reported to be 0.02% and is highest after laparoscopic and abdominal hysterectomy, and lowest after vaginal hysterectomy [3]. The most common risk factor associated with urinary tract injury at the time of hysterectomy is anatomical distortion. Common causes include endometriosis, uterine fibroids, prolapse procedures, previous cesarean birth, malignancy, and excessive bleeding at the time of surgery.

Preventative measures include meticulous surgical technique, optimized exposure to important anatomical structures such as the ureters, and sharp rather than blunt dissection, especially at the vesicouterine junction [4]. Routine intraoperative cystourethroscopy increases the detection rate of injuries and allows for immediate repair, which significantly reduces morbidity and improves outcomes. Routine cystourethroscopy can miss injuries caused by delayed thermal effect, postligature swelling, and defects too small to see [4]. When a bladder or ureteral injury is diagnosed intraoperatively, repair should be performed immediately by a surgeon with appropriate training and expertise.

Unrecognized injuries, as occurred in this patient, can result in increased morbidity, further medical expenses, and risks of medicolegal actions. Iatrogenic bladder and ureteral injuries increase the risk of hospital readmissions and potentially life-threatening complications [5]. Post-surgical fistula usually present days to weeks after surgery. If the fistula is diagnosed within 72 hours of the initial surgery, early repair is possible. Once past 72 hours, repair is typically delayed 6–12 weeks to allow for granulation tissue to resolve, improving the chance of a successful repair [1]. During this period, prolonged bladder drainage with a Foley catheter is recommended. Spontaneous closure is more likely to occur in patients with small urinary tract injuries that are diagnosed soon after surgery.

When a bladder injury is suspected postoperatively, speculum examination should be performed. If the defect is large, it is usually visualized without difficulty. If a fistula is not seen, a tampon test can be performed in the office. The test is performed by filling the bladder with diluted methylene blue or indigo carmine through a urinary catheter to maximum capacity. Provocative maneuvers, such as Valsalva and manual pressure over the bladder, can be used to reproduce and confirm the patient's symptoms. Presence of blue or green dye on the tampon is usually indicative of a vesicovaginal fistula. A wet but unstained tampon is strongly suggestive of a ureterovaginal fistula, but this requires confirmation. To test for both, the patient may be given 100 mg of oral phenazopyridine 1–2 hours prior to the test and a dye instilled into the bladder. Presence of orange color on the tampon suggests a ureterovaginal fistula, while presence of blue or green suggests of a vesicovaginal fistula. In this case, a cystogram confirmed the findings suggested by the tampon test and localized the vesicovaginal fistula to the posterior bladder wall. Cystourethroscopy should be performed to identify the location, number, and size of fistulous tracts. This patient had initial confirmation by cystogram, and further information obtained by in office cystoscopy, confirming a single vesicovaginal fistulous tract. CT cystogram is another imaging study that is used to confirm location of a fistula (Figure 84.2).

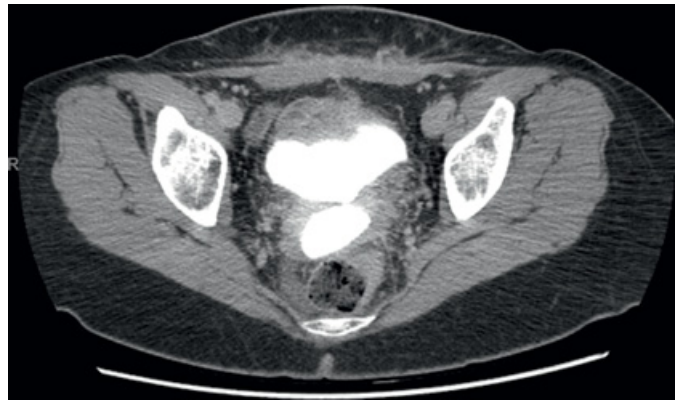

Figure 84.2 CT cystogram of a vesicovaginal fistula. Contrast present in both bladder and vagina.

Ureterovaginal fistulas are typically caused by ureteral kinking or obstruction. When a ureterovaginal fistula is suspected, CT IV pyelography is used to confirm the diagnosis [1]. Once a ureterovaginal fistula has been diagnosed postoperatively, immediate ureteral stenting for relief of renal obstruction is necessary to prevent kidney loss [6]. If a ureteral stent cannot be advanced, a nephrostomy tube should be placed. At time of repair surgery, if ureteral kinking or ligation with a suture is found, the suture should be removed or a ureteral stent placed if possible, as this may relieve the obstruction and avoid the need for more invasive procedures. If the ureter has extensive damage or has been transected, reanastomosis or ureteroneocystostomy is usually necessary [7].

Key Teaching Points

- Urinary tract injuries occur in approximately 0.33% of hysterectomies, with 0.24% bladder and 0.08% ureter injuries
- Repair should be performed immediately when an injury is identified intraoperatively
- Postoperative injury recognition requires a high level of suspicion. Cystoscopy and imaging studies are used to determine the location and extent of the injury
- Patients with vesicovaginal fistula typically present days to weeks after surgery with watery vaginal discharge
- Conservative management with catheter drainage or ureteral stenting may be the first-line management option for small fistulas
- Unless the fistula is diagnosed immediately postoperatively, repair should be delayed 6–12 weeks to allow granulation tissue to resolve

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CASE 85 A 34-Year-Old G0 Jehovah's Witness Undergoing Myomectomy

Kamilah Dixon-Shambley

History of Present Illness

A 34-year-old gravida 0 patient presents to your clinic with complaints of heavy menses and dysmenorrhea. She reports monthly periods lasting 10 days during which time she soaks overnight pads every 2 hours. She often passes large clots and has bled onto her sheets at night. She takes ibuprofen for cramping during her period and often misses work due to her symptoms. She has never been pregnant, but she and her partner would like to have children in the next few years. She denies other medical history and has never had surgery. She takes no medications besides ibuprofen and has no drug allergies. She states that she is a Jehovah's Witness and does not accept blood products.

Physical Examination

General appearance: Well-developed female, no distress

Vital signs:

Temperature: 36.7°C
Pulse: 86 beats/min
Blood pressure: 126/75 mmHg
Oxygen saturation: 99% on room air
Height: 65 inches
Weight: 175 lb
BMI: 29.1 kg/m^2

Abdomen: Soft, normal active bowel sounds, non-tender to palpation, uterus palpated to 2 cm above umbilicus

Pelvic:

Vulva: Normal external genitalia, no lesions
Vagina: Normal pink rugae, no discharge, no masses, no blood in the vault
Cervix: Normal, deviated to the right, no lesions, no discharge
Uterus: Enlarged, irregularly shaped, 22-week-sized, non-tender to palpation
Adnexa: Normal bilateral adnexa, no masses appreciated

Laboratory studies:

Hb: 9.1 g/dL
Hct: 27.3%
Ferritin: 25 ng/mL
Urine pregnancy test: Negative

Imaging: Pelvic ultrasound shows a bulky enlarged uterus measuring 10 × 6 × 5 cm with two enlarged subserosal fibroids at the fundus measuring 7 × 6 cm and 8 × 6 cm. Normal bilateral ovaries and fallopian tubes

How Would You Manage This Patient?

The patient was counseled regarding her treatment options for her symptomatic multifibroid uterus including expectant management, hormonal medications, surgical management with myomectomy or hysterectomy, and uterine artery embolization. As she wanted to preserve her fertility, she opted for abdominal myomectomy. The patient was counseled regarding the risks of abdominal myomectomy including pain, infection, bleeding, hemorrhage, damage to surrounding structures, fibroid recurrence, possible need for hysterectomy, and likely need for cesarean delivery with future pregnancy. She was advised of the need to correct her anemia prior to surgery given the likelihood of surgical blood loss and her inability to accept blood transfusion.

The products and procedures that were acceptable to the patient in the event of hemorrhage were clarified. She agreed to the use of volume expanders, intraoperative cell salvage, and postoperative use of erythropoietin and clotting factors if necessary. Before the procedure, the patient agreed to iron supplementation. She wanted to minimize side effects, so chose a short course of hormonal birth control instead of a gonadotropin-releasing hormone (GnRH) analog to diminish her bleeding and to schedule the surgery after her anemia was corrected.

IV iron was administered and six weeks later her hemoglobin improved to 11.2 g/dL and surgery was performed through a vertical incision. She had a total estimated blood loss of 300 mL. Cell salvage was used, and tranexamic acid was given intraoperatively. The patient recovered well postoperatively.

Jehovah's Witness Undergoing Abdominal Myomectomy

Jehovah's Witness is a denomination of Christianity which was started in Pittsburgh, Pennsylvania. There are approximately 8 million Jehovah's Witnesses worldwide with a little over 1 million in the United States. One of the notable tenets is adherence to biblical text which prohibits participants from accepting whole blood or its primary components in any form including red blood cells, white blood cells, platelets, and plasma [1].

While the acceptance of whole blood is prohibited in this religion, administration of some blood components may be acceptable to some patients. A full list of potential options is available in the Jehovah's Witness literature and includes the use of hemin, hemoglobin, albumin, clotting factors, fibrinogen, and immunoglobins [2]. While autologous blood transfusion is generally not acceptable, the use of cell salvage may be accepted by some patients, like the patient in this case, and some may request continual reinfusion of the blood if possible [3]. Counseling, and preoperative and intraoperative management are summarized in Figure 85.1.

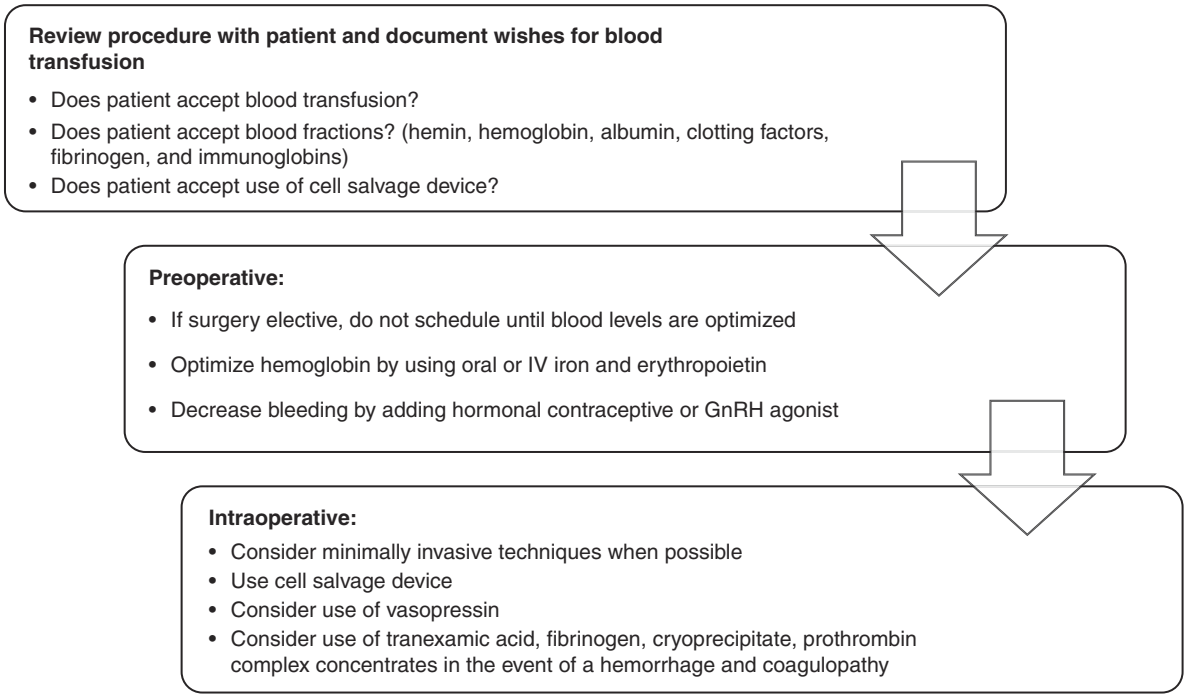

Figure 85.1 Management of patient undergoing abdominal myomectomy who declines blood transfusion.

Counseling of this patient includes describing the risks and benefits of blood transfusion and frank discussion of the possibility of death with refusal of blood products. While death is rare, risk of death is increased in Jehovah's Witness patients with a hemoglobin of less than 8 g/dL and can double with every 1 g/dL decrease in nadir hemoglobin [4, 5]. Shared decision-making should be conducted between the patient and her medical team regarding which medications, products, or procedures she would accept in the event of acute hemorrhage. A list of potential alternatives can be provided to the patient for her review and multiple discussions may be necessary to clarify the patient's desires. This discussion is optimally done at least in part with the patient alone to diminish possible undesired influences from family or religious leaders. It is not appropriate to assume that specific procedures would absolutely be denied by a specific patient. One study based on anonymous surveys of Jehovah's Witness patients reported 10–12% stated they would accept transfusion in a life-threatening situation [4]. Once common understanding is reached regarding acceptable options, the decisions made should be documented clearly for the entire medical team to eliminate confusion in the event of an acute hemorrhage. Medical ethics supports the autonomy of the patient to decline medical treatments including blood transfusion during a life-threatening event. Once the desires of the patient have been clarified, it is the responsibility of the medical team to respect her decisions even if doing so may cause harm or death [5].

Previous studies report an average blood loss for abdominal myomectomy ranging from 200 to 800 mL depending on the size of the uterus [6]. Published transfusion rates range from 6% to as high as 52% [7]. Patients should be counseled regarding the risks and management of surgical blood loss, especially if they refuse transfusion. With this patient's continued desire for fertility, less invasive treatments such as uterine artery embolization were not employed. Her religious faith should not limit her from getting the best treatment option and surgical interventions can still be performed despite her refusal of blood transfusion.

Preoperative management should focus on optimizing blood counts prior to surgery. Both oral and IV iron supplementation are effective for preoperative correction of iron deficiency anemia. IV iron is well tolerated and has been shown to be as effective as oral iron with fewer gastrointestinal side effects [8]. There are many formulations of IV iron, and selection is based on patient factors. It can be administered as a single or series of doses. A systematic review noted that IV iron increases the hemoglobin and reduces allogenic red blood cell transfusions [8]. Erythropoietin can also help optimize blood levels, especially in anemia of chronic disease. Erythropoietin increases erythrocyte production and promotes release of erythrocytes from the bone marrow, which in turn increases the blood count. On average, erythropoietin administration can lead to an increase of hemoglobin by 1.44 g/dL per week [5]. If there is concurrent iron deficiency, it is best used in concert with IV iron to maximize formation of blood components. There are two FDA approved regimens for erythropoietin based on time to surgery in which weekly or daily doses are used [3, 4]. In addition to optimization of iron levels, prevention of further blood loss is extremely important in reversing preoperative anemia. Hormonal birth control or GnRH agonists can be used to suppress menses and optimize starting hemoglobin. In this case, the patient opted for the use of combined oral contraceptives to avoid the menopausal side effects of GnRH therapy.

A minimally invasive technique can be considered if technically feasible, but depending on the anatomical considerations and previous history, a laparotomy may be necessary. This patient's large myomas precluded a minimally invasive approach. As laparotomy was necessary, the use of a vertical incision was helpful in gaining adequate access in the event of acute hemorrhage. Multiple myomas were removed from as few incisions on the uterus as possible to decrease blood loss. Surgical techniques aimed at decreasing blood loss such as the administration of vasopressin and use of uterine tourniquet are discussed in Case 82. The use of a cell salvage device is recommended in cases where patients cannot receive blood transfusion [5]. A Cochrane review showed that in elective surgery predominantly in the orthopedics field, the use of cell salvage decreased the need for allogenic blood transfusion by 38% [9]. The cell salvage device is a self-contained unit composed of a suction device with tubing connected to a reservoir. Suction is used to obtain blood lost from the surgical field, which is then transferred to a reservoir for filtration. Once debris is filtered out of the blood, it can be infused back into the patient. Processing of the blood is triggered by a blood volume in the reservoir which varies between 375 and 750 mL. The whole reservoir can be processed in 3 minutes [5]. Typically, arrangements need to be made in advance to have the equipment and operator available for the case.

In the event of hemorrhage, the use of antifibrinolytics such as tranexamic acid has been shown to decrease the need for blood transfusion. The use of fibrinogen and other blood components such as cryoprecipitates and prothrombin complex concentrates has also been proven to be beneficial in the management of patients with acute hemorrhage who may also have developed coagulopathies [3, 4]. As they are blood products, their potential use should be clarified with the patient prior to the procedure. IV iron, erythropoietin, and continued menstrual suppression can be employed to correct postoperative anemia.

Key Teaching Points

- Jehovah's Witness is a denomination of Christianity which prohibits the transfusion of blood products
- Jehovah's Witness patients can safely have surgical procedures despite their refusal of blood products
- Shared decision-making is essential in preserving the autonomy of Jehovah's Witness patients and each patient may have different acceptance of various blood components based on their beliefs
- Patients should have menstrual suppression and iron supplementation to correct preoperative anemia and optimize blood levels prior to surgery
- Cell salvage, if acceptable to the patient, is useful intraoperatively to decrease need for blood transfusion

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Preoperative Optimization

Identifying and optimizing risk factors prior to surgery are key to reducing surgical risks for obese patients. Weight loss prior to surgery would be ideal but delaying surgery for the months or years required is rarely practical. It would not have been appropriate for this patient. Hypertension, diabetes, and OSA are common in obese patients. Factors not related to weight, such as smoking, should also be addressed. This patient had hypertension and diabetes. Although obesity alone is not an indication for specific preoperative testing, the preoperative evaluation should address the patient's specific comorbidities. Preoperative testing for this patient should include an electrocardiogram, evaluation of diabetes control (such as with a hemoglobin A1c), and adjustment of medications to achieve good control [3].

Obstructive sleep apnea can be screened for using the STOP-BANG questionnaire [4] or other similar screening tools. STOP-BANG incorporates symptoms, hypertension, age, BMI, neck circumference, and gender. Using this scoring system, a score ≥5 indicates high risk and the need for further evaluation for OSA, including referral to anesthesia or sleep medicine and possibly polysomnography. This patient had three risks (BMI >35 kg/m^2, age >50 years, and hypertension) as well as symptoms, giving her a score of 6, warranting further workup. OSA increases the difficulty of intubation, the risk of cardiac events, intensive care unit admission, and longer hospital stays [2]. Pre and postoperative CPAP and good pain management can help decrease these risks.

This patient's large uterus required an abdominal approach. Vaginal and minimally invasive approaches should be used when possible as morbidity is lower with these approaches in obese patients, as it is in normal weight patients [5].

Intraoperative Strategies to Maximize Access and Decrease Morbidity

Obese patients need to be positioned to avoid injury and maximize exposure, and equipment appropriate for the patient's weight is required. Boot-type stirrups provide more support than other stirrup types and can support patients from 227 kg to 354 kg. Operating tables usually have weight limits from 205 kg (standard) to 455 kg [3]. Side extensions are available and may be necessary. Obese patients are more susceptible to nerve injuries and pressure sores, and extra padding should be used as necessary. The pannus can be taped up to allow access to the lower abdomen and restore the abdominal wall to a more anatomic position if needed [6]. Depending on the individual's anatomy, some patients' exposure may be enhanced by taping the pannus down and incising above the umbilicus. Patients should be examined in position for surgery to make the determination, which will include factors such as minimizing depth of soft tissue, mobilizing the pannus out of the way, avoiding the skin fold under the pannus, and ensuring fascia is entered in an appropriate location to visualize the pelvis. Even if not obese, this patient would have required a vertical incision because of the size of her uterus and prior surgeries. The shape of her pannus made better visualization likely by elevating the pannus and making an infraumbilical incision as opposed to leaving it in its anatomic position or pulling it down and incising supraumbilically. Longer instruments and retractors with deeper blades are usually necessary.

Risk of surgical site infection (SSI) can be reduced with appropriately dosed preoperative antibiotics and skin preparation. Although data in gynecologic surgery are limited, weight-based doses of prophylactic antibiotics are generally recommended, and patients who weigh more than 120 kg should receive a 3 g dose of cefazolin as opposed to the standard 2 g [7]. Patients should be assessed for thromboembolism risk and receive prophylaxis as recommended in the CHEST guidelines. Obesity is a risk factor for venous thromboembolic events, and factors into the Caprini score for assessing risk of perioperative venous thromboembolism (VTE). Depending on other risk factors, patients who are obese undergoing gynecologic surgery often fall into the moderate- or high-risk categories. This patient had a Caprini score of 5 based on weight, major surgery, lung disease, and age. CHEST guidelines recommend pharmacologic prophylaxis with heparin and also suggest using mechanical prophylaxis, such as with sequential compression devices. This patient received both. Patients who are at moderate risk of VTE, but high risk of serious bleeding, should have mechanical prophylaxis alone, until the risk of bleeding has decreased [8].

Different surgical techniques have been suggested to decrease SSI, including closure of subcutaneous tissue and special surgical dressings like wound vacuums. Data on these techniques are limited in benign gynecologic surgery and more studies are needed [3].

Postoperative Considerations

Postoperatively, care should be taken to prevent DVT and decrease respiratory complications, especially in patients with OSA. Measures to prevent thromboembolism include early ambulation. In moderate- to high-risk patients, mechanical and pharmacologic prophylaxis should be continued as per the CHEST guidelines [8]. Physical therapy and other hospital services may be useful in helping with ambulation [6, 8]. Sequential compression devices and heparin were continued through this patient's hospital stay.

Obese patients, especially those with OSA, are at increased risk for postoperative hypoxia. Patients who are on CPAP at home should bring their machines to the hospital to use postoperatively. Use of incentive spirometry can decrease hypoxia. Limiting opioids is important to avoid decreasing respiratory drive. Other analgesics, such as nonsteroidal anti-inflammatory drugs, can be used to decrease narcotic requirements. Enhanced recovery after surgery (ERAS) pathways have been studied in both obesity and gynecologic surgeries and have been found to be helpful in limiting opioid intake and decreasing length of hospitalization [3].

Given the long-term health consequences of obesity, patients should be counseled about weight loss, including

exercise and healthy diet, and referred as appropriate for weight loss programs or medical or surgical therapies.

Key Teaching Points

- Medical comorbidities including diabetes and hypertension should be optimized prior to surgery
- Screening for OSA with tools such as the STOP-BANG questionnaire should be considered preoperatively
- Need for thromboembolism prophylaxis should be assessed with a standardized tool such as the Caprini score, which includes BMI
- Prophylactic antibiotic doses should be adjusted for weight
- Postoperatively, patients should continue thromboembolism prophylaxis as per guidelines and early ambulation should be encouraged
- Opioid use should be minimized to avoid impairing respiratory drive in patients with OSA

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CASE 87

A 60-Year-Old G2P2 Woman with Nausea and Abdominal Distension Following Abdominal Hysterectomy and Lysis of Bowel Adhesions

Sally A. Mullany

History of Present Illness

A 64-year-old woman, gravida 2, para 2, underwent a total abdominal hysterectomy and bilateral salpingo-oophorectomy due to symptomatic uterine fibroids. Intraoperative findings were notable for significant adhesive disease involving loops of small bowel to the anterior abdominal wall from a prior ventral hernia repair with mesh. Adhesiolysis took 1 hour. Postoperative days 1 and 2 were uneventful except for minimal oral intake with progressive abdominal distension. On the morning of postoperative day 3, she complained of nausea and abdominal distension. She reported worsening dyspepsia, minimal appetite, and no flatus or bowel movement since surgery. Her pain remained well controlled on oral pain medication. She was ambulating without difficulty.

The patient's medical history is notable for obesity, hypertension, and type II diabetes. Her surgical history is notable for a cholecystectomy and umbilical hernia repair with mesh. She is active and lives at home with her spouse. She does not use tobacco or alcohol.

Physical Examination

General appearance: Pale, mild distress, lying in bed

Vital signs:

Temperature: 37.5°C
Pulse: 95 beats/min
Blood pressure: 139/65 mmHg
Respiratory rate: 18 breaths/min
Oxygen saturation: 98% on room air
BMI: 39 kg/m^2

HEENT: Unremarkable

Cardiovascular: Regular rate and rhythm; no murmurs, rubs, clicks, or gallops

Lungs: Clear upper lung fields, slightly diminished bases

Abdomen: Moderately distended, mildly tender to palpation throughout, tympanic, no rebound or guarding. Midline incision clean, dry, and intact

Extremities: Trace lower extremity edema, no palpable cords, no tenderness

Neurologic: Alert and oriented × 3

Lymphatics: Negative

How Would You Manage This Patient?

The patient's symptoms and examination findings were concerning for an evolving postoperative ileus (POI) after extensive lysis of adhesions. She was made NPO and intravenous fluids were started. Over the course of the day, the patient became progressively more nauseated despite antiemetics and had several episodes of large volume emesis in the evening. She remained afebrile and hemodynamically stable. Hemoglobin (11 g/dL) was as expected postoperatively and she had no significant leukocytosis (white blood cells 9000/μL). Her metabolic panel was within normal limits except for mild hypokalemia (3.2 mEq/L), which was corrected with potassium supplementation. A plain abdominal radiograph showed dilated loops of small and large intestine with air in the colon and no obvious transition point (Figure 87.1a and b). A nasogastric (NG) tube was placed. Over the course of the next several days, the patient continued to have high-volume NG output. A contrast-enhanced computed tomography (CT) scan was performed which showed fluid filled loops of bowel, contrast through to the colon, and no transition point, consistent with ileus (Figure 87.2). On postoperative day 6, she had flatus and decreased NG output. She tolerated a trial of NG tube clamping and the tube was removed. She had slow advancement of diet from clear liquids to a general diet by postoperative day 8, at which time she was discharged home. Her subsequent course was uncomplicated and she had recovered to her baseline function when she was seen in clinic six weeks postoperatively.

Postoperative Ileus

Every patient undergoing abdominal surgery, including minimally invasive surgery, will develop normal physiologic transient impairment of gastrointestinal motility. Some patients will have clinically significant POI with substantial distress and increased hospital stay and cost. POI does not have a consistent definition, limiting understanding of incidence, etiology, and optimal management strategies. In 2017, Gero et al. used the Delphi technique across an international panel of leading colorectal surgeons to develop consensus on definition, prevention, and treatment. They defined POI as a temporary inhibition of gastrointestinal motility after surgical intervention due to non-mechanical causes and which prevents sufficient oral intake [1]. The reported incidence is anywhere from 10% to 30% of patients undergoing abdominal surgery, with a duration of two to six days [2]. Artinyan et al. defined prolonged POI as symptoms lasting greater than six days (versus the more traditional three days) [3].

The pathophysiology of POI is likely multifactorial including pharmacologic, neurogenic, and immune-mediated mechanisms [4]. Normal physiologic return to function occurs first in the small intestine 0–24 hours after surgery, then the stomach at 24–48 hours, followed last by the large intestine at 48–72 hours. Lack of return to normal bowel function greater than 72 hours postoperatively with associated symptoms of

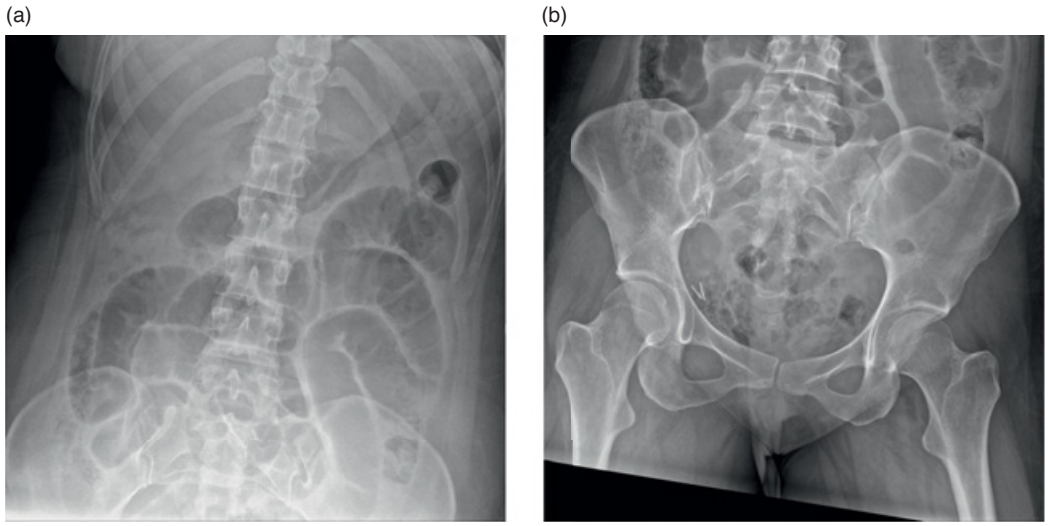

Figure 87.1 (a) Abdominal radiograph with dilated loops of small bowel. (b) Abdominal radiograph with dilated loops of large intestine and air in colon.

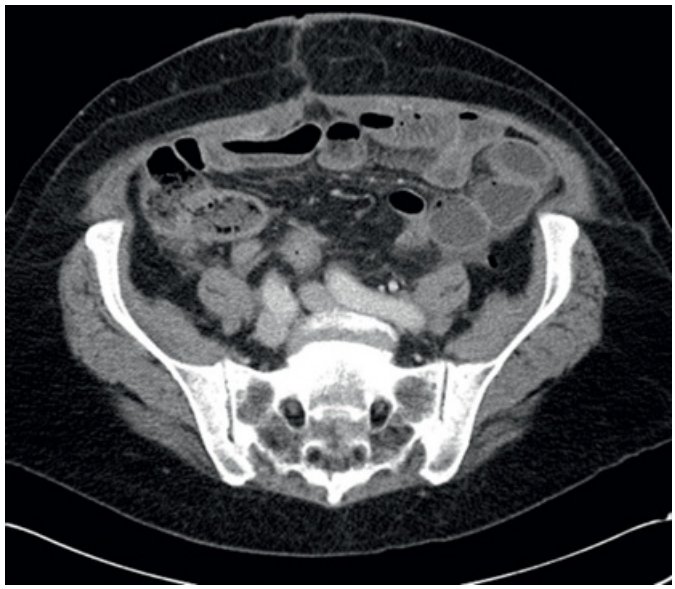

Figure 87.2 CT scan of abdomen showing dilated loops of small intestine with air–fluid levels and contrast passing through descending colon.

abdominal distension and nausea is consistent with POI. Risk factors include operative difficulty, open abdominal surgery, prolonged manipulation of the bowel (as in this patient's extensive lysis of adhesions), electrolyte abnormalities (particularly hypokalemia, as this patient also had), anesthetic and analgesic agents, immobility, increasing age, underlying medical comorbidities, and intra-abdominal infection, inflammation, or hematoma [5]. Opioids are an important cause of gastrointestinal dysmotility.

Efforts to prevent POI have primarily focused on the implementation of multimodal enhanced recovery after surgery (ERAS) programs, which include guidelines for perioperative fluid management, early ambulation and oral intake, and optimal analgesia [6]. Restricted intravenous fluid regimens are a mainstay of ERAS programs with evidence demonstrating a quicker return of gastrointestinal motility compared with standard IV hydration, possibly due to less bowel wall edema. Minimally invasive surgery is associated with significantly reduced time to return of bowel function, length of hospital stay, and opioid requirements [7].

POI typically presents slowly, with increasing abdominal distention and diffuse pain without peritoneal signs. Patients may also have nausea and vomiting, inability to tolerate oral intake, and lack of flatus. Examination findings typically include nontoxic appearance, a tympanic distended abdomen with mild tenderness on palpation, and minimal bowel sounds. In comparison, a patient with a mechanical bowel obstruction will typically have more rapid appearing symptoms, can have peritoneal signs, and will often have high pitched tinkling bowel sounds.

This patient showed progressive clinical decline by postoperative day 3, with worsening nausea, increased abdominal distension, and onset of emesis. High on the differential diagnosis was POI as well as small bowel obstruction, infection, and electrolyte abnormalities, which are all possible sequelae of her extensive surgery, known adhesive disease, indwelling mesh, and medical comorbidities. Investigative studies were performed to distinguish between a POI and a mechanical bowel obstruction and to identify potentially reversible causes. These studies should include a complete blood count and electrolyte panel including calcium and magnesium to evaluate for signs of infection, anemia, or metabolic derangements which could be suggestive of abscess, hematoma, or electrolyte abnormalities, which are reversible, treatable causes of ileus. Radiographic studies should include plain chest and supine and upright abdominal radiographs. Chest imaging provides information about chest pathology such as pneumonia, which could contribute to a patient's symptoms. Abdominal radiographs commonly show dilated loops of small and large intestine with associated air–fluid levels if ileus is present. There should also be air in the colon without a clear transition point, as in this patient's case (Figure 87.1a and b). Clinical findings and abdominal radiography may not be able to adequately distinguish mechanical bowel obstruction from ileus.

A contrast-enhanced CT scan can differentiate by identifying transition points (dilated to non-dilated bowel) and obstruction (contrast proximal to the site of blockage, absent distal to obstruction). It can also identify possible contributory causes such as hematoma or abscess [8].

Clinical evaluation in this patient's case revealed signs and symptoms suggestive of POI, supported by an abdominal radiograph consistent with ileus, and laboratory investigations not indicating an infectious etiology, abscess, or hematoma as potential causes. The treatment of her POI focused on addressing reversible or aggravating factors while providing supportive care. Electrolyte abnormalities, particularly hypokalemia, hypocalcemia, hypermagnesemia, and hyponatremia should be monitored and corrected [9, 10]. Opioid medications should be reduced or discontinued, and the patient transitioned to nonsteroidal anti-inflammatory agents, unless contraindicated [10]. Placement of an NG tube should be individualized. The NG tube will not shorten the duration of the ileus but should be placed for symptomatic relief of refractory nausea and vomiting and to decrease aspiration risk [11]. Intravenous fluid therapy should be administered, although optimal management is unclear. Gastric losses from emesis or NG tube aspiration should be replaced with an equivalent volume using balanced isotonic crystalloid solution such as lactated Ringer's solution. Early ambulation has not been shown to impact the period of gut dysmotility after surgery or shorten a postoperative ileus but has other benefits and should be encouraged. Parenteral nutrition should be implemented after seven days of inadequate oral intake and weaned once the POI has resolved and adequate oral intake has been achieved [10].

Key Teaching Points

- Transient impairment of gastrointestinal motility is normal after abdominal surgery
- Postoperative ileus is a multifactorial inhibition of gastrointestinal motility due to non-mechanical causes, resulting in significant distress to the patient, and preventing adequate oral intake
- Risk factors include difficult open abdominal surgery, pharmacologic side effects, electrolyte derangements, and medical comorbidities
- Preventative measures focus on use of minimally invasive surgery and enhanced recovery after surgery programs which entail restrictive perioperative fluids, early ambulation and oral intake, and minimizing opioids
- Diagnostic efforts should include physical examination, laboratory investigation including complete blood count and electrolytes, and chest and abdominal radiographs. Contrast-enhanced CT scan should be used to evaluate for mechanical bowel obstruction
- Treatment is supportive and includes correction of electrolyte abnormalities, use of nonsteroidal anti-inflammatory drugs instead of opioids, selective use of nasogastric drainage, and IV fluid therapy

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CASE 88 A 15-Year-Old Adolescent with Severe Abdominal Pain and Hemoperitoneum

Rita Tsai

History of Present Illness

A 15-year-old gravida 0 adolescent presents to the emergency room complaining of severe abdominal pain. She states that she had a sudden onset of sharp right lower quadrant pain after her physical education class earlier in the day. Her pain has been increasing, and she now reports additional upper abdominal pain radiating to her shoulder. She rates the pain an 8 out of 10 and notes associated nausea. She denies any further complaints other than some lightheadedness with sitting up. She reports menarche at age 13, with regular monthly bleeding that lasts for five days. Her last menstrual period was three weeks ago. She is not sexually active. The patient denies any medical problems or prior surgeries. She takes no medications.

Physical Examination

General appearance: Well-developed, well-nourished, alert and oriented, in mild distress

Vital signs:

Temperature: 37.0°C
Pulse: 110 beats/min
Blood pressure: 100/60 mmHg
Respiratory rate: 18 breaths/minute
Oxygen saturation: 99% on room air
Height: 64 inches
Weight: 125 lb
BMI: 21.5 kg/m^2

Lungs: Clear to auscultation bilaterally. Equal breath sounds

Cardiovascular: Tachycardia with regular rhythm. No murmurs noted

Abdomen: Moderate tenderness to palpation with rebound and guarding noted. No masses appreciated

Pelvic: Deferred

Laboratory studies:

Urine pregnancy test: Negative
Urinalysis: Trace ketones and trace protein
WBCs: 11 000/μL
Hb: 8.5 g/dL
Platelets: 251 000/μL
Electrolytes: Within normal limits
Liver function test: Within normal limits
Coagulation panel: Within normal limits

Imaging: Pelvic ultrasound shows an anteverted, anteflexed uterus measuring 7.3 × 5 × 4.2 cm with an endometrial stripe of 10 mm. Ovaries not definitively identified. Large volume of pelvic fluid obscures view of adnexa. Moderate amount of free fluid with echogenic debris is present within the cul-de-sac and extending to the fundus of the uterus. Fluid is also noted in the paracolic gutters

How Would You Manage This Patient?

This patient has acute abdominal and pelvic pain with a large peritoneal fluid collection on imaging. With pregnancy ruled out, the most likely diagnosis is a ruptured ovarian cyst. With severe and worsening abdominal pain, peritoneal signs on examination, a large volume of hemoperitoneum on imaging, and tachycardia, large and possible ongoing blood loss may be present. The patient was posted urgently for laparoscopy. Intraoperative findings confirmed a hemoperitoneum caused by a ruptured right ovarian cyst with continued bleeding. One and a half liters of blood and clots were evacuated from the peritoneal cavity with suction and irrigation, and hemostasis was obtained with bipolar coagulation. The hemorrhagic cyst was identified and excised. The patient's hemoglobin was stable postoperatively at 8 g/dL. She recovered well and was discharged home within 24 hours. Postoperatively, she underwent testing for coagulation disorders and was started on combined oral contraceptive pills for ovulation suppression.

Ruptured and Bleeding Corpus Luteum

Ovarian cyst rupture is common in reproductive-age women. These cysts are frequently physiologic, such as a follicular cyst or corpus luteal cyst, although pathologic cysts such as dermoids and endometriomas can also rupture. Due to their increased vascularity, the theca interna and the corpus luteum are at increased risk for bleeding. Two-thirds of corpus luteal cysts involve the right ovary, and rupture occurs most often in the luteal phase on cycle days 20 to 26 [1]. The pain from a ruptured ovarian cyst is presumed to be due to an irritant effect, with bleeding into the ovary causing stretching of the ovarian capsule and bleeding into the abdomen causing peritoneal irritation. Pain is likely dependent on the volume of fluid released and individual sensitivity to the fluid.

Ovulation and cyst formation are associated with risk of rupture. Ovulation induction is associated with an increased risk and use of combined oral contraceptive pills is associated with a decreased risk. Vaginal intercourse has also been described as a risk factor [2]. Conditions with impaired coagulation are associated with hemorrhage from ruptured ovarian cysts, with case reports of hemoperitoneum in women with congenital or acquired thrombophilias and women on anticoagulation therapy [1]. Pregnancy can also be a risk factor, as corpus luteal cysts persist longer and are more likely to reach a larger size. However, as in this patient, cyst rupture often occurs without any identifiable risk factors.

Clinical presentation of a ruptured ovarian cyst is variable. Many patients are without any symptoms or signs, while others may present with severe pain and even shock. As seen in this patient, most symptomatic patients will present with sudden onset of severe lower abdominal pain, often starting during an acute strenuous activity such as exercise or intercourse. The right side is more commonly affected, which may be due to the protection the rectosigmoid colon offers the left ovary. The majority of women with cyst rupture will remain systemically well with vital signs in the normal range. Most women will have only mild to moderate tenderness on deep palpation of the abdomen, although overt peritonitis with rebound, guarding, and rigidity of the abdominal wall is possible. If significant blood loss has occurred, signs of hypovolemic shock will be evident. As most rupture events occur in young women who are generally fit and healthy, changes in blood pressure or pulse may be delayed until the patient has lost a significant amount of blood.

Given the similar presentation of ruptured ectopic pregnancy, pregnancy testing is important in the initial evaluation. Ruptured ovarian cysts can occur in pregnant women, but ectopic pregnancy is a life-threatening diagnosis and should be excluded first in women with a positive β-hCG. Pregnancy testing should be performed in adolescents like this patient, as they may not acknowledge sexual activity. On lab evaluation, patients may have a low hemoglobin and hematocrit due to hemorrhage from a ruptured ovarian cyst, but the initial value may often by normal or only mildly decreased.

Ultrasound is the first-line imaging modality for suspected ovarian cyst rupture. The finding of a cystic mass and a large amount of fluid in the pelvis makes a diagnosis of rupture more likely. However, an ovarian cyst may not be visualized since it may collapse after rupture. The presence of small amounts of fluid in the pelvis is not diagnostic, as this can be a normal finding in women of reproductive age [1]. As seen in the images, free fluid noted extending to the level of the uterine fundus (Figure 88.1) is considered moderate in amount. This amount of fluid should prompt evaluation of the paracolic gutters and Morison's pouch in the right upper quadrant between the liver edge and the kidney (Figure 88.2). Fluid filling these areas indicates a minimum volume of 500 mL in the peritoneal cavity. Fluid that has low-level echoes or echogenic debris is consistent with hemoperitoneum with clot.

Diagnosis of a ruptured ovarian cyst is usually made clinically as imaging is not always helpful. The differential should also include other urgent conditions such as appendicitis, ovarian torsion, and pelvic inflammatory disease/tubo-ovarian abscess. If hemoperitoneum is suspected, other diagnoses such as vascular aneurysms, rupture of the liver or spleen, and perforated ulcer should be considered. Coagulopathy should be considered if unanticipated amounts of bleeding are noted, such as in this young patient with a massive hemoperitoneum. Prothrombin time (PT), activated partial thromboplastin time (aPTT), platelet count, fibrinogen level, and blood smear should be reviewed, with additional tests based on the clinical scenario. Early consultation with a hematologist should be sought for those with evidence of hemostatic abnormalities to assist with evaluation and

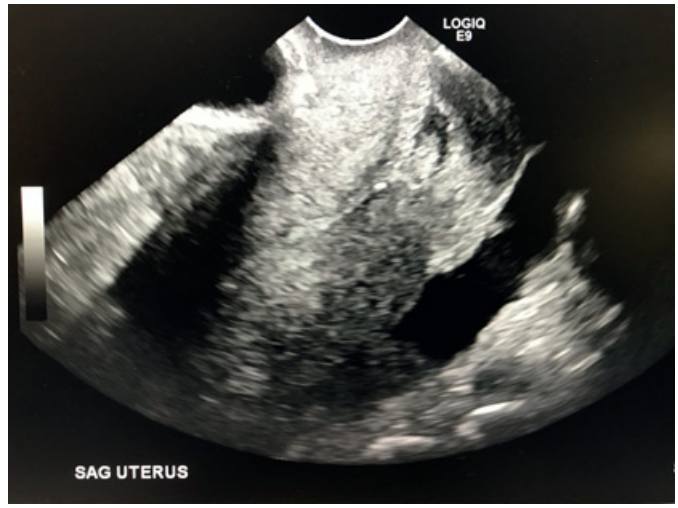

Figure 88.1 Ultrasound image of free fluid in the pelvis approaching the level of the uterine fundus.

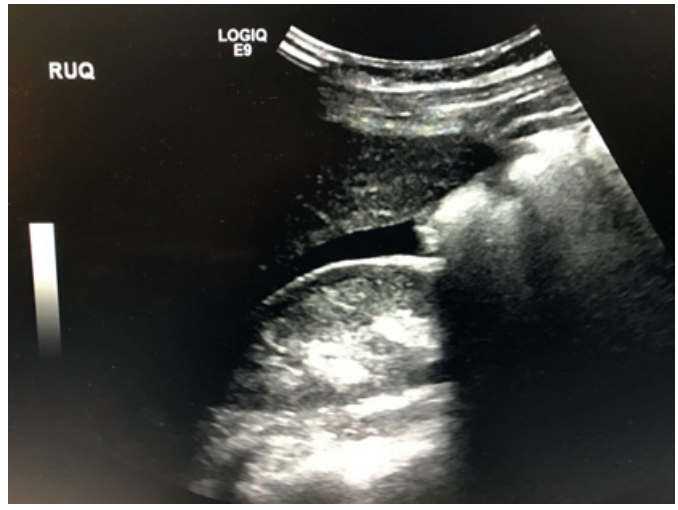

Figure 88.2 Ultrasound image of fluid in Morison's pouch in the right upper quadrant between the liver edge and the kidney.

determination of likely causes and to help in obtaining and dosing hemostatic products if needed.

Most patients with cyst rupture can be managed expectantly with analgesia and observation. Any predisposing cause to hemorrhage such as von Willebrand's disease should be addressed. A conservative management strategy can include hospitalization for the close monitoring of vital signs, serial hemoglobin, or hematocrit levels, and repeat imaging to assess the possibility of active bleeding. Surgery should be performed for any of the following indications: (1) hemodynamic compromise, (2) falling hemoglobin levels, (3) increasing hemoperitoneum on follow-up imaging, (4) severe or persistent pain despite the use of analgesics, and (5) diagnostic uncertainty [1–3].

In patients who require surgery, laparoscopy is preferred to laparotomy due to the known advantages of minimally

invasive surgery, including smaller incisions, shorter operating time, faster recovery, and less postoperative pain. Laparotomy is indicated in the rare situation of complete circulatory collapse [3].

Preoperatively, patients should be informed of the general surgical risks associated with laparoscopy, including consent for transfusion. Patients should be counseled about the risk of oophorectomy due to extensive bleeding or injury to the ovary and that a variable degree of ovarian reserve may be lost with ovarian surgery [4, 5].

Placement of a 10 mm port allows for use of large bore suction cannula, through which large volumes of blood and organized clot can be rapidly evacuated [6]. Hemostasis is usually achieved using energy sources such as bipolar electrosurgical devices. Electrosurgery application should be limited to minimize damage to ovarian tissue and potential decrease to the ovarian reserve. The area of bleeding should be isolated so that the bipolar device can be applied to a targeted area. Hemostasis using laparoscopic suturing is less damaging to the ovary when compared with surgical energy. However, it is technically difficult and is not universally practiced. Energy can be applied more quickly and is appropriate for active bleeding. If suturing is used, the tissue should be reapproximated without strangulation to minimize ovarian injury. Suturing under tension can tear the ovary and overly tight knots can cause ischemia. Suture exposure can also result in postoperative inflammation and adhesion formation [4, 5].

Hemostatic agents such as oxidized regenerated cellulose and gelatin matrix-thrombin combination products can be used as adjuncts to minimize the need for energy. No data are available regarding the impact on ovarian function of hemostatic agents compared with laparoscopic suturing and energy [4]. Hemostatic sealant use has been associated with postoperative adhesions and small bowel obstruction [4, 5]. Excess material should be removed to reduce the risk of inflammatory complications.

With cyst rupture, the cyst wall is often removed by stripping the tissue from the ovarian stroma. The tissue edges are grasped with atraumatic forceps, and traction and countertraction are used to separate the tissues along the cleavage plane. To prevent damage to the ovary, the dissection plane should be clearly delineated to prevent tearing and trauma to the tissue, which may require frequent grasping and regrasping of the cyst wall and ovarian tissue along the plane. Hydrodissection with vasopressin injection has been described to optimize ovarian sparing cystectomy by minimizing blood loss and the need for further hemostatic measures. Diluted vasopressin is injected between the cyst wall and ovarian cortex [4]. The ovarian capsule is not sutured closed following cyst removal to avoid increased adhesion formation.

Postoperatively, suppression of ovulation with combined oral contraceptive pills or depot medroxyprogesterone acetate should be considered, particularly if the patient has a predisposing factor for hemorrhage such as anticoagulation therapy or coagulation disorder. Newer pills with lower estrogen amount are less likely to suppress ovulation compared with higher dose pills. Progestin-only pills are associated with an increased incidence of functional ovarian cyst formation [7]. In addition, in patients where undiagnosed coagulopathy is a consideration, full evaluation for defects should be completed in the outpatient setting after the patient has recovered, particularly as acute bleeding can produce changes in the hemostatic system that impair detecting abnormalities.

Key Teaching Points

- Hemodynamic status is a key determinant of whether a patient with a ruptured ovarian cyst requires surgery
- When surgery for a ruptured cyst is required, laparoscopy is preferred to laparotomy. Preservation of ovarian tissue should also be considered when surgery is performed
- Conservative management of a ruptured ovarian cyst with observation is recommended when cases are uncomplicated
- Evaluation for coagulopathy should be performed in patients at risk for an undiagnosed bleeding disorder
- Hormonal suppression of ovulation can help to prevent the development of new cysts

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CASE 89 A 24-Year-Old Woman Presents with Evidence of a Ruptured Ectopic Pregnancy and Is Reporting Concomitant Fever, Chills, and a Productive Cough

Natalie Bowersox

History of Present Illness

A 24-year-old female, gravida 1, para 0, presents to the emergency department with a positive home pregnancy test and the acute onset of lower abdominal pain, right shoulder pain, and vaginal spotting. The pain is severe and woke her from sleep. She rates the pain as 8/10. She is a nurse and has stayed home from work the last three days due to fever, chills, and cough. She describes the cough as productive of yellow sputum. She has pain in her chest with coughing. She denies nausea, vomiting, or urinary symptoms. Her last menstrual period was six weeks ago.

Her past medical history is significant for chlamydia that was treated two years ago. She is sexually active with one partner and uses condoms for contraception. She has not had prior surgery. She takes no medications and has no drug allergies.

Physical Examination

General appearance: Tearful and anxious woman in obvious pain. Well developed. Well nourished

Vitals signs:

Temperature: 38.5°C
Pulse: 110 beats/min
Blood pressure: 110/70 mmHg
Respiratory rate: 22 breaths/min
Oxygen saturation: 95% on room air
BMI: 24 kg/m^2

Heart: Tachycardic, regular rhythm

Lungs: Decreased breath sounds left lower side with rales noted. Right side normal breath sounds

Abdomen: Diffusely tender, worse in the right lower quadrant. Distended, involuntary guarding, no masses palpated. Distant bowel sounds

Pelvic: Normal external female genitalia. Vagina with physiologic-appearing discharge. Cervix nulliparous in appearance with small amount of bright red blood at the os. No active bleeding. Moderate cervical motion tenderness present. Small, midline uterus without abnormalities. Left adnexa without masses or tenderness. Right adnexa tender to palpation, with the examination limited by extreme patient discomfort and guarding

Laboratory studies:

WBCs: 18 000/μL with 70% neutrophils
Platelets: 325 000/μL
Hb: 10.0 g/dL
β-hCG: 1585 mIU/mL
Urinalysis: Moderate ketones with small leukocyte esterase

Imaging: Transvaginal ultrasound shows normal-sized uterus with endometrial thickness of 7 mm. Normal left ovary. Three-centimeter complex-appearing mass in the right adnexa. Large amount of free fluid

How Would You Manage This Patient?

The clinical scenario of acute abdominal pain, a positive quantitative β-hCG, and physical examination findings of an acute abdomen, along with an ultrasound that suggests the presence of intra-abdominal blood lead to a differential diagnosis of hemorrhagic cyst, ruptured corpus luteum cyst, and ectopic pregnancy. Ruptured ectopic pregnancy is most likely, and the decision is made to proceed with urgent laparoscopy for diagnosis and treatment.

Given her associated respiratory symptoms and need for surgery, anesthesia was immediately consulted and pulmonary evaluation performed. Chest x-ray showed normal volume in both lungs with infiltrate noted in the left lower and middle lobes (Figure 89.1). Tests for influenza, respiratory syncytial virus (RSV), and COVID-19 were obtained. Anesthesia was concerned that she has pneumonia of indeterminate etiology. Given the emergent nature of the likely ruptured ectopic pregnancy, the decision was made to administer ceftriaxone 1 g and azithromycin 500 mg IV and proceed immediately with surgery under general anesthesia. Due to her need for emergency surgery in the setting of a pregnancy, she was assigned an ASA

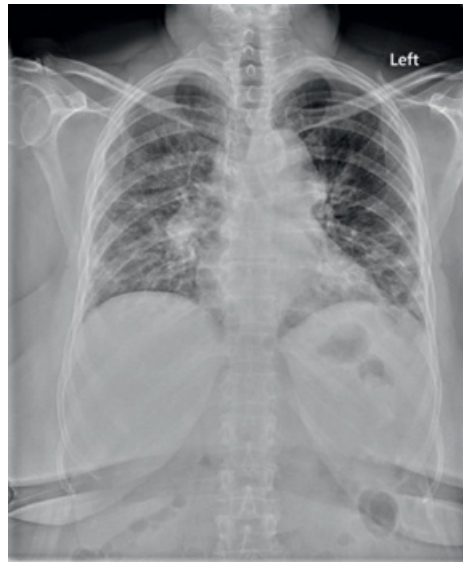

Figure 89.1 Chest x-ray with left lower lobe and middle lobe.

The ASA Physical Status Classification System is used to assess and classify a patient's pre-anesthesia medical comorbidities. Pregnancy, including ectopic, is considered a systemic disease state making the patient ASA class II or III. The letter 'E' is added to the ASA status in situations like this one, where delay in treatment would lead to significantly increased threat to a patient's body part or life [4]. For patients with respiratory infection requiring emergency surgery, monitored anesthesia care or neuraxial anesthesia is preferred. Laparoscopy for ectopic pregnancy warrants use of general anesthesia [5]. Patients with pneumonia undergoing general anesthesia can have upper airway hyperreactivity, which can lead to laryngospasm during induction and extubation. Patients can also have bronchial hyperreactivity causing bronchoconstriction and hyperresponsiveness, which can lead to bronchospasm. Airway management in patients with a CAP resembles asthma management. If wheezing is present on evaluation, a bronchodilator should be given [6]. Precautions to reduce the risk of bronchospasm and laryngeal irritation may include use of a supraglottic airway rather than an endotracheal tube and laryngoscopy. Because of risk for atelectasis and barotrauma, lung-protective ventilation, which uses lower tidal volumes, can help to reduce ventilator-associated lung injury (VALI) in this setting where progression to more severe respiratory complications is a risk. VALI can cause hyperinflation leading to shearing injury, alveolar rupture which can cause pneumothorax, and can cause the release of inflammatory mediators [7]. During extubation, stimulation of airway reflexes should be avoided by allowing spontaneous ventilation and using a low dose of opioids for pain control. Comorbidities, type of surgery, and intraoperative course should be considered when planning for the extubation [7]. In a typical gynecology procedure, extubation would routinely be done at the conclusion of the surgery, as it was in the case described. Circumstances that might warrant the patient remaining intubated include severe CAP that has led to septic shock requiring vasopressors or inability to safely wean the patient at the end of the case due to respiratory failure.

The postoperative management of patients with CAP includes determining whether recovery should occur in an intensive care unit or post-anesthesia care unit setting. If any respiratory complication occurs during surgery, a higher level of monitoring for oxygen desaturation, cough, and bronchospasm following the case is warranted. These symptoms are more likely to occur within the first 24 hours following surgery. Resolution of symptoms depends on the etiology of the illness, and recovery following surgery is directed toward both optimizing the postoperative course and timely treatment of the CAP. Routine use of an incentive spirometer, encouraging cough, and early ambulation will aid in recovery. Follow-up chest x-ray is not recommended for patients who have resolution of their symptoms within five to seven days [3].

Key Teaching Points

- Risks of patients undergoing general anesthesia with respiratory illness include worsening respiratory infection, aspiration pneumonitis, pneumothorax, respiratory failure, bronchospasm, atelectasis, and pleural effusion
- The diagnosis of pneumonia is based on clinical presentation, presence of leukocytosis with a leftward shift, and evidence of an infiltrate on chest x-ray
- Although viral and bacterial causes frequently coexist, treatment is usually begun with antibiotics
- ASA status is helpful in predicting perioperative risks by classifying a patient's pre-anesthesia and medical comorbidities. For emergencies an 'E' is added to the classification to indicate a delay in treatment would lead to an increased threat to a patient's body part or life
- Following surgery, a higher level of monitoring for oxygen desaturation, cough, and bronchospasm, which are more likely to occur in the first 24 hours following surgery is warranted

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CASE 90 A 26-Year-Old Female Presents for Nexplanon Removal with a Non-palpable Device

Kathryne A. Sanserino

History of Present Illness

A 26-year-old woman, gravida 1, para 1, presents for removal of an etonogestrel (Nexplanon) contraceptive implant after utilizing it for contraception for 28 months. The device was initially placed by her primary care provider (PCP). In the referral notes, the PCP describes that she was not able to palpate the device. She ordered an ultrasound of the left arm, which confirmed the presence of the Nexplanon implant in the arm. The patient is requesting removal as she now desires another pregnancy. She reports satisfaction with Nexplanon as a contraceptive method. She does report menstrual irregularities since device placement, but since the result was lighter, less frequent menses, these changes were acceptable to her. She reports she has gained approximately 10 lb since the device was placed, but she attributes this to unhealthy eating habits and decreased physical activity. She denies any pain, numbness, tingling, or weakness in her upper extremity. Her past medical history is significant for childhood asthma and surgical history for wisdom tooth extraction. She is taking multivitamins and has no known drug allergies.

Physical examination

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

Vital signs:

Temperature: 36.6°C
Pulse: 80 beats/min
Blood pressure: 116/72 mmHg
Respiratory rate: 18 breaths/min
Oxygen saturation: 100% on room air
Height: 61 inches
Weight: 142 lb
BMI: 26.8 kg/m^2

Abdomen: Soft, non-tender, non-distended abdomen with normoactive bowel sounds in all four quadrants

Pelvic: Not indicated

Extremities: Left upper extremity with a moderate amount of subcutaneous fat. Unable to palpate implant. Small scar in left arm consistent with implant placement. The left arm has normal strength and sensation, full passive and active range of motion, intact reflexes, and normal perfusion. No clubbing or cyanosis is present, and the distal pulse is intact. Right upper extremity within normal limits

Laboratory studies: Urine pregnancy test: Negative

Imaging: Ultrasound: High frequency sonographic examination was performed with the patient supine with her left upper extremity externally rotated. Parallel to the axis of the humerus approximately 3 mm in relation to the skin surface a small elongated hyperechoic structure is located in the subcutaneous fat pad

How Would You Manage This Patient?

This patient presents requesting removal of a non-palpable Nexplanon device. At the time that this is recognized, pregnancy should be immediately excluded. The patient should be counseled to use barrier contraception until the presence of the device can be confirmed. Additionally, the location of placement should be determined through patient history, physical examination, and review of records. Initial examination included a basic neurologic and musculoskeletal examination of the upper extremity, which did not reveal any deficits or abnormalities [1].

An office ultrasound confirmed that the device was present in the upper extremity. The device was visualized 1.5 cm above the small white insertion site scar. The depth of the device was 3 mm. The brachial artery and basilic vein were visualized and noted to be a subjectively safe distance from the implant. The device was then removed in the office under ultrasound guidance using aseptic technique and local anesthesia. A 5 mm incision parallel to the long axis of the implant was made overlying the distal end of the implant and the "pop-out" removal technique was performed. After removal, the device was measured to 4 cm, confirming complete removal. The skin was reapproximated with a Steri-strip. The patient tolerated the procedure well [2]. She was started on prenatal vitamins and pre-conception counseling was performed.

Non-palpable Nexplanon Devices

Nexplanon, manufactured by Merck (Whitehouse Station, New Jersey, USA), is a single rod device which contains 68 mg of etonogestrel. It is approximately the size of a matchstick – 4 cm in length and 2 mm in diameter. It is the latest generation in a series of implantable contraception devices. Earlier versions included the Norplant system (Wyeth-Ayerst Laboratories, Collegeville, Pennsylvania, USA), which was comprised of six rods and was available in the early 1990s. This system was plagued by difficult removals and associated lawsuits and eventual discontinuation of distribution in the United States in 2002. Following Norplant, Implanon was introduced as a single-rod contraceptive device, which was attractive because of its relative ease of insertion and removal. Nexplanon (also known as

Implanon-NXT outside of the United States) differs from the originally marketed Implanon device by the addition of barium sulfate, making it radiopaque, and by changes made to the design of the applicator [3].

Since the Nexplanon device is radiopaque, a variety of imaging modalities can be used to visualize the device [3]. Ultrasound is the optimal modality as it is inexpensive and often readily available in the office. Other options for visualizing a non-palpable Nexplanon include plain film radiographs, CT scan, MRI, compression mammography, and fluoroscopy. It is possible to visualize the Nexplanon in the office with portable ultrasound. While it is preferable to use a high frequency (7–14 MHz, ideally 12–14 MHz) linear probe, portable ultrasound probes can be used. Several adaptations can be made to ultrasound settings to increase chances of successful device localization [4]. The implant will appear as a small echogenic "white dot" on transverse scanning. It is very important not to exert too much pressure when performing ultrasound as this will distort measurement of the depth of the implant, once localized. The ultrasound probe should be used to identify both ends of the implant, the depth of the implant, and to locate the relationship of the implant to underlying vascular structures and nerves.

Reasons for non-palpable Nexplanon devices include deep insertion, non-insertion, and device migration. Of these, deep insertion is the most common cause [2]. Deep insertion occurs because of failure to correctly place the device between the dermis and subdermis. A single-handed inserter system was developed to reduce the incidence of deep insertion; however, user variability in the angle of insertion and too deep insertions still occur. The tip of the insertion needle should be slightly angled, less than 30 degrees, and inserted until the bevel is just under the skin but no further. The skin should be tented up while the applicator is leveled to a nearly horizontal position. It is during these critical steps of insertion that too deep insertion can inadvertently occur [5].

Non-insertions occur less commonly with the Nexplanon device than with the previous Implanon iteration; however, it is still possible if the provider is not careful to check the appliance to ensure the implant is loaded within the applicator device. If all imaging fails to localize the device, etonogestrel blood level determination can be used to determine presence of the implant. Reference levels are available from the manufacturer. Failure to detect etonogestrel in the blood is diagnostic of device non-insertion [3].

Device migration more than 2 cm is a rare, but potentially dangerous cause of a non-palpable device. A prospective cohort study which followed patients after 7364 insertions found an incidence proportion implant migration of 1.4 per 1000 removals [6]. The device can migrate within the biceps muscle, or other more distant sites of migration can include adjacent to the ulnar nerve below the deep fascia, next to the median nerve, and even to the pulmonary artery (via the basilic vein) [7].

Removal Techniques

Once the device is localized with ultrasound, assuming it is suprafascial, and deemed to be a safe distance from underlying vascular structure and nerves, removal can be safely attempted with ultrasound guidance. This can be accomplished with the traditional "pop-out" technique described by the manufacturer. However, if the middle of the device is reached rather than the end, vasectomy clamps can be a useful tool for grasping the diameter of the device and bringing it to the surface of the incision [2, 3, 8].

If ultrasound-guided removal of the non-palpable implant is attempted and is unsuccessful, the patient should be referred. In the United Kingdom and in the United States, a network of specialty removal centers are available for patient referral. The device manufacturer can assist in locating these referral centers [9, 10]. These providers may work in a multidisciplinary approach with interventional radiology, orthopedic surgeons, general surgeons, vascular surgeons, or peripheral nerve or hand surgeons [1]. However, if referral to these specialty centers is not possible, patients can be referred to obstetrician-gynecologists with fellowship training in complex family planning, or to specialists in anatomy of the upper arm such as plastic surgeons, peripheral nerve surgeons, vascular surgeons, or orthopedic surgeons, or some general surgeons.

There are several circumstances under which a general gynecologist should not attempt removal and should strongly consider referral. Indications for primary referral include:

- Implant location immediately adjacent to vascular structures or nerves
- Implant location below the fascia or more than 2 cm deep
- Neurologic symptoms such as sensory or motor changes or neuropathic pain [1]
- Device migration to the axilla or thorax

Key Teaching Points

- The most common reason for non-palpation of a Nexplanon device is deep insertion
- If a Nexplanon cannot be palpated, pregnancy should be excluded, and the patient should be counseled to use barrier contraception until location is confirmed
- Device location should be confirmed before any attempts at removal
- Depending on provider experience and comfort, ultrasound-guided office removal is reasonable provided the device is suprafascial and is not immediately adjacent to any critical structures
- Blind surgical exploration should not be done in the setting of a non-palpable Nexplanon device
- Providers who are inexperienced or unskilled in ultrasound-guided removal should refer to appropriate specialists

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