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- *Anorectal Disorders* [Update May 2015]
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- *Obesity* [Update August 2017]
- *Occupational Diseases and Injuries* [Update July 2016]
- *Sleep Disorders* [Update September 2015]
- *Upper Gastrointestinal Tract, Biliary, and Pancreatic Disorders* [Update June 2017]
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This monograph is designed to enable the obstetrician–gynecologist to do the following:

- Identify pertinent comorbidities that may complicate surgical outcome
- Initiate comprehensive perioperative assessment
- Provide appropriate perioperative, intraoperative, and postoperative care

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**Disclosure Statement**

Current guidelines state that continuing medical education (CME) providers must ensure that CME activities are free from the control of any commercial interest. All authors, editorial board members, and reviewers declare that neither they nor any business associate nor any member of their immediate families has material interest, financial interest, or other relationships with any company manufacturing commercial products relative to the topics included in this publication or with any provider of commercial services discussed in this publication except for Russell R. Snyder, MD, who is a panel member of the FDA Advisory Committee for Medical Devices and Anne E. Burke, MD, who receives research support from Bayer for Database Study of Contraceptive Outcomes. Any conflicts have been resolved through group and outside review of all content.
The practice of obstetrics and gynecology includes a significant amount of time performing surgical procedures. It is the surgeon’s responsibility to guide the patients through the preoperative process, manage their intraoperative conditions, and ensure their successful postoperative recovery. Often, these patients have challenging medical comorbidities requiring special expertise. A previous popular monograph of the Clinical Updates in Women’s Health Care series, entitled “Perioperative Considerations for Coexisting Medical Conditions,” helped guide obstetrician–gynecologists through these complex cases. The editorial board commissioned a new monograph with the goal of providing the most current and evidence-based guidance but also to introduce a system-based approach to patients with common significant medical comorbidities that obstetrician–gynecologists encounter. The authors are both gynecologic oncologists who are uniquely familiar with the surgical procedures that our patients require and understand how our delivery of care changes across each phase of a woman’s life cycle.

Dr. Aaron Shafer is Associate Professor in the Department of Gynecologic Oncology and Reproductive Medicine at the University of Texas MD Anderson Cancer Center in Houston. Dr. Paola Gehrig is the Director of the Division of Gynecologic Oncology and Professor at the University of North Carolina in Chapel Hill. They provide an expert overview of accurate perioperative risk assessment, medical optimization, route of surgery, anesthetic choices, and postoperative management of complicated cases. They have devoted sections specifically to the care of older women, pregnant patients, and obese women. You should find this monograph particularly useful in providing comprehensive quality care in the safest and most appropriate way for even the most challenging patients.

Russell R. Snyder, MD
Editor

Correction - April 2019

Outdated information regarding prophylactic dosages of clindamycin plus gentamicin or metronidazole plus gentamicin was removed, and an appendix was added to provide current dosages and additional details regarding prophylactic antibiotic treatment for patients with penicillin allergy.
ABSTRACT: Obstetrician–gynecologists often incorporate surgical procedures in the care of women. Each phase of a woman’s life cycle presents different challenges regarding preoperative, intraoperative, and postoperative management. Appropriate workup and preparation of patients for surgery are key to a successful surgical outcome. As women age, their risk of medical comorbidities, such as coronary artery disease, diabetes mellitus, or obesity, increases, as does the need for surgical procedures. Correctly identifying medical conditions and related surgical risks will help obstetrician–gynecologists provide safe, appropriate, and evidence-based care to women. Increasingly, obstetrician–gynecologists work in the setting of multidisciplinary teams, and many have access to preoperative assessment clinics and hospitalists to assist in the management of preoperative and perioperative patients. It is the responsibility of the referring physician to understand the services these clinics and hospitalists provide. An appropriate and cost-effective evidence-based preliminary workup, such as laboratory and imaging tests, also is important. The purpose of this monograph is to help guide obstetrician–gynecologists through the appropriate preoperative assessment of women who require surgery and identify intraoperative and postoperative management strategies that will help decrease avoidable morbidity and mortality of these patients.

Basic Science Update

Physiologic Response to Surgery

The physiologic response to surgery is based on the interplay of multiple organ systems, including cardiovascular (CV), pulmonary, renal, endocrinologic, and hematologic. The initial response to surgery is mostly mediated by three events: 1) activation of the sympathetic nervous system and subsequent catecholamine release, 2) endocrinologic response within the pituitary gland and an increase in systemic insulin resistance, and 3) local immunologic and hematologic response to injury (1, 2). These immediate physiologic changes can cause tachycardia, hypertension, fluid retention, and increased catabolism, which in turn, can put stress on the heart, kidneys, lungs. A woman’s ability to tolerate surgery and recover depends on the severity of the physiologic disturbance as well as the woman’s underlying medical comorbidities.

Soon after surgery begins, afferent nerves in the autonomic nervous system are activated, leading to stimulation of the sympathetic nervous system and release of catecholamines, such as epinephrine and norepinephrine. The most immediate response is tachycardia and hypertension. Furthermore, the renin–angiotensin–aldosterone cascade is triggered in the kidneys and adrenal glands. This leads to constriction of arterioles in the kidney as well as increased reabsorption of sodium in the renal tubule, potentially
resulting in increased blood pressure (BP) and water retention and, possibly, placing further stress on the CV system. These catecholamines also stimulate gluconeogenesis in the liver and skeletal muscle (1, 2). This stress response and gluconeogenesis often lead to an increase in circulating glucose, which can be dramatic in diabetic patients who already have relative insulin resistance.

The pituitary gland is the site of increased secretion of growth hormone, adrenocorticotropic hormone (ACTH), prolactin, vasopressin (also known as antidiuretic hormone [ADH]), and beta-endorphin. The release of ACTH leads to an increase in cortisol levels. The amount of cortisol produced is related to the size and duration of the surgical intervention. The more invasive and longer the procedure, the more robust and longer the cortisol production. This release does not appear to be inhibited by exogenous corticosteroid administration. The increase in cortisol production leads to more gluconeogenesis and a decrease in glucose uptake by skeletal muscle, thus exacerbating the relative insulin resistance state. The increase in ACTH levels also stimulates aldosterone production, which further drives reabsorption of sodium and water in the distal tubule of the kidney. Another profound effect of the pituitary activation is the release of ADH. Increased circulating ADH increases systemic vascular resistance and water resorption in the nephron. This leads to decreased urine output in the perioperative setting. Increased aldosterone and ADH levels lead to increased blood volume and development of hypertension, which can put stress on the heart and the lungs (1, 2).

Other pituitary hormones seem to have less of a physiologic effect in the immediate perioperative period. Prolactin and beta-endorphin release increases, but the exact effect is not well established. Thyroid-stimulating hormone (TSH) levels may increase or decrease immediately after surgery. Generally, triiodothyronine (T₃) and thyroxine (T₄) levels decrease slightly immediately after surgery, but they return to normal within a few days.

Another area of concern is tissue damage during surgery, namely, local hematologic and immunologic responses. Leukocytes (especially macrophages), endothelial cells, and fibroblasts release interleukins, interferons, and tumor necrosis factor. The major mediator of this stress response is the cytokine interleukin-6 (IL-6). Levels of IL-6 increase within 30 minutes of surgery and the amount of increase is directly related to the amount of surgical trauma. Interleukin-6 along with other acute phase reactants leads to increased vascular permeability; sequestration of cations in the liver; reduction of transport proteins, such as albumin and transferrin; and increased skeletal muscle breakdown. Hematologic effects include neutrophil leukocytosis and differentiation of lymphocytes. Most of these effects are local and the cytokine peak is 24 hours after surgery, but the levels remain increased for several days (2).

**Modifying the Stress Response**

Both the route of surgery and anesthesia can help modify the stress response to surgery. Opioids alone have been shown to decrease the secretion of pituitary hormones, such as
ACTH and growth hormone. Additionally, fentanyl has been shown to decrease glucose, cortisol, and growth hormone levels during pelvic surgery. However, this is not the case in patients undergoing upper abdominal surgery. Etomidate and benzodiazepines also have been shown to decrease ACTH production and release from the hypothalamus and the pituitary gland. Regional epidural anesthesia can decrease the autonomic and endocrinologic responses to surgery. Serum glucose, ACTH, cortisol, growth hormone, and catecholamine levels are decreased and, in some cases, return to normal levels. This process is caused by the blockade of the afferent nerves that carry signals back to the central nervous system (CNS) that activates the autonomic and hypothalamic–pituitary–adrenal (HPA) response (1, 2).

The magnitude of the physiologic changes that occur in the stress response to surgery is related to the amount of trauma. Hence, the route and type of surgery performed can help mediate the physiologic stress that a patient experiences. Laparoscopic procedures appear to elicit less cytokine release, probably because of less tissue damage, ie, smaller incisions. Minimally invasive surgery also decreases the amount of fluid shift because this type of procedure is associated with less vascular permeability and less body fluid loss than laparotomy.

**System-Based Approach to Perioperative Management**

The goal of preoperative evaluation is to identify underlying medical comorbidities that may exacerbate the normal physiologic perturbations that surgery can cause and, ideally, reduce their effect. This goal is achieved through accurate risk assessment, medical optimization, route of surgery, and anesthetic choices.

**Cardiovascular Disease**

Cardiovascular disease (CVD) is the leading cause of death in American women, accounting for more than 400,000 deaths yearly. It is estimated that one in three adult women has some form of CVD (3). As the population ages, the risk of CVD will increase. These statistics underscore the importance of evaluating women for CVD risk before surgery, specifically their risk of myocardial infarction (MI), stroke, and congestive heart failure. Unlike men, women often do not exhibit the classic symptoms or signs of CVD and MI, such as chest pain (4). Standard diagnostic tests, such as electrocardiography and exercise stress tests, do not have the same sensitivity, specificity, and positive predictive value in women as they do in men (5). Additionally, women often present with more atypical symptoms, such as arm pain, nausea, indigestion, fatigue, and a sense of dread (4, 6). It is important to remember that traditional risk factors for coronary artery disease (CAD), such as a high cholesterol level, may not be as predictive of CVD in women, whereas other components of the hyperlipidemia profile may be more
important than in men (7). Menopausal status affects a woman’s risk of CVD. After menopause, the risks of hypertension and diabetes mellitus increase, thus increasing the risks of CAD, MI, and stroke (8). Although postmenopausal women have higher risks of CAD and MI, younger women who experience MI have a higher mortality than men of the same age (6). Successful glucose and BP control can help reduce these risks and may be important when planning elective surgery. Smoking also appears to affect a woman’s risk of CVD, and younger women have a higher rate of smoking than women older than 55 years. Counseling regarding smoking cessation can have a great effect on reducing CVD risk in women (6). Key points for obtaining the patient’s medical history and performing a physical examination that are specific for CVD risk are listed in Box 1.

**Box 1. Key Elements of a Cardiovascular History and Physical Examination**

**History**
- Personal history of certain diseases and conditions
  - Coronary artery disease
  - Congestive heart failure
  - Diabetes mellitus
  - Peripheral vascular disease
  - Cerebral vascular accident
  - Renal disease
  - Pulmonary disease (chronic obstructive pulmonary disease or asthma)
- New or worsening symptoms
  - Chest pain
  - Dyspnea on exertion
  - Paroxysmal nocturnal dyspnea or orthopnea
- Functional capacity
  - Ability to walk around the block
  - Ability to walk a flight of stairs
  - Ability to perform daily household activities

**Physical Examination**
- Blood pressure measurement in both arms while seated
- General examination for pallor or cyanosis
- Cardiac auscultation for murmur
- Arterial pulse
- Bruits
- Neurologic deficit from a previous cerebrovascular accident
- Evidence of congestive heart failure
- Presence of peripheral edema
- Presence or absence of jugular venous distention or hepatojugular reflex
- Pulmonary examination for rales or wheezing
Previously, procedures were grouped into, low, intermediate, and high cardiac risk categories. Recently, regarding cardiac workup and evaluation, that stratification has changed to just low risk and increased risk. This is because there was little to no difference in recommendations between those patients undergoing intermediate or high-risk procedures. Low-risk procedures are those with a risk of cardiac morbidity and mortality of less than 1%, whereas procedures with increased CVD risk are those with a cardiac risk of 1% or more. Endoscopy, simple plastic surgery, and cataract surgery are all examples of low-risk procedures. Most cases of dilation and curettage, hysteroscopy, and simple laparoscopy (eg, tubal ligation) also are categorized as low-risk procedures. Most major gynecologic surgical procedures, such as hysterectomy and myomectomy, are considered increased-risk procedures (9).

If a patient has not had recent cardiac evaluation or has not had recent general medical care, the clinician must assess whether the patient has significant cardiac risk that requires either further testing or referral to a specialist. The first step of this assessment often involves a combined evaluation of the patient’s clinical status and the procedure characteristics to establish a risk of major adverse cardiac event, such as cardiac death or MI in the perioperative period. As mentioned previously, a low risk is less than 1% and an increased risk is 1% or greater. Box 2 lists three popular risk calculators: 1) the Revised Cardiac Risk Index, 2) American College of Surgeons (ACS) calculator, and 3) ACS National Surgical Quality Improvement Program calculator. The Revised Cardiac Risk Index calculator is a simple tool with six risk factors, each worth a point. A total score of 2 or more indicates an increased cardiac risk. The Revised Cardiac Risk Index calculator is easy to use, can be used almost in real time when evaluating a patient, is fast, and is validated. The ACS scales are a little more cumbersome and depend on more subjective assessments (9). A patient who has a low risk of a major adverse cardiac event (score of 0 or 1) on the Revised Cardiac Risk Index can proceed to surgery without further preoperative evaluation.

If the Revised Cardiac Risk Index score is 2 or more, further clinical investigation is warranted. Before a referral to cardiology, the obstetrician–gynecologist can begin that investigation by determining the patient’s functional status or exercise capacity. A patient’s ability to achieve 4 metabolic equivalents (METs) or greater or a patient’s ability to work indicates a low risk of perioperative major adverse cardiac event. A metabolic equivalent is a ratio of metabolic rate at work to metabolic rate at rest; 1 MET is the amount of oxygen consumed at rest. Tools for evaluating a patient’s functional capacity and METs also are listed in Box 2. Patients who can achieve 10 METs have a very low cardiac risk and can proceed to surgery without further testing (9). Generally, patients who achieve 4–10 METs also can proceed to surgery without further workup. If a patient is unable to achieve 4 METs, which is equivalent to walking up a flight of stairs, or her functional status cannot be determined, she should be referred for further cardiac workup and testing. Figure 1 provides a visual representation of this process.
If a patient has an increased cardiac risk (the Revised Cardiac Risk Index score greater than 2) or if she cannot perform an activity equivalent to 4 METs, further cardiac testing is warranted. If the patient has a good functional status but still has a large number of cardiac risk factors, exercise stress testing can be considered. However, if her functional status is poor, noninvasive stress testing is recommended (9). The most common tests are dobutamine stress echocardiography and pharmacologic stress imaging. Both tests have a high negative predictive value; ie, women with a normal test result have a low risk of perioperative cardiac morbidity. The consulting cardiologist typically decides which of these tests to use based on his or her specific comfort and expertise (9).

Although a positive pharmacologic stress test result does not necessarily mean that a woman will have perioperative complications, it warrants further cardiac evaluation. Usually, these women will need coronary angiography. Depending on these results, patients may require percutaneous angioplasty or, possibly, coronary stent placement. At this time, good communication with the consulting cardiologist is essential to discuss the

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**Box 2. Tools for Evaluating Cardiac Risk and Function**

<table>
<thead>
<tr>
<th>Major Adverse Cardiac Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Revised Cardiac Risk Index</td>
</tr>
<tr>
<td>- American College of Surgeons’ calculator <a href="http://www.surgicalriskcalculator.com/miorcardiacarrest">www.surgicalriskcalculator.com/miorcardiacarrest</a></td>
</tr>
<tr>
<td>- American College of Surgeons’ National Surgical Quality Improvement Program calculator <a href="http://www.riskcalculator.facs.org/RiskCalculator">www.riskcalculator.facs.org/RiskCalculator</a></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cardiac Functional Capacity</th>
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*Examples of activities that have a score of 4 metabolic equivalents or higher:*
- Climbing a flight of stairs
- Walking up a hill
- Walking level ground at 4 mph
- Heavy household and yardwork
urgency of the gynecologic procedure. The type of cardiac intervention can influence the timing of subsequent, elective surgery. Elective surgery should be delayed for 14 days after balloon angioplasty, 30 days after a bare metal stent, and 6–12 months after a placement of a drug-eluting stent (9). Most patients with stents require dual antiplatelet therapy, usually aspirin plus clopidogrel. If possible, aspirin should be continued during the surgery, and the clopidogrel should be withheld for 5 days before surgery and restarted as soon as safely possible after surgery.

In patients with cardiac disease, beta-blockers have been reported to reduce cardiac morbidity and MI in the postoperative period, but it may be associated with a higher risk of mortality and stroke (10). One can consider starting a beta-blocker in a patient with hypertension or another condition that requires a beta-blocker (10). If possible,
beta-blockers should be started at least 2 days before surgery. However, if another reason for beta-blockade is absent, there is probably little benefit in this therapy, yet there is possible harm (ie, bradycardia, hypotension, stroke, or death) (10). Statins also may decrease the risk of perioperative cardiac morbidity. If a patient has other reasons to start a statin, it is reasonable to start one preoperatively because it may decrease perioperative cardiac mortality and also may have positive long-term health benefits (9). Both the beta-blocker and statin should be started in coordination with the patient’s primary care provider or cardiologist.

**CASE NO. 1.** A 65-year-old patient requires a hysterectomy and bilateral salpingo-oophorectomy for complex endometrial hyperplasia. She has a past medical history of hypertension and atrial fibrillation after unsuccessful ablation and receives long-term warfarin therapy. She asks about perioperative anticoagulation.

The most important factors to consider in managing a patient’s perioperative anticoagulation are her risk of thrombotic complications (stroke and MI) without anticoagulation and her risk of perioperative bleeding with anticoagulation. Generally, stroke is the greatest thromboembolic risk associated with atrial fibrillation, particularly paroxysmal atrial fibrillation. For this reason, many women with atrial fibrillation will use long-term anticoagulation to prevent stroke and other thromboembolic events.

Oral anticoagulants usually include warfarin and newer antithrombin medications, such as direct thrombin inhibitors (eg, dabigatran) and factor Xa inhibitors (eg, rivaroxaban, apixaban, and edoxaban). Although warfarin has been the mainstay of oral anticoagulation for many years, newer oral anticoagulants are becoming popular. Oral Xa inhibitors have the following advantages:

- They have standard dosages.
- Their use does not require routine blood tests.
- Their mechanisms of action are not as affected by dietary changes as those of warfarin.

Additionally, oral Xa inhibitors may be superior at preventing strokes in patients with atrial fibrillation (11). The advantages of warfarin include expense, extensive evidence, and easy reversibility with vitamin K. When deciding on perioperative anticoagulation management, two general options are available: 1) operating through a “heparin window,” ie, bridging anticoagulation or 2) stopping the anticoagulation 3–7 days before surgery and then restarting it after surgery once the risk of bleeding has decreased. A large randomized, placebo-controlled trial of individuals using warfarin therapy for atrial fibrillation showed that the no-bridging option did not significantly increase the risk of arterial thromboembolic events and it did alleviate the risk of both major and minor bleeding (12). As such, in most patients who receive anticoagulation for atrial fibrillation, it is probably safe to just stop anticoagulation and restart it after surgery without a bridging period. If patients use warfarin, it should be stopped 5 days before surgery.
and restarted 24–48 hours after surgery as long as patients are receiving adequate oral dietary intake (12). If patients receive new oral anticoagulants, the timing of stopping them depends on the type of surgery and the patient’s renal function. For minor procedures, with a low risk of bleeding (i.e., hysteroscopy, dilation and curettage, and loop electrosurgical excision procedure), stopping the new oral anticoagulants 24–48 hours before the procedure usually is adequate. For major procedures, a 72-hour period probably is safer (13, 14).

In the past, the CHADS2 scoring system was used to predict a patient’s risk of stroke. It assigned point values to several risk factors:

- Congestive heart failure (1 point)
- Hypertension (1 point)
- Age older than 75 years (1 point)
- Diabetes mellitus (1 point)
- Stroke (a previous history) (1 point)

The total risk of stroke was estimated based on the final score (the sum of points) from 1.9% per year for 0 points to 18% per year for 6 points (15). In 2012, the CHADS2 score system was expanded with the addition of three risk factors, including vascular disease, age 65–74 years, and female sex (16). This new system is called the CHA2DS2-VASc scoring system, and it recommends no treatment for a score of 0; no treatment, aspirin, or oral anticoagulant for a score of 1; and oral anticoagulant for a score greater than 2 in women (17). Based on CHA2DS2-VASc, the risk of stroke is 0 for a score of 0; 1–3% for a score of 1–3; 4–9% for a score of 4–7; and 12–15% for a score of 8–9 (17). The risk of stroke should be balanced with the risk of bleeding. Consultation with the patient’s cardiologist would be reasonable in the preoperative setting.

If the patient has a more complicated anticoagulation and thrombotic history and has been using warfarin, then bridging with low-molecular-weight (LMW) heparin should be considered. Usually, this can be accomplished on an outpatient basis with subcutaneous LMW heparin given once daily (1.5 mg/kg subcutaneously) or twice daily (1 mg/kg subcutaneously) until the day before surgery. Low-molecular-weight heparin can be restarted 12–24 hours after surgery (14). In patients who take one of the new oral anticoagulants, bridging usually is not necessary (14). Generally, in patients who have a low postoperative bleeding risk, new oral anticoagulants can be restarted 24 hours after surgery at their usual dosage (14). If the patient has a high risk of postoperative bleeding, delaying the new oral anticoagulant for 48–72 hours is reasonable (13). In patients with both a high risk of thrombotic event and a concern for postoperative bleeding, consideration for LMW heparin at a dosage of 40 mg daily for 48 hours is reasonable (13).

**Pulmonary Diseases**

Postoperative pulmonary complications are common and have the potential to lead to significant morbidity, including increased length of hospital stay, increased readmission rates, and perioperative mortality (18). Both patient factors and procedure-related
Characteristics must be evaluated when considering the risk of postoperative pulmonary complications. The most important patient factors include the following:

- Current or recent smoking status
- History of chronic obstructive pulmonary disease (COPD)
- Obesity
- Age
- History of another chronic lung disease

A full list of patient risk factors is presented in Box 3.

Patients with a history of smoking have an increased risk of pulmonary complications, particularly those with a greater than 20 pack-year history. Smoking cessation even as little as 4 weeks before surgery can help reduce the risk of postoperative pulmonary complications and the longer the time from quitting to surgery, the lower the risk of postoperative pulmonary complications. Although the benefits of smoking cessation less than 3–4 weeks before surgery are not as great, quitting smoking so close to surgery does not increase postoperative pulmonary complications (18, 19).

Chronic obstructive pulmonary disease is an important patient risk factor that can lead to postoperative pulmonary complications. Patients with severe COPD have an increased risk of postoperative pneumonia, reintubation, and prolonged intubation. Patients with recent or current acute exacerbations of COPD, in particular, have a risk of postoperative pulmonary complications, and consideration of delaying surgery is warranted.

### Box 3. Patient Risk Factors for Postoperative Pulmonary Complications

**Pulmonary Risk Factors**

- Smoking
- Chronic obstructive pulmonary disease
- Asthma
- Interstitial lung disease
- Upper respiratory infection

**Nonpulmonary Risk Factors**

- Obesity
- Obstructive sleep apnea
- Pulmonary hypertension
- Congestive heart failure
- Poor nutritional status
- Poor functional status
- Neurologic impairment
Obstructive sleep apnea (OSA) is a respiratory disorder of repeated collapse of the upper airway during sleep with apneic periods. Obstructive sleep apnea is known to increase the risk of numerous postoperative complications, including hypoxemia and hypercarbia (20, 21). These morbidities can be exacerbated in patients with OSA by the use of narcotics for postoperative pain. Preoperatively, it is important to screen for OSA, especially among obese patients. The American Society of Anesthesiologists published a practice guideline in 2014 recommending the use of the STOP-BANG questionnaire as a screening tool (see the section “Resources”). A score of 2 or lower indicates a low risk of OSA. Patients with scores of 5 or higher have a high risk of OSA and should be considered for preoperative evaluation and treatment of probable OSA (22). For patients at high risk of OSA or those with known OSA, preoperative treatment with continuous positive airway pressure (CPAP) may be helpful. Patients with known OSA who undergo CPAP therapy at home should be instructed to bring their CPAP machine to the hospital or surgical center on the day of surgery. This can be used to help manage patients in the immediate postoperative period (23). Additionally, using postoperative carbon-dioxide monitoring may help ensure that patients at high risk of postoperative hypercarbia because of OSA are identified in the postanesthesia care unit before complications occur.

Procedure-related risks of postoperative pulmonary complications are related to the site of surgery, the route of surgery, the length of surgery, and the type of anesthesia. The closer the surgical incision is to the diaphragm, the higher the risk of postoperative pulmonary complications (18). The size of the incision is inversely proportional to the risk of postoperative pulmonary complications. Laparoscopic procedures, despite the need for general anesthesia, have a lower risk of postoperative pulmonary complications than laparotomy. The most likely explanation for this is less postoperative pain leading to less atelectasis, emphasizing a benefit of minimally invasive surgeries (laparoscopic or vaginal). Additionally, a low abdominal or transverse (Pfannenstiel) incision is associated with a lower risk of postoperative pulmonary complications than a vertical incision. Regional anesthesia has a lower risk of postoperative pulmonary complications, especially in high-risk patients, compared with general anesthesia; therefore, if an open procedure is needed, epidural or spinal anesthesia should be considered in high risk patients (18).

The preoperative evaluation of a patient with pulmonary disease begins with obtaining a detailed medical history and performing a thorough physical examination. Specifically, asking about a personal history of asthma, COPD, and OSA is particularly important. Specific symptoms to address include new or worsening cough and shortness of breath. Patients should be asked to elaborate about whether or not the cough produces sputum. In patients with dyspnea, it should be determined whether it occurs at rest or with exertion. If the shortness of breath occurs with exertion, additional details should be obtained, such as how much activity is required to bring on the dyspnea and whether there are precipitating factors (eg, temperature or environmental allergens). On physical examination, auscultation should be performed to check for the presence of rales,
rhonchi, and the presence or absence of breath sounds. Patients should be observed for the presence of purse-lip breathing, jugular venous distention, and equal chest rise with inspiration.

Routine pulmonary function tests are not necessary. A pulmonary function test should be ordered only if it will change perioperative management, which occurs rarely. Usually, these tests are used to confirm a new diagnosis of pulmonary disease in patients with a previously undiagnosed pulmonary disease and should be ordered by or in coordination with a pulmonologist. Chest imaging, specifically chest radiography, should not be ordered routinely or reflexively in preoperative patients. In patients with a known pulmonary or cardiac disease who are older than 50 years or in patients with new or worsening pulmonary symptoms, chest radiography should be considered. Patients without pulmonary symptoms and no history of pulmonary disease should not undergo routine chest radiography preoperatively unless indicated because of concerns for a gynecologic malignancy (24). For patients with known or suspected gynecologic malignancies, chest radiography may still be warranted. This can include a chest X-ray or computed tomography of the chest depending on the level of suspicion for metastatic disease.

Postoperatively, it is important to manage patients with pulmonary diseases aggressively. Early ambulation and incentive spirometry are two easy and inexpensive interventions that help increase alveolar recruitment and decrease residual capacity. This helps reduce the risk of postoperative pneumonia. Adequate pain control is important because pain can lead to splinting and avoidance of coughing and ambulation. However, opioid use should be limited, if possible, because opioids can decrease respiratory drive and lead to hypoxia and hypercarbia. Regional and local anesthesia can help decrease the amount of necessary postoperative opioids necessary (as discussed in the section “Enhanced Recovery”). Postoperative nasogastric tubes are associated with an increased risk of postoperative pneumonia and atelectasis. Their routine use should be avoided. Patients with a preoperative diagnosis of OSA should be encouraged to bring a CPAP machine to the hospital or one should be provided. The use of supplemental oxygen should be limited only for those patients who need it to maintain oxygen saturation above 90–92%.

Renal Disease
Chronic kidney disease is a persistent abnormality in renal function or anatomy that is present for more than 3 months and has health implications (25). It is a common medical condition affecting approximately 30 million adults in the United States (26). Most individuals with chronic kidney disease have mild impairment and are probably not even aware of the fact that they have renal impairment. The severity of chronic kidney disease is based on the glomerular filtration rate measurements (GFR) and categorized into grades 1–5, with Grade 1 (G1) as normal (GFR greater than 90 mL/min/1.73 m²) and G5 as kidney failure (GFR less than 15 mL/min/1.73 m²). The range between
normal and true kidney failure also includes G2 (mild decrease in function with GFR 60–89 mL/min/1.73 m²), G3a (mild to moderate decrease in function with GFR 45–59 mL/min/1.73 m²), G3b (moderate to severe decrease in function with GFR 30–44 mL/min/1.73 m²), and G4 (severely decreased function with GFR 15–29 mL/min/1.73 m²) (25).

The most common causes of chronic kidney disease in the United States are diabetes mellitus and hypertension, which together account for almost 75% of cases (26). In daily life, the kidneys often can compensate for even moderate degrees of impairment with little to no consequence to the patient. However, acute stressors, such as surgery, can tip the balance, leading to fluid and electrolyte imbalances in a previously well-compensated patient (27).

The patient's medical history should be obtained preoperatively, focusing on a personal history of diabetes, hypertension, and heart disease because women with these conditions are known to have a higher risk of kidney disease and impairment than other populations. Also, systemic lupus erythematosus, scleroderma, and sickle cell disease can lead to renal insufficiency. Preoperative physical examination should focus on evidence of fluid overload, such as peripheral edema, pulmonary edema, and jugular venous distention. In patients with congestive heart failure, these signs may occur as a result of cardiac dysfunction. The best and easiest evaluation of renal function is the measurement of GFR, traditionally accomplished with a 24-hour urine collection. An easier and adequate alternative approach is checking a serum creatinine level and calculating the creatinine clearance using the Modification of Diet in Renal Disease equation (also referred to as MDRD) or Chronic Kidney Disease–Epidemiology Collaboration equation (also referred to as CKD-EPI) (28). Occasionally, a confirmatory 24-hour urine collection will need to be performed. It is important to note that creatinine clearance is normally lower in African American women than in other populations and naturally decreases with age. Therefore, not all high creatinine levels are pathologic. Serum creatinine level is naturally higher in men and African Americans than in other populations. It is equally important to remember that a normal serum creatinine level in elderly patients with low muscle mass may actually be an indicator of mild renal insufficiency. Patients with known kidney disease, diabetes mellitus, and known heart disease also should undergo electrolyte tests, including magnesium, calcium, and phosphorus, as part of the evaluation of the renal function. Electrolyte abnormalities may be indicative of renal disease and determine the degree of impairment. Specifically, one should look for hyperkalemia, hypocalcemia, and hyperphosphatemia. If new, previously unknown kidney disease is found (ie, serum creatinine clearance is less than 60 mL/min/1.73 m² (1.002 mL/s/m²)) a referral to a nephrologist is indicated before surgery if there are clinical concerns. In patients with known kidney disease in whom creatinine clearance is significantly worse than their baseline, new electrolyte abnormalities are found, or volume overload has deteriorated, nephrology referral should be considered before surgery. If new, severe, previously unknown kidney disease is found (ie, creatinine clearance less than 30 mL/min/1.73 m² (0.501 mL/s/m²), a referral to a nephrologist should considered (25). These patients may need medical optimization before elective surgery.
For patients already receiving dialysis, coordination with their nephrologists is very important before elective surgery. Ideally, hemodialysis should be performed the day before surgery and then again 24–48 hours after surgery. Using intravenous (IV) fluids carefully with the goal of maintaining normal BP is important (27). Minimally invasive surgical techniques, which are believed to be associated with lower volume shifts, are critically important in this patient population.

Perioperatively, volume management and electrolyte evaluation are very important. It is important to avoid volume overload in patients with chronic kidney disease. Patients with chronic kidney disease also can have impairment in sodium reabsorption in the renal tubules; therefore, they may be less able to respond to hypovolemia. Hence, maintaining a euvoletic state is important. Electrolyte levels should be evaluated more frequently in these patients in the perioperative period with specific focus on potassium and serum creatinine. Nonsteroidal antiinflammatory drugs (NSAIDs) and other nephrotoxic medications should be used with great caution in patients with moderate to severe chronic kidney disease because they can lead to acute kidney injury. Proper dosages of prophylactic LMW heparin should be administered or heparin should be used in patients with chronic kidney disease who require pharmacologic prophylaxis for venous thromboembolism (VTE). Most opioids are safe for patients with chronic kidney disease, but morphine should be used with caution because its metabolites can accumulate in the kidneys (27). Box 4 provides a list of commonly used medications that can be nephrotoxic and should be used with caution in patients during the perioperative period, especially in those patients with already compromised renal function.

**Box 4. Common Nephrotoxic Medications**

- Angiotensin-converting enzyme inhibitors
- Nonsteroidal antiinflammatory drugs
- Aminoglycoside antibiotics
- Vancomycin
- Sulfonamide-based antibiotics
- Quinolone antibiotics
- Acyclovir
- Antiretrovirals
- Amphotericin B
- Lithium
- Thiazide diuretics
- Proton pump inhibitors
Postoperative acute kidney injury is particularly concerning in patients with chronic kidney disease, but it also can occur in women with no previous renal dysfunction. Acute kidney injury is an abrupt decrease in renal function that meets any of the following criteria (29), with details provided in Box 5:

- An increase in serum creatinine level by 0.3 mg/dL (26.52 micromol per liter) or more within 48 hours
- An increase in serum creatinine level by 1.5 times the baseline or more within the previous 7 days
- Urine volume less than 0.5 mL/kg/hr for 6 hours

Depending on the setting, postoperative acute kidney injury can occur in as little as 1–3% of patients undergoing laparotomy but in as much as 15% of patients undergoing joint replacement surgery (30). In high-risk patients undergoing abdominal surgery, the risk of acute kidney injury was estimated to be 12% in one series (31). In a large series of gynecologic surgery patients, the rate of postoperative acute kidney injury was 13% (32). However, in patients undergoing surgery for benign indications, the rate was 5% (32). None of these patients had chronic kidney disease preoperatively. Although death from

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**Box 5. Staging of Acute Kidney Injury**

**Stage 1**
- Serum creatinine level*: 1.5–1.9 times baseline or an increase of 0.3 mg/dL or higher
- Urine output*: less than 0.5 mL/kg/hr for 6–12 hours

**Stage 2**
- Serum creatinine level*: 2–2.9 times baseline
- Urine output*: less than 0.5 mL/kg/hr for 12 hours or longer

**Stage 3**
- Serum creatinine level*: 3 times baseline, increase in serum creatinine level to 4 mg/dL or more, initiation of dialysis, or glomelular filtration rate of less than 35 mL/min/1.73 m² in patients younger than 18 years
- Urine output*: less than 0.3 mL/kg/hr for 24 hours or longer or anuria for 12 hours or longer

*Acute kidney injury is defined by the following:
- An increase in serum creatinine level by 0.3 mg/dL or more within 48 hours
- An increase in serum creatinine level to 1.5 times baseline or higher (measured within the past 7 days)
- Urine output of less 0.5mL/kg/hour for 6 hours

acute kidney injury generally is uncommon, those who did develop acute kidney injury had a 90-day mortality rate of 10% (32). Often, the cause postoperatively is hypoperfusion either from blood loss or inadequate resuscitation leading to hypovolemia. The treatment is supportive with the goal of maintaining a mean arterial pressure greater than 80 mm Hg. It is important to use IV fluids judiciously because they can exacerbate problems and the use of lactated ringers should be avoided because it may precipitate hyperkalemia. If the patient has fluid overload in the setting of acute kidney injury, furosemide and bumetanide can be used (27). Transfusion of packed red blood cells can be used to correct anemia from surgical blood loss. This must be performed with care if the patient already has acute kidney injury because it may precipitate volume overload. Preoperatively, correcting anemia and optimizing blood glucose levels may help prevent postoperative acute kidney injury (30). Choosing surgical techniques that are associated with the lowest blood loss, such as minimally invasive surgery, and preventing insensible fluid losses, help reduce the risk of acute kidney injury, especially in patients with chronic kidney disease.

**Diseases of the Endocrine System**

The stress response to surgery includes the release of counterregulatory hormones, such as epinephrine, norepinephrine, and cortisol. General anesthesia itself also causes an endocrinologic response. This release of hormones can affect many body systems, including CV, renal, and metabolic, and cause problems in healthy individuals. Also, it can increase the risk of complications in surgical patients with comorbid endocrinologic conditions.

**Diabetes Mellitus**

The incidence of diabetes mellitus is increasing in this country partly because of the obesity epidemic. Approximately 10% of the U.S. population has diabetes mellitus of which 90–95% has type 2 diabetes mellitus (33). According to a 2006 article, 15–20% of surgical patients in the United States have diabetes mellitus (34). Patients with diabetes mellitus are at an increased risk of a number of perioperative complications, including wound infection, impaired wound healing, and CV and renal complications (35). Cardiovascular risk in women with diabetes mellitus is higher than in men with diabetes mellitus (34).

Diabetes mellitus and hyperglycemia can have multiple adverse effects on patients in the perioperative period. Patients with diabetes mellitus have a high risk of metabolic, infectious, renal, electrolyte, and cardiac complications. Hyperglycemia impairs wound healing by reducing the function of phagocytes and granulocytes, and collagen synthesis is impaired at blood glucose levels higher than 200 mg/dL (11.1 mmol/L) (35). Hyperglycemia also has been shown to reduce monocyte function. Additionally, patients with diabetes mellitus often have vascular disease, which impairs delivery of oxygen to tissues.
All of these factors contribute to impaired wound healing and predispose women with diabetes mellitus to higher infectious morbidity, especially wound infections, potentially explaining the strong evidence of the association between obesity and poor surgical outcomes, particularly wound healing (36). A number of studies have shown reduced infectious morbidity for patients with good glucose control (35), highlighting the importance of appropriate glycemic control in the perioperative period.

**Preoperative Evaluation.** The goal of any preoperative evaluation is to minimize conditions that may increase perioperative morbidity or mortality. The first step in the preoperative assessment of a patient with diabetes mellitus is determining the extent of disease and evaluating the patient’s current regimen and success of glucose control. Part of this assessment should include determining whether a patient has type 1 diabetes mellitus or type 2 diabetes mellitus and how long she has been treated for diabetes. Women who have been treated for diabetes mellitus for more than 10 years are at higher risk for diabetic complications, such as neuropathy or nephropathy, than women who have been treated for less than 10 years (35). If the patient has type 2 diabetes mellitus, it is important to consider whether her blood glucose level is controlled with diet alone, diet plus oral hypoglycemics, subcutaneous insulin, or any of the newer injectable agents. Careful documentation of the type of the oral hypoglycemic agent, the amount of insulin, the type of insulin, and the dosage schedule is essential. This information, along with her glucose level records (preprandial and postprandial) and most recent hemoglobin A\textsubscript{1c} (HbA\textsubscript{1c}) level, indicates the extent to which a patient’s condition in controlled. A patient’s medical history also should include an assessment of end-organ dysfunction, such as peripheral vascular disease, renal dysfunction, peripheral neuropathy, and cardiac disease. If the HbA\textsubscript{1c} level is greater than 7–8 mmol/L (0.07–0.08 proportion of total hemoglobin), indicating poor glycemic control, an anesthesia consultation may be warranted to help plan intraoperative management of blood glucose, possibly with an insulin drip, if the surgery is urgent. If the surgery is nonemergent or elective, coordination with the patient’s primary physician to improve her glucose control before surgery is preferred.

Physical examination is imperative before considering any patient for surgery, but in women with diabetes mellitus, care should be taken to evaluate for end-organ damage by assessing peripheral pulses, peripheral neuropathy, and retinopathy. Referral to the patient’s primary physician, endocrinologist, or another specialist may be warranted if new end-organ damage is identified or there are other concerns. Preoperative laboratory and radiographic testing should be tailored to the patient’s medical conditions. Patients with diabetes mellitus have an increased risk of CAD, and a preoperative electrocardiography (ECG) is recommended to compare the latest result with previous results to rule out occult CAD. Additional laboratory tests, including serum electrolyte measurement, a complete blood count (CBC), and assessments of diabetic control (eg, HbA\textsubscript{1c} measurement result if no recent one is available), are indicated. Assessing the patient’s
creatinine clearance is particularly important because diabetic nephropathy is not associated with any overt physical manifestations. Other testing, including chest radiography, urinalysis, and coagulation testing, should be tailored to the individual patient rather than being routinely ordered. Across surgical guidelines, routine urinalysis is not recommended in asymptomatic patients except those undergoing surgical implantation of foreign material or invasive urologic procedures (37).

Preparing a patient with diabetes mellitus for surgery focuses on balancing the need for euglycemia with a reduced caloric intake the day before and the day of surgery (38). Maintenance of preoperative glucose levels of 150–180 mg/dL (8.3–9.99 mmol/L) or less is a reasonable goal (39). If a patient receives only metformin, it can be withheld starting the evening before surgery; stopping it too early may compromise glucose control. Women who use sulfonylurea agents (glipizide, glyburide, or glimepiride) or meglitinides (nateglinide or repaglinide) should stop using these agents 24 hours before elective surgery because of an increased risk of myocardial ischemic injury secondary to the effects of these agents on adenosine triphosphate-dependent channels (39). However, for women with type 1 diabetes mellitus, it is important to remember that they need a constant, basal amount of insulin and cannot have their insulin therapy stopped completely. In the absence of exogenous insulin, they can have diabetic ketoacidosis even with normal blood glucose levels. For patients undergoing a minor outpatient procedure, such as a dilation and curettage, two thirds of their normal insulin dose should be taken on the morning of surgery (35). Longer acting types of insulin should be reduced to one half of the usual dose on the morning of surgery. In women who use 70/30 insulin or 75/25 insulin, these agents should be replaced with neutral protamine Hagedorn (also referred to as NPH or isophane) insulin on the morning of surgery (39). Patients undergoing minor outpatient surgery who use continuous subcutaneous insulin can continue using the pump. However, for major surgery, these patients should be transitioned to an IV insulin infusion the day of surgery (38). For these patients, maintenance of blood glucose levels of 180 mg/dL or less is recommended.

**Intraoperative Glucose Management.** Some experts suggest that intraoperative insulin levels may not affect surgical outcomes because of the short duration of insulin therapy. However, studies have shown that intraoperative glucose levels are associated with postoperative outcomes (39). One study reported that intraoperative glucose concentrations greater than 200 mg/dL (11.1 mmol/L) were associated with a high risk of morbidity and mortality (40). However, low glucose concentration also is associated with poor outcomes and increased mortality and morbidity (39). It appears that the target should be 141–170 mg/dL (7.83–9.44 mmol/L). Patients maintained on diet alone or on an oral hypoglycemic agent alone need glucose monitoring during surgery. If their blood glucose levels normally are well controlled, most likely they will not need an IV insulin infusion during surgery. During this time, their blood glucose levels should be monitored at least every 1–2 hours (35, 38). This applies to both major and minor surgical procedures.
Intravenous insulin infusion during surgery should be considered in patients taking insulin or in patients taking oral hypoglycemic agents who have poor glycemic control. This should be discussed and coordinated with the anesthesia team. During surgery, when blood glucose levels can fluctuate widely and subcutaneous insulin can take 15 minutes or longer to take effect, it is advantageous to use IV insulin infusion.

**Postoperative Glucose Management.** The Joint Commission’s Surgical Care Improvement Project recommends target blood glucose levels less than 180 mg/dL (9.99 mmol/L) for the 18–24 hours after the end of anesthesia (41). Patients who take metformin should wait 48 hours after major surgery or until they are tolerating a regular diet before resuming therapy with metformin. Generally, it is recommended that metformin be held for 48 hours after any stress to the hepatic or renal system. Patients normally maintained on subcutaneous insulin undergoing relatively short, minor procedures who will be eating a regular diet later that afternoon or evening may be able to make their own adjustments.

For other patients, there are a variety of recommendations in the noncritical patient population. Generally, these recommendations encourage advancing meals in a timely fashion and consistency in the carbohydrate content of each meal (see the section “Enhanced Recovery”). Box 6 shows the recommendations from the Joslin Diabetes Center.

**Box 6. Recommendations for Inpatient Management of Surgical Patients With Diabetes Mellitus**

- Patients who use home oral hypoglycemics and noninsulin injectables should be given a basal insulin infusion with bolus infusion and corrective insulin (to be determined by institutional nomograms).
- Patients who use home basal insulin and their dose is less than 0.4 units per kilogram should be given 80% of their home basal dose of intermediate or long-acting insulin and then provided with 50% of their home rapid or short-acting insulin.
- Patients who use home-mixed basal or bolus premixed insulin (70/30, 75/25, etc) should resume 80% of their home dose.
- Patients who use an insulin pump, who are not cognitively impaired, can continue their usual basal rate, continue monitoring carbohydrates for prandial insulin administration, and use the dosage based on glucose monitoring with their pump.

**CASE NO. 2.** A 55-year-old obese woman with diabetes mellitus (body mass index [BMI] 35, calculated as weight in kilograms divided by height in meters squared) has a 10 cm complex adnexal mass and CA 125 level of 160 kU/L. Her referring primary physician has recommended computed tomography (CT). The patient has questions about imaging and is concerned about the management of diabetes mellitus at the time of surgery. Her most recent HbA$_1c$ level was 6.9% (0.069 proportion of total hemoglobin), and she takes metformin.

The obstetrician–gynecologist counsels the patient that typically metformin is held while patients are hospitalized, and insulin therapy can be maintained to keep the glucose levels at less than 180 mg/dL (9.99 mmol/L). As long as the patient’s renal function is normal, she can undergo CT with contrast. However, it is recommended that she stop taking metformin for 24–48 hours before CT out of the concern for lactic acidosis. She would also need to stop taking metformin on the night before surgery. This patient had an HbA$_1c$ level lower than 9% (0.09 proportion of total hemoglobin), which allows her to undergo elective surgery. She should undergo a CBC and assessment of her renal function. An ECG would be reasonable because she has a risk of cardiac disease. In the absence of pulmonary symptoms or risk factors, she does not require chest radiography or routine urinalysis. If the hospital has an enhanced recovery after surgery program, this patient can participate and have her diet advanced quickly after surgery (see the section “Enhanced Recovery”).

**Thyroid Diseases**

The goal of the perioperative management of a woman with thyroid disease is to maintain a euthyroid state. The perioperative management of a patient with thyroid disease starts with obtaining a detailed medical history, medication reconciliation, physical examination, and laboratory analysis. Generally, it should be determined if the current treatment regimen is appropriate. If so, patients with hypothyroidism or hyperthyroidism should be maintained on this preoperative regimen through the surgical period.

**Hypothyroidism.** Hypothyroidism affects approximately 1% of the U.S. population and is more prevalent in women than in men (42). It can have an effect on multiple organ systems, including cardiac, vascular, metabolic, and central nervous. The most serious surgical complications in a patient with hypothyroidism are CV collapse and postoperative myxedema coma. Although this condition is rare, it should be considered in a patient with unexplained seizures, coma, heart failure, or hypothermia in the early postoperative period.

Preoperatively, it is important to obtain a detailed history of hypothyroidism. Patients should be asked about any prior thyroid surgery, thyroid irradiation (external or radioactive iodine), or any other head and neck radiation exposure (43). Symptoms of hypothyroidism can include lethargy, fatigue, headache, coarse voice, depression, and cold intolerance. Physical examination should focus on identifying signs of hypothyroidism, such as dry skin, coarse hair, delayed reflexes, bradycardia, carpal tunnel syndrome,
sleep apnea, or goiter (43, 44). Certain medications can induce hypothyroidism, including iron, amiodarone, and cholestyramine, so a careful review of all patient’s medications is imperative.

According to one review, patients with hypothyroidism presenting for surgery can be categorized into one of the following groups: 1) hypothyroid, well controlled; 2) mild to moderately hypothyroid; and 3) severely hypothyroid, either presenting with or developing myxedema coma perioperatively (beyond the scope of this review) (42). Before surgery, a serum TSH level should be checked in any patient with known thyroid disease who is taking thyroid hormone replacement therapy or any patient with signs or symptoms of hypothyroidism. An increased TSH level is indicative of hypothyroidism. In a patient with a mildly elevated TSH level, a T4 level also should be checked. If the T4 level is normal, the patient is euthyroid but may have an underlying tendency for hypothyroidism, and close monitoring for signs of hypothyroidism in the postoperative period is warranted.

In the surgical patient, untreated hypothyroidism can decrease cardiac output by 30–60% (43). Hypothyroid patients are more likely to have arrhythmias, such as bradycardia and torsades de pointes, and increased peripheral vascular resistance than other populations. Plasma volume is decreased because of increased vascular permeability, renal perfusion, and decreased creatinine clearance. Additionally, patients are more likely to have electrolyte disturbances, such as hyponatremia and azotemia (43). From a gastrointestinal (GI) perspective, patients with hypothyroidism often have chronic constipation, and surgery can cause an ileus; thus, patients with hypothyroidism who undergo abdominal or pelvic surgery have an increased risk of a slow return of bowel function (35, 43).

In patients with mild hypothyroidism, even if not controlled with thyroid hormone replacement therapy, emergent or urgent surgery does not have to be postponed to achieve a euthyroid state (35). These patients can start thyroid hormone replacement therapy in the perioperative period and continue postoperatively. However, if the patient has severe hypothyroidism or surgery can be delayed for a few weeks, then thyroid hormone replacement therapy should be initiated with levothyroxine, and referral to an endocrinologist is warranted. Patients with severe hypothyroidism who require urgent surgery should be given IV T3 or T4, and an endocrinology consultation should be obtained.

Surgery affects circulating thyroid hormones in a way that mimics a euthyroid sick syndrome. Total T3 level is reduced whereas T4 level remains stable (43). However, patients who are euthyroid before surgery do not require routine administration of a thyroid hormone. The half-life of levothyroxine is 1 week, and it is not necessary for a patient to take her dose the morning of surgery (45). If the patient is not able to tolerate oral medications in the postoperative period, levothyroxine can be administered intravenously,
noting that half of the parenteral dose is equivalent to the full oral dose. Once the patient is able to tolerate oral medications, the oral administration of levothyroxine can be resumed.

Patients who have severe hypothyroidism and require emergent surgery can be given IV T₃ or T₄, and endocrinology should be consulted. These patients should be given IV levothyroxine, 200–500 micrograms, followed by a daily IV dosage of 50–100 micrograms. These patients also may have coexistent adrenal insufficiency, and thyroid hormone replacement therapy may precipitate adrenal crisis; therefore, corticosteroids should be administered concurrently (46) in collaboration with endocrinology and anesthesia.

Myxedema coma is a rare condition that is characterized by confusion, coma, seizure, hypothermia, and heart failure. This diagnosis should be considered in any woman who has acute changes in the postoperative period. When myxedema coma is suspected or confirmed, immediate resuscitation with IV fluids is initiated. Thyroid and corticosteroid agents are administered, and intensive care unit transfer and appropriate consultations are instituted immediately.

**Hyperthyroidism.** The most common cause of hyperthyroidism in the United States is Graves disease, which is caused by antibodies directed at TSH receptors leading to increased thyroid function. Clinical signs and symptoms include tachycardia, fever, tremor, diarrhea, atrial fibrillation, goiter, and exophthalmus (42).

Struma ovarii and increased β-hCG levels are two thyroid-related situations specifically relevant to the obstetrician–gynecologist. Struma ovarii, in which a mature teratoma predominantly consists of thyroid tissue, can be hormonally active and can cause hyperthyroidism. Once it is surgically removed, hyperthyroidism usually resolves. It is important to monitor a patient’s thyroid functions before and after surgery if struma ovarii is the presumed or confirmed diagnosis. Increased β-hCG levels associated with a molar pregnancy also can cause hyperthyroidism because β-hCG and TSH share the same alpha subunit. Therefore, it is important to check the TSH level and T₄ level in any patient with increased β-hCG levels, tachycardia, and a presumed molar pregnancy. Use of beta-blockers is important in these patients before evacuation of the uterus by dilation and curettage, and the patients should be monitored postoperatively for signs and symptoms of thyroid storm.

Preoperatively, a serum TSH level should be checked in any woman with known thyroid disease who is taking thyroid hormone replacement therapy or in any patient with signs or symptoms of hyperthyroidism. If a patient’s TSH level is in the borderline low range, a free T₄ test should be ordered to confirm the diagnosis of hyperthyroidism.

Like patients with hypothyroidism, patients with mild hyperthyroidism can safely undergo surgery with little or no delay as long as a beta-blocker, such as propranolol, is administered before and after surgery. Patients in whom hyperthyroidism is well
controlled or who have mild hyperthyroidism also can undergo surgery with only the addition of a beta-blocker. Historically, propranolol has been the beta-blocker of choice; however, it has to be administered up to four times a day. Newer, long-acting beta-blockers, such as atenolol, are effective and can be administered intravenously and then easily converted to oral administration postoperatively.

In patients with uncontrolled hyperthyroidism who will be undergoing nonemergent surgery, surgery should be postponed until a stable medical regimen has been established. For emergent procedures, anesthesiology should be alerted as soon as possible to prepare for necessary interventions (beta-blocker, antithyroid medications, and iodine).

Patients with hyperthyroidism should take their medications on the morning of surgery. The most serious concern related to untreated hyperthyroidism in the perioperative period is thyroid storm. Often, it occurs during or soon after surgery and is characterized by hyperthermia, tachycardia, and confusion. If not treated, it can lead to CV collapse (35). The mortality from thyroid storm can range from 10% to 75% (47). Although thyroid storm usually occurs after induction of anesthesia and after surgery, thyroid storm occurring just before or at induction of anesthesia, possibly caused by an undetected hyperthyroid state combined with emotional stress, has been reported (47). In such cases, thyroid storm may be confused with malignant hyperthermia.

Patients with mild hyperthyroidism can proceed with surgery after treatment with a beta-blocker is initiated. If the diagnosis of hyperthyroidism or thyrotoxicosis was established perioperatively or postoperatively, beta-blockers and antithyroid agents, such as iodine, thioamides (methimazole or propylthiouracil, and iopanoic acid, should be administered (35). Consultation with endocrinology is recommended.

**IMMUNOSUPPRESSION**

In 1994, there was a recommendation that patients taking long-term corticosteroid therapy receive corticosteroid replacement based on the degree of surgical stress—moderate (eg, abdominal hysterectomy) or major (eg, ovarian cancer debulking) (48). A comprehensive review of the literature in 2008 highlighted differentiating between those patients who are receiving therapeutic doses of corticosteroids but have an intact HPA and those who are being treated for primary HPA dysfunction (49). This review of nine studies and 315 patients concluded that the biochemical tests are probably too sensitive and that for most patients, continuing their baseline corticosteroid regimen is appropriate. Surgeons should be aware that corticosteroids should be administered in a patient with hypotension who does not respond to usual resuscitative measures.

**Preoperative Management.** In patients who have been taking corticosteroids on a long-term basis, an appropriate release of cortisol (due to the stress of surgery) may not be possible because their HPA axis is blocked from exogenous fixed-dose corticosteroid use. This can lead to conditions similar to Addison disease with CV collapse (35). Patients
who take the daily equivalent of 5 mg of oral prednisone or less do not demonstrate HPA suppression; therefore, they do not need extra perioperative corticosteroid administration. Furthermore, patients who have taken corticosteroids of any dose for less than 3 weeks and those who have taken short-acting corticosteroids every other day do not have HPA suppression (35).

Patients taking more than 5 mg of prednisone daily are in an intermediate risk category and may require HPA testing. In patients undergoing minor outpatient surgery that is not expected to last longer than 1–2 hours, their normal corticosteroid dose can be administered before surgery, and no supplementation is needed (35). Alternatively, if a procedure is expected to produce moderate to high surgical stress, it is acceptable to test the HPA axis. Often, a cosyntropin stimulation test is recommended. In this test, a dose of 250 micrograms of cosyntropin is given intravenously, and serum cortisol level is measured 30 minutes later. A cortisol level of less than 500 nmol/L indicates an inappropriate HPA response and, in the past, indicated the needs for supplementation. However, a small double-blind randomized prospective study was performed in patients who showed an inadequate response on cosyntropin stimulation test. Patients were randomized to receiving hydrocortisone before and after surgery or to receiving saline infusion. There was no difference in hypotension or heart rate, before, during, or after the procedure (50).

More recent systematic reviews, including a Cochrane review, have highlighted the change in practice over the past 20 years (51, 52). One review highlights the change in paradigm and indicates that patients most likely do not need supratherapeutic doses of corticosteroids in the perioperative and postoperative periods (49). The rationale for this and for the judicious use of perioperative corticosteroids instead of liberal administration is that there are risks with unnecessary corticosteroid administration perioperatively. The possible adverse effects of corticosteroids include impaired surgical wound healing, immunosuppression, and interaction with anesthetic agents (48). By following these guidelines, patients who take corticosteroids on a long-term basis can avoid adrenal insufficiency perioperatively while minimizing the risks of unnecessary corticosteroid administration.

It has been demonstrated that long-term use of inhaled and topical corticosteroids can cause HPA suppression. However, this is the case only with extremely high doses, and the clinical significance is not known. Generally, it is not recommended to provide perioperative supplementation if the only source of daily corticosteroids is inhaled or topical (35).

**Perioperative Management.** In most patients, continuing their baseline corticosteroid dose in the perioperative period is appropriate; modification may be necessary if the patient cannot tolerate oral medications. Health care providers should be alert and provide a supplemental corticosteroid regimen if a patient develops hypotension that does not respond to traditional resuscitative measures (49, 52).
Blood Product Considerations

Preoperative Management

Although each institution may have its own algorithm for preoperative blood management, it is likely based on the “Practice Guidelines for Perioperative Blood Management: An Updated Report by the American Society of Anesthesiologists Task Force on Perioperative Blood Management” published in 2015 (53). This document varies from previous guidelines; it emphasizes the use of transfusion algorithms and other pharmacologic therapies, when available and feasible, to decrease blood transfusions. The general theme of the guideline favors restrictive versus liberal use of blood products along with massive transfusion protocols to improve the use of different blood components (53).

Determination of the hemoglobin threshold (6–10 g/dL [60 g/L–100 g/L]) is critical to minimize blood transfusion, and a transfusion rarely is indicated when the hemoglobin concentration is greater than 10 g/dL (100 g/L) (54). Preoperatively, erythropoietin with or without iron should be administered if time permits. Additionally, anticoagulation should be reversed when possible depending on the patient’s other medical conditions. Warfarin should be discontinued, and bridging therapy with heparin or LMW heparin should be initiated. In addition to stopping anticoagulant therapy, antithrombotic agents (ie, clopidogrel or aspirin) also should be discontinued after consultation with the patient’s other physicians. In select cases, the use of autologous or donor-directed blood can be considered, if hemoglobin concentration can be restored in a timely manner or a suitable directed donor is available.

A detailed medical history should be obtained, including the use of any herbal supplements and vitamins. These agents, especially dong quai, fish oil, flax seed oil, garlic, ginger, gingko biloba, chamomile, and vitamin E, can decrease platelet aggregation or inhibit clotting.

Intraoperative and Postoperative Management

Administration of other products, such as platelets, fresh frozen plasma, and cryoprecipitate, can be considered in patients with excessive intraoperative bleeding. In the absence of a massive transfusion protocol, administration of platelets typically is not indicated unless the patient has a level of less than 50×10^9/L and excessive bleeding occurs. During massive transfusion protocols, most experts recommend a 1:1:1 ratio of plasma-to-platelets-to-packed red blood cells. In one multicenter prospective study, this ratio was preferred over a 1:1:2 ratio (55). Other indications for fresh frozen plasma administration include the correction of bleeding in the presence of an international normalized ratio greater than 2 when heparin was not administered. Cryoprecipitate is indicated when the fibrinogen concentration is less than 80–100 mg/dL (2.35–2.94 micromol per liter) in the presence of excessive bleeding or as an adjunct in the case of massive transfusion when the fibrinogen level cannot be measured in a timely manner (53).
**Topical Hemostatic Agents**

Several topical hemostatic agents are commonly available, and the use of each of these agents needs to be determined based on clinical need, route of surgery, and cost. Gelatin matrices are available as a sponge, film, or powder, and they function by forming a physical matrix for blood clot formation. They tend to be fairly inexpensive and can be combined with a thrombin liquid. Cellulose comes as a mesh or packed fiber. As with the gelatin matrices, it serves as a physical matrix for blood clot formation. It is easy to place through laparoscopic ports and is relatively inexpensive. As with the previous two products, microfibrillar collagen serves as a physical matrix for blood clot formation; however, it also is available as a powder in addition to a sponge. Like the cellulose, it is easy to place laparoscopically but is more expensive. There are three liquid hemostatic agents. Topical thrombin can be combined with any of the aforementioned physical matrices, and it is an agent that converts fibrinogen to fibrin. There are foam matrices that have properties of both a compression physical matrix and a thrombin to promote clot formation. They can be applied through laparoscopic ports and can be used on small arterial bleeds. The other matrices typically are used on small venous surfaces. The foam matrices tend to be more expensive, but they have properties of both a physical matrix and an agent for conversion of fibrinogen to fibrin. Fibrin sealant is a liquid that can be used on larger surfaces as compared to the other hemostatic agents. It is composed of thrombin and fibrinogen to promote blood clot formation.

**Operating Room Considerations**

**Prophylaxis**

Surgical site infections develop in 1 in 24 patients who undergo inpatient surgery in the United States every year (56). These infections can be superficial incisional, deep incisional, or organ/space. Although superficial incisional infections lead to surgical morbidity, organ/space infections are responsible for surgical mortality. Most gynecologic procedures are classified as clean, such as laparoscopic bilateral salpingo-oophorectomy, or clean-contaminated, such as hysterectomy. Prophylactic antibiotics must cover a variety of gram-positive, gram-negative, and anaerobic organisms (57).

Although meticulous surgical technique is paramount, patient factors exist that increase the risk of surgical site infections, including diabetes mellitus, smoking, obesity, and poor nutritional status. Preoperatively, chlorhexidine washing the evening before surgery has been advocated because it has been shown to decrease the incidence of surgical site infections (58, 59). Hair shaving is discouraged, but clipping can be performed before a procedure if it facilitates the surgical incision. Preoperatively, all women undergoing hysterectomy should receive prophylactic antibiotics. Cefazolin, 1–2 g intravenously, is the preferred regimen; in women who weigh greater than 120 kg (265 lb), a dose of 3 g should be considered. For women with a penicillin allergy, the adequate
substitutions are listed in Appendix. These regimens should be administered 30–60 minutes before incision and readministered if the surgical procedure lasts longer than 3 hours or excessive blood loss (greater than 1,500 mL) occurs.

The prevention of VTE is a major focus of most health care institutions because VTE and pulmonary embolism remain the most preventable causes of hospital death, including in gynecologic patients (60). According to the American College of Chest Physicians, surgical patients can be assigned into categories based on the risk of VTE in untreated patients as follows (61):

- Very low risk (0.5%)
- Low risk (1.5%)
- Moderate risk (3%)
- High risk (6%)

These categories are based on the modified Caprini risk assessment tool (Table 1), which assigns points based on age, type of surgery, duration and route of surgery, medical comorbidities, previous history of VTE or thrombophilia, and duration of surgery. The total score indicates the risk category and resulting recommendations.

Most patients undergoing hysterectomy for nononcologic indications will be in the low or moderate risk category. The American College of Chest Physicians classifies all minimally invasive abdominal procedures as minor, leading to a debate regarding the type of prophylaxis needed in these patients. By general consensus, patients who are undergoing minimally invasive surgery for oncologic indications, those who undergo long procedures, and obese patients, should receive at least mechanical and pharmacologic prophylaxis for the duration of the hospitalization. The American College of Obstetricians and Gynecologists (ACOG) recommends thromboprophylaxis based on the patient factors and procedure risk factors, not the route of surgery (62). There is a paucity of data to help guide the use of VTE prophylaxis in patients undergoing minimally invasive surgery (63).

Positioning

Upper and lower extremity nerve injuries can occur during surgery for obstetric and gynecologic indications. The incidence of lower-extremity injuries is 1.1–1.9% and of the upper-extremity injuries is 0.16% (64, 65). Nerve injuries are categorized based on the mechanism of action into neuropraxia, axonotmesis, or neurotmesis. Neuropraxia occurs most commonly because of compression and subsequent demyelination and will resolve in weeks to months. Axonotmesis is more severe and results from compression and axon damage and may take up to a year to resolve. Neurotmesis results from transection of the nerve and will not improve without corrective surgery. Although nerve injuries are distressing to the patient and to the health care provider, most patients can expect a full recovery with a median time to resolution of 31.5 days (range, 1 day to 6 months) (66).
### Table 1. Caprini Deep Vein Thrombosis Risk Assessment

<table>
<thead>
<tr>
<th>Risk Category</th>
<th>Caprini Score*</th>
<th>Risk of Venous Thromboembolism</th>
<th>Mechanical Prophylaxis</th>
<th>Pharmacologic Prophylaxis</th>
<th>Extended Prophylaxis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very low risk</td>
<td>0–2</td>
<td>0.5%</td>
<td>Yes</td>
<td>Not indicated; early mobility and frequent ambulation</td>
<td>No</td>
</tr>
<tr>
<td>Low risk</td>
<td>3–4</td>
<td>1.5%</td>
<td>Yes</td>
<td>Not indicated; early mobility and frequent ambulation</td>
<td>No</td>
</tr>
<tr>
<td>Moderate risk</td>
<td>5–6</td>
<td>3%</td>
<td>Yes</td>
<td>Yes (low-molecular-weight heparin, heparin, and other agents)</td>
<td>Only during hospitalization</td>
</tr>
<tr>
<td>High risk</td>
<td>7–8</td>
<td>6%</td>
<td>Yes</td>
<td>Yes (low-molecular-weight heparin, heparin, and other agents)</td>
<td>Yes, during hospitalization and for 28 days after surgery</td>
</tr>
</tbody>
</table>

*The Caprini score is calculated by assigning an appropriate number of points for each of the following factors and adding up the individual scores to calculate the total score:

<table>
<thead>
<tr>
<th>Check Points Factor</th>
<th>One Point for Each of the Following</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age 41–60 years</td>
<td></td>
</tr>
<tr>
<td>Minor surgery (less than 45 minutes)</td>
<td></td>
</tr>
<tr>
<td>Major surgery within the past month</td>
<td></td>
</tr>
<tr>
<td>Visible varicose veins</td>
<td></td>
</tr>
<tr>
<td>Personal history of inflammatory bowel disease</td>
<td></td>
</tr>
<tr>
<td>Swollen legs</td>
<td></td>
</tr>
<tr>
<td>Overweight or obesity</td>
<td></td>
</tr>
<tr>
<td>Heart attack within the past month</td>
<td></td>
</tr>
<tr>
<td>Congestive heart failure</td>
<td></td>
</tr>
<tr>
<td>Serious infection in the past month</td>
<td></td>
</tr>
<tr>
<td>Current lung disease, such as emphysema or chronic obstructive pulmonary disease</td>
<td></td>
</tr>
<tr>
<td>Bedrest or restricted mobility</td>
<td></td>
</tr>
<tr>
<td>Current use of oral contraceptive pills or hormone therapy</td>
<td></td>
</tr>
<tr>
<td>Pregnancy or giving birth within the past month</td>
<td></td>
</tr>
<tr>
<td>History of recurrent pregnancy loss, preeclampsia, or intrauterine growth restriction</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Two Points for Each of the Following</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age 61–74 years</td>
</tr>
<tr>
<td>Current or past malignancy (not including nonmelanomatous skin cancer)</td>
</tr>
<tr>
<td>Minor procedure planned for longer than 45 minutes</td>
</tr>
<tr>
<td>Immobility of leg for the past month</td>
</tr>
<tr>
<td>Current central venous access (port or peripherally inserted central catheter)</td>
</tr>
<tr>
<td>Confinement to bed for the past 72 hours</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Three Points for Each of the Following</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age 75 years or older</td>
</tr>
<tr>
<td>Personal history of deep vein thrombosis or pulmonary embolism</td>
</tr>
<tr>
<td>Personal or family history of hypercoagulable state</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Five Points for Each of the Following</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elective hip or knee replacement in the past month</td>
</tr>
<tr>
<td>Hip or pelvic fracture in the past month</td>
</tr>
<tr>
<td>Serious trauma leading to a fracture in the past month</td>
</tr>
<tr>
<td>Spinal cord injury resulting in paralysis</td>
</tr>
<tr>
<td>Stroke in the past month</td>
</tr>
</tbody>
</table>

UPPER EXTREMITY

Brachial plexus injuries are most commonly caused by stretching, such as when the arm board extends the arm at more than a 90-degree angle from the bed or when the patient’s arm falls off the arm board. Also, they can occur if shoulder blocks are used during minimally invasive surgery and if the shoulder block is not appropriately placed over the acromio-clavicular joint. The use of shoulder blocks should be avoided; other antislip mechanisms are available. Arms should be positioned and secured on the arm board before the patient is draped to allow for maximal visualization during positioning. Patients also can develop ulnar neuropathy if there is too much pressure on the medial aspect of the elbow. Appropriate padding should be used, and the patient should be placed in the “thumbs up” position when tucking in the arms for minimally invasive surgery (67).

LOWER EXTREMITY

The femoral nerve injury is the most common lower-extremity injury and results from compression from the lateral blades of self-retaining retractors or from stretch when women are placed in the lithotomy position, and the hip is hyperflexed. Obturator nerve injuries can occur during pelvic surgery for advanced gynecologic malignancies, pelvic lymphadenectomy, or the repair of paravaginal defects of the placement of transobturator tapes. The sciatic nerve and the common peroneal nerve typically are injured as a result of hyperflexion of the thigh and as a result of pressure on the lateral head of the fibula, respectively. Ilioinguinal and iliohypogastric nerve injuries are purely sensory and usually result from suture entrapment at the time of a low transverse skin incision, although they can occur from low lateral laparoscopic port sites. Genitofemoral nerve injuries are purely sensory, and they can cause symptoms over the anterior medial thigh and mons pubis. Typically, this results from an external iliac lymphadenectomy. The pudendal nerve typically is injured during vaginal procedures and is exemplified by pain that worsens with stretching the nerve (eg, when sitting).

CASE NO. 3. A 32-year-old woman with a BMI of 23 undergoes a total abdominal hysterectomy and bilateral salpingectomy through a vertical midline incision for a leiomyoma with the uterine size of a 30-week gestation. The surgery is uncomplicated other than a blood loss of 500 mL (estimated). On the first postoperative day, the patient is not able to get out of bed to void after removal of the Foley catheter. On examination, she is unable to extend her knee and flex her right hip. A physical therapist evaluates the patient and determines that the patient has weakness in the distribution of the femoral nerve on the right side. A 3 days-per-week physical therapy regimen is recommended. The patient is distressed and inquires how such injury may have happened. It is explained that because of the size of the leiomyomas, a self-retaining retractor and lateral blades had to be used. The positioning of the lateral blades was checked several times during the procedure, and the shortest blades possible were used so as not to put too much pressure on the psoas muscle, where the femoral nerve courses. However, a transient femoral nerve deficit may have
occurred. The patient should be assured that most injuries improve with physical therapy within approximately 30 days. Outpatient physical therapy is prescribed. The patient returns to the surgeon’s office 4 weeks after surgery and she notes that her strength has almost completely returned. Although this injury can occur from the lateral blades of a self-retaining retractor, other considerations would be a pelvic hematoma or anesthesia-related injury (if the patient had spinal or epidural anesthesia). Additionally, if a patient undergoes laparotomy in the lithotomy position, one needs to ensure that the hip is not stretched excessively in the downward position because this can cause a stretch injury of the femoral nerve as it travels through the femoral canal.

Special Populations

Older Women

The life expectancy of American women continues to increase. Based on 2010 census data, the percentage of the population aged 65 years and older was 13% in 2010 and is projected to reach 20.9% by 2050. In 2010, 22.9 million women were older than 65 years in the United States, and this number is projected to increase to 30.9 million by 2020 (68).

This trend also indicates an increasing population of older women who will develop conditions requiring surgical care, namely pelvic organ prolapse and gynecologic malignancy. Although some retrospective studies have suggested that age is not a significant risk factor for surgical morbidity and mortality, most of these studies do not contain enough data for adequate statistical analysis and have not been able to adjust or control for confounding comorbid risk factors (69, 70). Other studies have shown that when urogynecologic surgery is performed in older patients, the overall risk of death and morbidity is low; yet older populations have a higher risk of these complications (71). Although postoperative death is relatively rare, the most common causes of death are attributed to MI and respiratory failure. In one study using National Surgical Quality Improvement Program data, the authors reported that morbidity rates increased in a linear fashion with age; surgical morbidity increased by 0.71% per year. However, there was an exponential increase of surgical mortality rates in relation to increasing age. In the multivariate analysis, age was statistically significantly associated with mortality (odds ratio, 1.04; 95% confidence interval, 1.02–1.06; *P* <.001) and wound, renal, CV, and respiratory morbidity (72).

Preoperative Management

Older women are more likely to have significant medical comorbidities than younger women. This is particularly true for CVD, renal disease, and pulmonary diseases. Diabetes mellitus and other endocrinopathies also are more commonly found in older women. Previous sections have outlined the appropriate evaluation and consultative services for specific recognized medical comorbidities. However, the gynecologic surgeon also must be aware that older women may have unrecognized medical illnesses that may be
Surgical Considerations

identified only by a detailed medical history and physical examination. However, although medical comorbidities are frequent predictors of collective postoperative morbidities, emergency surgery, physical status classification (by the American Society of Anesthesiologists), smoking, transfer between facilities, and decreased sensorium also are important.

Aging causes the decline of most organ systems even in those individuals who have remained physically and mentally active. In an older woman, the decline in physiologic and anatomic integrity may result in a decreased ability to respond to the stress of surgery, especially if there is a complication that might result in hypovolemia or infection. Underlying diseases (eg, CAD, COPD, and diabetes mellitus) may be further magnified by these physiologic changes.

Medications

The use of prescription and nonprescription drugs is disproportionately higher in older patients than in younger patients. Polypharmacy may be significant and must be considered in the preoperative evaluation. Obtaining a complete list of currently used medications is mandatory. Asking the patient to bring all of her medications to the office and reviewing them is critical because it is not unusual for patients to have medications in their possession or on their medication list that they are no longer taking. Confirmation with the patient’s caregiver, if applicable, is important to be certain of the correct medications, dosages, and schedules.

Drug metabolism may be altered secondary to the decrease in renal and hepatic function. From a pharmacokinetic perspective, older patients usually have adequate capacity for absorption from the GI tract. However, given the decrease in lean body mass and the increase in proportional body fat, drug distribution may be altered. The volume of distribution of water-soluble drugs tends to decrease, whereas the volume of distribution of fat-soluble drugs tends to increase. Altered distribution may affect the elimination half-life of drugs. Further clearance of drugs excreted by the kidneys will decrease predictably in older patients. Estimation of renal function must be based on the calculation of GFR rather than the measurement of the serum creatinine level because the decrease in lean body mass is accompanied by a decrease in creatinine production. However, the serum creatinine level may remain in the normal range despite significantly altered renal clearance. Drugs that require dosage adjustments based on renal clearance (ie, GFR) include aminoglycosides, penicillins, cephalosporins, digoxin, cimetidine, many chemotherapy agents, and LMW heparins. Also, the patient with altered renal function is more likely to have further acute renal insufficiency with the use of IV contrast for imaging studies.

Declining hepatic function may be further affected if the patient is taking medications that are cleared by the liver. It may be affected by diminished hepatic blood flow and altered liver enzyme activity. Both may result in decreased clearance of medications, such as diazepam, propranolol, and warfarin.
Assessment of Functional Status

A review of data from the National Surgical Quality Improvement Program reported that increasing age independently predicted morbidity and mortality, which may reflect “increasing frailty of senescence” (72). The authors comment that the elderly patient may not be able to meet the increased functional demands of stressors, such a surgery. Other predictors of adverse outcomes in a frail patient included unintentional weight loss, emergency surgery, American Society of Anesthesiologists’ classification of physical status, and impairment of activities of daily living. In the office, the obstetrician-gynecologist can estimate the patient’s functional status by assessing the following activities:

- Eating or feeding
- Continence
- Transferring
- Toileting
- Dressing
- Bathing

Patients who have severely limited functional capacity are at an extreme risk of significant postoperative morbidity. The deconditioned patient has little reserve to recover from the stress of surgery. Exercise tolerance is a sensitive predictor of postoperative cardiac and pulmonary complications. Exercise testing might be considered; however, patients who are unable to climb a flight of stairs or walk up a hill have a significant risk of postoperative cardiac complications.

Understanding the reasons for diminished functional status is important because some patients may benefit from preoperative rehabilitation, improved nutrition, or physical therapy. Use of any such adjunctive measures depends on the acuity and elective nature of the procedure. Other issues that should be assessed include any problems with balance or falls or the need for assistive devices (ie, cane, walker, or an elevated toilet seat). Anticipating and preparing for postoperative needs is important to ensure a successful surgical outcome.

Assessment of cognitive function also is an important part of assessing functional status. Dementia and delirium are more prevalent in older patients than in other populations and may be aggravated by the stress of surgery, anesthesia, use of pain medications, and an unfamiliar hospital environment. Inviting a family member to be present at night and bringing in familiar items may help with surgical recovery. Preoperatively, a patient’s baseline mental status should be evaluated so that any postoperative changes can be compared with the patient’s preoperative baseline.
Nutrition

Malnutrition is a common problem in older patients. It is estimated that 13.5–53% of institutionalized elderly women (in a hospital, nursing home, or a rehabilitation facility) and 5% of elderly women in the community are malnourished (73). Clearly, postoperative complications, such as wound healing and pneumonia, are directly related to nutritional status. The causes of malnutrition in older patients are multifactorial and may include poor dentition, medications that diminish appetite, lack of financial resources, lack of available food, and depression. A number of nutritional assessment tools are available. However, measurement of the serum albumin level gives a surgeon a reasonable means for assessment at little expense.

Postoperative Management

Although there are many postoperative complications that can occur in any patient, a neurologic illness (most commonly delirium) can be one of the most distressing and the most common in the elderly. Often, cardiac, pulmonary, renal, infectious, and thromboembolic complications can occur, but they may be anticipated based on the patient’s preoperative evaluation.

Postoperative delirium can occur in 15–53% of older postoperative patients (74). Comorbidities that are associated with an increased risk of delirium include advancing age (older than 65 years), preoperative dementia, poor vision or hearing, history of alcohol use, severe illness, and current infection (75). It is important to correct any electrolyte or glucose abnormalities preoperatively and to maintain the corrected levels in the postoperative setting. Intraoperatively, electroencephalographic monitoring is used to maintain the least amount of anesthesia necessary, which may help reduce postoperative delirium (75). Older patients with postoperative delirium should be evaluated for dehydration and infection and, if present, the patients should be treated immediately. These patients are particularly susceptible to wound, urinary, and respiratory infections. Additionally, poorly controlled postoperative pain is associated with postoperative delirium. Older patients are more susceptible to the effects of opioids than other populations, and using a multimodal regimen in the postoperative pain management will lead to a decreased use of opioids and improved pain scores. Liposomal bupivacaine, NSAIDs, or other nonopioids may help decrease opioid-related adverse effects and delirium (75). It is important to ensure that the patient’s glasses and hearing aid devices are available for them postoperatively to help with communication and to minimize confusion.

Case No. 4. A 75-year-old woman presents with vaginal vault prolapse and stress incontinence. She lives alone and is accompanied by her daughter who responds to most of the questions posed to her mother because the patient has become forgetful in recent months. The patient’s past medical history is significant for diabetes mellitus, controlled with diet and oral agents. She has hypertension and had coronary angioplasty 5 years ago. She has moderately severe osteoarthritis of the
knees and hips. Previous surgical procedures include appendectomy, vaginal hysterectomy, and laparoscopically assisted cholecystectomy. The patient takes glyburide, metformin, atorvastatin, clopidogrel, baby aspirin, hydrochlorothiazide, atenolol, ginkgo biloba, ibuprofen, and multivitamins. She is allergic to penicillin and sulfonamide antibiotics.

After preoperative evaluation, the patient underwent an abdominal sacrocolpopexy and suburethral sling placement. The procedure lasted 2 hours and she experienced a blood loss of 150 mL. She has stable vital signs and hematocrit the first postoperative day. The nurses note that the patient is not able to ambulate on her own with the IV line and Foley catheter. A physical therapist is consulted. Subsequently, the patient develops an ileus that necessitates placement of a nasogastric tube and further limits her mobility. At 1 AM on the fifth postoperative day, she is found sitting on the floor of her room with the IV and Foley catheter pulled out. She is alert and pleasant, but confused, disoriented, and unable to answer when asked if she knows where she is or what time it is. There is no evidence of trauma on examination.

Delirium and a confused state are among the most common mental disorders encountered in older patients postoperatively. The most common diagnosis in this age group of hospitalized patients is sundowning, a frequently observed but poorly understood phenomenon of behavioral deterioration during the evening hours, typically in hospitalized patients with some degree of dementia. In this patient, a closer preoperative evaluation of her functional and mental status may have revealed an underlying dementia and predicted sundowning. This confused state usually is instigated by the effects of impaired circadian regulation or nocturnal factors in the hospital (ie, shift changes, noise, unfamiliar staff, or an unfamiliar environment). Asking a family member or friend to stay with the patient at night may help avoid this response. However, in this particular case, a broader differential diagnosis should be considered, and sundowning should be presumed to be delirium when it is a new pattern. Common causes of delirium are listed in Box 7.

Electrolyte disturbances also should be considered because this patient has been receiving prolonged IV fluid replacement and has a nasogastric tube removing GI contents. Also, she has diabetes mellitus and takes a number of medications. Serum electrolytes, creatinine, glucose, and calcium levels; a CBC; and a urinalysis should be obtained. Despite a physical examination that did not reveal any trauma, neuroimaging with a CT scan of the head would be prudent because the patient was found out of her bed sitting on the floor.

Blood gas determination also would be reasonable to identify the patient’s acid-base balance. Respiratory alkalosis, usually from hyperventilation, may direct further investigation to detect early sepsis, hepatic failure, early salicylate intoxication, or cardiopulmonary causes. Metabolic acidosis usually reflects uremia, diabetic ketoacidosis, lactic acidosis, late phases of sepsis, or salicylate intoxication. Respiratory acidosis may point toward a pulmonary embolus with hypoxemia or heart failure. Echocardiography and chest radiography also should be considered and performed based on other test results and clinical findings.
Pregnant Women

Nonobstetric surgery in pregnant patients occurs relatively infrequently. This may be caused by the fact that pregnant patients are younger and healthier than the general population. The most common conditions requiring surgical intervention include gallbladder disease, appendicitis, ovarian neoplasms, cervical neoplasia, trauma, breast lesions, and bowel obstruction. Although obstetrician–gynecologists may not play an active role in performing many of these surgical procedures, it is paramount that they are attuned to key issues that might affect the pregnant patient and the fetus and serve as a key resource for the surgical and anesthesiologic teams in preventing avoidable errors.
Physiologic Changes in Pregnancy

Numerous physiologic changes occur in pregnancy that are advantageous to the pregnant woman and her fetus. However, these physiologic changes also may affect the patient who has an underlying medical condition and may affect an otherwise healthy woman undergoing surgery. The physiology of nearly all organ systems is altered in pregnancy and should be recognized in the assessment of the patient as well as planning anesthesia and surgery.

Pregnancy-related physiologic changes should be taken into consideration when evaluating the pregnant woman who will undergo surgery. Cardiovascular changes include a 30–50% increase in blood volume secondary to increased sodium and fluid retention. The heart rate increases by 10–15 beats per minute, whereas the BP usually decreases because of a decrease in systemic vascular resistance.

A number of hematologic changes occur in pregnancy. The hematocrit will decrease to 30–50% of normal levels because of an increase in plasma volume resulting in dilutional anemia, also referred to as “physiologic anemia of pregnancy.” Further, the iron requirements of the developing fetus will diminish the maternal iron stores, requiring iron supplementation throughout the pregnancy. A physiologic leukocytosis during pregnancy often will increase the white blood cell count to 10,000–14,000 per liter (10–14 × 10⁹/L). This normal increase may make it difficult to diagnose infection, based on an increased white blood cell count. Clotting factors II, VII, VIII, IX, X and fibrinogen levels are all increased in pregnancy, contributing to the increased occurrence of VTE. Diminished cellular immunity occurs as pregnancy progresses. This results in an increased susceptibility to viral and bacterial infections.

Pulmonary changes place the pregnant patient having surgery at increased risk of hypoxia (the functional residual capacity is decreased 20% because of the elevation of the diaphragm) and diminished buffering capacity of metabolic acidosis (physiologic hyperventilation causes a compensatory metabolic acidosis with a decrease in the maternal bicarbonate level). Forced expiratory volume in 1 second and vital capacity are unchanged in pregnancy.

Decreased bowel motility, caused by progesterone-mediated smooth muscle relaxation, results in decreased lower esophageal sphincter tone, subsequent gastroesophageal reflux disease, and increased risk of aspiration. Decreased motility also may contribute to increased postoperative ileus and postoperative nausea and vomiting. Gallbladder stasis is thought to be the etiology for an increased incidence of cholecystitis in pregnancy.

Mechanical compression from the uterus after 16 weeks of gestation as well as decreased ureteral motility (progesterone-mediated) increases the frequency of hydro-ureter, urinary stasis, and pyelonephritis. An increase in GFR and renal blood flow will decrease the normal serum creatinine level by 0.4–0.5 mg/dL (35.36–44.2 micromol per
Pregnancy also alters a number of endocrine functions. It induces a diabetogenic state, increased total T₃ and total T₄ levels because of increased levels of thyroid-binding globulin and decreased levels of free T₃ and free T₄.

**Preoperative Management**

Before a surgical procedure, it is mandatory to obtain a complete medical history, perform a physical examination on the pregnant woman, and assess the fetus. In cases of trauma, the woman should be stabilized first, and the fetus is assessed afterward. Underlying medical conditions should be identified because they may complicate surgery and subsequent recovery. As with the nonpregnant patient, optimization of the patient’s medical condition should be achieved in conjunction with appropriate medical, anesthesiologic, and surgical consultation. Recognition of the physiologic changes in pregnancy is critical to the overall assessment of physical findings and evaluation of laboratory results.

The effects of surgery and anesthesia on the developing fetus will vary based on the length of gestation. Exposure to drugs and anesthetic agents in the first trimester may result in fetal anomalies or spontaneous abortion, although anesthetic agents do not have any teratogenic effects (76). However, it is advised that elective surgery be deferred until the second trimester, after organogenesis has occurred and during a time when the risk for premature labor and delivery is at a minimum, or even until after pregnancy, if possible.

A viable fetus should be monitored throughout the surgical procedure, when possible, and during the immediate postoperative phase. Preoperative preparation should ensure that an emergency cesarean delivery can be performed for fetal distress and that neonatal care is immediately available. For a previable fetus, the fetal heart rate should be documented preoperatively and postoperatively.

**Diagnostic Imaging**

Imaging often is useful in evaluating a patient who may require surgical intervention. Although ultrasonography and magnetic resonance imaging have been shown to have no effect on the developing fetus, concern is expressed about the exposure of the fetus to X-rays and radioisotopes. In certain situations, diagnostic radiology is an unavoidable part of the evaluation of the pregnant surgical patient and the benefits of such procedures should be weighed against accurately assessed risks.

Most radiologic studies are benign and expose the fetus to relatively low doses of radiation (typically less than 0.01 Gy). For example, chest radiography (two views) results in a fetal exposure of 0.002–0.007 Gy and an abdominal radiograph (one view) in a fetal exposure of 0.001–0.004 Gy. However, CT of the pelvis exposes the fetus to a radiation dose of 0.025–0.079 Gy. Lead shielding of the abdomen should be used whenever possible...
to reduce the dose of radiation to the fetus. Additional resources regarding the use of diagnostic imaging during pregnancy are provided in section “Resources.”

**Intraoperative Management**

Clearly, surgery is associated with risks to the fetus. However, there are also specific maternal risks during pregnancy, including relative incompetence of the lower esophageal sphincter, which increases the risk for aspiration of gastric contents and compression of the vena cava.

Minimally invasive (laparoscopic or robotic assisted) surgery during pregnancy may be performed with acceptable maternal and fetal morbidity (77, 78). In addition to the usual advantages of minimally invasive surgery, the benefits during pregnancy include decreased preterm labor rates secondary to decreased uterine manipulation and less fetal depression secondary to reduced postoperative narcotic use. In a large retrospective study of 20,000 women undergoing either an appendectomy or cholecystectomy, laparotomy was associated with a higher risk of adverse obstetrics outcomes than laparoscopy (79).

Certain challenges are inherent to minimally invasive surgery in pregnancy, including increased technical difficulty because of the gravid uterus and the unknown risks of fetal acidosis caused by carbon dioxide absorption. The pneumoperitoneum may result in decreased uterine blood flow and fetal hypotension from decreased maternal cardiac output. Intraabdominal pressure should not exceed 12 mm Hg, which is below the typical 15 mm Hg used in traditional laparoscopy (80). The anesthesiologist should pay particular attention to maternal end tidal carbon dioxide level, which should be continuously monitored and maintained at 25–30 mm Hg to minimize maternal acidosis and, thereby, fetal acidosis. Prompt adjustments to minute ventilation changes are critical. Because there is an increased risk of perforation of the gravid uterus by the insertion of a Veress needle or trochar through the umbilicus, many experts advocate for either an open technique for placing the initial cannula or a left upper quadrant entry.

As mentioned previously, if the fetus is of viable gestational age, continuous fetal monitoring throughout the surgery is recommended. During a minimally invasive procedure, the use of transvaginal ultrasonography is advised over the use of transabdominal ultrasonography. The latter would be complicated by the presence of pneumoperitoneum. If there is evidence of fetal distress, the pneumoperitoneum should be released immediately.

Whether undergoing a minimally invasive procedure or laparotomy, the patient should be placed in the left lateral decubitus position on the operating room table if she is beyond 16 weeks of gestation. Either dual or single VTE prophylaxis should be administered to the patient, depending on the indications for surgery, the duration of surgery, the route of surgery, and the type of anesthesia (general or regional).
**Postoperative Management**

For a previable fetus, the fetal heart rate should be monitored intermittently in the recovery room. However, a viable fetus should be monitored continuously. The patient should be monitored for contractions, and tocolytics should be considered as appropriate for the obstetric indications. Nonsteroidal antiinflammatory drugs should be avoided throughout pregnancy but are of particular concern after 32 weeks of gestation because of the risk of premature closure of the fetal ductus arteriosus.

**CASE NO. 5.** A woman at 18 weeks of gestation presents with a persistent complex 8-cm right adnexal mass. Secondary to the persistent nature of the mass, after discussion with her obstetrician–gynecologist and referral to a gynecologic oncologist, the patient and her partner make the decision to proceed with definitive surgery. Risks and benefits of laparoscopy and laparotomy are discussed. It is noted that the patient is at the optimal gestational age to proceed with surgery and that an 8-cm mass would be amenable to a minimally invasive procedure. The retrospective data, which also are reviewed with the patient, suggest that a minimally invasive approach may be associated with fewer risks than laparotomy. The patient has normal preoperative laboratory results and no further imaging is necessary other than ultrasonography.

The patient is scheduled for surgery and fetal heart tones are established in the pre-care holding area. The anesthesiologist explains to the patient that no alterations in her anesthetic regimen are indicated. In the operating room, the patient is placed in a left lateral tilt position with a wedge, and sequential compression devices are placed. After induction of anesthesia, her arms are tucked in the appropriate fashion and she is secured to the operating room table to prevent sliding with Trendelenburg positioning. An oral–gastric tube is placed. No devices are placed in the vagina. After draping and confirming the oral–gastric tube placement, a 5 mm incision is made in Palmer’s point (3 cm below the costal margin and at the midclavicular line in the left upper quadrant). Using an optical trocar, intraabdominal placement is confirmed. The abdomen is insufflated to 12 mm Hg and the patient is slowly placed in the Trendelenburg position. Additional trocars are placed as indicated, and the procedure is concluded with the frozen section revealing benign findings.

Upon arrival in the recovery room, the fetal heart tones are documented, and the patient recovers without incident. She is discharged from the recovery room with a prescription for acetaminophen, an NSAID, and an opioid for breakthrough postoperative pain. She receives routine postoperative instructions, emphasizing bleeding and cramping indications for calling her primary care provider.

**Obese Women**

A comprehensive discussion of all issues associated with surgery in the obese woman is beyond the scope of this monograph. Therefore, this section will focus on some critical information regarding the route of surgery and anesthetic considerations (Box 8). Obese women may have a variety of other comorbidities that have been previously discussed, including diabetes mellitus, hypertension, renal disease, or CVD. Because of the difficulties with mobility, they may have an increased risk of VTE after surgery, and this must
be considered when evaluating the role of VTE prophylactic strategies. Additional information is provided in the section “Resources.”

In the United States, approximately two thirds of adults are overweight and one third of these adults are obese or morbidly obese (81). Obesity increases the risk of other comorbidities, including cancer. Several studies have shown that if individuals lose weight, they can reduce their risk of cancer (82), and weight loss will affect their other comorbidities. Obese women who are undergoing gynecologic surgery have an increased risk of intraoperative and postoperative complications, have an increased length of hospital stay, and longer operative times (83, 84). When considering obesity in a surgical patient, the surgeon must recognize that waist–hip circumference may be more predictive of complications than the BMI alone (85).

### Box 8. Key Considerations for Obese Patients

- Increased prophylactic antibiotic dosing for women who weigh more than 120 kg (264.5 lb)
- Preoperative screening for diabetes mellitus and careful postoperative glucose control for patients with known or newly diagnosed diabetes mellitus
- Avoidance of incisions under skin folds or pannus
- Closure of the subcutaneous layer of tissue if deeper than 2 cm (0.8 in)
- The use of the Caprini score to evaluate the risk of use of thromboembolic prophylaxis preoperatively and postoperatively
- Careful positioning of obese patients to avoid nerve injury from retractors or from sliding while in the Trendelenberg position

### Preoperative Management

The preoperative evaluation of the obese patient should be focused on optimizing the other medical comorbidities and assessing the planned route of surgery. All nonsurgical options should be exhausted, and the least invasive route for the safe completion of the surgical procedure should be planned. Minimally invasive surgery will have some benefits when compared with laparotomy regarding postoperative complications, particularly wound infections (86, 87). The percentage of body fat has been shown to be associated with a risk of surgical site infection. For example, a patient with 20% body fat has an approximate 10% risk of a surgical site infection compared with 20% in a patient with 45% body fat (88). Preoperative anesthesiologic consultations should be considered so that the patient’s pulmonary status and IV access can be evaluated. Smoking is a particularly serious surgical risk, especially in an obese patient. Smoking
cessation should be considered if the acuity of the surgical procedure permits. Additional information regarding the preoperative management of the obese patient is listed in the section “Resources.”

**Intraoperative Management**

Surgical site infections are among the greatest complications in the obese patient; therefore, the efforts to minimize them are critical. The nomogram shown in the ACOG Committee Opinion entitled “Gynecologic Surgery in the Obese Woman” (see the section “Resources”) can help the surgeon predict the risk of wound infection for an individual patient (89). Strategies include consideration of minimally invasive surgery, appropriate antibiotic prophylaxis, use of wound protectors, appropriate placement of the incision, and meticulous surgical technique. If a transverse incision is chosen, it should not be placed under the pannus. For women undergoing cesarean delivery, closure with sutures is preferred over closure with staples (90, 91). Whether the incision is transverse or vertical, it should not include the area under the pannus because that area is prone to infection and cannot be seen by the patient to monitor for signs of infection. One meta-analysis concluded that suture closure of the subcutaneous fat in women with more than 2 cm of subcutaneous tissue decreased the risk of wound infection after cesarean delivery (92). Regarding drains, a Cochrane Database systematic review did not reach a conclusion that drains placed at the time of cesarean delivery conferred any benefit (93) nor did it appear that negative pressure wound therapy improved outcomes in the obese woman (94).

The Trendelenburg position poses risks in all patients, but they are magnified in obese patients. Antiskid measures need to be implemented to decrease the risk of nerve injuries. The anesthesiologists will need to balance Trendelenburg position, abdominal insufflation, peak airway pressures, carbon dioxide retention, and changes in renal perfusion, which are all exaggerated with abdominal insufflation. Intraabdominal pressure should not be greater than 15 mm Hg in any laparoscopic procedure (95). Because of difficulties with exposure, self-retaining retractors will be necessary. Lateral blades must be placed carefully ensuring that they are not too deep. Even in the obese patient, pressure on the psoas muscle may lead to a femoral nerve injury (see the section “Positioning”).

Because obesity increases the risk of VTE in patients undergoing pelvic surgery (96), pneumatic compression devices and pharmacologic VTE prophylaxis are warranted. Patients should receive either 5,000 units of unfractionated heparin subcutaneously or 40 mg of LMW heparin at least 30 minutes before incision.

**Postoperative Management**

Once the comorbidities are accounted for, the general postoperative recovery for the obese patient is not significantly different from that for any other patient. Patients should receive postoperative VTE prophylaxis (see the section “Cardiovascular Disease”), ambulate
early and often during their postoperative hospital stay and at home, use an incentive spirometer, and be aware of the signs and symptoms of surgical site infection. If the patient has diabetes mellitus, glycemic control in the hospital and after discharge will significantly aid wound healing.

Enhanced Recovery

The ultimate goal of postoperative care is the return of the patient to her preoperative function as soon as possible. Ideally, this postoperative care begins before surgery. Enhanced recovery after surgery is a systematic, standardized approach to preoperative, intraoperative, and postoperative care that aims to improve outcomes for patients in the perioperative period. Specifically, the aim is to reduce length of stay, improve patient experience, and reduce the need for opioid pain medication. Enhanced recovery programs have been shown to decrease length of stay, improve return of bowel function, decrease morbidity and decrease cost. Key elements of enhanced recovery are early ambulation, early feeding, a multimodal opioid-sparing pain regimen, minimizing IV fluids, and DVT prophylaxis (97).

Enhanced recovery pathways have been most rigorously studied in patients who underwent colorectal surgery, but the approach is being increasingly used in gynecologic surgery. The MD Anderson Cancer Center instituted an enhanced recovery program in 2014. This was a collaboration among anesthesiology, nursing, and perioperative services. The highlights of the program will be reviewed in this section.

Preoperatively, patients are not allowed to ingest solid food after midnight of the day of surgery, but they can ingest clear liquids up to 2 hours before surgery. This is a transition from the traditional nothing-by-mouth directive. Patients are given a carbohydrate load the night before surgery (100 g) and the morning of surgery (50 g), but caution should be used patients with poorly controlled diabetes mellitus. Mechanical bowel preparation is no longer used even if bowel surgery is anticipated. Patients in the preoperative unit receive prophylactic tramadol, pregabalin, celecoxib, and acetaminophen orally for analgesia. Preoperative IV lines are modified with a saline lock and do not contain actively infusing IV fluids (Table 2). For patients undergoing minimally invasive procedures, pregabalin is not used because it causes significant postoperative somnolence and can affect patients scheduled for a same-day discharge. For the same reason, one also may consider avoiding pregabalin in the elderly patient. Intraoperatively, antibiotic prophylaxis is used as per ACOG guidelines (98) and VTE prophylaxis is used as per American College of Chest Physicians guidelines (99). Intravenous fluids are titrated using goal-directed therapy to minimize IV fluids. The goal is normovolemia. Patients are observed with noninvasive cardiac monitoring to measure stroke volume. Small IV fluid boluses are used to check for an increase in stroke volume. If there is no increase from this bolus, vasopressors are used instead of large IV fluid boluses. A patient’s temperature should be monitored to avoid hypothermia. Epidural anesthesia is not used; instead,
the surgical area is injected just above the level of the fascia with 60 mL of local anes-
thesia (0.25% bupivacaine without epinephrine).

Postoperatively, patients are given a regular diet after surgery. Nasogastric tubes are
not routinely used. Ambulation eight times a day, if possible, is encouraged with meals
taken in a chair, not in the bed, for a total of 8 hours per day. Postoperative IV fluids are
administered at 40 mL/h, and a saline lock is placed once the patient is able to toler-
ate 500 mL of fluid taken orally. For pain management, patients are given regularly
scheduled dosages of acetaminophen, pregabalin, and ibuprofen. Oral oxycodone and
IV hydromorphone are used as needed if the nonopioids do not control their pain. Foley
catheters are removed on postoperative day 1. Bolus IV fluids based on low urine output
are not administered. A restrictive transfusion policy has been instituted. If a patient is
not significantly symptomatic, blood transfusions are avoided unless the hemoglobin
level is less than 7 mg/dL (70 g/dL) (Table 3). With this protocol, the length of the hos-
pital stay has been decreased with no increase in complication rates, decrease in narcotic
use and no increase in pain scores.

Enhanced recovery is not only a multimodal process but also a multidisciplinary pro-
gram. It requires participation from nursing, anesthesiology, and the surgical services as
well as the patient. Ideally, when instituting an enhanced recovery program, outcome
data should be collected to ensure that at the very least patient experience is not worse
than it was before the change in the practice. Some important measures include, but
are not limited to, the length of stay, readmission rates, wound infection rates, and pain
scores. Enhanced recovery also is a dynamic process that requires periodic assessment
and adjustment as necessary and should adhere to guidance from institutional quality
committees. An enhanced recovery program has been established for patients undergo-
ing minimally invasive procedures and laparotomy at MD Anderson Cancer Center; how-
ever, its benefits are not as well established as in patients undergoing laparotomy.

<table>
<thead>
<tr>
<th>Table 2. Example of a Preoperative Protocol</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Components</strong></td>
</tr>
<tr>
<td>Diet</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Bowel preparation</td>
</tr>
<tr>
<td>Premedication</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Intravenous fluid</td>
</tr>
</tbody>
</table>

*This protocol is used at MD Anderson Cancer Center.
Other Medical Conditions

This monograph has outlined the most common medical comorbidities that a practicing obstetrician–gynecologist will encounter when considering and preparing a patient for surgery. However, there are other rare conditions that are associated with specific perioperative risks and management. Some of them are listed in Table 4.

### Table 3. Postoperative Protocol

<table>
<thead>
<tr>
<th>Components*</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intravenous fluid</td>
<td>Intravenous fluid at 40 mL/hr&lt;br&gt;Saline lock once tolerating intake of 500 mL orally</td>
</tr>
<tr>
<td>Analgesia</td>
<td>Acetaminophen, 1,000 mg orally every 6 hours&lt;br&gt;Ibuprofen, 800 mg orally every 8 hours&lt;br&gt;Pregabalin, 75 mg orally twice a day for 48 hours&lt;br&gt;Oxycodone, 5 mg orally every 4 hours when necessary&lt;br&gt;Hydromorphone, intravenously as needed for breakthrough pain</td>
</tr>
<tr>
<td>Diet</td>
<td>Regular diet on the day of surgery with oral hydration</td>
</tr>
<tr>
<td>Foley catheter</td>
<td>Removed on postoperative day 1</td>
</tr>
<tr>
<td>Ambulation</td>
<td>Ambulation 8 times per day&lt;br&gt;All meals should be taken in a chair&lt;br&gt;Mobilization for 8 hours per day</td>
</tr>
<tr>
<td>Blood transfusion</td>
<td>For patients with a hemoglobin level lower than 7 mg/dL</td>
</tr>
</tbody>
</table>

*This protocol is used at MD Anderson Cancer Center.

### Table 4. Other Medical Conditions

<table>
<thead>
<tr>
<th>Condition*</th>
<th>Presentation</th>
<th>Perioperative concerns</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hereditary angioedema</td>
<td>Recurrent; often involving the skin, gastrointestinal tract, or upper airway</td>
<td>Laryngeal swelling can be triggered by surgery and complicate extubation.</td>
</tr>
<tr>
<td>Autonomic dysreflexia</td>
<td>An exaggerated response to stimuli in patients with a spinal cord injury, it can cause intense vasoconstriction below the level of the injury as well as headache, tachycardia, bradycardia, and hypertension</td>
<td>Surgery can trigger this response in patients with history of spinal cord injuries.</td>
</tr>
<tr>
<td>Malignant hypothermia</td>
<td>A genetic condition that can cause accelerated and uncontrolled skeletal muscle metabolism leading to fever, lactic acidosis, and rhabdomyolysis</td>
<td>Triggered by succinylcholine and inhalational anesthesia agents.</td>
</tr>
<tr>
<td>Idiopathic thrombocytopenic purpura</td>
<td>An acquired thrombocytopenia caused by the development of antibodies to platelets</td>
<td>Severe thrombocytopenia may require use of perioperative corticosteroids or intravenous immunoglobulin.</td>
</tr>
<tr>
<td>Thrombocytopenic purpura</td>
<td>Thrombocytopenia-caused small-vessel thrombi as a result of decreased activity of a von Willebrand factor–cleaving protease; it can be acquired or genetic</td>
<td>Surgery may be contraindicated in patients with an acute attack or exacerbation.</td>
</tr>
</tbody>
</table>

*These conditions require a referral to a specialist in anesthesia and multidisciplinary preoperative planning.
The use of complementary and alternative therapies has increased steadily in the past years. According to the National Institutes of Health, it is estimated that 30% of adults have used some form of health care that is not derived from conventional Western medicine (100). This includes dietary and herbal supplements whose manufacturers do not follow the same safety and efficacy regulations as those of standard medications. It also can include practices, such as massage, reiki, acupuncture, meditation, and hypnosis. Practices, such as acupuncture and hypnosis, have been shown to have little to no harm with potential benefit related to pain and anxiety. However, many dietary supplements can have adverse effects in the perioperative setting (Table 5). Therefore, it is imperative that health care providers ask about all herbal and nonherbal dietary supplements that patients are taking as part of obtaining a medication history. Alternative and herbal medicines can increase the risk of bleeding, increase CV stress, potentiate or decrease the effects of other medications, or cause electrolyte or metabolic derangements (101). Many of these supplements induce or suppress cytochrome p450 enzymes (102). Some anesthesiologists recommend that if possible, patients should discontinue the use of all herbal agents or supplements 2–3 weeks before surgery to help minimize the possible interactions. The National Center for Complementary and Integrative Health provides additional detailed information on the use of complementary and alternative medicine in women’s health, including surgical considerations (see the section “Resources”).

<table>
<thead>
<tr>
<th>Supplement</th>
<th>Possible Uses</th>
<th>Possible Adverse Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aloe vera</td>
<td>Laxative and skin conditions</td>
<td>Potentiates thiazide diuretics</td>
</tr>
<tr>
<td>Black cohosh</td>
<td>Menopausal symptoms and menstrual symptom relief</td>
<td>Potentiates hypotensive effects</td>
</tr>
<tr>
<td>Echinacea</td>
<td>Common cold and other infections</td>
<td>Allergic reaction; decreases effectiveness of immunosuppressants</td>
</tr>
<tr>
<td>Ephedra (ma huang)</td>
<td>Asthma, bronchitis, and allergies</td>
<td>Myocardial ischemia, tachycardia, hypertension, ventricular arrhythmias, and life-threatening interaction with monoamine oxydase inhibitors</td>
</tr>
<tr>
<td>Fish oil</td>
<td>Cardiovascular health</td>
<td>Intraoperative bleeding</td>
</tr>
<tr>
<td>Garlic</td>
<td>Hypertension and high cholesterol</td>
<td>Increased bleeding caused by antiplatelet effects and hypoglycemia</td>
</tr>
<tr>
<td>Ginger</td>
<td>Nausea and gastrointestinal upset</td>
<td>Increased bleeding</td>
</tr>
<tr>
<td>Gingko biloba</td>
<td>Improved memory and cognition</td>
<td>Increased bleeding caused by antiplatelet effects</td>
</tr>
<tr>
<td>Ginseng</td>
<td>Diabetes, concentration, memory, depression, anxiety, and fatigue</td>
<td>Hypoglycemia, increased bleeding, and decreased diuretic effectiveness</td>
</tr>
<tr>
<td>Green tea</td>
<td>Increased cholesterol, weight loss, and chronic fatigue</td>
<td>Arrhythmias, tachycardia, nausea, and vomiting</td>
</tr>
<tr>
<td>Guarana</td>
<td>Weight loss, chronic fatigue, athletic performance, and stimulating effects</td>
<td>Hypertension and excessive sympathetic tone or stimulation</td>
</tr>
</tbody>
</table>

(continued)
Appropriate evaluation and preparation of women for surgery is imperative for a successful surgical outcome. This monograph serves as a guide for obstetrician–gynecologists as they manage their patients in the preoperative, perioperative, and postoperative settings. The following are a few take-away points, but consultation with other medical providers is recommended for the complex patient care:

- **Appropriate preoperative assessment involves a thorough history and physical examination focused on preexisting medical conditions and the degree to which they are managed.**

- **Patients with known or suspected cardiac disease should be evaluated in the context of the procedural risk and their clinical risk for major adverse cardiac events.**

- **Screening for smoking use and screening for OSA are easy and effective ways to anticipate surgical effects on patients’ general health and to help reduce postoperative pulmonary complications.**

### Table 5. Popular Dietary Supplements and Surgical Considerations (continued)

<table>
<thead>
<tr>
<th>Supplement</th>
<th>Possible Uses</th>
<th>Possible Adverse Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kava</td>
<td>Anxiety, depression, and attention deficit–hyperactivity disorder</td>
<td>Excessive sedation, difficult emergence from general anesthesia, and withdrawal symptoms</td>
</tr>
<tr>
<td>Licorice</td>
<td>Gastrointestinal disorders, osteoarthritis, systemic lupus erythematosus, and chronic fatigue</td>
<td>Hypertension and hypokalemia</td>
</tr>
<tr>
<td>Mistletoe</td>
<td>Hypertension</td>
<td>Hypotension, acute and chronic hepatitis, vomiting, and diarrhea</td>
</tr>
<tr>
<td>Pomegranate</td>
<td>Hypertension, congestive heart failure, coronary artery disease, obesity, chronic obstructive pulmonary disease, and diabetes mellitus</td>
<td>Angioedema</td>
</tr>
<tr>
<td>Skullcap</td>
<td>Insomnia, anxiety, hyperlipidemia, atherosclerosis, stroke, epilepsy, allergies, and dermatitis</td>
<td>Hepatotoxicity</td>
</tr>
<tr>
<td>St. John’s wort</td>
<td>Depression, anxiety, attention deficit–hyperactivity disorder, fibromyalgia, seasonal affective disorder, obsessive–compulsive disorder, migraine, and chronic fatigue</td>
<td>Induction of cytochrome p450, excessive sedation, difficult emergence from anesthesia, and serotonin syndrome if combined with serotonergic agents</td>
</tr>
<tr>
<td>Yerba mate</td>
<td>Depression, chronic fatigue, congestive heart failure, diabetes mellitus, and high cholesterol level</td>
<td>Hypertension, hypotension, and excessive sympathetic nervous system stimulation</td>
</tr>
<tr>
<td>Yohimbine</td>
<td>Weight loss, athletic performance, hypertension, sexual dysfunction, and depression</td>
<td>Hypertension, anxiety, and agitation</td>
</tr>
</tbody>
</table>

• Patients with known or suspected diabetes mellitus should undergo HbA1c screening to determine their level of glycemic control if a recent level has not been obtained or is not known. Patients with an HbA1c level greater than 7–8 mmol/L (0.07–0.08 proportion of total hemoglobin) should be considered for preoperative assessment by their primary care provider and anesthesiologist.

• For postoperative patients with diabetes mellitus, the goal is to keep blood glucose levels at less than 180 mg/dL (9.99 mmol/L). It is important to use basal and short-acting insulin to achieve this goal.

• The risk of VTE for the patient should be assessed based on operative and patient characteristics using the Caprini score. This should guide the use of pharmacologic and nonpharmacologic prophylaxis in the preoperative, intraoperative, and postoperative settings.

• Preoperative assessment of older patients (ie, those older than 65 years, but especially those older than 75 years) should include determination of their functional status. A history of medication use and substance use also should be carefully noted because they can affect the risk of postoperative delirium and morbidity.

• For pregnant patients who need to undergo surgery, the second trimester timing is ideal, if the situation permits. Consultation and collaboration with anesthesia and perinatology specialists also should be considered.

• Obese patients require extra consideration with regard to positioning, antibiotic use, VTE prophylaxis use, and surgical approach. These patients also should be carefully screened for cardiac disease and diabetes mellitus preoperatively.

• Enhanced recovery pathways can decrease the length of hospital stay and postoperative morbidity. This approach requires institutional approval and participation of a multidisciplinary team, including, but not limited to, surgery, anesthesia, nursing, and internal medicine disciplines.
Resources


The following list is for information purposes only. Referral to these sources and websites does not imply the endorsement of the American College of Obstetricians and Gynecologists. This list is not meant to be comprehensive. The exclusion of a source or website does not reflect the quality of that source or website. Please note that websites are subject to change without notice.


Complete the answer sheet at www.clinicalupdates.org under “Test Your Clinical Skills” and receive 5 continuing medical education credits. The answers appear on page 56.

**Directions: Select the one best answer or completion.**

1. Of the following responses to surgery, which has the least physiologic effect?
   A. Release of antidiuretic hormone
   B. Release of beta-endorphin
   C. Release of catecholamine
   D. Production of cortisol

2. A patient who underwent placement of a drug-eluting stent should delay elective surgery for
   A. 14 days
   B. 30 days
   C. 3 months
   D. 6–12 months

3. The CHA2DS2-VASc scoring system is used to predict the probability of
   A. heart failure
   B. MI
   C. stroke
   D. VTE

4. In a 60 kg woman who had hysterectomy 2 days ago and had large blood loss, which of the following findings noted on morning rounds today would indicate acute kidney injury?
   A. Doubling of blood urea nitrogen level compared with preoperative level
   B. An increase in serum creatinine level of 17.68 micromol per liter compared with preoperative level
   C. An increase in serum creatinine level of 1.6 times compared with preoperative level
   D. Urine output of 190 mL in the past 6 hours

5. Which of the following is the best metformin regimen for a patient with type 2 diabetes mellitus undergoing a hysterectomy?
   A. Discontinue 12 hours preoperatively
   B. Discontinue 24 hours preoperatively
   C. Resume 12 hours postoperatively
   D. Resume 24 hours postoperatively

6. Which of the following patients receiving corticosteroid therapy should receive a perioperative corticosteroid boost?
   A. A patient who takes 7.5 mg of prednisone daily
   B. A patient who has been taking corticosteroids for 2 weeks
   C. A patient who takes short-acting corticosteroids every other day
   D. A patient who uses inhaled corticosteroids

7. The risk of VTE in a high-risk patient (based on Caprini risk assessment) is how many times more likely than in a low-risk patient?
   A. 2
   B. 4
   C. 6
   D. 12
8. Injury to which of the following nerves during gynecologic surgery causes motor dysfunction?
   A. Genitofemoral
   B. Iliohypogastric
   C. Ilioinguinal
   D. Obturator

9. Renal function in the older patient should be based on
   A. creatinine clearance
   B. glomerular filtration rate
   C. serum blood urea nitrogen level
   D. serum creatinine level

10. A reasonable estimate of nutritional status can be obtained from a measurement of a blood level of
    A. albumin
    B. ferritin
    C. globulin
    D. hemoglobin

11. A CT of the pelvis of a pregnant woman exposes the fetus to what multiple of the radiation exposure from one-view abdominal radiography?
    A. 2 times
    B. 10 times
    C. 15 times
    D. 25 times

12. How should the fetus of a woman undergoing laparoscopic surgery at 24 weeks of gestation be monitored?
    A. Not at all
    B. By intermittent auscultation
    C. By transabdominal ultrasonography
    D. By transvaginal ultrasonography

13. A woman with 45% body fat who has surgery has what probability of surgical site infection?
    A. 5%
    B. 10%
    C. 15%
    D. 20%

14. For the enhanced recovery protocol, the authors do not recommend giving which of the following medications before minimally invasive procedures?
    A. Acetaminophen
    B. Celoxib
    C. Pregabalin
    D. Tramadol
### Antibiotic Prophylaxis Regimens in Patients With Immediate Hypersensitivity Reactions* to Penicillin

<table>
<thead>
<tr>
<th>Agent*</th>
<th>Dose</th>
<th>Half Life (h)</th>
<th>Interval to Repeat (h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clindamycin or Metronidazole PLUS‡</td>
<td>900 mg or 500 mg</td>
<td>2–4 or 6–8</td>
<td>6 or NA†</td>
</tr>
<tr>
<td>Gentamicin or Aztreonam</td>
<td>5 mg/kg§ or 2 g</td>
<td>2–3 or 1.3–2.4</td>
<td>NA†</td>
</tr>
</tbody>
</table>

*Anaphylaxis, urticaria, or bronchospasm. Patients with exfoliative dermatitis (Stevens–Johnson syndrome, toxic epidermal necrolysis) from β-lactam antibiotics should also not receive cephalosporins.

†No repeat administration is needed.

‡Ciprofloxacin, 400 mg, is an additional effective alternative. Given the FDA warning (U.S. Food and Drug Administration, FDA Drug Safety Communication: FDA updates warnings for oral and injectable fluoroquinolone antibiotics due to disabling side effects. Silver Spring [MD]: FDA; 2017), its use should be restricted to patients for whom both gentamicin and aztreonam are not acceptable. Does not require repeat dosage.

§Dosage is based on the patient’s actual body weight. If the patient’s actual weight is more than 20% above ideal body weight (IBW), the “dosing weight” (DW) can be determined as follows: DW=IBW+0.4 (actual weight – IBW).


23. Practice guidelines for the perioperative management of patients with obstructive sleep apnea: an updated report by the American Society of Anesthesiologists Task Force on Perioperative Management of patients with obstructive sleep apnea. Anesthesiology 2014;120:268–86. (Level III) 


58. Webster J, Osborne S. Preoperative bathing or showering with skin antiseptics to prevent surgical site infection. Cochrane Database of Systematic Reviews 2015, Issue 2. Art. No.: CD004985. DOI: 10.1002/14651858.CD004985.pub5. (Systematic review)


83. O’Hanlan KA, Dibble SL, Fisher DT. Total laparoscopic hysterectomy for uterine pathology: impact of body mass index on outcomes. Gynecol Oncol 2006;103:938–41. (Level II-2)


Studies were reviewed and evaluated for quality according to the method outlined by the U.S. Preventive Services Task Force:

I  Evidence obtained from at least one properly designed randomized controlled trial.

II-1  Evidence obtained from well-designed controlled trials without randomization.

II-2  Evidence obtained from well-designed cohort or case–control analytic studies, preferably from more than one center or research group.

II-3  Evidence obtained from multiple time series with or without the intervention. Dramatic results in uncontrolled experiments also could be regarded as this type of evidence.

III  Opinions of respected authorities, based on clinical experience, descriptive studies, or reports of expert committees.

Answers

Forthcoming and Current Titles

Each monograph in Clinical Updates in Women’s Health Care is an overview of a topic of importance to obstetrician–gynecologists in practice. Upcoming titles include the following:

• Evaluation and Management of Lipid Disorders
• Approach to the Patient With Acute Cough
• Migraine and Other Headache Disorders

If not previously completed, earn CME credits for back issues of Clinical Updates in Women’s Health Care. Listed are updates and all current titles by publication date. Online access to the complete title list is available at www.clinicalupdates.org.

Updates

Also available at www.clinicalupdates.org are the following content updates:

• Anorectal Disorders (May 2015)
• Common Dermatologic Conditions (January 2018)
• Complementary and Alternative Medicine (June 2015)
• Obesity (August 2017)
• Occupational Diseases and Injuries (July 2016)
• Sleep Disorders (September 2015)
• Upper Gastrointestinal Tract, Biliary, and Pancreatic Disorders (June 2017)

List of Titles

2019
Surgical Considerations (Vol. XVIII, No. 1, January 2018)

2018
Common Dermatologic Conditions (Vol. XVII, No. 1, January 2018)
Arthritis (Vol. XVII, No. 2, March 2018)
Asthma (Vol. XVII, No. 3, May 2018)
Incidental Radiologic Findings (Vol. XVII, No. 4, July 2018)
The Role of Physical Therapy in the Obstetric–Gynecologic Practice (Vol. XVII, No. 5, September 2018)
Perioperative Pain Management (Vol. XVII, No. 6, November 2018)

2017
Liver Disease: Reproductive Considerations (Vol. XVI, No. 1, January 2017)
Structural Heart Disease (Volume XVI, No. 2, March 2017)
Arrhythmias (Volume XVI, No. 3, May 2017)
Gynecologic and Obstetric Care for Breast Cancer Survivors (Volume XIV, No. 4, July 2017)
Mood and Anxiety Disorders (Volume XVI, No. 5, September 2017)
Ischemic Heart Disease (Volume XVI, No. 6, November 2017)

2016
Hypertension (Vol. XV, No. 1, January 2016)
Genetics: Counseling, Testing, and Diagnosis (Vol. XV, No. 2, March 2016)
Thrombosis, Thrombophilia, and Thromboembolism (Vol. XV, No. 3, May 2016)
Polycystic Ovary Syndrome (Vol. XV, No. 4, July 2016)
Challenging Patient Encounters (Vol. XV, No. 5, September 2016)
Liver Disease: General Pathophysiology, Diagnosis, and Management
   (Vol. XV, No. 6, November 2016)
Liver Disease: General Pathophysiology, Diagnosis, and Management Supplement
   (Vol. XV, No. 6, November 2016)

2015
Metabolic Bone Disease (Vol. XIV, No. 2, April 2015)
Benign Breast Disease (Vol. XIV, No. 3, July 2015)
Hormone Therapy and Alternative Therapies for Menopause (Vol. XIV, No. 4, October 2015)
Lower Gastrointestinal Tract Disorders (Vol. XIV, No. 5, November 2015)

2014
Sexuality and Sexual Disorders (Vol. XIII, No. 2, April 2014)
Nutrition (Vol. XIII, No. 3, July 2014)
Adverse Drug Reactions (Vol. XIII, No. 4, October 2014)
Memory Loss and Dementia (Vol. XIII, No. 5, November 2014)

2013
Obesity (Vol. XII, No. 1, January 2013)
Exercise (Vol. XII, No. 2, April 2013)
Allergies (Vol. XII, No. 4, October 2013)
Thyroid Disorders (Vol. XII, No. 5, November 2013)

2012
Sleep Disorders (Vol. XI, No. 3, July 2012)
Upper Gastrointestinal Tract, Biliary, and Pancreatic Disorders (Vol. XI, No. 4, October 2012)
Anemia (Vol. XI, No. 5, November 2012)

2011
Complementary and Alternative Medicine (Vol. X, No. 4, October 2011)

2010
Anorectal Disorders (Vol. IX, No. 1, January 2010)
Anorectal Disorders Supplement (Vol. IX, No. 1, January 2010)
Occupational Diseases and Injuries (Vol. IX, No. 3, July 2010)

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