



# 6

## Preoperative Assessment of Colorectal Patients

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### Key Concepts

- A thorough history and physical exam performed by the surgeon is the single best preoperative “test.”
- Complex surgical patients with multiple comorbidities need careful preoperative assessment in order to minimize risk of perioperative complications.
- Preoperative laboratory studies should be ordered on a selective basis, as “routine” preoperative labs on otherwise asymptomatic, healthy patients have low diagnostic yield.
- Depending on patient’s risk factors, a preoperative cardiac risk assessment should be made and appropriate testing obtained. Cardiac medications should be continued, although beta blockers should not be initiated in the preoperative setting. Cardiac interventions should be performed for standard indications, independent of the need for abdominal surgery.
- Smoking cessation should be strongly encouraged prior to elective surgery.
- The surgeon should carefully review the patient’s medication list, paying particular attention to anticoagulants, immunosuppressants, and chemotherapy agents.

### Evaluation of the Routine Colorectal Patient

#### In Office by Surgeon

The in-office surgical consultation, including a detailed history and physical exam performed by the surgeon, is the single most important part of the preoperative evaluation. This also includes a thorough review of the patient’s medical record, which often will uncover additional relevant medical and surgical history, as well as medications. Particularly for complex patients with known cardiopulmonary disease or other major comorbidities (as well as patients with surgical diseases involving multidisciplinary care teams such as inflammatory

bowel disease (IBD) and rectal cancer), it is essential to obtain the names, phone numbers, and e-mail addresses of the patients’ specialists for further communication and coordination of care. Many patients shuttle between different hospital systems and despite advances in information technologies, fluid communication between specialists remains challenging. The task of coordinating these patients’ preoperative care can be enormously time-consuming for the busy surgeon; however, it is incredibly important to communicate and exchange vital information prior to elective surgery, in order to minimize risk of perioperative complications.

#### *Major Abdominal Surgery*

It goes without saying that the surgeon should personally perform a detailed history and physical examination of every patient undergoing elective abdominal surgery. The history should make sure to include a detailed list of active medications, including blood thinners and over-the-counter drugs or topical agents. The history should include complementary or alternative medicine practices and substances. Personal and/or family history of clotting or bleeding disorders (or bleeding complications from prior surgery) should be obtained. Additionally, the surgeon should ask about activity level, in order to estimate exercise capacity. Poor baseline exercise capacity has been shown to correlate with increased risk of perioperative cardiac complications [1]. Can the patient walk up a flight of stairs, do heavy housework, or walk up a hill? “Yes” to these questions indicates that the patient can perform at least four METs (metabolic equivalents) and if otherwise healthy, the patient does not need a preoperative cardiac workup [2].

#### *Anorectal Surgery*

Anorectal surgical procedures are considered low acuity and do not trigger the major physiologic changes associated with major abdominal surgery. Accordingly it is not necessary to obtain any additional preoperative workup for healthy patients undergoing

elective anorectal procedures. This includes patients who are over 50 years old, with comorbidities such as hypertension, hyperlipidemia, and diabetes that are well-compensated and properly managed by their PCP or specialists.

## Preoperative Testing

### *Laboratory Studies*

Multiple studies have demonstrated that routine preoperative labs are very low-yield in identifying abnormalities that require a change in management in healthy, asymptomatic patients. A selective approach to preoperative laboratory studies should be taken, based on the evidence outlined in this section. A landmark retrospective study of 2000 patients undergoing elective surgery demonstrated that approximately 60% of all preoperative laboratory studies were not indicated, and only 0.2% of these non-indicated tests (which occurred in ten patients) revealed abnormalities that could potentially result in a change in management [3]. Further analysis of these ten individual patient charts was performed and it was determined that no further actions were taken in any instance. When laboratory tests are indicated, lab values from the 4 month timeframe prior to surgery may be used, unless there has been a change in clinical status (uptodate.com, preoperative evaluation of the healthy patient).

*Hemoglobin* is recommended for all patients age 65 or older who are undergoing abdominal surgery. Younger patients should be tested if there is potential for major blood loss, or if the history is suggestive of anemia. *White blood cell count* as a screening test is of limited utility, but is certainly relevant in cases where recent infection has been treated or in the setting of immunosuppression. *Platelet counts* should be checked if the patient will undergo spinal or epidural anesthesia. *Coagulation studies and bleeding time* are not needed in patients with no personal or family history of bleeding disorders. Further, abnormal prothrombin time and bleeding time have not been shown in large studies to correlate with increased risk of intraoperative or postoperative bleeding complications [4, 5]. Pre-transfusion testing consisting of *ABO and Rh typing* (“type and screen”) should be performed preoperatively in all patients undergoing major abdominal surgery, including bowel resection. This is particularly important for patients who have a significant transfusion history, who may have multiple alloantibodies.

Serum *creatinine* should be checked in patients 50 years or older, as elevated creatinine is an independent predictor of increased postoperative cardiac complications [6], as well as mortality [7] in elective noncardiac surgery. Further, some anesthetics require dose adjustments for patients with impaired renal function, so this information is vital to our anesthesia colleagues. Routine *electrolytes* are not required unless the patient has a history of prior electrolyte abnormalities, chronic kidney disease, or diuretic use. Routine blood **glucose** measurements are not indicated in nondiabetic patients, as the incidence of asymptomatic hyperglyce-

mia is low [8]. The same logic also applies to *liver function tests*, which also should not be routinely ordered in a healthy, asymptomatic patient [4]. Routine *urinalysis* does not need to be performed in healthy, asymptomatic patients, and should be only performed on a more selective basis, in patients with history of frequent urinary tract infections or other relevant urinary symptoms. In most instances, asymptomatic patients with positive urinalyses may be treated empirically for urinary tract infection, and may proceed with elective abdominal surgery as scheduled. Most studies of the utility of preoperative urinalysis are from the orthopedic surgery literature, and they do not demonstrate a correlation between preoperative positive urinalysis or bacteriuria and postoperative infectious complications [9].

*Pregnancy tests* should be performed on all women of child-bearing age, if the results would alter management [10]. While serum human chorionic gonadotropin (HCG) assays are the most sensitive in detecting very early pregnancy, most urine pregnancy tests are positive within a week of a missed period, and can be processed quickly in the preoperative setting.

### *Electrocardiogram*

Electrocardiograms (ECGs) are quick, noninvasive, and inexpensive; consequently, they are overutilized in the routine preoperative workup of most patients. In asymptomatic patients undergoing low-risk surgery, ECG is unlikely to identify abnormalities that result in a change in management. Further, the incidence of abnormal ECGs is very low in patients under 45 years old. According to the ACC/AHA guidelines, preoperative ECG should be performed on patients with known heart disease, peripheral arterial disease, or cerebrovascular disease [11].

### *Chest X-Ray*

The American College of Physicians recommends obtaining chest X-ray (CXR) for patients with known cardiopulmonary disease, as well as all patients 50 years or older who require major abdominal surgery [12]. The American Heart Association also recommends CXR (posterior–anterior and lateral views) on obese patients with BMI  $\geq 40$  [13]. Despite these recommendations, CXR are low yield in identifying clinically significant abnormalities that alter management [14].

## Patients with Specific Comorbidities

### Assessment of Cardiac Risk

The overall risk of perioperative cardiac events is low in patients undergoing elective noncardiac surgery; however, it is essential to identify patients who may be at increased risk, in order to optimize them preoperatively and thereby minimize their potential for adverse perioperative cardiac events. A large study of over 8000 high-risk patients undergoing noncardiac

surgery demonstrated that postoperative myocardial infarction is associated with high 30-day mortality (11.6%), and the majority (65%) was not associated with ischemic symptoms [15]. It is therefore important to ensure that these risks are identified preoperatively and patients are optimized, as these adverse events can range from subtle to fatal.

### Initial Workup

The most common postoperative cardiac events include myocardial infarction, heart failure, arrhythmia, and cardiac arrest. The first step is to obtain a detailed history and physical during the office consultation. Patients should be asked whether they can climb two flights of stairs, and/or walk four city blocks (noting that some may have orthopedic issues limiting these tasks) [16]. They should also be asked about the following symptoms: palpitations, chest pain, syncope, dyspnea, orthopnea. Not only is history of cardiac disease important (including valvular or ischemic heart disease, cardiomyopathy, and arrhythmia), but history of diabetes, renal impairment, peripheral artery disease, and cerebrovascular disease is also highly relevant in assessing risk due to their association with coronary artery disease.

There are several validated models that can be used by the clinician to predict risk of perioperative cardiac adverse events. The simplest of these models is the Revised Goldman Cardiac Risk Index (RCRI) (Table 6-1) [6]. Other user-friendly models include the American College of Surgeons' National Surgical Quality Improvement Program (ACS-NSQIP) risk calculator, which requires more input variables, but also will provide quantification of other, noncardiac risks [17]. The calculator is online, and accessible at <http://riskcalculator.facs.org>.

### Who Needs Additional Testing?

The extent of preoperative workup is based on the patient's estimated risk according to these models. Patients with less than 1% risk of perioperative death from cardiac disease do

not require additional workup. Patients whose risk is 1% or more are likely to have a known history of recent myocardial infarction, unstable angina, heart failure, valvular disease, or arrhythmias. These patients should be evaluated preoperatively by their cardiologist, as the decisions regarding which additional testing to pursue, if any, is rarely simple. The American College of Cardiology/American Heart Association (ACC/AHA) guidelines suggest that functional performance status is an important indicator of whether additional testing is necessary in higher risk patients [11]. Further testing may include echocardiography, stress test (exercise or pharmacologic), 24-h ambulatory monitoring and cardiac catheterization. Generally, additional testing is not usually performed beyond what is ordinarily needed if the patient were not undergoing surgery, as this has not been shown to improve perioperative outcomes in noncardiac, nonvascular surgery.

### Preoperative "Optimization"

Once the preoperative cardiac assessment has been completed and risk estimated, the primary care physician or cardiologist may institute treatment that optimally limits the risk of a perioperative cardiac adverse event. While long-standing beta-blockers should be continued, beta-blockers should NOT be initiated in the preoperative setting. While there may be a benefit with regard to non fatal MI, multiple studies and meta-analyses have documented a significantly increased risk of non fatal stroke and mortality when beta-blockers are started as soon as 24 h before surgery [18, 19]. Antihypertensive medications can be adjusted to avoid perioperative hypotension, targeting a systolic blood pressure of 116–130 mmHg and heart rate of 60–70 beats per minute [18, 20]. When diagnosed, new dysrhythmias can be controlled with antiarrhythmic agents. Decompensated heart failure increases perioperative risk and this risk may be mitigated by treatment with ACE inhibitors, aldosterone antagonists, and digoxin for at least 1 week preoperatively [21]. While cardiac catheterization should be reserved for patients with high-risk features on noninvasive testing (including

TABLE 6-1. Revised Goldman Cardiac Risk Index (RCRI) [6]

Six Independent Predictors of Major Cardiac Complications [1, 85]

- High-risk type of surgery (examples include vascular surgery and any open intraperitoneal or intrathoracic procedures)
- History of ischemic heart disease (history of myocardial infarction (MI) or a positive exercise test, current complaint of chest pain considered to be secondary to myocardial ischemia, use of nitrate therapy, or ECG with pathological Q waves; do not count prior coronary revascularization procedure unless one of the other criteria for ischemic heart disease is present)
- History of heart failure (HF)
- History of cerebrovascular disease
- Diabetes mellitus requiring treatment with insulin
- Preoperative serum creatinine <2.0 mg/dL (177 μmol/L)

Rate of cardiac death, nonfatal myocardial infarction, and nonfatal cardiac arrest according to the number of predictors [2]

- No risk factors—0.4% (95% CI: 0.1–0.8)
- One risk factor—1.0% (95% CI: 0.5–1.4)
- Two risk factors—2.4% (95% CI: 1.3–3.5)
- Three or more risk factors—5.4% (95% CI: 2.8–7.9)

reversible large anterior wall defect, multiple reversible defects, ischemia occurring at a low heart rate, extensive stress-induced wall motion abnormalities, transient ischemic dilatation) the role for percutaneous coronary intervention (PCI) or operative revascularization remains controversial. While the discussion is beyond the scope of this chapter, revascularization should be reserved for those patients who meet criteria for cardiac intervention regardless of the need for non cardiac surgery and the timing should be chosen based on the indication for and urgency associated with the colorectal resection.

### *Coronary Stent Management*

For patients with either a bare-metal stent (BMS) or drug-eluting stent (DES), the current recommendation is to continue dual antiplatelet therapy (aspirin plus an oral antiplatelet agent such as clopidogrel) for at least 12 months. For patients who need to undergo nonemergent noncardiac surgery, the recommendation is to complete at least 1 month dual antiplatelet therapy preoperatively for BMS, and at least 6 months for DES [22, 23].

These recommendations are based on existing data that quantifies risk of postoperative coronary and cerebrovascular thrombotic events in this patient population. The RECO study is a prospective multicenter observational cohort study of 1134 consecutive patients with coronary stents undergoing noncardiac surgery from 2007 to 2009. The goal of the study was to quantify risk of adverse cardiac and cerebrovascular events (MACCEs) and major bleeding, and to risk stratify patients according to preoperative characteristics. Of the study group, 54.9% had bare-metal stents (BMS) only, and 32.4% had drug-eluting stents (DES) ( $\pm$  BMS); in 12.7% the stent type was unknown. Overall, there was a 10.9% rate of MACCEs, and a 9.5% rate of hemorrhagic complications. Multivariable logistic regression was used to determine preoperative characteristics that were risk factors for MACCEs, which included the following: complete cessation of oral antiplatelet agent  $>5$  days preoperatively, preoperative hemoglobin  $<10$  g/dl, creatinine clearance  $<30$  ml/min, and emergency or high-risk surgery. Risk factors for major bleeding included hemoglobin  $<10$  g/dl, creatinine clearance 30–60 ml/min, duration from stent implantation to surgery  $<3$  months, and high-risk surgery. This study highlights the importance of delaying elective surgery  $>3$  months after stent placement if possible, as well as the need to maintain oral antiplatelet agents through the perioperative period in order to minimize risk for major adverse cardiac and cerebrovascular events.

Not infrequently colon and rectal surgeons are presented with patients who require urgent abdominal surgery, who also have recently implanted DES. A common scenario is the patient who has a lower gastrointestinal bleed while on oral antiplatelet therapy after DES implantation, who is found on colonoscopy to have a bleeding colon cancer. Patients on oral

antiplatelet agents for recently implanted drug-eluting coronary stents can be safely “bridged” with IV infusions of shorter-acting antiplatelet agents. A pilot study of 30 patients with recently implanted DES (median 4 months; range 1–12 months) undergoing major (ten had abdominal surgery) or eye surgery had clopidogrel withheld 5 days preoperatively and were bridged with tirofiban (started 24 h later, discontinued 4 h preoperatively and restarted 2 h postoperatively until clopidogrel is resumed) [24]. Fourteen of the patients (47%) were maintained on aspirin throughout the perioperative course. There were no adverse cardiac events during the index hospitalization, and 28 patients (93%) did not experience significant postoperative bleeding. One of the two patients had an anastomotic bleed after partial colectomy that occurred 4 days after restarting clopidogrel; this was controlled with endoscopic clip placement. This study demonstrates the importance of careful coordination with the inpatient cardiologist in order to optimize outcomes for these complex patients who require urgent abdominal surgery while on antiplatelet therapy for a recently placed coronary stent.

### *AICD/Management*

For nonemergent procedures, it is essential that these high-risk and complex cardiac patients are evaluated by a cardiologist, preferably the patient’s own electrophysiologist. The importance of communication between the cardiologist and anesthesiologist cannot be overstated; above all, it is the obligation of the colon and rectal surgeon to ensure that this occurs. Patients with automatic implantable cardioverter-defibrillators (AICD) often have underlying ischemic heart disease, which should not be overlooked during the preoperative assessment. It is important for the anesthesiologist to find out from the cardiologist whether the patient is pacemaker-dependent, which means that the patient has atrial, ventricular, or both chambers paced 100% of the time. For patients who are not pacemaker-dependent, the anesthesiologist should place a magnet over the device, which will prevent inappropriate delivery of shocks [2]. For patients who are pacemaker-dependent, the device may need to be reprogrammed intraoperatively. All AICD patients should have an external defibrillator and transcutaneous pacer immediately available, and the pads should be affixed to the patient at the start of the case. In emergent settings, in which a formal cardiology consultation is not feasible, a 12-lead EKG can be used to determine pacemaker-dependence.

It is important for the surgeon to understand that AICD activity can be affected by monopolar cautery, causing electromagnetic interference [2]. This can result in delivery of inappropriate shocks to the patient, or inadequate pacing. Intent to use monopolar cautery should be clearly communicated to the anesthesia team prior to the case. Use of bipolar whenever possible can help decrease risk of electromagnetic interference but is not feasible for most colorectal procedures.

## Assessment of Pulmonary Risk

### COPD

Patients with chronic obstructive pulmonary disorder (COPD) are at high risk of perioperative pulmonary complications. Preoperative optimization of pulmonary function is the best way to minimize risk. These patients should be evaluated by their primary care physician, or pulmonologist, if they see a specialist. Bronchodilators should be continued perioperatively. Glucocorticoid use must be balanced against potential for increased risk of surgical complications such as anastomotic leak (see below section on steroids); tapering down or off is advantageous if at all possible, and should be discussed with the specialist. A randomized controlled trial of 48 high-risk pulmonary patients demonstrated significant decrease in postoperative pulmonary complications, 60% versus 22% ( $p < .01$ ), in the group receiving aggressive pulmonary care, which included bronchodilators, antibiotics, chest physical therapy, nebulizers, and smoking cessation, compared to a group who did not receive these therapies [25].

### Obstructive Sleep Apnea (OSA)

Obstructive sleep apnea (OSA) is the most common sleep disorder, and is characterized by upper airway obstruction, causing apneic episodes. Rates of OSA are on the rise, partially due to increased incidence of obesity, a major risk factor. A study of almost 1000 patients revealed that 60% of surgical patients with moderate-to-severe OSA are undiagnosed by the anesthesiologist, and 92% were undiagnosed by the surgeon [26]. OSA is important to recognize preoperatively, as it is a risk factor for perioperative cardiopulmonary complications, and is associated with unplanned ICU admission [27]. One reason why OSA is under diagnosed is that it can present with a wide

range of symptoms, beyond the more classically described loud snoring, daytime sleepiness, and witnessed apnea by a sleep partner. Other symptoms include morning headaches, poor concentration, altered mood, vivid or disturbing dreams, restless sleep, GERD, and nocturia [28].

Patients undergoing major abdominal surgery should be screened for OSA, particularly those with high BMI and multiple comorbidities. There are several simple and efficient clinical screening tools available, including the STOP-Bang questionnaire (Table 6-2) [29]. Patients with high scores who are undergoing major abdominal surgery should be referred to a pulmonologist for a formal workup. A randomized controlled trial of 177 patients with documented OSA demonstrated that patients who used auto-titrated continuous positive airway pressure (APAP) perioperatively ( $N=87$ ) had significantly decreased rates of hypoxia and apnea compared to the untreated group ( $N=90$ ); the APAP group had three events/hour postoperatively, decreased from their preoperative baseline of 30 events/hour ( $P < 0.001$ ), and the control group had 31.9 events/hour, increased from preoperative baseline of 30.4 events/hour ( $P=0.302$ ). Importantly, the investigators noted compliance rates (defined as wearing the device nightly) of only 45%, which was most commonly attributed to generalized discomfort, nausea, or vomiting [30]. Patients with a known diagnosis of OSA should provide the anesthesiologist with documentation of their sleep study results and recent pulmonary consultations, and should bring their CPAP machine to the hospital for perioperative use.

### Diabetes

Diabetic patients represent a complex subset of surgical patients, who often have long-term complications of their disease (neuropathy, visual impairment), as well as other

TABLE 6-2. STOP-bang questionnaire [29, 84]

<input type="radio"/> Yes	<input type="radio"/> No	<i>Snoring?</i> Do you <i>Snore Loudly</i> (loud enough to be heard through closed doors or your bed-partner elbows you for snoring at night)?
<input type="radio"/> Yes	<input type="radio"/> No	<i>Tired?</i> Do you often feel <i>Tired, Fatigued, or Sleepy</i> during the daytime (such as falling asleep during driving)?
<input type="radio"/> Yes	<input type="radio"/> No	<i>Observed?</i> Has anyone <i>Observed</i> you <i>Stop Breathing</i> or <i>Choking/Gasping</i> during your sleep?
<input type="radio"/> Yes	<input type="radio"/> No	<i>Pressure?</i> Do you have or are being treated for <i>High Blood Pressure</i>
<input type="radio"/> Yes	<input type="radio"/> No	<i>Body Mass Index more than 35 kg/m<sup>2</sup>?</i>
<input type="radio"/> Yes	<input type="radio"/> No	<i>Age older than 50 years old?</i>
<input type="radio"/> Yes	<input type="radio"/> No	<i>Neck size large? (Measured around Adams apple)</i> For male, is your shirt collar 17 in. or larger? For female, is your shirt collar 16 in. or larger?
<input type="radio"/> Yes	<input type="radio"/> No	<i>Gender = Male?</i>
<i>Scoring criteria*:</i>		
<i>Low risk of OSA: Yes to 0–2 questions</i>		
<i>Intermediate risk of OSA: Yes to 3–4 questions</i>		
<i>High risk of OSA: Yes to 5–8 questions</i>		

OSA obstructive sleep apnea

related comorbidities, such as chronic renal insufficiency and cardiovascular disease [6, 31]. The initial office consultation with the surgeon should include a detailed history, focusing on the type and duration of diabetes, symptoms, how glucose is monitored at home, baseline glucose range, glycosylated hemoglobin (A1C) levels, related symptoms, as well as the contact information of their primary care physician and/or endocrinologist. Diabetic patients undergoing major abdominal surgery should have the following as part of their preoperative workup: ECG, CXR, serum creatinine, serum glucose, and an A1C level (within 4–6 weeks preoperatively). In particular, elevated A1C levels have been shown in cardiac surgery to be associated with increased risk of surgical complications, including infections, myocardial infarction, and death [32]. Close perioperative involvement of the anesthesiologist is also critical, as some patients undergoing major operations will require preoperative intravenous insulin infusion to attain euglycemia prior to initiation of surgery [33].

## Obesity

More than one-third of adults in the USA are obese, which is defined as having body-mass index (BMI) of 30 or more. One in 20 adults is considered super-obese (BMI of 40 or more) [34]. BMI is considered a screening tool to identify obesity, and is calculated as the patient's weight (in kilograms) divided by square of the height (in meters). An online BMI calculator is available at on the CDC website ([http://www.cdc.gov/healthyweight/assessing/bmi/adult\\_BMI/english\\_bmi\\_calculator/bmi\\_calculator.html](http://www.cdc.gov/healthyweight/assessing/bmi/adult_BMI/english_bmi_calculator/bmi_calculator.html)).

Despite the fact that the obese patient creates substantial technical challenges for the surgeon, they do not have significantly greater risk of perioperative mortality. A prospective multicenter study of over 100,000 patients undergoing nonbariatric surgery demonstrated that overweight and obese patients actually had a statistically significantly lower postoperative mortality, compared to nonobese patients (overweight patients: OR 0.85, 95% CI 0.75–0.99; moderately obese OR 0.73, CI 0.57–0.94). This unexpected result was termed the “obesity paradox” and can potentially be explained by increased nutritional stores, as well as the chronic inflammatory state of obesity that may prime these patients for the inflammatory surge of surgery [35].

In terms of postoperative morbidity, obese patients undergoing nonbariatric abdominal surgery have been shown to have increased risk of perioperative venous thromboembolism and superficial site infection. A prospective study of over 6000 patients found that the risk of superficial site infection after open abdominal surgery was 4% for obese versus 3% for nonobese patients,  $P=0.03$  [36].

Obese patients pose significant intraoperative challenges, some of which can be mitigated with appropriate preoperative planning. For example, if a stoma may be needed, a visit from the enterostomal therapist is extremely important, as

marking on the thinner upper abdomen will be helpful. It is especially important to ensure that these patients are able to reach the stoma so they can care for it independently. Both laparoscopic and open surgery is technically demanding in obese patients; however, if feasible, laparoscopic surgery has the advantage to the patient of smaller incisions and improved visualization for the surgeon. Avoiding lower midline and Pfannenstiel incisions is helpful in minimizing superficial site infections and other wound-related complications in the obese patient with a large pannus. Clear communication with the operating room staff prior to the case is essential, to ensure availability of long instruments, deep retractors, appropriate beds and equipment such as blood pressure cuffs and large pneumatic compression boots.

## Malnutrition

Colorectal surgeons are commonly faced with challenging patients who are malnourished due to advanced malignancies or inflammatory bowel disease that result in intestinal blockages, intestinal fistulas, poor absorptive capacity, and large volume losses from the GI tract. Nutritional risk tends to be a reflection of the patient's overall health, and in oncology has correlated with the Eastern Cooperative Oncology Group score and the presence of anorexia or fatigue [37]. Such nutritional risk is associated with increased postoperative complications, longer length of stay, and higher mortality following elective surgery [38, 39], and is particularly pronounced in patient with colorectal cancer [40]. Incidence remains under recognized and malnutrition continues to negatively impact postoperative recovery and patient outcomes, as well as mortality [41]. Although logistically challenging, nutritional support can be delivered in the preoperative or postoperative setting and can be administered via the enteral and parenteral routes. Most studies are limited by heterogeneous patient populations, variable study designs, different feeding protocols that often result in parenteral overfeeding, and outdated methodologies. When delivered appropriately, the malnourished colorectal patient realizes several benefits from perioperative nutritional support including fewer postoperative complications, shorter hospital length of stay, and lower mortality [42].

The evaluation of the potentially malnourished patient begins with the history and physical examination. Most patients will complain of some degree of intolerance of oral intake as a result of poor appetite, nausea, abdominal bloating, abdominal pain, and weakness. Patients will relate a recent weight loss, typically over a 1–3 month time period. On physical examination, the patient appears thin, pale, and weak with muscle wasting and loose skin. These variables can be objectified using grading systems such as the relatively intuitive Subjective Global Assessment (SGA) to classify patients as well nourished, moderately malnourished, or severely malnourished [43]. The SGA utilizes five features of the history (weight loss over 6 months, dietary intake

change, gastrointestinal symptoms, functional capacity, and the impact of disease on nutritional requirements) and four features of the clinical exam (loss of subcutaneous fat, muscle wasting, ankle edema, sacral edema, ascites) to elicit a SGA rank based on subjective weighting.

Serum albumin level has been considered the “classic” test reflecting overall nutritional status, with serum concentration of  $<3.0$  g/dL defining the “malnourished state.” However, in real practice its utility and reliability is limited as levels fluctuate for many reasons, including production alterations in the catabolic or anabolic states, external losses, or redistribution between the various fluid compartments of the body [44]. Other short turnover proteins such as prealbumin, transferrin, and retinol binding protein have similar limitations as nutritional markers as a result of variable half-lives and response to dietary intake and renal/liver dysfunction, although all of these proteins can be useful when followed as trends over time.

Inflammatory bowel disease, intestinal obstruction, large tumors, fistulizing diseases, and patients with diarrhea are often unable to sustain themselves orally due to a poor appetite or resultant abdominal bloating and pain. This limits the ability to intervene preoperatively, particularly when considering utilizing the enteral route. Options include oral nutritional supplements (standard or immunonutrition) or feeding via nasogastric feeding tubes. Total parenteral nutrition (TPN) can be used as long as central intravenous access is obtained, an appropriate formula is prescribed (1.5 g per kilogram and 25 kcal per kilogram) and tight glycemic control is maintained (serum blood sugars  $<150$  g/dL). Unfortunately, the use of preoperative nutrition has not been well studied in the malnourished GI surgery patient populations. A recent Cochrane review [45] highlights this paucity of evidence and the reality that many of the studies are outdated, with only two trials evaluating the administration of enteral nutrition (years 1992 and 2009) including only 120 participants and a high risk of bias. Neither study showed any difference in primary outcomes. The three studies that evaluated preoperative parenteral nutrition (years 1982, 1988, and 1992) showed a significant reduction in postoperative complications, predominantly in malnourished patients.

### Solid Organ Transplant Recipients

The introduction of novel, more effective immunosuppression regimens has resulted in improved long-term survival after solid organ transplant. Over 150,000 patients in the USA are living with functional kidney transplants, and this number is on the rise. It is increasingly common for surgeons to encounter transplant patients in their practice, in both the elective and emergency settings. The vast majority of these patients are maintained on chronic immunosuppressive regimens. These agents are generally continued throughout the perioperative and early postoperative period in order to minimize risk of rejection. It is therefore essential that surgeons

familiarize themselves with the more commonly used immunosuppressive agents and their potential to impact perioperative outcomes. Communication with the transplant team of physicians is necessary prior to elective surgery.

The newer immunosuppressive agents, sirolimus and everolimus, which belong to the drug class known as inhibitors of the mammalian target of rapamycin (mTOR), have been shown to negatively impact healing of surgical wounds. mTOR is a cytoplasmic kinase that is essential for cell growth and proliferation [46]. Inhibition of lymphocyte proliferation despite stimulation results in immunosuppression. This same mechanism is also responsible for inhibition of the wound healing process. In a prospective trial of 123 patients randomized to receive either sirolimus or tacrolimus on postoperative day 4 after kidney transplant, Dean et al. found a significantly higher rate of wound-related complications (including superficial site infection and incisional hernias) in the sirolimus cohort, compared those receiving tacrolimus (47% vs. 8%,  $P<0.0001$ ) [47]. This data has prompted clinicians to replace mTOR inhibitors with tacrolimus for 6 weeks prior to elective surgery.

### Substance Abuse

All surgical patients should be asked about their use of tobacco, alcohol, and street drugs. A large database study from 2002 determined that 7.6% of Americans had a substance abuse disorder within the prior year (95% CI 6.6–8.6%) [48]. The surgeon must also recognize narcotic dependency and use of prescription opioids that are not medically indicated. It is important for surgeons to make patients feel comfortable in answering these questions honestly and accurately. It is never safe to simply assume that a particular patient does not fit the expected profile of an “alcoholic” or “drug addict.” Substance abuse has been shown to affect the elderly [49], as well as highly functional individuals with families and careers [50]. It is therefore critical to screen *all* patients preoperatively in order to minimize perioperative risk.

### Alcohol

Alcoholism has been shown to be associated with a number of different perioperative complications, in a dose-dependent manner. Large studies have demonstrated that alcoholism is associated with surgical site and other infections, cardiopulmonary complications, and also correlates with longer hospital stay, increased rates of ICU stay, and increased rates of reoperation [51, 52]. The AUDIT-C questionnaire is a validated screening tool that can be used by the clinician to identify patients at high risk for perioperative complications (Table 6-3) [53]. A randomized controlled trial of 41 patients with alcoholism (defined as consumption  $>60$  g ethanol per day) undergoing elective colorectal surgery demonstrated that abstinence 1 month preoperatively was associated with fewer cardiac complications, including myocardial ischemia

TABLE 6-3. AUDIT—C questionnaire

<i>Question # 1: How often did you have a drink containing alcohol in the past year?</i>	
Never	(0 points)
Monthly or less	(1 point)
Two to four times a month	(2 points)
Two to three times per week	(3 points)
Four or more times a week	(4 points)
<i>Question # 2: How many drinks did you have on a typical day when you were drinking in the past year?</i>	
1 or 2	(0 points)
3 or 4	(1 point)
5 or 6	(2 points)
7 to 9	(3 points)
10 or more	(4 points)
<i>Question # 3: How often did you have six or more drinks on one occasion in the past year?</i>	
Never	(0 points)
Less than monthly	(1 point)
Monthly	(2 points)
Weekly	(3 points)
Daily or almost daily	(4 points)

The AUDIT-C score on a scale of 0–12 (scores of 0 reflect no alcohol use). In men, a score of 4 or more is considered positive; in women, a score of 3 or more is considered positive

(23% vs. 85%,  $P < 0.05$ ) and arrhythmias (33% vs. 86%,  $P < 0.05$ ), as well as overall decreased complication rate (31% vs. 74%,  $P = 0.02$ ) [54]. It is unknown what the optimal alcohol-free interval is prior to elective surgery, in terms of maximizing risk reduction, although the trial investigators recommend 3–8 weeks, highlighting the importance of intensive counseling and monitoring of these patients during this interval [55].

### Tobacco

Smoking has been shown in multiple studies to increase perioperative pulmonary risk, as well as risk of wound infections, neurologic complications, and ICU admission [56]. The best way to minimize this risk is to encourage patients to quit smoking prior to elective surgery. Previously it was felt that smoking cessation less than 8 weeks preoperatively was associated with a paradoxical increase in pulmonary complications, possibly due to a compensatory increase in secretions. This has now been disproven in multiple large studies. A large trial of 522 smokers undergoing gastric cancer surgery compared risk of postoperative pulmonary complications between three groups: (1) active smokers or those who quit less than 2 weeks prior to surgery, (2) those who quit 4–8 weeks prior, and (3) those who quit 8 or more weeks prior to surgery. The odds ratio for postoperative pulmonary complications were 2.92 for group 1 (95% CI 1.45–5.90), 0.98 for group 2 (0.28–3.45), and 1.42 for group 3 (0.66–3.05) [57]. Therefore, the recommendation is to encourage smoking cessation, regardless of the timing of surgery, although ideally surgery can be planned for at least 4 weeks from the “quit date.”

### Opioids

There are many different types of patients with chronic opioid dependence, including: abusers of street drugs such as heroin; abusers of prescription-only opioids; patients with prior history of opioid abuse, maintained on long-acting agents such as methadone; and patients on long-term narcotics prescribed for a chronic medical condition. Overall, prescription opioid use is on the rise in the USA and therefore this is being encountered by the surgeon with increasing frequency [58]. For all patients on narcotics, the surgeon should always ask preoperatively what the indication is, how long they have been taking it, side-effects (such as constipation), if there is a plan to wean off the drug, as well as who has been prescribing it. The patient’s responses should be corroborated with the prescribing physician and/or medical record. Regardless of whether it is warranted for an underlying condition, opioid dependency will result in increased narcotic requirements perioperatively. Whenever possible, it is helpful to involve the acute pain management service preoperatively, in anticipation of these issues, in order to provide the best perioperative pain management. Non-narcotic adjunct therapies can be considered, including thoracic epidural catheters, transversus abdominus plane (TAP) blocks, as well as drugs such as ketorolac (Toradol), acetaminophen and gabapentin (Neurontin). Preoperatively, a clear plan should be made with the patient and the clinician who has been prescribing chronic opioids regarding postoperative pain management following hospital discharge, particularly who will be prescribing, and for how long. This is instrumental in avoiding concerns in the outpatient setting with over-prescribing and relapse.

### Other Illicit Drugs

All patients undergoing elective surgery should be screened for the use of illicit drugs— not just “street drugs,” but also other prescription-only drugs, such as benzodiazepines, that are not medically indicated. For patients requiring elective surgery, intensive efforts should be made to encourage cessation prior to planned surgery. This requires clear communication with the patient’s primary care physician and/or psychiatrist. Discussion of individual drugs is beyond the scope of this chapter; however, additional information is well-summarized in this 2014 reference from the anesthesia literature [59].

### Medications

In the era of polypharmacy, it is essential for the colorectal surgeon to carefully assess the patient’s current medication list. Novel anticoagulants, chemotherapy, and immunosuppressants may be disguised by long, difficult to pronounce names. It is therefore critical for surgeons to be familiar with these newer agents. In many instances, patients are maintained indefinitely on medications that may pose significant perioperative risk. Discussing these situations preoperatively with the prescribing physician is essential, as the need for surgery may provide the necessary impetus to discontinue chronic medications that are no longer necessary or applicable.

### Anticoagulation

In recent years, several novel oral anticoagulants have become commercially available and are widely used in patients with atrial fibrillation or history of stroke, as well as in patients with coronary or endovascular stents. When determining how to manage anticoagulation perioperatively, risk of bleeding must be balanced against the risk of thromboembolic complications. Additionally, it should be determined whether “bridging” with a short-acting anticoagulant is necessary. Although there are evidence-based guidelines, these decisions should be made on a case-by-case basis, and should closely involve the patient’s cardiologist and/or hematologist. The patient should be educated upfront about the potential risks involved and to recognize that the ability to restart the medication postoperatively relates to the extent of surgery and associated bleeding risk.

*Clopidogrel (Plavix)* is a member of the platelet receptor P2Y<sub>12</sub> blocker drug class, and is used in patients with history of myocardial infarction or stroke, as well as recent coronary or peripheral vascular stent placement. For most patients, the maintenance dose is 75 mg orally per day. If the decision has been made to discontinue clopidogrel prior to elective surgery, it should be discontinued 5–7 days preoperatively [23]. Clopidogrel should be restarted as soon as possible after surgery. A more extensive discussion of clopidogrel earlier in the chapter—refer to the section on “Coronary Stent Management.”

*Warfarin (Coumadin)* is an inhibitor of vitamin-K-dependent clotting factor synthesis (factors II, VII, IX, and X). The half-life of warfarin is 36–42 h. Therapeutic dose range is measured by the prothrombin time (PT), which is generally maintained at a goal of INR (international normalized ratio) 2.0–3.0 for most conditions. Patients with cardiac valves may be maintained at higher doses, with a goal INR 2.5–3.5. For elective surgery, warfarin should be discontinued 5 days preoperatively. Most abdominal surgery is safe to perform when INR is  $\leq 1.4$  [60]. Ideally, INR should be checked the day prior to surgery, if possible. For urgent surgery (within 1–2 days), warfarin can be reversed with vitamin K (2.5–5 mg oral or intravenous). For emergency surgery, warfarin can be rapidly reversed with fresh frozen plasma (FFP), which contains the necessary clotting factors [61]. Provided that there was adequate hemostasis during surgery, warfarin may be restarted (at the preoperative dose) as early as 12–24 h postoperatively, although the timing depends on indication for anticoagulation (for example short term thromboembolic risk is higher with a mechanical mitral valve compared to atrial fibrillation).

*Heparin* binds to and inactivates antithrombin III and has a half-life of 45 min. Unfractionated heparin is administered as an IV infusion, using a weight-based nomogram to titrate the dose [62, 63]. Compared to low molecular weight heparin, unfractionated heparin is less costly, is easier and faster to reverse, and is preferable in patients with renal insufficiency (the dose is not affected by creatinine clearance). Unfractionated heparin should be held 6 h prior to surgery. *Enoxaparin (Lovenox)* is a low molecular weight heparin that has comparable efficacy to unfractionated heparin, but has many advantages. It is easier to use, is administered as a subcutaneous injection (and therefore can be given in the outpatient setting) and does not require monitoring. Its half-life is 3–5 h. It can be given at prophylactic dose for venous thromboembolism, as well as therapeutic, weight-based dose. In preparation for surgery, if twice-daily dosing is used, the evening dose should be held on the night prior to surgery; if once daily dosing is being used, a half-dose should be given the morning prior to surgery [60]. Other low molecular weight heparin products available in the USA include dalteparin (Fragmin) and tinzaparin (Innohep). Patients on any heparin derivative need to be monitored for heparin-induced thrombocytopenia (HIT), although this risk is less significant with low molecular weight heparin. Heparin products can be reversed with protamine sulfate.

*Apixaban (Eliquis)* is an oral factor Xa inhibitor that is commonly used in patients with atrial fibrillation, as well as for both prophylaxis and treatment of venous thromboembolism. Additionally, apixaban has been used as postoperative DVT prophylaxis after hip surgery [64]. The major advantage of apixaban over coumadin is that drug levels do not need to be checked routinely (although the drug does prolong PT/PTT/INR). The drug is dosed twice daily, is unaffected by dietary intake, and can be crushed and administered via nasogastric tube. The dose must be decreased for Cr  $\geq 1.5$ ,

as well as for age  $>80$  and body weight  $\leq 60$  kg. The drug is generally well-tolerated with a favorable side-effect profile. Apixaban should be discontinued a minimum of 48 h prior to abdominal or anorectal surgery, although depending on the indication for anticoagulation, it would be acceptable to discontinue it 24 h preoperatively for anorectal surgery, if necessary from a risk standpoint. There is a boxed warning regarding the use of neuraxial anesthesia and risk of spinal or epidural hematoma (which could result in temporary or permanent paralysis), as the optimal interval from drug discontinuation to intervention is not well-defined. Therefore we recommend not using this drug for perioperative anticoagulation if an epidural catheter or spinal anesthesia is planned. Although not routinely used to assess drug levels, anti-Factor 10a (Anti-FXa) levels can help guide management. There are currently no specific reversal agents for this drug.

*Aspirin* impairs platelet function primarily by downstream effects of irreversibly inhibiting cyclooxygenase-1 (COX-1). Its antiplatelet effects start as soon as 30 min after ingestion, and last throughout the platelet life span, which ranges from 8 to 10 days.

Despite the fact that there is no clear consensus among surgeons regarding perioperative aspirin use in noncardiac surgery, the risk of aspirin on postoperative bleeding is actually well studied in the literature. Perioperative continuation of low-dose (81 mg) aspirin in low-risk patients (for primary prevention of thrombotic cardiovascular events) undergoing abdominal surgery has not been shown in randomized controlled trials to be associated with an increase in major postoperative bleeding complications [65]. Other larger randomized controlled studies have demonstrated comparable results in patients at higher risk for adverse cardiovascular thromboembolic events, who are on chronic low-dose aspirin for secondary prevention of myocardial infarction or stroke. The STRATAGEM trial randomized 291 patients undergoing elective intermediate- or high-risk noncardiac surgery (of which 20% was abdominal surgery) to receive low-dose (75 mg) aspirin versus placebo starting 10 days preoperatively; these patients were all on long-term aspirin or another antiplatelet agent for secondary prevention of cardiovascular thromboembolic events [66]. Although the study was underpowered due to difficulty with recruitment, the investigators found no statistically significant difference in the rate of major bleeding complications within 30 days postoperatively between the aspirin and placebo groups, 6.2% versus 5.5%, respectively;  $P=0.81$ . Importantly, they also found no difference in the rate of cardiovascular thrombotic events, 3.4% versus 2.7%,  $P=0.75$ . Surprisingly, very few studies specifically evaluate the perioperative risk of high-dose (325 mg) aspirin; many of the larger studies on antiplatelet agents do not even take the aspirin dose into account [67]. A retrospective analysis of 1017 patients undergoing elective pancreatic resection compared patients on aspirin (55 patients on 325 mg aspirin, 234 patients on 81 mg aspirin) to no-aspirin ( $n=728$ ), and found no significant dif-

ference in rate of blood transfusion within 30 days postoperatively between groups (29% versus 26%  $P=.37$ ) [68]. The higher dose aspirin group was too small to stratify risk according to aspirin dose.

In our practice, we do not discontinue low-dose “baby” aspirin perioperatively for anorectal or abdominal cases, regardless of the indication for its use. For patients on high-dose (325 mg) aspirin, the decision is more individualized and requires input of the patient’s cardiologist and/or vascular surgeon. If the decision is made to discontinue aspirin preoperatively, it should be held for 7 days prior to surgery.

## Immunosuppressive Agents

*Corticosteroids* have been shown to impair wound healing in both animal models as well as clinical studies. In animal models, corticosteroids have been shown to alter multiple independent signaling pathways, impairing all three phases of wound healing: inflammatory, proliferative, and remodeling. Clinical studies have also demonstrated a higher rate of anastomotic complications in patients on chronic steroids [69]. A prospective study performed in the 1980s specifically evaluated the risk of steroids in Crohn’s patients, and demonstrated in multivariate analysis that corticosteroids were associated with an increased overall postoperative complication rate in Crohn’s patients undergoing surgery involving bowel anastomosis (15.4% vs. 6.7%;  $p=.03$ ) [70]. One of the largest studies looking at anastomotic leak in colorectal patients included 250 left sided resections with anastomosis. The overall anastomotic leak rate was 7.5%. When patients were administered corticosteroids, either perioperatively or long term, the multivariate model concluded that corticosteroid use increased the risk for AL by more than seven times (OR, 7.52; standard error, 4.47;  $P=0.001$ ; 95% CI, 2.35–24.08 [71]. A meta-analysis evaluating the risk of corticosteroids on colorectal anastomotic integrity is included 9564 patients from 12 studies demonstrated an overall leak rate of 6.77% (95% CI 5.48–9.06) compared to 3.26% (95% CI 2.94–3.58) in the non-corticosteroid group [72]. In addition, corticosteroids impact wound healing and are a risk factor for the development of superficial and deep surgical site infections and have even been shown to impact postoperative mortality [73]. Ultimately, this understanding allows the surgeon to better counsel the patient regarding possible postoperative complications, wean steroids during the preoperative period when possible, and make decisions in the operating room (such as the decision to create diverting stoma and wounds closure) to optimize patient outcomes.

*Immunomodulators*, including azathioprine and 6-mercaptopurine, are used in both Crohn’s disease and ulcerative colitis to maintain steroid-induced remission. These drugs often take 3–4 months until clinical benefit is apparent, and have infrequent but serious side-effects such as leucopenia, liver function abnormalities, pancreatitis, and lymphoma.

A retrospective study of 417 operations involving bowel anastomoses for Crohn's disease demonstrated no difference in the rate of anastomotic complications for patients on immunomodulators (10% vs. 14%;  $p=0.263$ ) [74]. Similar to the studies above, they also found that in multivariate analysis, corticosteroids (preoperative prednisolone 20 mg or more) was a predictor of anastomotic complication (OR 0.355, 95% CI 0.167–0.756;  $p=0.007$ ). Accordingly these medications are often continued until surgery.

*Biologic agents* include infliximab (Remicade), a chimeric monoclonal antibody that targets tumor necrosis factor, a pro-inflammatory cytokine that has been shown to be elevated in inflamed tissue of IBD patients. Biologics including infliximab have been demonstrated to induce remission and control symptoms in patients with moderate-to-severe Crohn's and ulcerative colitis. With more widespread use of biologic agents such in other inflammatory conditions such as rheumatoid arthritis and psoriasis, surgeons are seeing a larger percentage of patients on these agents perioperatively. Krane et al. performed a retrospective analysis of 518 patients with IBD undergoing elective laparoscopic bowel resection, of which 142 patients were on preoperative infliximab [75]. There was no difference in the rate of anastomotic leak, which was overall low in both groups (2.1% with infliximab versus 1.3% without;  $p=0.81$ ). A significantly higher percentage of the patients on infliximab were also on steroids, 73.9% vs. 58.8%,  $p=0.006$ , and still this did not impact anastomotic leak rate. Overall the existing literature is limited and controversial but biologic agents are thought to impact wound healing and most surgeons prefer to hold these agents for 4–6 weeks if possible prior to major abdominal surgery [76].

## Chemotherapy

Through a myriad of mechanisms, the final common pathway of cytotoxic chemotherapy is induction of cell death. Ideally this effect is minimized in nontumor cells, including healing anastomoses. Large studies have attempted to evaluate the overall effect of neoadjuvant and adjuvant chemotherapy on the rate of anastomotic leak, and there have been conflicting results. In a recent single-center study of 797 patients with a single anastomosis, Lucan et al. determined in multivariate analysis that preoperative chemotherapy was one of the strongest independent risk factors for anastomotic leak, with an odds ratio of 2.85 (95% CI 1.21–6.73,  $P=0.017$ ) [77]. Morse et al. performed a similar study of 682 patients with intestinal anastomoses over a 5 year period, and determined in bivariate analysis that chemotherapy (administered within 6 weeks of the operation) was not a risk factor for anastomotic leak.

*Bevacizumab* (Avastin) is a humanized monoclonal antibody, which targets vascular endothelial growth factor A (VEGF-A), and is thought to work in solid tumors by restricting neoangiogenesis, which is necessary for tumor growth. It is the first of the antiangiogenic drugs to be approved for

first-line treatment of metastatic colorectal cancer, and is also used for other solid tumors including breast, kidney, ovarian, and lung cancer. Bevacizumab is associated with increased incidence of postoperative complications, including impaired wound healing and anastomotic leak. Consequently, phase II and III studies of bevacizumab for colorectal cancer excluded patients who underwent major surgery within the previous 28 days [78–80]. Yoshioka et al. retrospectively evaluated 78 patients with resectable advanced or metastatic colorectal cancer who received neoadjuvant bevacizumab prior to surgical resection (this included 46 rectal resections and 4 colectomies) [81]. Overall median interval from last bevacizumab dose to surgery was 9 weeks; anastomotic leaks occurred in six patients, four of which required re-laparotomy. The mean interval from surgery to diagnosis of anastomotic leak was 15.8 days (range 4–34 days). Although the authors did not document mean in-hospital length of stay, presumably most of the leaks occurred after discharge. In multivariate analysis, primary colorectal anastomosis was the only independent predictive risk factor for major postoperative complications (OR 8.285;  $P=0.013$ ). Interestingly, the interval from last bevacizumab dose to surgery was not an independent risk factor for postoperative complications. Bevacizumab has also been associated with late anastomotic complications [82]. Unsurprisingly, other newer antiangiogenic drugs have also been implicated in the development of anastomotic leak, including pazopanib and aflibercept in small series and case reports [83]. As with most chemotherapy agents, these agents are held for 6 weeks before major surgery, when possible.

## Conclusion

The preoperative assessment of colorectal surgery patients should be comprehensive and often requires involvement of physicians from multiple specialties. The assessment of cardiopulmonary risk has been well studied and tends to be the focus of most surgeons. Attention to other organ systems as well as comorbidities such as substance abuse, malnutrition, and obesity deserve specific attention. Medications including anticoagulation and immunosuppressive agents are commonly encountered and their optimal management (or cessation) demands a balance between the treatment of conditions and the risk of bleeding and wound healing. With a thorough preoperative patient evaluation, patient outcomes can be optimized, by minimizing the risk of perioperative complications.

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