Preoperative Evaluation and Risk Management

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ABSTRACT

All colorectal operations carry significant associated risk. To facilitate the best outcomes it is essential to perform a comprehensive evaluation of patient risk preoperatively. Once risk factors are identified the appropriate steps must be taken to minimize their effects. The evaluation of the patient can be broken down by organ systems such as cardiac, pulmonary, hepatic, renal, and gastrointestinal. Additionally, one can assess whether the patient is at risk for infection, hyperglycemia, malnutrition, venous thromboembolism, and anemia. There are many preemptive steps that can be taken to improve patient outcomes in all of these categories.

KEYWORDS: Preoperative evaluation, operative risk, risk assessment, risk management

Objectives: On completion of this article, the reader should be able to systematically assess preoperative risk in a variety of categories and implement strategies to reduce perioperative risk.

> We are only entitled to operate when there are reasonable chances of success. To use the knife when those chances are lacking is to prostitute the splendid art and science of surgery, and to render it suspect among the laity and among one's colleagues. We have to ask ourselves, then, by what standard we can measure the chances of success. We shall learn then through the indefatigable study of our science, through shrewd criticism of our own and others' observations, through careful consideration of individual cases, and through the meticulous appraisement of our results.
>
> Theodor Billroth
> 1881

Complications after colorectal operations frequently lead to major hardship for the patient and frustration for the surgeon. There has been increasing monitoring of outcomes within institutions as well as by outside organizations. Surgical morbidity and mortality can be greatly improved through a systematic assessment of organ-specific and pathophysiologic risk factors followed by implementation of preoperative corrective strategies. In recent years, an increasing number of assessment tools have been designed to quantify risk. It is imperative that the colorectal surgeon use all available means to improve patient care.

GENERAL RISK ASSESSMENT

There are several scoring systems used to evaluate the overall risk of the surgical patient. The most widely used instruments are the American Society of Anesthesiologists (ASA) classification, the Goldman Cardiac Risk Index, and the Revised Cardiac Risk Index. There are

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other modalities of assessment that are commonly used as research tools, but may also be useful in clinical practice. The Physiology and Operative Severity Score for Enumeration of Mortality and Morbidity (POSSUM) and Portsmouth POSSUM (P-POSSUM) have been used to predict mortality based on physiologic and operative factors.[1,2] These scores tend to overpredict mortality in colorectal surgical patients. This has led to further modifications and development of the Colorectal POSSUM (CR-POSSUM), which more accurately predicts mortality when compared with the POSSUM and P-POSSUM.[3] The CR-POSSUM score is based on age, cardiac failure, blood pressure, pulse, blood urea nitrogen, hemoglobin, and operative severity. The Association of Coloproctology of Great Britain and Ireland (ACPGBI) scoring system, which is based on age, completeness of cancer resection, ASA score, cancer stage, and urgency of operation, is better at predicting mortality in patients having elective operations by colorectal surgeons when compared with the POSSUM, P-POSSUM, and CR-POSSUM surveys.[4] The ASA classification system is used to assess the patient for underlying illness that may affect outcomes for surgery (Table 1).[5] Although the ASA score is mainly used to alert the anesthesiologist of underlying illness, it can also be used to aide the surgeon with the assessment of perioperative risk and mortality.[6] The use of one or more of these risk assessment tools may help guide difficult preoperative decision making.

CARDIAC ASSESSMENT

Perioperative adverse cardiac events may occur in the noncardiac surgical patient. The high-risk patient can usually be identified during a comprehensive history, review of systems, and physical examination. The history should elicit conditions such as stable or unstable angina, recent or past myocardial infarction, heart failure, significant arrhythmias, valvular disease, and the presence of a pacemaker or defibrillator. Also, the patient should be asked about smoking, diabetes mellitus, and renal insufficiency. Functional status should be quantified based on the metabolic equivalent (MET), which is used in the American College of Cardiology/American Heart Association Guidelines (ACC/AHA).[7] For example, a person functioning at 1 MET is limited to simple activities such as eating, dressing, and using the toilet. A person with 4 METs can climb a fight of stairs, walk up a hill, or walk on level ground at 4 mph, and would generally not require extensive cardiac workup. Physical examination should be used to look for jugular venous distention, arrhythmias, and abnormal heart sounds such as an S_3 gallop or murmurs. The information obtained from the history and examination can be used to assess risk and direct further testing.

Indices for assessment of cardiac morbidity and mortality in noncardiac surgery have been established. In 1977, Goldman and colleagues published a Cardiac Risk Index based on weighted risk factors (Tables 2 and 3).[8] Although the Goldman Index is still useful in alerting the clinician to cardiac risks, the newer Revised Cardiac Risk Index (RCRI) is simpler and more widely used (Table 4).[9] If it is determined that the patient is at significant risk for a postoperative cardiac event, further workup should be done, and the condition should be optimized prior to the operation if possible. A consultation with a cardiologist should be sought when coronary or valvular disease is suspected or if assistance is needed with management of pacemakers or defibrillators.

Table 1 American Society of Anesthesiologists Classification

I	A normal healthy patient
II	A patient with mild systemic disease
III	A patient with severe systemic disease
IV	A patient with severe systemic disease that is a constant threat to life
V	A moribund patient who is not expected to survive without the operation
E	Emergency

Table 2 Goldman Cardiac Risk Point Scale

Criteria	Points
Age > 70 years	5
Myocardial infarction in previous 6 months	10
S_3 gallop or jugular venous distention	11
Important aortic valve stenosis	3
Rhythm other than sinus or premature atrial contractions on last preoperative electrocardiogram	5
> 5 premature ventricular contractions per minute documented at any time before operation	7
$PO_2 < 60$ or $PCO_2 > 50$ mm	3
K< 3.0 or $HCO_3 < 20$ mEq/L	
Blood urea nitrogen > 50, or creatinine > 3.0 mg/dL	
Abnormal aspartate aminotransferase (AST) or chronic liver disease	
Bedridden patient	
Intraperitoneal, intrathoracic, or aortic operation	3
Emergency operation	4

Table 3 Goldman Cardiac Risk Index

Class	Points	Life-Threatening Complication (%)	Cardiac Death (%)
I	0–5	0.7	0.2
II	6–12	5	2
III	13–25	11	2
IV	> 26	22	56

Table 4 Revised Cardiac Risk Index (RCRI)

Risk factors	
Ischemic heart disease	
Congestive heart failure	
Cerebrovascular disease	
Diabetes mellitus requiring preoperative insulin	
Serum creatinine > 2.0 mg/dL	
High-risk surgery (Intraperitoneal, intrathoracic or suprainguinal vascular)	
RCRI Classification	Event Rate (%)
Low risk (0 factors)	0.5
Low risk (1 factor)	1.3
Intermediate risk (2 factors)	3.6
High risk (3 or more factors)	9.1

Adapted from Lee et al.[9]

In 2007, the ACC/AHA Task Force on Practice Guidelines published the Revised Guidelines on Perioperative Cardiovascular Evaluation and Care for Noncardiac Surgery.[7] These guidelines are based on the risk level of the operation and on clinical risk factors that parallel the RCRI parameters. The following is a summary of the ACC/AHA guidelines as they pertain to intermediate risk colorectal operations.

Twelve-Lead Electrocardiogram

A preoperative electrocardiogram (EKG) is indicated within 30 days of operation in patients with known coronary disease, peripheral vascular disease, or cerebrovascular disease. It may be reasonable to obtain an EKG in patients with a single clinical risk factor (e.g., diabetes mellitus, renal insufficiency, or congestive heart failure), who are to have an intermediate risk operation. There is no evidence to support the routine use of EKG in patients without risk factors.

Noninvasive Testing of Left Ventricular Function

Evaluation of left ventricular function by radionuclide angiography or echocardiography is reasonable in patients with dyspnea of unknown origin or worsening dyspnea in the setting of known congestive heart failure. Otherwise, the routine evaluation of left ventricular function is not indicated.

Noninvasive Stress Testing

Noninvasive stress testing involves radionuclide or echocardiographic imaging combined with pharmacologic stress to evaluate for ischemia and arrhythmias in patients who are unable to exercise. Patients with one or two clinical risk factors and poor functional capacity (< 4 METs) should be considered for noninvasive stress testing. Routine noninvasive stress testing is not indicated in patients without clinical risk factors. Patients with active cardiac conditions should usually be evaluated by other methods.

Coronary Artery Bypass Grafting

Coronary artery bypass grafting is indicated prior to elective noncardiac surgery in patients with stable angina and either left main coronary stenosis, two-vessel disease with left anterior descending artery stenosis, or three-vessel disease. It is also recommended in patients with unstable angina or myocardial infarction.

Percutaneous Angioplasty/Stent

In patients who are candidates for percutaneous intervention and are scheduled for noncardiac surgery, consideration should be given to balloon angioplasty and bare metal stent placement. Antiplatelet medication should be given for 4 to 6 weeks after these procedures. If a drug-eluting stent is placed, elective noncardiac operations should be postponed for 12 months if possible. If urgent operation is required, the patient may be converted from antiplatelet therapy to aspirin therapy. After the operation, the antiplatelet therapy should be restarted as soon as possible.

Beta-Blocker Therapy

Patients who have been placed on β-blockers prior to their operation, should be continued on this therapy throughout the perioperative period. According to the ACC/AHA guidelines, it is probably recommended that patients with known coronary artery disease or more than one clinical risk factor be placed on β-blockers. More recent databased data on larger randomized trials have essentially reversed the recommendation set forth by the ACC/AHA guidelines on β-blockers in high-risk patients.[10] Therefore, the routine use of β-blockers is not advised.

Statin Therapy

Statins provide protection against cardiac ischemia in patients who have noncardiac surgery. Patients who are on statins should continue them throughout the perioperative period. Statins may be considered in patients with at least one clinical risk factor who are undergoing intermediate-risk operations.

Pulmonary Artery Catheter

Pulmonary artery catheters should rarely be used. The only recommended use is in patients who are at risk of major hemodynamic disturbances.

A thorough evaluation for cardiac risk factors should be performed on every patient undergoing major colorectal surgery. The ACC/AHA guidelines can help direct workup and management of at-risk patients. Individuals with significant risk should be referred to a cardiologist for further work-up and treatment if necessary.

PULMONARY ASSESSMENT

Postoperative pulmonary complications can lead to significant morbidity and mortality. These complications include atelectasis, pneumonia, pleural effusion, bronchitis, respiratory failure, and acute respiratory distress syndrome (ARDS). Patient-related risk factors for pulmonary complications include chronic obstructive pulmonary disease (COPD), pneumonia, sleep apnea, dyspnea, advanced age, obesity, and smoking. The pertinent surgery-related risk factors are general anesthesia, emergency surgery, upper abdominal incisions, and placement of nasogastric tubes.[11] Laparoscopic colectomy has been shown to have lower pulmonary complications when compared with open colectomy.[12]

The most important part of a pulmonary risk assessment is a thorough history and physical examination. Specifically, the patient should be asked about shortness of breath, dyspnea on exertion, productive cough, and symptoms of sleep apnea. A smoking history should also be obtained. Scoring systems such as the Postoperative Pneumonia Risk Index[13] and the Respiratory Failure Risk Index[14] may be helpful tools (Tables 5 and 6).

Additional testing should be used selectively. Routine chest roentgenograms and arterial blood gas analysis are not indicated unless concerns are raised during the initial patient evaluation. In addition, though office oximetry, spirometry, and pulmonary function testing may be readily available, they should not be used on all patients. The routine use of pulmonary function testing does not predict postoperative complications and is economically wasteful.[15] These tests should be performed selectively on patients who are suspected to have lung disease based on history or exam. In patients with pulmonary symptoms, consideration should be given to obtaining a pulmonology consultation to help guide further work-up and optimization of care.

Table 5 Respiratory Failure Risk Index

Preoperative Predictor	Point Value
Type of operation	
Abdominal aortic aneurysm	27
Thoracic	21
Neurosurgery, upper abdominal, peripheral vascular	14
Neck	11
Emergency surgery	11
Albumin < 3 g/dL	9
Blood urea nitrogen > 30 mg/dL	8
Partially or fully dependent functional status	7
History of chronic obstructive pulmonary disease	6
Age ≥ 70 years	6
Age 60–69 years	4

From Arozullah et al,[14] with permission.

Table 6 Respiratory Risk Index Scores

Class	Point Total	Predicted Probability of Postoperative Respiratory Failure (%)
1	≤ 10	0.5
2	11–19	2.2
3	20–27	5.0
4	28–40	11.6
5	> 40	30.5

Adapted from Arozullah et al.[14]

Smoking cessation may reduce postoperative pulmonary complications. Soon after smoking is stopped the patient will experience an increased mucociliary response and airway hypersensitivity which will, in turn, increase the risk of pulmonary complications. Ideally, to reduce pulmonary morbidity, the patient should stop smoking for at least 8 weeks prior to the operation.[11] Unfortunately, in many abdominal colorectal operations, waiting this amount of time is not feasible.

Sleep apnea is a common and underdiagnosed problem. Risk factors include obesity, male gender, a short stout neck, macroglossia, and enlarged tonsils. Symptoms and signs related to apnea are snoring, nighttime choking or gasping, observed cessation of breathing by a partner, morning headaches, and daytime sleepiness.[16] In at-risk patients, consideration should be given to a pulmonology consultation and sleep laboratory testing prior to operation. A continuous positive airway pressure (CPAP) device should be used in the perioperative period. Also, premedication with clonidine given the night before and 2 hours prior to surgery has been shown to reduce the need of operative anesthesia and improve perioperative hemodynamics, anesthetic recovery, and pain control in the patient with sleep apnea.[17] These benefits occur without deleterious effects on respiratory function.

HEPATIC ASSESSMENT

Liver failure imparts a high risk of morbidity and mortality in patients undergoing abdominal surgery. The most common etiologies of hepatic disease include alcoholism, viral hepatitis, and primary sclerosing cholangitis. The pertinent manifestations of liver disease in regards to surgical risk are malnutrition/hypoalbuminemia, ascites,

Table 7 Pugh Scoring System

	Severity Points		
Variable	**1**	**2**	**3**
Encephalopathy	None	Grades 1 and 2	Grades 3 and 4
Ascites	Absent	Slight	Moderate
Bilirubin	1–2 mg/dL	2–3 mg/dL	>3 mg/dL
Albumin	>3.5 g/dL	2.8–3.5 g/dL	<2.8 g/dL
Prothrombin time	1–4 seconds > control	4–6 seconds > control	>6 seconds > control

Adapted from Pugh R, Murray-Lyon I. Transection of the esophagus in bleeding oesophageal varices. Br J Surg 1973;60:646–652.
Pugh Class A: 5–6 points, Class B: 7–9 points, Class C: 10–15 points.

encephalopathy, coagulopathy, and portal venous hypertension. These factors may lead to poor healing, massive bleeding, and uncontrolled ascites leakage. The severity of liver disease can be assessed using the Child scoring system or the Pugh modification (Table 7). According to one series, the risk of mortality after celiotomy was 10% for Child class A, 30% for Child class B, and 82% for Child class C.[18] Regardless of Child class, emergency operations were associated with a 50% mortality risk in patients with liver disease.

In the colorectal surgical patient with underlying liver disease, optimization should be attempted. Nutrition can be managed with both parenteral and enteral feedings. Coagulopathy may be corrected with vitamin K, fresh frozen plasma, and cryoprecipitate transfusion. Recombinant factor VIIa may also be used immediately before operation to correct coagulopathy, but it is associated with an increased risk of thrombotic complications. Portal hypertension may be managed with β-blockade medications. Alternatively, a "neoadjuvant" transjugular intrahepatic portosystemic shunt (TIPS) procedure may be of benefit in reducing bleeding risk and ascites-related complications in patients with severe portal hypertension.[19] Occasionally, if a nonurgent operation is being considered for causes other that malignancy, liver transplantation may be indicated prior to the colorectal procedure. The goal in these patients with liver disease is to correct abnormalities in hepatic function and reduce portal venous hypertension; however, in Child–Pugh class B or C patients presenting for elective operations the benefit of the operation must be carefully weighed against the high perioperative mortality risk.

RENAL ASSESSMENT

Renal failure has been associated with increased risk of surgical infection[20] and problems with wound healing.[21] Also, renal failure can lead to disturbances in electrolytes and fluid balance, which may exacerbate the physiologic changes that occur during the perioperative period. In the patient with known or suspected renal failure undergoing major colorectal surgery, serum should be sent for electrolytes including potassium, magnesium, calcium, and phosphate. Blood urea nitrogen and creatinine assays should be obtained and the glomerular filtration rate should be calculated. Patients with newly diagnosed renal failure should be evaluated by a nephrologist prior to surgery. Dialysis may be indicated if the uremia is found to be significant.

In renal failure patients, care must be used in choosing a bowel preparation. Oral sodium phosphate (OSP) solutions should be avoided. The main risk associated with these preparations is hyperphosphatemia, which can lead to fatal complications.[22] Care must also be taken in diabetic patients with normal baseline renal function, where there is an increased risk of renal failure after consumption of OSP.[23] The U.S. Food and Drug Administration (FDA) has advised against the use of OSP preparations in patients with impaired renal function, dehydration, and electrolyte abnormalities. Additionally, caution should be used in patients taking diuretics, angiotensin converting enzyme inhibitors, angiotensin receptor blockers, and nonsteroidal antiinflammatory drugs (NSAIDS).[24] Sodium phosphate enemas also pose a risk to the renal failure patient by leading to hyperphosphatemia and potential hypercalcemic tetany.[25] If the bowel must be cleansed in these patients, a polyethylene glycol solution should be used; however, the safest option may be to use no mechanical preparation at all.

GASTROINTESTINAL FUNCTIONAL ASSESSMENT

When considering major colorectal surgery the functional status of the intestine must be assessed. A technically successful operation may result in a poor functional outcome in the form of life-altering fecal incontinence. Usually, one can determine the risk of postoperative incontinence by obtaining a simple bowel history, preoperatively. If there is preexisting poor function prior to operation, this will likely worsen after bowel resection. Assessment tools may be used to try to quantify the degree of fecal incontinence and its impact on the patient's life. These include the Fecal Incontinence Severity Index[26] and the Fecal Incontinence Quality of Life Scale.[27] In the patient with significantly

poor function, it is often better to offer a colostomy or enterostomy after bowel resection.

Advances in surgical care have reduced the necessity for colostomy creation, but there are still many patients who will require either a permanent or temporary ostomy. Candidates for bowel resection of any kind should be counseled about the potential need for a stoma. The selection of the correct site and proper maturation may make the difference between a good stoma and one that causes significant discomfort. The most important factor in assuring a good outcome is the preoperative counseling and marking by an enterostomal therapist. If no enterostomal specialist is available, the surgeon should be prepared to mark the patient prior to the operation. This should be done in the standing, sitting, and lying positions with the goal of avoiding creases, beltlines, and scars. Ideally, the stoma should be placed on a prominent, flat surface that is easily seen by the patient. In regards to assessing the need for a stoma and ensuring correct position, a small amount of diligent preparatory work may save hours of pain and frustration down the road.

DIABETES AND HYPERGLYCEMIA

The prevalence of diabetes in the United States has been increasing and is estimated to be 10%.[28] Many individuals remain undiagnosed. At the physiologic level, hyperglycemia has been shown to be associated with immune dysfunction, elevation of inflammatory markers, vascular endothelium dysfunction, and thrombosis.[29] Clinically, hyperglycemia can lead to increased surgical site infection,[30,31] and postoperative mortality.[32,33]

At-risk patients should be assessed for hyperglycemia prior to surgery. Known diabetics should have a hemoglobin A_{1C} test, and have their fasting serum glucose level checked. Optimization of glucose control prior to the operation should be undertaken if possible. For nondiabetic patients especially those who are at risk for hyperglycemia (e.g., the obese and the elderly patients), consideration should be given to checking a preoperative and intraoperative fasting glucose level. If the level is elevated, measures to tightly control serum glucose (e.g., insulin infusion) should be initiated. The evidence for aggressive perioperative glucose control that is based mainly on the cardiac and critical care experience should be readily extrapolated to lend support to the concept of maintaining normoglycemia in the colorectal surgical patient.

NUTRITIONAL ASSESSMENT

Malnutrition, or more specifically undernutrition, has been associated with increased risk of morbidity, mortality, and anastomotic leakage in the surgical patient.[34,35] The Joint Commission for Accreditation of Health Care Organizations has recommended nutritional screening within 24 hours of hospital admission. Although this is reasonable, an earlier assessment would better allow for corrective measures prior to operation.[36]

There are many ways to assess nutritional status. These include a Subjective Global Assessment (SGA) of nutrition,[37] measurement of serum protein levels (albumin, prealbumin, and transferrin), and calculation of weight loss. The SGA is based on a history of weight change, dietary intake change, gastrointestinal symptoms >2 weeks, and change in functional capacity combined with physical changes such as loss of subcutaneous fat, muscle wasting, edema, and ascites. These changes can be put into a formula and quantified to give a rating of well-nourished, moderately malnourished, or severely malnourished. Anergy testing and anthropomorphic skin-fold thickness testing are also occasionally used in clinical practice. Another assessment tool, the Prognostic Nutritional Index (PNI) designed by Buzby and colleagues is based on serum albumin, serum transferrin, skin-fold thickness, and delayed type hypersensitivity.[38] An increasing PNI risk value has been shown to be associated with increased incidence of death, and complications including sepsis in gastrointestinal surgery patients.

Preoperative nutrition supplementation should be considered in malnourished patients if the operation can be delayed. Parenteral nutrition can be used in the patient whose alimentary tract is inflamed, obstructed, or otherwise nonfunctional. Parenteral nutrition can reduce the complication rates in malnourished patients, but does not affect mortality. In the patient with a well-functioning gastrointestinal tract, enteral feeding, which has also been shown to improve outcomes in the malnourished individual, is preferred over total parenteral nutrition.

SURGICAL SITE INFECTION RISK ASSESSMENT

Surgical site infection (SSI) leads to 38% of all nosocomial infections in surgical patients.[39] The risk of wound infections is likely higher in colorectal patients when compared with other surgery patients.[40] These infections not only cause individual hardship, they lead to a significant economic strain on the health care system. Many of these infections can be prevented.

Several programs have been created to measure and reduce surgical site infections. The Surgical Infection Prevention Project (SIP), established by the Centers for Disease Control (CDC) and the Centers for Medicare and Medicaid Services (CMS), is designed to promote the use of appropriate preoperative antibiotics given within 60 minutes of incision and discontinued within 24 hours of the completion of the operation. The CMS developed another program, the Surgical Care

Improvement Project (SCIP), which added other measures to the SIP parameters. These include glucose control for cardiac surgery patients, appropriate hair removal, normothermia (> 36 C) in colorectal surgical patients, venous thromboembolism prevention, and use of β blockers. The use of β blockers remains a SCIP measure, but this category has been deemphasized. Through the implementation of SCIP measures and the placing of Penrose drains in the subcutaneous space of patients with body mass indices (BMI) > 25 kg/m^2 after colorectal operations, Hedrick and colleagues were able to reduce SSI rates from 25.6 to 15.9%.[41] Clearly, a multifactorial approach should be used to effectively reduce wound infections.

Predicting which patients may be at risk for surgical site infections might allow for implementation of maneuvers designed to reduce infection rates. Using National Surgical Quality Improvement Project (NSQIP) data, Neumayer and colleagues identified several independent variables that put patients at risk for surgical site infections.[42] Based on these variables, a Surgical Site Infection Risk Index was designed (Table 8). By preoperatively analyzing patient data using the index, one can establish an overall score. If the score is greater than 8, the risk of SSI is deemed to be high (7.51%). In this situation superficial SSI could be prevented by delayed primary closure, placing incisional drains or wicks, or allowing healing by secondary intention. With the available assessment tools, the surgeon should be able to stratify risk preoperatively, and significantly reduce the incidence of surgical site infection.

Table 8 Surgical Site Infection Risk Index

Variable	Points
Type of operation	
Stomach, intestines	2
Aneurysm, blood vessel repair	1
Thoracoabdominal aneurysm	1
Integumentary and musculoskeletal	2
Respiratory system	1
Mouth, palate	0
Hernia, endocrine	1
Condition	
Work RVU > 17	4
Work RVU 10–17	2
Contaminated or infected wound	2
ASA class 2–5	2
Emergency surgery	2
Clean/contaminated wound	1
Diabetes	1
Smoker	1
Dyspnea	1
Steroid use	1
Serum albumin ≤ 3.5 g/dL	1
Age ≥ 40	1
Bilirubin > 1.0 mg/dL	1
Radiotherapy for malignancy in last 90 days	1
> 2 alcoholic drinks/day	1

Adapted from Neumayer et al.[42]
RVU, relative value unit; ASA, American Society of Anesthesiologists.

ASSESSMENT FOR VENOUS THROMBOEMBOLISM RISK

Patients undergoing major operations are at risk for venous thromboembolic events. Venous thromboembolism (VTE) occurs at a higher rate in patients having colon and rectal surgery when compared with general surgery patients.[43] VTE can lead to significant morbidity in the form of leg thrombophlebitis, postphlebitic syndrome, and complications associated with long-term anticoagulation. Furthermore, pulmonary embolus is the most common cause of preventable deaths in hospital patients.[44] The risk of venous thromboembolism should be assessed preoperatively using the Seventh ACCP Conference on Antithrombotic and Thrombolytic Therapy guidelines.[44] VTE factors that place patients in the moderate to high-risk categories are listed in Table 9.

Based on the American Society of Colon and Rectal Surgeons Practice Parameters for DVT (deep venous thrombosis) Prophylaxis, "Patients in the moderate-risk to high-risk categories for VTE undergoing abdominal surgery should receive prophylaxis with

Table 9 Risk Factors for Venous Thromboembolism (VTE)

Surgery
Trauma (major or lower extremity)
Immobility, paresis
Malignancy
Cancer therapy (hormonal, chemotherapy, or radiotherapy)
Previous VTE
Increasing age
Pregnancy and the postpartum period
Estrogen-containing oral contraception or hormone replacement therapy
Selective estrogen receptor modulators
Acute medical illness
Heart or respiratory failure
Inflammatory bowel disease
Nephrotic syndrome
Myeloproliferative disorders
Paroxysmal nocturnal hemoglobinuria
Obesity
Smoking
Varicose veins
Central venous catheterization
Inherited or acquired thrombophilia

From Geerts et al,[44] with permission.

unfractionated or low-molecular-weight heparin. Patients at risk for bleeding may receive mechanical prophylaxis instead."[45] The majority of patients undergoing colorectal abdominal operations are in the moderate-risk or high-risk categories. For patients with no additional risk factors having minor anorectal operations, DVT prophylaxis is not recommended.

ASSESSMENT FOR POTENTIAL TRANSFUSION

Patients undergoing major colorectal operations are at risk for bleeding and may require blood product transfusion. Many of these patients, especially those with malignancy or colitis, will be anemic preoperatively. It is reasonable to submit a sample to hold for blood type for all patients having major surgery. Cross matching of red blood cells should be performed in those patients who have preoperative anemia or who are expected to have significant blood loss. Patients with age >65 years, body mass index >27 kg/m2, and ASA score >2 have been shown to have increased risk of needing a transfusion.[46]

If there is a high risk of requiring a postoperative transfusion, the patient should be counseled about the options. Preoperative autologous donation is appealing, but may not be practical in the patient who has preexisting anemia or who must have surgery urgently. Similar limitations occur with the administration of the hormone, erythropoietin. The use of intraoperative cell salvage is limited at this time in colorectal cases, most of which are in the clean/contaminated category. Acute normovolemic hemodilution is another way to reduce the need for allogenic transfusion, but it is also rarely used in colorectal operations. The majority of patients who require transfusions, will receive allogenic blood. The risks of transfusion, including the adverse oncologic effects should be discussed thoroughly, and the decision to transfuse should be weighed very carefully.

SUMMARY

Risk evaluation and stratification should be done for every colorectal surgical patient. A diligent evaluation using the presented guidelines will allow optimization of care throughout the perioperative period. The ultimate goal of achieving improved outcomes should encourage the consistent assessment of all potential risk factors for each patient.

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