CHAPTER 5

PREOPERATIVE MEDICAL ASSESSMENT

Lopa Dalmia, DPM

INTRODUCTION

In the United States, more than 33 million surgeries are performed annually and each year approximately 1 million patients sustain medical complications after surgery. Complications include myocardial infraction, heart failure, stroke, pneumonia, respiratory failure, venous thromboembolism, delirium, or renal failure.[1] Preoperative medical assessment is an important component of surgical planning. The podiatric surgeon, hospitalist, and anesthesiologist are key players in determining intra-operative risks and risk of postoperative complications for each patient prior to surgery. A thorough preoperative medical assessment can decrease the length of a hospital stay as well as minimize postponed or cancelled surgeries.[2]

Preoperative medical assessment involves a history and physical examination, focusing on risk factors for cardiac, pulmonary and infectious complications, and a determination of a patient's functional capacity. Specific components of the preoperative evaluation will be outlined, guidelines will be offered for preoperative risk assessment for medical comorbidities involving cardiac complications, pulmonary complications, diabetes mellitus, and nutrition.

PHYSIOLOGIC EFFECT OF SURGERY

The initial hours following surgical or traumatic injury are metabolically associated with a reduced total body energy expenditure and urinary nitrogen wasting. Upon adequate resuscitation and stabilization of the injured patient, a reprioritization of substrate utilization ensues to preserve vital organ function and for the repair of injured tissue. This phase of recovery also is characterized by functions that all participate in the restoration of homeostasis, such as augmented metabolic rates and oxygen consumption, enzymatic preference for readily oxidizable substrates such as glucose, and stimulation of the immune system.

Epinephrine, norepinephrine, and cortisol levels increase during surgery and remain elevated for 1–3 days.[3] Serum antidiuretic hormone levels may be elevated for up to 1 week postoperatively. There is evidence that anesthesia and surgery may be associated with a relative hypercoagulable and inflammatory state mediated by increases in plasminogen activator-1, factor VIII, and platelet reactivity, and increased levels of tumor necrosis factor, interleukins 1 and 6, and C-reactive protein.[3]

Anesthetic agents usually cause peripheral vasodilatation, and most of the commonly used general anesthetic regimens also decrease myocardial contractility. These effects often result in transient mild hypotension or, less frequently, prolonged or more severe hypotension. A decrease in tidal volume caused by general and spinal-epidural anesthesia can close small airways and lead to atelectasis. These effects may be less evident with spinal or epidural anesthesia compared with general anesthesia. The degree to which these hypercoagulable or inflammatory states contribute to perioperative morbidity is not known.

Perioperative morbidity and mortality generally fall into one of three categories: cardiac, respiratory and infectious complications.[4] One large study documented at least one complication in 17 percent of surgical patients (Table 1).[4]

Table 1

SURGICAL COMPLICATIONS[2]

Complication	Incidence %
Infection	14.3
Wound	5.1
Pneumonia	3.6
Urinary tract	3.5
Systemic sepsis	2.1
Respiratory	9.5
Pneumonia	3.6
Failure to wean from respirator in 48 hours	3.2
Unplanned intubation	2.4
Pulmonary embolus	0.3
Cardiac	4.5
Pulmonary edema	2.3
Cardiac arrest	1.5
Myocardial infarction	0.7

PREOPERATIVE HISTORY AND PHYSICAL EXAMINATION

Preoperative assessment is typically performed days before surgery. It entails a thorough review of the patient's history, drug history, surgical and anesthetic history, alcohol and tobacco use, allergies to drugs and latex, bleeding history, functional class, and physical examination.

History

The history includes information about the condition for which the surgery is planned, any past surgical procedures, the patient's experience with anesthesia, and chronic medical conditions, particularly of the heart and lungs. In children, the history includes birth history, focusing on risk factors such as prematurity at birth, perinatal complications, and congenital chromosomal or anatomic malformations, and history of recent infections, particularly upper respiratory infections or pneumonia.

Medications

Medications with dosages, including over-the-counter medications and herbal medicines are noted. Drug dosages may need to be adjusted in the perioperative period. See Table 2 for preoperative recommendations of cardiovascular, pulmonary, diabetes, and other medications. Immunization status can be documented, and vaccines can be updated if necessary.

Allergies

Latex allergy is uncommon and occurs in 5-10% of the population.[1] Patients with a history of chronic urologic problems, spina bifida, and atopic dermatitis are considered high risk for latex allergy. Allergy to antibiotics, pain medications, metal and adhesive tapes are common.

Social History

Smoking history and alcohol and drug use are important to reduce perioperative pulmonary complications.[5] Moller et al recorded smoking and drinking habits, and history of chronic diseases of 811 patients who had undergone hip or knee arthroplasty. They found that smoking was the single most important risk factor for the development of postoperative complications, particularly those relating to wound healing, cardiopulmonary complications, and the requirement of postoperative intensive care. A delay in discharge from the hospital was usual for those experiencing a complication. In those patients requiring prolonged hospitalization (>15 days) the proportion of smokers with wound complications was twice that of non-smokers.[5]

Smoking has known detrimental effects on healing bone and tissue. It has been associated with intervertebral disc disease and low back pain. Further, nicotine causes delay in tendon-to-bone healing in animal models.[6] The patient should quit smoking 8 or more weeks before surgery to minimize the surgical risk associated with smoking.[2]

Functional Capacity and Exercise Tolerance

The Duke Activity Status Index (DASI) is a brief self-administered questionnaires developed in 1989 to determine the degree of physiologic stress the patient can handle.[8] The index includes common physical activities ranging from running to being bedbound and places into 1 to 4 functional classes based on the single most difficult activity that the patient can perform. A metabolic equivalent of activity (MET) is listed for each functional classification. One MET is equal to 3.5 mL of oxygen used per kilogram per minute of activity. If a patient can run and swim, then he has MET of >8 and is considered in functional class I of DASI. If the patient can climb stairs, do yard work and walk uphill then he has MET of 4-5 and is considered in functional class II of DASI.[7] If the patient can do light house work and walk, then he has MET of <4 and is considered in functional class III of DASI, and if the patient is bedbound or has limited activities of daily living then the patient is classified in Class IV of DASI. The risk of perioperative cardiovascular complications is low for patients reporting that they can tolerate more than 4 MET.[9]

The ACC/AHA Task force defines functional capacity as poor- or moderate-based patient activity level and metabolic equivalents. Patients who are able to perform light house work and walk 1-2 blocks on level ground exhibit poor functional capacity with METs of 1-4. Patients who are able to climb stairs and hills, run short distances, bowl, dance, golf, and swim have moderate functional capacity with METS >4.[10]

The validity of self reported exercise tolerance in predicting perioperative risk has been controversial. However, Reilly et al performed a study of 600

Table 2

RECOMMENDATIONS BASED ON HISTORY AND PHYSICAL EXAMINATIONS[1]

DRUG/DRUG CATEGORY	RECOMMENDATIONS
Acetaminophen	CONTINUE use
Aspirin	HOLD 7-10 days prior to surgery - due to irreversible inhibitor activity of platelet cyclo-oxygenase
NSAID	HOLD 3 days prior to surgery - due to reversible inhibitor activity of platelet cyclo-oxygenase
Clopidogrel	HOLD 7-10 days prior to surgery -due to its irreversible antiplatelet effect
Cardiovascular Drugs	
Digioxin Clonidine Beta-blockers Ca channel blockers	CONTINUE up to and including day of surgery
Diuretics ACE inhibitors Angiotensin II receptor blocker	HOLD on the morning of surgery -especially if indication is CHF because there is an increased risk of hypotension during surgery
Cholesterol lowering drugs	HOLD 1 day prior to surgery
Pulmonary Drugs	
Inhaled beta-agoinist Inhaled ipratropium Inhaled corticosteroid	CONTINUE up to and including day of surgery
Diabetes Drugs	
Insulin	Give long-acting insulin at ½ the normal dose, hold short-acting morning of surgery
Metformin	HOLD 2 days prior to surgery -due to risk of lactic acidosis if patient has renal problems preoperatively
Sulfonylureas Thiazolidinediones Alpha-glucosidase inibitors	HOLD on the morning of surgery
Vitamins	
Vitamin E supplements	HOLD 7-10 days prior to surgery - due to a risk of bleeding

patient undergoing 612 non-cardiac procedures to show that patients reporting poor exercise tolerance had more perioperative cardiopulmonary complications than the patients with good exercise tolerance who may better tolerate the physical rigors of surgery and mobilize more rapidly post-operatively.[9]

Laboratory Testing

Preoperative laboratory testing should be selective and not routine. Current recommendations are for laboratory tests based on the specific signs, symptoms and diagnosis.[11] Normal lab test results obtained 4 to 6 months before surgery may be used as preoperative tests, provided there are no changes in the clinical status of the patient. MacPherson et al

found that <2% of test results conducted 4 months before surgery had changed at the time of clinical evaluation. Preoperative laboratory studies include a complete blood count, extensive blood chemistry profile, coagulation profile, urinalysis, electrocardiogram (ECG), and chest radiographs.

A urine pregnancy test should be considered for women of childbearing age. Chemistry profile should be performed in patients with a history of hypertension, diuretic use, COPD or obstructive sleep apnea, diabetes, renal disease, chemotherapy. Complete blood count should be performed in patients with a history of fatigue, dyspnea on exertion, liver disease, blood loss, signs of coagulopathy, or tachycardia. Coagulation profile is indicated if the patient is receiving anticoagulant therapy, has a family or personal history that suggests a bleeding disorder or has evidence of liver disease.[11] Renal and liver function tests are indicated for patients who have a medical condition or medication use that would serve as indications for these tests. An ECG is not routinely indicated in patients 40 years or younger, but it should be obtained in patients older than 40 years or in patients with cardiac indications based on the past medical history.[11]

Chest radiographs should be obtained if there are signs of pulmonary disease.

PREOPERATIVE ANESTHESIA ASSESSMENT

Modern anesthesia is extremely safe. Mortality among healthy patients undergoing surgery is low; estimates range from 0.01 to 0.03%.[3] Patient and procedure related factors are more important contributors to perioperative morbidity than anesthesia itself. Inhalational anesthetic agents have predictable physiologic effects. All inhalational anesthetic agents are myocardial depressants. Although not clinically significant in healthy patients, this effect leads to a dependence on cardiac preload that may cause an accentuated response to the induction of anesthesia in patients who are volume-depleted due to illness or over diuresis or who have left ventricular dysfunction. Anesthesia leads to a decrease in lung volumes, which may lead to atelectasis and is a principal factor leading to the development of postoperative pulmonary complications.

Controversy exists regarding the relative safety of general versus spinal or epidural anesthesia in patients at risk for postoperative cardiac or pulmonary complications. In a recent large meta-analysis of randomized controlled trials of anesthetic technique, patients who were randomized to spinal or epidural anesthesia as a component of their anesthesia had significantly lower rates of venous thromboembolism, pneumonia, respiratory depression, myocardial infarction, or death than patients receiving general anesthesia exclusively; relative risk reductions ranged from 30 to 55%. In general, the choice of anesthetic technique or agent, the decision to use invasive hemodynamic monitoring, and the regulation of body temperature should be left to the anesthesiologist.

The American Society of Anesthesiologists (ASA) has adopted basic standards for the evaluation of patients prior to surgery. These standards require the anesthesiologist to determine the medical status of the patient by developing a plan of anesthetic care and to discuss this plan with the patient. Table 3 discusses the American Society of Anesthesiology ASA classification along with examples of each class. Although subjective, a score of 2-5 indicates an increased level of severity and increased postoperative morbidity.[12]

PREOPERATIVE CADIOVASCULAR ASSESSMENT

Cardiovascular disease is the leading cause of death in United States, with more than 60% of cardiovascular-related deaths due to coronary artery disease.[13] Orthopedic or podiatric surgery is often considered to pose an intermediate to low risk for cardiac complications owing to short anesthesia and operating time.[10] However, many podiatric patients have multiple coronary risk factors, including smoking, diabetes, hypertension, elevated cholesterol, and obesity.[14] Risk of postoperative cardiac death or major cardiac complications is less than 6% in patients older than 40 years undergoing major non-cardiac operations. However, the risk is not uniform, and is increased by old age and pre-existing heart disease. The most important element of cardiac risk evaluation is based on cardiovascular history, physical examination and electrocardiography.

Several multivariate indices of risk have been developed for patients with known or suspected cardiac disease. All seem to be similar in their

Table 3

PREOPERATIVE ANESTHESIA ASSESSMENT: American Society of Anesthesiology (ASA) classification[12]

Class I	A normal, healthy patient Ex: healthy with good exercise tolerance
Class II	A patient with mild systemic disease Ex: Controlled hypertension or controlled diabetes without systemic effects, cigarette smoking without COPD, anemia, mild obesity, age younger than 1 year or older than 70 years, pregnancy
Class III	A patient with severe systemic disease Ex: controlled congestive heart failure (CHF), stable angina, old myocardial infarction, poorly controlled hypertension, morbid obesity, bronchospastic disease with intermittent symptoms, chronic renal failure.
Class IV	A patient with severe systemic disease that is a constant threat to life. Ex: unstable angina, symptomatic COPD, symptomatic CHF, hepatorenal failure
Class V	A patient with a critical medical condition with little chance of survival with or without the surgical procedure. Ex: multiorgan failure, sepsis syndrome with hemodynamic instability, hypothermia, poorly controlled coagulopathy
Class VI	A declared brain dead patient who is undergoing anesthesia care for the purposes of organ donation
E	If the procedure is an emergency, the physical status is followed by "E" (for example, "2E")

Table 4

AMERICAN COLLEGE OF PHYSICIANS (ACP) GUIDELINES

	Risk
Age older than 70 years	5
Myocardial infarction within six months	10
Myocardial infarction after six months	5
Canadian Cardiovascular Society Angina Classification*	
Class III	10
Class IV	20
Unstable angina within six months	10
Alveolar pulmonary edema	
Within one week	10
Ever	5
Suspected critical aortic stenosis	20
Arrhythmia	
Rhythm other than sinus or sinus plus atrial premature beats	5
More than five premature ventricular beats	5
Emergency operation	10
Poor general medical status	5

Class	Points	Cardiac risk
I	0 to 15	Low
II	20 to 30	
III	31 +	High

ability to predict cardiac problems during the operation. The American College of Physicians (ACP) Guideline is purely-evidence based. The ACP guideline includes Detsky's modified cardiac risk and a list of low variables. In 1986, Detsky proposed a modified Goldman's cardiac risk assessment by calculating the overall complication rate stratified by type of surgical procedure (Table 4). Goldman's cardiac risk index in 1977 was one of the first attempts to systematically evaluate a patient's risk of cardiac complications with surgery. This index compiled the risk factors into a point scale that correlated with a patient's risk for perioperative cardiac morbidity and mortality.[15] Patients at high risk for complications usually warrant cardiology consultation and possibly angiography. Cardiac stress testing should be performed in patients at intermediate risk and with poor functional capacity or who are undergoing high-risk procedures, such as vascular surgery. For patients with minor clinical predictors, only patients who have poor functional capacity and are undergoing a high-risk procedure requires stress testing. Patients with positive stress test results warrant cardiology consultation before proceeding with surgery.

The American College of Cardiology and the American Heart Association (ACC/AHA) guidelines uses the best evidence available. It was developed in 1996 based on 3 main considerations in assessing cardiac risk: the patient's clinical predictors, the patient's functional capacity, and the individual risks of specific types of surgery. Figure 1 outlines the step wise approach. The clinical predictors are classified as major, intermediate or low (Table 5). Patient's functional capacity is based on exercise capacity as discussed earlier. Most non-cardiac surgeries, including orthopedic and podiatric surgeries have intermediate or minor risk predictors. Non invasive testing is indicated in the presence of 2 of the 3 negative factors: intermediate or major clinical predictors, high risk surgery and poor exercise capacity.

The Revised Cardiac Risk Index described by Lee in 1999 and customized by Kertai in 2005 is based on 6 independent predictors of major cardiac complications. The six predictors are: high-risk surgery, preoperative treatment with insulin, preoperative serum creatinine level greater than 2mg/dL, history of ischemia heart disease, history of congestive heart failure, and history of cerebrovascular disease.

If the patient has no clinical predictors mentioned above, the associated risk of cardiac complication is 0.4-0.5%. The presence of 1 clinical predictor increases the risk of cardiac complication to 0.9-1.3%. If the patient has 2 clinical predictors mentioned above, the associated risk of cardiac complication is 4-7% and 3 or more clinical predictors increases the risk of cardiac complications to 9-11%. This system stratifies the risk of cardiac events, however does not make any specific recommendations as to what to do with the information

In summary, recommendations do not call for preoperative cardiac testing in all patients. The need for further cardiac evaluation before surgery is determined by the clinical risk predictors identified from the patient's history, physical examination, ECG and functional status, along with the risk associated with the operation itself. Cardiac interventions are recommended only for patients who would benefit regardless of any planned non-cardiac surgery.[10]

It should also be emphasized that almost half of perioperative cardiac complications are due to postoperative ischemia or congestive heart failure.[13] The incidence of postoperative complications is the highest in the first 48 hours after surgery, and ischemia is clinically silent in up to 90 percent of cases.[13] While preoperative risk assessment and interventions are important, attention to possible complications in the postoperative period is also crucial.

Table 5

ACC/AHA CLINICAL PREDICTORS OF INCREASED PERIOPERATIVE CARDIOVASCULAR RISK (MYOCARDIAL INFARCTION, HEART FAILURE, DEATH)

Major
- Unstable coronary syndromes
- Decompensated heart failure
- Significant arrhythmias
- Severe valvular disease

Intermediate
- Mild angina pectoris
- Previous MI by history or pathologic Q waves
- Compensated or prior heart failure
- Diabetes mellitus (particularly insulin-dependent)
- Renal insufficiency

Minor
- Advanced age
- Abnormal ECG
- Rhythm other than sinus
- Low functional capacity
- History of stroke
- Uncontrolled systemic hypertension

PREOPERATIVE PULMONARY ASSESSMENT

Estimation of cardiac risk is a major focus of the preoperative evaluation; postoperative pulmonary complications are as prevalent as cardiac complications and contribute equally to morbidity, mortality, and length of hospital stay. Therefore, estimation of the risk of pulmonary complications is a necessary part of the preoperative evaluation. Important postoperative pulmonary complications include

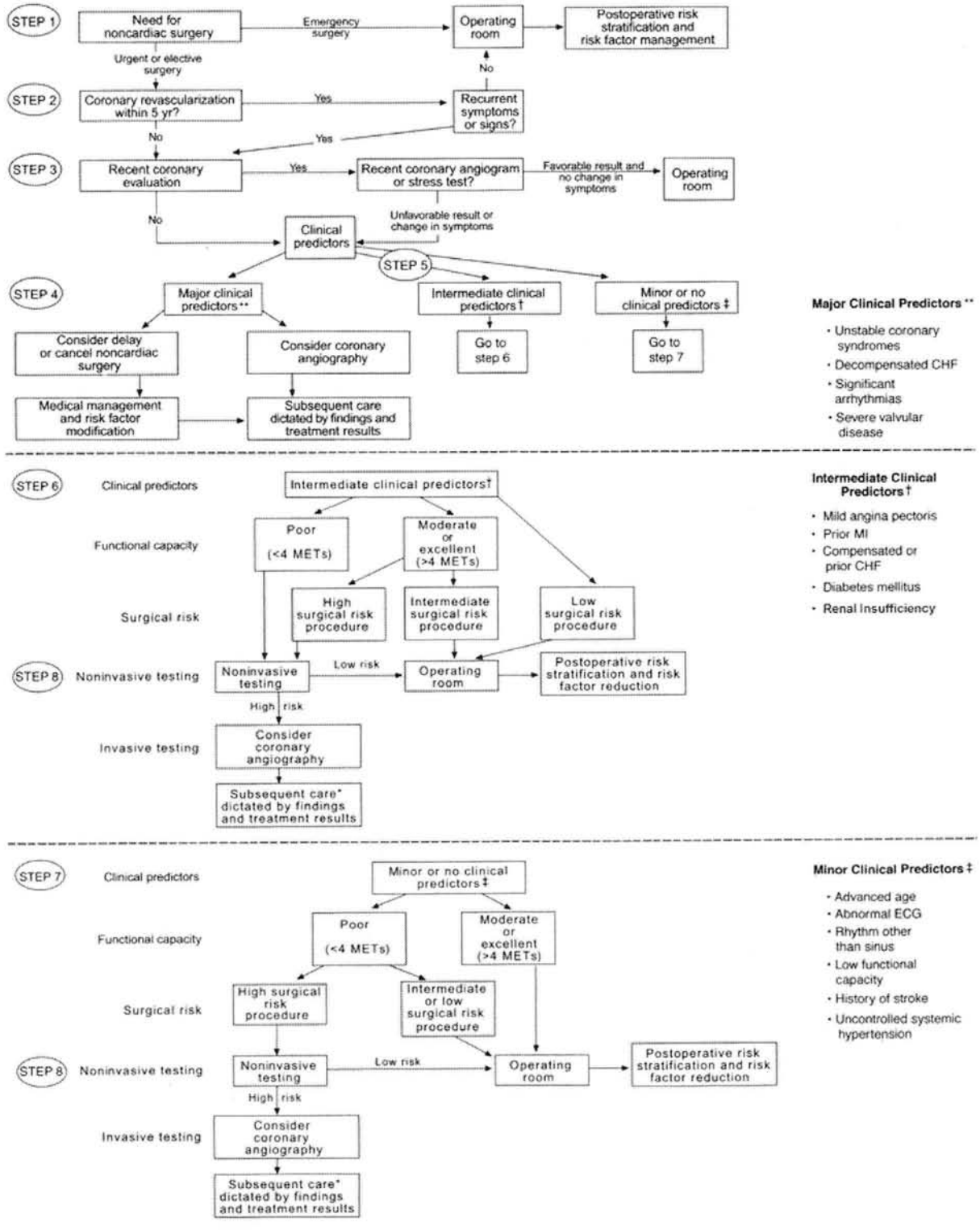

Figure 1: ACC/AHA Algorithm

Figure 1.

pneumonia, respiratory failure with prolonged mechanical ventilation, atelectasis, bronchospasm, and exacerbation of underlying chronic obstructive pulmonary disease.[16] A careful history taking and physical examination are the most important parts of preoperative pulmonary risk assessment (Table 6). A history of exercise intolerance, chronic cough, or unexplained dyspnea should be obtained. The physical examination may identify findings suggestive of unrecognized pulmonary disease. Among such findings, decreased breath sounds, dullness to percussion, wheezes, rhonchi, and a prolonged expiratory phase predict an increase in the risk of pulmonary complications.[17]

Since the publication of the first cardiac risk index in 1977, clinicians have been aware of the importance of, and the risk factors for, cardiac complications.[15] Clinicians who care for patients in the perioperative period may be surprised to learn that postoperative pulmonary complications are equally prevalent and contribute similarly to morbidity, mortality, and length of stay. For example, in a large retrospective cohort study of 8,930 patients undergoing hip fracture repair, 1,737 (19%) patients had postoperative medical complications. Serious pulmonary complications occurred in 229 (2.6%) patients and serious cardiac complications occurred in 178 (2.0%) patients.

Any pulmonary infection should be treated preoperatively. Pulmonary complications may be prevented by providing patients with instructions on how to perform incentive spirometry and deep-breathing exercises. Deep-breathing exercises and incentive spirometry in the postoperative period may be particularly beneficial in obese patients, in patients with lung disease and in patients undergoing abdominal or thoracic procedures.

PREOPERATIVE DIABETES ASSESSMENT

The most important perioperative risk attributable to diabetes mellitus is that of cardiac complications. The principal goal of the preparation of patients with diabetes before surgery is a careful assessment of cardiac risk, as discussed above. Diabetes also increases the risk of surgical wound infections. For the subset of patients with diabetic neuropathy, there is additional risk for aspiration of gastric contents during anesthesia if gastroparesis is present, and for blood pressure liability during surgery if autonomic neuropathy exists.[5]

Table 6

PULMONARY RISK ASSESSMENT (MODIFIED FROM THE AMERICAN SOCIETY OF ANESTHESIOLOGISTS, LAST AMENDED OCTOBER 1984.[12]

Patient-related risk factors	Procedure-related risk factor
Chronic obstructive pulmonary disease	Surgical site: - Thoracic surgery - Abdominal aortic aneurysm surgery - Upper abdominal surgery - Neurosurgery - Peripheral vascular surgery
Cigarette use <8 weeks before surgery	General anesthesia
ASA class >2	Pancuronium use
Goldman class 2–4a	Emergency surgery
Age >60	Surgery lasting >3 hours
Dependent functional status	
Albumin <3.0 g/dL	
Blood urea nitrogen >30 mg/dL	
Abnormal chest radiograph	

Strategies to control blood sugar in the perioperative period must balance the risk of hyperglycemia due to the stress of surgery and anesthesia and the need for patients to fast before surgery that may increase the risk of hypoglycemia. One achieves this balance through frequent monitoring and the use of short-acting insulin as needed to achieve blood sugar goals. Optimal perioperative blood sugars are between 120 and 200 mg/dL.[3] Patients who are diet-controlled may proceed to surgery without additional treatment of blood sugar other than careful perioperative monitoring of blood sugar by fingerstick. Those who receive oral hypoglycemic agents should hold their medication on the morning of surgery. Intravenous fluids for oral agent- and insulin-treated patients should include glucose to decrease the risk for lipolysis and ketone production.

PREOPERATIVE NUTRITION ASSESSMENT

Malnourished patients experience increased surgical morbidity and mortality. A preoperative history and physical examination includes an assessment of risk factors for malnutrition, especially in the elderly. Social isolation, limited financial resources, poor dentition, weight loss, and chronic disorders such as pulmonary disease, congestive heart failure, depression, diarrhea, and constipation are commonly associated with malnutrition.[2] In addition, patients often cannot eat for varying periods before and after surgery, further compromising nutritional status.

The most optimal means of defining a patient's nutritional status has not been established. However, if there are nutritional concerns, additional factors can be considered. A weight loss of more than 5% in one month or of 10% or more over six months, a serum albumin of less than 3.2 g per dL (32 g per L), and a total lymphocyte count of less than 3,000 per µL3 (3.0 3 109 per L) can signify an increased risk of postoperative complications.[3]

Effective assessment of the medical status of patient undergoing surgery, the physician should understand the risk associated with the particular type of surgery planned and relate this risk to the patient's underlying acute and chronic medical problems. A detailed understanding of how the presence of and severity of medical illness correlates with an increased risk for perioperative complications will better serve our patients undergoing elective podiatric surgery.

REFERENCES

1. Perioperative Medicine Summit. Using evidence to improve quality, safety and patient outcomes. *Clev Clin J Med* 2006;73 Suppl 1:1-120.
2. Kloehn GC, O'Rourke RA. Perioperative risk stratification in patients undergoing noncardiac surgery. *J Int Care Med* 1999;14:95-108.
3. Harrison's Internal Medicine. Introduction to Clinical Medicine:. Medical Evaluation Of The Surgical Patient.
4. Khuri SF, Daley J, Henderson W, Barbour G, Lowry P, Irvin G, et al. The National Veterans Administration Surgical Risk Study: risk adjustment for the comparative assessment of the quality of surgical care. *J Am Coll Surg* 1995;180:519-31.
5. Moller, AM, Pedersen T, Villebro N. Effect of smoking on early complications after elective orthopaedic surgery. *J Bone Joint Surg Br* 2003;85:178-81.
6. Galatz, LM, Silva, MJ, Rothermich SY, Zaegel MA, Havlioglu N, Thomopoulos S. Nicotine delays tendon-to-bone healing in a rat shoulder model. *J Bone Joint Surg Am* 2006;88:2027-34.
7. Vanzetto G, Machecourt J, Blendea D, Fagret D, Borrel E, Magne JL, et al. Additive value of thallium single-photon emission computed tomography myocardial imaging for prediction of perioperative events in clinically selected high cardiac risk patients having abdominal aortic surgery. *Am J Cardiol* 1996;77:143-8.
8. Nelson CL, Herndon JE, Mark DB, et al. Relation of clinical and angiographic factors to functional capacity as measured by the Duke Activity Status Index. *Am J Cardiol* 1991;68:973–5.
9. Reilly DF, McNeely MJ, Doerner D, et al. Self-reported exercise tolerance and the risk of serious perioperative complications. *Arch Intern Med* 1999;159:2185–92
10. Eagle KA, Coley CM, Newell JB, Brewster DC, Darling RC, Strauss HW, et al. Combining clinical and thallium data optimizes preoperative assessment of cardiac risk before major vascular surgery. *Ann Intern Med* 1989;110:859-66.
11. Marcello PW, Roberts PL. Routine" preoperative studies: which studies in which patients. *Surg Clin North Am* 1996;76:11-23.
12. American Society of Anesthesiologists approved by the House of Delegates on October 14, 1987.
13. Mangano DT. Perioperative cardiac morbidity. *Anesthesiology* 1990;72:153-84.
14. Crausman RS, Glod DJ. Perioperative medical assessment of the podiatric surgical patient. *J Am Podiatr Med Assoc* 2004;94:86-9.
15. Goldman L, Caldera DL, Nussbaum SR, et al. Multifactorial index of cardiac risk in noncardiac surgical procedures. *N Engl J Med* 1977;297:845-50.
16. Smetana GW, Lawrence VA, Cornell, JE. Preoperative Pulmonary Risk Stratification for Noncardiothoracic Surgery: systematic review for the American College of Physicians. *Ann Intern Med* 2006;144:581-95
17. Smetana GW. Preoperative pulmonary evaluation *New Engl J Med* 1999;340:937-44.
18. Macpherson DS, Snow R, Lofgren RP. Preoperative screening: value of previous tests. *Ann Intern Med* 1990;113:969-973.
19. Detsky AS, Abrams HB, McLaughlin JR, et al. Predicting cardiac complications in patients undergoing non-cardiac surgery. *J Gen Intern Med* 1986;1:211-9.