03 - 492 Medical Evaluation of the Patient Undergoing Noncardiac Surgery

492 Medical Evaluation of the Patient Undergoing Noncardiac Surgery

Parikh NI et al: Adverse pregnancy outcomes and cardiovascular dis ease risk: Unique opportunities for cardiovascular disease prevention in women: A scientific statement from the American Heart Associa tion. Circulation 143:e902, 2021. Regitz-Zagrosek V et al: 2018 ESC guidelines for the management of cardiovascular diseases during pregnancy. Eur Heart J 39:3165, 2018. Tita AT et al: Treatment for mild chronic hypertension during preg nancy. N Engl J Med 386:1781, 2022. Verlohren S et al: Clinical interpretation and implementation of the sFlt-1/PlGF ratio in prediction, diagnosis and management of pre eclampsia. Pregnancy Hypertens 27:42, 2022. Prashant Vaishnava, David I. Sahar, Kim A. Eagle

Medical Evaluation of

the Patient Undergoing Noncardiac Surgery Cardiovascular and pulmonary complications continue to account for major morbidity and mortality in patients undergoing noncardiac surgery. Emerging evidence-based practices dictate that the internist should perform an individualized evaluation of the surgical patient to provide an accurate preoperative risk assessment and stratification that will guide optimal perioperative risk-reduction strategies. This chapter reviews cardiovascular and pulmonary preoperative risk assessment, emphasizing the goal-directed management of patients at elevated risk for adverse cardiovascular outcomes in the perioperative period. In addition, perioperative management of diabetes mellitus and prophy laxis of endocarditis and for venous thromboembolism are reviewed. EVALUATION OF INTERMEDIATE- AND HIGH-RISK PATIENTS Simple, standardized preoperative screening questionnaires, such as the one shown in Table 492-1, have been developed for the purpose of identifying patients at intermediate or high risk who may benefit from a more detailed clinical evaluation. Evaluation of such patients for sur gery should always

begin with a thorough history and physical exami nation and with a 12-lead resting electrocardiogram, in accordance with the American College of Cardiology/American Heart Association guidelines. The history should focus on symptoms of occult cardiac or pulmonary disease. The urgency of the surgery should be determined, as true emergency procedures are associated with unavoidably higher morbidity and mortality risk. Preoperative laboratory testing should be carried out only for specific clinical conditions, as noted during clini cal examination. Thus, healthy patients of any age who are undergoing elective surgical procedures without coexisting medical conditions should not require any testing unless the degree of surgical stress may result in unusual changes from the baseline state. PREOPERATIVE CARDIAC RISK ASSESSMENT A stepwise approach to cardiac risk assessment and stratification in patients undergoing noncardiac surgery is illustrated in Fig. 492-1. The evaluation begins with characterization of the combined surgical and clinical risk into categories of low (<1%) and elevated risk for major adverse cardiovascular events (MACEs). Select surgeries are associated with very low risk for MACE; these surgeries and procedures include select ophthalmologic surgeries (e.g., cataract surgery), select endo scopic procedures, and select superficial procedures. Patients under going these low-risk procedures should proceed to surgery without

TABLE 492-1 Standardized Preoperative Questionnairea

1. Age, weight, height
2. Are you: Female and 55 years of age or older or male and 45 years of age or older? If yes, are you 70 years of age or older?
3. Do you take anticoagulant medications (“blood thinners”)?
4. Do you have or have you had any of the following heart-related conditions? Heart disease Heart attack within the last 6 months Angina (chest pain) Irregular heartbeat Heart failure
5. Do you have or have you ever had any of the following? Rheumatoid arthritis Kidney disease Liver disease Diabetes
6. Do you get short of breath when you lie flat?
7. Are you currently on oxygen treatment?
8. Do you have a chronic cough that produces any discharge or fluid?
9. Do you have lung problems or diseases?
10. Have you or any blood member of your family ever had a problem other than CHAPTER 492 nausea with any anesthesia? If yes, describe:
11. If female, is it possible that you are pregnant? Pregnancy test: Please list date of last menstrual period: Medical Evaluation of the Patient Undergoing Noncardiac Surgery aUniversity of Michigan Health System patient information report. Patients who answer yes to any of questions 2–9 should receive a more detailed clinical evaluation. Source: Reproduced with permission from KK Tremper, P Benedict: Paper “Preoperative Computer.” Anesthesiology 92:1212, 2000. further testing. Clinical risk may be estimated with the American College of Surgeons’ National Surgical Quality Improvement Program (NSQIP) risk calculator (http://www.riskcalculator.facs.org) or with calculation of the Revised Cardiac Risk Index (RCRI). Additional tools include the Surgical Outcome Risk Tool (SORT) or the American University of Beirut (AUB)-HAS2 Cardiovascular Risk Index. The former is based, in part, on the American Society of Anesthesiologists Physical Status (ASA-PS) grade; the latter provides for estimation of 30-day death, myocardial infarction (MI), or stroke risk. Previous studies have compared several cardiac risk indices. The

American College of Surgeons' NSQIP prospective database has identified five predictors of perioperative MI and cardiac arrest based on increasing age, American Society of Anesthesiologists class, type of surgery, dependent functional status, and abnormal serum cre atinine level. However, given its accuracy and simplicity, the RCRI (Table 492-2) is often the favored risk index. The RCRI relies on the presence or absence of six identifiable predictive factors: high-risk surgery, ischemic heart disease, congestive heart failure, cerebrovas cular disease, diabetes mellitus treated with insulin, and renal insuf ficiency with a creatinine >2.0 mg/dL. Each of these predictors is assigned one point. The risk of major cardiac events—defined as MI, pulmonary edema, ventricular fibrillation or primary cardiac arrest, and complete heart block—can then be predicted. Based on the pres ence of none, one, two, three, or more of these clinical predictors, the rate of development of one of these four major cardiac events is esti mated to be 0.4%, 0.9%, 7%, and 11%, respectively (Fig. 492-2). The clinical utility of the RCRI is to identify patients with three or more predictors who are at very high risk (≥11%) for cardiac complications and who may benefit from further risk stratification with noninvasive cardiac testing, initiation of preoperative preventive medical manage ment, or avoidance of surgery. For patients at elevated combined clinical and surgical risk for MACE, the stepwise perioperative cardiac assessment for coronary

Patient Needs emergency noncardiac surgery Needs elective noncardiac surgery Exhibits evidence of acute coronary syndrome Perioperative risk for MACE* <1% Perioperative risk for MACE* >1% PART 19 Consultative Medicine Consider noninvasive testing if results would change management Proceed to surgery Proceed to ACS evaluation Proceed to surgery Proceed to surgery Proceed to surgery PERIOPERATIVE MEDICAL INTERVENTION WHEN CONSIDERING NONCARDIAC SURGERY Beta-blockers Statin Alpha agonist • Start in intermediate- to high-risk patients • Should not start on day of surgery • Should not be withdrawn if taking chronically • Continued if on chronically • Start in vascular surgery patients • Considered in patients with clinical indications, undergoing elevated-risk procedures Initiation not recommended prior to noncardiac surgery FIGURE 492-1 Composite algorithm for cardiac risk assessment and stratification in patients undergoing noncardiac surgery. Preoperative evaluation involves a stepwise clinical evaluation. Those individuals requiring emergency surgery should proceed without further risk stratification. Acute coronary syndrome (step 2) should be evaluated and treated according to goal-directed medical therapy. For patients awaiting nonemergent surgeries and without acute coronary syndrome, perioperative risk is a combination of clinical and surgical risk. Select procedures and surgeries (e.g., select endoscopic procedures) are associated with low (<1%) perioperative risk, and no further clinical testing is generally necessary. For those procedures associated with elevated risk, an assessment of functional capacity informs the decision for further testing. Those individuals with moderate or greater functional capacity do not require further testing and should proceed to surgery. Individuals with poor or unknown functional capacity may require pharmacologic stress testing if it would change decision-making or perioperative care. ACE, angiotensin-converting enzyme; ACS, acute coronary syndrome; MACE, major adverse cardiovascular event. (Reproduced with permission from AY Patel et al: Cardiac risk of noncardiac surgery. J Am Coll Cardiol 66:2140, 2015.) artery disease (CAD) proceeds with consideration of functional capacity. Participation in activities of daily living offers an expres sion of functional capacity, often expressed in terms of metabolic equivalents (METs). For predicting perioperative events, poor exercise tolerance has been defined as the inability to walk four blocks or climb two flights of stairs at a normal pace or to

meet a MET level of 4 (e.g., carrying objects of 15–20 lb. or playing golf or doubles tennis) because of the development of dyspnea, angina, or excessive fatigue (Table 492-3). Patients with moderate or greater (≥4 METs) functional capacity (e.g., climbing up a flight of stairs, walking up a hill, or walking on level ground at 4 mph) generally should not undergo further noninvasive cardiac testing prior to elective noncardiac surgery. Those patients with poor (<4 METs) or unknown functional capacity should undergo pharmacologic stress

- Estimate major adverse cardiac event risk using: • American College of Surgeons National Surgical Quality Improvement Program Surgical Risk Calculator • Revised Cardiac Risk Index, which takes into consideration these factors:

- High-risk surgery
- History of ischemic heart disease
- History of congestive heart failure
- History of cerebrovascular disease
- Preoperative treatment with insulin
- Preoperative creatinine >2 mg/dL No evidence of ongoing ACS Functional capacity: Unknown Functional capacity: Excellent Functional capacity: Moderate – Good Functional capacity: Poor Consider noninvasive testing if results would change management ACE inhibitor Aspirin Continued, or if held before surgery, restart postoperatively as soon as clinically feasible Continued when the risk of increased cardiac events outweights the risk of increased bleeding testing if the results of such testing would impact decision-making or perioperative care. ■ ■PREOPERATIVE NONINVASIVE CARDIAC TESTING FOR RISK STRATIFICATION There is little evidence to support widespread application of preopera tive noninvasive cardiac testing for all patients undergoing major sur gery. The current paradigm to guide the need for noninvasive cardiac testing is to perform such testing in patients with poor or unknown capacity if it would alter clinical management or modify perioperative care. Options for pharmacologic stress testing include dobutamine stress echocardiography or myocardial perfusion imaging with coro nary vasodilator stress (dipyridamole, adenosine, or regadenoson) with thallium-201 and/or technetium-99m. Similarly, there is a limited

TABLE 492-2 Clinical Markers Included in the Revised Cardiac Risk Index High-Risk Surgical Procedures Vascular surgery (except carotid endarterectomy) Major intraperitoneal or intrathoracic procedures Ischemic Heart Disease History of myocardial infarction Current angina considered to be ischemic Requirement for sublingual nitroglycerin Positive exercise test Pathological Q waves on ECG History of PCI and/or CABG with current angina considered to be ischemic Congestive Heart Failure Left ventricular failure by physical examination History of paroxysmal nocturnal dyspnea History of pulmonary edema S3 gallop on cardiac auscultation Bilateral rales on pulmonary auscultation Pulmonary edema on chest x-ray Cerebrovascular Disease History of transient ischemic attack History of cerebrovascular accident Diabetes Mellitus Treatment with insulin Chronic Renal Insufficiency Serum creatinine >2 mg/dL Abbreviations: CABG, coronary artery bypass grafting; ECG, electrocardiogram; PCI, percutaneous coronary intervention. Source: Adapted from TH Lee et al: Circulation 100:1043, 1999. role for perioperative coronary computed tomography angiography (CCTA) in patients undergoing noncardiac surgery. While some inves tigators have shown in observational studies that CCTA may improve prediction of MACEs

perioperatively when compared to RCRI, there are few data to demonstrate that such improved prognostication trans lates to improved outcomes. Furthermore, coronary revascularization before noncardiac surgery is not recommended for the express purpose of reducing perioperative cardiac events. That said, revascularization before noncardiac surgery should be considered in patients if it would RCRI

≥3 Event Rate 0.50% 1.30% 6.00% 11% Std Dev
0.45% 1.10% 5.30% 10.00% 15% Risk stratification Risk of cardiac events 10% 4–7 5% 0.9–1.3 0.4–0.5 0% Low risk Intermediate risk High risk

≥3 Revised Cardiac Risk Index (RCRI) FIGURE 492-2 Risk stratification based on the Revised Cardiac Risk Index; derivation and prospective validation of a simple index for prediction of cardiac risk in patients undergoing major noncardiac surgery. Cardiac events include myocardial infarction, pulmonary edema, ventricular fibrillation, cardiac asystole, and complete heart block. (Adapted from TH Lee et al: Circulation 100:1043, 1999.)

TABLE 492-3 Assessment of Cardiac Risk by Functional Status Higher • Has difficulty with adult activities of daily living • Cannot walk four blocks or up two flights of stairs or does not meet a MET level of 4 • Is inactive but has no limitations • Is active: easily does vigorous tasks Risk Lower • Performs regular vigorous exercises Abbreviation: MET, metabolic equivalent. Source: From LA Fleisher et al: Circulation 116:1971, 2007. be indicated regardless of the surgery planned and instead according to clinical practice guidelines. In the Coronary Artery Revascularization Prophylaxis trial, there were no differences in perioperative and longterm cardiac outcomes with or without preoperative coronary revascu larization; of note, patients with left main disease were excluded. ■ ■RISK MODIFICATION: PREVENTIVE STRATEGIES TO REDUCE CARDIAC RISK Perioperative Coronary Revascularization Prophylactic coro nary revascularization with either coronary artery bypass grafting (CABG) or percutaneous coronary intervention (PCI) provides no short- or mid-term survival benefit for patients without left main CAD or three-vessel CAD in the presence of poor left ventricular systolic function and is not recommended for patients with stable CAD before noncardiac surgery. Although PCI is associated with lower procedural risk than is CABG in the perioperative setting, the placement of a coro nary artery stent soon before noncardiac surgery may increase the risk of bleeding during surgery if dual antiplatelet therapy (DAPT) (aspirin and P2Y12) is administered; moreover, stent placement shortly before noncardiac surgery increases the perioperative risk of MI and cardiac death due to stent thrombosis if such therapy is withdrawn prematurely (Chap. 287). It is recommended that, if possible, elective noncardiac surgery be delayed for 6 months after elective PCI and 12 months after acute coronary syndrome. Contemporary stent platforms allow for greater flexibility in the earlier interruption of DAPT; accordingly, time sensitive noncardiac surgery could be a consideration as soon as 1 month of treatment with DAPT has passed. For patients who must undergo noncardiac surgery early (>14 days) after PCI, balloon angio plasty without stent placement appears to be a reasonable alternative because DAPT is not necessary in such patients. CHAPTER 492 Medical Evaluation of the Patient Undergoing Noncardiac Surgery PERIOPERATIVE PREVENTIVE MEDICAL THERAPIES The goal of peri operative preventive medical therapies with β-adrenergic antagonists, hydroxymethylglutaryl-coenzyme A (HMG-CoA) reductase inhibitors (statins), and antiplatelet agents is to reduce perioperative adrenergic stimulation, ischemia, and inflam mation, all of which are heightened during the perioperative period. a-ADRENERGIC ANTAGONISTS The use of

perioperative beta blockade should be based on a thorough assessment of a patient's perioperative clinical and surgery-specific cardiac risk (e.g., as with the RCRI). The paradigm for beta blockade in the perioperative period has shifted in recent years owing, first, to the publication of the PeriOperative Ischemic Evalu ation (POISE) trial demonstrating that, while perioperative beta blockade reduces the perioperative risk for MI, this is at the expense of increased death and stroke. Regarding POISE, this trial has been scrutinized for the use of an excessive dose of beta blocker in the perioperative period and one that may not be reflective of clinical practice, nor one that was titrated in the days or weeks preceding the procedure or sur gery. Second, research misconduct has discredited the Dutch Echocardiographic Cardiac Risk Evaluation Applying Stress Echocardiography (DECREASE) family of studies, which pre viously contributed to the bedrock of data supporting the use of perioperative beta blockade but have now been retracted. 9–11

Current guidelines emphasize the following key points:

1. Continuation of beta blockade in patients undergoing surgery and who have been receiving such therapy chronically.
2. Avoidance of beta-blocker withdrawal or initiation on the day of surgery.
3. Consideration of initiation of beta-blocker therapy perioperatively (ideally far enough in advance to assess safety and tolerability) in very select high-risk patients, namely, those with intermediate- or high-risk ischemia or three or more RCRI risk factors. HMG-COA REDUCTASE INHIBITORS (STATINS) A number of prospec tive and retrospective studies support the perioperative prophylactic use of statins for reduction of cardiac complications in patients with established atherosclerosis. For patients undergoing noncardiac sur gery and currently taking statins, statin therapy should be continued to reduce perioperative cardiac risk. Initiation of statin therapy is reasonable for patients undergoing vascular surgery independent of clinical risk. There is equipoise about the perioperative initiation of statin therapy in patients undergoing other elevated-risk procedures. In the Lowering the Risk of Operative Complications Using Atorvastatin Loading Dose (LOAD) randomized, placebo-controlled trial, the use of 80 mg of atorvastatin within 18 h before surgery and then followed by 40 mg daily for 7 days in statin-naïve patients (24% of whom had a history of cardiovascular disease) did not reduce the risk of major adverse events. PART 19 Consultative Medicine ANGIOTENSIN-CONVERTING ENZYME (ACE) INHIBITORS It is impor tant to maintain continuity of therapy with inhibitors of the reninangiotensin-aldosterone system (when such therapy is used for the treatment of heart failure or hypertension). ORAL ANTIPLATELET AGENTS The 4- to 6-week period following implantation of an intracoronary stent (bare metal or drug eluting) constitutes the period of time of greatest risk for the development of stent thrombosis. If possible, noncardiac surgery should be avoided in this vulnerable period. The duration of DAPT thereafter is dictated by the circumstances in which PCI was performed and whether the indication was stable ischemic heart disease or acute coronary syn drome. For the former among patients treated with a drug-eluting stent (DES), DAPT should be given for at least 6 months. For the latter, DAPT should be given for at least 12 months. However, DAPT may be interrupted to allow for noncardiac surgery 30 days after bare metal stent (BMS) and 6 months after DES, respectively. Elective, noncardiac surgery should be delayed for 5 days since the last dose of clopidogrel; 7 days since the last dose of prasugrel; and 3–5 days since the last dose of ticagrelor. The use of cangrelor, an intravenous reversible P2Y12

receptor antagonist, may be an appealing bridging strategy, although studies of its use in those undergoing cardiac and noncardiac sur gery are limited. If P2Y12 inhibitor therapy (clopidogrel, prasugrel, or ticagrelor) is interrupted or discontinued in patients who have received intracoronary stents, aspirin should be continued perioperatively (save select circumstances where the risk of bleeding may be catastrophic as in neurosurgical or spinal procedures) and the P2Y12 receptor inhibitor should be restarted as soon as possible postoperatively. Decisions sur rounding antiplatelet management in the perioperative setting among patients who have received intracoronary stents are complex and should involve multidisciplinary decision-making. `2 AGONISTS Based on the results of POISE-2 (a large multicenter, international, blinded randomized clinical trial of aspirin and clonidine), α2 agonists for prevention of cardiac events are not recommended in patients who are undergoing noncardiac surgery. In this trial, clonidine increased the rate of nonfatal cardiac arrest and clinically important hypotension, while reducing the rate of death or nonfatal MI. CALCIUM CHANNEL BLOCKERS Evidence is lacking to support the use of calcium channel blockers as a prophylactic strategy to decrease perioperative risk in major noncardiac surgery. SODIUM-GLUCOSE COTRANSPORTER 2 INHIBITORS The use of sodium-glucose cotransporter 2 (SGLT-2) inhibitors has grown in

TABLE 492-4 Gradation of Mortality Risk of Common Noncardiac Surgical Procedures Higher • Emergent major operations, especially in the elderly • Aortic and other noncarotid major vascular surgery (endovascular and nonendovascular) • Prolonged surgery associated with large fluid shift and/or blood loss Intermediate • Major thoracic surgery • Major abdominal surgery • Carotid endarterectomy surgery • Head/neck surgery • Orthopedic surgery • Prostate surgery Lower • Eye, skin, and superficial surgery • Endoscopic procedures Source: Reproduced with permission from LA Fleisher et al: ACC/AHA 2007 Guidelines on perioperative cardiovascular evaluation and care for noncardiac surgery. Circulation 116:1971, 2007. recent years owing to their beneficial impact in patients with and with out type 2 diabetes mellitus and with heart failure with either reduced or preserved ejection fraction. However, euglycemic diabetic ketoaci dosis is a known, but rare, complication with this therapy and one that may be precipitated by changes and fasting in the perioperative state. Accordingly, SGLT-2 inhibitor therapy should be interrupted for at least 3–4 days prior to scheduled noncardiac surgery. ANESTHETICS Mortality risk is low with safe delivery of modern anesthesia, especially among low-risk patients undergoing low-risk surgery (Table 492-4). Inhaled anesthetics have predictable circula tory and respiratory effects: all decrease arterial pressure in a dosedependent manner by reducing sympathetic tone and causing systemic vasodilation, myocardial depression, and decreased cardiac output. Inhaled anesthetics also cause respiratory depression, with diminished responses to both hypercapnia and hypoxemia, in a dose-dependent manner; in addition, these agents have a variable effect on heart rate. Prolonged residual neuromuscular blockade also increases the risk of postoperative pulmonary complications due to reduction in functional residual lung capacity, loss of diaphragmatic and intercostal muscle function, atelectasis, and arterial hypoxemia from ventilation–perfusion mismatch. Several meta-analyses have shown that rates of pneumonia and respiratory failure are lower among patients receiving neuroaxial anesthesia (epidural or spinal) rather than general anesthesia. However, there were no significant differences in cardiac events between the two approaches. Evidence from a meta-analysis of randomized controlled trials supports postoperative epidural analgesia for >24 h for the purpose of pain relief. However, the risk of epidural hematoma in the setting of systemic anticoagulation for venous thromboembolism pro phylaxis (see below) and postoperative epidural

catheterization must be considered. PREOPERATIVE PULMONARY RISK ASSESSMENT Perioperative pulmonary complications occur frequently and lead to significant morbidity and mortality. Clinical practice guidelines recommend the following:

1. All patients undergoing noncardiac surgery should be assessed for risk of pulmonary complications (Table 492-5).
2. While select studies have suggested that quitting smoking shortly before surgery increases the risk for postoperative complications through increased sputum production and/or decreased cough, meta-analysis of the available data has challenged this, and all patients should be advised of the imperative to stop smoking presurgically.
3. Patients undergoing emergency or prolonged (3–4 h) surgery; aor tic aneurysm repair; vascular surgery; major abdominal, thoracic, neurologic, head, or neck surgery; and general anesthesia should

TABLE 492-5 Predisposing Risk Factors for Pulmonary Complications

1. Upper respiratory tract infection: cough, dyspnea
2. Age >60 years
3. Chronic obstructive pulmonary disease
4. Cigarette use
5. American Society of Anesthesiologists Class ≥2
6. Functional dependence
7. Congestive heart failure
8. Serum albumin <3.5 g/dL
9. Obstructive sleep apnea
10. Impaired sensorium (confusion, delirium, or mental status changes)
11. Abnormal findings on chest examination
12. Alcohol use
13. Weight loss
14. Spirometry threshold before lung resection a. FEV1 <2 L b. MVV <50% of predicted c. PEF <100 L or 50% predicted value d. PCO2 ≥45 mmHg e. PO2 ≤50 mmHg Abbreviations: FEV1, forced expiratory volume in 1 s; MVV, maximal voluntary ventilation; PCO2, partial pressure of carbon dioxide; PEF, peak expiratory flow rate; PO2, partial pressure of oxygen. Source: A Qaseem et al: Ann Intern Med 144:575, 2006. Modified from GW Smetana et al: Ann Intern Med 144:581, 2006, and from DN Mohr et al: Postgrad Med 100:247,
15.

be considered to be at elevated risk for postoperative pulmonary complications. 4. Patients at higher risk of pulmonary complications should undergo incentive spirometry, deep breathing exercises, cough encourage ment, postural drainage, percussion and vibration, suctioning and ambulation, intermittent positive-pressure breathing, continuous positive airway pressure, and selective use of a nasogastric tube for postoperative nausea, vomiting, or symptomatic abdominal disten tion to reduce postoperative risk. Multiple pulmonary risk indices are available to estimate the postoperative risk of respiratory failure, pneumonia, and other pulmonary complications; among these is the ARISCAT risk index, which accounts for the following seven risk factors: age, low preoperative oxygen saturation, respiratory infection within the preceding month, upper

abdominal or thoracic surgery, surgery lasting >2 h, hemoglobin <10 g/dL, and emergency surgery (Table 492-6). 5. Preoperative spirometry and chest radiography should not be used routinely for predicting risk of postoperative pulmonary complica tions but may be appropriate for patients with chronic obstructive pulmonary disease or asthma. 6. Spirometry is of value before lung resection in determining candi dacy for coronary artery bypass; however, it does not provide a spi rometric threshold for extrathoracic surgery below which the risks of surgery are unacceptable. 7. Pulmonary artery catheterization, administration of total parenteral nutrition (as opposed to no supplementation), or total enteral nutri tion has no consistent benefit in reducing postoperative pulmonary complications. PERIOPERATIVE MANAGEMENT AND PROPHYLAXIS ■ ■DIABETES MELLITUS (See also Chaps. 415-417) Many patients with diabetes mellitus have significant symptomatic or asymptomatic CAD and may have silent myocardial ischemia due to autonomic dysfunction. Intensive (vs lenient) glycemic control in the perioperative period is generally not associated with improved outcomes and may increase the risk of hypoglycemia. Practice guidelines advocate a target glucose range of 100–180 mg/dL in the perioperative period. Oral hypoglycemic

TABLE 492-6 Risk Modification to Reduce Perioperative Pulmonary Complications Preoperatively • Smoking cessation • Training in proper lung expansion techniques • Inhalation bronchodilator and/or steroid therapy, when indicated • Control of infection and secretion, when indicated • Weight reduction, when appropriate Intraoperatively • Limited duration of anesthesia • Avoidance of long-acting neuromuscular blocking drugs, when indicated • Prevention of aspiration and maintenance of optimal bronchodilation Postoperatively • Optimization of inspiratory capacity maneuvers, with attention to: • Mobilization of secretions • Early ambulation • Encouragement of coughing • Selective use of a nasogastric tube • Adequate pain control without excessive narcotics CHAPTER 492 Source: From VA Lawrence et al: Ann Intern Med 144:596, 2006, and WF Dunn, PD Scanlon: Mayo Clin Proc 68:371, 1993. agonists should not be given on the morning of surgery. Periopera tive hyperglycemia should be treated with IV infusion of short-acting insulin or subcutaneous sliding-scale insulin. Patients whose diabetes is diet controlled may proceed to surgery with close postoperative monitoring. Medical Evaluation of the Patient Undergoing Noncardiac Surgery ■ ■INFECTIVE ENDOCARDITIS (See also Chap. 133) Prophylactic antibiotics should be administered to the following patients before dental procedures that involve manipu lation of gingival tissue, manipulation of the periapical region of teeth, or perforation of the oral mucosa: those with prosthetic cardiac valves (including transcatheter prosthetic valves); prosthetic material used in valve repair (annuloplasty ring or artificial chord); previous infective endocarditis; cardiac transplant recipients with valvular regurgitation from a structurally abnormal valve; and unrepaired cyanotic congenital heart disease or repaired congenital heart disease, with residual shunts or valvular regurgitation at the site adjacent to the site of a prosthetic patch or prosthetic device. ■ ■AORTIC STENOSIS Previous American College of Cardiology/American Heart Association guidelines have cautioned against surgery in patients with severe aortic stenosis, citing a 10% mortality risk. More recent guidance, rooted in contemporary data, offers greater latitude for noncardiac surgery in appropriately selected patients with severe aortic stenosis. In an analy sis of patients undergoing moderate- or high-risk surgery at the Mayo Clinic from 2000 to 2010, there was no significant difference in 30-day mortality between those with severe aortic stenosis and matched con trols (5.9 vs 3.1%, p = .13); however, those with severe aortic stenosis had more MACEs (18.8 vs 10.5%, p = .01), mainly due to heart failure. In sum, severe aortic stenosis is associated with adverse outcomes in patients undergoing noncardiac surgery; however, in contemporary cohorts, this risk is less than has previously been stated. Patients with severe

symptomatic aortic stenosis should generally undergo aortic valve intervention (surgical aortic valve replacement or transcath eter aortic valve implantation) if noncardiac surgery can be deferred. Asymptomatic patients with severe aortic stenosis and preserved ejec tion fraction can generally safely undergo low- or intermediate-risk noncardiac surgery. Balloon valvotomy is usually not recommended but may serve a role in the minority of patients who need “bridging” to a necessary surgery or procedure. ■ ■VENOUS THROMBOEMBOLISM (See also Chap. 290) Perioperative prophylaxis of venous thromboem bolism should follow established guidelines of the American College of

Chest Physicians. Aspirin is not supported as a single agent for throm boprophylaxis. Low-dose unfractionated heparin (≤5000 units SC bid), low-molecular-weight heparin (e.g., enoxaparin, 30 mg bid or 40 mg qd), or a pentasaccharide (fondaparinux, 2.5 mg qd) is appropriate for patients at moderate risk; unfractionated heparin (5000 units SC tid) is appropri ate for patients at high risk. The use of direct oral anticoagulants may be an alternative to the use of prophylactic doses of low-dose unfractionated heparin and low-molecular-weight heparin; among patients immobilized after nonmajor orthopedic surgery, rivaroxaban 10 mg once daily when compared to enoxaparin was associated with a decrease in venous throm boembolic events, without a significant change in bleeding. Graduated compression stockings and pneumatic compression devices are useful supplements to anticoagulant therapy or as alternatives to anticoagulant therapy in patients at excessive bleeding risk.

■ ■FURTHER READING Eagle KA et al: Perioperative cardiovascular care for patients under going noncardiac surgical intervention. JAMA Intern Med 175:835, 2015. Fleisher LA et al: 2014 ACC/AHA guideline on perioperative car diovascular evaluation and management of patients undergoing noncardiac surgery: A report of the American College of Cardiology/ American Heart Association Task Force on Practice Guidelines. Circulation 130:e278, 2014. PART 19 Consultative Medicine

Halvorsen S et al: 2022 ESC Guidelines on cardiovascular assess ment and management of patients undergoing non-cardiac surgery: Developed by the task force for cardiovascular assessment and man agement of patients undergoing non-cardiac surgery of the European Society of Cardiology (ESC) Endorsed by the European Society of Anesthesiology and Intensive Care. Eur Heart J 39:3826, 2022. Hwang JW et al: Assessment of perioperative cardiac risk of patients undergoing noncardiac surgery using coronary computed tomo graphic angiography. Circ Cardiovasc Imaging 8:e002582, 2015. Levine GN et al: 2016 ACC/AHA guideline focused update on dura tion of dual antiplatelet therapy in patients with coronary artery disease. A report of the American College of Cardiology/American Association Task Force on Clinical Practice Guidelines. J Am Coll Cardiol 68:1082, 2016. Otto CM et al: 2020 ACC/AHA guideline for the management of patients of valvular heart disease: A report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines. Circulation 143:e72, 2021. Smilowitz NR, Berger JS: Perioperative cardiovascular risk assess ment and management for noncardiac surgery: A review. JAMA 324:279, 2020. Tashiro T et al: Perioperative risk of major non-cardiac surgery in patients with severe aortic stenosis: A reappraisal in contemporary practice. Eur Heart J 35:2372, 2014.

Revision #1
Created 2026-01-06 16:36:15 UTC by Omar Ayman
Updated 2026-01-06 16:36:15 UTC by Omar Ayman