

Preop Assessment of the Patient With Cardiac Disease

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The past several years has seen a dramatic increase in the number and quality of randomized and prospective studies to define the optimal and most cost-effective approach to the value of preoperative cardiovascular evaluation and management for noncardiac surgery, including several studies published in the past year evaluating the role of coronary revascularization before noncardiac surgery. By the time this refresher course lecture is presented, an update to the Guidelines on Perioperative Cardiovascular Evaluation before Noncardiac Surgery will be published which includes a new algorithm (<http://www.acc.org/qualityandscience/clinical/topic/topic.htm>). While the specific changes to the Guidelines and the algorithm can be found on the website, the new studies and their implications will be reviewed.

The basic tenet in preoperative evaluation remains that information regarding the extent and stability of disease will effect patient management and lead to improved outcome. In the case of cardiovascular disease, the preoperative evaluation attempts to define the extent of coronary artery disease and the left ventricular function.

Perioperative interventions based upon preoperative cardiac evaluation

Decision to forego surgery

Modification of surgical procedure

Delay case for treatment of unstable symptoms

Modification of intraoperative monitors

Modification of perioperative medical therapy

Initiation of beta-blockers, statins, alpha-2 agonists

Modification of postoperative monitoring (eg. Intensive Care Unit)

Coronary revascularization before noncardiac surgery

Modification of location of care

Clinical Assessment

Since the original manuscript by Goldman and colleagues in 1977 describing a Cardiac Risk Index, multiple investigators have validated various clinical risk indices for their ability to predict perioperative cardiac complications.¹ The most recent index was developed in a study of 4315 patients aged 50 years or greater undergoing elective major noncardiac procedures in a tertiary-care teaching hospital. Six independent predictors of complications were identified, and included in a Revised Cardiac Risk Index (RCRI): high-risk type of surgery, history of ischemic heart disease, history of congestive heart failure, history of cerebrovascular disease, preoperative treatment with insulin, and preoperative serum creatinine >2.0 mg/d, with increasing cardiac complication rates noted with increasing number of risk factors.² The RCRI has become the standard tool in the literature in assessing the prior probability of perioperative cardiac risk in a given individual and has been used to direct the decision to perform cardiovascular testing and implement perioperative management protocols. A primary issue with all of these indices from the anesthesiologist's perspective is that a simple estimate of risk does not help in refining perioperative management, and therefore it is important that the anesthesiologist determine the extent and stability of the patient's coronary artery disease through obtaining information from the primary caregiver or cardiologist or through a thorough history or physical examination.

Revised Cardiac Risk Index²

- High risk surgery
 - intraperitoneal, intrathoracic or suprainguinal vascular procedures
- Ischemic heart disease
- H/O CHF
- H/O Cerebrovascular disease
- Insulin therapy for DM
- Preop Cr>2.0mg/dl

A thorough history should focus on cardiovascular risk factors and symptoms or signs of unstable cardiac disease states, such as myocardial ischemia with minimal exertion, active congestive heart failure, symptomatic valvular heart disease, and significant cardiac arrhythmias. In patients with symptomatic coronary disease, the preoperative evaluation may lead to the recognition of a change in the frequency or pattern of anginal symptoms. The patient with stable angina represents a continuum from mild angina with extreme exertion to dyspnea with

angina after walking up a few stairs. A patient with dyspnea on mild exertion would be at high risk for developing perioperative ventricular dysfunction, myocardial ischemia, and possible MI. These patients have an extremely high probability of having extensive coronary artery disease, and additional monitoring or cardiovascular testing should be contemplated, depending upon the surgical procedure and institutional factors. In virtually all studies, the presence of active congestive heart failure preoperatively has been associated with an increased incidence of perioperative cardiac morbidity. Stabilization of ventricular function and treatment for pulmonary congestion is prudent prior to elective surgery. Also, it is important to determine the etiology of the left heart failure since the type of perioperative monitoring and treatments would be different.

Patients with a prior MI have coronary artery disease, although a small group of patients may sustain an MI from a nonatherosclerotic mechanism. Since the publication of the original Guidelines in 1996, there has been a consensus that the traditional recommendation to wait 6 months for elective surgery has been modified.³ Instead, patients should be evaluated from the perspective of their risk for ongoing ischemia. There is general consensus that delaying surgery for approximately 6 weeks to allow the myocardial scar is prudent.

For those patients without overt symptoms or history, the probability of CAD varies with the type and number of atherosclerotic risk factors present. Diabetes mellitus is common in the elderly and represents a disease that impacts on multiple organ systems. Diabetes accelerates the progression of atherosclerosis, which can frequently be silent in nature, leading many clinicians to assume coronary artery disease in this population and treating them as such. Diabetes is an independent risk factor for perioperative cardiac morbidity and the preoperative treatment with insulin has been included in the RCRI. In attempting to determine the degree of this increased probability, the treatment modality, length of the disease and other associated end-organ dysfunction should be taken into account, including autonomic neuropathy. Hypertension has also been associated with an increased incidence of silent myocardial ischemia and infarction. Those hypertensive patients with left ventricular hypertrophy and who are undergoing noncardiac surgery are at a higher perioperative risk than nonhypertensive patients.⁴ There is a great deal of debate regarding a trigger to delay or cancel a surgical procedure in a patient with poorly or untreated hypertension. In the absence of end-organ changes, such as renal insufficiency or left ventricular hypertrophy with strain, it would seem appropriate to proceed with surgery. A randomized trial of treated hypertensive patients without known CAD who presented the morning of surgery with an elevated diastolic blood pressure was unable to demonstrate any difference in outcome between those who were actively treated versus those in whom surgery was delayed.⁵ In contrast, a patient with a markedly elevated blood pressure and the new onset of a headache should have surgery delayed for further evaluation and potential treatment..

Importance of Surgical Procedure

The surgical procedure influences the extent of the preoperative evaluation required by determining the potential range of changes in perioperative management. There is little hard data to define the surgery specific incidence of complications, and the rate may be very institution dependent. Eagle et. al. published data on the incidence of perioperative myocardial infarction and mortality by procedure for patients enrolled in the coronary artery surgery study (CASS).⁶ Higher risk procedures for which coronary artery bypass grafting reduced the risk of noncardiac surgery compared to medical therapy include major vascular, abdominal, thoracic, and orthopedic surgery. Ambulatory procedures denote low risk. Vascular surgery represents a unique group of patients in whom there is extensive evidence regarding preoperative testing and perioperative interventions.

Importance of exercise tolerance

Exercise tolerance is one of the most important determinants of perioperative risk and the need for invasive monitoring. If a patient can walk a mile without becoming short of breath, than the probability of extensive coronary artery disease is small. Alternatively, if patients become dyspneic associated with chest pain during minimal exertion, then the probability of extensive coronary artery disease is high. Reilly and colleagues demonstrated that the likelihood of a serious complication occurring was inversely related to the number of blocks that could be walked or flights of stairs that could be climbed.⁷ Exercise tolerance can be assessed with formal treadmill testing or with a questionnaire that assesses activities of daily living.

Approach to the Patient

The algorithm to determine the need for testing proposed by the American College of Cardiology/American Heart Association Task Force was modified in the Guidelines Update in 2007, and approaches the decision to perform testing based upon clinical history, surgery specific risk and exercise tolerance, as outlined in previous Guidelines.³ Given that this refresher course was written before the Guidelines were formally approved, they cannot

be discussed here. However, specific recommendations remain the same. For example, for pathways which may suggest testing, the recommendation is not for mandatory testing, but simply identification of a group that may benefit. Since coronary revascularization has not been shown to be beneficial in patients undergoing major vascular surgery with small to moderate areas at risk for ischemia, the need for testing in any asymptomatic patient with moderate exercise tolerance is negligible.(see below)⁸ This is further supported by the lack of efficacy of a testing protocol demonstrated by my group in a small randomized trial of 99 patients who were at low or intermediate cardiovascular risk undergoing major vascular surgery and underwent either no testing or preoperative diagnostic testing with interventions based upon the results of the test.⁹ Importantly, this was a highly functional ambulatory group who were seen in a preoperative cardiology clinic and were begun on optimal medical therapy. In this highly selected group of patients, the overall rate of morbid cardiac events was very low and we were unable to demonstrate any difference in outcome between those tested and the no-testing group. There were no patients in this cohort who had preoperative cardiac imaging with a sufficiently large area at-risk who underwent coronary revascularization, further supporting the contention that preoperative testing in highly functional vascular surgery patients may not be indicated.

Choice of Diagnostic Test

There are multiple noninvasive diagnostic tests which have been proposed to evaluate the extent of coronary artery disease before noncardiac surgery. Although exercise electrocardiogram has been the traditional method of evaluating individuals for the presence of coronary artery disease, patients with a good exercise tolerance will rarely benefit from further testing. Therefore, pharmacologic stress testing has become popular, particularly as a preoperative test in vascular surgery patients.

Several authors have shown that the presence of a redistribution defect on dipyridamole thallium imaging in patients undergoing peripheral vascular surgery is predictive of postoperative cardiac events. In order to increase the predictive value of the test, several strategies have been suggested. Lung uptake, left ventricular cavity dilation, and redistribution defect size have all been shown to be predictive of subsequent morbidity.¹⁰ Dobutamine stress echocardiography has been suggested as the best preoperative test in several recent meta-analyses.¹¹ The appearance of new or worsened regional wall motion abnormalities is considered a positive test. The advantage of this test is that it is a dynamic assessment of ventricular function. Dobutamine echocardiography has also been studied and was found to have among the best positive and negative predictive values. Poldermans et al. demonstrated that the group at greatest risk were those who demonstrated regional wall motion abnormalities at low heart rates.¹² The presence of 5 or more segments of new regional wall motion abnormalities denotes a high risk group who did not benefit from perioperative beta blockade in one trial.¹³ Beattie and colleagues performed a meta-analysis of stress echocardiography versus thallium imaging and demonstrate that stress echocardiography has better negative predictive characteristics.¹¹ A moderate-to-large perfusion defect by either test predicted postoperative MI and death.

Interventions for patients with documented CAD

Strategies to reduce the perioperative risk of noncardiac surgery have recently been reviewed. Eagle et al studied over 3000 noncardiac surgeries in patients who were originally enrolled in the Coronary Artery Surgery Study and compared the rate of perioperative cardiac morbidity and mortality in those patients in the surgical versus medical treatment arms.⁶ In those patients who survived CABG, the rate of perioperative MI was lower for intermediate or high-risk surgeries but not low risk surgeries. McFalls and colleagues reported the results of a multi-center randomized trial in the Veterans Administration Health System in which patients with documented coronary artery disease on coronary angiography, excluding those with left main disease or severely depressed ejection fraction (<20%), were randomized to coronary artery bypass grafting (CABG)(59%) or percutaneous transluminal coronary angiography (PTCA)(41%) versus routine medical therapy.¹⁴ At 2.7 years after randomization, mortality in the revascularization group was not significantly different (22%) percent compared to the no-revascularization group (23%) percent. Within 30 days after the vascular operation, a postoperative myocardial infarction, defined by elevated troponin levels, occurred in 12 percent of the revascularization group and 14 percent of the no-revascularization group (P=0.37). The authors suggested that coronary revascularization is not indicated in patients with stable coronary artery disease.

Poldermans and colleagues studied 770 patients who needed major vascular surgery and had intermediate cardiac risk, defined as the presence of 1 or 2 cardiac risk factors (age >70 yr, angina, history of MI, a history of or compensated CHF, diabetes, creatinine >2.0 mg/dl, or previous transient ischemic attack or cerebrovascular

accident) and who were randomized to either undergo further risk stratification with DSE or proceed to surgery.⁸ All patients received preoperative bisoprolol initiated before, and continued after surgery with a targeted HR of 60-65 bpm. Of the 34 patients who were considered for revascularization because of extensive ischemia on DSE, 12 underwent revascularization (10 PCI and 2 coronary artery bypass grafting [CABG]) with complete revascularization in only 6. The 30-day incidence of cardiac death and non-fatal MI was similar in both groups (1.8% in the no testing group vs 2.3% in the tested group). The conclusion of the authors was that further risk stratification in this group of patients considered at intermediate risk based on clinical history alone was unnecessary as long as perioperative beta-blockers were used. Testing only delayed necessary vascular surgery.

CABG for triple vessel disease may be beneficial. When Ward and colleagues reanalyzed the CARP data, they reported fewer PMI after the vascular operation in CABG patients (6.6%) than in PCI patients (16.8%), despite more diseased vessels in the CABG group¹⁵. Landesberg and colleagues reported improved long-term survival in patients with intermediate clinical risk factors who had stress testing and coronary revascularization¹⁶. Therefore, revascularization by CABG for selected patients with extensive disease may show benefit.

The current evidence does not support the use of percutaneous transluminal coronary angioplasty (PTCA) beyond established indications for nonoperative patients, since the incidence of perioperative complications does not appear to be reduced in those patients in whom PTCA was performed less than 90 days prior to surgery. Based upon the prevailing evidence, the indications for CABG and PTCA are identical to those in the nonoperative setting, and simply performing coronary revascularization to “get the patient through surgery” is not indicated. Coronary stent placement may be a unique issue in that 2 studies suggest that a minimum of 2 weeks, but preferably 6 weeks, is required before the rate of perioperative complications is low.¹⁷ We have recently demonstrated that perioperative morbidity and mortality remains elevated for approximately 35 days after previous stent placement.¹⁸ Drug-eluting stents may represent an additional risk over a prolonged period (up to 6 months) based upon case reports. In February of 2007, the ACC/AHA in conjunction with the Society for Cardiovascular Angiography and Interventions (SCAI), American College of Surgeons (ACS), the American Dental Association (ADA), and the American College of Physicians (ACP), published an advisory statement regarding the premature discontinuation of dual anti-platelet therapy after coronary stents¹⁹. It recommended that strong consideration be given to the placement of BMS in patients likely to undergo surgery within 12 months and that elective surgery be deferred for one year in patients with DES who would be at high risk for perioperative bleeding if dual anti-platelet therapy were continued. For patients with a DES, who need surgical procedures within 12 months of stent placement, and in whom discontinuation of thienopyridine therapy is absolutely necessary, it is advised that aspirin be continued and thienopyridine therapy restarted as soon as possible.

There is now a great deal of evidence to suggest that perioperative medical therapy can be optimized in those patients with coronary artery disease as a means of reducing perioperative cardiovascular complications. Multiple studies have demonstrated improved outcome in patients given perioperative beta-blockers, especially if heart rate is controlled at 60-70 bpm.²⁰⁻²² The current Focused Update to the ACC/AHA Guidelines on perioperative beta-blockade advocate that perioperative beta-blockade is a Class I indication and should be used in patients previously on beta-blockers and those with a positive stress test undergoing major vascular surgery.²³ The use of these agents in those without active CAD or undergoing less invasive procedures is advocated as a Class IIa recommendation. Based upon these newer studies, beta blockers may not be effective if heart rate is not well controlled, or in lower risk patients. A study of 497 vascular surgery patients randomized to a fixed dose of metoprolol versus placebo demonstrated no difference in perioperative outcome.²⁴ A trial of metoprolol in diabetic patients undergoing a diverse group of surgical procedures was unable to demonstrate any difference in perioperative outcomes.²⁵

Other pharmacologic agents have also been shown to improve perioperative cardiac outcome. Alpha-2 agonists have been shown to improve both perioperative mortality and 6 month event-free survival.²⁶ Most recently, perioperative statins have been shown to improve cardiac outcome.²⁷ Durazzo and colleagues published a randomized trial of 200 vascular surgery patients in which statins were started an average of 30 days prior to vascular surgery.²⁸ A significant reduction in cardiovascular complications was demonstrated using this protocol. A multi-modal approach to medical management should be taken in high risk patients.

Summary

Preoperative evaluation should focus on identifying patients with symptomatic and asymptomatic coronary artery disease and the exercise capacity of the patient. The decision to perform further diagnostic evaluation depends upon the interactions of patients and surgery specific factors, as well as exercise capacity and should be reserved for those at moderate risk undergoing major or intermediate surgery with poor exercise capacity. The indications for coronary interventions are the same in the perioperative period as for the non-operative setting.

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