Preoperative 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 preoperative cardiovascular evaluation and management for noncardiac surgery, including studies evaluating the role of coronary revascularization before noncardiac surgery and perioperative beta-blockers. In 2009, the American Heart Association/American College of Cardiology (AHA/ACC) Guidelines on Perioperative Cardiovascular Evaluation before Noncardiac Surgery were updated which included a new algorithm (2007) and new recommendations regarding perioperative beta-blockade usage.[1] In addition, the European Society of Cardiology (ESC) has also produced Guidelines for pre-operative cardiac risk assessment and perioperative cardiac management in non-cardiac surgery: the Task Force for Preoperative Cardiac Risk Assessment and Perioperative Cardiac Management in Non-cardiac Surgery, which has been endorsed by the European Society of Anaesthesiology (ESA).[2] These recommendations are similar to the AHA/ACC recommendations with an algorithm, although the beta-blocker recommendations are slightly different.

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 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.[3] 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.[4] 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, and has recently been validated for both short- and long-term outcomes.[5] 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.

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. In virtually all
studies, the presence of active congestive heart failure preoperatively has been associated with an increased incidence of perioperative cardiac morbidity.[6] 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.[7] Instead, patients should be evaluated from the perspective of their risk for ongoing ischemia. A recent analysis using Medicare Claims data suggests that the risk of reinfarction remains high for at least 2 months after an MI, and that coronary artery bypass grafting (CABG) may reduce that risk while coronary stent placement soon after an MI does not.[8, 9] 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.[10] 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.[11] 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. For the purpose of the Guidelines, a list of active cardiac conditions and clinical risk factors were defined.

Active Cardiac Conditions
- Unstable coronary syndromes
  - Unstable angina
  - Recent MI (consider w/in 2 mon)
- Decompensated Heart Failure
- Significant arrhythmias
- Significant valvular disease

Clinical Risk Factors
- Ischemic heart disease
- H/O CHF
- H/O Cerebrovascular disease
- Diabetes mellitus
- Preop Cr>2.0mg/dl
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).[12] 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. Endovascular stent placement is associated with lower perioperative risk, particularly the risk of death, but similar long-term mortality compared to open procedures.

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, then 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.[13] Exercise tolerance can be assessed with formal treadmill testing or with a questionnaire that assesses activities of daily living. There is some suggestion that cardiopulmonary testing is useful for more accurately predicting risk.

Approach to the Patient

The figure presents in algorithmic form a framework for determining which patients are candidates for cardiac testing. Given the availability of this evidence, the AHA/ACC Writing Committee chose to include the level of the recommendations and strength of evidence for many of the pathways. Importantly, the value of adopting the algorithm depends upon local factors such as current perioperative risk and rate of utilization of testing.

Step 1: The individual should determine the urgency of noncardiac surgery. In many instances, patient- or surgery-specific factors dictate an obvious strategy (eg, emergent surgery) that may not allow for further cardiac assessment or treatment.

Step 2: Does the patient have 1 of the active cardiac conditions? In patients being considered for elective noncardiac surgery, the presence of unstable coronary disease, decompensated heart failure, or severe arrhythmia or valvular heart disease usually leads to cancellation or delay of surgery until the cardiac problem has been clarified.
and treated appropriately. Examples of unstable coronary syndromes include previous MI with evidence of important ischemic risk by clinical symptoms or noninvasive study, unstable or severe angina, and new or poorly controlled ischemia-mediated heart failure. Depending on the results of the test or interventions and the risk of delaying surgery, it may be appropriate to proceed to the planned surgery with maximal medical therapy.

Step 3: Is the patient undergoing low-risk surgery? In these patients, interventions based on cardiovascular testing in stable patients would rarely result in a change in management, and it would be appropriate to proceed with the planned surgical procedure. Step 4: Does the patient have moderate functional capacity without symptoms? In highly functional asymptomatic patients, management will rarely be changed on the basis of results of any further cardiovascular testing and it is therefore appropriate to proceed with the planned surgery. If the patient has poor functional capacity, is symptomatic, or has unknown functional capacity, then the presence of clinical risk factors will determine the need for further evaluation. If the patient has no clinical risk factors, then it is appropriate to proceed with the planned surgery, and no further change in management is indicated.

If the patient has 1 or 2 clinical risk factors, then it is reasonable either to proceed with the planned surgery, with heart rate control, or to consider testing if it will change management. In patients with 3 or more clinical risk factors, if the patient is undergoing vascular surgery, recent studies suggest that testing should only be considered if it will change management. In nonvascular surgery in which the perioperative morbidity related to the procedures ranges from 1% to 5% (intermediate-risk surgery), there are insufficient data to determine the best strategy (proceeding with the planned surgery with tight heart rate control with beta blockade or further cardiovascular testing if it will change management).

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. 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. 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. Beattie and colleagues demonstrate that stress echocardiography has better negative predicative characteristics than thallium imaging. They found that moderate-to-large perfusion defect by either test predicts postoperative MI and death.

Interventions for patients with documented CAD
There is increasing evidence that coronary revascularization before noncardiac surgery does not reduce the incidence of perioperative cardiac morbidity. McFalls and colleagues reported the results of a multi-center randomized trail in the Veterans Administration Health System in which patients with documented coronary artery disease on coronary angiography (CARP), excluding those with left main disease or severely depressed ejection fraction (<20%), were randomized to coronary artery bypass grafting (CABG) or percutaneous coronary interventions (PCI) versus routine medical therapy. 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). In a follow-up analysis, Ward and colleagues reported improved outcome in the...
subset who underwent CABG compared to PCI.[19] When patients who underwent coronary angiography in both the randomized and nonrandomized portion of the CARP trial, only the subset of patients with unprotected left main disease showed a benefit with preoperative coronary artery revascularization.[20] Poldermans and colleagues randomized 770 patients having major vascular surgery and considered as having intermediate cardiac risk, defined as the presence of 1 or 2 cardiac risk factors to either undergo further risk stratification with stress imaging or proceed right to surgery.[21] All patients received preoperative bisoprolol with a targeted heart rate (HR) of 60-65 initiated before, and continued after surgery. The 30 day incidence of cardiac death and non-fatal MI was similar in both groups (1.8% in the no testing group versus 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, and testing only delayed necessary vascular surgery. In a pilot study (DECREASE V), 101 patients with 3 or more risk factors and a markedly positive stress test were randomized to coronary revascularization versus medical therapy. In those patients in whom there was successful revascularization, there was significant improvement in long-term outcome.[22]

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.[23] Coronary stent placement may be a unique issue and several studies suggest that a minimum of 30 days is required before the rate of perioperative complications is low.[24-27] Several reports suggest that drug-eluting stents may represent an additional risk over a prolonged period (up to 12 months), particularly if antiplatelet agents are discontinued.[28] However, a recent case series suggests that an elevated risk continues beyond 1 year.[29] The new Guidelines suggest continuing aspirin therapy in all patients with a coronary stent and discontinuing clopidogrel for as short a time interval as possible for patients with bare-metal stents <30 days or drug-eluting stents <1 year. Based upon the non-perioperative literature, there is a suggestion that hold clopidogrel for the traditional 8 days may actually increase risk associated with a hypercoagulable rebound suggesting a shorter period of time may be optimal. 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.[30, 31] However, newer studies have demonstrated that beta blockers may not be effective if heart rate is not well controlled, or in lower risk patients.[32-34] The POISE trial was published in which 8351 high-risk beta-blocker naive patients were randomized to high dose metoprolol CR versus placebo.[35] There was a significant reduction of the primary outcome of cardiovascular events, associated with a 30% reduction in MI rate, but with a significantly increased rate of 30-day all-cause mortality and stroke. Patients at intermediate risk were randomized to statin therapy, beta-blocker therapy, both (started on average 30 days in advance) or double placebo. Beta-blocker therapy was associated with significantly decreased cardiovascular events, while statin therapy was not.[36] The current AHA/ACC 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. The new recommendations advocate that beta blockers titrated to heart rate and blood pressure are probably recommended for patients undergoing vascular surgery who are at high cardiac risk owing to coronary artery disease or the finding of cardiac ischemia on preoperative testing (Class IIa). The ESC Guidelines continue to advocate that both recommendations are Class I. Flu et al. demonstrated that β-blocker treatment initiated >1 week before surgery is associated with improved outcome, compared with treatment initiated <1 week pre-operative which is associated with an increased risk of stroke.[37] Wallace et al. reported that perioperative β-blockade administered according to the Perioperative Cardiac Risk Reduction protocol is associated with a reduction in 30-day and 1-yr mortality. [38] Perioperative withdrawal of β-blockers is associated with increased mortality. 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.[39] Most recently, perioperative statins have been shown to improve cardiac outcome. 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.[40] A significant reduction in cardiovascular complications was demonstrated using this protocol. Le Manach and colleagues demonstrated that statin withdrawal greater than 4 days was associated with a 2.9 odds ratio of increased risk of cardiac morbidity in vascular surgery.[41] Most recently, a total of 250 patients were assigned to fluvastatin, and 247 to placebo, a median of 37 days before vascular surgery.[42] Perioperative fluvastatin therapy was associated with an improvement in postoperative cardiac outcome. The recent Guidelines advocate continuing statin therapy in patients currently taking statins as a Class I indication. 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.

References


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