Cardiac Risk Stratification for Noncardiac Surgery

Cardiac risk stratification for noncardiac surgery has evolved through medical technologic and economic revolutions over the past 22 years. Prior to 1977, physicians had only the anesthesia classes 1 to 5 to advise their patients and families of the risks of anesthesia and surgery. This clinical index was subjective and did not predict cardiac morbidity well.1 Goldman et al2 developed the first validated model to predict cardiac complications in a general surgical population. A cardiac risk index for cardiac death and life-threatening complications of myocardial infarction, pulmonary edema, and ventricular tachycardia was defined for patients in four risk classes. Patients with angina were excluded from this early study.

As thallium scintigraphy became widespread and IV dipyridamole became available, Boucher et al3 defined a 30% risk of perioperative ischemic events in patients with redistribution on thallium scans. This launched hundreds of studies and articles to define preoperatively the risk of general anesthesia and surgery in patients with coronary heart disease (CHD).

The original cardiac risk index of Goldman et al2 was modified by Detsky et al4 in 1986 to include angina pectoris, remote myocardial infarction, congestive heart failure, aortic stenosis, and emergency surgery. A simplified scoring system and three classes of risk were validated on patients undergoing vascular and nonvascular surgery.

Combining clinical criteria and thallium scan results in patients undergoing major vascular surgery, Eagle et al5 found five clinical predictors for cardiac complications. An age > 70 years, angina pectoris, diabetes mellitus, Q waves on ECG, and premature ventricular contractions on ECG were found to be predictive of cardiac complications. If the patient had one predictor, there was a 3% risk of cardiac complications. If there were two or three predictors, there was a 3 to 15% risk, which increased to a 30% risk if reperfusion was present on thallium scans. If there were four or five predictors, the risk was > 15% and further preoperative cardiac studies were indicated. From a practical and economic standpoint, these criteria are still used by many clinicians performing preoperative evaluations.

Thallium perfusion scans were utilized extensively until 1991 when Mangano et al6 found that the scan results were not always predictive of ischemic events. The development of stress echocardiography and dobutamine stress echocardiography provided a more convenient and less expensive risk stratification procedure. Poldermans et al7 defined the benefits of dobutamine stress echocardiography for assessment of perioperative cardiac risk in patients undergoing major vascular surgery. The use of atropine to reach target heart rates in patients undergoing dobutamine stress echocardiograms increased the sensitivity and specificity of this test.8

Because of the enormous medical-legal and economic implications of perioperative risk management in patients with CHD, clinical practice guidelines were published by the American College of Cardiology, American Heart Association, and the American College of Physicians.9,10

In response to the membership of the American College of Chest Physicians, this supplement addresses the preoperative risk assessment, the intraoperative management of cardiac and pulmonary monitoring, fluids, and blood transfusions, and the postoperative management of pain, ventilation, nutrition, and renal insufficiency. Special topics of elderly patients and cancer patients are addressed. Evidence-based tables are presented when the literature can provide this analysis.

Preoperative Risk Stratification

Preoperative risk stratification involves examining and testing patients to stratify them on clinical grounds into low-, medium-, and high-risk categories. While intuitively we may believe that physicians can treat patients better with a battery of screening studies, preoperative tests should not be performed unless they will influence patient treatment. Unfortunately, there is little evidence or consensus that screening patients with an ECG, chest radiograph,
pulmonary function test, echocardiogram, or even blood chemistry tests significantly alters the outcomes. These tests can diagnose diseases and are routinely ordered, but in the future must relate to the medical history, proposed operative procedure, and the potential for cardiac morbidity or mortality.

In the preoperative evaluation, liver function tests, renal function tests, hemoglobin, hematocrit, pregnancy testing, coagulation tests, electrolytes, certain drug levels, and urinalysis should be ordered for specific indications.

Patients with unstable coronary syndromes require evaluation and treatment prior to elective noncardiac surgery. In the critical care unit, cardiac patients in unstable condition with congestive heart failure, cardiac arrhythmias, and metabolic abnormalities require invasive monitoring individualized to the anticipated perioperative problems. In the high-risk surgical patient undergoing prolonged surgery, with the potential for blood loss or hemodynamic instability, pulmonary artery monitoring should be utilized.

Asymptomatic patients who have had coronary revascularization within 5 years or normal results of noninvasive evaluations within 2 years usually do not need to undergo risk stratification. Guidelines recommend elective surgery be postponed for 6 weeks after acute myocardial infarction. To our knowledge, no studies of coronary angiography findings as predictors of perioperative risk are available, and there are no prospective evaluations of preoperative percutaneous transluminal coronary angioplasty or coronary stent placement. Coronary revascularization has not been shown to reduce short-term mortality in patients undergoing noncardiac surgery. In patients with CHD who are undergoing vascular surgery and are at intermediate or high risk, we recommend either noninvasive dobutamine stress echocardiography or dipyridamole thallium scintigraphy to define the risk of perioperative ischemic complications.

**Comorbid Factors**

Weight loss, hypoalbuminemia, and protein calorie malnutrition are predictors of high postoperative complications, including infections, multiple organ dysfunction, and delayed wound healing. The nutritional status of the critically ill patient undergoing surgery can be enhanced by enteral feedings, which are presently underutilized in clinical practice. Perioperative enteral tube feeding is well tolerated and improves postoperative morbidity and mortality.

Chronic lung disease is the most significant risk for postoperative pulmonary complications. In patients with pulmonary disease, smoking cessation, weight loss, and chest physiotherapy have some benefit in reducing pulmonary complications of general anesthesia and surgery. Bronchodilators and steroids decrease the risk of postoperative pneumonia in selected patients with COPD. In patients with moderate or severe COPD, measurements of spirometry, arterial blood gases, and O₂ saturation should be obtained before lung resection or before general anesthesia if there have been changes in the patient’s respiratory symptoms.

**Recommendations for Future Directions in Research**

Providing cost-effective quality care in a managed care environment requires improved communication among specialists involved in the care of the patient during the perioperative period. This includes determining which tests provide the most cost-efficient information that affects the patient’s outcome. Future clinical research should address the cost-effectiveness of preoperative risk stratification testing. Well-designed studies are needed to determine which noninvasive tests can improve risk stratification among intermediate-risk patients undergoing nonvascular surgery. Studies are needed to define the role of prophylactic revascularization in reducing perioperative myocardial ischemia and death.

For the perioperative period, further research is needed to define the benefits of prophylactic nitrate, β-blocker, and calcium channel blocker therapies in intermediate- and high-risk patients. Nutritional studies are needed to compare the benefits of enteral vs parenteral nutritional support in improving outcomes related to infections, multiple organ dysfunction, wound healing, and functional recovery.

Future guidelines should also address the optimal care of patient subgroups, including the elderly, women, and patients with coexisting chronic pulmonary, renal, nutritional, metabolic, neurologic, and endocrine diseases.

**References**


