Perioperative Management of the Patient with Coronary Artery Disease

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In 1996 the American College of Cardiology and American Heart Association (ACC/AHA) published guidelines for perioperative cardiovascular evaluation for noncardiac surgery (1); these were updated in 2002 (2). The guidelines present an organized approach to the surgical patient with known or suspected cardiac disease, based on the presence of "clinical predictors" (history, medical conditions), functional capacity, and procedure-related surgical risk. The interaction of these factors determines the need for noninvasive testing, possibly leading to coronary angiography and revascularization in a small percentage of patients. Patients with a reliable history of good exercise tolerance should rarely require assessment of coronary status (e.g., noninvasive testing or coronary angiography). Patients with risk factors and exercise tolerance that is difficult to assess should probably have noninvasive testing to assess for inducible ischemia. This is especially true if they are presenting for vascular surgery.

Preoperative Management

Preoperative "optimization" of medical status is always a desirable goal, which in the case of coronary artery disease (CAD) could mean either maximum medical management to control ischemia or a revascularization procedure. Patients with new or changing ischemic symptoms should not have elective surgery until this has been addressed. For patients with stable symptoms or with ischemia elicited only by a noninvasive test, the approach is controversial. A recent study by McFalls et al. (3) found no benefit from coronary artery bypass grafting (CABG) before aortic or lower extremity vascular surgery in patients with moderate coronary disease (1 of 3 had 3-vessel disease; none had >50% left main disease). The risks of coronary surgery add morbidity and cost to that of the planned surgery (4), angioplasty may be associated with adverse outcomes in some populations (5), and angioplasty/stent placement may result in acute mortality if surgery follows in less than a month (6).

Data from two randomized clinical trials demonstrate a reduction in adverse cardiac outcomes with the use of perioperative β-blockade for vascular surgery. In a study by Mangano and Wallace (7,8), patients with risk factors for or a known history of CAD received acute perioperative β-blockade with atenolol and had a reduced incidence of perioperative ischemia and fewer cardiac events on follow-up. In a study by Poldermans et al. (9), patients with positive dobutamine stress echocardiograms received oral bisoprolol for several weeks perioperatively; the decrease in cardiac events with β-blockade was striking. The actual degree of coronary disease in the Mangano study was not documented; in the Poldermans study patients with inducible wall motion abnormalities of large areas of the myocardium were excluded. In a follow-up analysis of the Poldermans data, Boersma et al. (10) suggest β-blockade slightly reduced ischemic events in patients with <3 risk factors for CAD (age ≥70 yr, angina, myocardial infarction [MI], congestive heart failure [CHF], prior cerebrovascular accident [CVA], diabetes, and renal failure) and dobutamine stress echocardiography (DSE) was of minimal value. In patients with 3 or more risk factors without wall motion abnormalities on DSE, β-blockade reduced events significantly, but in those with 3 or more risk factors and modest wall motion abnormalities (up to 4 motion segments), β-blockade was associated with a dramatic reduction in events.

Although some perioperative myocardial infarctions occur as a result of plaque rupture, often at noncritical lesions, Landesberg (11) has provided data suggesting most are "stress related," resulting, in part, from tachycardia, occurring without vessel occlusion. Ellis et al. (12) studied a population of patients who underwent coronary catheterization before and after surgery and found many infarctions occurred in areas distal to a preoperative occlusion, supplied by (inadequate) collaterals, and others occurred without any occlusion being observed. These findings may explain the relative lack of benefit from revascularization procedures in moderate coronary disease and the benefit from β-blockade in these same patients. On the other hand, if severe 3-vessel disease or significant left main disease is identified before elective major surgery, revascularization ought to be seriously considered, just as it would if surgery were not planned.

Perioperative treatment with α-2 agonists may reduce the incidence of myocardial ischemia (13,14). A case-control study suggests patients receiving statin drugs at the time of surgery may have a decreased mortality (15). On the other hand, sulfonylurea hypoglycemic drugs may interfere with myocardial preconditioning mechanisms (16).

Intraoperative Monitoring

London et al. (17) demonstrated that the V5 lead of the electrocardiogram (ECG) is the single most sensitive lead for detecting perioperative ischemia, with approximately 75% the sensitivity of all 12 leads. Although the V4 lead was almost as good in this study, a more recent publication by Landesberg et al. (18) suggests V4 is the most sensitive. Both studies indicate 2 or 3 precordial leads will detect more than 90% of ischemia available from all 12 leads, but most operating room monitors will not support multiple precordial lead monitoring. The ECG with ST segment trending of at least 2 leads should be considered a standard monitor for all patients with coronary artery disease.

Whether patients with coronary disease should be monitored with pulmonary artery catheters (PACs) or transesophageal echocardiography (TEE) is controversial. Although both of these techniques can detect ischemia, comparative studies have failed to demonstrate that either technique provides a benefit over 2-lead ECG monitoring (19,20). Two randomized trials in abdominal aortic surgical patients failed to demonstrate a benefit with the use of pulmonary artery (PA) catheters, although treatment algorithms based on information from the PACs were not used in either study (21,22). Guidelines for the perioperative use of PACs published by the American Society of Anesthesiologists (23) and for perioperative use of TEE published by the Society of Cardiovascular Anesthesiologists (24) do not recommend use of these technologies for routine monitoring in patients with CAD. They should be considered when there is a diagnostic or treatment question that can be answered or guided by the additional information or where there is a known history of cardiac dysfunction such as CHF in a patient undergoing major surgery.

Anesthetic Technique

Beyond the adherence to fundamental principles of maintaining coronary perfusion pressure and avoiding increases in myocardial oxygen demand—in particular, tachycardia, there is no scientific basis for recommending any particular anesthetic agent or technique in the patient with CAD. That having been said, there is now considerable laboratory evidence and emerging clinical evidence that volatile anesthetic agents may have cardioprotective properties. Seven original articles on this topic appeared in the July 2002 *Anesthesiology*, with editorial comment summarizing this exciting possibility (25). In patients undergoing CABG, volatile anesthetic based anesthetic protocols (desflurane and sevoflurane) were associated with less myocardial enzyme release than IV drug based protocols (midazolam or propofol) (26).

A meta-analysis of 141 trials evaluating intraoperative neuraxial-blockade suggested significant reductions in mortality and complications with spinal or epidural anesthesia (27); however, a large randomized trial of perioperative epidural-blockade in major surgery failed to confirm these findings (28). In this latter study there was a clear benefit in terms of pain control and an apparent reduction in respiratory failure (rather loosely defined to include reintubation immediately after surgery). The authors suggested "many high risk patients undergoing major intra-abdominal surgery will receive substantial benefit from combined general and epidural anesthesia intraoperatively with continuing postoperative epidural analgesia," although there were no cardiac benefits documented in this study of 915 patients.

Although more than 50% of intraoperative ECG-detected ischemic episodes do not appear to be related to hemodynamic changes, there is an association between tachycardia and ischemia both intraoperatively and postoperatively (29,30). Landesberg et al. (11) found most, if not all, significant myocardial enzyme release after vascular surgery was preceded by prolonged period of ST segment depression, usually associated with tachycardia. Avoidance of major changes in coronary perfusion pressure and heart rate should be a priority in these patients. Preoperative anemia and perioperative hypothermia have been associated with adverse cardiac outcomes (31,32).

Postoperative Management

The risk of perioperative myocardial infarction continues into the first postoperative week; continuation of β-blockade into this period is probably essential for the protective effects documented above. Continuation of ECG or other monitoring into the postoperative period has not been evaluated in a prospective trial. Le Manach et al. (33) recently reported that even relatively low levels of troponin I release after major vascular surgery are associated with adverse cardiac outcome. It may be that "routine" sampling for this enzyme in these high-risk patients (major vascular surgery) would afford an early opportunity to intervene. Many ischemic episodes are associated with tachycardia, which may be related to the sympathetic stimulation which occurs with pain. Beta adrenergic-blockade cannot substitute for adequate analgesic techniques.

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