THE POST MYOCARDIAL INFARCTION SURGICAL PATIENT

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Postoperative myocardial infarction is the leading cause of morbidity and mortality in the surgical patient. The overall incidence of myocardial infarction in the postoperative patient is generally considered to be 0.15% of all surgeries. However, the occurrence is much greater in patients with a history of prior myocardial infarction or significant risk factors, which predispose the patient to cardiac complications in the peri-operative setting.

The overall reinfarction rate in patients with a prior MI was originally reported to be 5-8%. Fifteen to thirty percent suffered a reinfarction if surgery was within three months, and ten to fifteen percent suffered a reinfarction if the time interval was from three to six months following the initial insult. Subsequently, the rate stabilized at 2-6% if more than six months elapsed between original infarction and surgery. Of the patients who suffered a reinfarction, the mortality rate was reported from 23- 86%. However, with the development of more sophisticated monitoring techniques and instruments, and specific pharmacologic agents to treat peri-operative alterations in vital functions, the risk of reinfarction has precipitously fallen according to recent studies.

Rao et al. reported a six year study of 733 surgical patients who had a prior history of myocardial infarction. The reinfarction rate was 5.8% within three months, and 2.3% within six months. Thereafter, the reinfarction rate stabilized at 1.7%. The authors attributed this reduction in the reinfarction rate to invasive monitoring and rapid treatment of cardiovascular variables which deviated from standard values. Strict monitoring began intraoperatively and followed for 96 hours. It is well established that it is this time period when reinfarction is most likely to occur, with the third postoperative day being the most frequent.

RISK FACTOR IDENTIFICATION

Pre-operative patient evaluation with a thorough history and physical examination will facilitate identification of patients at risk for cardiac complications in the operative setting. (Table 1) Not surprisingly, the majority of these risk factors are

TABLE 1

Cardiac Risk Factors

- Myocardial Infarction within six months
- Severe congestive heart failure on physical exam
- Abnormal rhythm on ECG
- More than five PVC's per minute on ECG
- Age > 70
- Unstable angina pectoris
- Hypertension
- Cardiac hypertrophy
- Family history of coronary artery disease
- Diabetes mellitus
- Peripheral vascular disease
- Carotid bruit
- Dyspnea on exertion, orthopnea, paroxysmal nocturnal dyspnea
- Hypokalemia (<3.0 mEq/L)
- Blood urea nitrogen >50 mg%
- Hypercholesterolemia
- History of cigarette smoking

identifiable through a thorough history and physical examination.

A leading cause of death in the elderly is cardiovascular disease. Thus, age as a risk factor becomes more significant, particularly in patients over 70 years of age. The relationship between age and surgical mortality climbs exponentially after the age of 40, and increasing age correlates with a depressed cardiac response to stress and catecholamine release. Subsequently, cardiovascular complications in this population are more frequently observed with a much more severe outcome.

The diabetic patient is predisposed to early onset coronary artery disease, the leading cause of death in adult diabetics. The detection of cardiac symptoms is often masked in diabetics, as a large percent of these patients demonstrate ECG evidence of prior silent painless myocardial infarctions, and invasive stress tests frequently demonstrate perfusion defects in asymptomatic diabetic males. Peripheral vascular disease, which is also common in the diabetic, is associated with coronary artery stenosis. These patients may or may not present with angina pectoris.

Hypertensive patients are at an increased risk for cardiovascular complications and systolic blood pressure correlates with postoperative morbidity. With the additional factors of hypercholesterolemia, cigarette smoking, and ECG changes, the risk of fatal MI is markedly increased in the patient with diastolic hypertension (>90mm Hg). A search for end organ damage (CNS, kidney, coronary arteries, peripheral blood vessels) is warranted in patients presenting with hypertension. Untreated hypertension leads to an increased incidence of myocardial ischemia and infarction, but few patients present today with severe labile hypertension. The decline in death due to hypertensive cardiovascular disease over the last fifteen years correlates directly to successful control of hypertension, but controversy still exists, however, with regards to the surgical risks associated with mild to moderate hypertension. In the well managed, mild to moderately hypertensive patient undergoing minor surgery, there is no conclusive evidence to suggest increased perioperative risk. Recommendations suggest continuing antihypertensive medications pre-operatively and alerting the anesthesiologist of recent changes in medication or pattern of symptoms. Elective surgery in the untreated hypertensive patient should be postponed until optimal control is achieved.

Optimizing the status of patients with coronary artery disease often includes invasive techniques such as coronary artery bypass grafting (CABG) and coronary angioplasty. Patients with a previous CABG have a significantly reduced risk of a peri-operative myocardial infarction in non-cardiac surgery, but this protection is likely to diminish with time.

PRE-OPERATIVE TESTING

When determining which pre-operative tests should be performed, it is necessary to determine:

1. Which tests are most likely to identify subclinically compromised cardiac patients?
2. In patients with known CAD or a history of MI, what information is needed to optimize their pre-operative cardiac status?

Routine screening should be based on risk factors which are most likely to be identified or treated prior to surgery. Based on age alone, the elderly have the highest predictive value in identifying true pathology, and the lowest incidence of false positive tests. Second to age, symptomatology based on history and physical findings should direct the testing in pre-operative patients.

The presence of an ECG abnormality directly correlates with adverse outcome, and is a sensitive indicator of potential complications. Since the incidence of organic heart disease increases exponentially with age, all patients over 60 years of age should have a screening ECG. Patients with known CAD should have a 12-lead ECG to determine the presence and location of previous MI, left ventricular hypertrophy (LVH), conduction abnormalities, or ST-T wave changes indicating ischemia. If an abnormality is present, comparison to an old ECG is necessary to determine the chronicity of the abnormality. An ECG is also indicated, irrespective of age, in patients with known risk factors or clinically suspicious findings on physical examination.

Obtaining a pre-operative chest X-ray is also only indicated based on age (>60 years old) and clinical findings. A routine chest X-ray is unjustified in otherwise healthy patients under the age of 40, and questionable in the 40-60 age range.

Significant clinical findings include a history of cigarette smoking, environmental exposure to toxins, pulmonary compromise, hypertension, or heart disease/heart failure.

Functional studies such as the Exercise Treadmill Test (ETT) are important in identifying CAD in the patient with chest pain of unknown etiology. However the predictive value of an ETT is not significantly more effective than a routine ECG in identifying surgical patients at risk for cardiac complications. Dipyridamole (Persantine, a coronary artery vasodilator)-Thallium imaging is currently being used to detect and quantify coronary artery stenosis as small as 30%. In the initial scan, an area of perfusion defect presents as a decreased image intensity, and a repeat scan 2-3 hours after the initial thallium infusion demonstrates an increased intensity in the so-called "reperfusion abnormality" due to impaired clearance of thallium from the compromised myocardium.

In compiling information on the pre-operative patient pertaining to cardiovascular risk factors, one must weigh the risk versus benefit of the proposed procedure. Fortunately, most podiatric procedures are elective in nature and can be postponed until proper evaluation is performed. Emergency surgery (traumatic or septic patients) must often be performed in the presence of known cardiovascular risk factors, and medical optimization must be obtained pre-operatively.

INTRA-OPERATIVE CONSIDERATIONS

Intra-operative decision making can adversely influence complications in patients with known cardiovascular risk factors and in patients susceptible to transient alterations in vital functions. Avoidance of myocardial ischemia intra-operatively correlates with improved outcome. The release of endogenous catecholamines stresses the myocardium and can induce arrhythmias or hypertension. Therefore, avoidance of stressful stimuli aids in circumventing ischemic events. Pain is the most common cause of patient stress, and minimizing pain aids in avoiding fluctuations in vital functions. A relatively atraumatic local anesthesia nerve block with a small bore needle administered slowly can significantly reduce the stress response to pain.

The choice of anesthesia can influence the intra-operative clinical course as well as postoperative complications. Regional anesthesia is generally considered to be safer than general anesthesia in patients with coronary artery disease due to the hemodynamic changes which occur with induction and emergence. When general anesthesia is indicated, a smooth and rapid induction and intubation prevents the rise in blood pressure and heart rate so commonly observed. This is of importance since extremes in intra-operative blood pressure affect myocardial oxygen supply and demand.

The use of pharmacologic therapy to treat intra-operative myocardial ischemia has proven beneficial to peri-operative morbidity and mortality. The most common agents used include the nitrates, B-adrenergic blockers, and slow calcium channel antagonists.

Surgery on the lower extremity commonly employs the use of pneumatic tourniquets to aid in hemostasis and facilitate dissection, thus decreasing the operative time. Prolonged tourniquet use (>1 hour) results in tourniquet pain, which is often unrelieved by intravenous narcotics or sedatives. Systemic hypertension is commonly observed representing cellular ischemia, and tourniquet deflation is associated with the release of toxic metabolic products, and a rapid and profound fall in both central venous and arterial pressures. Sudden cardiac arrest has been observed in this setting. Location of the tourniquet also correlates with observed changes, in that a thigh tourniquet occludes a greater mass of tissue than an ankle tourniquet, and the injudicious use of thigh tourniquets in forefoot surgery out of convenience must be seriously challenged. Finally, an increased length of surgery corresponds to an increased incidence of cardiovascular related morbidity and mortality.

POSTOPERATIVE CONSIDERATIONS

The postoperative state has been identified as the most crucial time for the development of myocardial ischemia and infarction. The onset of pain and release of endogenous catecholamines, a hyper-coagulable state and platelet adhesiveness, anemia from blood loss, and the release of vasoactive mediators of tissue repair (thrombox-

ane), contribute to the development of postoperative cardiovascular complications.

It is well established that the first 92 hours following surgery is the time when most complications occur, with the third postoperative day exhibiting the majority of myocardial infarctions. Detection of myocardial infarction is commonly masked by administered narcotics which eliminates the normal chest pain response. The sudden appearance of shock, dyspnea, cyanosis, tachycardia, arrhythmia, or congestive heart failure, should alert the clinician to the diagnosis. It is not beyond reasonable considerations to routinely monitor postoperative patients with a history of prior myocardial infarction in an intensive care unit, since the mortality rate is about 30% for new infarctions following surgery. Daily monitoring with an ECG, serum SGOT, and CPK-MB isoenzyme will determine whether an infarction has occurred. Arterial blood gasses will differentiate cardiac from respiratory conditions.

Early mobilization has been identified as critical in the rehabilitation of the post-myocardial infarction patient, and the "sitting position" increases peripheral venous pooling, decreased venous return, and reduced cardiac work. Other beneficial effects include a lower incidence of thromboembolic and respiratory complications. The guidelines for early mobilization include a daily supervised, low-level intensity, gradually progressive, isotonic regime for return to activity. In addition, the use of a bedside commode has been recommended over using a bedpan, due to avoidance of the Valsalva maneuver, which increases myocardial stress and oxygen consumption.

Patients with a history of significant cardiac risk factors present a special challenge to the surgeon, cardiologist, and anesthesiologist, and a thorough work-up including a complete history and physical examination will alert the clinician to the proper pre-operative diagnosis. Routine tests should be ordered based on these clinical findings, and the patient with a prior myocardial infarction should wait at least six months to have elective surgery performed. Intra-operative consideration should be given to the use of regional anesthesia and ankle tourniquets as opposed to general anesthesia with a thigh tourniquet for every surgical patient. Finally, postoperative care of patients at risk for cardiovascular complications should include close monitoring of vital signs, early ambulation, and adequate management of pain.

RISK MANAGEMENT CONCERNS

Pre-operative patient evaluation with a thorough history and physical examination will facilitate identification of patients at risk for cardiac complications in the operative setting. Not surprisingly, the majority of these risk factors are identifiable through a thorough history and physical examination.

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