Review Article

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Perioperative considerations in the management of a patient with coronary artery disease undergoing noncardiac surgery

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ABSTRACT

Patients with cardiac disease presenting for non cardiac surgery pose considerable challenge. They are prone to develop serious perioperative complications such as myocardial infarction (MI), arrhythmias and pulmonary insufficiency. It is generally agreed that the number of patients with cardiac disease undergoing noncardiac surgery is on the increase. This may be due to the fact that percentage of older patients presenting for surgery is increasing. Whatever may be the situation, the clinicians must be familiar with the pathophysiology of the cardiac lesion, the risk indices of cardiac lesions and the management strategies of cardiac lesion. This helps to make an accurate assessment of the patient and offer the optimum management that minimizes the perioperative cardiac morbidity. He should also be aware of the possible interactions between the cardiac lesion and the disease for which noncardiac surgery is undertaken.

This article briefly summarises the perioperative considerations in the management of a patient with CAD undergoing noncardiac surgery.

Key Words : Perioperative Evaluation, Non Cardiac surgery, Coronary artery disease, beta blockers, Statins.

Introduction -

Patients with cardiac disease presenting for noncardiac surgery pose considerable challenge. They are prone to develop serious perioperative complications such as myocardial infarction (MI), arrhythmias and pulmonary insufficiency. It is generally agreed that the number of patients with cardiac disease undergoing noncardiac surgery is on the increase. This may be due to the fact that percentage of older patients presenting for surgery is increasing. With improvement in the cardiac surgical results, a large number of patients who have undergone corrective cardiac surgery are also subjected to noncardiac surgery. These patients, of course, are easier to manage as their cardiac pathophysiology has been restored to normal or at least near normal. However, they might need alterations in their medication such as anticoagulant therapy. The management of patients who have cardiac disease should be based on the following principles.

1. If the surgery is elective or less urgent and the cardiac disease is of such a magnitude that surgical correction is indicated, then it is preferable to perform the cardiac surgery [or some relevant interventional procedure such as percutaneous transluminal coronary angioplasty (PTCA) for coronary artery disease (CAD) or balloon mitral vlvotomy (BMV) for mitral stenosis (MS)] before noncardiac surgery is attempted. Alternately, if the cardiac disease does not warrant surgical correction, then the medical management should be optimised before subjecting the patient to noncardiac surgery.
2. If the surgery is of emergent nature and does not allow sufficient time for the treatment of cardiac lesion, then surgery should be undertaken with an elevated or low risk. This stratification should be decided after preoperative evaluation. However, an attempt should be made to optimize the cardiac condition by medical management (such as diuretics, inotropes, dilators) or mechanical

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support [such as intra-aortic balloon pump (IABP) counterpulsation], before and during noncardiac surgery.

Whatever may be the situation, the clinicians must be familiar with the pathophysiology of the cardiac lesion, the risk indices of cardiac lesions and the management strategies of cardiac lesion. This helps to make an accurate assessment of the patient and offer the optimum management that minimizes the perioperative cardiac morbidity. He should also be aware of the possible interactions between the cardiac lesion and the disease for which noncardiac surgery is undertaken.

This article briefly summarises the perioperative considerations in the management of a patient with CAD undergoing noncardiac surgery.

Coronary Artery Disease -

CAD is a very common cardiac disease and many patients are subjected to noncardiac surgery. CAD represents a significant cause of perioperative morbidity and mortality. Proper preoperative evaluation of these patients is crucial to identify those with either acute myocardial infarction (MI) or unstable angina. Traditionally, during preoperative evaluation, clinicians have attempted to have complete understanding of the patients' cardiovascular status. The information so obtained is expected to modify preoperative medical interventions as the perioperative management including aggressive treatment of haemodynamic disturbances during surgery. Sometimes, patients may be subjected to coronary revascularization before the noncardiac surgery is undertaken. Although, there are no randomized trials to address this issue, several studies have suggested that patients who have undergone coronary artery bypass grafting (CABG) have a low risk of subsequent noncardiac surgery.[1] It has been shown that the postoperative MI rates as well as 30-day mortality rate is decreased as the interval between MI and the operation is increased up to six months.[2] This risk was modified by the presence and type of coronary revascularization, CABG versus percutaneous coronary intervention (PCI) that occurred at the time of MI.[3] The data suggest that = 60days should elapse after MI before noncardiac surgery in the absence of coronary intervention.[4] Some other factors such as age and physical well being should be considered before subjecting the patient to CABG, e.g. a 75 or 80 year old diabetic patient with significant co-morbid disease may not benefit much by undergoing coronary revascularization (unless he has unstable angina). On the contrary, a 50 year old man with CAD, is likely to derive significant benefit from preoperative cardiovascular investigations and coronary revascularisation. Patient's age is also important in determining the risk of ischaemic stroke, a higher incidence of stroke is reported in patients more than 65 years of age.[5] It has been shown that recent MI (less than 6 months) is an independent risk factor for perioperative stroke leading to eight-fold increase in mortality.[6] These data perhaps indicate that six months is an ideal time interval between MI and noncardic surgery.

Prior PTCA is also expected to improve the outcome following noncardiac surgery. It was shown that the overall mortality and infarction rate after noncardiac surgery was reduced significantly soon after PTCA (within 11 days).[7] Similar results were not observed after bare metal stent (BMS) placement. A study assessed the clinical course of patients who underwent PTCA with BMS placement six weeks before noncardiac surgery.[8] It was shown that all deaths and MIs occurred in patients subjected to surgery fewer than 14 days from stenting. It was concluded that elective noncardiac surgery should be postponed for two to four weeks after coronary stenting to permit completion of the mandatory antiplatelet regimen, thereby reducing the risk of stent thrombosis and bleeding complications.

The evolution of drug eluting stents (DES) has changed the scenario, in the sense that dual antiplatelet therapy (clopidogrel and aspirin) is to be continued for at least 1 year after implantation of the DES. This is in order to allow the completion of the endothelialization process. The discontinuation of clopidogrel before 1 year of implantation of DES poses the risk of stent thrombosis. Hence the current American College of Cardiology (ACC) / American Heart Association (AHA) guidelines[4] recommend

that : 1. Elective noncardiac surgery shall be delayed 30 days after BMS implantation and 365 days after DES implantation, 2. Elective noncardiac surgery after DES implantation may be considered after 180 days, if the risk of further delay is greater than the expected risk of ischaemia and stent thrombosis, 3. Elective noncardiac surgery is considered harmful within 30 days after BMS, and within 12 months after DES, if antiplatelet medicine and aspirin need to be discontinued perioperatively.

Preoperative Evaluation -

Preoperative evaluation is performed not simply to give medical clearance, but should include evaluation of the patient's current medical status as well as the recommendations concerning the management and risk of cardiac problems over the entire perioperative period. The consultant may recommend changes in medication, suggest preoperative tests or procedures or propose higher levels of care postoperatively. In general, preoperative tests are not recommended, if the functional capacity of the patient is good (4-10 METs). Preoperative testing is considered, if the functional capacity cannot be assessed or if the information obtained will result in a change in the surgical procedure performed, a change in medical therapy or monitoring during or after surgery. The current ACC / AHA guidelines are slightly different than the earlier ones. The major clinical predictors or the active cardiac conditions are not a consideration and do not find a place in the algorithm for the management of patients. The diagnosis of CAD or presence of risk factors for CAD is considered.

The clinical risk factors with the exclusion of the type of surgery, (which is incorporated elsewhere in the approach to the patient) include the following.

- Heart failure
- Insulin dependent diabetes mellitus
- creatinine = 2 mg/dL
- History of cerebrovascular accident
- Ischaemic heart disease

A patient with zero or one predictors of risk is considered to have a low risk of major adverse cardiac event (MACE), while patients with = 2 predictors of risk have an elevated risk.

The functional status of the patient based on the metabolic equivalent (MET) should also be assessed. [1 MET represents the oxygen consumption of a resting adult (3.5 mL/Kg)]. If the patient is unable to meet a 4 MET demand (1 to 4 MET includes activities such as eating, dressing, walking around the house and dish washing), perioperative cardiac and long term risks are increased. The risk assessment should also include the type of surgery, which has been modified into only two classes as under.

- Low risk (< 1% risk of MACE), e.g. cataract, plastic surgery
- Elevated risk (risk of MACE > 1%)

Based on the presence of CAD or risk factors for CAD, functional class, and the type of surgery, the ACC/AHA has suggested an algorithm for the management of the patients undergoing noncardiac surgery. In essence, it suggests that : 1. In case of emergency, one should proceed with surgery with clinical risk stratification, 2. In elective surgery in patients with acute coronary syndrome (ACS), further evaluation is necessary if the patient is undergoing elevated risk surgical procedure and the functional class is < 4 or is not known. If testing is abnormal, coronary revascularization should be considered.

The patients may have known CAD or may have a high risk of CAD. In patients having known CAD, the presence of unstable angina has been associated with a high preoperative risk of MI.[9] Such patients should, therefore, be evaluated further by the cardiologist for medical or coronary interventions. In patients with stable angina, the degree of effort that precipitates angina may be a useful guide. The patient who manifests angina after strenuous exercise is a well controlled patient and does not require any change in management. In contrast, a patient who develops dyspnoea with angina on mild exertion would be at a high risk for developing perioperative ventricular dysfunction and MI. These patients have high chances of having severe CAD and additional investigations and monitoring may be necessary. Perioperative MI has been shown to be an

early event after surgery, occasionally associated with chest pain, usually non-Q wave in nature and carries a high mortality.[10]

Presence of CHF preoperatively is associated with increased incidence of perioperative cardiac morbidity.[11] Stabilisation of ventricular function and treatment of pulmonary congestion is necessary prior to elective surgery.

In patients without any history or symptoms of CAD, several factors that predispose to CAD may be present. These include peripheral arterial disease, diabetes, and hypertension. These factors increase the probability of CAD. Adequate control of diabetes and hypertension is desirable as diabetes is an independent risk factor for perioperative cardiac morbidity[12] and hypertensive patients with left ventricular (LV) hypertrophy are at a higher perioperative risk than nonhypertensive patients.

The surgical procedure should also be taken into consideration as different noncardiac operations are associated with different risks of MACE. Plastic surgery and cataract surgery are associated with very low risk of MACE and operations for peripheral vascular disease are among those with highest perioperative risk. An emergency operation is also considered to increase the risk. The intermediate risk category of operations is eliminated from the current guidelines. The American College of Surgeons has developed a new tool of risk assessment : National Surgical Quality improvement Program (NSQIP). The various patient characteristics can be entered into the performa that can be accessed at www.surgicalriskcalculator.com. A score is generated based on which the risk can be assessed. The risk calculator offers the estimation of surgery-specific risk of a MACE and death.

In summary, past medical history of CAD necessitates in-depth investigation of the current cardiac status of the patient. In some patients it may be necessary to carry out tests to better confirm or define CAD. These include pharmacological stress testing, stress echocardiography and ambulatory ECG (Holter) monitoring. These should be carried out according to the recent ACC / AHA guidelines.[4] The ultimate aim is to optimize the patient's medical condition so that perioperative outcome is improved. It is also desirable to inform the patient about the perioperative risks based on the preoperative evaluation.

Perioperative goals -

The main goals are avoiding extremes of blood pressure (BP) and tachycardia. It has been shown that intraoperative tachycardia and hypertension are associated with negative postoperative outcomes (hospital stay of more than 10 days with a morbid condition or death during the hospital stay) after major noncardiac surgery of long duration.[13] The authors suggested that intraoperative tachycardia and hypertension may have independent effects on outcome over and above the risk imparted by the underlying medical conditions. Although, ischaemia is known to occur even in the absence of significant haemodynamic changes, careful monitoring is essential. It is conceivable that patients with active ischaemia prior to the operation will require more aggressive monitoring and treatment than those with chronic stable ischaemic heart disease. The monitoring for cardiac ischaemia should include at least a multilead ECG. Direct arterial pressure monitoring along with pulmonary artery catheter can be of further help. In addition, if the facility and expertise is available, transoesophageal echocardiography (TOE) can be used to monitor ischaemia (regional wall motion abnormalities). TOE is more sensitive and a faster way of detection of ischaemia than ECG.[14,15]

Haemodynamic control during surgery can be achieved by a meticulously planned anaesthetic technique and pharmacological agents such as nitroglycerin (NTG), beta blockers and calcium channel blockers may be necessary to achieve the desired goal. Perioperative beta blockade is being increasingly utilized particularly in the elevated-risk group of patients undergoing major noncardiac vascular surgery. The anaesthetic management of a patient with CAD undergoing noncardiac surgery is focused towards preventing perioperative MI that carries high morbidity and mortality. Since, prophylactic CABG in patients with stable CAD before high-risk noncardiac surgery has failed to

provide much benefit, attention has been focused on medical management.

Beta-blockers -

By virtue of decreasing myocardial oxygen demand, increasing diastolic perfusion time and reducing the frequency of arrhythmias, beta blockers are expected to decrease myocardial ischaemia and hence perioperative MI. The DECREASE trials and other derivative studies by Poldermans (which formed the basis of some of the recommendations of the 2007 ACC/AHA guidelines) have been retracted and hence, not included in the formulation of the current practice guidelines by the ACC / AHA. The initial randomized trial by Mangano et al[16] was followed by a few others and a comprehensive review by Auerbach and Goldman reported substantial efficacy in patients managed with beta blockers.[17] The meta-analyses by Schouten[18] et al and Devereaux et al[19] revealed conflicting results suggesting either a reduction or no difference in cardiovascular events. Later on meta-analysis by Bangalore et al[20] and the POISE trial[21] demonstrated an increased risk of deaths due to stroke in patients receiving beta blockers. Although, the POISE trial was criticized for high dose of metoprolol and very low target heart rate and blood pressure, the recent meta-analysis[22] and the systematic review by Wijeysundera[23] demonstrated that use of perioperative beta blockers could reduce perioperative cardiac risk but they had significant deleterious association with bradycardia, stroke, and hypotension. The results were similar even after excluding the DECREASE trials from the analysis. Thus, the perioperative beta blockade started 1 day or less before nonardiac surgery helps prevent nonfatal MI, but at the cost of increased risk of stroke, death, hypotension and bradycardia. The recent ACC/AHA guidelines recommend the following -

Class I :

1. Patients who have been on beta blockers chronically (level of evidence, LoE B).

Class IIa :

1. Management of beta blockers after surgery to be guided by clinical circumstances independent of when the agent was started (LoE B)

Class IIb :

1. In patient with intermediate or high risk myocardial ischaemia noted in preoperative tests (LoE C).
2. Patients with 3 or more risk factors (LoE B)
3. Patients with compelling long term indications for beta blockers but no other risk factors (LoE B).
4. It may be reasonable to begin beta blockers long enough in advance of operative date that clinical effectiveness and tolerability can be assessed (LoE B)

Class III : harm

1. Beta blocker therapy should not be started on the day of surgery. (LoE B)

In conclusion, although several issues related to beta blockade need to be addressed, the existing evidence does point towards application of perioperative beta blockade on a selective basis in clinical practice. It appears that it should be continued in patients already on therapy and started in patients with high cardiac risk undergoing elevated risk surgery.

Statins -

3-Hydroxy-3 methylgultaryl coenzyme A inhibitors, usually referred to as statins are commonly prescribed for primary and secondary prevention of cardiovascular events. Although this was considered useful in patients with hypercholesterolaemia, more recently, statins have been used in patients with normal cholesterol levels who are at risk for or are known to have CAD. Therefore, the ACC / AHA guidelines recommend statin therapy for management of patients with unstable angina or MI.[24] The heart protection study demonstrated that cardiovascular event reduction was similar in patients treated with statins regardless of baseline low-density lipoprotein cholesterol concentration.[25] It seems, therefore, that there are mechanisms other than reduction in low-density lipoprotein cholesterol that might play a role. Prominent amongst them are the anti-inflammatory effect (plaque stability), and reduction in vascular smooth muscle proliferation in response to injury. A meta-analysis has demonstrated protenial benefits

of continuing perioperative statin therapy in patients undergoing cardiac, vascular, and all other types of surgeries.[26] The benefit was particularly seen with regards to early mortality and was variable with relation to MI, stroke and arrhythmias. Two recent studies have confirmed these findings.[27, 28] It is important to restart statin early after surgery (oral or via nasogastric tube) as delay (more than 4 days) can result in myonecrosis.[29] The ACC / AHA guidelines[4] recommend that statins should be administered to patients already taking statins and scheduled for noncardiac surgery (class I), patients undergoing vascular surgery with or without risk factors (class IIa), and patients with clinical indications according to guidelines directed medical therapy who are undergoing elevated risk procedures (class IIb). In summary, statins are important class of durgs that decrease cardiovascular morbidity and mortality. However, questions such as type and the dose of statin, and the exact time of initiation of therapy need to be answered.

Inotropes may be required and should be readily available. Because these agents are administered in the form of an infusion, a central venous line should be inserted in these patients. In very sick patients placement of an IABP catheter may be required to support the circulation and has been shown to be beneficial.[30] However, as already emphasized, in nonemergency situations in patients with unstable angina, revascularisation prior to noncardiac surgery must be considered. In this respect it is important to remember that the indications for revascularization remain the same and it is not that the revascularization should be performed just to perform the noncardiac surgery.

Haemodynamic changes associated with laryngoscopy and intubation should be minimized. Administration of adequate doses of analgesics (morphine 5 to 10 mg or fentanyl 5 to 10 µg/Kg) should accompany the induction of anaesthesia. The intravenous induction agent should be properly titrated so that smooth induction and endotracheal intubation are accomplished without coughing, bucking, tachycardia and hypertension. Significant decreases in heart rate and BP should also not occur. The induction agent or the anaesthetic technique is probably less important than the manner in which it is administered. This is easier said than done and perhaps, the experience of the anaesthesiologist is a crucial factor. Thiopentone, midazolam and propofol can be used, but the selection should be based on the individual needs and characteristics of each patient. Hypnotics, inhalational agents and analgesics can be combined along with nitrous oxide for maintenance of anaesthesia. Patients can be extubated at the end of surgery, but depending upon the nature of surgery and the doses of narcotic drugs that have been used, elective ventilation for some duration after the operation can be considered.

Regional versus general anaesthesia -

Although general anaesthesia continues to be the most common anaesthetic technique used for cardiac patients undergoing noncardiac surgery,[18,31] there are a few advocates of regional anaesthesia, at least in patients having certain operations. The onset of angina can be indicated by an awake patient, but vast majority of intraoperative ischaemia can be silent so that angina is not a good monitor of cardiac ischaemia. Some authors have shown that the rates of perioperative adverse cardiac events do not differ when general or regional anaesthesia is used.[32,33,34] Others have shown that the rate of reinfarction is less with spinal anaesthesia as compared with general anaesthesia in patients undergoing transurethral resection of prostate.[35]

Epidural analgesia reduces cardiac preload and afterload, postoperative adrenergic and coagulation responses, and produces coronary vasodilatation (thoracic epidural only). These effects are beneficial to the cardiovascular system and may reduce postoperative myocardial ischaemia. However, evidence showing the benefits of the technique is not currently available.

Non steroidal anti-inflammatory drugs (NSAIDs) such as ketorolac may be useful in patients with CAD, due to their analgesic and antiplatelet effects. However, substantial data are lacking. Concerns about increased postoperative bleeding make the use of these agents in surgical patient controversial. Inhalational anaesthetic gents have been shown to provide pharmacological preconditioning and hence

protection from reperfusion injury.[36] Therefore, they may be considered a good choice in these patients. However, a recent study has failed to demonstrate any decrease in myocardial ischaemia or MI between volatile versus total intravenous anaesthesia in patients undergoing noncardiac surgery.[37]

Patients with intracoronary stents : The patients who have undergone stent placement are on dual antiplatelet regime (clopidogrel and aspirin). The antiplatelet agents pose the risk of excessive surgical bleeding and discontinuing them poses the risk of stent thrombosis and perioperative myocardial infarction. The antiplatelet medication should be continued until the endothelialisation is complete so that the thrombus formation is prevented on the rough surface. In general, the endothelialisation is completed by 2 weeks after angioplasty, 4-6 weeks after BMS placement, and 1 year after the placement of a DES. According to the ACC/AHA guidelines[4], if the stent implantation has been within 4-6 weeks, elective surgery should be postponed for 2 weeks after angioplasty, 30 days after BMS and 1 year after DES placement. For urgent surgery, before the above duration, dual antiplatelet therapy should be continued unless risk of bleeding is greater than the risk of stent thrombosis. If the DES has been implanted > 30 days but <365 days before surgery, if the risk of surgical delay is greater than the risk of thrombosis, proceed to surgery after 180 days, if not, delay surgery until after optimal period (BMS 30 days and DES 365 days). If the DES has been implanted >365 days before surgery, the dual antiplatelet regime should be continued unless the surgery demands discontinuation of clopidogrel inhibitors, in which case aspirin should be continued and clopidogrel should be restarted as soon as possible.

The other aspect of the above discussion is that the cardiologist should defer DES implantation if it is known to him that the patient is awaiting elective surgery. In semi-urgent situations, only angioplasty should be performed so that the semi-urgent noncardiac surgery can be performed after 2 weeks. Once the patient recovers from the noncardiac surgery, BMS or DES can be placed.

In conclusion, a patient with CAD undergoing noncardiac surgery requires careful evaluation and risk assessment. The current ACC/AHA guidelines are useful in this respect. The recommendations for managing the patients with implanted stents are much clearer now and individualized approach as regards the discontinuation of antiplatelet agents should be a consideration. Finally, a team approach amongst surgeons, anaesthesiologists, cardiologists and haematologists is desirable while dealing with such patients.

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