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Original article

Incidence and predictors of perioperative myocardial infarction in patients undergoing non-cardiac surgery in a tertiary care hospital

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ABSTRACT

Background: The stress in the perioperative period is compounded by unpredictable and un-physiological changes in sympathetic tone, cardiovascular performance, coagulation and inflammatory responses, all of which in turn lead to alterations in plaque morphology predisposing to perioperative myocardial infarction (PMI). PMI has a considerable morbidity and mortality in patients undergoing not only high risk surgery, but also even with minor surgical interventions. Objective: To study the incidence of PMI and its predictors in patients undergoing non-cardiac surgery in a tertiary care hospital.Materials and methodsPatients undergoing non-cardiac surgery were included in this prospective single-center observational study. The revised cardiac risk index (RCRI) was used for risk stratification. ECG monitoring was done for all patients. For patients suggestive of acute myocardial ischemia, echocardiography and serum troponin were evaluated. The patient was labelled as having a PMI if there was raised troponin level along with any one evidence of myocardial ischemia (symptoms, ECG changes or imaging results) and in these patients the factors predisposing to PMI were evaluated. All patients in the study were followed up to 30 days.ResultsOf the 525 patients analyzed, 33 patients (6.28%) had a PMI. 12 out of the 33 (36.36%) PMI patients died within 30 days following surgery. Patients undergoing high risk surgery, smokers and patients with a past history of ischemic heart disease were found to be at higher risk of developing PMI. The ASA physical status classification and the RCRI proved to be good predictors of PMI. Most of the PMI events (72.7%) occurred within 48 hours of surgery.ConclusionPerioperative myocardial infarction is a dreaded complication associated with a very high mortality. High risk surgery, smoking and past history of ischemic heart disease were independent predictors of PMI. The RCRI is a useful tool in pre-operative risk stratification of patients.

1. Introduction

Despite forty years of cumulative interest in the cardiovascular management of the patient undergoing noncardiac surgery, the subject matter remains as relevant as ever. The overall perioperative care of the patient has improved with the introduction of newer surgical techniques, combined with improved monitoring and patient safety during anaesthesia. However the age and Co-morbidities of patients undergoing non-cardiac surgery has increased. The incidence of perioperative myocardial infarction (PMI) has been investigated in several large-scale studies giving variable results between 0.3% to 36%, depending on the target population, study design, and the PMI definition used.[1,2] In-hospital mortality rates are between 12% to 40% after PMI have been reported.[1–6] PMI is one of the most important predictors of short- and long-term morbidity and mortality, length and cost of hospitalization associated with non-cardiac surgery.[6] Given the silent nature and high mortality rate of PMI, prevention of a PMI is thus a prerequisite for an improvement in overall postoperative outcome.

2. Materials and methods

After the approval by the institutional ethics committee a total of 525 patients, meeting the inclusion criteria, not having any exclusion criteria posted for elective, non-cardiac surgery of at least 30 min duration were evaluated. Informed consent was taken. The sample size was calculated as 525 on the basis of an earlier

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study by J.Y. Rao et al.,[7] considering incidences of PMI in patients undergoing non-cardiac surgery and anticipated odds ratio as 5, level of significance 5%, with multiple correlation co-efficient as 0.5. Demographic data were collected from the patient and anaesthesia record. Preoperative ECG and 2D echocardiography findings were noted if obtained. The patients were risk stratified based on the Revised Cardiac Risk Index (RCRI) as well as the American Society of Anaesthesiologists (ASA) physical status classification.

Perioperative data collected were type of surgery, type of anaesthesia, intra-operative blood loss as well as perioperative events. Perioperative events were defined as: tachycardia (heart rate greater than 100 per minute for greater than 5 min), bradycardia (heart rate less than 60 per minute), hypotension (systolic blood pressure less than 30% of baseline), or hypoxemia (SpO2 less than 90% for greater than 5 min).[8] Intraoperatively all patients had continuous ECG monitoring (with ST analysis) as well as repeat ECG done 24 h and 48 h following surgery. ECG signs of myocardial ischemia were defined as ST segment elevation or depression $\geq$ 1-mm or presence of new Q waves lasting $\geq$ 0.04 s and $\geq$ 1-mm deep in at least two contiguous leads and new onset LBBB.[8] For patients with symptoms, haemodynamic disturbance or ECG changes suggestive of acute myocardial ischemia, cardiology consultation, bedside echocardiography and serum troponin levels were advised. Troponin-T was determined by the Cobas immuno-assay analyzer (Roche Diagnostics, Mannheim, Germany). The normal range of Troponin-T values in our laboratory was 0.0001–0.0249 ng/ml. The diagnosis of perioperative MI was made in patients with troponin levels higher than the normal laboratory range, along with any one evidence of myocardial ischemia (symptoms, ECG changes or RWMA). In these subsets of patients, the factors predisposing to MI were evaluated. All the patients were followed up to 30 days following surgery via a telephonic call to assess the mortality rate.

3. Inclusion criteria

Patients undergoing non-cardiac surgery of at least 30 min duration, aged more than 45 years and not having exclusion criteria were included in the study.

4. Exclusion criteria

The following group of patients was excluded from the study

- Age <45 years
- Patients with LBBB or hemi-block (on preoperative ECG)
- Patients with pericarditis
- Valvular heart disease
- Severe Left Ventricular dysfunction (Ejection Fraction <30%)
- Patients with subarachnoid haemorrhage or patients with intracranial pathology.
- Not willing to consent

5. Statistical analysis

Descriptive and inferential statistics were used in our study. Continuous variables were represented as mean ± standard deviation. Categorical variables are represented as numbers or percentage when appropriate. For comparing continuous variable between PMI and non-PMI patients Independent *t*-test was used. For comparing categorical data Chi square test was used. A p value less than 0.05 was considered significant. Univariate/multivariate logistic regression analysis was used to test the association between the variables and the outcome. The data were analyzed with IBM SPSS software version 22.0.

6. Observation and results

A total of 525 patients, meeting the inclusion criteria, posted for elective, non-cardiac surgery were enrolled in this prospective observational study. The demographic data are presented in (Tables 1 and 2). The mean age and gender distribution between the PMI and Non PMI patients were comparable ($p = 0.7$ & 0.2 respectively). Of the total patients, 152 (29%) had diabetes mellitus, 62 (11.8%) had a history of ischemic heart disease (IHD), 210 (40%) were hypertensives, 20 (3.8%) had a history of CVA, and 130 (24.8%) patients were smokers. Past history of IHD and smoking increased the risk of patients developing MI which was statistically significant (p value 0.004 and 0.005 respectively), whereas a history of diabetes, hypertension, CVA and alcohol consumption were statistically not significant. (p values 0.08, 0.8, 0.09 and 0.08 respectively) (Table 1)

Of the 525 patients, who were prospectively studied, 33 patients developed PMI. The incidence of PMI was 6.3%. The distribution of patients across various surgical departments and the incidence of PMI in each group is shown in Table 2. The incidence of PMI was highest in the oncosurgery and vascular surgery group, wherein 25% of patients undergoing these surgeries had PMI, which was statistically significant ($p < 0.0001$) (Table 2).

Revised cardiac risk index (Modified Lee's index) and the American society of anaesthesiologist physical status was used for risk assessment of patients. As shown in Table 1, the incidence of PMI in ASA grade III and IV was 8.4% and 25% respectively and it was statistically significant. ($p < 0.0001$).The patients were also classified based on the type of surgery as per the ACC/AHA Cardiac Risk Stratification for Noncardiac surgeries (NCS)[15] as high risk, intermediate risk and low risk surgeries. (Table 1) The incidence of PMI in high risk surgeries was 18.8%, whereas that in low risk and intermediate risk surgeries was 3.2% and 5.1% respectively. The difference in incidence of PMI was statistically significant. ($p < 0.0001$).

Risk stratification was also done based on the Revised Cardiac Risk Index (RCRI, Modified Lee's Index, Table 1) shows the number of patients with each of the six variables/predictors of the Revised Cardiac Risk Index (RCRI). 28.2% of the patients underwent a high risk surgery as per the definition in the RCRI. 13.5% had a history of IHD. 24.4% were preoperatively on treatment with insulin for the control of DM. 4% had a previous history of CVA and 2.1% had a history of congestive heart failure. 16% patients had a preoperative creatinine > 2 mg/dl. The incidence of PMI was 10.1% in patients undergoing a high risk surgery. 14.1% of patients with a history of ischemic heart disease had a PMI. The incidence of PMI in patients with congestive heart failure, history of stroke, on preoperative insulin therapy was 18.2%, 14.3% and 9.4% respectively. 16% of patients with preoperative serum creatinine greater than 2 mg/dl had PMI. Of all the parameters in RCRI, only high risk surgery, history of IHD and preoperative creatine greater than 2 mg/dl were independent predictors of PMI (p value 0.02, 0.01 and 0.04 respectively) in our study. (Table 1)

Patients were also grouped according to the number of RCRI variables/predictors they had preoperatively. 243 patients (46.2%) had none of the predictors in the RCRI, 188 patients (35.8%) had one predictor, 70 (13.3%) patients had two predictors and 24 patients had three or more than three predictors. After logistic regression analysis, we observed that the incidence of PMI increased as the number of predictors increased, the incidence of PMI with two, three and four predictors were 11.4%, 20% and 25% respectively ($p = 0.001$). Based on the number of predictors, patients were classified into Classes I to IV, where Class I had zero predictors and

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