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PRE-OPERATIVE CARDIAC AND PULMONARY EVALUATION OF ELECTIVE NON-CARDIAC SURGICAL PATIENTS

General Medicine

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ABSTRACT

undergo surgeries every year. Cardiovascular complications in the perioperative period are one of the most common events leading to increased morbidity and mortality. Although such events are very small in number, they are associated with a high mortality rate making it essential for physicians to understand the importance of perioperative cardiovascular risk assessment and evaluation. Its involves a detailed process of history taking, patient's medical profile, medications being used, functional status of the patient, and knowledge about the surgical procedure and its inherent risks. Different risk assessment tools and calculators have also been developed to aid in this process, each with their own advantages and limitations. After such a comprehensive evaluation, a physician will be able to provide a risk assessment or it may all lead to further testing if it is believed that a change in management after such testing will help to reduce perioperative morbidity and mortality. There is extensive literature on the significance of multiple perioperative testing modalities and how they can change management. The purpose of our review is to provide a concise but comprehensive analysis on all such aspects of perioperative cardiovascular risk assessment for noncardiac surgeries and provide a basic methodology toward such assessment and decision making.

KEYWORDS

Perioperative cardiac evaluation, noncardiac surgery, risk assessment

INTRODUCTION

Cardiovascular and pulmonary complications continue in to account, for the major morbidity and mortality, in the patients which experience any noncardiac surgery. Per year about 100 million peoples undergo non-cardiac surgery; the incidence of cardiac complications is 0.5-1.0% which is the leading cause of peri-operative morbidity and mortality[1]. The incidence of these complications is higher in patients undergoing vascular surgical procedures[2]. The risk of peri-operative cardiac complications is increase due to both the patient characteristics and the specific surgical procedures were done.

With growing of evidence-based medicine the internist should dictate a pre-operative evaluation of the patient which undergo surgical procedure to predict an preoperative cardiac risk assessment and stratification to guide optimum peri-operative management and reduction of risk. Most common cardiac complications are myocardial infarction, angina & heart failure. Postoperative pulmonary complications are very common after surgery and anaesthesia, for which preoperative pulmonary risk assessment is necessary. The most important and morbid postoperative pulmonary complications are atelectasis, pneumonia respiratory failure, and exacerbation of underlying chronic lung disease.

While clinicians are very conscious of the importance of, and risk factor for, cardiac complication, clinicians who care for patient in the peri-operative period may be surprised to learn that postoperative pulmonary complications are equally prevalent and contribute similarly to morbidity, mortality, and length of stay[3-7]. Pulmonary complication may also be more likely than cardiac complications to predict long-term mortality after surgery, particularly among older patient[8].

All patients scheduled to undergo noncardiac surgery should have an assessment of the risk of a cardiovascular peri-operative cardiac event[9-10]. The purpose of this assessment is to help the patient and healthcare providers weigh the benefits and risks of the surgery and optimize the timing of surgery. On occasion, risk assessment will uncover undiagnosed problems sub-optimally treated prior conditions that need attention. The clinician uses information obtained from the history, physical examination, and type of surgery in order to develop an initial estimate of peri-operative cardiac risk.

Advances in anaesthetic and surgical techniques have improved peri-operative outcome in recent years. There is a trend towards performing procedures in older and sicker patients, among whom the prevalence of or risk factors for cardiovascular disease is increasing. This tendency and the fear of peri-operative cardiac complications prompt preoperative risk identification, stratification and modification of risk factors.

Hence we were study cardiac and pulmonary preoperative risk to minimize morbidity and mortality in intra-operative and postoperative period in our study.

AIM:

- Cardiovascular and pulmonary preoperative risk assessment.
- Assessment of morbidity and mortality in intra-operative and post-operative period.
- To reevaluate RCRI Index and to evaluate peri-operative risk with other parameters i.e. old and recent MI on ECG & RWMA on Echo-cardiography.
- To reevaluate CANETs risk index and to evaluate peri-operative pulmonary complication with other parameters like X-ray chest (PA) view, smoking status, asthma and S. albumin.
- To reevaluate ASA score.
- If possible development of a combined score to predict cardiac and pulmonary peri-operative risk of non-cardiac surgery.

MATERIAL AND METHODS

We conducted our in the Department of Medicine, MLB Medical College, Jhansi, on approximately 250 patients, who was present to department for pre-surgical cardiac and pulmonary evaluation.

Inclusion criteria:

Any patient undergoing non-cardiac surgery.

Exclusion criteria:

Exclusion criteria were as follow:

- Any patient undergoing Cardiac surgery
- Any patient Younger than 18 yrs of age.
- Any Procedure in which only local or peripheral nerve anaesthesia
- Any Patient with preoperatively intubated trachea.
- Questionnaire for the candidate were filled. Thereafter all the patientwereexamined and investigated according to working proforma.
- The Working proforma is attached.

RESULTS AND DISCUSSION

We conducted our study in the department of Medicine, M.L.B. Medical College and hospitals, Jhansi, U.P. on 250patients, who were

admitted to this hospital for non-cardiac surgical procedure and referred to our department for cardiopulmonary fitness. We followed thesepatients in intra-operative and post-operative period for cardiac and pulmonary complications.

Our study data showed that MCCs occurred more often in patients with a "high risk surgery type" (7.14% as compared to 3% in RCRI data and 3.4% in CAIS data), "history of ischemic heart disease" (10% as compared with3.6% in RCRI data and 5.9% in CAIS data), "CVD patients" (10% as compared to 5.8% in RCRI data and 6% in CAIS data) and "raised serum creatinine mg/dI)" (10% as compared to 8.7% in RCRI data and 6.9% in CAIS data).

In our study 9.09% patients developed MCCs who had features of Congestive Heart Failure (CHF), while 5.3% patients in RCRI data and 11.6% patients in CAIS data developed MCCs who had CHF. Thus more percentage of patients in our study developed MCCs in patients who had CHF as compared to RCRI data but less as compared to CAIS data.

The patients who were being treated with insulin for diabetes mellitus had nearly rates of MCCs in all the three study populations i.e. 7.69% MCCs in our study as compared to 6.3% in RCRI data and 5.3% in CAIS data.

Cardiac complications evaluation- We compared our study data with original RCRI data and CAIS data (from study by Davis et al.)- The present study had more no. of male population as compared to original RCRI study by Lee TH et al., (66.4% as compared to 48.6%), and study by Davis et at, (51.5%). The mean age of our study population was 44.11 years. The RCRI data did not report the mean age of the study population Thelinear age of study done by Davis et al. (CAIS data; CAIS=Clinical Anaesthesia Information System) [6]as 66 years. Present study had 5.6% of high risk surgeries (as compared to 32.1% in RCRI study, 26.3% in CAIS data). In our study percentage of cases with history of CAD was 4% as compared to 33.1% in RCRI data and 18.5% in CAIS data. Present study had 5.2% diabetes patients on insulin therapy as compared to 4% in RCRI data and 2.4% in CIAS data. In our study, 4.4% patients were having features suggestive of CHF (Congestive Heart Failure) as compared to 16% in RCRI data and 3% in CAIS data. Present study had 2% cases with CVA as compared to 10.0%in RCRI data and 7.2% in CAIS data. Present study had 4% cases with renal failure (serum creatinine >2 gm/dL) as compared to 3.7% in RCRI data and 1.4% in CAIS data.

The prevalence of MCCs in each of the six component risk factors is compared with the original RCRI and CAIS data.

MCCs developed inout of 250 cases in our study. Thus MCCs developed in 3.6% of patients in our study. Rate of MCCs in RCRI study and in CAIS data was 2.1% in each i.e. percentage of MCCs developed more in our study. Myocardial infarction developed in 1.2% patients in our study. RCRI data reported nearly similar rates of postoperative MI i.e. 1.1%. However MI developed in 1.7% patients in CAIS data. Most common MCCs was myocardial infarction in our study similar to the RCRI study and CAIS data. Rate of pulmonary edema in our study was 1.2% while it developed in 1% patients in RCRI data and in only 0.2% patients in CAIS data. In our study, cardiac arrest developed in 0.8% patients but it developed in only 0.4% in RCRI data and in 0.3% in CAIS data.

Ventricular tachycardia and atrial fibrillation developed in 1 patienteach.i.e. 0.4% eachin our study population, while these events were not reported in RCRI and CAIS data. Complete heart block, which was recorded in only 0.1% of the RCRI population (4/4,315), was not reported in our study data and CAIS data. Ventricular fibrillation was combined with cardiac arrest in the RCRI data and CAIS data, but in our study data, cardiac arrest was recorded alone.

In our study, patients who had RCRI score '0' i.e. in low risk category, developed 1.14% MCCs as compared to 0.4% in RCRI study and 0.5% in CAIS data 3.54% developed MCCs in our study when patients had RCRI score '1' i.e. intermediate risk, as compared to 1.1% in RCRI study and 2.6% CAIS data. When patients had RCRI score '2' i.e. intermediate risk, there were 9.09% MCCs in our study, while in 4.6% and 7.2% in RCRI model and CAIS data respectively. In our study, 28.57% patients developed MCCs when patients had high risk of MCCs i.e. RCRI >3 as compared to 9.7% risk in RCRI model and 14.4% risk in CAIS data. The large difference in risk of MCCs in high risk category could be because of small no. of patient in this category in our study (7 cases in high risk category).

Thus our study confirmed that risk of MCCs was progressively increasing with higher points of RCRI variables as it was in other studies also and thus RCRI can be used to predict major cardiac complications in perioperative period.

This study reinforces the importance and validity of the RCRI as a means of predicting major cardiac events after surgery. Almost two decades later, in spite of rapidly changing surgical techniques and improvements to clinical diagnostic testing, the factors identified in the original report are relevant in a modern surgical patient's population. The results of the present study are approximately similar to those in the original description.

Preoperative treatment with insulin had approximately similar risk in our study population also as in RCRI study but a recent large retrospective analysis of the Veterans Affairs Medical Centre surgical database failed to find diabetes as a significant predictor of cardiac outcomes. Focused attempts to include modified terms related to diabetes mellitus or preoperative blood sugar levels could not significantly improve the ability to predict the risk of MCCs or improve the accuracy or the discrimination of the index. Glycosylated hemoglobin has been advocated as an important risk factor in diabetic outcomes and may be a factor that could potentially improve the index; however, the data in our database were not inclusive of this variable. Diabetes continues to be highly associated with cardiac disease, renal failure, and cerebral vascular disease, all of which remain highly predictive of postoperative major cardiac events.

On comparing Improved Cardiac Risk Index (IMCRI) score with RCRI score, as a tool for predicting MCCs, Sensitivity of assessing the risk of Improved Cardiac Risk (IMCRI) Index (18.37%) better than RCRI Score (6.76%) but still sensitivity of this score is low. Improved Cardiac Risk Index (IMCRI) is highly specific (98.69%), as similar to RCRI score (98.86%).

Postoperative pulmonary risk evaluation:

6.8% incidence of postoperative pulmonary complication (PPCs) was observed in our study population. A total of 24 PPCs were recorded in 17 patients out of 250 studied patients (6.8%). Postoperative respiratory failure and pleural effusion developed in 4 patients each (i.e.1.6% each), bronchospasm in 2 (0.8%), respiratory infection/pneumonia in 11 (4.4%), atelectasis in 2 (0.8%), and pneumothorax in 1 (0.4%). The comparison of demographic and clinical characteristics between present study and study by Canetet al[11].

In our study, median age of the population was 43 years (18-85) 10th-90thpercentile), while in Canetet al[11]. study, it was 60 years (31.680) 10th-90thpercentile). 66.4% population in our study was of males, as compared to 50.8% in Canetet al[11]. study. 32% patients in our study were smokers, and 68% were none smokers, while in Canetet al[11]. study, smokers were 50.1%. MedianSPO2 level in our study was 96% as compared to 97% in study by Canetet al[11]. 37.6% patients in our study came under ASA classification >1, while 73.5% patients in Canetet al[11] study. 9.6% patients in our study underwent emergency surgery, comparable to 14.2% in Canetet al[11] study. Median duration of surgery in our study was 1.6 hours (0.5-3.2) (10th-90th uth percentile), as compared to 1.8 hours (0.8-3.9) (10th-90th percentile) in Canetet al[11] study.

Age is a consistently reported predictor of PPCs, and our findings confirm this. We found that risk of PPCs is lowest in age group <50 years (4.48%), 7.61% in age group 51-80 yrs, and highest in age group >80 yrs (50%). Canetet al[11] made the similar observation i.e. risk of PPCs increased as the age of patients increased.

In our study, 2.79% (5 out of 179 cases) developed PPCs when SPO2 was 96%. Canetet al[11] made the similar observation i.e. 3% risk of PPCs when SPO2 was 96%. In our study, 14.49% (10 out of 69 patients) developedPPCs when they were having SP02 was 91-95% and 50% developed PPCs when SP02 was <90%. Thus risk of PPCs increased as SPO2 level decreased similar to observation by Canetet al[11].

We found that 16.67% (2 out of 12 cases) developed. In our study, PPCs when they were having respiratory infections, and 6.30% (15 out of 238 cases) risk of PPCs, when they did not have respiratory infections in last month. Canetet al[11], and 4.2% risk in also made similar observations i.e. they observed 17.8% PPCs in those who had respiratory infection in last month is increased when patient had those who did not. Thus risk of PPCs respiratory infection in last month.

Preoperative anemia (hemoglobin concentration lower than or equal to 10 g/dL) raised the risk for PPCs almost 2 fold. In our study, 5.46% patients (10 out of 183 cases) developed PPCs when they were not anemic, and 10.44% (7 out of 67 cases) developed PPCs when they were having hemoglobin level <10 g/dL. Canetet al[11] made the similar observations. In their study, 105 (4.6%) patients out of 2305 patients developed PPCs when patients were not anemic, and 18 patients (11.3%)out of 159 patients developed PPCs when they were anemic. Recent studies also identified anemia as a predictor of poor outcome in critical and postoperative patients. Even minimal degrees of anemia are associated with a significant increase in the risk of 30-day postoperative mortality and cardiac events, although so far, there is no clear evidence that preoperative transfusion would reduce risk.

We confirm that surgery-related risk factors are highly relevant. In our study, patients who underwent emergency surgery, development 16.67% risk of PPCs as compared to 4.87% in those who underwent elective surgery. Thus emergency surgery has higher risk of PPCs as it is found in Canet et al[11], study also.

In our study, risk of PPCs was found to be 4.81% when surgical incision site was peripheral, 13.16% when incision site was upper abdomen, and 25% when incision site was intrathoracic. Thus risk of PPCs was maximum in intrathoracic incision and minimum when incision site was peripheral. Canet et al[11] found the similar observations i.e. maximum risk of PPCs when incision site was intrathoracic, and minimum when it was peripheral.

We found that when duration of surgery was <2 hrs, risk of PPCs was 6.58% (10 out of 152cases), and 5.26% (5out of 95cases) risk when duration was 2-3 hrs. Canet et al[11] also found that risk of PPCs increased when durationof surgery was more. We found no PPC when duration of surgery was >3 hours. This might be because of only 3patient underwent surgery of >3 hours duration.

These identified as independent predictors name anatomical site (upper abdomen or intrathoracic incision), duration of surgery longer than 2 hrs, and emergency surgery are factors that, to some extent, can be controlled by surgeon in patients at high risk.

In our study, 15 (6.25%) patients out of 240 patients developed PPCs who were not asthmatic, and 1(10%) patient out of 10 patients developed PPCs who were asthmatic. Thus risk of PPCs was high in asthmatic patients. Risk of PPCs was also higher in study by Canet et al[11] i.e. 4.8% patients developed) PPCs in nonasthmatics as compared to 8.7% in asthmatics.

In our study, 6 patients (3.85%) out of 156 patients developed PPCs who came under ASA classification 1, and 8patients (8.51 %) out of 94 risk in those who can under ASA >1. Thus risk of PPCs in our study increased in those with higher ASA classification. Risk of PPCs was also more in study by Canetet al[11] i.e. 1.5% in patients with ASA 1, and 6.24% in those with ASA classification >1.

Risk of PPCs in our study was 4.71% in non-smokers as compared to 11.25% in smokers i.e. risk approximately doubled in smokers. Canetet al[11] found the similar observations. In their study, 3.7% non-smokers developed PPCs as compared to 6.24% smokers i.e. risk of PPCs approximately doubled in smokers. We found that 5.24% patients developed PPCs who did not have COPD, and 14.28% developed PPCs who were suffering from COPD Thus rate of PPCs is more in COPD patients. Risk of PPCs was also more in Canetet al[11] study in COPD patients (16.4% in COPD patientsvs.3.5% in non-COPD patients).

The risk of PPCs increased with heart failure and renal failure as in Canet et al[11], study. There was marginal increased in risk of PPCs in patients with coronary artery disease in our study. The incidence of PPCs by risk score. We chose cut point of 26 (as in Canet risk index), above which indicated moderate risk; a score greater than 45 indicted high risk as (as in Canet risk index).

In our study, least percentage of patients developed PPCs who came under low risk category (3 out of 182 cases, 1.65%)similar to 1.6% risk in Canetet al[11] study in low risk group. 14 29% patients developed PPCs who came under intermediate risk category {8 out of 56 cases}, comparable to Canetet al[11] study (13.3%). Maximum percentage of patients with PPCs occurred in high risk group {6 out of 12 cases, 50%), comparable to 42.1% risk of PPCs in high risk group in Canetet al[11] study. Thus our study confirmed the findings of Canetet al[11], study that risk of PPCs progressively increases from low risk group to high risk group. Results in our study were comparable to those found in study by Canetet al[11] as mentioned in above and Canet risk index can be used for predicting risk of PPCs in noncardiac surgeries.

New index Improved Pulmonary Risk Index was taken in to account, as a tool for predicting PPCs, sensitivity for assessing the risk of Improved Pulmonary Risk Index (29.47%) better than Canet risk Score (20.59%) but still sensitivity of this score is low. Improved Pulmonary Risk Index is highly specific (98.71 %), as similar toCanet risk score (98.35%).

CONCLUSIONS

We concluded that RCRI index is a good tool for preoperative assessment of cardiac risk and predicting major cardiac complication during surgery. But its sensitivity can be further enhanced by addition of 2 other parameter i.e. ECG s/o old or recent MI and RWMA on 2D-Echo. We proposed a new index Improved Cardiac Risk Index from three parameter-i.e. RCRI clinical markers, abnormal ECG finding and abnormal 2D-Echo finding whose sensitivity is better than RCRI index.

Canet et al[11] risk index is a good tool for assessment of preoperative pulmonary risk and for predicting pulmonary complications after surgery. But its sensitivity can be further enhance by addition of 4 more parameters i.e. low serum albumin levels (<3.5 g/dL), smoking status, asthma, and chest X-Ray suggestive of COPD. We also proposed a new index Improved Pulmonary Risk Index (IPRI) from four parameter i.e. Canet risk factors, history of COPD, history of Smoking and abnormal chest x-ray finding whose sensitivity is better than Canet risk index.

We recommend that future research should aim to validate these parameters with similar cohorts of elective non-cardiac surgery patients so that more comprehensive postoperative pulmonary risk assessment could be done.

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