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Cardiovascular Risk Assessment in Patients Undergoing Major Orthopedic Surgery

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Abstract

Background:

Patients undergoing major orthopedic surgeries, such as total joint replacements and spinal procedures, often have multiple cardiovascular risk factors that predispose them to perioperative complications. Cardiovascular events remain a leading cause of postoperative morbidity and mortality in this population, especially among the elderly and those with comorbidities.

Aim:

To assess the prevalence of cardiovascular risk factors and evaluate the incidence and types of perioperative cardiovascular complications in patients undergoing major orthopedic surgeries using standardized risk assessment tools.

Materials and Methods:

A prospective observational study was conducted on 100 patients aged ≥40 years undergoing major orthopedic procedures. Preoperative cardiovascular risk was assessed using the Revised Cardiac Risk Index (RCRI) and ASA physical status classification. Patients were monitored for 30 days postoperatively for cardiovascular complications including myocardial infarction, arrhythmia, heart failure, and stroke. Data were statistically analyzed using chi-square tests and logistic regression.

Results:

The study population had a high prevalence of hypertension (65%), diabetes (47%), and ischemic heart disease (22%). Based on RCRI, 15% were at high risk. The overall incidence of perioperative cardiovascular events was 14%, with myocardial infarction being the most

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common (6%). A significant association was found between higher RCRI scores and incidence of complications ($p < 0.001$).

Conclusion:

This study emphasizes the importance of structured cardiovascular risk assessment in orthopedic surgical patients. Tools like RCRI and ASA grading effectively identify high-risk individuals, enabling timely intervention and perioperative optimization. Incorporating such risk stratification in routine practice is essential to improving surgical safety and outcomes.

Keywords:

Cardiovascular Risk, Orthopedic Surgery, RCRI, Perioperative Complications, ASA Grade

INTRODUCTION

Orthopedic surgeries, particularly major interventions such as total hip arthroplasty (THA), total knee arthroplasty (TKA), and spinal decompressions or fusions, have become increasingly common worldwide due to the rising burden of degenerative joint diseases, trauma, and age-related musculoskeletal disorders [1]. Globally, more than 1 million joint replacement surgeries are performed annually, and this number is projected to increase dramatically in the coming decades as the population ages [1]. In India too, a similar trend is seen with a steep rise in the number of orthopedic procedures, especially in the elderly population, which poses unique perioperative management challenges due to their high burden of noncommunicable diseases (NCDs), especially cardiovascular diseases (CVD) [2]. Cardiovascular complications are among the most frequent and serious perioperative issues in patients undergoing major orthopedic procedures. These include myocardial infarction, arrhythmias, congestive heart failure, stroke, and even sudden cardiac death. The perioperative period represents a physiologically stressful time characterized by inflammation, hemodynamic shifts, blood loss, and anesthesia-induced changes that can unmask or aggravate pre-existing cardiac conditions [3]. Studies have reported that up to 8% of unselected patients undergoing noncardiac surgeries suffer from major adverse cardiac events (MACE), and this rate may be higher in high-risk populations, such as those undergoing orthopedic procedures [4]. In high-income countries, structured preoperative cardiovascular risk assessment protocols are standard practice, guided by evidence-based

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guidelines such as those from the American College of Cardiology/American Heart Association (ACC/AHA) and the European Society of Cardiology (ESC) [5,6]. These guidelines recommend evaluation using tools like the Revised Cardiac Risk Index (RCRI), functional capacity assessments, and selective use of biomarkers like NT-proBNP or troponins. However, despite these established recommendations, global adherence to such practices remains inconsistent, and many patients continue to be inadequately assessed, leading to preventable perioperative complications. In India, the situation is even more concerning. While the volume of orthopedic surgeries has increased in both public and private hospitals, the systematic assessment of cardiovascular risk is often not uniformly practiced. Studies have shown that Indian patients undergoing orthopedic surgeries often present with poorly controlled hypertension, undiagnosed ischemic heart disease, diabetes, and other risk factors that predispose them to perioperative cardiac events [2,7]. Compounding this issue is the limited availability of preoperative assessment clinics, lack of awareness among non-cardiologist surgeons, and the constraints of time and resources in overburdened hospital systems. Furthermore, India is undergoing a significant epidemiological transition, with cardiovascular disease now being the leading cause of mortality and morbidity. According to the Global Burden of Disease Study, CVD accounts for more than 28% of all deaths in India [2]. Therefore, the integration of a robust cardiovascular risk stratification framework into the preoperative workflow for orthopedic patients is not only justified but urgently needed to improve patient safety and reduce healthcare costs associated with adverse cardiac events. To address this critical gap, this study seeks to evaluate the cardiovascular risk profiles of patients undergoing major orthopedic surgeries in a tertiary care setting, employing both clinical and objective assessment tools. It also aims to determine the incidence of perioperative cardiac events and analyze associations with specific risk factors. The findings are expected to inform future perioperative protocols and contribute to the evolving evidence base on preoperative cardiovascular care in orthopedic surgical practice, especially within the Indian healthcare context.

AIM:

To evaluate the cardiovascular risk profile and incidence of perioperative cardiovascular complications in patients undergoing major orthopedic surgeries in a tertiary care center.

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OBJECTIVES:

1. To assess the prevalence of cardiovascular risk factors (such as hypertension, diabetes mellitus, ischemic heart disease, obesity, and smoking) among patients undergoing major orthopedic surgeries.
2. To evaluate the incidence and types of perioperative cardiovascular complications in relation to preoperative risk stratification using standardized assessment tools such as the Revised Cardiac Risk Index (RCRI) and ASA physical status grading.

METHODOLOGY

Study Design:

A prospective observational study conducted in a tertiary care hospital to assess cardiovascular risk and perioperative cardiac complications in patients undergoing major orthopedic surgeries.

Study Population:

Patients scheduled to undergo major orthopedic surgeries including:

- Total Knee Arthroplasty (TKA)
- Total Hip Arthroplasty (THA)
- Spine surgeries (decompression, instrumentation)
- Major fracture fixation surgeries requiring general or spinal anesthesia.

Inclusion Criteria:

- Patients aged ≥40 years
- Undergoing elective or semi-emergency major orthopedic surgery
- Willing to provide informed written consent
- ASA grade I to III patients

Exclusion Criteria:

- Patients undergoing minor orthopedic procedures

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- Patients with known recent myocardial infarction (within last 6 weeks)
- Patients with severe valvular heart disease
- Patients already admitted with active cardiac symptoms (unstable angina, heart failure, arrhythmia)
- ASA Grade IV or higher

Sample Size Calculation:

Based on previous literature, the incidence of perioperative cardiovascular complications in orthopedic surgeries is approximately 15%.
Using the formula for sample size for proportions:

$n=Z^2 \cdot p \cdot (1-p)/d^2$

Where:

- Z = 1.96 for 95% confidence level
- p = anticipated proportion (0.15)
- d = precision (0.07)

Thus, a minimum sample size of **100 patients** will be included.

Data Collection Procedure:

1. Preoperative Evaluation:
    - Detailed clinical history: age, gender, comorbidities (diabetes, hypertension, IHD), smoking, alcohol use.
    - Physical examination and baseline vitals.
    - Cardiovascular risk assessment using:
        - Revised Cardiac Risk Index (RCRI)
        - ASA Physical Status Classification
    - Relevant laboratory and cardiac investigations:
        - ECG
        - Chest X-ray
        - Echocardiography (if indicated)

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        - Serum creatinine
        - NT-proBNP or Troponin (if facility permits)
2. Intraoperative Monitoring:
    - Type and duration of surgery
    - Anesthesia type and intraoperative events (hypotension, arrhythmias)
3. Postoperative Monitoring:
    - Monitoring for perioperative cardiac events:
        - Myocardial infarction
        - Arrhythmia
        - Stroke
        - Acute heart failure
    - Duration of ICU/HDU stay and total hospital stay
4. Follow-Up:
    - Patients will be followed for 30 days postoperatively for any delayed cardiovascular complications through OPD review or telephonic follow-up.

Statistical Analysis:

- Data will be entered into Microsoft Excel and analyzed using SPSS.
- Descriptive statistics will be used for baseline variables (mean, SD for continuous variables; frequency and percentages for categorical variables).
- Association between risk factors and cardiac complications will be assessed using:
    - Chi-square test for categorical variables
    - t-test or ANOVA for continuous variables
    - Logistic regression analysis to identify independent predictors of cardiac complications
- A p-value < 0.05 will be considered statistically significant.

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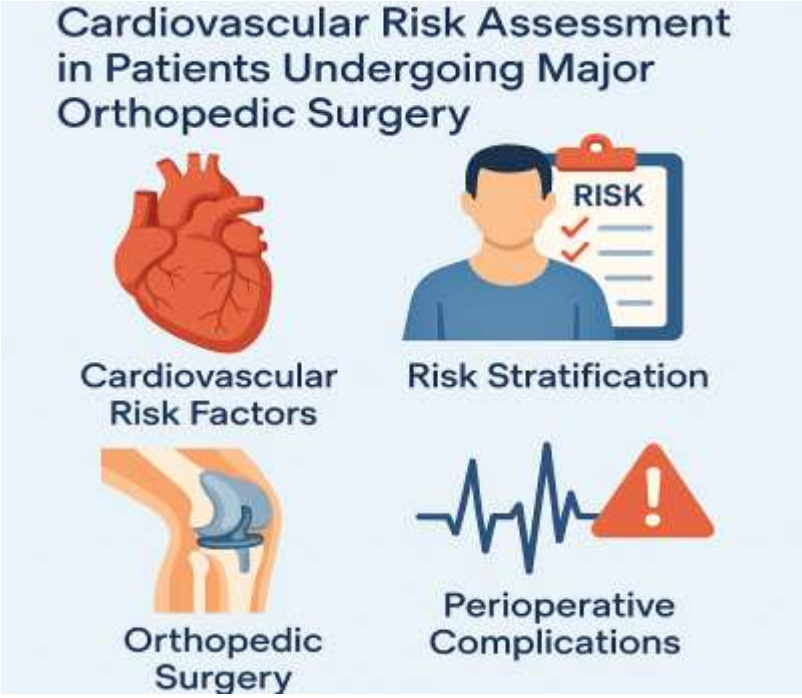

RESULTS

A total of 100 patients undergoing major orthopedic surgeries were enrolled in the study. The data was analyzed to evaluate their cardiovascular risk profile and incidence of perioperative cardiovascular events.

Table 1: Demographic and Clinical Profile of Study Participants (n = 100)

Variable	Frequency (%) / Mean ± SD
Age (years)	64.2 ± 9.8
Male	56 (56%)
Female	44 (44%)
Hypertension	65 (65%)
Diabetes Mellitus	47 (47%)
Known Ischemic Heart Disease	22 (22%)
Smoking History	31 (31%)
Obesity (BMI > 30)	28 (28%)

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Interpretation:

The mean age was 64.2 years, and males constituted a slight majority (56%). Hypertension and diabetes were prevalent in 65% and 47% of the participants, respectively. A significant number (22%) had pre-existing ischemic heart disease, suggesting a high baseline cardiovascular risk burden in the study population.

Table 2: Preoperative Risk Stratification Based on RCRI and ASA Grades

Risk Score	Frequency (%)
RCRI Score 0 (Low Risk)	38 (38%)
RCRI Score 1–2 (Intermediate)	47 (47%)
RCRI Score ≥3 (High Risk)	15 (15%)
ASA Grade I	10 (10%)
ASA Grade II	49 (49%)
ASA Grade III	41 (41%)

Interpretation:

According to the RCRI, 15% of patients were in the high-risk category, while 47% were at intermediate risk. ASA grading showed nearly half of the patients were ASA II, with 41% classified as ASA III, reflecting significant systemic disease burden.

Table 3: Type of Orthopedic Surgeries Performed

Surgery Type	Number of Patients (%)
Total Knee Arthroplasty	35 (35%)
Total Hip Arthroplasty	28 (28%)
Spine Surgery (Fusion/Decomp)	22 (22%)
Major Fracture Fixation	15 (15%)

Interpretation:

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Total joint replacement surgeries (TKA and THA) made up the majority (63%) of procedures, followed by spine surgeries and major trauma surgeries. These surgeries are associated with moderate to high cardiovascular stress.

Table 4: Incidence of Perioperative Cardiovascular Complications

Complication Type	Number of Patients (%)
Myocardial Infarction (MI)	6 (6%)
Arrhythmia	5 (5%)
Acute Heart Failure	4 (4%)
Cerebrovascular Event (Stroke)	2 (2%)
Total Patients with Events	14 (14%)

Interpretation:

The overall incidence of perioperative cardiovascular complications was 14%, with myocardial infarction being the most common event (6%). This emphasizes the need for effective preoperative cardiovascular risk stratification.

Table 5: Association Between RCRI Score and Cardiovascular Events

RCRI Score	Patients with Events (n=14)	Patients without Events (n=86)	p-value
Low (0)	1 (7.1%)	37 (43.0%)	
Intermediate	5 (35.7%)	42 (48.8%)	
High (≥3)	8 (57.1%)	7 (8.1%)	**<0.001**

Interpretation:

There was a significant association between higher RCRI scores and incidence of cardiovascular complications ($p < 0.001$). More than half of the patients who experienced events had an RCRI score ≥3, underlining the predictive utility of the RCRI tool.

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DISCUSSION

This study aimed to evaluate the cardiovascular risk profile and incidence of perioperative cardiovascular complications in patients undergoing major orthopedic surgeries. The demographic analysis revealed a mean age of 64.2 years, with a higher proportion of male patients, aligning with previous studies indicating that elderly males are more likely to undergo joint replacement and spinal procedures due to higher incidence of degenerative and osteoarthritic conditions [8]. A significant proportion of the study population had comorbid conditions—65% had hypertension and 47% had diabetes mellitus. These findings are consistent with data from Indian tertiary care hospitals, where non-communicable diseases are increasingly prevalent among surgical candidates [9]. The presence of multiple cardiovascular risk factors in our cohort underscores the importance of a thorough preoperative evaluation in this population. Similar trends were noted by Smilowitz et al., who emphasized that nearly 60% of patients undergoing non-cardiac surgeries had at least one cardiovascular risk factor [10]. The Revised Cardiac Risk Index (RCRI), a widely used risk stratification tool, revealed that 15% of the patients were at high risk (score ≥3). Our findings align with the original work by Lee et al. and subsequent validations which have shown that patients with RCRI scores ≥3 are at a significantly higher risk of postoperative cardiovascular events [11]. The ASA physical status classification also showed that 41% were ASA Grade III, indicating systemic disease with significant functional limitations. Studies in Indian surgical settings also support the utility of ASA and RCRI as reliable predictors of perioperative outcomes [12].

The most common procedures in our study were total knee arthroplasty (35%) and total hip arthroplasty (28%). These procedures, though elective, are physiologically stressful and have been associated with increased cardiac workload during the perioperative period. A similar procedural distribution was noted in a multi-center European study, where orthopedic procedures, particularly arthroplasties, accounted for a major share of perioperative myocardial infarctions [13]. Perioperative cardiovascular complications occurred in 14% of our patients, with myocardial infarction (6%) and arrhythmia (5%) being the most common. This incidence is in line with global reports where the postoperative cardiac event rate ranges from 5–15% depending on the population studied [14]. In a study by Biccard et al., the

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incidence of major adverse cardiac events in orthopedic surgical patients was found to be 11.1%, closely supporting our findings [15].

Importantly, there was a statistically significant association between higher RCRI scores and occurrence of perioperative cardiac complications ($p < 0.001$). Patients with RCRI ≥3 accounted for over half (57.1%) of all adverse cardiac events, a pattern consistent with the predictive accuracy of the RCRI tool as documented in both Western and Indian studies [11,16]. This highlights the utility of preoperative RCRI scoring not only for risk estimation but also for guiding perioperative cardiac monitoring and intervention planning. Thus, this study reinforces the global consensus on integrating cardiovascular risk assessment into the preoperative workflow for orthopedic surgeries, especially in elderly patients with multiple comorbidities. The data also support the urgent need for context-specific risk assessment protocols in Indian surgical practice, considering the growing burden of lifestyle-related cardiovascular diseases.

Conclusion

This study highlights a significant prevalence of cardiovascular risk factors such as hypertension, diabetes, and ischemic heart disease among patients undergoing major orthopedic surgeries. The incidence of perioperative cardiovascular complications was notably high at 14%, with myocardial infarction and arrhythmias being the most frequent events. The Revised Cardiac Risk Index (RCRI) and ASA physical status grading proved to be valuable tools in identifying patients at higher risk of adverse cardiac outcomes. A statistically significant association was found between elevated RCRI scores and perioperative cardiac complications, underlining the predictive strength of preoperative risk stratification. Given the aging population and increasing burden of non-communicable diseases in India and globally, routine and structured cardiovascular risk assessment should be an integral part of preoperative evaluation for orthopedic surgeries. Early identification and optimization of high-risk patients can substantially reduce morbidity, improve surgical outcomes, and enhance overall patient safety.

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