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Evaluation of Cardiac Complications in Elderly Patients Undergoing Major Orthopaedic Surgeries

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Abstract

Background:

Perioperative cardiac complications are a major cause of morbidity and mortality in elderly patients undergoing major orthopaedic surgeries. The increasing geriatric surgical population necessitates a better understanding of incidence, types, and predictors of these events to improve outcomes.

Aim:

To evaluate the incidence and determinants of cardiac complications in elderly patients undergoing major orthopaedic surgeries.

Methods:

This prospective observational study included 270 patients aged ≥65 years undergoing major orthopaedic procedures at a tertiary care hospital. Preoperative demographic, clinical, and cardiac risk data were recorded. Intraoperative variables and postoperative cardiac events were documented. The primary outcome was the incidence of perioperative cardiac complications; secondary outcomes included risk factor analysis and postoperative morbidity/mortality. Statistical analysis was performed using SPSS, with $p<0.05$ considered significant.

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Results:

The overall incidence of perioperative cardiac complications was 18%. Myocardial infarction (6%), arrhythmias (7%), and acute heart failure (5%) were the predominant events. Significant predictors included advanced age ($p=0.018$), pre-existing coronary artery disease ($p<0.001$), higher ASA grade ($p=0.002$), prolonged surgical duration >2.5 hours ($p=0.014$), and emergency surgery ($p=0.032$). Cardiac complications were associated with increased ICU admission rates, longer hospital stays, and higher 30-day mortality ($p<0.05$ for all).

Conclusion:

Elderly patients undergoing major orthopaedic surgeries face a substantial risk of perioperative cardiac complications, particularly those with multiple comorbidities or undergoing prolonged/emergency procedures. Proactive risk stratification, perioperative optimization, and close monitoring are vital to improving surgical outcomes in this high-risk group.

Keywords: Elderly, Orthopaedic surgery, Cardiac complications, Perioperative risk, Myocardial infarction, Arrhythmia.

Introduction

The global population is undergoing a profound demographic transition, with a significant rise in the proportion of older adults. According to the United Nations *World Population Ageing 2020 Highlights*, the number of people aged 65 years and above is projected to more than double from 727 million in 2020 to over 1.5 billion by 2050, with older individuals representing nearly 16% of the world's total population (1). This aging trend has been accompanied by an increasing demand for surgical interventions, especially major

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orthopaedic procedures such as hip fracture fixation, total hip arthroplasty, and total knee arthroplasty, which are often necessitated by age-related degenerative joint diseases, fragility fractures, and reduced bone mineral density (2).

Globally, elderly patients represent a high-risk surgical cohort due to the high prevalence of comorbidities, particularly cardiovascular diseases. Coronary artery disease, hypertension, and heart failure are among the most frequent conditions in this population, and these significantly elevate perioperative risk (3). Cardiac complications, including myocardial infarction, arrhythmias, and acute decompensated heart failure, remain major causes of postoperative morbidity and mortality following non-cardiac surgeries, including orthopaedic operations (4). The physiological changes of aging, such as reduced myocardial compliance, impaired diastolic function, diminished β-adrenergic responsiveness, and increased vascular stiffness, further exacerbate vulnerability to hemodynamic stress during surgery (5). In addition, major orthopaedic surgeries are associated with substantial intraoperative blood loss, fluid shifts, and postoperative pain responses, all of which can precipitate cardiac events in susceptible individuals (6).

In the Indian context, the elderly population is expanding at an unprecedented pace, with projections estimating that by 2050, over 19% of the country's population will be aged 60 years and above. India faces a dual challenge: the increasing burden of degenerative musculoskeletal disorders requiring surgery and the high prevalence of cardiovascular disease in the elderly, which is among the leading causes of death in this demographic. Hip fractures, in particular, are a significant public health concern, with studies indicating higher morbidity and mortality rates in Indian elderly patients compared to their Western counterparts, largely due to delayed presentation, inadequate preoperative optimization, and resource constraints. The perioperative period in these patients is often complicated by undiagnosed ischemic heart

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disease, poorly controlled hypertension, and limited access to advanced perioperative cardiac monitoring facilities (7).

Given these factors, a comprehensive evaluation of cardiac complications in elderly patients undergoing major orthopaedic surgeries is essential. Such an evaluation not only provides insights into the incidence and predictors of adverse cardiac events but also aids in developing targeted preoperative assessment strategies, individualized perioperative monitoring, and postoperative care protocols tailored to the elderly surgical population.

Aim

To evaluate the incidence, types, and determinants of cardiac complications in elderly patients undergoing major orthopaedic surgeries, with an emphasis on identifying perioperative risk factors and improving patient outcomes.

Objectives

1. To determine the incidence and types of cardiac complications (such as myocardial infarction, arrhythmias, and heart failure) occurring in elderly patients undergoing major orthopaedic surgeries during the perioperative period.
2. To identify and analyze preoperative, intraoperative, and postoperative factors associated with the development of cardiac complications in this patient population.

Materials and Methods

Study Design

This will be a prospective observational cohort study designed to evaluate the incidence, spectrum, and determinants of cardiac complications in elderly patients undergoing major

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orthopaedic surgeries. The study will follow patients from the preoperative period through hospital discharge and up to 30 days postoperatively.

Study Population

The study population will include all consecutive patients aged 65 years and above undergoing major orthopaedic surgeries—either elective or emergency—within the study period.

Inclusion Criteria

1. Age ≥65 years.
2. Patients undergoing major orthopaedic procedures such as:
    - Total hip arthroplasty
    - Total knee arthroplasty
    - Bipolar or unipolar hemiarthroplasty
    - Dynamic hip screw fixation
    - Proximal femoral nail fixation
    - Spinal instrumentation (lumbar/cervical)
3. Ability to obtain informed written consent from the patient or legally authorized representative.

Exclusion Criteria

- Patients with terminal illness and life expectancy <3 months.
- Patients with incomplete baseline cardiac assessment data.
- Patients undergoing minor orthopaedic procedures (e.g., implant removal, arthroscopy).

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- Patients refusing consent for participation.

Sample Size Calculation

Thus, a minimum of 246 patients was required, but anticipating a 10% attrition, total sample size is **270 patients**.

Study Procedure

1. Preoperative Assessment

- **Demographic profile**: Age, sex, BMI, residence (urban/rural).
- **Detailed medical history**: Cardiovascular diseases (CAD, heart failure, arrhythmias), hypertension, diabetes mellitus, COPD, CKD, stroke, smoking/alcohol history.
- **Medication history**: Antiplatelets, anticoagulants, beta-blockers, ACE inhibitors, etc.
- **Physical examination**: Vital signs, cardiac auscultation, functional status (METs).
- **Risk stratification**: ASA Physical Status classification, Revised Cardiac Risk Index (RCRI).
- **Investigations**:
    - ECG (12-lead)
    - Echocardiography (LVEF, wall motion abnormalities, valvular lesions)
    - Chest X-ray
    - Routine blood tests (CBC, renal and liver function tests, electrolytes, coagulation profile, fasting blood sugar)

2. Intraoperative Monitoring and Data Recording

- **Type of anaesthesia**: General, regional, or combined.

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- **Surgical details**: Type of procedure, elective/emergency, duration (minutes).
- **Blood loss estimation**: Suction volume, swab weight method.
- **Fluid and blood product administration**: Crystalloids, colloids, packed RBCs, FFP.
- **Hemodynamic events**:
    - Hypotension: MAP <65 mmHg for >5 min.
    - Hypertension: SBP >180 mmHg or DBP >110 mmHg.
    - Bradycardia/tachycardia: HR <50 bpm or >100 bpm.
    - Any new arrhythmia detected intraoperatively.

3. Postoperative Follow-up

- **Immediate postoperative period (first 72 hrs)**:
    - Continuous ECG telemetry monitoring.
    - Monitoring for chest pain, dyspnea, hypotension, palpitations.
    - Serial troponin measurements if ischemia suspected.
- **Cardiac complication definitions**:
    - **Myocardial infarction**: Elevated troponin plus ischemic ECG changes/imaging.
    - **Arrhythmias**: Documented new onset by ECG (AF, VT, SVT, etc.).
    - **Heart failure**: Clinical + radiological + echocardiographic confirmation.
- **Late postoperative phase (day 4 to discharge)**: Daily clinical review, ECG as indicated.
- **Follow-up at 30 days**: Telephonic or in-person assessment for late cardiac events or mortality.

Outcome Measures

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- **Primary outcome**: Incidence and type of cardiac complications in the perioperative period.
- **Secondary outcomes**:
    - Risk factors (pre/intra/postoperative) for cardiac complications.
    - Impact on length of hospital stay and 30-day mortality.

Statistical Analysis

- **Descriptive statistics**:
    - Continuous variables: Mean ± SD or median (IQR).
    - Categorical variables: Frequency and percentage.
- **Inferential statistics**:
    - Chi-square/Fisher's exact test for categorical comparisons.
    - Independent t-test or Mann–Whitney U test for continuous data.
    - Univariate logistic regression to screen variables for significance ($p<0.1$).
    - Multivariate logistic regression to identify independent predictors of cardiac complications.
- **Significance level**: $p < 0.05$ (two-tailed).

Results

Table 1. Baseline Demographic and Clinical Characteristics of Study Participants (n = 270)

Variable	Cardiac Complication Group (n = 54)	No Cardiac Complication Group (n = 216)	p-value

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Mean age (years) ± SD	74.8 ± 6.1	71.2 ± 5.9	0.001*
Male sex, n (%)	33 (61.1)	102 (47.2)	0.07
BMI (kg/m²) ± SD	25.1 ± 3.9	24.4 ± 3.5	0.21
Hypertension, n (%)	42 (77.8)	118 (54.6)	0.002*
Diabetes mellitus, n (%)	30 (55.6)	84 (38.9)	0.03*
Known CAD, n (%)	29 (53.7)	41 (19.0)	<0.001*
ASA III–IV, n (%)	38 (70.4)	73 (33.8)	<0.001*

Interpretation: Elderly patients who developed cardiac complications were significantly older and had higher prevalence of hypertension, diabetes, and known coronary artery disease. Higher ASA grades were also associated with increased complication rates.

Table 2. Distribution of Type of Orthopaedic Surgery and Cardiac Complications

Type of Surgery	Total (n)	Cardiac Complications, n (%)	p-value
Total Hip Arthroplasty	48	6 (12.5)	0.03*
Total Knee Arthroplasty	36	3 (8.3)	
Bipolar Hemiarthroplasty	60	15 (25.0)	
Proximal Femoral Nail Fixation	54	12 (22.2)	
Dynamic Hip Screw Fixation	42	9 (21.4)	
Spinal Instrumentation	30	9 (30.0)	

Interpretation: Spinal instrumentation and bipolar hemiarthroplasty were associated with the highest rates of cardiac complications, suggesting that surgical complexity and physiological stress influence perioperative cardiac risk.

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Table 3. Intraoperative Factors Associated with Cardiac Complications

Variable	Cardiac Complication Group (n=54)	No Cardiac Complication Group (n=216)	p-value
Mean surgery duration (min) ± SD	148.6 ± 34.2	126.4 ± 29.8	<0.001*
Mean blood loss (ml) ± SD	740 ± 210	530 ± 180	<0.001*
Hypotensive episodes, n (%)	28 (51.9)	51 (23.6)	<0.001*
New-onset arrhythmia, n (%)	9 (16.7)	3 (1.4)	<0.001*

Interpretation: Longer surgical duration, higher blood loss, and intraoperative hypotension were strongly associated with the occurrence of postoperative cardiac complications.

Table 4. Types of Cardiac Complications Observed in the Perioperative Period

Type of Cardiac Event	Frequency (n)	Percentage (%)
Myocardial Infarction	18	33.3
Atrial Fibrillation	15	27.8
Ventricular Tachycardia	3	5.6
Acute Decompensated Heart Failure	12	22.2
Cardiac Arrest	6	11.1

Interpretation: Myocardial infarction and atrial fibrillation were the most common cardiac complications, together accounting for more than 60% of all events.

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Table 5. Multivariate Logistic Regression Analysis of Independent Predictors of Cardiac Complications

Risk Factor	Adjusted OR	95% CI	p-value
Age ≥75 years	2.10	1.10 – 4.00	0.024*
Known CAD	3.45	1.78 – 6.68	<0.001*
ASA grade III–IV	2.82	1.47 – 5.42	0.002*
Intraoperative hypotension	2.95	1.55 – 5.62	0.001*
Surgery duration >150 min	1.88	1.02 – 3.47	0.043*

Interpretation: Known coronary artery disease, high ASA grade, intraoperative hypotension, advanced age, and prolonged surgery duration emerged as independent predictors of postoperative cardiac complications.

Discussion

In the present prospective observational study, we evaluated the incidence, types, and predictors of cardiac complications in elderly patients undergoing major orthopaedic surgeries. Our findings indicate that 20% of patients developed perioperative cardiac complications, with myocardial infarction and atrial fibrillation being the most common events. These findings are consistent with international literature, where the reported incidence of cardiac events in elderly non-cardiac surgical patients ranges between 10–25% depending on population characteristics and definition criteria used (8,9). Advanced age emerged as a significant risk factor in our study, with patients aged ≥75 years having more than double the odds of developing cardiac events. Aging is associated with reduced cardiovascular reserve, diastolic dysfunction, and increased arterial stiffness, all of which impair the ability to tolerate perioperative hemodynamic fluctuations (10). Similar associations have been demonstrated in large cohort studies, including the VISION trial,

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which emphasized age as a non-modifiable yet strong predictor of adverse postoperative cardiac outcomes (11).

The presence of pre-existing coronary artery disease (CAD) was found to be the strongest independent predictor in our multivariate model (adjusted OR: 3.45). CAD increases susceptibility to perioperative myocardial ischemia due to the imbalance between myocardial oxygen supply and demand during surgical stress (12). In the Indian context, the prevalence of CAD among elderly surgical patients is higher than in many Western populations, reflecting the country's high background burden of atherosclerotic cardiovascular disease (13). Our results also highlight the impact of intraoperative factors, particularly hypotension and prolonged surgery duration, on postoperative cardiac outcomes. Intraoperative hypotension has been identified in several studies as a modifiable risk factor that can precipitate myocardial injury, especially in patients with compromised coronary perfusion (14). Prolonged surgeries may lead to greater fluid shifts, blood loss, and prolonged exposure to anesthetic agents, thereby increasing the physiological stress and risk of ischemia.

Interestingly, spinal instrumentation and bipolar hemiarthroplasty procedures were associated with the highest cardiac complication rates in our study. These findings may be explained by the greater operative time, blood loss, and hemodynamic instability associated with these procedures, as observed in prior orthopaedic outcome studies (15).

The types of cardiac complications seen in our study — notably myocardial infarction and atrial fibrillation — align with previously published literature on elderly surgical patients. Postoperative atrial fibrillation is often precipitated by systemic inflammation, catecholamine surge, and fluid-electrolyte imbalances in the perioperative period (16). These arrhythmias may further predispose to ischemic events and heart failure, highlighting the need for continuous cardiac monitoring in high-risk patients.

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Overall, our findings underscore the importance of comprehensive preoperative cardiac assessment, meticulous intraoperative hemodynamic management, and vigilant postoperative surveillance. Implementing targeted perioperative protocols, especially for elderly patients with known CAD, high ASA grade, or undergoing high-risk orthopaedic procedures, may substantially reduce morbidity and improve surgical outcomes.

Conclusion

The present prospective observational study highlights that elderly patients undergoing major orthopaedic surgeries are at significant risk of developing perioperative cardiac complications, with an overall incidence of 18% in the present cohort. Myocardial infarction, arrhythmias, and acute heart failure constituted the majority of events, most of which occurred within the first 72 hours postoperatively. Increasing age, pre-existing coronary artery disease, higher ASA physical status, prolonged surgery duration, and emergency procedures were identified as important risk factors. These findings emphasize the necessity for comprehensive preoperative cardiovascular assessment, vigilant intraoperative monitoring, and intensive postoperative surveillance in elderly patients scheduled for major orthopaedic procedures. Implementation of standardized perioperative cardiac risk stratification protocols and optimization of modifiable risk factors could substantially reduce morbidity and mortality in this vulnerable population.

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