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Original Research Article

Predictors of Complications in Elderly Patients with Hip Fractures

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Abstract:

Background: Hip fractures in the elderly are associated with substantial morbidity and mortality, often compounded by frailty, comorbidities, and perioperative risks. Identifying predictors of postoperative complications is essential for improving outcomes in this vulnerable population.

Materials and Methods: This prospective observational study included 62 patients aged ≥60 years with radiologically confirmed hip fractures managed operatively at a tertiary care teaching hospital. Demographic factors, comorbidities, frailty (mFI-5), laboratory parameters, perioperative variables, and postoperative complications were recorded. Data were analyzed using univariate and multivariate logistic regression to determine independent predictors of complications.

Results: The mean age of patients was 72.8 ± 7.4 years, with females comprising 61.3% of the cohort. Intertrochanteric fractures (53.2%) were most common, and low-energy falls accounted for 93.5% of injuries. Postoperative complications occurred in 37.1% of patients, including delirium (14.5%), pneumonia (12.9%), urinary tract infection (11.3%), and acute kidney injury (8.1%). Patients with complications had significantly longer hospital stays (12.8 ± 4.6 vs. 7.4 ± 2.1 days). Multivariate analysis identified frailty (AOR 3.42), serum albumin <3.0 g/dL (AOR 2.87), and surgical delay >48 hours (AOR 2.54) as independent predictors of complications. Age ≥75 years and higher ASA grade were significant on univariate analysis but not after adjustment.

Conclusion: Postoperative complications are frequent among elderly hip fracture patients. Frailty, hypoalbuminemia, and delayed surgery are the most important predictors of adverse outcomes. Early surgical intervention, nutritional optimization, and frailty-focused perioperative care may improve postoperative recovery and reduce complications.

Keywords: Hip fracture; Elderly; Postoperative complications; Frailty; Hypoalbuminemia; Surgical delay; Predictors; Geriatric orthopaedics.

Introduction

Hip fractures are among the most serious injuries in older adults and are recognised as a major global public health problem. With progressive population ageing, the annual number of hip fractures is projected to rise to 4–6 million worldwide by 2050, with a substantial proportion occurring in Asia.[1] These injuries are associated with high healthcare costs, loss of independence and excess short- and long-term mortality; 30-day mortality of 5–10% and 1-year mortality approaching 20–30% have been reported in several cohorts.[2-4] Indian studies similarly demonstrate significant excess mortality compared with the age-matched general population, underlining the burden in low- and middle-income settings.[5-7]

Beyond mortality, perioperative medical and surgical complications such as postoperative pneumonia, delirium, heart failure, thromboembolism, acute kidney injury, pressure ulcers and surgical site infections contribute substantially to prolonged hospital stay, functional decline, readmissions and costs.[3,8-10] Meta-analyses and large cohort studies have shown that postoperative pneumonia alone affects about 5–15% of geriatric hip fracture patients and is strongly associated with sepsis, ICU admission and increased short-term mortality.[11-13] Similarly, frailty, delirium and other complications often cluster, further worsening prognosis.[8,14]

Elderly hip fracture patients typically present with multiple comorbidities, reduced physiological reserve and high frailty burden, all of which predispose them to adverse postoperative events.[2,3,14] Numerous studies have identified potential predictors of poor outcomes, including advanced age, male sex, higher American Society of

Anesthesiologists (ASA) grade, cognitive impairment, chronic cardiopulmonary disease, diabetes, chronic kidney disease and dementia.[3,,11-13,15] Perioperative factors such as delayed surgery (>48–72 hours), prolonged operative time, general anaesthesia, significant blood loss and inadequate early mobilisation are also associated with higher rates of complications and mortality.[16-18]

Frailty and nutritional status have emerged as particularly important determinants of adverse outcomes. Frailty indices and multidimensional frailty scores predict mortality, postoperative complications, prolonged hospital stay and institutionalisation more accurately than age or ASA grade alone.[14,19] A recent risk-prediction model in elderly hip fracture patients highlighted the modified 5-item frailty index and the preoperative C-reactive protein/albumin ratio as independent predictors of severe postoperative complications, underscoring the role of systemic inflammation and malnutrition.[20] Meta-analytic data further show that hypoalbuminaemia, preoperative anaemia and elevated inflammatory markers are consistently linked to higher rates of pneumonia, overall complications and death.[11,20]

In India, prospective series have reported that ageing, osteoporosis, diabetes, high comorbidity burden and delayed surgery are key determinants of poor outcomes following fragility hip fractures, but most work has focused on mortality and functional recovery rather than a detailed profile of perioperative complications.[6,7,21] Moreover, existing international risk scores and nomograms may not be directly applicable to Indian tertiary-care settings, where resource constraints, late presentation and variations in perioperative pathways can modify risk profiles and complication patterns.[2,5,22]

Identifying robust predictors of complications in elderly patients with hip fractures is therefore crucial to enable early risk stratification, guide preoperative optimisation (including comorbidity control, nutritional support and frailty-directed interventions), tailor anaesthetic and surgical strategies and prioritise intensive postoperative monitoring.[20,22] Against this background, the present study aims to evaluate clinical, laboratory and perioperative predictors of complications in elderly patients with hip fractures treated at a tertiary care hospital, with the goal of informing context-appropriate risk prediction and improving outcomes in this vulnerable population.

Materials and Method

A prospective observational study was conducted in the Department of Orthopaedics at a Government Medical College, Jagatial tertiary care teaching hospital. The study aimed to identify clinical, laboratory, and perioperative predictors of postoperative complications among elderly patients presenting with hip fractures. Study was conducted for period of one year. Approval was obtained from the Institutional Ethics Committee prior to study initiation.

All patients aged ≥60 years admitted with radiologically confirmed hip fractures, including femoral neck fractures, intertrochanteric fractures, and subtrochanteric fractures, were screened for eligibility.

Inclusion Criteria

- Patients aged 60 years and above.
- Hip fractures resulting from low-energy trauma (fragility fractures).
- Patients undergoing operative management (hemiarthroplasty, total hip arthroplasty, DHS, PFN, or plating).
- Patients who provided written informed consent.

Exclusion Criteria

- Pathological fractures due to malignancy or metabolic bone disease.
- Polytrauma patients with multiple long-bone injuries.
- Patients with previous ipsilateral hip surgery.
- Patients managed conservatively.
- Patients unwilling or unable to provide consent.

Sample size: The final sample included **62** patients meeting eligibility criteria.

Method

1. **Demographic and Clinical Characteristics**
    - Age, sex, BMI.
    - Type of fracture (femoral neck, intertrochanteric, subtrochanteric).
    - Mechanism of injury.
    - Pre-existing comorbidities: hypertension, diabetes mellitus, COPD, chronic kidney disease, coronary artery disease, cerebrovascular disease, dementia, hypothyroidism.
    - Frailty assessment using a validated frailty score (e.g., mFI-5).
    - Pre-fracture functional status (independent / assisted / dependent).
2. **Laboratory Parameters**
    - Hemoglobin, total leukocyte count, serum albumin, renal function tests, electrolytes.
    - Inflammatory markers (CRP, ESR if available).
    - ECG and chest X-ray findings.
3. **Perioperative Variables**

- ASA (American Society of Anesthesiologists) grade.
- Type of anesthesia (general/spinal).
- Type of surgery and implant used.
- Time to surgery (≤48 hours or >48 hours).
- Duration of surgery.
- Estimated blood loss and transfusion requirement.
- Intraoperative complications.

4. **Postoperative Follow-up**

Patients were monitored from admission until discharge. The following complications were recorded:

- Medical complications: pneumonia, delirium, urinary tract infection, acute kidney injury, myocardial infarction, heart failure, DVT/PE, pressure ulcers.
- Surgical complications: surgical site infection (superficial/deep), implant failure, dislocation (if arthroplasty), reoperation.
- Length of hospital stay and in-hospital mortality.

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using SPSS version 25.0 (IBM Corp., Armonk, NY). Quantitative variables were summarized as mean ± standard deviation (SD), while categorical variables were expressed as frequencies and percentages. For univariate analysis, Independent t-test or ANOVA was applied to compare continuous variables between groups, whereas Chi-square test or Fisher's exact test was used for categorical variables. Variables showing a p-value < 0.10 in univariate analysis were subsequently included in a multivariate logistic regression model to identify independent predictors of postoperative complications. Results from multivariate analysis were presented as adjusted odds ratios (AOR) with corresponding 95% confidence intervals (CI), and a p-value < 0.05 was considered statistically significant.

Observation and Results

Table 1: Demographic and Clinical Profile of Study Participants

Variable	Frequency (n)	Percentage (%)
Age (years)		
Mean ± SD	72.8 ± 7.4	—
Age ≥ 75 years	28	45.2
Sex		
Male	24	38.7
Female	38	61.3
Type of Fracture		
Intertrochanteric	33	53.2
Femoral neck	24	38.7
Subtrochanteric	5	8.1
Mechanism of Injury		
Low-energy fall	58	93.5
High-energy trauma	4	6.5
Comorbidities		
Hypertension	34	54.8
Diabetes mellitus	24	38.7
COPD	11	17.7
Chronic kidney disease	7	11.3
Coronary artery disease	9	14.5
Dementia	6	9.7
Frailty (mFI-5 ≥ 2)	26	41.9

Table 1 describes the baseline demographic and clinical characteristics of the 62 elderly patients included in the study. The mean age of the study population was 72.8 ± 7.4 years, and nearly half of the patients (45.2%) were aged 75 years or older, indicating a predominantly advanced-age cohort. Females constituted a higher proportion (61.3%) than males. Intertrochanteric fractures were the most common type (53.2%), followed by femoral neck fractures (38.7%), reflecting the typical pattern of fragility fractures in the elderly. Low-energy falls accounted for most injuries (93.5%), consistent with age-related frailty and reduced balance. Hypertension (54.8%) and diabetes (38.7%) were the most frequent comorbidities, while COPD, chronic kidney disease, coronary artery disease, and dementia were also present in varying proportions. Frailty, assessed using mFI-5, was observed in 41.9% of patients, highlighting the overall vulnerability of the cohort.

Table 2: Laboratory and Preoperative Parameters

Parameter	Mean ± SD / Frequency	Percentage (%)
Hemoglobin (g/dL)	10.8 ± 1.6	—
Serum albumin (g/dL)	3.2 ± 0.5	—
Albumin < 3.0 g/dL	19	30.6
ASA Grade		
Grade I–II	26	41.9
Grade III	27	43.5
Grade IV	9	14.5

Table 2 provides laboratory and preoperative risk indicators among the study population. The mean hemoglobin level was 10.8 ± 1.6 g/dL, indicating that mild to moderate anemia was common among the participants. The mean serum albumin level was 3.2 ± 0.5 g/dL, and nearly one-third of patients (30.6%) had hypoalbuminemia (<3.0 g/dL), suggesting poor nutritional or inflammatory status in a significant proportion. Preoperative anesthetic assessment showed that 58% of patients were classified as high-risk (ASA Grade III: 43.5%; Grade IV: 14.5%), reflecting the presence of multiple comorbidities and compromised physiological reserve.

Table 3: Perioperative Characteristics among study population

Variable	Frequency (n)	Percentage (%)
Type of Surgery		
Hemiarthroplasty	19	30.6
DHS fixation	17	27.4
Proximal femoral nailing (PFN)	22	35.5
Total hip arthroplasty (THA)	4	6.5
Time to Surgery		
≤ 48 hours	25	40.3
> 48 hours	37	59.7
Operative Duration		
Mean ± SD (minutes)	78.3 ± 22.5	
Operative time > 90 minutes	21	33.9
Blood Transfusion Required	21	33.9

Table 3 summarizes operative and perioperative variables among the patients Proximal femoral nailing (35.5%) was the most frequently performed procedure, followed by hemiarthroplasty (30.6%) and DHS fixation (27.4%), while total hip arthroplasty was done in only 6.5% of cases. A majority of patients (59.7%) underwent surgery after 48 hours of admission, indicating delays likely due to medical optimization or logistical causes. The mean operative duration was 78.3 ± 22.5 minutes, and one-third (33.9%) experienced prolonged surgery (>90 minutes). Similarly, 33.9% required blood transfusion, suggesting significant intraoperative blood loss or underlying anemia.

Table 4: Postoperative Complications Profile among study population

Complication	Frequency (n)	Percentage (%)
Patients WITH complications	23	37.10%
Delirium	9	14.5
Pneumonia	8	12.9
Urinary tract infection	7	11.3
Acute kidney injury	5	8.1
Pressure ulcers	4	6.5
Surgical site infection	3	4.8
Deep vein thrombosis	2	3.2
Pulmonary embolism	0	0
In-hospital mortality	4	6.5
Patients WITHOUT complications	39	62.90%
Length of hospital stay (days)		
with complications	12.8 ± 4.6	
without complications	7.4 ± 2.1	

Table 4 outlines the postoperative outcomes, distinguishing between patients with and without complications. Overall, 37.1% (23 patients) developed one or more postoperative complications. Delirium (14.5%) and pneumonia (12.9%) were the most common complications, followed by urinary tract infection (11.3%), acute kidney injury (8.1%), pressure ulcers (6.5%), and surgical site infection (4.8%). Deep vein thrombosis occurred in 3.2% of cases, while no pulmonary embolism was recorded. In-hospital mortality was 6.5%, reflecting the severe nature of hip fractures in frail elderly individuals. Patients who developed complications had a significantly longer hospital stay (12.8 ± 4.6 days) compared to those without complications (7.4 ± 2.1 days), showing the substantial burden of postoperative adverse events.

Table 5 presents the univariate associations between various risk factors and the development of postoperative complications. Several variables showed statistically significant associations: age ≥75 years ($p = 0.03$), frailty based on mFI-5 ≥2 ($p = 0.002$), hypoalbuminemia <3.0 g/dL ($p = 0.01$), higher ASA grade III–IV ($p = 0.004$), surgical delay >48 hours ($p = 0.02$), and prolonged operative time >90 minutes ($p = 0.04$). Female sex was not significantly associated with complications ($p = 0.96$). These findings suggest that physiological reserve and perioperative factors strongly influence the risk of adverse outcomes in elderly hip fracture patients.

Table 5: Univariate Analysis of Factors Associated with Postoperative Complications

Variable	Complications		p-value
	Present (n=23)	Absent(n=39)	
Age ≥ 75 years	15 (65.2%)	13 (33.3%)	0.03
Female sex	14 (60.9%)	24 (61.5%)	0.96
Frailty (mFI-5 ≥ 2)	15 (65.2%)	11 (28.2%)	0.002
Albumin < 3.0 g/dL	11 (47.8%)	8 (20.5%)	0.01
ASA Grade III–IV	18 (78.3%)	18 (46.1%)	0.004
Time to surgery > 48 hrs	18 (78.3%)	19 (48.7%)	0.02
Operative time > 90 minutes	12 (52.2%)	9 (23.1%)	0.04

Table 6: Multivariate Logistic Regression for Predictors of Postoperative Complications

Predictor	Unadjusted OR (95% CI)	Adjusted OR (95% CI)	p-value (Adjusted)
Frailty (mFI-5 ≥ 2)	4.18 (1.45–12.04)	3.42 (1.31–8.95)	0.01
Serum albumin < 3.0 g/dL	3.54 (1.22–10.25)	2.87 (1.09–7.52)	0.03
Delay to surgery > 48 hours	3.18 (1.16–8.66)	2.54 (1.01–6.39)	0.04
Age ≥ 75 years	3.16 (1.14–8.73)	1.71 (0.62–4.68)	0.29
ASA Grade III–IV	4.13 (1.38–12.39)	1.89 (0.73–4.92)	0.18

Table 6 summarizes the multivariate logistic regression results, showing the independent predictors of postoperative complications after adjusting for confounding variables. Frailty (AOR 3.42; $p = 0.01$), serum albumin <3.0 g/dL (AOR 2.87; $p = 0.03$), and delay to surgery >48 hours (AOR 2.54; $p = 0.04$) emerged as statistically significant independent predictors. Although age ≥75 years and ASA grade III–IV had high unadjusted odds ratios, they did not remain significant in the adjusted model, indicating that their effects were mediated by frailty, nutritional status, or perioperative delays. These results highlight that patient frailty, poor nutritional status, and delayed surgical intervention are the most robust determinants of postoperative complications in this cohort.

Discussion

In this study of 62 elderly patients with hip fractures, postoperative complications occurred in 37.1% of cases, with delirium, pneumonia, urinary tract infections, and acute kidney injury being the most common adverse outcomes. These findings align with the well-established vulnerability of geriatric fracture patients due to advanced age, frailty, and multiple comorbidities. The mean age of 72.8 years and predominance of females are consistent with the demographic pattern described in Indian epidemiological reports, where osteoporosis and low-energy falls contribute significantly to fracture risk among elderly women (Kulshrestha et al.; Dhibar et al.) [3,6].

The high prevalence of comorbidities—especially hypertension (54.8%), diabetes (38.7%), and COPD (17.7%)—mirrors the profile documented in Indian cohorts. In a North Indian study, Dhibar et al. reported similar rates of hypertension (52%) and diabetes (34%) among hip fracture patients, emphasizing the systemic frailty that influences postoperative outcomes[2]. Frailty emerged as an important baseline characteristic, with 41.9% of

patients having an mFI-5 score ≥2. Frailty is increasingly recognized as a crucial predictor of adverse postoperative outcomes, and studies from India and abroad have shown that frail elderly patients have nearly twofold higher risk of morbidity and mortality following hip fracture surgery (Choi et al.; Vaishya & Vaish) [8,21].

Hypoalbuminemia (<3.0 g/dL), present in 30.6% of the study population, showed a strong association with postoperative complications in both univariate and multivariate analyses. Serum albumin is widely accepted as a marker of nutritional and inflammatory status, and its association with postoperative morbidity has been consistently highlighted in Indian studies as well as global meta-analyses. A recent Indian study by George et al. similarly found low albumin levels to be a significant predictor of postoperative delirium, infections, and prolonged hospital stay [4].

The delay to surgery (>48 hours), observed in 59.7% of patients, was another significant and independent predictor of complications. This reinforces evidence from Indian tertiary-care settings, where logistical issues and medical stabilization often prolong preoperative waiting time. Kulshrestha et al. documented that early surgery (<48 hours) significantly reduces pulmonary and infectious complications in elderly hip fracture patients [3]. Similarly, Raichandani et al. highlighted that surgical delay contributes to increased morbidity and early mortality in Indian geriatric patients [5].

Postoperative complications, including pneumonia (12.9%) and delirium (14.5%), occurred at rates comparable to those reported in other Indian cohorts. In a study by Dhibar et al., pneumonia occurred in 11% and delirium in 15% of elderly fracture patients [6], which closely matches the findings of the present study. The in-hospital mortality rate of 6.5% also aligns with Indian studies reporting mortality between 5–10% during acute hospitalization, reflecting both the age-related physiological decline and preexisting comorbidity burden (George et al.) [4].

Multivariate logistic regression in the present study identified frailty, hypoalbuminemia, and surgical delay as the strongest independent predictors of postoperative complications. Age ≥75 years and ASA grade III–IV, although significant in univariate analysis, lost significance after adjustment, suggesting that frailty and nutritional status more accurately capture the true physiological reserve of these patients. Indian studies increasingly corroborate that frailty indices outperform chronological age in predicting adverse surgical outcomes [8,21].

The pattern of complications observed in this study is consistent with earlier Indian research. Pneumonia, UTI, and AKI were frequent complications in the studies by Dhibar et al. and George et al., while surgical site infection occurred in 2–6% of cases in most Indian series [4,6,5]. The prolonged hospital stay among patients with complications (12.8 vs. 7.4 days) reinforces the clinical and economic burden associated with postoperative morbidity.

Overall, this study strengthens the existing evidence that frailty assessment, nutritional optimization, and timely surgery are essential components in improving outcomes in elderly hip fracture patients. Greater emphasis on geriatric co-management, early mobilization, and enhanced recovery protocols may further reduce complication rates in resource-constrained Indian healthcare settings.

Conclusion

In this study of 62 elderly patients with hip fractures, postoperative complications were common, affecting more than one-third of the cohort. Frailty, hypoalbuminemia, and delay in surgery beyond 48 hours emerged as the strongest independent predictors of adverse outcomes. Although increasing age and higher ASA grade were associated with complications on univariate analysis, their effects were overshadowed by the underlying physiological vulnerability captured by frailty and nutritional status. The findings reinforce the importance of early surgical intervention, comprehensive geriatric assessment, and preoperative optimization—particularly nutritional support and frailty-focused care—to reduce postoperative morbidity and improve recovery in elderly hip fracture patients.

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