J Orthop Spine Trauma. 2022 December; 8(4): 118-24. DOI: http://dx.doi.org/10.18502/jost.v8i4.10452

Research Article

Influence of Risk Factors and Comorbidities on Postoperative Complications and Outcomes after Hip Fracture Surgery in the Elderly

Khazi Syed Asif Hussain[1], Aluka Sundeep Kund Reddy[2,*], Mayani Raju[3], Chandrashekhar Patnala[4]

[1] Additional Professor, Department of Orthopedics, Nizam's Institute of Medical Sciences, Panjagutta, Hyderabad, India
[2] Associate Professor, Department of Orthopedics, Nizam's Institute of Medical Sciences, Panjagutta, Hyderabad, India
[3] Senior Resident, Department of Orthopedics, Nizam's Institute of Medical Sciences, Panjagutta, Hyderabad, India
[4] Professor, Department of Orthopedics, Nizam's Institute of Medical Sciences, Panjagutta, Hyderabad, India

[*]Corresponding author: Aluka Sundeep Kund Reddy; Department of Orthopedics, Nizam's Institute of Medical Sciences, Panjagutta, Hyderabad, India. Tel: +-9550987404, Email: drkund@gmail.com

Received: 01 April 2022; **Revised:** 27 May 2022; **Accepted:** 15 June 2022

Abstract

Background: Older adults who sustain hip fractures usually have multiple comorbidities that may impact their treatment and outcome. This study was conducted with the aim to analyze the risk factors that contribute to falls in elderly individuals and analyze the effect of comorbidities on the outcome and the treatment in elderly patients with hip fractures.
Methods: This cohort study was conducted on patients with hip fractures. We prospectively analyzed 140 individuals with geriatric hip fractures who had undergone surgery. The Charlson Comorbidity Index (CCI) and American Society of Anesthesiology (ASA) score of each geriatric hip fracture patient were calculated based on data obtained from medical records. Clinical assessment was assessed using a modified Harris Hip Score (HHS) during each visit.
Results: The mean age of patients was 72.21 ± 12.2 years. Their mean CCI and ASA was 1.02 ± 0.3 and 2.0 ± 0.53, respectively, and both were significantly associated with time-to-surgery ($P < 0.001$) and surgical treatment ($P < 0.001$). The length of hospital stay, duration of postoperative intensive care, and hospital expenses were associated with both CCI ($P = 0.037$) and ASA ($P = 0.002$). The greater the CCI and ASA scores were, the higher the chances of developing postoperative complications were ($X^2 = 15.724$; $P = 0.001$). Delirium was the most common postoperative complication (15.7%), and pulmonary infection (11.4%) was the most fatal complication.
Conclusion: Patients with high CCI and ASA grading, and revision surgery were at high risk of postoperative complications, morbidity, and mortality. Orthogeriatric care offers the best chance for a successful outcome through efficient medical co-management of these patients.

Keywords: Hip; Risk Factors; Comorbidity

Citation: Hussain KSA, Reddy ASK, Raju M, Patnala C. **Influence of Risk Factors and Comorbidities on Postoperative Complications and Outcomes after Hip Fracture Surgery in the Elderly.** *J Orthop Spine Trauma* 2022; 8(4): 118-24.

Background

The term hip fracture includes both femoral neck fractures and inter-trochanteric fractures and is one of the most common causes of hospitalization, leading to loss of independence, morbidity, and mortality in the elderly. Incidence of hip fractures is drastically increasing worldwide, varies from country to country, and depends upon age, sex, underlying risk factors, and comorbidities.

Incidence of hip fractures increases with age; most of the subjects are over the age of 65 years and experience a hip injury mostly after a fall. In addition, it is more prevalent in women compared to men (1). This increase in incidence is considerably greater among women after menopause and among men after the age of 70 years, and the risk is much higher in both sexes with underlying comorbidities such as hypertension, diabetes mellitus (DM), and several systemic diseases such as hypothyroidism and hyperthyroidism, dementia, chronic obstructive pulmonary diseases (COPD), chronic kidney diseases, cardiovascular diseases and neurological problems such as parkinsonism, vertigo, stroke, and epilepsy (2, 3). Numerous factors may also predict the risk of hip fractures, including age, gender, ethnicity, hip axis length, bone mass, nutrition, height, and weight, prior history of hip fracture, chronic use of certain medications (antipsychotic drugs, antihypertensive medications, corticosteroids, antidepressants, and anticonvulsants), chronic smoking and alcohol consumption, place of residence, lack of a caregiver, institutionalization, prolonged immobilization, decreased bone mineral density, knee arthritis, reduced level of activity, and visual impairment.

These fractures can cause numerous complications. Some of these are medical, and others are related to the surgical treatment itself (4, 5). The possible medical complications include cognitive and neurological alterations, cardiopulmonary affections, venous thromboembolism, gastrointestinal tract bleeding, urinary tract complications, perioperative anemia, and electrolytes imbalance. These common medical complications are related to pre-existing medical illness and hospitalization (6, 7). Post-surgical complications are fracture-specific, and avascular necrosis and nonunion are common complications related to disturbed biology in patients with intracapsular fracture. In extracapsular fractures, by contrast, the problem is mechanical and related to load-bearing; hence, fixation failure is a notable complication. There are other factors that determine the post-surgical outcome, including surgical skill, anesthesia skill, and the interval between fracture and surgery, duration of the hospital stay, good peri-operative management of pre-morbid conditions, and good post-operative management of post-operative complications, and prevention of deep vein thrombosis (DVT) and pulmonary embolism (8).

Hence, careful pre-operative assessment of risk status,

American Society of Anesthesiology (ASA) score, and predicted post-procedure functional outcome, which affects both treatment and prognosis, are of fundamental importance when approaching hip fracture patients (9). The present study was conducted with the aim to (i) analyze and investigate the risk factors for hip fractures in geriatrics, (ii) determine the relationship between comorbid conditions and outcomes of hip fracture surgery, and (iii) analyze the influence of comorbidities to determine the risk stratification in terms of outcome (post-operative complications, returning to the pre-injury health status, morbidity, and mortality) among hip fracture patients aged ≥60 years.

Methods

This cohort study was conducted at Nizam's Institute of Medical Sciences, Hyderabad, Iran, between 2018 and 2019. The participants included over 140 hip fracture patients who met the proposed inclusion criteria. The inclusion criteria included hip fracture of non-pathological origin in individuals above the age of 60 years with no prior history of cognitive and functional disability, with clinical and surgical indications, independent of surgical type and approach. The approval of the ethics committee was obtained for the study.

Inclusion Criteria

1. Patients of ≥60 years of age diagnosed with hip fracture
2. Ability to perform daily living activities independently before the occurrence of the hip fracture (pre-injury functional status) and willing to undergo surgery

Exclusion Criteria

1. Patients of less than 60 years of age
2. Conservatively managed hip fracture
3. Patients who are medically unfit for surgery
4. Patient with any other associated fracture
5. Periprosthetic hip fractures
6. Pathological hip fractures
7. Simultaneous bilateral hip fractures

Study Design: The study was a prospective, observational, cohort study. The collected data include demographic characteristics, type of fracture, preoperative comorbidities, operative treatment, and postoperative complications. The data were collected from medical history, medication prescriptions, and previous medical records. Anesthetists assess pre-surgical fitness and refer the unfit cases to the related department for treatment recommendation and assuring about surgical fitness. Sample size was determined using the formula $N = 4PQ/d^2$, where p is the prevalence in previous studies, Q is 100-P, and d is the allowable error (2.5-10%); ~ 140 patients were analyzed as per the study design. There were no dropouts in our study.

Assessment of Comorbidities: The Charlson Comorbidity Index (CCI) was used to predict the outcome in relation to patient comorbidity. The CCI determines the number of pre-existing comorbid conditions and their severity. It presents the sum of the weighted index for different subsets of conditions. Myocardial infarction (MI), congestive heart failure, peripheral vascular disease, cerebrovascular disease (except hemiplegia), dementia, chronic pulmonary disease, connective tissue disorders, ulcer disease, mild liver disease, and DM without complications received 1 point each. DM with end-organ damage, hemiplegia, moderate or severe renal disease, or any malignancy, including leukemia, lymphoma, diabetes with chronic complications, and solid tumors (non-metastatic) received 2 points each. Moreover, moderate or severe liver disease received 3 points, while acquired immune deficiency syndrome (AIDS) and metastatic solid tumors received 6 points. Higher scores correspond to an increased risk of mortality. The total score was calculated for each patient; based on the total score, the study population was classified into four ordinal categories of 0, 1-2, 3-4, and ≥5 points. In addition, age-adjusted CCI was also calculated, wherein 1 point was given for each decade of life after the age of 50 years. Hypertension and osteoporosis, which are not included in the CCI, were also included in the analysis.

Statistical Analysis: Continuous variables are expressed as mean ± standard deviation (SD) and compared using Student's t-test. Categorical variables are expressed as percentages and compared using the chi-squared test. The CCI and other comorbidities were used as independent variables. Binary logistic regression models were used to examine the relationship of the CCI score with complications, surgical choice, time-to-surgery, transfusion, anticoagulation, analgesia, and complications after hip fractures. Linear regression analysis was used to examine the relationship of the length of hospital stay and hospital expenses with CCI, age-adjusted CCI, osteoporosis, and hypertension. The results are presented as crude and adjusted regression coefficients and 95% confidence intervals (CIs), standardized coefficients, and P values. All statistical tests of significance were two-tailed, and P values < 0.05 were considered statistically significant.

Results

A total of 140 patients with hip fractures were included in the study. Among them, 92 (65.8%) were women, and 48 (34.2%) were men, with a male to female ratio of 1:2.1. The maximum number of cases was in the age group of 60-70 years. The mean age of patients was 72.21 ± 12.20 years.

Patients with femoral neck fractures accounted for 35% of the population, whereas inter-trochanteric fractures accounted for 65%. In addition, right-sided injuries (57.5%) were more common than left-sided injuries (43.5%). Domestic fall (90%) is the most frequent mode of injury, and the majority of injuries occurred in the early hours of the morning (65.8%) while going to the washroom and carrying out their routine activities. In the Kuppuswamy socioeconomic scale, the maximum number of hip fracture cases was reported in the lower middle and upper middle class. The average time interval between injury and presentation is 24-48 hours, and between presentation and surgery is 48-72 hours [χ^2(chi-square) = 18.250; P = 0.001]. Delayed presentation was observed in femoral neck fracture with a maximum delay of 8 months.

Most of the patients had a CCI in the range of 0-2 points. Female patients exhibited higher CCI than male patients (P = 0.057). The age-adjusted CCI for male patients was significantly higher than that for female patients (P = 0.017). The mean age-adjusted CCI of patients with intertrochanteric fracture was significantly higher than that of patients with femoral neck fracture (P = 0.010).

The prevalence of comorbidities and complications in our study population is presented in table 1. Most of the patients scored 1 point for chronic diseases; there was a high proportion of patients who had uncomplicated diabetes and MI with post-percutaneous transluminal angioplasty (PTA) status.

Table 1. Description of the comorbidities and post-hip fracture complications in the study population

Variable	Points	n (%)
Comorbidities taken into account in the CCI		
Chronic pulmonary disease	1	4 (2.8)
Connective tissue diseases	1	1 (0.7)
Congestive heart failure	1	2 (1.4)
Cerebrovascular disease (without hemiplegia)	1	2 (1.4)
Dementia	1	3 (2.1)
Diabetes without complications	1	56 (40)
Mild liver disease	1	12 (8.5)
Myocardial infarction	1	16 (11.4)
Peripheral vascular insufficiency	1	2 (1.4)
Ulcer disease	1	5 (3.5)
Diabetes with chronic complications	2	9 (6.4)
Moderate-to-severe renal disease	2	14 (10)
Hemiplegia	2	9 (6.4)
Tumors including leukemia and lymphoma	2	-
Severe hepatopathy	2	1 (0.7)
Acquired immune deficiency syndrome	6	-
Metastatic cancer	6	-
Presence of other comorbidities	-	
Hypertension	-	104 (74.2)
Osteoporosis	-	118 (84.2)

CCI: Charlson Comorbidity Index

The prevalence of hypertension was 74.2%, and most of the participants sustained an injury during early hours of the morning while carrying out daily activities, particularly those on diuretics. The prevalence of osteoporosis was 84.2%, and most of the participants had a Singh index grade of below 3 (40%). Delirium was the most common postoperative complication (15.7%), and pulmonary infection (11.4%) was the most lethal complication and it was higher in patients in groups 3 and 4 of the CCI (Table 2).

Table 2. Reported systemic complications after hip fracture surgery

Complication	No. of patients	Percentage
Delirium	22	15.7
Dementia	12	8.6
Cerebrovascular accidents	2	1.4
Lower respiratory tract infection (Pneumonia)	16	11.4
Acute respiratory distress syndrome	14	10
Pulmonary embolism	0	0
Myocardial infarction	6	4.3
Urinary tract infections	8	5.7
Urinary retention	14	10
Renal failure	2	1.4
Deep vein thrombosis	4	2.8
Gastrointestinal tract complications	32	22.8
No. of complications		
1	24	
2	10	
≥3	32	

Wound infection and periprosthetic fractures are surgical complications reported in hemiarthroplasty, screw back out or cut through, and peri-implant fractures in dynamic hip screw (DHS) and proximal femoral nail (PFN) groups. Length of hospital stay, duration of postoperative intensive care, and hospital expenses showed significant association with grade 3 ASA and higher and patients of CCI 3 and 4 (χ^2 = 15.724; P = 0.001) (Table 3).

Functional Outcome

Functional outcomes were assessed using the Harris Hip Score (HHS).

Hemiarthroplasty: Among the 60 patients, 32 (53.33%) patients had excellent outcomes, 22 (36.66%) had good, 2 (3.33%) were fair, and 2 (3.33%) had poor outcome. This was not applicable to 2 patients due to death.

Dynamic Hip Screw: OF the 50 patients, 6 (12%), 22 (44%), 2 (4%), and 2 (4%) patients had excellent, good, fair, and poor outcomes, respectively. This score was not applicable to 9 patients due to death.

Proximal Femoral Nail: Of the 30 patients, 10 (33.3%), 12 (40.0%), 2 (6.6%), and 4 (13.3%) had excellent, good, fair, and poor outcome, respectively. This was not applicable to 1 patient due to death.

Functional outcomes according to CCI are presented in table 4. As can be seen, 30 (62.5%) and 14 (29.1%) cases had excellent outcomes with CCI grades 1 and 2, respectively, and 4 patients (8.3%) had excellent outcomes even with CCI grades 3 and 4.

In this study, 75% of the excellent and 71.42% of the good outcome groups were complication-free, whereas 75% of the fair and poor outcome group developed 3 complications (χ^2 = 51.491; P = 0.001). The greater the CCI and ASA scores were, the higher the chances of developing postoperative complications were (χ^2 = 15.724; P = 0.001).

The reported death rate in this study was 22 (15.70%), out of which 20 (90.90%) developed more than 3 complications in the postoperative period and 17 (77.27%) had CCI grades 3 and 4, and ASA grade 4 and higher (χ^2 = 15.724; P = 0.001). The remaining cases were due to inadequate preoperative optimization. A higher chance of death was reported among revision surgeries, 8 (66.60%) out of 12 revision cases (χ^2 = 9.000; P = 0.002).

Discussion

In the present study, 76.9% of geriatric patients with hip fractures were not operated on during the first 48 hours. This is likely attributable to the time required to assess and stabilize comorbid diseases. The weight of comorbidities in elderly patients with hip fracture (as assessed by CCI) was associated with time-to-surgery in excess of 48 hours, which implies that an increase in the CCI increased the risk of delayed surgery. However, it showed no significant association with time-to-surgery in excess of 48 hours after adjusting for age. Additionally, the weight of comorbidities in elderly patients with hip fracture (as assessed by age-adjusted CCI) was associated with unavailable operation, and increased transfusion, hospital stays, and hospital expenses.

The maximum number of cases was in the age group of 60-70 years, with a mean age of 72.1 years. There was a female preponderance (2.8:1) in our patients due to post-menopausal osteoporosis, a higher frequency of falling while engaging in household activities, and greater longevity compared to men. Domestic fall is the most frequent mode of injury in both women and men, but road traffic accidents (RTA) is quite common in men compared to women as they engage in more outdoor activities like agriculture and driving motor vehicles. Delayed presentation was common in the upper lower class and rural population due to a lack of caregivers, financial issues, and superstition.

Table 3. Reported surgical complications after hip fracture surgery

Complication	Hemiarthroplasty	DHS		PFN	
Wound infection	10	4		0	
Nonunion	0	0		0	
Malunion	0	22		6	
Implant failure	Periprosthetic fracture	Screw back out	Peri implant fracture	Screw cut through	Peri implant fracture
	2	6	1	4	2

DHS: Dynamic hip screw; PFN: Proximal femoral nail

Table 4. Functional outcomes according to Charlson Comorbidity Index (CCI)

CCI	Excellent	Good	Fair	Poor
I	30	36	-	
II	14	16	-	4
III	3	2	5	1
IV	1	2	1	3

CCI: Charlson Comorbidity Index
$\chi^2 = 25.190$, P = 0.001

In the present study, hip fractures showed diurnal variation and were most common during the early hours of the morning, and this may be due to the fact that older people do most of their routine activities in the early hours of the morning. In this study, most of the patients had either hypertension or DM, and increased frequency of urination, either because of diabetes or due to diuretics for hypertension management and because of electrolyte imbalance, contributed to the occurrence of the fall in early hours of the morning in this population. The second peak was during evening hours. This may be because of impaired vision.

In the present study, most of the fractures occurred in the lower middle and upper middle classes compared to the upper class according to the Kuppuswamy socioeconomic scale. This is attributed to a lack of dependents and caregivers; they have to do their household chores by themselves. Most of the patients are self-dependent without a caregiver. This could be one of the reasons for the fall.

In the present study, mean time until hospital presentation was 8.94 days with a minimum delay of 6 hours to a maximum delay of 4 months. Delay in the presentation was quite common in the intracapsular group compared to the inter-trochanteric group because of less pain and impact on mobilization. The delayed presentation was also because of a lack of caregivers, ignorance, and the superstition among rural people that they can be cured through native massages. Sangbong et al. reported an average time delay of 9.6 days for hospital presentation and diagnosis of hip fracture (10).

The mean time until surgery in the present study was 4.39 days, with a minimum period of 3 days to a maximum of 9 days. Time interval between presentation and surgery was individualized based on general condition, number of comorbidities, and drug therapy.

In the present study, the reason for the delay in surgery was variable perioperative blood sugars among those with DM and hypertension, uncontrolled blood pressure, further evaluation, and preoperative optimization of patients with other systemic illnesses. There was a delay in surgery because of certain drug therapies like antiplatelet medication, where we had to wait for surgery. In this study, 12.8% of patients were on dual antiplatelet medication either for treatment purposes or for the prevention of impending stroke or myocardial ischemia. In such cases, we waited up to 5 days until platelet count returned to the desired level (> 1 lakh). In a few cases, a platelet aggregometry test was performed and platelet count was not within the optimal range (< 1 lakh). In the study by Vidan et al., the mean time until surgery was 3 days (11). In a study by Smeets et al., delay in surgery of more than 48 hours was associated with more postoperative complications, but like us, they suggested that time until surgery needed to be individualized (12).

In the present study, 102 out of 140 patients were hypertensive, and among the 102 hypertensive patients, 52 were using diuretics in combination with other antihypertensive drugs for hypertension management and had a history of falling in the early hours of the morning. This was due to the increased frequency of urination and electrolyte imbalance in them. People with DM and uncontrolled blood sugar also have an increased frequency of urination and falling in the washroom. In some cases, longstanding insulin-treated and oral hypoglycemic agents-treated DM leads to osteoporosis and increased vulnerability to falls. Among the patients with central nervous system (CNS) disturbance, anticonvulsants for epilepsy, benzodiazepines, and antidepressants probably contributed to the fall because of side effects like confusion, dizziness, and drowsiness. In the present study, patients on polypharmacy therapy were at risk of injury because of the side effects.

In our study, the mean body mass index (BMI) of patients was 23.3, with a minimum of 14.7 to a maximum of 31.2. Most of the patients in our study fell into the underweight and overweight categories. High BMI was prevalent among people with DM and hypothyroid patients. The prevalence of BMI in this study was 42.8% among overweight, 35.7% among underweight, and 21.4% among normal-weight individuals. The risk of falls is higher among both underweight and overweight people.

De Laet et al. recognized low body weight as a risk factor for fracture in the elderly (13). The increased risk associated with low BMI may result from several factors, including low bone mineral density (BMD), less soft tissue that may protect bones from impact forces, and increased fall risk resulting from muscle weakness. Other risk factors that may have contributed to the occurrence of the fall in this study are visual impairment, osteoporosis, lower limb arthritis, and alcohol addiction. Shafiei et al. found age to be the major risk factor for 1 year mortality (14).

In this study, 60 patients underwent hemiarthroplasty, 50 DHS, and 30 PFN. The operating time varied from procedure to procedure. The mean duration of hemiarthroplasty, DHS, and PFN was 41.25, 70, and 58.6 minutes, respectively. In our study, the mortality at the end of 1 year was found to be less in patients treated with hemiarthroplasty as compared to DHS or PFN, this was similar to the findings of Zandi et al. who compared mortality in hemiarthroplasty with DHS (15).

CCI and ASA grading influence the duration of postoperative ICU stay. The greater the ASA and CCI grading are, the more the chances of postoperative complications leading to prolonged intensive care support are. In our study, the mean duration was 2.54 ± 3.14 days, and the maximum number of cases was 80 (57.4%). In the study conducted by Eschbach et al., 336 (85%) of all patients were in the ICU postoperatively for a mean of 2.50 ± 3.70 days (16).

In the study by Mousapour et al., patients who had undergone bipolar hemiarthroplasty for hip fractures were found to have lower morbidity and mortality compared to those who had undergone DHS fixation (17). In a study by Saeb et al., the effectiveness of tranexamic acid on bleeding control during surgery was found to be significant, this was not in line with our study results which showed no significance in intraoperative bleeding (18).

Postoperative Systemic Complications (Table 5)

Pulmonary Complications: Lower respiratory tract infection (Pneumonia) and acute respiratory distress syndrome (ARDS) are fatal complications among patients with high ASA and CCI grading, especially male patients who are smokers and alcoholics.

Table 5. Type of preoperative comorbidities in patients with postoperative complications in this study

Post-operative complications	No. of patients	Male	Female	Preoperative comorbidities	No. of patients
Delirium	22	14	8	HTN	22
				DM	6
				Electrolyte disturbance	12
				CVA	4
				Alcoholic	8
Dementia	12	6	6	HTN	10
				DM	4
				CVA	2
				TIA	2
				Alcoholic	6
CVA	2	0	2	HTN with h/o TIA	
Lower respiratory tract infections	16	4	12	HTN	14
				DM	10
				Smokers	4
				H/o hospitalization	12
				Cognitive disturbance	8
Acute respiratory distress syndrome (ARDS)	14	4	10	HTN	14
				DM	10
				Smokers	4
				Hospitalization	12
				H/o Cognitive disturbance	8
Myocardial infraction	6	4	2	HTN	6
				DM	6
				H/o compromised cardiac function	6
				Smokers	4
Urinary tract infections	8	3	5	HTN	4
				DM	6
				H/o compromised renal function	2
				Catheterization of bladder ≥3 days	6
Urinary retention	7	6	1	HTN	5
				DM	4
				H/o compromised renal function	3
				BPH	4
Deep vein thrombosis	3	0	3	HTN	3
				DM	3
				Bedridden	2
Renal failure	5			HTN	4
				DM	5
				Diabetic Nephropathy	4
				Analgesic Nephropathy	1
Constipation	30	10	20	HTN	24
				DM	20
Dyspepsia	28	8	20	HTN	18
				DM	12
Paralytic ileus	3	3	0	HTN with electrolyte imbalance	3

DM: Diabetes mellitus; HTN: Hypertension; TIA: Transient ischemic attack; CVA: Cerebrovascular accident

In our study, chest physiotherapy and spirometry were recommended for optimization of the pulmonary reserve, and patients were made to sit in Fowler's position while eating to prevent aspiration-related complications. To prevent volume overload and related complications in patients with renal compromise, fluid input and output are strictly monitored.

Cardiac Complications: We monitored patients with serial ECG, analyzed the cardiac profile of patients with significant ECG changes, and performed strict fluid management to prevent volume overload on the heart in patients with compromised cardiac function.

Central Nervous System: Cognitive complications were reported in 21.42% of patients in which delirium was the most common.

In this study, most of our patients with delirium had electrolytes imbalance and a history of alcoholism, and we treated them through the management of fluids and electrolytes and prompt initiation of a certain drug therapy.

Smeets et al. reported the underlying mechanisms responsible for developing cognitive complications; in their study, delirium was the most frequently reported cognitive complication (19).

Urinary Tract Complications: Urinary retention (10%), urinary tract infections (5.7%), and acute kidney injuries (1.4%) were reported as postoperative urinary tract complications in this study.

We monitored renal function with strict input and output charting, and corrected metabolic disturbances based on ABG, and avoided using nephrotoxic medications, epidural drugs, and opioids for postoperative pain management.

Chong et al. studied the medical problems in hip fracture patients. They reported that urinary retention and urinary tract infection are common postoperative urinary tract complications (5).

Gastrointestinal Tract Complications: Gastrointestinal tract (GIT) complications are the most commonly reported complications within the first 3 days, and the underlying mechanism responsible for this is multifactorial. It is probably drug-induced or due to fluid and electrolyte disturbance. Constipation and dyspepsia are commonly reported postoperative gastrointestinal complications, and we treat them with laxatives. Paralytic ileus is the most attention-seeking GIT complication and is managed through the correction of electrolyte imbalance and enteral feeding using a Ryles tube.

Chong et al. studied over medical problems in hip fracture patients. They reported constipation and dyspepsia as the most common GIT complications (5).

Deep Vein Thrombosis: In our study, the incidence of DVT was 2.8%. The underlying mechanism responsible for this is unclear. All of these cases had undergone osteosynthesis (DHS & PFN); thus, DVT may have been the result of prolonged immobilization. In addition, all of these individuals had high ASA grading and CCI. We treated them through anticoagulation therapy and intermittent pneumatic compression (IPC).

Liu et al. analyzed 222 geriatric patients with hip fractures, and they reported an incidence of 1.4% for DVT (20).

In a study by Kastanis et al., patients with a high ASA score required a multidisciplinary approach and a special assessment to decrease postoperative morbidity and mortality and offer optimal functionality (9). With the

presence of multiple preoperative comorbidities, high ASA grading, and revision surgery, patients are at high risk of the development of postoperative complications, morbidity, and mortality.

Postoperative Surgical Complications: The reported incidence for surgical site infection is 10%, and it is 7.2% and 2.8% among those who have undergone hemiarthroplasty and DHS, respectively. No infection was reported in the PFN group. We managed these complications with the appropriate antibiotics and wound care.

Malunion (varus malunion) was the most commonly reported complication among those who had undergone DHS [22 (44%)]. The underlying reason for this is multifactorial, either insufficient reduction, presence of lateral wall comminution, implant failure, and presence of posteromedial comminution and osteoporosis. In the PFN group, there were 6 (20%) cases of varus malunion. Among these cases, 4 (13.33%) cases developed screw cut out, and 2 had varus malreduction. Factors responsible for varus malunion in this study may be varus malreduction leading to the placement of screws in a superior and posterior position in the head and neck, thus leading to varus collapse. Early cut out of the screw, unstable fracture pattern, and poor bone quality may also be determining factors in this regard. Considering the 4 screw cut-outs in this study with the resultant fixation failure, we believe it was due to a technical failure, fracture, and patient characteristics rather than implant failure. We reported 1 peri-implant fracture and 1 PFN case with a broken implant. By the time of writing this article, the fracture had already united. Periprosthetic fractures were reported in 4 (6.66%) patients who had undergone hemiarthroplasty, 1 occurred intraoperatively during forceful implantation and 1 occurred during the post-operative period. Intraoperative periprosthetic fractures may be due to iatrogenic injury and is also associated with the pre-existing bone quality.

Hrubina et al. studied 367 post-operative cases of DHS and analyzed the cut-out phenomenon (6), avascular necrosis of the femoral head (5), progression of coxarthrosis (4), screw breakage (2), and femoral fracture under the plate (2). Screw back out was reported in 6 (20%) cases of DHS fixation. Unstable fracture pattern and the presence of osteoporotic bone are the possible contributing factors (21).

Siddiqui et al. analyzed the modes of failure of the proximal femoral nail (PFN) in 45 cases of unstable trochanteric fractures (22). They observed varus malunion in 4 cases, 2 patients developed cut out, and the rest went into successful varus malunion.

The present study analyzed risk factors and comorbidities in elderly patients and their influence on postoperative complications and outcomes after hip fracture surgery. These findings cannot be generalized to the entire population as the sample size is small. A meta-analysis is required to explore the findings in the current study.

Conclusion

Due to the increasing life span, the incidence of geriatric hip fractures is on the rise. Early optimization, meticulous surgery, suitable post-operative management, and early mobilization are the key factors for a successful outcome. Patients with high CCI and ASA grading, and revision surgery patients are at high risk of postoperative complications, morbidity, and mortality, and thus, require special attention and appropriate management. Orthogeriatric units offer the best chance for a successful outcome through efficient medical co-management of these patients, thus reducing the length of stay, in-patient problems, and mortality, and allowing the patient to recover to their pre-injury ambulatory state.

Conflict of Interest

The authors declare no conflict of interest in this study.

Acknowledgements

We want to express our sincere gratitude to the staff of the orthopedic wards in Nizam's Institute of Medical Sciences hospital, Hyderabad.

References

1. Swiontkowski MF, Winquist RA, Hansen ST. Fractures of the femoral neck in patients between the ages of twelve and forty-nine years. *J Bone Joint Surg Am*. 1984;66(6):837-46. doi: 10.2106/00004623-198466060-00003. [PubMed: 6736085].
2. Gallagher JC, Melton LJ, Riggs BL, Bergstrath E. Epidemiology of fractures of the proximal femur in Rochester, Minnesota. *Clin Orthop Relat Res*. 1980;(150): 163-71. [PubMed: 7428215].
3. Hedlund R, Lindgren U, Ahlbom A. Age- and sex-specific incidence of femoral neck and trochanteric fractures. An analysis based on 20,538 fractures in Stockholm County, Sweden, 1972-1981. *Clin Orthop Relat Res*. 1987;(222):132-9. [PubMed: 3621713].
4. Roche JJ, Wenn RT, Sahota O, Moran CG. Effect of comorbidities and postoperative complications on mortality after hip fracture in elderly people: Prospective observational cohort study. *BMJ*. 2005;331(7529):1374. doi: 10.1136/bmj.38643.663843.55. [PubMed: 16299013]. [PMCID: PMC1309645].
5. Chong CP, Savige JA, Lim WK. Medical problems in hip fracture patients. *Arch Orthop Trauma Surg*. 2010;130(11):1355-61. doi: 10.1007/s00402-009-1038-y. [PubMed: 20049603].
6. Monte-Secades R, Pena-Zemsch M, Rabunal-Rey R, Bal-Alvaredo M, Pazos-Ferro A, Mateos-Colino A. Risk factors for the development of medical complications in patients with hip fracture. *Rev Calid Asist*. 2011;26(2):76-82. [In Spanish]. doi: 10.1016/j.cali.2010.09.003. [PubMed: 21339079].
7. Menzies IB, Mendelson DA, Kates SL, Friedman SM. The impact of comorbidity on perioperative outcomes of hip fractures in a geriatric fracture model. *Geriatr Orthop Surg Rehabil*. 2012;3(3):129-34. doi: 10.1177/2151458512463392. [PubMed: 23569706]. [PubMed Central: PMC3598442].
8. Handoll HH, Farrar MJ, McBirnie J, Tytherleigh-Strong G, Milne AA, Gillespie WJ. Heparin, low molecular weight heparin and physical methods for preventing deep vein thrombosis and pulmonary embolism following surgery for hip fractures. *Cochrane Database Syst Rev*. 2002;(4):CD000305. doi: 10.1002/14651858.CD000305. [PubMed: 12519540].
9. Kastanis G, Topalidou A, Alpantaki K, Rosiadis M, Balalis K. Is the ASA Score in geriatric hip fractures a predictive factor for complications and readmission? *Scientifica (Cairo)*. 2016;2016:7096245. doi: 10.1155/2016/7096245. [PubMed: 27293978]. [PubMed Central: PMC4880678].
10. Je S, Kim H, Ryu S, Cho S, Oh S, Kang T, Choi S. The consequence of delayed diagnosis of an occult hip fracture. *J Trauma Inj*. 2015;28(3):91-7. doi: 10.20408/jti.2015.28.3.91.
11. Vidan MT, Sanchez E, Gracia Y, Maranon E, Vaquero J, Serra JA. Causes and effects of surgical delay in patients with hip fracture: A cohort study. *Ann Intern Med*. 2011;155(4):226-33. doi: 10.7326/0003-4819-155-4-201108160-00006. [PubMed: 21844548].
12. Smeets SJ, Poeze M, Verbruggen JP. Preoperative cardiac evaluation of geriatric patients with hip fracture. *Injury*. 2012;43(12):2146-51. doi: 10.1016/j.injury.2012.08.007. [PubMed: 22995981].
13. De Laet C, Kanis JA, Oden A, Johanson H, Johnell O, Delmas P, et al. Body mass index as a predictor of fracture risk: A meta-analysis. *Osteoporos Int*. 2005;16(11):1330-8. doi: 10.1007/s00198-

005-1863-y. [PubMed: 15928804].
14. Shafiei SH, Ghaderzadeh S, Rastegar M, Siavashi B, Golbakhsh M, Mortazavi SJ. Mortality rate and quality of life in patients with intertrochanteric fractures treated with dynamic hip screw. *J Orthop Spine Trauma*. 2022;8(2):52-6. doi: 10.18502/jost.v8i2.9311.
15. Zandi R, Karimi A, Sadighi M, Minator Sajjadi M, Okhovatpour MA, Ebrahimpour A, et al. Primary long distal fitting bipolar hemiarthroplasty for unstable intertrochanteric fracture in elderly patients. *J Orthop Spine Trauma*. 2020;4(3):42-7. doi: 10.18502/jost.v4i3.3070.
16. Eschbach D, Bliemel C, Oberkircher L, Aigner R, Hack J, Bockmann B, et al. One-Year Outcome of geriatric hip-fracture patients following prolonged ICU treatment. *Biomed Res Int*. 2016;2016:8431213. doi: 10.1155/2016/8431213. [PubMed: 26881228]. [PubMed Central: PMC4737470].
17. Mousapour A, Mardanpour K, Hojabrian A, Saeb M, Khabiri SS, Safari-Faramani R, et al. A comparison of bipolar hemiarthroplasty versus dynamic hip screw fixation of basicervical femoral neck fractures. *J Orthop Spine Trauma*. 2020;5(1):25-8. doi: 10.18502/jost.v5i1.3321.
18. Saeb M, Mousapour A, Shafiee A, Khabiri SS, Safari-Faramani R, Gholami A, et al. Tranexamic acid effectiveness on the amount of bleeding during surgery and surgeon's satisfaction in intertrochanteric fracture fixation: A randomized clinical trial. *J Orthop Spine Trauma*. 2020;5(1):17-20. doi: 10.18502/jost.v5i1.3319.
19. Smeets SJM, van Wunnik BPW, Poeze M, Slooter GD, Verbruggen JPAM. Cardiac overscreening hip fracture patients. *Arch Orthop Trauma Surg*. 2020;140(1):33-41. doi: 10.1007/s00402-019-03270-z. [PubMed: 31471640]. [PubMed Central: PMC6942037].
20. Liu Z, Han N, Xu H, Fu Z, Zhang D, Wang T, et al. Incidence of venous thromboembolism and hemorrhage related safety studies of preoperative anticoagulation therapy in hip fracture patients undergoing surgical treatment: A case-control study. *BMC Musculoskelet Disord* . 2016;17:76. doi: 10.1186/s12891-016-0917-y. [PubMed: 26873584]. [PubMed Central: PMC4752756].
21. Hrubina M, Skotak M, Behounek J. Complications of dynamic hip screw treatment for proximal femoral fractures. *Acta Chir Orthop Traumatol Cech*. 2010;77(5):395-401. [In Czech]. [PubMed: 21040651].
22. Siddiqui Y, Khan AQ, Asif N, Sherwani M. Modes of failure of proximal femoral nail (PFN) in unstable trochanteric fractures. *MOJ Orthop Rheumatol*. 2019;11(1):7-16. doi: 10.15406/mojor.2019.11.00460.