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Factors associated with one-year mortality after hip fractures: A five-year retrospective cohort study

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ABSTRACT

Objectives: Hip fractures are a significant public health concern globally, particularly among the elderly population. They are associated with high rates of morbidity and mortality. This study investigates factors associated with one-year mortality following hip fractures in patients treated at a single center.

Methods: A retrospective cohort study was conducted, and data from 73 patients treated for hip fractures between May 2016 and April 2021 were analyzed. Patient characteristics, fracture types, surgical timing, and mortality outcomes were assessed.

Results: The one-year mortality rate was 47.9%. Neck of femur fractures and delayed surgeries (>48 h) were significant predictors of increased mortality. Multivariate analysis revealed that intertrochanteric fractures, American society of anesthesiologists scores ≥3, and delayed surgery were associated with higher mortality risks. Other variables, including sex and age, showed no statistically significant associations.

Conclusion: This study highlights the critical need for timely surgical intervention and comprehensive management strategies to reduce mortality among hip fracture patients. Further multicenter studies are recommended to validate these findings.

Keywords: American society of anesthesiologists, Delayed surgeries, Hip fractures, Mortality, Neck of femur fracture

INTRODUCTION

It has been well established that the population is aging worldwide, and more patients are becoming prone to hip fractures. It is becoming one of the major medical concerns with a high burden on the health care system; the elderly are most at risk of complications following the injury, with higher mortality, disability, and chronic pain.[1-3] It is an increasing diagnosis as the population is aging. It is estimated that the number of hip fractures will reach 6.26 million globally by 2050, which is a significant increase compared to 1.66 million in 1990.[4] Hip fractures are classified anatomically into neck, intertrochanteric (IT), and subtrochanteric (ST) fractures.[5] Each is treated based on the classification and surgeon preference.[6]

Sadat-Ali *et al.* (2017) found that the mortality rate is about 26.98% within 2 years of follow-up.[7] Furthermore, they found that only 48.23% returned to their functional status pre-hip fracture.

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Alsheikh *et al*. (2020) in Saudi Arabia found that about 4% of patients died within 30 days, and 11% died within one year.[8]

Risk factors such as older age, lower body mass index (BMI), American society of anesthesiologists (ASA) type 3, 4, 5, and renal diseases are highly correlated with mortality rate.[8] Despite the increasing number of hip fractures and mortality rate, there is still a lack of enough data in Saudi Arabia.[2]

Therefore, our aim in this study was to identify the factors associated with the mortality rate for the past five years among elderly patients with hip fractures. In addition, we re-evaluated the importance of early intervention in hip fractures.

MATERIALS AND METHODS

Study design

This single-center retrospective cohort study was conducted in a hospital with 500 beds. Ethical approval was granted based on the proposed protocol. The data were extracted from the hospital information system (HIS). The study was based on patients who were diagnosed with hip fractures and treated operatively from May 01, 2016, to April 31, 2021. Data were collected through the hospital's digital records by identifying the hip fracture diagnosis based on the international classification of disease 10 coding system. In addition, we used variables such as age, BMI, ASA score, sex, ethnicity, time to surgery, type of fracture, side of surgery, ambulatory status, and type of anesthesia as possible factors for mortality. Identifying deceased patients was limited as some data were not documented in the HIS. However, the phone numbers of patients and family members were recorded in the HIS. Patients and patient family members were approached by calling them from the hospital's official line to confirm the patient's mortality status after clearly identifying the called person.

Inclusion and exclusion criteria

According to the inclusion and exclusion criteria, we have included 73 patients out of 324 treated from 2016 to 2021.

Inclusion criteria

Patients who sustained a hip fracture and underwent orthopedic hip surgeries: Arthroplasty or open/closed reduction and internal fixation from May 01, 2016, to April 31, 2021, in our hospital.

Exclusion criteria

Patients with periprosthetic fractures, pathological fractures, revision surgery, incomplete data or registration, loss of follow-up, and patients younger than 25 years of age were excluded from the study. Although osteoporotic fractures are likely in most of our cases, none of them were diagnosed before admission, so we did not exclude them.

Data analysis

Descriptive statistics were used to present the demographic and associated patient variables using means ± standard deviation for continuous variables and counts and percentages for ordered and nominal variables. Comparisons between groups of patients who were alive or dead one year after their hip fracture were analyzed using Pearson's Chi-squared tests for parametric data, and independent samples *t*-test for non-parametric data. All dependent variables were included in a multivariable logistic stepwise regression analysis to assess if any risk factors were independently associated with one-year mortality. All analyses were performed using the Statistical Package for the Social Sciences (SPSS) software (Version 28; SPSS Inc., Chicago, IL). Two-tailed $P < 0.05$ were considered statistically significant.

RESULTS

This study analyzed a cohort of 73 hip fracture patients at our hospital, with a predominant age group of 70 years and older (64.4%). The sex distribution was almost equal, with 49.3% females and 50.7% males. Most patients were Saudi nationals (69.9%), while non-Saudis accounted for 30.1%. A significant proportion of the cohort had comorbidities; 52.1% had hypertension, 45.2% had diabetes mellitus, and smaller proportions had ischemic heart disease with heart failure (15.1%), cerebrovascular accidents (5.5%), or end-stage renal disease (2.7%).

Regarding the type of fracture, 49.3% of cases were IT fractures, followed by 42.5% with neck of femur (NOF) fractures and 8.2% with ST fractures. Most patients were classified as ASA II (39.7%) and ASA III (41.1%), indicating moderate to severe systemic disease. Subarachnoid spinal anesthesia was used in 64.4% of the surgeries, while the remainder had general anesthesia. Right-sided hip fractures accounted for 50.7%, and 84.9% of patients were ambulatory before the time of admission. Delayed surgeries (beyond 72 h after injury) were common, occurring in 74% of cases. Length of hospital stay varied, with 43.8% staying 3–6 days, and 41.1% staying for 7 or more days. The one-year mortality rate was notably high at 47.9% [Table 1].

The comparison of one-year mortality in hip fracture patients is given in Table 2. The type of fracture emerged as a crucial factor, with NOF fractures showing a higher one-year mortality rate (74.2%) compared to IT fractures (25%) and ST fractures (50%). This difference was statistically significant ($P < 0.001$), indicating a strong association between the type of fracture and the likelihood of mortality within one

Table 1: Patient characteristics.

	No.	Percentage
Age		
≤39 years	2	2.7
40–59 years	12	16.4
60–69 years	12	16.4
≥70 years	47	64.4
Sex		
Female	36	49.3
Male	37	50.7
Nationality		
Saudi	51	69.9
Non-Saudi	22	30.1
Comorbidities		
Diabetes mellitus	33	45.2
Hypertension	38	52.1
End-stage renal disease	2	2.7
Ischemic heart disease with heart failure	11	15.1
Cerebrovascular accident (stroke)	4	5.5
Type of femur fracture		
Intertrochanteric	36	49.3
Neck of Femur	31	42.5
Subtrochanteric	6	8.2
Patient status at admission		
ASA I	10	13.7
ASA II	29	39.7
ASA III	30	41.1
ASA IV	3	4.1
ASA VI	1	1.4
Type of anesthesia		
General	26	35.6
Spinal (subarachnoid)	47	64.4
Side of operation		
Right	37	50.7
Left	36	49.3
Ambulatory status before injury		
Ambulatory	62	84.9
Non-ambulatory	11	15.1
Time from injury to surgery		
Within 24 h	3	4.1
24–48 h	7	9.6
48–72 h	9	12.3
After 72 h	54	74.0
Length of hospital stay		
Same day	3	4.1
1–2 days	8	11.0
3–6 days	32	43.8
≥7 days	30	41.1
1-year mortality		
No	38	52.1
Yes	35	47.9

ASA: American society of anesthesiologists

(Contd...)

Table 2: Comparison of one-year mortality with various patients' characteristics.

Patients characteristics	One-year mortality		*P*-value
	No (%)	Yes (%)	
Nationality			
Saudi	23 (45.1)	28 (54.9)	0.070
Non-Saudi	15 (68.2)	7 (31.8)	
Sex			
Female	19 (52.8)	17 (47.2)	0.903
Male	19 (51.4)	18 (48.6)	
Age			
≤39 years	1 (50.0)	1 (50.0)	0.865
40–59 years	7 (58.3)	5 (41.7)	
60–69 years	5 (41.7)	7 (58.3)	
≥70 years	25 (53.2)	22 (46.8)	
Type of fracture			
Intertrochanteric	27 (75)	9 (25)	<0.001
Neck of femur	8 (25.8)	23 (74.2)	
Subtrochanteric	3 (50)	3 (50)	
ASA score			
ASA I	4 (40.0)	6 (60.0)	0.293
ASA II	19 (65.5)	10 (34.5)	
ASA III	13 (43.3)	17 (56.7)	
ASA IV	2 (66.7)	1 (33.3)	
ASA VI	0 (0.0)	1 (100.0)	
Diabetes mellitus			
No	21 (52.5)	19 (47.5)	0.993
Yes	17 (51.5)	16 (48.5)	
Hypertension			
No	21 (60.0)	14 (40.0)	0.192
Yes	17 (44.7)	21 (55.3)	
End-stage renal disease			
No	38 (53.5)	33 (46.5)	0.135
Yes	0 (0.0)	2 (100.0)	
Ischemic heart disease			
No	34 (54.8)	28 (45.2)	0.258

(Contd...)

Table 2: *(Continued).*

Patients characteristics	One-year mortality		*P*-value
	No (%)	Yes (%)	
Yes	4 (36.4)	7 (63.6)	
CVA (stroke)			
No	36 (52.2)	33 (47.8)	0.933
Yes	2 (50.0)	2 (50.0)	
Type of anesthesia			
General	16 (61.5)	10 (38.5)	0.228
Spinal	22 (46.8)	25 (53.2)	
Side of operation			
Right	21 (56.8)	16 (43.2)	0.415
Left	17 (47.2)	19 (52.8)	
Ambulatory status			
Ambulatory	32 (51.6)	30 (48.4)	0.858
Non-ambulatory	6 (54.5)	5 (45.5)	
Time of surgery from date of injury			
Same day	0 (0.0)	3 (100.0)	0.229
After 24 h	3 (42.9)	4 (57.1)	
After 48 h	6 (66.7)	3 (33.3)	
After 72 h	29 (53.7)	25 (46.3)	
Number of days spent at the hospital			
0 day	0 (0.0)	3 (100.0)	0.253
1–2 days	4 (50.0)	4 (50.0)	
3–6 days	16 (50.0)	16 (50.0)	
≥7 days	18 (60.0)	12 (40.0)	

ASA: American society of anesthesiologists, CVA: Cerebrovascular accident

year. Other factors such as nationality, sex, age, ASA score, and comorbidities such as diabetes, hypertension, ischemic heart disease, and stroke did not show statistically significant differences in mortality rates ($P > 0.05$). The mortality rate was somewhat higher among Saudi patients (54.9%) than non-Saudis (31.8%), though this was not statistically significant ($P = 0.070$). Patients who underwent surgery on the same day of injury had a 100% mortality rate, though the difference was statistically insignificant ($P = 0.229$). In contrast, those who had surgery more than 72 h after injury exhibited a significantly lower mortality rate of 46.3% ($P = 0.043$).

The multivariate logistic regression analysis was done to assess predictors for one-year mortality among patients with hip fractures [Table 3]. It was found that IT fractures and NOF fractures were associated with increased odds of mortality. Patients with IT fractures had an odds ratio (OR) of 2.81 (95% Confidence interval [CI]: 1.01–4.61, $P = 0.046$), while those with NOF fractures had an OR of 1.98 (95% CI: 0.76–4.12, $P = 0.031$), suggesting that these fracture types

Table 3: Multivariate logistic regression for one-year mortality rate in hip fractures.

Variable	OR (95% CI)	*P*-value
Sex	1.09 (0.34–3.49)	0.883
Saudi/Non-Saudi	0.49 (0.13–1.80)	0.282
Intertrochanteric fractures	2.81 (1.01–4.61)	0.046
Neck of femur fractures	1.98 (0.76–4.12)	0.031
Subtrochanteric fracture	0.71 (0.32–1.32)	0.981
ASA class 3 or more	3.00 (1.67–6.01)	0.015
Diabetes mellitus	0.88 (0.26–2.93)	0.828
Hypertension	1.73 (0.48–6.28)	0.402
End-stage renal disease	2.10 (0.91–3.21)	0.999
Ischemic heart disease	2.39 (0.47–12.15)	0.293
Cerebrovascular accident (stroke)	0.76 (0.07–8.53)	0.822
Type of anesthesia	1.63 (0.49–5.46)	0.427
Side of operation	2.59 (0.82–8.14)	0.104
Ambulatory status	0.70 (0.14–3.52)	0.662
Delayed surgery (>48 h)	2.45 (1.30–4.82)	0.043
Prolonged hospital stay (>7 days)	0.53 (0.16–1.74)	0.298

ASA: American society of anesthesiologists, OR: Odds ratio, CI: Confidence interval

pose a higher risk of mortality compared to other types, such as ST fractures, which did not show significant association ($P = 0.981$). In addition, a higher ASA class (III or more) was a significant predictor of increased mortality, with an OR of 3.00 (95% CI: 1.67–6.01, $P = 0.015$), indicating that patients with severe systemic disease have a higher risk of dying within a year post-fracture. Delayed surgery beyond 48 h was another significant factor, with an OR of 2.45 (95% CI: 1.30–4.82, $P = 0.043$), implying that prolonged time to surgical intervention adversely affects survival.

DISCUSSION

This study with 73 patients provides valuable insights into the one-year mortality rate following hip fractures among patients treated operatively. The one-year mortality rate in this cohort was strikingly high at 47.9%, underscoring the severe outcomes associated with hip fractures in this population.[9] This rate is notably higher than previously reported figures in both international and local studies, such as those by Sadat-Ali *et al.*, who reported a two-year mortality rate of 26.98% in Saudi Arabia, and Alsheikh *et al.*, who documented a one-year mortality rate of 11%.[7,8] These differences may reflect variations in patient demographics, healthcare settings, or delays in treatment.

The type of fracture emerged as a significant predictor of one-year mortality.[10] Patients with NOF fractures experienced

the highest mortality rate (74.2%), followed by ST fractures (50%) and IT fractures (25%). This aligns with findings from earlier studies, such as those by Kannegaard *et al*., which reported that NOF fractures are associated with higher mortality compared to other fracture types.[11] The increased risk of mortality associated with NOF fractures is likely due to their complex vascular anatomy and the higher likelihood of complications. However, other hip fracture types, such as ST, had a correlation with no significance.

The timing of surgical intervention was another crucial factor.[12] We found the three patients who underwent fixation on the same day had a 100% one-year mortality with no significance ($P = 0.229$). However, this can be explained by the lack of patient optimization and two of them were multi-trauma cases with a high Injury severity score. Patients who underwent surgery after 48 h had significantly higher odds of death, with an OR of 2.45 (95% CI: 1.30–4.82, $P = 0.043$). This finding is consistent with other studies emphasizing the benefits of early surgical management in reducing mortality. Delayed surgery can lead to systemic complications such as infections, thromboembolism, and exacerbation of comorbid conditions. These results reinforce the importance of timely surgical intervention to optimize outcomes.[12]

Contrary to some prior research, factors such as sex, comorbidities (e.g., diabetes, hypertension, and ischemic heart disease), ASA classification, and type of anesthesia did not show statistically significant associations with one-year mortality in this cohort. However, a trend of higher mortality among patients with ASA scores of III or above was observed, consistent with the notion that a greater systemic disease burden correlates with poorer outcomes.

Interestingly, the association between spinal anesthesia and higher mortality rates warrants further investigation. Spinal anesthesia has generally been associated with lower mortality and complication rates compared to general anesthesia.[13] However, in this cohort, higher mortality in the spinal anesthesia group may reflect confounding factors, such as the higher ASA scores and frailty in patients selected for spinal anesthesia.

These findings highlight the multifactorial nature of mortality risk following hip fractures.[14,15] While fracture type and surgical timing play clear roles, individual patient characteristics and systemic health considerations remain critical. The high mortality rate observed in this study emphasizes the need for proactive measures, including early intervention, optimized perioperative care, and improved management of comorbidities, to mitigate these risks.

This study provides essential data on hip fracture outcomes in the Saudi population, addressing a significant gap in the literature. However, further research is required to explore regional differences and validate these findings in larger, multicenter cohorts.

Limitations

Due to incomplete data in the HIS at our institute, many have been excluded from the study, and we ended up with only 73 patients. Other limitations, such as lack of follow-up and patient consent, further reduced the sample size.

CONCLUSION

This study highlights the significant burden of hip fractures, with a high one-year mortality rate observed among patients. NOF fractures and delayed surgical intervention were identified as key predictors of mortality, underscoring the importance of timely and effective management. While factors such as sex, age, and comorbidities did not show statistically significant associations, their potential influence on outcomes warrants further exploration.

Recommendations: The findings emphasize the need for improved perioperative care and targeted strategies to reduce mortality. Future research should focus on larger, multicenter studies to better understand the factors influencing outcomes and to develop tailored interventions for this vulnerable population.

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Authors' contributions: EB: Conceived and designed the study, conducted research, provided research materials, and organized and analyzed data. AY: Collected, analyzed, and interpreted data, and conducted statistical analysis. IA: Analyzed data and literature search and data collection. AA: Provided logistic support, reviewed data, and helped write the discussion. All authors have critically reviewed and approved the final draft and are responsible for the manuscript's content and similarity index.

Ethical approval: This study was authorized by the institutional review board at the directorate of health affairs in 2022 with approval number A010409 and national registration number NCBE-KACST (H-02-J-002).

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patients have given their consent for their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published, and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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