ORIGINAL ARTICLE

Factors affecting one-year mortality in patients over 65 years of age undergoing surgery for hip fracture

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ABSTRACT

BACKGROUND: The objective of this study was to investigate the factors influencing one-year mortality in patients over 65 years of age who were hospitalized due to hip fracture.

METHODS: This retrospective cohort study was based on clinical data collected from our hospital archives between January 2013 and December 2021. All consecutive patients over the age of 65 who were admitted with a hip fracture were considered for inclusion.

RESULTS: Between January 2013 and December 2021, a total of 834 patients met the inclusion criteria. The one-year mortality rate was 33.5% (279/834). The mean time to surgery was 5.64 days in patients who died within one year, compared to 4.50 days in those who survived beyond one year (p=0.001). The mean hemoglobin, creatinine, lymphocyte count, and albumin levels in the one-year mortality group were 11.47 g/dL, 1.33 mg/dL, 1.10×10^3/μL, and 3.42 g/L, respectively. In patients who survived longer than one year, these values were 11.93 g/dL, 1.12 mg/dL, 1.35×10^3/μL, and 3.68 g/L, respectively (p=0.006, p=0.002, p=0.001, and p=0.000, respectively).

CONCLUSION: We found that advanced age, delayed surgery, low albumin level, low total lymphocyte count, and elevated creatinine levels at hospital admission were associated with increased mortality following hip fracture surgery. In contrast to some findings in the literature, comorbidities, the number of comorbidities, blood transfusions, and admission to the intensive care unit (ICU) were not associated with increased mortality.

Keywords: Elderly; fracture; hip; mortality; prognostic factors.

INTRODUCTION

Hip fractures are a leading cause of hospitalization and disability among older adult.[1] With the global population aging, the incidence of hip fractures is projected to rise significantly, reaching an estimated 2.6 million cases annually by 2025,[2] and potentially increasing to 4.5 million cases by 2050 based on current trends.[3] Older patients undergoing surgery for hip fractures face a heightened risk of various postoperative complications, including mortality.[4-10]

The occurrence of hip fractures in older adults is associated with significantly increased mortality rates. The one-year mortality rate after a hip fracture varies widely, ranging from 15% to 45%.[11-14] Among the factors affecting outcomes, delayed surgery is frequently cited as a critical contributor. Several studies have reported that early surgical intervention improves patient survival.[4,15-17] Other risk factors include patient gender, age, comorbid conditions, frailty, and pre-existing issues such as poor nutritional status or hypoalbuminemia.[18-23]

Malnutrition is common in older adults with hip fractures and

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has been linked in several studies to increased rates of postoperative complications and higher mortality.[22,24] Serum albumin concentration is the most widely used serum marker for evaluating nutritional status. Individuals with albumin levels below 3.5 g/dL are considered malnourished.[25-28] Additional risk factors that may influence mortality after hip fracture include low hemoglobin, elevated creatinine, and reduced lymphocyte count at the time of hospital admission.[23,29-31]

This study aimed to investigate the factors associated with one-year mortality in patients aged 65 years and older who were hospitalized due to hip fractures.

MATERIALS AND METHODS

This research is based on a cohort study with a retrospective approach, utilizing data obtained from our clinic between January 2013 and December 2021. The study was conducted in accordance with the Declaration of Helsinki, following approval from the local ethical research committee (approval number: 346, dated 10/07/2020). Eligible participants included all consecutive patients aged 65 years and older who were admitted to our hospital with femoral neck or intertrochanteric fractures. Medical records of the identified patients were retrieved from the hospital database and clinical archives. Mortality data were obtained from the national death reporting system. Exclusion criteria included patients younger than 65 years, those diagnosed with pathological fractures, multiple traumas, bilateral hip fractures, or periprosthetic fractures, as well as those with insufficient medical records. Patients treated conservatively, those with significant weight loss prior to surgery, or with a history of previous hip fracture were also excluded. Surgical treatments included hip arthroplasty (hemiarthroplasty or total hip arthroplasty) and osteosynthesis (proximal femoral nailing or dynamic hip screw).

Variables

In our study, the following variables were recorded from the digital hospital system and patient files: age, sex, fracture type, and time to surgery after hospital administration. Time to surgery was categorized into three groups: within the first 24 hours, 24-48 hours, and more than 48 hours. Additional variables included the American Society of Anesthesiologists (ASA) score, number of comorbidities (categorized as 0, 1, 2, or ≥3), preoperative and postoperative transfusion requirements, preoperative and postoperative intensive care unit (ICU) admission, as well as serum albumin, creatinine, hemoglobin levels, and total lymphocyte count at the time of hospital admission.

Pre-existing medical conditions were recorded from the hospital's digital recording system and clinical archives. These conditions were classified into five distinct groups based on the affected organ systems: nervous, circulatory, pulmonary, renal, and endocrine systems.

Statistical Analysis

Statistical evaluations were performed using SPSS (Statistical Package for the Social Sciences) for Windows, version 30.0 (SPSS Inc., Chicago, USA). Descriptive statistics (frequencies and medians, as appropriate) and the independent samples t-test were used to analyze the data. The Chi-square test was applied to assess categorical data. To investigate the relationship between a single dependent variable (mortality) and multiple independent variables (including initial hemoglobin, creatinine, albumin, total lymphocyte count, time to surgery, number of comorbidities, ASA score, etc.) multiple linear regression analysis was conducted. A p-value of less than 0.05 was considered statistically significant.

Informed consent was obtained from all patients prior to surgical procedures. The study was approved by the Local Ethics Committee and conducted in accordance with the ethical principles outlined in the Declaration of Helsinki.

RESULTS

Between January 2013 and December 2021, a total of 834 patients met the inclusion criteria and were included in the analysis. The number of female patients was approximately twice that of male patients [518 females (62%) and 316 males (38%)]. The average age at diagnosis was 79.3 years. Of the fractures, 305 (36.5%) were femoral neck fractures and 529 (63.5%) were intertrochanteric fractures. Regarding the side of injury, 438 (52.5%) fractures occurred in the right hip and 396 (47.5%) in the left hip (Table 1).

Our investigation into the relationship between surgical timing and mortality was based on two main objectives. The first was to compare one-year postoperative mortality rates among patients who underwent early versus delayed surgery. Given the variability in the literature regarding the definition of "early" surgery—with some studies using a 24-hour cutoff and others 48 hours—we categorized patients into three groups: <24 hours, 24-48 hours, and >48 hours. The goal was to assess whether there were statistically significant differences in mortality among these groups. The second objective was to examine whether surgical timing differed between patients who died within one year postoperatively and those who survived beyond one year. Together, these analyses provide a comprehensive evaluation of the association between surgical timing and postoperative mortality.

The one-year mortality rate among all patients was 33.5% (279/834). The mean age at death within the one-year follow-up period was 82.5 years, compared to 77.7 years in patients who survived beyond one year after surgery. This difference was statistically significant (p=0.000). When evaluating mortality by gender, the one-year mortality rate was 31.9% (165/518) in female patients and 36% (114/316) in male patients. However, this difference was not statistically significant.

Table 1. Comparison of patients who died vs. survived one year after surgery

Variables	Mortality Group (n=279, 33.5%)	Survivor Group (n=555, 66.5%)	Total (n=834)
Age	82.5±7.52	77.7±8.61	79.3
Gender			
Male	114 (36%)	202 (64%)	316 (100%)
Female	165 (31.9%)	353 (68.1%)	518 (100%)
Time to Surgery	5.64 days	4.50 days	4.88 days
Surgery Timing			
Within 24 hours	6 (16%)	32 (84%)	38 (100%)
24-48 hours	27 (22%)	96 (78%)	123 (100%)
>48 hours	246 (36.5%)	427 (63.5%)	673 (100%)
ASA* Score			
ASA 1	44 (31.9%)	93 (68.1%)	137 (100%)
ASA 2	91 (34.9%)	171 (65.1%)	262 (100%)
ASA 3	102 (29.2%)	247 (70.8%)	349 (100%)
ASA 4	42 (49.1%)	44 (50.9%)	86 (100%)
Mean hemoglobin (g/dL)	11.47	11.93	
Mean creatinine (mg/dL)	1.33	1.12	
Mean total lymphocytes ($10^3/\mu L$)	1.10	1.35	
Mean albumin (g/L)	3.42	3.68	
Comorbidities			
Cardiovascular system	192 (68.8%)	366 (65.9%)	558 (66.9%)
Pulmonary system	52 (18.8%)	117 (21.1%)	169 (20.3%)
Renal system	18 (6.5%)	45 (8.1%)	63 (7.6%)
Nervous system	60 (22%)	136 (24.6%)	196 (23.7%)
Endocrine system	90 (32.3%)	195 (35.1%)	285 (34.2%)
Number of Comorbidities			
0	42 (15.1%)	59 (10.5%)	101 (12.1%)
1	108 (38.7%)	228 (41.1%)	336 (40.3%)
2	91 (32.8%)	195 (35.1%)	286 (34.4%)
≥3	38 (13.4%)	75 (13.2%)	113 (13.3%)
Transfusion Required	36 (12.9%)	81 (14.6%)	117 (14%)
ICU Admission	84 (30.1%)	126 (22.7%)	210 (25.2%)
Fracture Type			
Intertrochanteric	165 (31.2%)	364 (68.8%)	529 (63.5%)
Femoral neck	114 (37.4%)	191 (62.6%)	305 (36.5%)

*ASA: American Society of Anesthesiologists Physical Status Classification

The mean time to surgery was 5.64 days in patients who died within one year and 4.50 days in those who survived beyond one year (p=0.001). One-year mortality rates by surgical timing were as follows: 16% for surgeries within the first 24 hours, 22% for surgeries between 24–48 hours, and 36.5% for surgeries after 48 hours. These differences were statistically significant (p=0.006) (Fig. 1).

Mortality rates by ASA score were 31.9% for ASA 1, 34.9% for ASA 2, 29.2% for ASA 3, and 49.1% for ASA 4. The higher mortality in the ASA 4 group was statistically significant compared to the other groups (p=0.038) (Fig. 2).

n patients who died within one year, the mean values for selected laboratory markers at admission were as follows: hemoglobin 11.47 g/dL, creatinine 1.33 mg/dL, lymphocyte

Table 2. Factors affecting mortality according to Cox regression analysis

Variable	p value	OR	95% CI	
			Lower	Upper
Age	0.000	1.05	1.03	1.07
Time to surgery	0.006	1.07	1.02	1.12
Mean creatinine	0.037	1.21	1.01	1.42
Mean total lymphocytes	0.005	0.68	0.52	0.89
Albumin	0.000	0.50	0.37	0.70

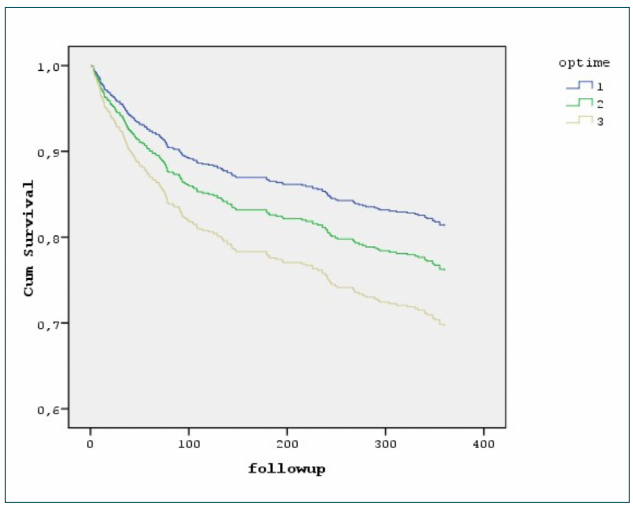


Figure 1. Cox regression curve showing the relationship between mortality and time until operation.

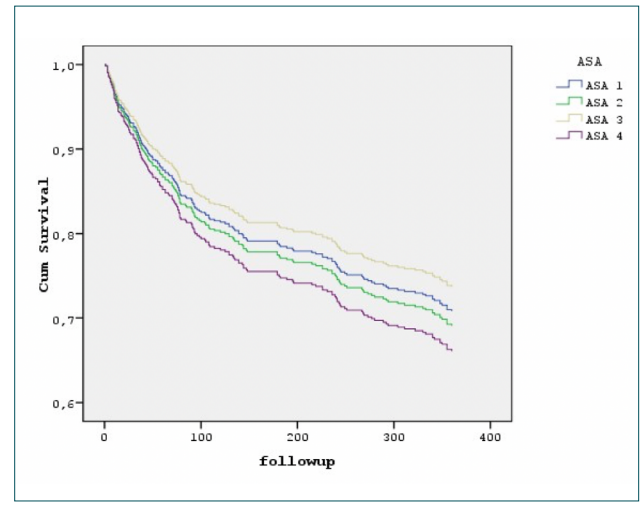


Figure 2. Cox regression curve showing the relationship between mortality and ASA score

count 1.10×10³/μL, and albumin 3.42 g/L. The mean values of hemoglobin, creatinine, lymphocyte count, and albumin in patients who survived more than a year were 11.93 g/dL, 1.12 mg/dL, 1.35×10³/μL, and 3.68 g/L, respectively. There were statistically significant differences between the mortality and survival groups for all four parameters: hemoglobin, creatinine, lymphocyte count, and albumin (p=0.006, p=0.002, p=0.001, and p=0.000, respectively) (Table 1).

The number of comorbid diseases, need for blood transfusion (p=0.680), ICU admission (p=0.073), and type of fracture (p=0.131) were similar between the two groups.

Of the total cohort, 498 patients (59.7%) underwent arthroplasty and 336 (40.3%) received proximal femoral nailing. The one-year mortality rate was 34.3% in the arthroplasty group and 32.1% in the proximal femoral nailing group. This difference was not statistically significant (p=0.088).

Cox regression analysis identified age, time to surgery, creatinine level, lymphocyte count, and albumin level at admission as statistically significant predictors of one-year mortality (p=0.000, p=0.0006, p=0.037, p=0.005, and p=0.000, respectively) (Table 2). Although ASA 4 patients had notably higher one-year mortality compared to other ASA groups, the ASA score was not found to be an independent predictor of mortality in the Cox regression model.

DISCUSSION

This study aimed to analyze the factors influencing one-year mortality in elderly patients who were hospitalized and underwent surgical intervention for hip fractures. Numerous variables have been recognized as influencing postoperative mortality and postoperative quality of life. Several studies suggest that early surgery is associated with improved postoperative outcomes and reduced mortality.[17,32-34] It is generally recommended that surgical intervention be performed as early as possible once the patient's medical condition has stabilized.[35] However, some evidence from other studies indicates that early surgery may not affect mortality outcomes.[36,37] Findings from our research suggest that the time from hospital admission to surgery is directly correlated with mortality. Patients who underwent surgery within the first 24 hours had significantly lower mortality rates compared to those operated on after 48 hours. The mean age of patients

who died within one year was 82.5 years, compared to 77.7 years in those who survived longer than one year. Although this difference was statistically significant, the mean ages of the two groups were relatively close.

The literature consistently demonstrates a link between the number of comorbidities and an increased risk of death.[38, 39] Surprisingly, our study did not find a statistically significant association regarding comorbid conditions. Similarly, although patients with an ASA score of 4—where comorbidities are a major factor—showed notably higher mortality, ASA classification was not a significant predictor of mortality in the regression analysis. No significant differences were found in relation to ICU admission, which is generally associated with the patient's overall condition and comorbid burden. This may indicate that the clinical condition of elderly patients can deteriorate rapidly after a hip fracture, regardless of their preoperative status, due to their advanced age and overall frailty. Variables such as the number of comorbidities, ASA score, and ICU requirements before or after surgery are believed to influence preoperative functional and cognitive performance, as well as overall quality of life. As a result, they were not analyzed independently but were included within their respective standardized categories.

Several studies have examined whether routine blood tests can help predict mortality in patients hospitalized with hip fractures.[40-42] A full blood count is typically performed upon hospital admission for proximal femoral fractures. Among these parameters, serum albumin is one of the most recognized and widely used markers of nutritional status. According to recent studies, hypoalbuminemia is an important standalone risk factor for mortality following surgical treatment of proximal femoral fractures in the elderly.[22] A recent comprehensive meta-analysis involving 34,363 individuals aged 74 to 85 who underwent surgery for proximal femoral fractures found that low serum albumin and lymphocyte levels were associated with increased risks of in-hospital mortality, postoperative complications, and overall mortality in older adults.[23,43] However, the meta-analysis concluded that only serum albumin level at the time of admission independently predicted one-year mortality. In our analysis, we observed that both serum albumin levels and total lymphocyte counts were significantly lower in patients who died within one year. Both factors were also identified as predictors of mortality in our regression analysis, consistent with findings in the literature.

Many studies have shown that elevated serum creatinine levels are an independent risk factor for increased mortality following proximal femoral fractures.[30,31,44] A recent retrospective study involving 767 consecutive patients reported that higher serum creatinine levels at hospital admission were associated with a greater risk of death, identifying creatinine as an independent predictor of mortality in elderly patients with proximal femoral fractures.[44] Another study evaluating 200 patients found that those with serum creatinine levels above 1.3 mg/dL had a 2.5-fold higher risk of mortality compared to those with lower levels.[31] In our study, the mean creatinine level in patients who died within one year was 1.33 mg/dL, compared to 1.12 mg/dL in those who survived beyond one year. Elevated creatinine levels were associated with an increased risk of death, confirming their role as an independent risk factor or one-year mortality following a proximal femoral fracture.

Another potential risk factor is the hemoglobin level at the time of hospital admission for hip fracture. Chronic disease-related inflammation can suppress erythropoiesis, leading to lower hemoglobin levels, and hemoglobin may also decline naturally with age.[45] Some studies have found that low hemoglobin levels at admission independently predict increased mortality after proximal femoral fractures.[29,46] In the present study, significantly lower hemoglobin levels were observed in patients who died within one year; however, regression analysis showed that hemoglobin was not one of the factors determining mortality. Additionally, there was no difference in mortality between groups based on preoperative or postoperative transfusion history.

This study has certain limitations. As a retrospective observational study focused on mortality risk, it lacks data on patient functional outcomes and quality of life. Although the importance of early postoperative mobilization in preventing pulmonary embolism and reducing mortality is well established, we were unable to evaluate its impact in this study due to the absence of data on mobilization timing and transition to full weight-bearing. Another limitation is that our cohort includes only patients who underwent surgery up to December 2021, which overlaps with the global Coronavirus Disease 2019 (COVID-19) pandemic in 2021-2022. Due to the retrospective design, we were unable to specifically assess COVID-19-related deaths among patients treated during the pandemic and, therefore, could not accurately determine the impact of COVID-19 on mortality in our study population. Finally, the type of anesthesia administered preoperatively and its potential association with mortality could not be evaluated due to the retrospective nature of the study.

Another limitation of this study is that patients who were managed conservatively were not included in the study. Additionally, other potential factors influencing mortality, such as smoking status and body mass index, were not evaluated.

CONCLUSION

Our findings indicate that increased age, delayed surgical intervention, low hemoglobin levels, decreased albumin levels, low total lymphocyte counts, and elevated creatinine levels at the time of hospital admission are associated with higher mortality rates following hip fractures. Contrary to some findings in the literature, comorbidities, the number of comorbidities, blood transfusions, and ICU requirements were not associated with increased mortality in our cohort. Ac-

cording to regression analysis, older age, delayed surgery, elevated creatinine, reduced lymphocyte count, and low albumin levels at admission were identified as independent predictors of mortality following a proximal femoral fracture. Although a statistically significant difference in hemoglobin levels was observed between patients who died within the first postoperative year and those who survived beyond it, regression analysis showed that low hemoglobin at admission was not an independent predictor of mortality.

Ethics Committee Approval: This study was approved by the Ankara Training and Research Hospital Ethics Committee (Date: 10.07.2020, Decision No: 346).

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Authorship Contributions: Concept: Z.G.; Design: Z.G., E.A.; Supervision: Z.G., C.N.A; Resource: Z.G.; Materials: Z.G., K.U.C.; Data collection and/or processing: Z.G., K.U.C.; Analysis and/or interpretation: E.E.; Literature review: Z.G., E.E.; Writing: Z.G., C.N.A.; Critical review: C.N.A.

Conflict of Interest: None declared.

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ORİJİNAL ÇALIŞMA - *ÖZ*

Kalça kırığı nedeniyle ameliyat edilen 65 yaş üzeri hastalarda 1 yıllık mortaliteyi etkileyen faktörler

AMAÇ: Bu çalışmada amacımız kalça kırığı nedeniyle hastaneye yatırılan 65 yaş üstü hastalarda 1 yıllık mortaliteyi etkileyen faktörleri araştırmaktı.
GEREÇ VE YÖNTEM: Bu retrospektif kohort çalışması Ocak 2013 ile Aralık 2021 arasında toplanan klinik arşivlerimizden alınan verilere dayanmaktadır. Hastanemize kalça kırığı nedeniyle yatırılan 65 yaş üstü tüm hastalar çalışmaya dahil edilmek üzere değerlendirildi.
BULGULAR: Ocak 2013 ile Aralık 2021 arasındaki dönemde 834 hasta dahil edilme kriterlerini karşıladı. Bir yıllık mortalite oranı %33.5 (279/834) idi. 1 yıllık mortalitesi olan hastalarda ortalama ameliyat süresi 5.64 gün; bir yıldan uzun yaşayan hastalarda ise 4.50 gündü (p=0.001). Bir yıllık mortalite grubundaki hastaların hemoglobin, kreatinin, lenfosit sayısı ve albüminin ortalama değerleri sırasıyla 11.47 g/dL, 1.33 mg/dL, 1.10x10^3/μL ve 3.42 g/L idi. Bir yıldan fazla hayatta kalanların aynı değerleri sırasıyla 11.93 g/dL, 1.12 mg/dL, 1.35x10^3/μL ve 3.68 g/L idi (sırasıyla, p=0.006, 0.002, 0.001 ve 0.000).
SONUÇ: Daha ileri hasta yaşı, gecikmiş cerrahi, düşük albümin seviyesi, düşük toplam lenfosit sayısı ve hastaneye yatışta yüksek kreatinin seviyelerinin kalça kırığı sonrası artan mortalite ile ilişkili olduğunu bulduk. Eşlik eden hastalıklar, eşlik eden hastalıkların sayısı, transfüzyonlar ve yoğun bakım ünitesi gereksinimleri, literatürde bildirilenin aksine, artan mortalite ile ilişkili değildi.

Anahtar sözcükler: ileri yaş, kırık, kalça, mortalite, prognostik faktörler

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