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Predictors of Early Mortality in Geriatric Patients after Hemiarthroplasty for Femoral Neck Fracture

Femur Boyun Kırığı Nedeniyle Hemartroplasti Uygulanan Yaşlı Hastalarda, Erken Mortalitenin Öngörücüleri

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ABSTRACT

Aim: Hemiarthroplasty is an appropriate treatment option for hip fractures that provides early mobilization, and good functional results. In the available literature, there are few studies that particulary investigate the risk factors affecting the 30-day mortality after hemiarthroplasty in geriatric patients with hip fractures. This study aimed to determine patient-related factors and biochemical predictors, which were easily accessible, inexpensive, and routinely examined in the perioperative period of 30-day mortality in geriatric patients after hemiarthroplasty for femoral neck fractures.
Materials and methods: We enrolled 169 patients in our study, retrospectively. Age, body mass index, hospitalization time from admission to surgery, total hospitalization time, comorbidities, American Society of Anesthesiologists scores, blood transfusions, anticoagulant medications, albumin and plasma replacements, preoperative and postoperative hemogram, and biochemical tests were analyzed to determine the major predictors of 30-day mortality.
Results: The 30-day mortality rate was 14.2%. Multivariate analysis indicated increased age (>80 years of age) (1.095 odds ratio, p = 0.029), American Society of Anesthesiologists score (3.584 odds ratio, p = 0.007), and postoperative creatinine level (2.845 odds ratio, p = 0.001) as the major predictors of 30-day mortality after hemiarthroplasty for femoral neck fractures in geriatric patients.
Conclusion: Older age (>80 years of age), higher American Society of Anesthesiologists scores (ASA score 3 or 4) and increased postoperative creatinine levels were associated with an increased risk of 30-day mortality.

Key words: femoral neck fractures; hip fractures; creatinine; hip replacement arthroplasty; osteoporotic fractures; mortality

ÖZ

Amaç: Kalça kırıkları tedavisinde uygulanan hemiartroplasti ile erken mobilizasyon ve iyi fonksiyonel sonuçlar elde edilmektedir. Güncel literatürde, kalça kırığı olan geriatrik hastalarda hemiartroplasti sonrası 30 günlük mortaliteye etki eden risk faktörlerini araştıran az sayıda çalışma bulunmaktadır. Bu çalışmamızda, geriatrik femur boyun kırıklarında hemiartroplasti uygulaması sonrası 30 günlük mortaliteye etki eden hasta ile ilişkili faktörler, ucuz, rutin olarak kullanılan ve kolayca ulaşılabilen biyokimyasal belirteçlerin incelenmesi amaçlanmıştır.
Yöntemler: Çalışmamızda 169 hasta retrospektif olarak incelenmiştir. Yaş, vücut kitle indeksi, başvuru - ameliyat arası geçen süre, toplam yatış süreleri, komorbid hastalıklar, Amerikan Anestezi Derneği Skorları, kan transfüzyonu, antikoagülan ilaç kullanımı, albumin ve plazma replasmanları, ameliyat öncesi ve sonrası hemogram ve biyokimya testlerinin 30 günlük mortaliteye etkisi incelenmiştir.
Bulgular: 30 günlük mortalite oranı %14,2 olarak bulunmuştur. Çoklu değişkenler analizi sonucunda; yaş (>80 yaş) (1.095 odds ratio, p = 0.029), Amerikan Anestezi Derneği Skoru (3.584 odds ratio, p = 0.007) ve ameliyat sonrası kreatinin değerleri (2.845 odds ratio, p = 0.001), geriatrik femur boyun kırıkları için uygulanan hemiartroplasti sonrası 30 günlük mortalitenin ana belirleyicileri olarak bulunmuştur.
Sonuç: İleri yaş (>80 yaş), yüksek Amerikan Anestezi Derneği skorları (ASA skoru 3 veya 4) ve artmış ameliyat sonrası kreatinin değerleri, artmış 30 günlük mortalite riski ile ilişkili bulunmuştur.

Anahtar kelimeler: femur boynu kırıkları; kalça kırıkları; kreatinin; kalça replasman artroplasti; osteoporotik kırıklar; mortalite

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Introduction

Proximal femur fractures are commonly seen in geriatric patients and are as a significant cause of mortality and morbidity [1-7]. An increased life expectancy increases the incidence of future geriatric proximal femur fractures [1, 2]. These fractures necessitates consideration of patient related factors for determining the surgical method [8, 9]. Hemiarthroplasty is an appropriate treatment option for a certain number of patients as it provides early mobilization and good functional results for unstable intertrochanteric and femoral neck fractures [10, 11].

Many studies have focused on the factors affecting 30-day mortality after varied treatment modalities for proximal femur fractures [1, 4, 5, 7-9, 12-19]. Most of these studies investigated the effects of different predicting factors on mortality, including the American Society of Anesthesiologists (ASA) score, sex, age, comorbidities, medications, troponin-T levels, surgeon experience, alanine transaminase (ALT) levels, hemoglobin (Hb) count, creatinine (Cre) levels, renal insufficiency, serum lactate levels, lymphocyte count, serum urea levels, type of hip fracture, and particularly hospitalization time between admission and operation [1-10, 12-23]. Routine blood tests, which are inexpensive, reliable, and accessible, that were frequently used in these studies can predict mortality risk after proximal femur fractures in the geriatric population [1, 2, 6, 8, 23].

The majority of studies examined the impact of hospitalization time between admission and surgery on the mortality rate; however, the results of these studies still remain controversial [4, 7, 9, 12-15, 21]. A majority of these studies demonstrated statistically significant, lower mortality rates with early surgery [4, 7, 9, 14, 15]. However, some other studies found no association between the preoperative hospitalization time and mortality [12, 13, 21].

There are several studies on the routine biochemical parameters that affect the 30-day mortality following cemented or cementless hemiarthroplasties for proximal femur fractures in the geriatric population [5, 17, 22].

Our study aimed to determine the patient-related factors and biochemical predictors, which were easily accessible, inexpensive, and routinely examined during the pre- and postoperative periods, of 30-day mortality in geriatric patients after hemiarthroplasty for the femoral neck fractures.

Material and methods

This retrospective study was conducted after obtaining the approval of the institutional review board of Ankara Research and Training Hospital (Approval Number: 07.06.2017/103). Between January 2015 and December 2018, 169 geriatric patients with femoral neck fractures who were treated with cemented or cementless hemiarthroplasty at Ankara Research and Training Hospital, Orthopaedics and Traumatology Department were enrolled in the study.

Patients younger than 65 years, those who were lost to follow-up, and who exhibited pathological fractures, those with polytrauma with concomitant fractures, and those with incomplete medical records were excluded from our study.

A total of 169 patients, 63 (37.2%) males and 106 (62.7%) females, who met these criteria were enrolled in our study.

Blood samples from all patients were taken at admission and 6 hours postoperatively. Blood samples of patients with pre-existing chronic renal failure were collected after preoperative hemodialysis.

Thromboembolic prophylaxis with 4000 IU low molecular weight heparin was subcutaneously administered at admission and was continued until the end of the postoperative first month. The hemiarthroplasties were performed by two surgeons using a modified Gibson approach in the lateral decubitus position. Preoperative intravenous prophylaxis with 1000 mg first-generation cephalosporin was administered to all patients 30 minutes before the surgery and continued for 24 hours postoperatively. Cemented or cementless standard bipolar prosthesis (Platin Medikal, Ankara, Turkey) was utilized for the fractures (Figure 1). A Hemovac drain was placed under the fascia for 24 hours postoperatively. There were no intraoperative deaths or complications

related to anesthesia or orthopedic intervention. All patients were followed up at the postoperative second and fourth week.

Patient medical records, hospital registry system, and radiological images were retrospectively investigated. Age, body mass index (BMI), hospitalization time from admission to surgery, total hospitalization time, comorbidities, ASA scores, blood transfusions, anticoagulant medications, albumin (Alb) and fresh frozen plasma replacements, preoperative and postoperative Hb level, platelet, white blood cells (WBCs), neutrophil and lymphocyte counts, Cre, blood urea nitrogen (BUN), sodium (Na), potassium (K), calcium (Ca), Alb, ALT, aspartate aminotransferase (AST), gamma-glutamyl transpeptidase, lactate dehydrogenase (LDH), international normalized ratio, bilirubin levels, hospitalization in the intensive care unit, and enzyme-linked immunosorbent assay markers were analyzed for all patients.

Statistical analysis was performed using the IBM SPSS Version 19 program (IBM Software, New York, United States). The results were presented as numbers and percentages for categorical variables and as mean ± standard deviation, median, and minimum- maximum for continuous variables. The distribution normality for continuous variables was confirmed using the Kolmogorov–Smirnov test. Comparison of the categorical variables between groups was performed using Chi-square or Fisher exact test. Independent continuous variables between the two groups were compared using the Student's t-test or Mann–Whitney U test depending on whether the statistical hypotheses were fulfilled or not. Multivariate logistic regression analysis was performed to determine the effects of possible risk factors on mortality risk. Thus, on the basis of the univariate analysis, variables significantly related to mortality risk and those with a significance of $p < 0.25$ were included in the analysis. Age and sex were included in the model as a biological factor. Post-hoc power analysis was performed with the use of G-Power Version 3.1.9.2 (Düsseldorf University, Düsseldorf, Germany), and the power of the study was found to be 98.8%. Power analysis was performed using the odds ratio (OR) = 2.845, R-square = 0.04 (between postoperative Cre and all other covariates in the model), and probability of mortality = 0.10 when the postoperative Cre is one standard deviation above its mean and all other covariates are set to their mean values. The statistical level of significance for all tests was considered as 0.05.

Results

In our study, 24 patients (14.2%) died within 30 days postoperatively, of whom 12 were males and 12 were females ($p = 0.16$).

Cemented hemiarthroplasty was performed in 88 patients (52%), whereas cementless hemiarthroplasty was performed in 81 patients (48%). There was no statistically significant difference in the mortality rates between the cemented and cementless hemiarthroplasty groups ($p = 0.5$). A total of 162 patients (95.8%) were operated under spinal anesthesia, and seven patients (4.1%) were operated under general anesthesia. In the preoperative period, 67 patients (39.6%) were prescribed anticoagulant medication (acetyl salicylic acid, clopidogrel, or warfarin). The mean BMI of the patients was 27.1 ± 5 kg/m2 (range, 17.5–42 kg/m2). The comorbidities of the patients are shown in Table 1.

Table 1 Comorbidities of the patients

Diseases	Number of patients
Hypertension	126 (74.5%)
Diabetes Mellitus	55 (32.5%)
Coronary artery disease	83 (49.1%)
Respiratory system disease	66 (39%)
Chronic renal insufficiency	30 (17.7%)
Neurological disease	55 (32.5%)
Hepatitis B	5 (2.9%)
Hepatitis C	2 (1.1%)

In our study, a total of thirty patients with chronic renal insufficiency (ten patients in the deceased group and twenty patients in the surviving group) were evaluated. The main causes of chronic renal insufficiency were hypertensive nephropathy in the deceased group (70%) and diabetic nephropathy in the surviving group (60%). Although the difference between groups in terms of pre-existing chronic renal insufficiency was statistically significant according to the univariate analysis ($p= 0.001$), multivariate analysis results revealed no statistically significant difference ($p= 0.276$).

The mean hospitalization time from admission to surgery was 3.3 ± 2.9 days (range, 1–28 days). The patients in this study were divided into three groups based on the hospitalization time from admission to surgery: group 1, operation in 48 h; group 2, operation between 48–96 h; and group 3, operation after 96 h. The group distribution of patients is indicated in Table 2. Multivariate analysis revealed that there was no statistically significant difference for the mean hospitalization time from admission to surgery between the surviving (3.3 ± 3.1 days) and deceased (3.5 ± 1.9 days) patient groups in the 30-day follow-up period (p = 0.3). The mean total hospitalization time was 9.2 days (range, 3–37 days).

Table 2 Distribution of the patients based on the hospitalization time from admission to surgery

		Alive	Mortality	Total
<48 hours	n	61	10	71
	%	85.9%	14.1%	100%
48–96 hours	n	55	5	60
	%	91.7%	8.3%	100%
>96 hours	n	29	9	38
	%	76.3%	23.7%	100%
Total	n	145	24	169
	%	85.8%	14.2%	100%

Univariate analysis revealed that sex, coronary artery disease, chronic renal insufficiency, neurological disease, ASA score, age, pre- and postoperative WBC count, preoperative K level, pre- and postoperative BUN, postoperative Alb, pre- and postoperative Cre, pre- and postoperative LDH, postoperative AST, and postoperative neutrophil count were statistically significant (p < 0.025) between the two groups.

These parameters were included in multivariate logistic regression analysis to determine the major predictors of 30-day mortality after hemiarthroplasty. Age, ASA score, and postoperative Cre parameters were found to have an effect on early mortality risk (Table 3).

The mean age of our study group was 81.3 ± 6.8 (range, 65–96 years). According to the results of the multivariate analysis, there was a statistically significant difference between the age of the surviving (80.8 ± 6.8 years) and deceased (84.4 ± 5.6 years) patient groups (p = 0.029).

The results of the multivariate analysis showed that there was a statistically significant difference in the postoperative Cre levels between the surviving (1 ± 0.5 mg/dL) and deceased (1.9 ± 1.5 mg/dL) patient groups (p = 0.001). A 1 mg increase in the postoperative Cre level increases the risk of mortality by 2.8 times. OR and 95% confidence intervals for variables are presented in Table 3.

Table 3. Results of multivariate logistic regression analysis (major predictors of 30-day mortality after hemiarthroplasty for femoral neck fractures in the elderly)

	Odds Ratio	95% Confidence Interval)		P
		Lower	Upper	
Age	1.095	1.009	1.189	0.029
Postoperative Creati-nine	2.845	1.569	5.165	0.001
ASA score	3.584	1.411	9.105	0.007

The median ASA score was 3 (range, 1–4). All deaths were seen in patients with ASA scores of 3 and 4. According to the multivariate analysis results, there was a statistically significant difference in the ASA scores between the surviving and deceased patient groups (p = 0.007). An increase in the ASA score increases the risk of mortality by 3.5 times (Table 3).

Discussion

In our study, increased postoperative Cre levels, increased ASA scores (ASA scores of 3 or 4), and older age (> 80 years of age) were found to be the major predictors of 30-day mortality after hemiarthroplasty for femoral neck fractures among geriatric patients.

The strongest predictor of mortality in this study was increased postoperative Cre levels. To the best of our knowledge, there is no study suggesting that increased postoperative Cre levels are associated with increased 30-day mortality in patients who were treated with only hemiarthroplasty due to femoral neck fractures. Pre-existing chronic renal insufficiency is a known risk factor for the increased 30-days and one year mortality after proximal femur fracture surgery in geriatric population [3, 20]. There are many studies in the current literature showing that an increase in pre- or postoperative parameters indicative of renal dysfunction is associated with early and late mortality after proximal femur fracture surgery [3, 5, 7, 16-20, 22, 23]. An increased postoperative

Cre level, which can only be preventable and correctable within the parameters determined in the multivariate analysis of our study, is a major predictor of 30-day mortality. The incidence of acute renal insufficiency (ARI) after proximal femur fracture in the geriatric population is about 24% [20]. Older age, male sex, and having more than one comorbidity were found to be risk factors for developing postoperative ARI [20]. The patients who developed postoperative ARI have a longer hospital stay and an increased requirement of intensive care unit services, increased medical expenses, and increased mortality and morbidity [17, 18, 20]. Limitation of long starvation times, suitable fluid replacement, better control of intraoperative hemorrhage, correction of hypotension, avoidance of nephrotoxic medications, and prompt treatment of sepsis may prevent postoperative ARI and associated potential problems [18, 20].

The ASA score is the main comorbidity index widely used in clinical practice [24]. It is validated, universal, and easily reproducible for different patient cohorts [25]. In our study, 30-day mortality was observed only in patients with ASA scores of 3 and 4. Our results support other studies in the literature emphasizing that high ASA scores are associated with increased 30-day mortality [9, 14].

According to the results of our study, older age (>80 years of age) is a major predictor of 30-day mortality after hemiarthroplasty. Our results support other studies in the literature that have emphasized increased mortality rates for the geriatric patients after proximal femur fracture surgery in the short- and long-term follow-up [2, 7-9, 14, 16].

The mean hospitalization time from admission to surgery in our study was 3.3 ± 2.9 days (range, 1–28 days). The most important reasons for the unavoidable delays in our study were the difficulties of finding an operative theater, electrolyte imbalance, and the use of anticoagulant medication in patients [12, 15, 17]. It was noted that there was no statistically significant difference in the mortality rates between the groups when the patients were categorized according to the hospitalization time from admission to surgery. The lack of significant differences between the groups may be attributed to the heterogeneity in the distribution of patient numbers between groups and the small number of patients in our study.

In our study, 24 patients (14.2%) died within the 30-day follow-up. The 30-day mortality rates of reported studies after surgical treatment of proximal femur fractures vary between 4.3 and 11%; the mortality rate in this study was higher than that of the other studies [1, 4, 7-9, 12-16, 19]. In many studies, different treatment modalities (internal fixation methods, total hip arthroplasty, or hemiarthroplasty) have been used for treating proximal femur fractures, and the effects of these methods on mortality rates have been evaluated together [4, 8, 9, 13-16, 19]. These studies have shown that the mortality rate and risk in patients undergoing arthroplasty are higher than in those undergoing other treatment modalities [9, 13]. In these studies, the number of patients undergoing different treatment modalities, were heterogeneous with frequent application of internal fixation methods [8, 9, 13, 15, 16]. This heterogeneity may have resulted in lower mortality rates.

Another reason for the high mortality rate in our study is the inclusion of patients treated with hemiarthroplasty alone, which is the typically preferred method in, older age patients with limited mobility and low-demand [10, 11].

Our study has some limitations. The major limitation of our study was the inclusion of only the patients, who were treated with hemiarthroplasty for the femoral neck fractures. The different types of proximal femur fracture (intertrochanteric, subtrochanteric) or the different treatment modalities (total hip arthroplasty, cannulated screws, intramedullary nail, dynamic hip screw or plates) could alter the early mortality rates. Another limitation of our study may be the short follow-up period, however the one of the main goals of our study was to determine the preventable and correctable parameters, that could be used to prevent early mortality in the perioperative period. The different results could be obtained with a longer follow up period. Although our study includes the small number of samples, the power of our study was found 98.8%. A large study population may reveal different outcomes. Moreover, our study was retrospectively designed. A prospectively

designed study with a larger number of patients may yield different results.

In conclusion, hemiarthroplasty is still an appropriate and frequently used treatment option for elderly patients with femoral neck fractures, as it provides early mobilization and good functional results. The patients older than 80 years of age with ASA scores of 3 or 4, who are scheduled for hemiarthroplasty due to femoral neck fractures, should be evaluated carefully during the perioperative period in terms of increased early mortality risk. We suggest that geriatric patients treated with hemiarthroplasty for femoral neck fractures should be monitored closely with regard to renal functions during the postoperative period, and thus, appropriate treatments may be beneficial in increasing survival rates.

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