

Predictive factors for early hospital readmission and 1-year mortality in elder patients following surgical treatment of a hip fracture

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ABSTRACT

BACKGROUND: Early hospital readmission after surgically treated hip fracture is a common entity, often involving an adverse event and causing strains on an already overburdened healthcare system. The main purposes of the present study were to determine the 30-day readmission rate, analyze the predictive factors for early hospital readmissions, and assess 1-year mortality following surgical treatment of hip fracture in elderly patients. Retrospective case-control study.

METHODS: In total, 517 patients with a mean age of 74 years were evaluated. The rate of early readmission, age, gender, body mass index, fracture type, pre-fracture mobility status, preoperative time to surgery, American Society of Anesthesiologists score, implant type, postoperative intensive care unit stay, total length of postoperative hospital stay, comorbidities, and the main reasons for readmission were the criteria for data collection. Multivariate analysis was performed to determine the main predictors of early hospital readmission. Mortality within the first year after surgery was also assessed.

RESULTS: A higher prevalence of chronic obstructive pulmonary disease, cardiac arrhythmia or ischemic heart disease, diabetes, and dementia or Parkinson's disease was detected in readmitted patients. Advanced age, American Society of Anesthesiologists (ASA) grade ≥ 3 , postoperative intensive care unit (ICU) stay, and pre-existing cardiac arrhythmia or ischemic heart disease were identified as the main predictors. The 1-year mortality rate for the readmitted group was 53.9%, whereas it was 24% for those patients who were not readmitted.

CONCLUSION: The readmission rate following surgical treatment of hip fracture in elder patients was 12%, and its main predictive factors were advanced age, ASA grade ≥ 3 , postoperative ICU stay, and pre-existing cardiac arrhythmia or ischemic heart disease. Hospital readmission within the first 30-day period following initial discharge was significantly correlated with an increased 1-year mortality rate.

Keywords: Elderly; hip fracture; mortality; readmission.

INTRODUCTION

The elderly population is growing worldwide in parallel with

the rising life expectancy in recent decades. Hip fractures in this age group are among the most common acute pathologies in the clinical practice of orthopedic traumatology.^[1] Approximately 90% of cases occur due to a simple fall from a standing position.^[2] It has been estimated that the incidence of hip fracture will rise to more than 6 million by the year 2050.^[3,4] The main purpose of surgical interventions in elderly patients with hip fracture is to return them to a preinjury level of daily living activities and social functioning.^[5] However, an increased risk of developing perioperative and/or postoperative infective, cardiac, respiratory, genitourinary, and gastrointestinal complications causing significant rates of mortality and morbidity has been reported for such patients.^[6] In-hospital mortality rates may rise to 10%.^[7,8] Further-

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more, several studies have demonstrated that up to one third of these patients die within the first year postoperatively.^[9,10] Active clinical problems at the time of discharge from hospital following surgical treatment of a hip fracture are also common.^[11] The impact of comorbidities on the risk of readmission and death after hip fracture surgery has not been sufficiently discussed and is still controversial in the literature.^[12] Readmission to hospital following a hip fracture often involves an adverse event.

The main purposes of the present study were to determine the 30-day readmission rate, analyze the predictors of early hospital readmissions, and assess the 1-year mortality rate in relation to early postoperative readmission following surgical treatment of a hip fracture in elderly patients.

MATERIALS AND METHODS

The present study retrospectively evaluated clinical data on 517 patients who underwent surgical treatment for a hip fracture between January 2010 and January 2014. Polytrauma patients, fractures associated with a primary or secondary tumor of the bone, patients who were already wheelchair bound or permanently bedridden before the fracture, those with incorrect or incomplete medical records in their hospital files, those who died preoperatively or without discharge postoperatively, and those who were lost to follow-up were excluded. The study group consisted of 354 females and 163 males with a mean age of 74 (range, 65–96) years at the time of surgery. The preoperative diagnosis was intracapsular femoral neck fracture in 290 (56%) and intertrochanteric or subtrochanteric fracture in 227 (44%) patients. Osteosynthesis was performed in 239 (46.2%) hips using either percutaneous cannulated screws (23 hips) or a proximal femoral nail (PFN) (216 hips). Hemiarthroplasty was performed in 201 hips, whereas total hip replacement (THR) was performed in 77. Routine clinical follow-up visits were conducted at 2 weeks, 1 month, 3 months, and 1 year postoperatively and annually thereafter.

The rate of early readmission within 30 days after discharge, age, gender, body mass index (BMI), fracture type, pre-fracture mobility status, preoperative time to surgery, American Society of Anesthesiologists (ASA) score, implant type applied during surgery, postoperative intensive care unit (ICU) stay, total length of postoperative hospital stay, comorbidities, and the main reasons for readmission were the criteria for data collection. Mortality within the first year after discharge from hospital was also assessed. Pre-fracture mobility status was categorized as independent walker, walker with a single crutch or stick, and walker with two sticks or a frame. The number and reasons for early hospital readmission were identified. Comparative analyses between readmitted and non-readmitted patient groups were completed to establish the most common factors for early hospital readmission.

The procedures followed were in accordance with the ethical standards of the committee responsible for human experimentation and with the Helsinki Declaration of 1975, revised in 2000. The current study was approved by the Ethical Research Institutional Review Board (Document number: 44495147-050.01.04-E.22337).

Statistical Analysis

Categorical data are presented as frequencies with percentages and continuous data as means with standard deviations. Relation status between categorical variables was assessed using the chi-square test. The two-sample t-test and the Mann–Whitney U test were implemented to compare independent variables. Multivariate analysis was performed to determine the main predictors of early hospital readmission. The level of significance was set at $\alpha=0.05$.

RESULTS

In total, 63 patients (12.2 %) were readmitted to hospital within 30 days of discharge. The mean time to readmission was 11.7 ± 6.7 (range, 1–25) days from initial discharge. The mean age of readmitted patients was significantly higher; however, there was no difference in the distribution by gender, BMI, or fracture type (Table 1). Over 50% of the readmitted patients could not walk unassisted prior to their hip fracture, whereas most of the non-readmitted patients could walk independently ($p<0.05$). The mean preoperative time from the first admission to surgery was 2.7 ± 1.8 days. No significant effect of time from injury to surgery on readmission rate was observed. The American Society of Anesthesiologists (ASA) grade was ≥ 3 in 47 of the 63 readmitted patients, whereas it was ≥ 3 in 211 of the 454 patients from the non-readmitted group ($p<0.05$). The rate of early hospital readmission did not differ significantly between patients treated with osteosynthesis and hip replacement surgery using either a hemiarthroplasty or total hip arthroplasty design. Two-hundred nine patients (40.4%) required an ICU stay for a mean of 6.4 ± 4.7 (range, 1–17) days. The proportion of patients who needed an ICU stay was higher in the readmitted group ($p<0.05$). However, the total length of hospital stay did not differ significantly between patient groups ($p>0.05$).

The primary causes of readmission were surgical in nature for 20 patients (31.7%), and 43 (68.3%) were readmitted for medical or other reasons (Table 2). Patients were more than twice as likely to be readmitted because of medical versus surgical complications. Nine of the 63 readmitted patients (14.3%) died following readmission. A higher prevalence of chronic obstructive pulmonary disease (COPD), cardiac arrhythmia or ischemic heart disease, diabetes, and dementia or Parkinson's disease were detected in readmitted patients ($p<0.05$) (Table 3). On the other hand, no significant difference was detected in the prevalence of hypertension, anemia, thyroid disease, or chronic renal failure between the two groups of patients.

Table 1. Comparison of demographic and clinical data of the readmitted and non-readmitted patient groups

Variable	Readmitted group (n=63)	Non-readmitted group (n=454)	p
Mean age (years), (Mean±SD)	81.2±9.6	73±8.2	<0.001
Gender, n (%)			
Male	22 (34.9)	141 (31)	
Female	41 (65.1)	313 (69)	
Mean body mass index (kg/m ²)	24.6	25.5	
Fracture type, n (%)			
Femoral neck	31 (49.2)	259 (57)	
Intertrochanteric	24 (38.1)	141 (31)	
Subtrochanteric	8 (12.7)	54 (11.9)	
Pre-fracture mobility, n (%)			<0.001
Independent	27 (42.8)	294 (64.7)	
Single stick	21 (33.3)	136 (30)	
Two sticks or frame	15 (23.8)	24 (5.3)	
Mean time to surgery (days), (Mean±SD)	2.6±1.5	2.7±1.9	
American Society of Anesthesiologists grade, n (%)			<0.001
I	1 (1.6)	3 (0.6)	
II	15 (23.8)	240 (52.8)	
III	27 (42.8)	157 (34.6)	
IV	20 (31.7)	54 (11.9)	
Implant type			
Cannulated screws	3 (4.8)	20 (4.4)	
Proximal femoral nail	32 (50.8)	184 (40.5)	
Hemiarthroplasty	23 (36.5)	178 (39.2)	
Total hip replacement	5 (7.9)	72 (15.8)	
Postoperative intensive care unit stay			
Number of patients, n (%)	38 (60.3)	171 (37.6)	
Mean duration (days), (Mean±SD)	7.8±4.5	5.7±4.4	<0.001
Postoperative hospital stay (days), (Mean±SD)	15.5±5.4	14±5.3	

SD: Standard deviation.

Age, pre-fracture mobility status, ASA grade ≥ 3 , ICU stay, COPD, cardiac arrhythmia or ischemic heart disease, diabetes, and dementia or Parkinson's disease were identified as potential risk factors according to univariate analysis for early hospital readmission following surgical treatment of a hip fracture. These factors were included in multivariate analysis. Age, ASA grade ≥ 3 , postoperative ICU stay, and pre-existing cardiac arrhythmia or ischemic heart disease were identified as the main predictors (Table 4).

The overall 1-year mortality rate was 27.6% (143 patients) for the whole cohort of the present study. The 1-year mortality rate for patients who were readmitted within 30 days of initial discharge from the hospital was 53.9% (34 patients), whereas it was 24% (109 patients) for those who were not readmitted ($p < 0.001$). There was a significant correlation be-

tween early hospital readmission following surgery for a hip fracture and the risk of 1-year mortality (OR: 3.7; 95% CI: 2.1–6.3; $p < 0.001$). The mortality rate was higher in patients with femoral neck fracture than in those with intertrochanteric or subtrochanteric fracture ($p < 0.05$).

DISCUSSION

Hip fracture has been reported among the most common causes of hospitalization in the geriatric age group.^[1,3] Parallel to the increase in the elderly population, it has been estimated that the incidence of hip fracture will rise to more than 6 million by the year 2050.^[3,4] Because these patients generally have multiple pre-existing medical problems, which may complicate their general health status as well as recovery after a surgical treatment, hospital readmissions can also be expected to rise. Identifying the major risk factors related

to early readmission and establishing a patient-oriented clinical approach for postoperative management can help reduce unexpected hospitalizations, which in turn decrease the fi-

ancial burden on the national healthcare system. Several studies demonstrated that the rate of readmissions within the first month after discharge from the hospital varied from 4% to 34%.^[14-16] The 30-day hospital readmission rate for our patients in the present study was 12.2%. This rate was consistent with the literature.^[17] However, because patients who might have been admitted to different healthcare facilities were not included in the current analysis, the true readmission rate may have been underestimated.

Many different patient-, fracture-, or surgery-related factors have been associated with undesirable early hospital admissions following hip fracture surgery. According to different studies, age, time to surgery, male gender, BMI, functional dependence status, ASA grade, ICU stay, and length of initial hospitalization have been discussed in direct relation to readmission rates by several authors.^[5,17,18] Eschbach et al. reported that patients of advanced age with hip-related fractures showed neither a prolonged in-hospital nor ICU stay, and there was no significant relation between advanced age and the number and type of complications.^[19] In the current study, univariate analysis of these factors revealed that age, pre-fracture mobility dependence, ASA grade ≥ 3 , and ICU stay were significant patient-related risk factors. However, there was no significant difference in the distribution by gender, BMI, fracture type, time from injury to surgery, implant

Table 2. Complications leading to readmission

Complication	n	%
Surgical		
Surgical site infection	6	9.5
Pain	4	6.3
Dislocation of the hip prosthesis	4	6.3
Hematoma	3	4.8
Hardware failure	3	4.8
Medical		
Pneumonia	10	15.9
Cardiovascular event	8	12.6
Acute respiratory distress	7	11.1
Urinary tract infection	7	11.1
Irregular glucose levels	4	6.3
Constipation	3	4.8
Cerebrovascular accident	2	3.2
Delirium	2	3.2

Table 3. Comparison of comorbidities between readmitted and non-readmitted patients

Comorbidity	Readmitted group (n=63)		Non-readmitted group (n=454)		p
	n	%	n	%	
Chronic obstructive pulmonary disease	17	27	72	15.9	0.028
Cardiac arrhythmia or ischemic heart disease	31	49.2	140	30.8	0.003
Hypertension	33	53.4	251	55.3	0.664
Diabetes	24	38	101	22.2	0.005
Chronic renal failure	5	7.9	40	8.8	0.817
Dementia or Parkinson's disease	12	19	33	7.3	0.001
Pre-existing anemia	15	23.8	126	27.8	0.509
Thyroid disease	6	9.5	36	7.9	0.187

Table 4. Main predictors of early readmission according to multivariate analysis of the risk factors

Variable	Univariate p-value	Multivariate analysis (logistic regression)	
		Odds ratio (95% Confidence interval)	p
Age	<0.001	1.11 (1.07 to 1.14)	<0.001
American Society of Anesthesiologists grade III-IV	<0.001	2.85 (1.47 to 5.52)	0.001
Postoperative intensive care unit stay	<0.001	2.09 (1.12 to 3.88)	0.019
Pre-existing cardiac arrhythmia or ischemic heart disease	0.003	1.84 (1.00 to 3.40)	0.049

type, or total length of the initial hospital stay according to our data.

It has been reported that surgical causes accounted for a limited number of readmissions.^[6] In their study, which aimed to identify causes and associated risk factors for admission, Buecking et al. also reported that the most frequent reasons were non-surgical, such as respiratory failure, cardiovascular diseases, and acute renal failure.^[17] Surgery-related factors accounted for 31.7% of our patients who were readmitted within the first 30 days of hospital discharge. Surgical site infection was the most common etiology among the surgery-related factors; however, no deep infection requiring implant removal was detected. Although surgery-related causes seemed to be higher than in some other studies in the literature, none of the patients in our study group had a life-threatening surgical complication or required an additional operation. According to Pollock et al., the most common complication precipitating readmission was non-surgical site infection.^[5] Respiratory tract infections, particularly pneumonia, have been emphasized by different authors as the leading cause in the literature.^[5,15,16,20] Pneumonia was also the most common reason in the current study, accounting for 15.9% of complications leading to readmission, followed by cardiovascular events, respiratory distress, and urinary tract infection. No significant correlation between a pre-existing history of chronic pulmonary disease and subsequent readmission due to pneumonia was detected.

Clinical status and management of patients with hip fracture may be affected by many factors.^[5] The burden of comorbidities has been demonstrated as significantly associated with a higher risk of readmission.^[18] Active clinical problems at the time of discharge may also play a leading role as the potential source of complications and readmission.^[11] Härstedt et al. mentioned that hypertension, cognitive disorders, and ischemic heart disease were the most common comorbidities in patients who underwent acute surgery for hip fracture.^[12] Khan et al. reported a higher prevalence of each comorbidity in readmitted patients than in the non-readmitted group.^[6] On the other hand, Golinvaux mentioned that diabetes confers little to no increased risk of postoperative complications after hip fracture surgery in geriatric patients.^[21] Therefore, no consensus exists regarding which comorbidities can be considered as precipitating factors of postoperative adverse events nor to what degree each one contributes to early readmission. Pre-existing hypertension, cardiac arrhythmia or ischemic heart disease, anemia, and diabetes were the most common comorbidities in our study group. Multivariate analysis of the individual clinical features of our study group, which were found to have a significantly higher prevalence among readmitted patients, revealed that age, ASA grade ≥ 3 , postoperative ICU stay, and pre-existing cardiac arrhythmia or ischemic heart disease were the main predictors of early hospital readmission following initial discharge from the hospital.

Overall 1-year mortality following surgical treatment for hip fracture in elder patients has been reported as high as 33%.^[22] According to French et al., the 1-year mortality rate increased by up to 48.5% in patients treated surgically for a fracture of the hip and with a medical history of early hospital readmission within the first 30 days following initial discharge from the hospital.^[15] Khan et al. also concluded that a more than two-fold increase in 1-year mortality was observed in patients readmitted within 28 days compared with those who were not.^[6] In the current study, although the overall 1-year mortality rate was 27.6% for our patients, it was 53.9% for those who were readmitted, indicating a significant correlation between early hospital readmission and increased risk of 1-year mortality (OR: 3.7; 95% CI: 2.1–6.3; $p < 0.001$). This finding was consistent with the previous literature.

The major limitation of the current study was the retrospective evaluation of a prospectively followed patient group. On the other hand, our cohort was a large series. We did not apply a priori calculation of the sample size. However, post hoc analysis was performed, and the statistical power of our study in the aspect of making a comparison between the two groups according to early hospital readmission was 0.99 with an alpha value of 0.05. Moreover, we performed univariate and multivariate analyses of many different parameters to achieve a better understanding of the main predictive factors. In conclusion, according to our data acquired during the present study, the readmission rate following surgical treatment of hip fracture in elder patients was 12%, and its main predictors were advanced age, ASA grade ≥ 3 , postoperative ICU stay, and pre-existing cardiac arrhythmia or ischemic heart disease. Hospital readmission within the first 30-day period following initial discharge was significantly correlated with an increased 1-year mortality rate.

Conflict of interest: None declared.

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ORJİNAL ÇALIŞMA - ÖZET

Cerrahi olarak tedavi edilmiş ileri yaş kalça kırığı hastalarında taburculuk sonrası erken dönem hastane başvurusu ve bir yıllık mortalitenin belirleyici faktörleri

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AMAÇ: Cerrahi olarak tedavi edilmiş kalça kırığını takiben taburculuk sonrası erken dönem hastane başvuruları genellikle altta yatan önemli bir etiyolojik faktöre bağlıdır ve sağlık sisteminin yükünü artırır. Bu geriyeye dönük çalışmanın amaçları cerrahi olarak tedavi edilmiş kalça kırığı hastalarında taburculuk sonrası erken dönem hastane başvuru oranlarını, bu duruma yol açan sebepleri ve hastaların ameliyat sonrası birinci yıl sonunda mortalite oranlarının belirlenmesidir.

GEREÇ VE YÖNTEM: Ortalama yaşı 74 olan toplam 517 hasta çalışmaya dahil edildi. Taburculuk sonrası erken hastane başvurusu, yaş, cinsiyet, vücut kitle endeksi, kırık tipi, kırık öncesi mobilizasyon seviyesi, ameliyata kadar geçen süre, American Society of Anesthesiologists (ASA) skoru, implant tipi, ameliyat sonrası yoğun bakımda kalış, toplam hastanede yatış süresi, komorbid hastalıklar ve hastane başvuru sebepleri veri toplama kriterleri olarak belirlendi. Çok değişkenli analiz ile majör belirleyici faktörler değerlendirildi.

BULGULAR: Taburculuk sonrası erken dönem hastane başvurusu olan hastalarda kronik obstrüktif akciğer hastalığı, kardiyak aritmi veya iskemik kalp hastalığı, diyabet, demans veya Alzheimer hastalığı prevalansı daha yüksek bulundu. Çok değişkenli analize göre hastane başvurusunun ana belirleyicileri ileri yaş, 3 veya üzeri ASA skoru, ameliyat sonrası yoğun bakımda kalma, kardiyak aritmi veya iskemik kalp hastalığı olarak belirlendi. Ameliyat sonunda ilk yıl içinde ölüm oranı taburculuk sonrası hastane başvurusu olan hasta grubunda anlamlı olarak yüksek bulundu.

TARTIŞMA: Cerrahi olarak tedavi edilmiş kalça kırığı hastalarında taburculuk sonrası erken dönem hastane başvurusu oranı %12 olarak tespit edilmiştir. Bu durumun ana belirleyicileri ileri yaş, yüksek ASA skoru, ameliyat sonrası yoğun bakım yatışı ve kardiyak aritmi ya da iskemik kalp hastalığı varlığıdır.

Anahtar sözcükler: Hastane başvurusu; kalça kırığı, mortalite; yaşlı hasta.

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