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Research Article

Risk factors for mortality and survival rates in elderly patients undergoing hemiarthroplasty for hip fracture

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ABSTRACT

Objective: The aim of this study was to analyze the relationship between mortality and possible risk factors in elderly patients surgically treated with hemiarthroplasty for hip fracture and to determine mortality rates and yearly survival outcome in a selected cohort.

Methods: A total of 92 patients (51 men (55.4%) and 41 women (44.6%); mean age: 76.47 years) who underwent hemiarthroplasty for hip fracture were included into the study. The following data associated with risk factors were recorded for 92 patients: age, gender, pre-fracture activities of daily living (ADL), type of fracture, American Society of Anesthesiologists (ASA) score, therapeutic procedure, type of anesthesia, length of time after fracture until operation, postoperative mobility, and duration of hospitalization. A multivariate logistic regression test was used to evaluate the correlation between the risk factors and first- and second-year mortality rates. Third-year mortality rate after surgery was analyzed and compared with the general mortality rate in a similar population of the same age group living in the same city.

Results: The mortality rate was 18.5% (17 patients) after the first-year follow-up and 25% (23 patients) after the second year. The mortality risk after hip fracture was found to be 11.7 times greater than the similar age group population in the third year. In addition, there was a significant relationship between a low (dependent) preoperative ADL score, advanced age (>80 years), male gender, high ASA score and poor ability to walk (unable to walk), and first- and second-year mortalities ($p<0.05$). However, no significant relationship was found between fracture type, fracture side, anesthesia type, time from fracture to surgery, or duration of hospitalization and mortality ($p>0.05$).

Conclusion: Advanced age, male gender, a high ASA score, a dependent preoperative ADL score, and a postoperative inability to walk were determined to be the most important risk factors affecting mortality in elderly patients with hip fracture. The mortality risk was 11.7 times greater than that of a population with similar characteristics.

Level of Evidence: Level IV, Therapeutic study

Hip fracture is one of the most important causes of functional failure and death in elderly patients (1). The anticipated life expectancy of elderly patients with hip fractures is lower. Approximately 15%–20% of patients die within one year after a hip fracture, and this rate is higher in males (2-5). Furthermore, mortality rates of up to 32% have been reported in elderly patients who underwent hemiarthroplasty due to an unstable hip fracture (6). The reported short, mid-, and long-term mortality rates vary between genders and among countries (3, 7-10).

Numerous risk factors related to geriatric hip fractures may affect mortality, such as age, gender, American Society of Anesthesiologist (ASA) score, dementia grade, gait ability, fracture type, surgical timing, surgery type, duration of hospitalization, and albumin level (10-13). The effects of comorbid diseases and predictive risk factors on mortality rates in elderly patients with hip fractures continue to be a subject of discussion (5-11). Although this topic has been extensively studied, the mortality rates and determinants of mortality after hip fractures are still not well-defined (3). There are only a few studies reporting long-term outcomes; however, the mortality rates of surgically treated patients with hip fractures have been found to exceed the age-matched death rates at 10-year follow-up (7, 14, 15).

This study aims to examine the relation between mortality and possible risk factors, and determine the mortality rate by year as well as long-term survival outcomes in elderly patients who underwent hemiarthroplasty due to hip fracture.

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Materials and Methods

The medical records of 114 patients who underwent hemiarthroplasty surgery in our clinic as a result of hip fractures between January 2000 and January 2004 were reviewed.

Patients over 65 years of age, patients who were mobile before the fracture, patients with no cognitive impairment, and Garden type 3-4 femoral neck fractures or some patients with AO type 31-A2 proximal femur fractures were included in the study. Since the patients' living conditions, i.e., in their own homes and/or in a family setting or a nursing home, could affect the results, only patients residing in their own homes were included in this study (15).

Patients with pathological hip fractures; bedridden patients; patients living in nursing homes before hip fractures occurred; patients who did not comply with the regular follow-up program, were lost to follow-up, or were inaccessible by phone; patients who underwent revision surgeries due to periprosthetic infection, dislocation, or periprosthetic fracture; and patients who died during hospitalization after hemiarthroplasty surgery were excluded from the study. After applying these exclusion criteria, 22 patients were excluded and the study was performed with 92 patients.

Information regarding gender, age, activities of daily life (ADL) score before hip fracture, type of hip fracture, ASA surgical risk score, treatment procedure, type of anesthesia, duration between injury and operation, postoperative mobilization ability, and duration of hospital stay were recorded. All patients were followed until death or revision surgery took place. Besides routine follow-ups, patients were requested to attend a control examination at 1 and 2 years after the surgery to evaluate their status. In the following years, the patients and/or relatives were contacted by phone. The number of deaths after the first and second years following hemiarthroplasty surgery due to hip fractures was recorded, and the relation between the specified risk factors of these patients and mortality was investigated.

The basic ADL scale, as defined by Katz et al. measures the capability of a patient to perform those frequent, necessary tasks for everyday life (16). In this study, the scoring system developed by Koval et al. which measures the ability of patients to perform ADL such as feeding, dressing, toileting, and bathing, was used to determine a score for each patient (3). The dependency of the patients was classified as dependent (e.g., 0, 1, or 2 points) or independent (e.g., 3 or 4 points) using Endo et al.'s method (4). Patients who were dependent in at least one activity were classified as dependent, and those who could independently perform the activities on the ADL scale were classified as independent.

The ASA score was used to define a low-risk group (e.g., ASA 1 or 2) and a high-risk group (e.g., ASA ≥3) (17). The patients were mobilized within 48 h after surgery, in accordance with the rehabilitation program (18). The postoperative ability to walk was classified as independent (i.e., assisted with a device or without any device), or dependent (i.e., with the help of another person or dependent on a wheelchair). Age categories of elderly (65–79 years) and very elderly (80+ years) were used, the fracture location was identified as being on the right or left side, the fracture type was classified as intracapsular or extracapsular, and the type of anesthesia used was classified as general or spinal/epidural.

Mortality rates through the first 5 years and the five-year survival outcomes were investigated in the long-term follow-up. The mortality rate in the third year was compared with that of a similar elderly population living in the same city, based on the Turkish Statistical Institute's mortality data (19).

Approval for this study was received from the ethics committee of the Süleyman Demirel University, School of Medicine (31.07.2013/164). The principles of the Declaration of Helsinki were observed throughout the research.

The medical files and other records of 114 cases were reviewed and 92 patients were selected for the study. The archived and all subsequent patient data included in the study were digitally recorded using Microsoft Excel 2000 (Microsoft Corp., Redmond, WA, USA). The relation between risk factors and mortality in the first and second years and a comparison of male and female demographic characteristics were the primary results of this study. The secondary results were a comparison of third-year mortality results and the mortality rate of a same age group in the general population. However, in the city where the study was conducted, detailed demographic data (total population and number of deaths by age, gender, and population percentage) released by the Turkish Statistical Institute were only available for 2007. Therefore, we could compare only the third-year data in our research, which corresponded to that year. Finally, the tertiary result was the calculation of 5-year survival rates.

The descriptive statistics were presented as the means, standard deviations, frequencies, and percentages. The qualitative/categorical data were expressed as frequency values and percentages. The distributions were defined using the numerical variable averages and standard deviations in normality analysis. The relation between the risk factors and mortality rates in the first and second years was investigated using a multiple-variable logistic regression model. The estimation risk odds ratios were calculated and a significance analysis was evaluated using Pearson's Chi-square test. Kaplan-Meier analysis was used for the total patient survival rate by year. $p<0.05$ was considered statistically significant.

Results

Among the 92 patients included in the study, 51 (55.4%) were male and 41 (44.6%) were female; the mean age was 76.47 years. According to the ADL score, 17 patients (18.5%) were classified as dependent and 75 patients (81.5%) were categorized as independent. The ASA score indicated that 42 (45.7%) patients were in

the low-risk group and 50 (54.3%) patients were in the high-risk group. After the first postoperative year, 75 (81.5%) patients were alive and 17 (18.5%) patients were deceased, and after the second postoperative year, 69 (75%) patients were alive and 23 (25%) had died. At five years after the hemiarthroplasty surgery, the mortality rate was 79%. The annual mortality rates and survival outcomes determined in this study are provided in Table 1 and Figure 1.

According to the multivariate analysis using logistic regression, no significant relation was found among the fracture type, fracture side, anesthesia type, length of time from fracture to surgery, duration of hospitalization, and mortality (Table 2). Evaluation of preoperative ADL scores revealed that the death rate was higher in the dependent group in both the first year (23.5% vs. 17.3%) and second year (29.4% vs. 24.0%) when compared to the independent group. Male patients had a higher death rate in both the first year (34.1% vs. 5.9%) and second year (41.5% vs. 11.8%) when compared to female patients. Patients older than 80 years had a higher mortality rate in both the first year (41.2% vs. 5.2%) and second

Table 1. Mortality rates and survival outcomes by years

Years	Ex % (n)	Cumulative survival
1	18.5 (17)	0.815±0.040
2	25 (23)	0.565±0.052
3	27.2 (25)	0.293±0.047
4	8.3 (8)	0.207±0.042
5	21 (19)	0.000±0.000
Total	100 (92)	

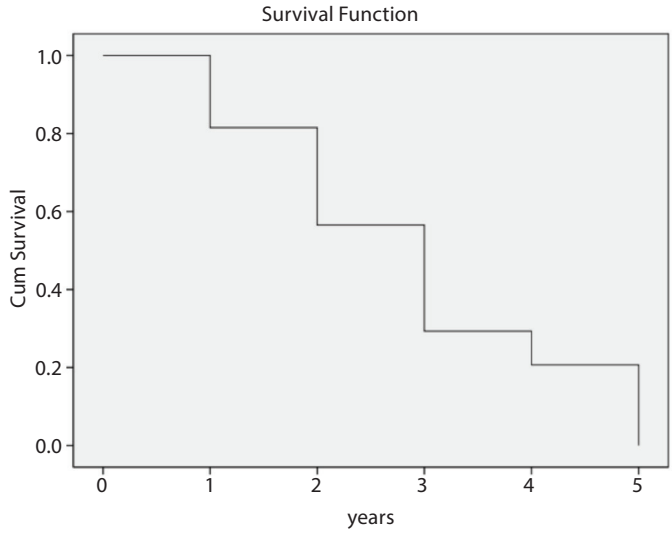

Figure 1. Patient cumulative survival outcome graph through Kaplan–Meier survival analysis

Table 2. Relation between mortality and risk factors after the 1st and 2nd years

	1st year mortality (n=17/92)			2nd year mortality (n=23/92)		
Risk factors	Subgroup (ex)	p	Odds ratio (95% CI)	Subgroup %ex	p	Odds ratio (95% CI)
Age	65–79 years (3)	0.000	0.078	65–79 years (6)	0.000	0.115
	≥80 years (14)			≥80 years (17)		
Gender	Female (3)	0.001	0.121	Female (6)	0.001	0.188
	Male (14)			Male (17)		
ASA score	Low risk (1)	0.000	0.052	Low risk (2)	0.000	0.069
	High risk (16)			High risk (21)		
ADL score	Independent (4)	0.048	1.467	Independent (5)	0.011	1.319
	Dependent (13)			Dependent (18)		
Able to walk	Walk (0)	0.000	0.564	Walk (0)	0.000	0.410
	No Walk (17)			No Walk (23)		
Fracture type	Intracapsular (6)	0.213	0.503	Intracapsular (10)	0.547	0.747
	Extracapsular (11)			Extracapsular (13)		
Side	Left (7)	0.365	0.613	Left (11)	0.718	0.840
	Right (10)			Right (12)		
Preop time	≤2 days (11)	0.175	0.458	≤2 days (15)	0.115	0.435
	>2 days (6)			>2 days (8)		
Anesthesia	Regional (7)	0.480	0.682	Regional (9)	0.278	0.589
	General (10)			General (14)		
Hospital time	<one week (8)	0.977	1.016	<one week (9)	0.398	0.662
	≥one week (9)			≥one week (14)		

year (50.0% vs. 10.3%) compared to the younger group. Patients who had a dependent ability to walk after surgery had a higher mortality rate in both the first year (43.6% vs. 18.5%) and second year (59% vs. 25.0%) when compared to the independent group. Consequently, in the first and second years, there was a significant relation between mortality and a low (dependent) preoperative ADL score, advanced age (>80 years), male gender, high ASA score and poor ability to walk after surgery ($p<0.05$) (Table 2).

Twenty-five (27.2%) patients were deceased after the third postoperative year. The reported mortality rate of the population aged 65 years or more living in the same city in 2007 was 2.33%. The results of this study indicated that, at 3 years after the hemiarthroplasty surgery, elderly patients with hip fractures had an 11.7 times greater risk of mortality than those of similar age in the general population.

Discussion

It has been established that only about one-third of elderly patients with hip fractures will survive for more than 5 years (15). It has also been reported that only 25% of these patients can return to their prior functional status after a hip fracture. The high rate of mortality is associated with the preoperative general condition of patients and with many risk factors (20, 21). The mortality rate is similar in elderly patients who undergo osteosynthesis or arthroplasty due to hip fracture (10). There are many studies that have investigated the annual mortality rates after surgically treated hip fractures, and various results have been reported from different countries. In a study of patients who underwent hemiarthroplasty for hip fractures in the Netherlands, the 1-year mortality rate was 28%, the 2-year mortality rate was 39%, the 3-year mortality rate was 49%, the 4-year mortality rate was 54%, and the 5-year mortality rate was 63%. All patients were followed until death or until a revision operation took place, and the mean survival time was reported to be 3.2 years (22). In a study conducted in Australia, the 1-year mortality rate was determined to be 34% and the 2-year mortality rate was 47% (9). In a community-based study in Norway, the 1-year mortality rate was 21.3% (male 30.7% and female 19.1%) and the 5-year mortality rate was reported to be 59.0% (male 70% and female 54.6%), thus showing a significant sex difference (7). In a study conducted in Denmark, both male and female patients with hip fractures were found to have higher mortality rates than the overall population. The 1-year mortality rate was 37.1% for males with hip fractures and was 9.9% in the general population of similar age; the 1-year mortality rate was 26% for females and 9.3% in the general population of similar age (8). In research analyzing a group with an average age of 82 years (71% female and 26% male) in Canada, the mean death rate in the hospital following hip fractures was found to be 6.3% (10% in males and 4% in females) (3). In a study that examined hip fractures in the elderly in the United Kingdom, the risk of death in each decade was 41%, and was 68% higher for males (15).

Our 1- and 2-year mortality rate results were significantly higher for men and for those who were older, which is consistent with the literature. In this study, 17 (18.5%) patients had died by the time of the first year control after the surgery and 23 (25%) had died by the second year. The mortality rate was higher for men; namely, 34.1% in the first year and 41.5% in the second year. Overall, 25 (27.2%) patients died during the third year. A notable outcome of this study was that the mortality risk was 11.7 times greater in the hip-fracture group when compared to a group of similar age in the general population.

Çamurcu et al. reported a 5-year cumulative survival rate of 5.6% for patients in Turkey who underwent hemiarthroplasty, whereas our results revealed a 5-year survival rate of 0%. One reason for this difference may be that in Çamurcu et al.'s study, only patients who underwent hemiarthroplasty for unstable extracapsular fractures were included (6). In our study, patients who underwent hemiarthroplasty for both extra- and intracapsular fractures were included. The effect of an extra- or intracapsular fracture on mortality may vary; however, the mortality rates were similar in our study (23, 24). Chang et al. also reported results that support our findings, at least for the first year (25).

Many studies have reported that advanced age, male gender, a long-term stay in the intensive care unit, poor postoperative mobilization ability, a poor or dependent preoperative ADL score, and multiple comorbidities that cause a high ASA score are associated with higher mortality (2, 9). In one study, it was determined that an increase of 1 point in the ASA score increased the risk of death by 51% (15). Endo et al. found that male gender was a risk factor for higher mortality at 1 year after hip fracture surgery, and that the ADL scores of males reflected greater dependency than those of women (4). Heinonen et al. found that a multivariate risk model identified only the prefracture ADL score as being statistically significant, and recommended more intensive rehabilitation immediately after the surgery (26). Sofu et al. found that the main determinants of mortality were advanced age, a high ASA score, postoperative intensive care unit admission, and cardiac arrhythmia or ischemic heart disease (5). Çamurcu et al. found that an ASA score of ≥3 and a postoperative mobilization time of ≥2 days were significantly correlated with 1-year mortality (6). Oztürk et al. reported that the factors of gender, cognitive functional status, and duration until surgery had no significant effect on mortality, but the survival rate was significantly higher in patients who could walk independently after surgery (20). They found that the patients who were categorized as high-risk were likely to die within 1 year. Cetinkaya et al. noted that a greater age and a higher ASA score significantly increased the mortality rates and that early mobilization was an important factor in reducing mortality (21). Some research has supported our results regarding the relation between mortality and both ADL and the ability to walk (4, 20, 26). In our study, there was a significant relation between mortality and a low (dependent) preoperative ADL score, old age (>80 years), gender (male), high ASA score and poor ability or inability to walk in the first and second years (Table 2).

We found no significant relation among mortality and fracture type, fracture side, anesthesia type, time from fracture until surgery, and hospitalization duration in the first and second years. Sener et al. however, found that the presence of comorbid diseases and delayed surgery after the fracture significantly increased mortality (13). Atay et al. reported that physical condition and preoperative delay were significant predictors of 1- and 2-year mortality in elderly patients with hip fractures (12). Doruk et al. found that early surgery for elderly patients with hip fractures reduced mortality rates, duration of hospital stays, and postoperative complication rates (27). Mutlu et al. reported that surgical delay may increase the risk of mortality in elderly patients with hip fractures, but that the anesthesia type did not affect mortality (28). In another research, it was found that regional anesthesia may reduce acute postoperative confusion, but no conclusions could be drawn for mortality or other outcomes (29, 30). This difference may be related to the method used or the medical characteristics of the patients studied. Some research has identified a surgical delay period within 5 days to be an important factor, but the optimal time for hip fracture surgery in the elderly is unclear (27). The mean time in our study was 2 days after the fracture occurred. Delay in surgical treatment may adversely affect postoperative functional outcomes and mortality. However, unresolved preoperative medical problems may increase pre- and postoperative complications (28). Therefore, this factor may have played a role in the results of our study.

We believe that our study results are an important new contribution to the data for Turkey. Among the studies conducted in Turkey, we did not find any research that compared the mortality rates of hip fracture patients with those of the general population in the same age group. Also, few studies have reported long-term mortality based on risk factors.

One limitation of this study is the small number of patients compared to similar previous studies (3, 7-9, 15, 22). However, in these studies, there were numerous variations, including the duration of the study (22), the age groups included (7), the databases used (9, 15), and the study design details such as reports from national medical records according to ICD codes (8) or population-based studies of medical record systems (3), which may affect the results. Another limitation of this study is that we did not investigate the cemented-cementless, unipolar-bipolar, or other subgroups, which may have influenced our results. The inconsistency of our results with some of the previous study results may be due to differences in fracture types, surgical treatment techniques, demographic data, clinical conditions, and comorbidities of the patients included in other studies. Renal disease, cardiac disease (23), and pulmonary embolism (28), which we did not examine in detail, have been reported to be associated with mortality and may have affected the results of our research.

Factors such as advanced age, male gender, a high ASA score, a dependent preoperative ADL score, and poor postoperative ability to walk were found to be the most important risk factors affecting long-term mortality in elderly patients with hip fractures. The mortality risk was found to be 11.7 times greater in patients with hip fractures compared to a general population of similar age. A detailed assessment of preventable risk factors associated with mortality is needed for elderly patients who have had hip fracture surgery. A multidisciplinary approach should be considered as part of the quality assurance process for the management of these patients.

Ethics Committee Approval: Ethics committee approval was received for this study from the Ethics Committee of Süleyman Demirel University, School of Medicine (31.07.2013/164)

Informed Consent: N/A.

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