Predictors of Mortality in Elderly Patients With an Intertrochanteric or a Femoral Neck Fracture

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Background: We retrospectively analyzed 112 intertrochanteric femur fracture patients and 136 femoral neck fracture patients to determine mortality rates and factors affecting mortality. Internal fixation is the standard treatment method for intertrochanteric femur fracture patients in our institute, and arthroplasty, as a treatment choice, shows an increase in mortality rates. We wanted to convey if there was any decrease in mortality rate of intertrochanteric femur fracture patients when compared with femoral neck fracture patients who were almost always treated with arthroplasty.

Methods: Patients' age at admission, trauma date, delay until surgery, comorbidities, operation durations, anesthesia, and treatment types were evaluated by patients' folders. All preoperative and postoperative radiographs checked over for treatment type. Patients' recent health and activity status were determined by telephone interview.

Results: There were no significant differences in mortality rates between patients of two fracture types. Treatment type, anesthesia type, and sex were significant predictors in univariate analyses. In multivariate analyses, only age and delay in surgery identified as predictors of mortality, age was the most significant. Although intertrochanteric femur fracture patients were significantly older than femoral neck fracture patients, the estimated mean survival time was higher for intertrochanteric femur fracture patients (57.9 months) than for femoral neck fracture patients (48.8 months).

Conclusion: We think that, in addition to the shorter delay in surgery, internal fixation choice led to decrease the mortality rate of intertrochanteric femur fracture patients. In conclusion, to decrease the mortality rate after hip fracture, since age and sex cannot be changed, needless delays in surgery should be avoided. Also, we recommend internal fixation and regional anesthesia to decrease the mortality rate.

Key Words: Hip fracture, Mortality, Delay in surgery, Internal fixation, Regional anesthesia.

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Hip fractures in the geriatric population are a major public health problem. Worldwide, elderly people represent the fastest growing age group; the yearly number of fractures is likely to rise substantially with the continued ageing of the population. Even if incidence rates for hip fracture remain stable, the estimated number of hip fractures worldwide will rise to 6.26 million by 2050.[1] Mortality risk increases after hip fracture especially during the first year, and increased risk may persist for several years.[2–5] A total of 23.8% of patients die in the first year after hip fracture and one in three patients require a higher level of long-term care.[6] Hip fractures are classified according to the anatomic location of fracture into fractures of the femoral neck (cervical or intracapsular) and intertrochanteric (extracapsular) regions.[7] In most of the survival studies according to the hip fracture type, patients with an intertrochanteric femur fracture were found to have higher mortality risk than those with a femoral neck fracture.[8–12] However, there are few studies that reported no significant difference in mortality between two types of hip fractures.[13–15] Arthroplasty, as a treatment choice, shows an increase in mortality rates when compared with internal fixation,[5] although there are some reports refuting this hypothesis.[13] In our institute, internal fixation is the standard treatment method for intertrochanteric femur fractures. So, we hypothesized that the internal fixation choice should lead to a decrease in mortality rate of intertrochanteric femur fracture patients when compared with femoral neck fracture patients who were almost always treated with arthroplasty.

The combined sciatic-paravertebral nerve block (SPNB) anesthesia technique for hip fracture operations is recommended especially for high-risk patients.[16] Epidural and spinal anesthesia (ESA) decreases overall mortality when compared with general anesthesia,[17,18] nevertheless, survival studies in hip fracture patients have not analyzed the effects of SPNB anesthesia technique on mortality.

Considering the developments in anesthesia techniques and actual treatment modalities, the objectives of this study, therefore, are to determine survival and functional outcome after hip fracture according to the fracture type and identify predictive factors for increased mortality.

PATIENTS AND METHODS

Three hundred sixty patients admitted to our institute between January 1, 1999, and November 30, 2006, because of hip fracture. Inclusion criteria were being white, aged 65 years or older, previously ambulatory and at least 1-year postoperative follow-up if they survived. Patients with pathological fractures and insufficient or inconsistent preoperative data were excluded. Two hundred forty-eight patients (69%) were included in this retrospective comparative study. There were two groups of patients according to the fracture type, 112 patients with intertrochanteric femur fracture and 136 patients with femoral neck fracture. According to the fracture type, the independent variables of this study were sex, age,

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comorbidities, delay in surgery, anesthesia type, and duration of operation, whereas the dependent variables were treatment type, postoperative mortality, and Barthel score. The mean ages for intertrochanteric femur and femoral neck fractures were 80.3 ± 8.5 and 77.9 ± 7.7, respectively. Patients' comorbidities, operation durations, and anesthesia types were evaluated by anesthesiology charts and data. These data were also checked from patients' records that were booked by the surgeon and patients with inconsistent data were excluded from the study. Age at admission, trauma date, and days passed until surgery were obtained from patients' computerized data, hospital charts, and folders. A member of the research team read all the preoperative radiographs of hip fractures for each patient and described them as an intertrochanteric femur fracture or a femoral neck fracture. The team member also checked postoperative radiographs for treatment type to describe them as an internal fixation and arthroplasty. The devices used for internal fixation were sliding hip screws, 95-degree or 135-degree angled blade plates and intramedullary nails. Patients' recent health and activity status were obtained by telephone interview. If a patient was not available for follow-up, a family member was interviewed. If the patients were dead, date of death and if they were alive, daily living activity questioned. Daily living activity was scored by using Barthel activities of daily living index,[19] which is shown in Table 1.

Comorbidities were classified into the following five groups: cardiovascular system, pulmonary system, renal system, central nervous system, and endocrine system diseases (diabetes mellitus included). These five comorbidities were chosen as the most important based on our experience and as reported in the literature.[20] Patients with cancer were excluded, as previously mentioned.

TABLE 1. Barthel Activities of Daily Living Index[19]

Activity	Point	Feature
Bowel activity	0	Incontinence (or laxative needed for defecation)
	1	Can't hold once a week
	2	Continence
Bladder	0	Incontinence, continuous catheterization and help needed
	1	Can't hold once in 24 hr
	2	Continence
Personal care	0	Needs help for care
	1	Independent
Toilet use	0	Dependent
	1	Needs partial help
	2	Independent
Feeding	0	Dependent
	1	Needs help for cutting or spreading butter
	2	Independent
Transfer (bed to chair and back)	0	Disable to do, imbalance while sitting
	1	Able to sit, but needs one or two guys
	2	Needs physically or verbal help
	3	Independent
Movement	0	Inactive
	1	Dependent to the wheelchair
	2	Needs physically or verbal help
	3	Independent (can sit with the help of a stick)
Wearing clothes	0	Dependent
	1	Need help but able to do some
	2	Independent (button, zip, and string)
Stairs	0	Disable to climb
	1	Needs verbal, physically help, or stick
	2	Independent
Bath	0	Dependent
	1	Independent

Statistical Analysis

The unadjusted χ^2 test was used for analyzing differences between proportions. The unpaired Student's t test was used for analyzing differences between means. The differences in median scores of comorbidities for two fracture types were analyzed by using Mann-Whitney test. The cumulative survival rates were obtained as Kaplan-Meier estimates and the log-rank test were used to find p value. To determine the association between potential predictors and mortality, the Cox proportional hazards regression test was used. In this method, the potential predictors were the predictors which were significant or close to significance in univariate tests. $p < 0.05$ was defined as significant in all tests.

RESULTS

Two hundred forty-eight patients met the inclusion criteria and were included in the study. There were two groups of patients according to the fracture type, 112 patients with an intertrochanteric femur fracture and 136 patients with a femoral neck fracture. The baseline characteristics of the study population according to the fracture type are summarized in Table 2. There were no significant differences between the two groups regarding to sex, comorbidities, anesthesia type, mean duration of operations, mortality, mean follow-up in months, and Barthel score. The patients' mean age was 80.3 years for intertrochanteric femur fractures and 77.9 years for femoral neck fractures ($p = 0.020$). The treatment types for intertrochanteric femur fractures were arthroplasty for 38 (33.9%) patients and internal fixation for 74 (66.1%) patients when compared with being arthroplasty for 133 (97.8%) patients and internal fixation for 3 (2.2%) patients in femoral neck fractures ($p < 0.001$). The mean delay until surgery was 8.7 days for intertrochanteric femur fractures and 11.3 days for femoral neck fractures ($p = 0.035$).

Mortality

The 1-month mortality rates of intertrochanteric femur fracture patients and of femoral neck fracture patients were 16.1% and 13.2%, respectively. The 1-year mortality rates of intertrochanteric femur fracture patients and of femoral neck fracture patients were 26.8% and 30.9%, respectively. The overall mortality rates (the rates of dead patients at the last interview) of intertrochanteric femur fracture patients and of femoral neck fracture patients were 42.9% and 50%, respectively. There were no significant differences in 1 month, 1

TABLE 2. Baseline Characteristics of the Study Population According to Fracture Type

Characteristics	Intertrochanteric Fracture (n = 112)	Femoral Neck Fracture (n = 136)	*p*
Sex			0.929
Male	34 (30.4)	42 (30.9)	
Female	78 (69.6)	94 (69.1)	
Age			
Mean	80.3 ± 8.5	77.9 ± 7.7	0.020*
Comorbidities			
Cardiovascular	82 (73.2)	106 (77.9)	0.387
Pulmonary	21 (18.8)	29 (21.3)	0.615
Renal	9 (8)	8 (5.9)	0.504
Central nervous	29 (25.9)	41 (30.1)	0.459
Endocrine	37 (33)	37 (27.2)	0.318
None	18 (16.1)	16 (11.8)	0.326
Delay in surgery			
Mean (d)	8.7 ± 6.8	11.3 ± 11.7	0.035*
Anesthesia type			0.447
General	70 (62.5)	85 (62.5)	
Spinal–epidural block	20 (17.9)	31 (22.8)	
SPNB	22 (19.6)	20 (14.7)	
Treatment type			
Arthroplasty	38 (33.9)	133 (97.8)	<0.001*
Internal fixation	74 (66.1)	3 (2.2)	
Duration of operation			
Mean (min)	146.3 ± 41.4	138.6 ± 39.9	0.135
Postoperative mortality			0.410
In 1 mo	18 (16.1)	18 (13.2)	
In 1 yr	30 (26.8)	42 (30.9)	
Overall	48 (42.9)	68 (50)	
Follow-up			
Mean (months)	31.3 ± 26.0	26.9 ± 23.0	0.160
Barthel score			
Mean	15.0 ± 6.2	15.1 ± 5.9	0.926

* $p < 0.05$.

year, or overall mortality rates between the two groups ($p = 0.209$), although the estimated mean survival time was higher for intertrochanteric femur fracture patients (57.9 months) than for femoral neck fracture patients (48.8 months). Survival curves for the two groups are presented in Figure 1.

In intertrochanteric femur fracture patients, estimated survival time for patients treated with arthroplasty was 42.9 months and it was 64.8 months for patients treated with internal fixation ($p = 0.018$). Survival curves for the two treatment types are presented in Figure 2. In femoral neck fracture patients, statistical analysis could not be performed according to the treatment type because there were only 3 patients treated with internal fixation compared with 133 patients treated with arthroplasty.

Considering all of the hip fracture patients, 116 patients died and 132 patients survived. The baseline characteristics of the dead and alive patients are summarized in Table 3. The mean age of the patients who died was 81.5 years when compared with the mean age of surviving patients, which was 76.8 years ($p < 0.001$). When comorbidities (5 systemic diseases) are counted for each patient, the median count of comorbidities affecting the patients with an intertrochanteric femur fracture was 1.5, and it was 2.0 for femoral neck fracture patients ($p > 0.05$). For the patients who died the median count was 2.0, and it was 1.5 for the patients who survived ($p > 0.05$). None of the comorbidities affect mortality rates as shown in Table 3. The mean delay for surgery was 11.5 days in dead patients and 8.9 in alive patients ($p = 0.037$). There was no significant difference in the duration of operations between the dead and alive patients, 141.1 minutes and 142.9 minutes, respectively ($p = 0.730$).

Forty-four of 76 male patients (57.9%) and 72 of 172 female patients (41.9%) died. The overall mortality rate was significantly increased in men ($p = 0.020$).

In regards to the choice of anesthesia, the overall mortality was 54.8% (85 of 155 patients) for general anesthesia, 35.3% (18 of 51 patients) for ESA, and 31% (13 of 42 patients) for SPNB ($p = 0.004$). When the ESA and SPNB types were grouped together as a regional anesthesia, and compared with general anesthesia, there was no significant difference in mortality in the first month after the operation (15.1% in regional anesthesia group and 14.2% in general anesthesia group, $p > 0.05$), but after the first month, the mortality rate was significantly decreased for regional anesthesia group (18.3% in regional anesthesia group and 40.6% in general anesthesia group, $p = 0.001$).

The significant predictors (age, sex, fracture type, treatment type, anesthesia type, and delay in surgery) were used to determine independent predictors of mortality by Cox regression analysis and the age of the patient ($p < 0.001$) as well as the delay in surgery ($p = 0.047$) were significant.

Functional Outcome

The mean Barthel score was 15.0 for intertrochanteric femur fracture patients and 15.1 for femoral neck fracture patients ($p = 0.926$). It was 14.8 for patients treated with arthroplasty and 15.5 for patients treated with internal fixation ($p = 0.493$).

DISCUSSION

We retrospectively analyzed 248 hip fracture patients to determine mortality rates and factors affecting patient mortality according to two hip fracture types.

We did not divide hip fracture or internal fixation device types into subgroups, which were the major limitations in our study. Also, personal characteristics and medical treatments of patients could not be considered in our results.

In this study, the mortality rates for both fracture types were highest for the first year after operation and declined gradually with time. This is similar to other investigators results.[2,5,21] The age of the patient was a significant predictor of mortality, which is also stated by most of the survival studies.[4,10,11,13,14]

We found men had a significantly higher mortality rate in univariate analysis, but in multivariate analysis, sex was not a significant predictor of mortality. This result is similar to other studies.[13,15] Conversely, White et al.[21] reported that male sex was predictive of increased mortality, but a significant proportion of the men were at high-risk group. Besides,

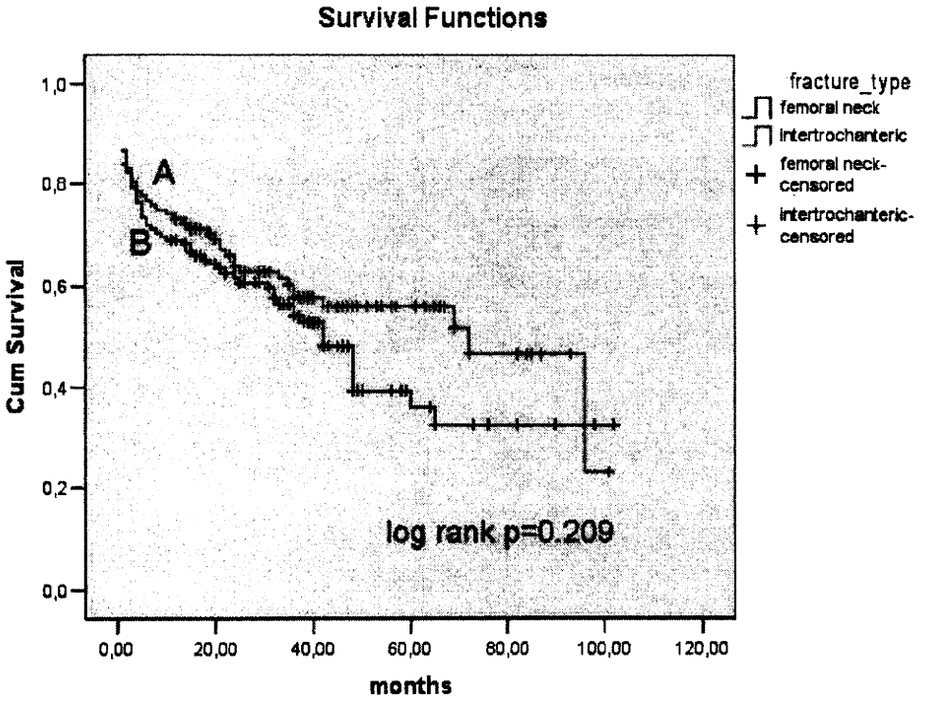

Figure 1. The graph shows a Kaplan-Meier survival curve for (*A*) intertrochanteric femur fracture and (*B*) femoral neck fracture patients.

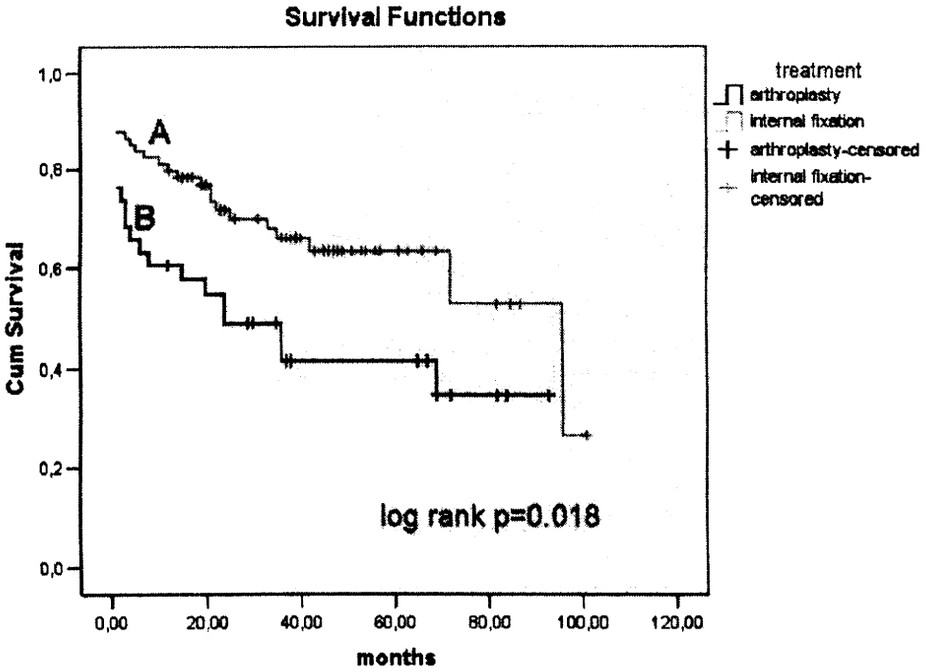

Figure 2. The graph shows a Kaplan-Meier survival curve for intertrochanteric femur fracture patients' who are treated with (A) internal fixation and (B) arthroplasty.

men had increased mortality even after controlling potential confounders in some reports.[22,23] Therefore, the relationship between sex and mortality risk remains controversial.

Although comorbidities were related with increased mortality in many studies,[2,9,10,12,15] we did not find any relationship similar to that of Aharonoff et al.[13]

TABLE 3. Baseline Characteristics of the Dead and Alive Patients

Characteristics	Dead Patients (n = 116)	Alive Patients (n = 132)	*p*
Age			
Mean	81.5 ± 8.0	76.8 ± 7.7	<0.001*
Comorbidities			
Cardiovascular system			0.227
Existing	92 (79.3)	96 (72.7)	
Nonexistent	24 (20.7)	36 (27.3)	
Pulmonary system			0.407
Existing	26 (22.4)	24 (18.2)	
Nonexistent	90 (77.6)	108 (81.8)	
Renal system			0.125
Existing	11 (9.5)	6 (4.5)	
Nonexistent	105 (90.5)	126 (95.5)	
Central nervous system			0.942
Existing	33 (28.4)	37 (28.0)	
Nonexistent	83 (71.6)	95 (72.0)	
Endocrine system			0.700
Existing	36 (31.0)	38 (28.8)	
Nonexistent	80 (69.0)	94 (71.2)	
None	13 (11.2)	21 (15.9)	0.283
Delay in surgery			
Mean	11.5 ± 10.6	8.9 ± 8.9	0.037*
Duration of operation			
Mean	141.1 ± 40.4	142.9 ± 41.0	0.730

* $p < 0.05$.

In this study, often the delays in surgery were too long. The operations were delayed for three main reasons, most often because of meaningless electrocardiographic anomalies, sometimes because of late admission to institute, and sometimes for patients with poor health who needed a reserved intensive care room for the postoperative period. We found that delay in surgery increased mortality rate significantly. Also, it was postulated that the patients should be operated on as early as possible.[17,20,24] Early treatment decreases pain and improves mobility, which in turn decreases pulmonary complications (atelectasis, pulmonary thromboemboli, and pneumonia).[23-27] Sexson and Lehner[20] reported that patients who developed postoperative complications had a 1-year mortality rate three times greater than that of patients without postoperative complications. In our study, considering the comorbidities were not a significant predictor, the needless delays to prepare the patients to surgery increased the mortality.

We found that the type of anesthesia was not predictive of increased mortality after controlling for other confounding factors. Nevertheless, in univariate analysis, regional anesthesia (SPNB and ESA) was found to decrease mortality rate after 1 month. In our institute, regional anesthesia is chosen for patients with poor health status and that explains the equivalence of the mortality rates in the first postoperative month. In several studies, the reduction in morbidity and mortality is shown with regional anesthesia.[17,18] The duration of operation had no significant influence on mortality rate, as concluded by White et al.[21]

The mortality rate of intertrochanteric femur fracture patients was higher than femoral neck fracture patients in most of the survival studies.[10,12] However, the patients with an intertrochanteric femur fracture were older and had more existing comorbidities. There are studies that confirmed higher mortality rates for intertrochanteric femur fracture patients, even when accounting for age and comorbidities by using multivariate analyses.[9,11] Fox et al.[8] found higher mortality rates for intertrochanteric femur fracture patients at 2 and 6 months after fracture when compared with femoral neck fracture patients, but 1-year recovery did not differ between fracture types. Also, some investigators reported that fracture type did not affect mortality.[13-15] Therefore, the relationship between fracture type and mortality remains controversial. In this study, there were no significant differences at 1 month, 1 year, and overall mortality rates between hip fracture types.

We did not find any significant difference between the two groups in regards to sex, comorbidities, anesthesia type, mean duration of operations, mortality, mean follow-up in months, and Barthel score. The mean age of patients with intertrochanteric femur fracture was significantly older than the patients with femoral neck fracture. Because age was an independent predictor of increased mortality in this study ($p < 0.001$), it is expected that the mortality rate of intertrochanteric femur fracture patients to be higher. Conversely, the mean delay in surgery was longer for femoral neck fracture patients. It was also an independent predictor of increased mortality in this study ($p = 0.047$), but not as significant as age when the p values are compared. So, it is still expected that the mortality rate of intertrochanteric femur fracture patients would be higher. However, in this study, estimated mean survival time was higher for intertrochanteric femur fractures (57.9 months) than for femoral neck fractures (48.8 months).

Kenzora et al.[15] and Aharonoff et al.[13] found no difference in mortality according to the treatment types. Vestergaard et al.[5] found higher mortality rates for patients who were treated with arthroplasty than patients who were treated with internal fixation. In intertrochanteric femur fracture patients, we also found higher mortality rates for patients who were treated with arthroplasty than patients who were treated with internal fixation. The reason might be due to the more complex surgery and so increased complications. We think that, even though the treatment type was not an independent predictor of mortality, internal fixation choice led to decrease the mortality rate of intertrochanteric femur fracture patients when compared with femoral neck fracture patients, who were almost always treated with arthroplasty. This is shown in Figure 1, A and B.

Regarding to functional outcome, no significant difference was seen in Barthel score of patients' according to the fracture types, similar to previous studies.[8,9] Also, when the patients' Barthel scores were compared according to the treatment type, there was no significant difference between arthroplasty and internal fixation groups.

In conclusion, to decrease the mortality rate after hip fracture, since age and gender are factors that are independent from treatment, needless delays in surgery should definitely be avoided. Also, we recommend internal fixation and regional anesthesia to decrease mortality rate. Finally, all findings in this study may be used to estimate prognosis of the patients to inform them and their families.

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