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Preoperative indicators affecting postoperative mortality in elderly patients with hip fractures

Hasan BOMBACI[1], Özgür ERDOĞAN[1], Fatih ÇETİNKAYA[1], Mehmet KUYUMCU[1], Emre KAYA[1], Elif BOMBACI[2]

[1]*Department of Orthopedics and Traumatology, Haydarpaşa Numune Training and Research Hospital, İstanbul, Turkey;*
[2]*Department of Anesthesiology and Reanimation, Dr. Lütfi Kırdar Kartal Training and Research Hospital, İstanbul, Turkey*

Objective: In this study, we aimed to evaluate the factors which affect postoperative mortality in elderly patients with hip fractures and the reliability of the American Society of Anesthesiologists (ASA) classification.

Methods: The study included 107 patients (70 females, 37 males) of 65 years of age or older who were operated due to hip fracture. Preoperative laboratory and clinical data were collected from hospital files. Follow-up was conducted over the phone. The number of the patients who died in the first postoperative 12 months was compared with the official Turkish Statistical Institute mortality data. Preoperative clinical and laboratory findings and ASA scores were compared between surviving and deceased patients.

Results: Twenty-eight patients died in the postoperative first year. The first year mortality rate was significantly higher than the normal population ($p<0.05$). Of these 28 patients, 16 died within the first 3 months; the majority due to respiratory insufficiency. The death ratio was significantly higher in patients with abnormal creatinine values ($p=0.001$) in the preoperative laboratory results and classified as ASA 4 ($p<0.0001$). Postoperative mobilization was slower and mortality was higher in patients with cognitive dysfunction, such as senile dementia.

Conclusion: The mortality rate in patients operated for hip fractures is higher when compared to the mortality rate of the same age group in general population. Because most deaths caused by pulmonary insufficiency occurred in the first 3 months in which patients were not adequately mobilized, the main cause of death might be pulmonary embolism. Abnormal creatinine values might indicate insufficient kidney function as another reason of death. ASA classification is useful for determination of preoperative risk in the elderly patients with hip fractures.

Key words: Femoral neck fracture; hip fracture; intertrochanteric; mortality.

Hip fractures are a common global health problem, particularly in the elderly population. As life expectancy increases, hip fractures have become one of the leading causes of death in the elderly.[1] Age-induced balance disorders result in more frequent falls and an increased prevalence of osteoporosis increase fracture risk after minor trauma.[2] Multiple chronic conditions that develop in adulthood can lead to deterioration of general health status.[3] For this reason, the mortality rate in patients with hip fractures is higher than that of their peers in the first year following fracture.[2,4-6]

Correspondence: Hasan Bombacı, Assoc. Prof. Haydarpaşa Numune Eğitim ve Araştırma Hastanesi Ortopedi ve Travmatoloji Kliniği, Tıbbiye Cad., 34671 Üsküdar, İstanbul, Turkey.

Tel: +90 216 - 414 45 02 - Ext.1590

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Factors that may increase postoperative mortality have been suggested as male gender, age over 85, multiple concomitant diseases, long wait time before surgery, surgeon's experience, and long hospitalization.[2,7] However, the predictive effect of preoperative laboratory results on postoperative mortality has not yet been investigated.

The aim of this study was to determine the reliability of preoperative tests and the widely-used American Society of Anesthesiologists (ASA) physical status classification in evaluating the postoperative mortality risk of hip fracture patients. In addition, the effects of patient's preoperative mental status and pre- and post-operative mobilization on mortality were investigated.

Patients and methods

Hospital records of 124 patients, aged 65 years and over, who underwent operation for hip fracture in our clinic between January 2008 and December 2010 were evaluated retrospectively. Of these, 117 patients or their relatives were reached by telephone. Patients who underwent surgery with partial endoprosthesis (PEP), sliding hip screw (SHS) or proximal femoral nail (PFN) were included in this study. One patient with total hip arthroplasty, two patients with long intramedullary nail and one patient with cannulated screws were excluded from the study. As the frequency of deaths occurring after the first 12 months after surgery is same as their peers, 6 patients who died after the 12th postoperative month were also excluded.[4-6] The remaining 107 patients (70 females, 37 males) were divided into two groups; "65 to 74 years" (32 patients) and "75 and older" (75 patients) according to the age segmentation of the Turkey Statistical Institute (TSI) (Table 1).[8,9] Surgery was conducted due to femoral neck fracture in 58 patients, intertrochanteric fracture in 44 and subtrochanteric fracture in 5 (Table 2). PEP was performed in 68 patients, SHS in 28 and PFN in 11 (Table 3). The mean surgical delay was 8.03±3.82 days.

Table 1. Gender distribution of patients according to age groups.

Age	Female	Male	Total
65-74 yrs.	14 (13.08%)	18 (16.82%)	**32 (29.91%)**
≥75 yrs.	56 (52.34%)	19 (17.76%)	**75 (70.09%)**
Total	**70 (65.42%)**	**37 (34.58%)**	**107**

All patients received antibiotic prophylaxis with a first-generation cephalosporin and thromboembolism prophylaxis with low-molecular-weight heparin (LMWH) for 48 hours. Patients were instructed to continue thromboembolism prophylaxis for 4 weeks after discharge. Patients were allowed to sit on the bed on the first postoperative day. On the second day, patients with appropriate overall condition were mobilized after the suction drain was removed. Patients undergoing PEP were allowed to walk by stepping on the operated side as permitted by pain. Patients undergoing osteosynthesis were mobilized on the 2nd postoperative day. Partial weight-bearing was begun 3 to 4 weeks postoperatively according to fracture status, presence or absence of severe osteoporosis, and applied implant. Patients with preoperative distorted walking functions and those with general condition that do not allow standing and walking were allowed to sit up in the bed at certain intervals. All other patients were encouraged to walk without weight-bearing.

Table 2. Distribution of the type of fracture according to age groups (p>0.05).

Age	Femoral neck fracture	Intertrochanteric fracture	Subtrochanteric fracture	Total
65-74 yrs.	17 (15.89%)	12 (11.21%)	3 (2.80%)	**32 (29.91%)**
≥75 yrs.	41 (38.32%)	32 (29.91%)	2 (1.87%)	**75 (70.09%)**
Total	**58 (54.21%)**	**44 (41.12%)**	**5 (4.67%)**	**107**

Table 3. The distribution of implants used according to age groups (p>0.05).

Age	PEP	SHS	PFN	Total
65-74 yrs.	18 (16.82%)	10 (9.35%)	4 (3.74%)	**32 (29.91%)**
≥75 yrs.	50 (46.73%)	18 (16.82%)	7 (6.54%)	**75 (70.09%)**
Total	**68 (63.55%)**	**28 (26.17%)**	**11 (10.28%)**	**107**

PEP: partial endoprosthesis, PFN: proximal femoral nail, SHS: sliding hip screw

Telephone interviews with patients or their relatives were conducted to determine whether the patient was alive or deceased, as well as cause and time of death, if necessary. Preoperative walking status was obtained both through the telephone interview and patient file. Preoperative mental status was divided into normal and dementia groups according to physical examination at the first admittance and statements by relatives. Patients who preoperatively were able to walk independently or with a walker (92 patients) and those who were only able to walk with the help of someone else or were non-ambulatory patients (15 patients) were evaluated in terms of postoperative mortality. Preoperative serum sodium, chloride, potassium, and creatinine values and ASA classification were obtained through hospital records.

Patient mortality within the first postoperative year was compared using the Fisher's exact test (Table 4). For statistical analysis of ASA assessment, ASA 3 and lower were classified as Group 1 (75 patients) and ASA 4 patients as Group 2 (32 patients). Mean waiting times for surgery were compared. The number of patients who died within the first 12 months after surgery was compared to the 2008 mortality rates of the TSI. Fisher's exact test, chi-square test and unpaired t-test were used to compare results. Statistical evaluations were performed using GraphPad InStat (GraphPad Software Inc., La Jolla, CA, USA) software. P values of less than 0.05 were considered statistically significant.

Results

Three of 32 patients (9.38%) in the 65 to 74 age group and 25 of 75 patients (33.33%) in the 75 years or older age group died within the first postoperative 12 months (Table 5). Compared with 2008 Turkey death statistics, the death rate of both groups were significantly higher than the normal population ($p=0.004$ and $p=0.0001$, respectively).[8,9] Sixteen patients (57.14%) died in the first 3 months, 7 patients (25%) in the second 3 months, 2 patients (7.14%) in the third 3 months and 3 patients (% 10.71) in the fourth 3 months (Table 5). The most common cause of death was respiratory failure. The cause of death could not be determined in four patients (Table 6).

There was no significant difference between the mean surgical delay of the patients who died in the first 12 months (7.50±3.06 days) and who survived (8.57±4.04 days) ($p>0.05$).

There were no significant differences between deceased and surviving patients who were able to walk with a walker/walk independently and those who were only able to walk with assistance or were non-ambulatory patients ($p>0.05$).

Creatinine levels were abnormal in 6 of the 79 patients (7.59%) who survived and 10 of the 28 (35.71%) who died. Creatinine levels ($p=0.001$) and ASA scores ($p<0.0001$) (Table 4) were significantly different between the two groups while sodium, potassium and chloride values were not statistically significant ($p>0.05$). There was a significant difference in postoperative mortality between patients with preoperative normal mental status (75 patients, 10 deceased, 13.33%) and patients with preoperative dementia or Alzheimer's disease (32 patients, 18 deceased, 56.25%) ($p<0.0001$).

Table 4. Evaluation of the ASA scoring of surviving and deceased patients.

	Surviving	Deceased	Total
ASA 4	10 (9.35%)	22 (20.56%)	**32 (29.91%)**
ASA 3	58 (54.21%)	6 (5.61%)	**64 (59.81%)**
ASA 2	10 (9.35%)	0 (0%)	**10 (9.35%)**
ASA 1	1 (0.93%)	0 (0%)	**1 (0.93%)**
Total	**79 (73.83%)**	**28 (26.17%)**	**107**

Table 5. Time of death after surgery according to age groups.

Age	<3 months	3-6 months	6-9 months	9-12 months	Total
65-74 yrs.	2 (7.14%)	0 (0%)	1 (3.57%)	0 (0%)	**3 (10.71%)**
≥75 yrs.	14 (50%)	7 (25%)	1 (3.57%)	3 (10.71%)	**25 (89.29%)**
Total	**16 (57.14%)**	**7 (25%)**	**2 (7.14%)**	**3 (10.71%)**	**28**

Table 6. Causes of death of patients who died in the first 12 months after surgery.

Age	Cardiopulmonary insufficiency	Respiratory insufficiency	Heart failure	Ischemic heart disease	Sepsis	Uncertain	Total
65-74 yrs.	1	0	0	0	0	2	**3**
≥75 yrs.	3	11	1	4	2	4	**25**
Total	**4**	**11**	**1**	**4**	**2**	**6**	**28**

Discussion

Numerous studies on an increase in the mortality rate of hip fractures in the first year have been reported.[4,6,7,10,11] Preoperative and postoperative care carried out in geriatric hip fracture patients has been found to reduce mortality risk.[10] In this study, the mortality rate of 26.16% in the first postoperative year after surgery is close to the 28.16% rate of patients undergoing PEP reported by Rogmark et al.[6] Postoperative mortality rates of patients 65 to74 and patients older than 75 years of age were higher than that of the normal population (p=0.004 and p=0.0001, respectively). These results indicate that hip fractures and their treatment are factors that increase mortality in elderly patients. Further research had indicated that the mortality rate of elderly patients with hip fractures increases with age and does not vary much according to the type of surgical intervention when osteosynthesis and hemiarthroplasty are taken into account.[6,7] In a study by Rogmark et al., patients died mostly in the first 4 months after surgery.[6] In this study, the vast majority of deceased patients (16/28, 57.14%) died in the first 3 postoperative months. The majority of complications such as deep vein thrombosis and pulmonary embolism occur in the first months following surgery due to extended patient bed rest.

Although thromboembolism prophylaxis reduces postoperative mortality rates, it is not a one hundred percent effective method.[10] Remaining bedridden for a long time, especially for elderly patients, increases the likelihood of deep vein thrombosis and related pulmonary embolism.[7] Although routine thromboembolism prophylaxis with LMWH is performed, as home and follow-up care is at the initial stage of adaptation in our country, consistent drug use following discharge cannot be controlled. In our study, the most common cause of death was respiratory failure (11 patients, 39.29%). Cardiopulmonary insufficiency (4 patients, 14.29%) was another common cause of death relevant for the respiratory system. This suggests that thrombosis and possible resultant pulmonary embolism may develop in patients that waited for an average of 8.03 days for surgery (Table 6). Heart-related problems were also a leading cause of death in this age group. Hypostatic pneumonia could also be considered to be the cause of sepsis in two patients. The development of home physical therapy and care services as well as follow-up and rehabilitation in geriatric clinics for patients at a high postoperative risk may be effective in reducing mortality rates.

The effect on mortality risk of waiting time to surgery is controversial. Both decreased and increased mortality rates in patients who underwent surgery in the first 24 hours have been reported.[4,7,12] Advocates of early surgery suggest that related complications such as deep vein thrombosis and urinary tract infection will decrease along with a decrease in the duration of bed rest. On the other hand, Sexson and Lehner indicated that surgery should be performed after stabilization of the patient's general health status if not appropriate for immediate surgery.[11] As a limited number of patients were operated on within 24 hours in this series, such an evaluation was not possible. Surgery on patients with an appropriate general condition in the first 24 hours may reduce the mortality rate by reducing the risk of thromboembolism. However, in our study, although of a similar duration, there was no significant difference in the average time to surgery between deceased and surviving patients (p>0.05). The relationship between abnormal preoperative creatinine values and postoperative mortality was reported in a study with a more limited number of patients.[13] Renal blood flow is reduced up to 50% in the elderly, even without kidney disease.[14] Serum creatinine levels are used to predict renal function (glomerular filtration rate).[14] Although blood urea nitrogen (BUN) can be used for similar purposes, it is not as reliable an indicator or renal function as it is affected by dietary protein or muscle mass. In addition, measurement of serum levels of creatinine is more practical than detailed testing such as measurement of the creatinine clearance in investigation of renal function. Chronic renal dysfunction in elderly patients becomes decompensated due to complications during or after surgery, renal function deteriorates further and oliguria and hyperkalemia enters into the terminal period. The treatment of complications will correct the compensation in kidney function although the underlying renal impairment will continue. However, pre- and postoperative preventive measures for reduced kidney function may be effective in reducing mortality risk.

The ASA classification is a scoring system that is used for the preoperative evaluation of the effects of systemic diseases on the patient's general condition.[15,16] Although a subjective evaluation system, the classification has been shown to be a useful risk marker in many studies.[2,17,18] Increased mortality rates with increasing comorbidities is a known fact.[3,16] With increasing age, the risks of mortality increase with increasing ASA score.[17] On the other hand, it is possible to decrease postoperative mortality and morbidity with follow-up and treatment at a geriatric clinic for patients with ASA scores of 3 or more.[11] In this series, the mortality rate in patients classified as ASA 4 was significantly higher than those classified as ASA 3 or less ($p<0.0001$) (Table 4). This shows that the ASA evaluation system is useful in determining postoperative mortality risk of elderly patients with hip fractures.

The mortality rate of patients with mental perception and communication problems such as dementia or Alzheimer's disease (32 patients, 18 deceased, 56.25%) was significantly higher than patients with normal cognitive function (75 patients, 10 deceased, 13.33%). In a study by Öztürk et al., all patients with dementia died within the first year.[19] Another striking finding in the present study was that postoperative mobilization of patients with cognitive dysfunction was mostly unsuccessful and patients are prone to remain bedridden. As the main factor affecting mortality after surgery is the postoperative mobilization of patient, this will cause an increase in the rate of complications and mortality. In this study, although the relationship between preoperative mobilization and mortality was not found ($p>0.05$), there was a significant difference between postoperative mobilization and mortality ($p<0.0001$).

A very large proportion of patients who were operated on in the specified time period (94.35%) were reached in this study. However, the inability to document cause of death with official reports and deficiencies in environment and follow-up data following discharge from the hospital are the weakness of this study.

In conclusion, preoperative renal dysfunction appears to be one of the most important factors affecting mortality risk in elderly hip fracture patients. ASA score was also found to be effective in predicting mortality rate. Respiratory failure was the most common cause of death and is possibly due to thromboembolism and related pulmonary embolism complication. Reducing this ratio may be possible with more stringent postoperative follow-up of thromboembolism prophylaxis and more widespread use of home care and follow-up services. Further studies identifying possible causes of death in the postoperative period may contribute to reducing mortality rates in elderly patients with hip fractures.

Conflicts of Interest: No conflicts declared.

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