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Comparison of mortality rates and risk factors for mortality between proximal femoral nailing and bipolar hemiarthroplasty for hip fractures

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ABSTRACT

Aims: The study aimed to compare in-hospital and post-discharge mortality rates and identify risk factors for patients who underwent bipolar hemiarthroplasty (BHA) or proximal femoral nailing (PFN) for hip fractures.

Methods: The files of 395 patients, consisting of 129 BHA and 266 PFN patients performed between January 2017 and October 2022, were analyzed retrospectively. The demographic characteristics of the patients, in-hospital and 1-year post-discharge mortality rates, and risk factors that may have affected these mortality rates were analyzed.

Results: There was no significant difference between the two groups in terms of demographic characteristics, intensive care unit (ICU) stay, American Society of Anesthesiologists (ASA) score, time to surgery, and intubation ($p>0.05$). The length of hospital stay and blood transfusion rates were higher in the BHA group ($p<0.05$). There was no significant difference between the two groups regarding in-hospital and 1-year post-discharge mortality rates ($p>0.05$). The 1-year post-discharge mortality rates were higher for patients with a higher mean age, longer length of hospital stay, longer length of ICU stay, time to surgery (>48 h), for patients who underwent intubation and blood transfusion, and for those with an ASA score of 4 ($p<0.05$). Chronic obstructive pulmonary disease (COPD) and congestive heart disease (CHF) were associated with higher in-hospital and 1-year post-discharge mortality, whereas dementia was only associated with higher 1-year post-discharge mortality ($p<0.05$).

Conclusion: There was no significant difference between the in-hospital and 1-year post-discharge mortality rates of patients who underwent PFN and those who underwent BHA. Patients with longer time to surgery (>48 h), longer length of hospital and ICU stay, patients with an ASA score of 4, and intubated patients had higher mortality rates. Comorbid CHF, COPD, and dementia increased the mortality rate in patients.

Keywords: Hip fracture, bipolar hemiarthroplasty, proximal femoral nail, mortality

INTRODUCTION

With technological advancements and higher socioeconomic statuses, life expectancy has increased significantly in the post-20th century period, especially in developed countries. A study conducted in Turkiye determined that life expectancy was 39.41 years in 1950, but the age increased to 77.77 years in 2020.[1] The increase in the elderly population and the corresponding increase in osteoporotic patients has led to a higher incidence of hip fractures caused by simple falls. The primary goal of hip fracture treatment is to mobilize the patient and help them return to daily life. Despite the high risk for mortality and morbidity, patients with hip fractures are operated on for this purpose. Outcomes in unoperated patients are poor.[2,3]

Proximal femoral nailing (PFN) and bipolar hemiarthroplasty (BHA) surgery have recently become the most commonly used options for hip fracture operations. The advantages of PFN include a smaller incision, a more biological approach with osteosynthesis, and less bleeding. In contrast, BHA requires no time for fracture union, has lower implant failure, and allows the patient to compress with full load postoperatively.[4,5]

Previous studies have reported that in-hospital mortality rates following hip fracture surgery vary between 2.7% and 15%, while 1-year mortality rates vary between 11.5% and 58.3%.[6] Many factors affecting mortality and morbidity in patients operated for hip fracture exist, including age, comorbidities, operation duration, and surgical technique.[7–9]

The main objective of this study was to compare in-hospital and post-discharge mortality rates for patients who underwent PFN for pertrochanteric fractures and BHA for femoral neck fractures. The secondary purpose was to determine the risk factors affecting mortality rates.

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METHODS

Institutional and researcher approval was obtained for the study. Ethical approval was obtained from the study was carried out with the permission of the University of Health Sciences Gazi Yaşargil Training and Research Hospital Clinical Researches Ethics Committee (Date: 13.01.2023, Decision No: 320); where all imaging and patient procedures were performed in a single center. There was no financial incentive to conduct the study, and all procedures were performed ethically and in accordance with the principles of the Declaration of Helsinki.

In the study, 395 patients who underwent PFN (Figure 1) (Zimed Medikal, Şehitkamil/Gaziantep/Turkiye) for pertrochanteric femur fractures and cementless BHA (Figure 2) (Zimed Medikal, Şehitkamil/Gaziantep/Turkiye) for femoral neck fractures between January 2017 and October 2022 were retrospectively analyzed. Exactly 129 patients underwent BHA, and 266 underwent PFN. Patients were first grouped according to whether they had gone through BHA or PFN surgery, and their in-hospital and 1-year post-discharge mortality rates, demographic characteristics, age, comorbid diseases, length of hospital stay, duration of surgery, length of intensive care unit (ICU) stay, and blood transfusion needs were compared. Patients who expired in the hospital were excluded. The differences between patients who died during the 1-year post-discharge period and those who survived in terms of demographic characteristics, surgeries performed, comorbid diseases, duration of ICU stay, intubation, blood transfusion, American Society of Anesthesiologists (ASA) physical status classification score,[10] time to surgery, and length of hospital stay were compared. Lastly, the effect of related parameters on mortality in patients who died in-hospital were analyzed. The 1-year post-discharge mortality of patients was verified using civil registry records. Precisely 162 of the patients were male, and 233 were female. Exactly 226 patients were operated on the right hip, and 169 patients were operated on the left hip. Patients with an ASA score of 2, patients who did not require a postoperative ICU stay, those exposed to high-energy trauma, patients <65 years of age, patients with pertrochanteric fractures who underwent calcar-supported BHA or cemented BHA, patients with pathologic fractures, those with multiple trauma, and patients who underwent revision surgery were excluded. The same group of experienced surgeons performed all operations. All patients were operated under spinal anesthesia. One gram of Cefazolin I.V. was administered to patients 30–60 min before surgery. Antithrombotic prophylaxis using low molecular weight heparin (Fraxiparine, GlaxoSmithKline, Brentford, UK) was administered in all cases. Patients undergoing PFN were performed on under traction on a traction table in the supine position, and patients undergoing BHA were performed on in the lateral decubitus position through a lateral incision. PFN patients were mobilized with partial load at the 24th postoperative hour, and BHA patients were mobilized with full load at the 24th postoperative hour under the supervision of a physiotherapist. Anterior-posterior and lateral radiographs were taken within 24 h post-operation to evaluate the position of the implant and the reduction of the fracture.

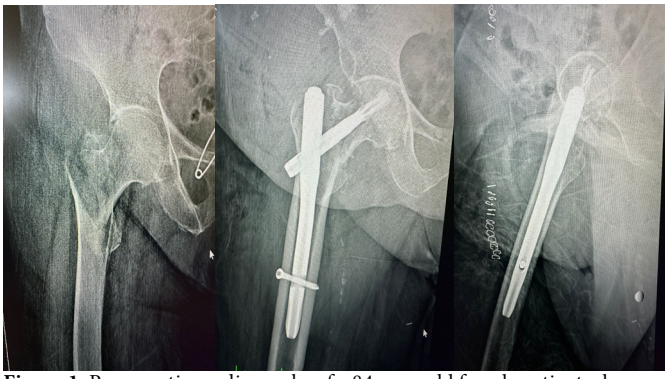

Figure 1. Preoperative radiographs of a 84-year-old female patient who underwent PFN due to pertrochanteric femur fractures (A); postoperative posterior-anterior (B1) and lateral radiographs (B2)

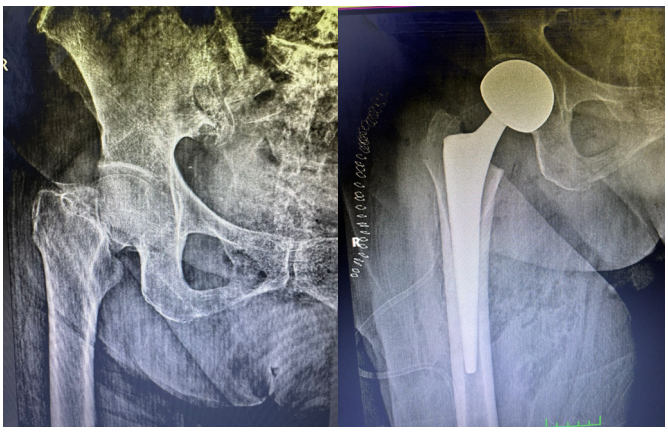

Figure 2. Preoperative radiographs of a 79-year-old female patient who underwent BHA due to femoral neck fractures (A); postoperative posterior-anterior radiographs (B)

Statistical Analysis

Statistical analyses were performed using the 2007 Number Cruncher Statistical System Statistical Software (Utah, USA) package program. Data were evaluated using descriptive statistical methods (mean, standard deviation, median, interquartile range). In addition, the Shapiro–Wilk normality test was used to determine the normality of the distribution of data; an independent samples t-test was used to compare paired groups of normally distributed variables; the Mann-Whitney U test was used to compare paired groups of non-normally distributed variables, and chi-square and Fisher's exact tests were employed to compare the qualitative data. Logistic regression analysis was performed to determine the factors affecting mortality. A statistical significance of $p<0.05$ was considered significant.

RESULTS

Of the 365 patients, 162 (44%) were male and 233 (56%) were female. The mean age was 78.59±8.9 years in the BHA group and 80.38±8.74 years in the PFN group. There was no significant difference between the groups in terms of demographic characteristics ($p>0.05$)(Table 1). The length of hospital stay was 7.51±4.91 days in the BHA group and 7.08±7.93 days in the PFN group. The length of hospital stay was significantly longer in the BHA group compared to the PFN group ($p=0.013$). The ICU stay was 3.4±4.01 days in the BHA group and 3.11±5.89 days in the PFN group.

No significant difference was observed between the groups in terms of ICU stay (p=0.085). No significant difference existed between the groups in terms of time to surgery, ASA score, and intubation in ICU (p>0.05). The blood transfusion rate was 32/129 (24%) in the BHA group and 21/266 (7.8%) in the PFN group.

Table 1. Comparison of patients who underwent bipolar hemiarthroplasty with those who underwent proximal femoral nailing

		Arthroplasty (BHA) group n: 129		PFN group n: 266		p
Age	Mean±SD	78.59±8.98		80.38±8.74		0.059*
Laterality	Right	73	56.59%	153	57.52%	0.861+
	Left	56	43.41%	113	42.48%	
Sex	Male	52	40.31%	110	41.35%	0.843+
	Female	77	59.69%	156	58.65%	
Length of hospital stay (days)	Mean±SD	7.51±4.91		7.08±7.93		0.013†
	Median (IQR)	6 (4-10)		5 (4-8)		
Length of ICU stay (days)	Mean±SD	3.4±4.01		3.11±5.89		0.085†
	Median (IQR)	1 (-4)		1 (1-3)		
Time to surgery	First 24 hours	85	65.89%	162	60.90%	0.217+
	24-48 hours	23	17.83%	68	25.56%	
	After 48 hours	21	16.28%	36	13.53%	
ASA score	III	59	45.04%	125	46.99%	0.339+
	IV	70	54.26%	141	53.01%	
Intubation	No	115	89.15%	233	87.59%	0.655+
	Yes	14	10.85%	33	12.41%	
Blood transfusion	No	97	75.19%	245	92.11%	0.0001+
	Yes	32	24.81%	21	7.89%	
1-year mortality	Survived	94	72.87%	199	74.81%	0.496+
	Within 0-6 months	18	13.95%	42	15.79%	
	Within 6-12 months	17	13.18%	25	9.40%	
In-hospital mortality	Survived	119	92.25%	245	92.11%	0.961+
	Died	10	7.75%	21	7.89%	

BHA: Bipolar hemiarthroplasty, PFN: Proximal femoral nailing, SD: Standart deviation, ASA: American Society of Anesthesiologists, ICU: Intensive care unit, *: Independent t-test, †: Mann-Whitney U test, +: Chi-square test, †: Fisher's Exact test

The blood transfusion rate was significantly higher in the BHA group than in the PFN group (p=0.0001). The in-hospital mortality rate was 10/129 (7.7%) in the BHA group and 21/266 (7.8%) in the PFN group. There was no significant difference between the in-hospital mortality rates of the two groups (p=0.961).

The 1-year post-discharge mortality rate was 18/129 (13.9%) between 0-6 months and 17/129 (13.1%) between 6-12 months in the BHA group. The 1-year post-discharge mortality rate was 42/266 (15.7%) from 0-6 months and 25/266 (9.4%) from 6-12 months in the PFN group. There was no significant difference between the 1-year post-discharge mortality rates of the two groups (p=0.496).

The post-discharge mortality rate increased significantly with an advanced age (p=0.0001). The post-discharge mortality rates were significantly higher in patients with longer hospital stays, longer ICU stays, in patients with an ASA score of 4, intubated patients, and patients who received a blood transfusion. The post-discharge mortality rates were significantly higher in patients with comorbid congestive heart disease (CHF) (p=0.003), chronic obstructive pulmonary disease (COPD) (p=0.0001), and dementia (p=0.001) (Table 2).

Table 2. Evaluation of criteria that may affect mortality in discharged patients

		Survived n: 293		Died n: 71		p
Age	Mean±SD	78.82±8.87		83.51±8.19		0.0001*
Type of operation	Arthroplasty (BHA)	94	32.08%	25	35.21%	0.614+
	PFN	199	67.92%	46	64.79%	
Laterality	Right	156	53.24%	49	69.01%	0.330+
	Left	137	46.76%	22	30.99%	
Sex	Male	122	41.64%	25	35.21%	0.322+
	Female	171	58.36%	46	64.79%	
Length of hospital stay (days)	Mean±SD	5.84±3.74		10.2±10.34		0.0001†
	Median	5 (3-7)		7 (512)		
Length of ICU stay (days)	Mean±SD	2.06±2.40		5.00±7.77		0.0001†
	Median	1 (4-12)		3 (1-5)		
DM	No	251	85.67%	57	80.28%	0.259+
	Yes	42	14.33%	14	19.72%	
OP	No	290	98.98%	70	98.59%	0.780†
	Yes	3	1.02%	1	1.41%	
CAD	No	39	13.31%	9	12.68%	0.887+
	Yes	254	86.69%	62	87.32%	
HT	No	103	35.15%	21	29.58%	0.374+
	Yes	190	64.85%	50	70.42%	
CRF	No	290	98.98%	70	98.59%	0.780†
	Yes	3	1.02%	1	1.41%	
CHD	No	286	97.61%	64	90.14%	0.003+
	Yes	7	2.39%	7	9.86%	
COPD	No	227	77.47%	38	53.52%	0.0001+
	Yes	66	22.53%	33	46.48%	
Dementia	No	227	77.47%	41	57.75%	0.001+
	Yes	66	22.53%	30	42.25%	
CVA	No	278	94.88%	65	91.55%	0.280+
	Yes	15	5.12%	6	8.45%	
Malignancy	No	292	99.66%	70	98.59%	0.275†
	Yes	1	0.34%	1	1.41%	
Time to surgery	First 24 hours	202	68.94%	36	50.70%	0.002+
	24-48 hours	64	21.84%	19	26.76%	
	After 48 hours	27	9.22%	16	22.54%	
ASA score	III	169	57.68%	14	19.72%	0.0001+
	IV	124	42.32%	57	80.28%	
Intubation	No	291	99.32%	57	80.28%	0.0001+
	Yes	2	0.68%	14	19.72%	
Blood transfusion	No	267	91.13%	56	78.87%	0.003+
	Yes	26	8.87%	15	21.13%	

SD: Standart deviation, *Independent t-test; †Mann–Whitney U test; +Chi-square test; †Fisher's Exact test

Logistic regression analysis was performed with age, length of hospital stay (days) and ICU stay (days), CHF, COPD, dementia, time to surgery, intubation, blood transfusion, and ASA variables to determine the factors affecting in-hospital mortality. The length of ICU stay (days) (p=0.263), dementia (p=0.261), time to surgery (p=0.223), and blood transfusion (p=0.241) did not significantly affect in-hospital mortality; however, an advanced age (p=0.014), a longer length of hospital stay (days) (p=0.016), comorbid CHF (p=0.036) and COPD (p=0.021), intubation (p=0.0001), blood transfusion, and an ASA score of 4 (p=0.016) significantly affected in-hospital mortality (Table 3).

Table 3. Factors affecting in-hospital mortality		
Logistic regression analysis		
	or (95% CI)	**p**
Age	1.05 (1.03-1.09)	0.014
Length of hospital stay (days)	1.14 (1.03-1.27)	0.016
Length of ICU stay (days)	0.91 (0.77-1.08)	0.263
CHD	3.82 (1.09-8.41)	0.036
COPD	2.04 (1.07-3.89)	0.021
Dementia	1.56 (0.72-3.39)	0.261
Time to surgery		0.223
24-48 hours	0.76 (0.35-1.62)	0.472
After 48 hours	0.33 (0.09-1.17)	0.086
Intubation	7.43 (2.47-9.07)	0.0001
Blood transfusion	1.81 (0.67-4.90)	0.241
ASA IV	2.51 (1.19-5.30)	0.016

ICU: Intensive care unit, CHD: Coronary heart disease COPD: Chronic obstructive pulmonary disease, ASA: American Society of Anesthesiologists,

DISCUSSION

In this study, there was no significant difference between patients who underwent BHA and PFN for hip fractures in terms of in-hospital and 1-year post-discharge mortality rates. The 1-year post-discharge mortality rates were higher in patients with CHF, dementia, and COPD than in patients with other comorbid diseases.

In a study by Çelen et al.[11] comparing patients who underwent modular stem hemiarthroplasty with distal fixation and patients who underwent PFN for hip fractures, the 1-year mortality rate was 15.4% in the hemiarthroplasty group and 15.2% in the PFN group, resulting in no significant difference. In their study comparing patients who underwent BHA and PFN for hip fractures, Kılınç et al.[12] found a 1-year mortality rate of 26.8% in the BHA group and 23.9% in the PFN group, which also did not result in a significant difference. Durgut et al.[13] obtained comparable results in their study. Erkmen et al.[14] also found mortality rates to be similar between patients who underwent calcar-supported cemented BHA and those who underwent PFN. However, the authors found that post-operative, life-threatening complications were more common in the BHA group. In their study involving 618 patients, İpek et al.[15] found no difference between the 1-year survival rates of patients who underwent PFN and BHA. In the current study, the 1-year mortality rate was 26.1% in the BHA group and 25.2% in the PFN group. The difference was not significant.

However, the need for a blood transfusion and length of hospital stay were significantly higher in the BHA group compared to the PFN group. Thus, PFN is more advantageous in terms of blood transfusion requirements and length of hospital stay. In addition to the positive effect of less prolonged treatment for patients, PFN is also less costly. Similar results have been reported in previous studies.[15]

Pincus et al.[16] analyzed a cohort of 42,230 Canadians in terms of time from diagnosis to surgery. They reported that those who underwent surgery within 24 h of presenting with hip fractures had a lower 30-day mortality rate. In their study involving 2,056 patients operated on for hip fractures, Uzoigwe et al.[17] compared surgeries performed 36 h after admission with surgeries performed before the 36-h mark; the authors found that surgeries performed 36 h after admission resulted in higher post-operative mortality rates. An early systemic review of 16 published studies revealed that delaying surgeries for 48 h caused increased 30-day and 1-year post-operative mortality.[18] The results of previous meta-analysis studies by Simunovic et al.[19] support this finding. We also found that surgeries performed after 48 h result in a high post-discharge mortality rate but found no significant difference regarding in-hospital mortality.

In their multicenter study, McHugh et al.[20] determined that diabetes and dementia affected mortality in all processes, while COPD was the only disease associated with in-hospital mortality. In a study of 911 deceased patients, Barcelo et al.[21] found that 146 of them had CHF and 126 had dementia. We found that CHF, COPD, and dementia increased post-discharge mortality and that CHF and COPD increased in-hospital mortality. Therefore, appropriate pre-medication should be given, and follow-up should be strict for patients with cardiac and pulmonary pathologies due to their high rate of in-hospital mortality. The fact that dementia does not affect in-hospital mortality but affects post-discharge mortality suggests that although cognitive functions do not show their effect as rapidly as basic life functions, they have a negative impact in the long term.

The strengths of our study include the high number of patients and the homogenization of the patient groups by excluding patients with an ASA score of 2, patients <65 years of age, and patients who underwent revision surgery. The study has some limitations. The fact that it was retrospective and not randomized is an important limitation. In addition, although we were able to determine 1-year survival in the patients, it was not possible to determine long-term survival due to their age. Another limitation was that more than one surgeon operated on the patients. Other limitations are that the duration of the operations was not compared, and an objective parameter, such as the Harris Hip Score, was not used to evaluate hip function. One of the most significant limitations is that surgeries performed using PFN for pertrochanteric fractures and BHA for femoral neck fractures were compared. Although the fracture types compared occur in the same region, they are still different.

CONCLUSION

PFN for pertrochanteric fractures and BHA for femoral neck fractures are reliable surgical methods with good outcomes. There was no significant difference between the in-hospital and 1-year post-discharge mortality rates linked to the two surgical procedures. The PFN group had a shorter hospital stay and required less blood transfusion due to the minimally invasive method used. Patients with a longer time to surgery (>48 h), length of hospitalization and ICU stay, patients with an ASA score of 4, and intubated patients had higher 1-year post-discharge mortality rates. In addition, comorbid CHF, COPD, and dementia increased mortality rates. In-hospital mortality factors were age, length of hospital stay, intubation, an ASA score of 4, CHF, and COPD.

ETHICAL DECLARATIONS

Ethics Committee Approval
The study was carried out with the permission of University of Health Sciences Gazi Yaşargil Training and Research Hospital Clinical Researches Ethics Committee (Date: 13.01.2023, Decision No: 320).

Informed Consent
Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process
Externally peer-reviewed.

Conflict of Interest Statement
The authors have no conflicts of interest to declare.

Financial Disclosure
The authors declared that this study has received no financial support.

Author Contributions
All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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