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Effects of anesthesia and perioperative management on mortality in geriatric orthopedic surgery: a retrospective study of 451 patients

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Abstract. – OBJECTIVE: We aimed to investigate the effects of anesthesia methods and perioperative procedures on mortality in geriatric patients operated for hip fracture.

PATIENTS AND METHODS: This retrospective study included patients over 65 years of age who underwent hip fracture surgery. Demographic data, risk scores, perioperative and anesthesia management were analyzed in terms of mortality.

RESULTS: Data from 451 patients who were eligible for the study were analyzed. It was determined that there was no difference in mortality between the anesthesia methods administered to the patients in hip fracture surgery (*p*>0.05). Being male increased the mortality risk by 4.568 times (95% CI: 1.215-17.168), and a one-unit increase in the number of erythrocyte suspensions given perioperatively increased the mortality risk by 2.801 times (95% CI: 1.509-5.197). Additionally, an American Society of Anesthesiologists (ASA) II score increased the mortality risk by 0.120 times (95% CI: 0.021-0.690), and a higher modified Charlson comorbidity index (mCCI) of 5-7 increased the mortality risk by 0.052 times (95% CI: 0.009-0.289).

CONCLUSIONS: Although high ASA and mCCI scores, male sex, and blood transfusion were associated with mortality in geriatric hip fracture surgery, we found that the method of anesthesia did not affect mortality.

Key Words:
Anesthesia, Hip fracture, Mortality, Geriatric.

Introduction

Advances in healthcare have led to a significant increase in life expectancy. However, with advancing age, physiological changes in organ functions and a rise in comorbidities are identified as the primary causes of postoperative complications[1]. Comorbidities, especially cardiovascular diseases, increase the risk of surgery and anesthesia[2]. Hip fractures are an important cause of morbidity and mortality in the elderly population. Hip fractures occur in approximately 1.6 million people worldwide annually, and it is estimated that this number could reach 6 million by 2050[1].

One-year mortality in hip fractures has been reported to vary between 14% and 37%[3]. Factors such as advanced age, sex, and multiple comorbidities have a non-modifiable effect on mortality, while preoperative waiting time, fluid electrolyte imbalance, nutritional status, high serum creatinine level, and low hemoglobin level are modifiable factors[4]. The method of anesthesia administered to patients is also among the modifiable factors that may have an effect on mortality. Regional anesthesia (RA) brings many advantages, such as keeping the patient awake, decreasing the risk of intraoperative hypotension, preservation of spontaneous breathing and protective reflexes, early postoperative mobilization, shortened hospital stay, and decreased delirium[5]. These advantages, especially in spinal anesthesia, have also been shown to be dose-dependent[6]. General anesthesia has advantages such as perioperative amnesia and higher patient satisfaction[7,8].

The main aim of this study was to evaluate the effects of perioperative management, anesthesia method, and postoperative follow-up on intra- and six-month mortality in geriatric patients undergoing orthopedic surgery.

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Patients and Methods

Study Design

Harran University Ethics Committee approval was obtained for the study protocol (date: 24/05/2021; No.: HRU/21.10.26-). The data of patients aged ≥65 years who underwent surgery for hip fracture between January 2017 and December 2020 were retrospectively analyzed by scanning the data in the Patient Information Tracking System of the Harran University Hospital in Sanliurfa/Turkey. Patients were contacted by telephone after discharge to examine their long-term mortality. Patients with a mid or distal femur fracture, pathologic fracture, bilateral femur fracture, or concomitant multiple trauma, revision, or recurrent fracture surgery were excluded.

Patients' age, sex, comorbidities, American Society of Anesthesiologists (ASA) score, type of operation, type of anesthesia, preoperative modified Charlson comorbidity index (mCCI) score, preoperative hemoglobin level, preoperative waiting time, postoperative intensive care unit (ICU) stay, postoperative hospital stay, postoperative complications, in-hospital mortality, and first six months mortality of discharged patients were analyzed.

Outcomes

Our primary outcome was to investigate the effect of anesthesia management on mortality in this patient group. The secondary outcome is to investigate other factors that may influence mortality.

Statistical Analysis

Number Cruncher Statistical System (NCSS) 2020 Statistical Software (NCSS LLC, Kaysville, UT, USA) was used for statistical analyses while evaluating the findings obtained in the study. While evaluating the study data, quantitative variables were shown with mean, standard deviation, median, min and max values, and qualitative variables were shown with descriptive statistical methods such as frequency and percentage. Shapiro Wilks test and Box Plot graphs were used to evaluate the conformity of the data to normal distribution.

Student's *t*-test was used for quantitative two-group evaluations with normal distribution. Mann Whitney-U test was used in the evaluations of variables that did not show normal distribution according to two groups.

Multivariate logistic regression analysis was used to determine the independent risk factors affecting mortality. The Chi-square test, Fisher's Exact test, and Fisher's Freeman-Halton test were used to compare qualitative data.

Results were evaluated at a 95% confidence interval, and significance was evaluated at $p<0.05$ level.

Power Analysis

Power analysis was performed using G*Power (v3.1.9.2, Kiel, Schleswig-Holstein, Germany) program to determine the sample size. According to the result obtained by looking at the difference in the length of stay in the intensive care unit according to the type of anesthesia, the effect size was calculated as d=0.675, and it was calculated that there should be at least 108 people in each group to obtain 99% power at $\alpha=0.01$ level.

Results

A total of 481 patients aged 65 years and older admitted to the hospital for hip fractures between January 2017 and December 2021 were identified from the Patient Information Tracking system. Thirty patients with distal femur fracture, multiple trauma, revision surgery, and missing hospital data were excluded. A total of 451 patients, 66.1% (n=298) female and 33.9% (n=153) male, were included in the study. The mean age of the patients was 74.28±7.17 years (min: 65, max: 112). It was observed that 3.8% of the patients were ASA I, 73.8% were ASA II, and 22.4% were ASA III. Of the patients included in the study, 46.3% (n=209) had HT, 26.2% (n=118) DM, 14% (n=63) coronary artery disease (CAD), 3.8% (n=17) chronic obstructive pulmonary disease (COPD), 4.4% (n=20) congestive heart failure (CHF), 0.2% (n=1) had epilepsy, 2.2% (n=10) had Cerebro Vascular disease (CVD), 1.3% (n=6) had arrhythmia, 0.9% (n=4) had chronic renal failure (CRF) and 0.4% (n=2) had Parkinson's disease (Table I)

General anesthesia was performed in 63.6% (n=287), regional anesthesia in 30.2% (n=136), and peripheral nerve block in 6.2% (n=28). When the mCCI was analyzed, 42.4% (n=191) had ≤4, 51.4% (n=232) had 5-7 and 6.2% (n=28) had ≥8 (Table I).

Mortality was higher in male sex ($p=0.004$; $p<0.01$). The anesthesia method had no effect on mortality ($p>0.05$) (Table II). CAD, COPD and

Table I. Distribution of descriptive characteristics.

		n (%)
Sex	Woman	298 (66.1)
	Male	153 (33.9)
Age	Mean±SD	74.28±7.17
	Median (Min-Max)	73 (65-112)
ASA Score	ASA I	17 (3.8)
	ASA II	333 (73.8)
	ASA III	101 (22.4)
Comorbidities	Absent	78 (17.3)
	Present	373 (82.7)
	Hypertension	209 46.3)
	Diabetus Mellitus	118 26.2)
	CAD	63 (14.0)
	CHF	20 (4.4)
	COPD	17 (3.8)
	CVD	10 (2.2)
	Arrhythmia	6 (1.3)
	CRF	4 (0.9)
	Parkinson	2 (0.4)
	Epilepsy	1 (0.2)
Anesthesia type	General anesthesia	287 (63.6)
	Regional anesthesia	136 (30.2)
	Nerve blockade	28 (6.2)
Operation time (min)	Mean±SD	120.22±42.15
	Median (Min-Max)	110 (60-435)
mCCI	≤4	191 (42.4)
	5-7	232 (51.4)
	≥8	28 (6.2)
Preoperative hemoglobin (gr/dl)	Mean±SD	12.52±1.95
	Median (Min-Max)	12.6 (7.8-16.8)
Postoperative hemoglobin (gr/dl)	Mean±SD	10.90±1.26
	Median (Min-Max)	10.9 (7.6-14.6)
Erythrocyte suspension /unit	Mean±SD	1.52±1.26
	Median (Min-Max)	1 (0-5)
Preoperative waiting time (days)	Mean±SD	2.16±0.82
	Median (Min-Max)	2 (0-5)
Postoperative stay in ICU (days)	Mean±SD	1.52±4.44
	Median (Min-Max)	0 (0-49)
Postoperative stay in hospital (days)	Mean±SD	8.19±5.37
	Median (Min-Max)	7 (0-49)
Postoperative follow-up	Service	300 (66.5)
	Intensive care	151 (33.5)
Postoperative complications	Absent	346 (76.7)
	Present	105 (23.3)
	Renal complications	10 (2.2)
	Pulmonary complications	26 (5.7)
	Neurological complications	8 (1.8)
	Cardiac complications	39 (8.6)
	Infectious complications	11 (2.4)
	Delirium	11 (2.4)
Mortality	Discharged	415 (92.0)
	Exitus	36 (8.0)

ASA: American Society of Anesthesiologists classification, CAD: coronary artery disease, COPD: chronic obstructive pulmonary disease, CHF: congestive heart failure, CVD: cerebrovascular disease, CRF: chronic renal failure.

renal disease, high ASA and mCCI scores, increased amount of erythrocyte suspension transfusion, postoperative follow-up in the intensive care unit, and postoperative complications were found to increase mortality (p=0.001; p<0.01) (Table II, Table III).

Table II. Comparison of descriptive characteristics by mortality.

		Mortality		
		Discharged (n=415)	Exitus (n=36)	*p*
Sex	Woman	282 (68.0%)	16 (44.4%)	[a]0.004**
	Male	133 (32.0%)	20 (55.6%)	
Age	Mean±SD	73.80±6.94	79.75±7.61	[b]0.001**
	Median (Min-Max)	72 (65-112)	78.5 (68-100)	
ASA Score	ASA I	17 (4.1%)	0 (0.0%)	[c]0.001**
	ASA II	329 (79.3%)	4 (11.1%)	
	ASA III	69 (16.6%)	32 (88.9%)	
Anesthesia type	General anesthesia	266 (64.1%)	21 (58.3%)	[c]0.448
	Regional anesthesia	122 (29.4%)	14 (38.9%)	
	Nerve blockade	27 (6.5)	1 (2.8%)	
Operation time (min)	Mean±SD	120.94±41.55	111.82±48.59	[b]0.233
	Median (Min-Max)	115 (60-435%)	95 (60-230)	
Operation type	Intertrochanteric nail	298 (71.8%)	13 (36.1%)	[a]0.001**
	Hemiarthroplasty	117 (28.2%)	23 (63.9%)	
Postoperative complications	Absent	346 (83.4%)	0 (0.0%)	[c]0.001**
	Present	69 (16.6%)	36 (100%)	
	Renal	10 (2.4%)	0 (0.0%)	
	Pulmonary	14 (3.3%)	12 (33.3%)	
	Neurological	8 (1.9%)	0 (0.0%)	
	Cardiac	15 (3.6%)	24 (66.7%)	
	Infection	11 (2.7%)	0 (0.0%)	
	Delirium	11 (2.7%)	0 (0.0%)	

[a]Pearson's Chi-square, [b]Student-*t* test, [c]Fisher's Freeman Halton Test, *$p<0.05$; **$p<0.01$. ASA: American Society of Anesthesiologists classification.

Table III. Impact of mCCI, hemoglobin levels, waiting time, and hospitalization duration on mortality.

		Mortality		
		Discharged (n=415)	Exitus (n=36)	*p*
mCCI	≤4	191 (46.0)	0 (0.0)	[c]0.001**
	5-7	218 (52.5)	14 (38.9)	
	≥8	6 (1.4)	22 (61.1)	
Preoperative hemoglobin (gr/dl)	Mean±SD	12.55±1.95	12.17±2.02	[b]0.255
	Median (Min-Max)	12.6 (7.8-16.8)	12.4 (8.2-15.7)	
Postoperative hemoglobin (gr/dl)	Mean±SD	10.90±1.25	10.85±1.44	[b]0.806
	Median (Min-Max)	11.1 (7.6-14.3)	10.8 (8.9-14.6)	
Erythrocyte suspension /unit	Mean±SD	1.45±1.24	2.42±1.20	[d]0.001**
	Median (Min-Max)	1 (0-5)	2 (0-5)	
Preoperative waiting time (days)	Mean±SD	2.17±0.83	2.03±0.77	[d]0.282
	Median (Min-Max)	2 (0-5)	2 (1-3)	
Postoperative stay in ICU (days)	Mean±SD	0.69±1.45	11.11±11.22	[d]0.001**
	Median (Min-Max)	0 (0-12)	7 (1-49)	
Postoperative stay in hospital (days)	Mean±SD	7.93±4.47	11.11±11.22	[d]0.989
	Median (Min-Max)	7 (0-40)	7 (1-49)	
Postop exit site	Service	300 (72.3)	0 (0.0)	[a]0.001**
	Intensive care	115 (27.7)	36 (100.0)	

[a]Pearson's Chi-square, [b]Student-*t* test, [c]Fisher's Freeman Halton Test, [d]Mann-Whitney U Test. **$p<0.01$. ICU: intensive care unit, mCCI: modified Charlson comorbidity index.

In the regression analysis of the risk factors affecting mortality, sex, erythrocyte transfusion (units), duration of intensive care unit stay (days), ASA score, and mCCI measurement formed a significant model. The explanatory coefficient of the model is 92%.

Male sex increases mortality risk by 4.568 times (95% CI: 1.215-17.168). Each additional unit of blood transfusion raises the mortality risk by 2.801 times (95% CI: 1.509-5.197). Additionally, each additional day of ICU stay increases the mortality risk by 1.508 times (95% CI: 1.203-1.892). An increase in ASA score increases the risk of mortality by 0.120 (95% CI: 0.021-0.690) times, and mCCI (5-7) increases the risk of exit by 0.052 (95% CI: 0.009-0.289) times. While other variables were effective risk factors on mortality in univariate evaluations, they were not significant in multivariate analysis (p>0.05) (Table IV).

When the postoperative 6th-month mortality rates of the patients were analyzed, it was seen that there were a total of 21 patients, 81% (n=17) of whom were female and 19.0% (n=4) were male. The ages of the patients ranged between 66 and 112 years, and the mean age was 77.90±11.49 years (Table V). When the mCCI rates of the cases were analyzed, 9.5% (n=2) had ≤4 mCCI, 71.4% (n=15) had 5-7 mCCI, and 19% (n=4) had ≥8 mCCI (Table V).

Discussion

The results of this study showed that general anesthesia was administered to a high proportion (66.7%) of patients aged ≥65 years who underwent surgery for hip fracture, but no significant relationship was observed between the method of anesthesia and mortality. Postoperative mortality was significantly increased in patients with preoperative CAD, COPD, and renal disease. The results of the study also showed that high preoperative mCCI and ASA score and increased erythrocyte suspension given during surgery were risk factors for mortality. Patients with postoperative mortality had higher rates of postoperative complications and longer postoperative intensive care unit stays.

In a meta-analysis, O'donnell et al[9] reported no difference in 30-day mortality between the two anesthesia techniques. In a prospective, single-center study by Huette et al[10] no association was found between type of anesthesia and mortality in a one-year follow-up period of 309 patients operated for hip fracture. In a meta-analysis of 23 studies, Van Waesberghe et al[11] reported that the type of anesthesia did not affect 30-day mortality but significantly reduced in-hospital mortality and length of hospital stay. However, some studies[12,13] have reported that neuraxial anesthesia may prolong survival compared to general anesthesia. Petersen et al[12] reported that regional anesthesia reduced 30-day mortality by 18% in patients aged 70 years and older. Ahn et al[13] reported that regional anesthesia was better than general anesthesia in terms of 30-day mortality in elderly patients undergoing hip surgery. In a study comparing spinal anesthesia with general anesthesia in older adults undergoing surgery for hip fracture, Neuman et al[14] found that spinal anesthesia was not superior to general anesthesia in terms of 60-day survival and improved ambulation; in addition, the incidence of postoperative delirium was similar in the two types of anesthesia.

In studies[15] conducted among geriatric surgical patients, it has been reported that although the application of peripheral nerve blocks has increased significantly in number, there is no difference in mortality and complication rates when compared with general anesthesia. Anesthesia management in these patients should be based on patient preference, comorbidities, possible postoperative complications, and clinical experience of the anesthesiologist[16]. In our study, there was no effect of the type of anesthesia on mortality in patients operated for hip fracture (p>0.05).

Table IV. Logistic regression analysis of risk factors affecting mortality.

			95% CI	
	p	Odds ratio	Lower	Upper
Sex (Male)	0.025*	4.568	1.215	17.168
Erythrocyte suspension/unit	0.001**	2.801	1.509	5.197
Duration of intensive care unit stay (days)	0.001**	1.508	1.203	1.892
ASA III score	0.018*	0.120	0.021	0.690
mCCI (5-7)	0.001**	0.052	0.009	0.289

*p<0.05, **p<0.01. ASA: American Society of Anesthesiologists, mCCI: modified Charlson comorbidity index.

Table V. Descriptive characteristics of patients with mortality within 6 months postoperatively (N=21).

		n (%)
Sex	Woman	17 (81.0)
	Male	4 (19.0)
Age	Mean±SD	77.90±11.49
	Median (Min-Max)	73 (66-112)
ASA Score	ASA II	4 (19.0)
	ASA III	17 (81.0)
Anesthesia type	General anesthesia	14 (66.7)
	Regional anesthesia	7 (33.3)
Operation type	Intertrochanteric nail	14 (66.7)
	Hemiarthroplasty	7 (33.3)
Operation time (min)	Mean±SD	120.95±50.56
	Median (Min-Max)	115 (60-280)
Postoperative complications	No	4 (19.0)
	Renal	3 (14.3)
	Pulmonary	5 (23.8)
	Cardiac	6 (28.6)
	Infection	3 (14.3)
mCCI	≤4	2 (9.5)
	5-7	15 (71.4)
	≥8	4 (19.0)
Preoperative hemoglobin (gr/dl)	Mean±SD	12.22±2.30
	Median (Min-Max)	12.1 (7.8-15.7)
Postoperative hemoglobin (gr/dl)	Mean±SD	10.79±1.38
	Median (Min-Max)	10.9 (7.6-13.4)
Erythrocyte suspension /unit	Mean±SD	1.19±0.98
	Median (Min-Max)	1 (0-3)
Preoperative waiting time (days)	Mean±SD	2.29±0.96
	Median (Min-Max)	2 (1-5)
Postoperative stay in ICU (days)	Mean±SD	3.38±2.29
	Median (Min-Max)	3 (0-8)
Postoperative stay in hospital (days)	Mean±SD	16.71±10.38
	Median (Min-Max)	13 (5-40)

ASA: American Society of Anesthesiologists, mCCI: modified Charlson comorbidity index, ICU: intensive care unit.

The ASA classification is an extremely common standardized measure that identifies high-risk patients before surgery. This score provides a standardized risk assessment for intra-operative and post-operative risk. In the literature, a high ASA score is associated with mortality in hip fracture patients[17,18]. In general, the Charlson comorbidity index (CCI) is associated with increased mortality in patients with osteoporotic fractures. Older patients with higher mCCI have more advanced osteoporosis[19]. The age-adjusted mCCI has been used to predict mortality in hip fracture patients and has also been strongly associated with frailty. An mCCI ≥6 in an elderly patient with a femur fracture was associated with a high risk of complications and mortality[20]. Wong et al[21] found a positive correlation between complications and a value ≥6 using logistic regression modeling (OR: 4.27, p=0.02). In our study, we found that ASA score and mCCI score were associated with postoperative mortality in these patients. We found that the ASA II score increased the mortality rate by 0.120 (95% CI: 0.021-0.690) times, and high mCCI (5-7) increased the mortality rate by 0.052 (95% CI: 0.009-0.289) times.

Studies[22] have identified some risk factors, such as dehydration, that affect morbidity, mortality, and functional outcomes after hip fracture, and various model analyses have been performed. These factors include medical factors, such as the presence of comorbidities and sarcopenia, as well as demographic, social, and functional factors. The prevalence of preoperative dehydration is high among elderly patients with hip fractures and is associated with severe frailty and length of hospitalization[23]. The frailest individuals are particularly exposed to the risk of postoperative dehydration, which is associated with an increased likelihood of developing complications and independently predicts prolonged hospital stays and medium- to long-term mortality[24]. Appropriate hemodynamic monitoring should be performed in the perioperative period for fluid therapy and management of these patients[25], and multimodal strategies for fluid management in intensive care follow-up should be determined[26].

According to the literature, there is a significant association between low preoperative hemoglobin levels and mortality. In a retrospective study by Nia et al[27], anemia (Hgb <12) was found to be an independent risk factor for mortality in geriatric patients operated on proximal hip fracture. Yombi et al[28] found significantly higher short-, medium- and long-term mortality rates after hip surgery in patients with preoperative hemoglobin levels <12. While some factors affecting mortality in patients with hip fractures are non-modifiable, such as age, sex, fracture type, hereditary predisposition, and comorbidities, there are also modifiable factors, such as physical health, nutritional status, high serum creatinine level, and low hemoglobin level. Although hemoglobin level is a potentially modifiable factor, uncertainty remains regarding the benefit of blood transfusion in patients with preoperative anemia associated with increased blood transfusions, morbidity, and mortality. In patients hospitalized for hip fractures, the management of anemia with preoperative erythropoietin (EPO) and intravenous iron therapy has been reported to reduce transfusion rates and transfusion-related complications by increasing erythrocyte production and oxygen-carrying capacity. In a meta-analysis[29], preoperative intravenous iron therapy in patients undergoing orthopedic surgery reduced the perioperative blood transfusion rate by 31%, shortened hospital stay by 1.6 days, and reduced the postoperative infection rate by 33%. However, no effect on mortality was found. In our study, no significant correlation was found between preoperative hemoglobin level and mortality. However, a significant correlation was found between intraoperative erythrocyte suspension transfusion and mortality (p=0.001; p<0.01). A one-unit increase in the number of erythrocyte suspensions/unit given intraoperatively increased the mortality risk by 2.801 (95% CI: 1.509-5.197) times.

Orosz et al[30] found that patient preparation for surgery and waiting time for surgery did not have a significant effect on mortality, but the presence of comorbidities increased mortality. In an observational study of geriatric patients undergoing surgery for hip fracture, Leer-Salvesen et al[31] found that a preoperative delay of more than 48 hours significantly increased early mortality. It was emphasized that the preoperative waiting time should not exceed 48 hours to optimize medical and hemodynamic conditions. Klestil et al[32] analyzed 28 prospective studies in a meta-analysis and reported that the one-year risk of death was 20% lower in patients operated on within 48 hours. In this study, the waiting times for survivors and patients with mortality were calculated as 2.17±0.83 and 2.03±0.77 days, respectively, but there was no statistical difference.

According to studies[33-35] investigating sex differences in mortality after hip fracture, male hip fracture patients have significantly higher mortality than female hip fracture patients. Male hip fracture patients showed greater impairment in activities of daily living, mobility, and walking speed compared to females. This may indicate a greater loss of physiological reserve after hip fracture in men than in women and thus a greater risk of death[35]. In our study, mortality was found to be statistically significantly higher in male patients with hip fractures in accordance with the literature (p=0.004; p<0.01).

Age is one of the most important factors affecting mortality in patients operated for hip fractures. Jiang et al[36] reported that the determinants of mortality were primarily advanced age, male sex, and presence of pre-fracture comorbidities. Soyalp et al[37] found that emergency surgery, advanced age, male sex, ASA- III and IV classes were associated with a higher probability of postoperative ICU transfer and higher mortality rates compared with elective surgery. In our study, we found that advanced age was associated with higher mortality rates in accordance with the literature (p=0.001; p<0.01).

The methods and implant choice in hip fracture surgery, along with other factors, may have an impact on mortality in hip fracture patients. In patients with hip fractures where hemiarthroplasty is preferred, bleeding may be higher than in intertrochanteric fractures where closed reduction and trochanteric nails are preferred. Biçen et al[38] reported that the mortality rates of patients who underwent cementless hemiarthroplasty in hip fracture surgery were higher than trochanteric nailing. However, unlike the present study, this rate is the mortality rate reported in the first 3 years of follow-up. In the present study, the mortality rate reported during hospitalization was significantly higher in the patient group for whom hemiarthroplasty was preferred. In our study, the mortality rate was found to be higher in patients who underwent hemiarthroplasty (p<0.01). This may be related to the fact that the duration of surgery, the amount of bleeding, and the use of cement were higher in the hemiarthroplasty group.

This study has some limitations. First of all, the study was designed retrospectively. In addition, the study is on mortality during early hospitalization, which may be misleading in terms of post-discharge mortality rates.

Conclusions

In conclusion, high ASA and mCCI scores, male sex, and blood transfusion are associated with mortality in geriatric hip fracture surgery, and it is important to determine the anesthesia method according to the patient's existing comorbidities and to take precautions for modifiable risk factors in these patients in terms of mortality.

Conflict of Interest
The authors declare no conflicts of interest with respect to the authorship and/or publication of this article.

Ethics Approval
The study protocol was approved by the Harran University Local Ethics Committee (date: 24/05/2021, No.: HRU/21.10.26). The study was conducted in accordance with the principles of the Declaration of Helsinki.

Informed Consent
Not applicable due to the retrospective nature of the study.

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Data Availability
All data generated or analyzed during this study are included in this published article; the datasets are available from the corresponding author upon reasonable request.

Authors' Contributions
Idea/concept, writing the article: A.A., E.B.; design, control/ supervision: A.A., E.B., A.Y.K.; data collection and/ or processing, analysis and/or interpretation, literature review: A.A., A.Y.K., M.A.K, N.A.; critical review: A.A., N.A., M.T., E.B., A.Y.K., M.A.K.

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