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Özgün Araştırma / *Original Article*

Factors Associated with Postoperative Mortality in Geriatric Orthopedic Surgery: A Retrospective Analysis of Single Center Data

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Geriatrik Ortopedik Cerrahide Postoperatif Mortalite ile İlişkili Faktörler: Tek Merkez Verilerinin Retrospektif Analizi

ABSTRACT

Objective: *In our study the factors related to anesthesia and peroperative variables associated with postoperative mortality among patients aged ≥65 years who had undergone orthopedic surgery were assessed.*
Methods: *Reports on patients aged ≥65 years who had undergone orthopedic surgery between 2015 and 2017 were investigated retrospectively.*
Results: *A total of 135 patients were included in the study. The operations comprised implantations of total hip prosthesis in 26%, total knee prosthesis in 18%, fixation of lower extremity fractures in 24, and upper extremity fractures in 14%, and amputation surgery in 17% of the patients. The postoperative mortality rates were highest (76.9%) among patients who underwent amputation surgery (p<0.05). It was found that anesthesia type, whether regional or general, was not related to mortality. Mortality was found to be associated with increasing age, ≥3 ASA score, emergency surgery, ≥3 accompanying diseases, prolonged preoperative hospital stay and low preoperative hemoglobin (Hb) values (p<0.05). Patients developing postoperative complications, those who were monitored in intensive care unit (ICU) and required mechanical ventilator (MV), and patients with prolonged ICU and hospital stay had higher mortality rates (p<0.05). 9% of all patients were determined dead.*
Conclusion: *Among geriatric orthopedic surgery patients, apart from gender and anesthesia method, increasing age, high ASA scores, emergency surgery, the number of accompanying diseases, duration of preoperative hospital stays, low preoperative Hb values, postoperative complications requiring ICU-MV and prolonged ICU and hospital stays were all factors that affected postoperative mortality. We believe that detailed preoperative assessment and perioperative clinical management are essential if postoperative prognosis after geriatric orthopedic surgery is to be improved.*

Keywords: *Geriatric anesthesia, orthopedic surgery, mortality*

ÖZ

Amaç: *Çalışmamızda, ortopedik cerrahi uygulanan 65 yaş ve üstü hastalarda postoperatif mortalite ile ilişkili peroperatif değişkenler ve anestezi ile ilişkili faktörler değerlendirildi.*
Yöntem: *2015-2017 yılları arasında ortopedik cerrahi geçiren ≥65 yaş hasta kayıtları retrospektif olarak incelendi.*
Bulgular: *Araştırmaya 135 hasta dahil edildi. Ameliyatların %26'sını total kalça protezi, %24'ünü alt ekstremite kırığı, %18'ini total diz protezi, %17'sini ampütasyon cerrahisi ve %14'ünü üst ekstremite kırığı oluşturuyordu. Amputasyon cerrahisi geçirenlerde postoperatif mortalite oranı (%76.9) en yüksekti (p<0.05). Bölgesel veya genel olsun, anestezi tipinin mortalite ile ilişkili olmadığı bulundu. Mortalitenin artan yaş, ≥3 ASA skoru, acil cerrahi, ≥3 eşlik eden hastalık olması, uzun preoperatif yatış süresi ve preoperatif düşük hemoglobin (Hb) değerleriyle ilişkili bulundu (p<0.05). Postoperatif komplikasyon gelişen, yoğun bakım ünitesinde (YBÜ) izlenen ve mekanik ventilatör (MV) gerektiren hastalar ile YBÜ ve hastanede yatışı uzun olan hastalar daha yüksek mortalite oranlarına sahipti (p <0.05). Tüm hastaların% 9.6'sının öldüğü saptandı.*
Sonuç: *Geriyatrik ortopedik cerrahi hastaları arasında cinsiyet ve anestezi metodu hariç, artan yaş, yüksek ASA skorları, acil cerrahiler, eşlik eden hastalık sayısı, preoperatif yatış süresi, preoperatif düşük Hb değerleri, YBÜ-MV gerektiren postoperatif komplikasyonlar ve YBÜ ve hastanede uzun kalış süreleri postoperatif mortaliteyi etkileyen faktörlerdi. Geriatrik ortopedik cerrahi sonrası postoperatif prognozu iyileştirmede detaylı preoperatif değerlendirmenin ve peroperatif klinik yönetimin gerekli olduğuna inanıyoruz.*

Anahtar kelimeler: *Geriyatrik anestezi, ortopedik cerrahi, mortalite*

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INTRODUCTION

With the increase in quality of life, the elderly population has become the fastest growing age group in the global population. Operations previously accepted as risky for elderly patients are performed more common today due to improvements in health conditions and developments in surgical and anesthesia techniques and medications [1]. Orthopedic surgery procedures, especially for femur and hip fractures, are common among geriatric patients and are serious health problems resulting in death. Together with increased age, physiological changes in organ functions and presence of accompanying disease added to the surgical trauma may rapidly disrupt the general status of these patients and increase the risk of postoperative complications [2]. Studies in the literature researching factors affecting morbidity and mortality of orthopedic surgery for patients aged older than sixty-five years found that these commonly comprise single extremity (especially hip surgery) surgeries and debilitating factors affecting mortality of these surgeries [3-6].

In this retrospective study, we aimed to assess all of the factors including anesthesia methods affecting mortality after upper and lower extremity surgery among patients ≥65 years.

MATERIAL and METHOD

The study was performed after receiving permission from Bülent Ecevit University, Faculty of Medicine Clinical Research Ethics Committee (date: 17/01/2018-meeting no: 2018/02). The study included all patients ≥65 years undergoing orthopedic surgery from January 2015 to December 2017 but excluded patients with multiple trauma. The study data were obtained by retrospective investigation of the hospital automation system and anesthesia records. Oral consent was obtained from all participants.

From the archive files, patient age, gender, American Society of Anesthesiologists (ASA) risk score, number of accompanying diseases (0: no disease, 1: one disease, 2: two diseases, ≥3: three or more diseases), preoperative hemoglobin (Hb), type of surgery [total hip prosthesis (THP), lower extremity fracture (LEF), total knee prosthesis (TKP), amputation, upper extremity fracture (UEF)], operation procedure (emergency/elective), anesthesia methods [general anesthesia (GA), regional anesthesia (RA), and GA+RA (for postoperative pain management)], preoperative admission duration, intraoperative volume replacement-blood transfusion and inotrope requirements, postoperative care location (ward/intensive care unit (ICU)/first ward then ICU), mechanical ventilator (MV) requirements, duration of stay in ICU, postoperative complications (hypoxia, atelectasis, aspiration pneumonia, pneumothorax, pulmonary embolism, urine retention, oliguria, acute renal failure, hemorrhage, delirium, wound infection, death) and total duration of hospital stay were recorded. Pathologies observed within the first 48 hour were accepted as postoperative complications. The minimum follow-up duration for patients was 1 year. Patients were divided into two groups based on status after discharge (surviving, dead) and 30-day and 6-month mortality rates were assessed.

The SPSS 24.0 (Statistical Package for the Social Sciences, Chicago, USA) program was used for statistical analyses The numerical variables in the study are presented as either mean and standard deviation (SD) or median. Comparisons between groups were made with the Mann-Whitney U test. Analysis of categorical variables was made with the Chi-Square test. A p-value below 0.05 was accepted as statistically significant.

RESULTS

Records for one-hundred and fifty-two patients were accessed. As telephone interviews to obtain information about the final outcome of patients did not reach 17 patients, the study was completed with 135 patients. The final analysis included a total of 135 patients, with 29 males (21.5%) and 106 females (78.5%). There was no significant correlation between gender and mortality ($p>0.05$). The mean age of patients was 72.92±6.5 years and the mortality rate of older patients was identified to be significantly higher ($p=0.045$). 94.1% of the patients had elective surgery while remaining 5.9% had emergency surgery. The mortality rates for patients with ≥3 ASA score or emergent surgery were identified to be high ($p<0.05$). As the number of additional diseases increased, the mortality rate was identified to significantly

increasing (p<0.05). The mean preoperative Hb value for patients was 11.31±1.6 g dL^{-1} and the mean preoperative Hb values for dead patients were identified to be lower than that of surviving patients (p=0.003). The mean preoperative admission to surgery duration for patients was 4.32±4.0 days, and the mortality rate was identified to significantly increasing as the preoperative duration in hospital increased (p=0.026) (Table I).

Table I. Patients' general characteristics and factors affecting mortality

	Survivors (n=122)	Dead Patients (n=13)	p
Gender (Female/Male)	97/25	9/4	0.294
Age (years)	72.38±5.9	78.00±9.2	0.045
ASA score (II/III/IV/V)	28/83/11/0	0/5/7/1	<0.001
Surgery procedure (elective/ emergency)	117/5	10/3	0.030
Number of preexisting comorbidities (0/1/2/≥3)	12/30/52/28	0/1/2/10	0.001
Preoperative hemoglobin (g dL^{-1})	11.43±1.5	10.19±1.9	0.003
Duration of preoperative hospital stay (day)	3.94±3.2	7.85±7.9	0.026

Data are presented mean±standard deviation or n. ASA: American society of anesthesiologists

When we examine the correlation between type of surgery and mortality, 43.5% of those undergoing amputation surgeries, 5.7% of those operated for UEF, 3% of those operated for LEF and 2.9% of those with THP died, while none of the patients with TKP died. There was a statistically significant correlation between surgery type and mortality rates, and the postoperative mortality rate (76.9%) of amputation surgeries was identified to be higher (p<0.05). When the correlation between anesthesia method and mortality is examined, it was determined that 7% of those with GA, 20.8% of those with RA and 9% of those with GA+RA died. There was no significant correlation identified between the methods used for anesthesia and mortality rate (p=0.119) (Table II).

Table II. Correlation of surgery type and anestheisa method with mortality

	Survivors (n=122,%)	Dead Patients (n=13,%)	p
Surgery Type			
Total hip prosthesis	34 (27.9)	1 (7.7)	
Lower extremity fracture	32 (26.2)	1 (7.7)	
Total knee prosthesis	25 (20.5)	0 (0.0)	<0.001
Amputation	13 (10.7)	10 (76.9)	
Upper extremity fracture	18 (14.8)	1 (7.7)	
Anesthetic Technique			
GA/ RA/ GA+RA	93/19/10	7/5/1	0.119

Data are presented n or %. GA: General anesthesia, RA: Regional anesthesia.

The mean amount of intraoperative fluid administered to all, dead and surviving patients were 2542.22±1141.61 mL^{-1}, 1915.38±861.05 mL^{-1} and 2069.02±1150.24 mL^{-1} respectively. There were no significant differences between the groups in terms of mortality (p>0.05). Two out of 28 patients (7.14%) with blood replacement in the intraoperative period had died while 11 of the 107 patients without replacement (10.28%) died. No significant difference was identified between blood replacement and mortality rates in the groups (p>0.05). Two patients had intraoperative inotropic medication requirements, 1 survived and 1 died (p=0.814).

In the postoperative period, 6 of 10 patients (60%) with complications and 7 of the 125 patients without complications (5.6%) died. There was a significant correlation between observation of postoperative complications and mortality (p<0.05). Additionally, the postoperative complication rate (46.5%) of dead patients was identified to be high. When the correlation between the location of postoperative care and MV requirements with mortality is investigated, 5 patients were monitored in the ward (38.5%), 6 were in the ICU (46.2%) and 2 were in the ward and then ICU (15.4%). Additionally, 7 of dead patients (53.8%) required MV, while none of the survivors required MV in their hospital stay (p<0.05). The mortality rate was significantly high among patients monitored in the ICU postoperatively and requiring MV (p<0.05). The mean duration of postoperative monitoring in

Table III. Factors associated with postoperative mortality

	Survivors (n=122)	Dead Patients (n=13)	p
Postoperative complications (yes/no)	4/118	6/7	<0.001
Postoperative discharge unit (Ward/ICU/Ward then ICU)	116/4/2	5/6/2	<0.001
Postoperative ventilator requirements (yes/no)	0/122	6/7	<0.001
ICU follow up duration (day)	2.67±2.06	10.38±11.17	0.009
Total hospital stay (day)	9.80±5.67	17.38±13.18	<0.001

Data are presented mean±standard deviation or n. ICU: Intensive care unit

the ICU was 7.07±9.19 days with mean hospital stay was 10.53±7.05 days. The mortality rates for patients with long duration of stay in the ICU or hospital were identified to be significantly higher ($p<0.05$) (Table III).

The total postoperative mortality rate was 9.6%, the postoperative 30-day and 6-month mortality rates were 4.4% and 6.7%, respectively.

DISCUSSION

In our study, apart from gender and anesthesia method, increasing age, high ASA score, emergency surgery, number of accompanying diseases, preoperative admission duration, low preoperative Hb values, surgery type, postoperative complications and ICU-MV requirements, and long duration of stay in ICU and hospital were determined to be associating factors on mortality among patients ≥65 years undergoing orthopedic surgery.

The elderly represent the fastest-growing population in the world. Since aging is associated with a decrease in the functional reserves of organ systems and an increase in the presence of comorbid conditions, advanced age has traditionally been considered a risk for surgery and anesthesia [7,8]. Though age is considered in many risk indices, age is not a contraindication for surgery and there are publications showing it does not affect mortality rates after hip fracture surgery [4-6,8,9]. In our study, we found the mean age of dead patients high, and it is thought that age is a significant factor regarding postoperative mortality risk.

There are studies reporting the death rates after hip fracture are higher for males compared to females, in addition to those reporting no correlation of mortality with gender [3,5,9-13]. In our study, it is difficult to interpret the effect of gender on mortality due to the low number of dead patients and the similar mortality rates were determined in both genders.

ASA classification is commonly used to determine preoperative comorbidities and risk factors [14]. The efficacy of ASA classification to determine postoperative mortality in elderly patients operated for hip fractures is controversial [3,5,6,9,10,15,16]. In our study of a heterogeneous patient group, 5 out of 88 patients in ASA 3 group, 7 out of 18 patients in ASA 4 group and 1 patient in ASA 5 group had died. The mortality rates according to ASA risk classification groups were 5.6%, 38.8% and 100% respectively. We identified that two patients operated for THP and LEF in ASA 4 risk group were female and their ages were 86 and 89 years, respectively. The only patient included in ASA 5 risk group, who died, was a female patient 88 years old, had ≥3 accompanying diseases and was operated for amputation. In our study, patients with high ASA risk scores were found to have high mortality rates in accordance with the literature.

There are different opinions about the increase in mortality for surgeries performed under emergency conditions for geriatric patients [5,15-19]. In our study, 3.75% of patients operated under emergency conditions died. Due to the small number of patients operated in emergency situations, we recommend further studies to confirm whether emergency surgery is a risk factor or not.

Age along with increasing diseases are among factors affecting peroperative mortality [6,8,9,12,15-19]. Svensson et al. [20] in a study associating one-year death rates after surgery with the number of accompanying health problems before surgery reported the mortality rate for patients without any other health problem was zero, while it was 14% for those with one-two health problems and 24% for those with three-four health problems. Roche et al. [21] performed a prospective observational study to assess postoperative complications in hip fracture patients and explain the effects of these complications on accompanying diseases and mortality. They concluded that in elderly patients the number of accompanying diseases ≥3 was the most important peroperative risk factor. The number of accompanying diseases among geriatric patients with hip fracture is reported to increase ICU requirements and incidence of mortality [16]. Similarly, our study showed that the number of accompanying diseases being ≥3 affected the high mortality rates.

Blood loss and transfusion requirements are higher in geriatric orthopedic surgery compared to young patients and it is reported that intraoperative blood transfusion requirements are associated with morta-

lity [22]. There is no consensus about the specific transfusion thresholds for elderly patients, but it is known that perioperative anemia does not require the previously recommended aggressive treatment and that patients tolerate low Hb values better than previously thought. Carson et al. [23] reported there was no proof that transfusion of Hb levels of 8.0 g dL^{-1} and above increased survival in elderly patients with chronic diseases operated for hip fractures. Preoperative anemia is reported to be an important parameter affecting perioperative mortality in geriatric patients undergoing hip operations [3,22,24]. Similar to the literature, in our study we found that low preoperative mean Hb values affect the high mortality rates. Our blood transfusion rate in the intraoperative period was 7.14%, with 15.4% of exitus patients receiving blood transfusion during this period. We did not identify any effect of blood transfusion on mortality. For good proof about transfusion risks, we believe there is a need for more studies to identify the cut-off for transfusion decisions in geriatric patients with moderate degrees of anemia.

It is reported in the literature that to reduce preoperative and postoperative risks to elderly patients to a minimum, the decision for the required surgery must be made in the shortest time possible as delayed surgery may increase mortality and morbidity [3,15,18,19,21]. Zuckerman et al. [25] reported that delays of longer than 3 days for fixation surgery doubled the death rates within the first year after surgery. Surgery performed within 24 hours of injury is reported to have shorter hospital stay, better outcome and lower postoperative mortality rate [26,27]. Though some studies have reported that delayed surgery durations of more than 2 days are associated with one-year mortality, current studies have shown no significant difference between surgical waiting times and mortality [5,6,15,16,19,21,26]. We consider that among reasons for longer preoperative admission times for dying patients is the presence of more than one medical problem, apart from age, and the requirements for multidisciplinary preoperative medical assessment and treatment planning.

The majority of studies researching mortality among patients undergoing orthopedic surgery in the geriatric age group appear to include single joint surgeries [3-6,9,11,13,15,17-22,26,27]. In our study, the mortality rates for all orthopedic surgery types were researched. The noteworthy point about our study, with low patient numbers, is that the mortality rates after amputation surgery in the geriatric age group were significantly high and we think there is a need for more studies to confirm this.

It is known that the effect of the chosen anesthesia method on long-term morbidity and mortality is very little among elderly patients undergoing orthopedic surgery, with no clear scientific proof that one type is superior to the others [3,5,6,9,12,15,16,22]. The effect of anesthesia method on mortality was not significant in our study, which shows that orthopedic surgery may be performed with general or regional anesthesia for geriatric patients and there is no proven difference on perioperative mortality.

Age-linked physiological changes in addition to many factors are reported to be responsible for the increase in postoperative complication rates [4,8,12,21]. Studies of patients undergoing orthopedic surgery have reported that postoperative complications rates rise as high as 45% and these are associated with lengthened hospital stay and increasing mortality [9,15-17,21,22,26-28]. In our study with a postoperative complication rate of 7.40%, we suppose that even this low rate is a significant factor in terms of mortality risk.

It is reported that lengthened duration of hospital stay is associated with mortality for geriatric patients [4,7,10,17,19,29]. In our study, we identified that the hospital stays of exitus patients were longer and we think advanced age, comorbidities, and other risk factors contribute to the discharge duration. As a result, we reckon there is a need for more advanced studies about comorbidities and risk factors rather than chronological age.

In spite of advances in anesthesia and surgical technique, the mortality rate for femur fractures varies from 14% to 36% [21,27]. In the literature, studies assessing patients ≥65 years reported mortality rates of up to 35% [29,30]. In our research, some of the reasons for our low mortality rates compared the mortality rates reported in previous years include development of surgery and anesthesia techniques linked to advancing technology, improvements in medical

care facilities through the years, heterogeneous surgery types and our hospital performing more surgeries on geriatric patients compared to previous years.

There are some limitations of this study. The first is that it is a retrospective, single-center study. The second is that all patients could not be included in the study due to deficiencies in the records and inability to reach some patients by telephone which led to relatively low case numbers. Finally, the surgical procedures included a heterogeneous group of operations from simple to complicated surgeries.

In conclusion, for geriatric orthopedic surgery, apart from gender and anesthesia method, increasing age, ASA ≥3 score, emergency surgery, number of accompanying diseases being ≥3, long preoperative admission, low preoperative Hb values, postoperative complications and ICU-MV requirements, and long ICU and hospital stays were found to be factors affecting mortality. When assessed according to surgery type, patients undergoing amputation surgery were determined to have higher ASA risk scores, numbers of accompanying disease, rates of emergency surgery, postoperative ICU requirements and early-term mortality rates. As a result, to improve the postoperative prognosis for geriatric patients, especially those requiring amputation surgery, we believe detailed preoperative assessment, early decision for surgery and peroperative clinical management are very important.

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