

## Comparison of Hip Fracture Surgery in Octogenarians with 50-80 Year-old patients: Treatment Patterns, Outcomes and Predictors of Perioperative Adverse Events

### Abstract

**Introduction:** Hip fracture is a significant health problem with a high morbidity and mortality, especially in patients aged 80 years and more. In this study, we aimed to identify demographic characteristics and management of octogenarian patients with hip fracture and also aimed to determine the predictors of perioperative complications.

**Methods:** Data for all patients aged 50 years old or more who were hospitalized for hip fracture between June 2015 and June 2020 were retrospectively analyzed. Data of patients aged 80 and older were compared with those younger than 80 from the same cohort.

**Results:** A total of 601 patients (mean age  $73.9 \pm 9.4$  years, 62.2% female) were included. Of the study population, 21 patients (3.5%) were treated conservatively, and 580 patients (96.5%) underwent surgery. Of the 580 patients who had surgery, 170 (29.3%) were aged 80 and older. Multivariate logistic regression analysis revealed that age, presence of atrial fibrillation and coronary artery disease were independent predictors of perioperative complications in octogenarians undergoing hip fracture surgery.

**Conclusions:** Octogenarians represent nearly one-third of the patients with hip fracture in the real-world practice. Increased age, coronary artery disease and atrial fibrillation predict perioperative adverse events in patients undergoing hip fracture surgery.

**Keywords:** Hip fractures, octogenarians, Treatment Outcome, Intraoperative Complications, Elderly

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### Introduction

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Most of the patients admitted to emergency departments with hip fracture require operative intervention and concurrently in recent years, hip fracture surgery constitutes a significant number of the orthopaedic surgeons' workload<sup>(1-3)</sup>. Hip fractures are very common injuries in elderly, and the number of elderly patients diagnosed with hip fracture is expected to increase as the population ages<sup>(4-5)</sup>. Since octogenarians (aged  $\geq 80$  years) form a distinct group of elderly patients, due to the high burden of comorbidities, and impaired cognitive function, management of vulnerable octogenarians with hip fracture remains a challenging issue<sup>(6,7)</sup>. Although early surgery has been shown to give the best outcomes in elderly patients with a hip fracture, some patients have poor health conditions and high morbidity therefore it might be better served with conservative management<sup>(8,9)</sup>. To decide whether to offer octogenarians the same surgical treatment as younger patients, knowledge about the differences in preoperative characteristics and perioperative outcomes between octogenarians and nonoctogenarian patients is crucial. However, data comparing conservative management with surgery for hip fractures in elderly people are scarce. Moreover, most of the data about the management of hip fracture in elderly patients are served from developed countries, and the quality of information from developing countries such as Turkey is limited compared with that from Europe and US.

Turkish Statistical Institute showed that Turkey is getting older as the people at the age of 65 and above increased 16 percent in the last five years and now they make up 8.8% of the total population<sup>(10)</sup>.

As life expectancy has increased in Turkey, more octogenarians with hip fracture are likely to be encountered in clinical practice. Therefore, we performed a retrospective study to examine the demographic characteristics, management, and perioperative complications of octogenarians in comparison with younger counterparts of patients with hip fracture.

## Methods

### *Study design and participants*

This cross-sectional retrospective study included all patients over 50 years, admitted to our department with hip fracture between June 2015 and June 2020. Both the patients who were hospitalized through the emergency room and outpatient clinic were included. The demographic variables, management strategy (conservative or surgical), medical history, preoperative laboratory variables, and preoperative ASA (American Society of Anesthesiologists) score were recruited from patient files. Type of the fractures (femoral neck, intertrochanteric, or subtrochanteric), and type of the surgical interventions (internal fixation, hemiarthroplasty, or total hip arthroplasty) were noted. All surgeries were performed by six orthopaedic trauma surgeons whom were well trained and qualified in hip fractures. The operating surgeon was determined according to the order of the orthopedist responsible for the emergency service duty on the day of admission to the emergency room. Patients with incomplete data and the patients with high energy trauma, patients with multiple fractures, and patients with cranial, thoracic and abdominopelvic posttraumatic pathologies were excluded. Patients who were referred to another hospital for any reason were also excluded from the study.

### *Study Endpoints*

Perioperative medical adverse events and morbidity were analyzed for patients

undergoing hip fracture surgery. In-hospital major perioperative adverse events were defined as cardiovascular and noncardiovascular complications. Cardiovascular complications were defined as nonfatal cardiac arrest, severe arrhythmias requiring treatment, acute heart failure, acute coronary syndrome, pulmonary thromboembolism, and cardioembolic stroke. Noncardiovascular complications were defined as delirium, lobar pneumonia, respiratory failure, requiring re-intubation, wound infection, bacteremia, acute kidney failure, and major and minor bleeding. Length of hospitalization was also noted. Characteristics, management, and perioperative complications of patients aged 80 and older were compared with characteristics and management those younger than 80.

### *Statistical analysis*

The results of descriptive analyses are expressed as mean  $\pm$  standard deviation for normally distributed variables; as medians and maximum-minimum values for non-normally distributed variables; and as percentages for categorical variables. In the evaluation of the differences between the categorical variables Fisher's exact test was used in row and column tables and Pearson Chi-Square Test was used for 2x2 tables. To compare continuous variables in octogenarian and nonoctogenarian groups, independent t-tests were used for normally distributed data, and Mann-Whitney U tests were used for non-normally distributed data. Univariate and multivariable logistic regression analyses were performed to determine independent predictors of perioperative complications and mortality. In cases of multicollinearity between covariates, the single factor that best encompassed the clinical entity was selected for the model. For statistical analysis, the Jamovi (Jamovi Project 2018, version 0.9.1.7, retrieved from <https://www.jamovi.org>) (open source) program was used. A p-value <0.05 was considered as significant.

## Results

After implementation of the exclusion criteria, 135 patients (85 patients were with incomplete data, 32 patients were with high energy trauma, 18 patients were referred to another hospital) were excluded and the study included a total of 601 patients (mean age  $73.9 \pm 9.4$  years, 62.2% female). The age distribution is shown in Figure 1. The most commonly injured age group was from 70 to 79-year-old ( $n=210$ , 34.9%). Of the study population, 179 participants (29.8%) were aged  $\geq 80$  years.

## Management of patients: conservative management vs surgical treatment

Among 601 patients, 21 patients (3.5%) were treated conservatively, and 580 patients (96.5%) underwent surgery. The proportion of patients treated conservatively increased by age (Figure 2). Although it did not reach statistical significance, patients in the octogenarian group ( $n=179$ , 29.8%) were more likely to be treated conservatively compared with the non-octogenarians (5 vs 2.8 %, respectively;  $p=0.087$ ) (Figure 3).

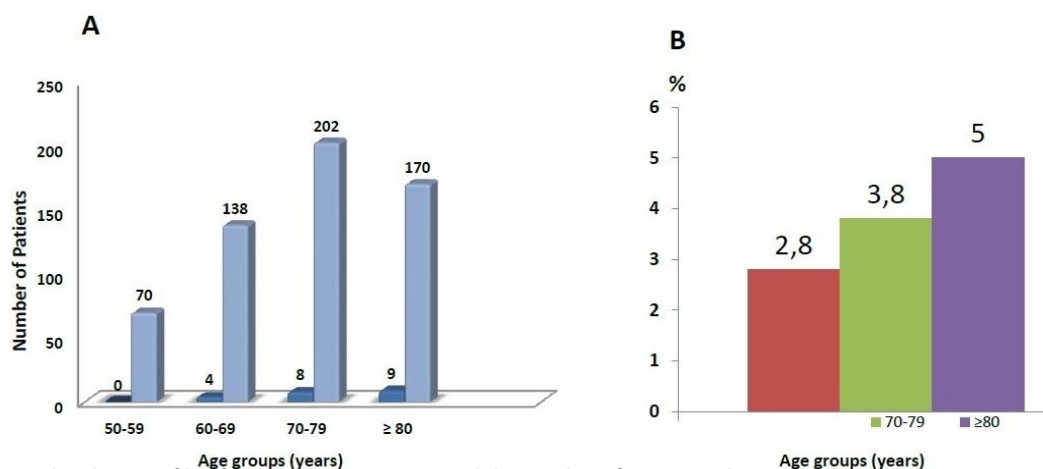


Figure 1. Age distribution of hip fracture in 601 patients and the number of patients who received conservative management or surgery among different age groups (A). Ratio of conservative management among different age groups (B).

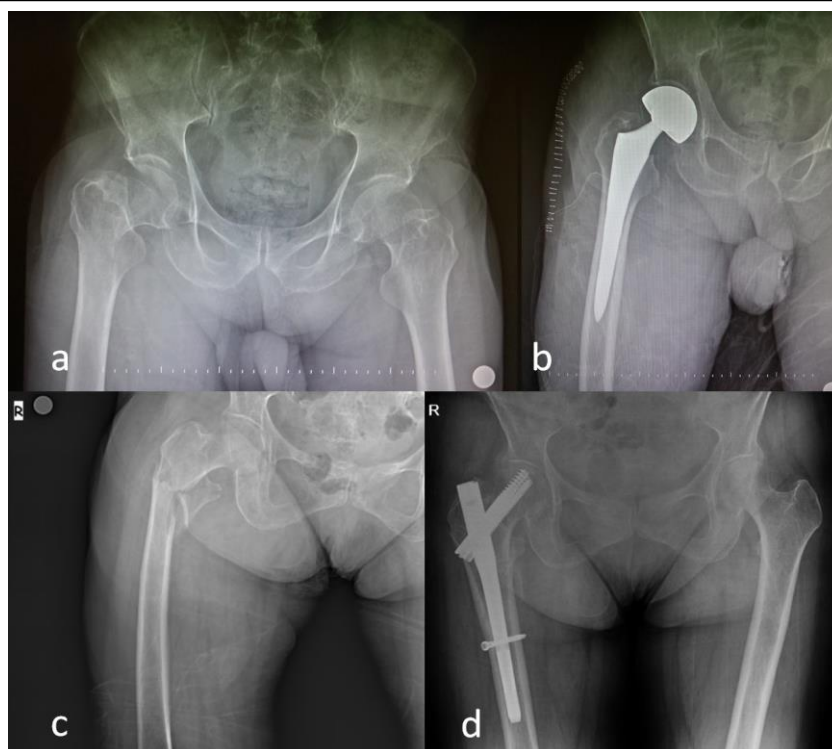


Figure 2. Preoperative and postoperative radiographs of a 82-years-old patient suffering from collum femoris fracture (A, B) and 88-years old patient suffering from subtrochanteric femoral fracture (C, D).

**Table 1- Demographic characteristics, comorbidities, laboratory parameters, and length of hospital stay in patients undergoing surgery for hip fracture.**

	Age < 80 y (n =410)	Age ≥ 80 y (n=170)	p value
Age, years	72.9 ± 9.3	84.2 ± 6.1	<0.001
Female sex	249 (60.7)	105 (61.8)	0.325
Smoking	42 (10.2)	15 (8.9)	0.152
Alcohol use	12 (2.9)	4 (2.3)	0.465
Body mass index, kg/m <sup>2</sup>	29.2 ± 5.7	27.3 ± 4.9	0.002
ASA physical status	3.3 ± 0.6	3.7±0.8	0.001
<b>Comorbidities</b>			
Atrial fibrillation	12 (2.9)	14 (8.2)	0.001
Hypertension	230 (56.1)	124 (72.9)	0.003
Diabetes mellitus	98 (23.9)	46 (27.1)	0.068
Anemia	105 (25.6)	60 (35.3)	0.005
Chronic kidney disease	45 (10.9)	23 (13.5)	0.089
Coronary artery disease	50 (12.2)	38 (22.4)	0.001
Cerebrovascular disease	25 (6.1)	15 (8.8)	0.102
<b>Laboratory parameters</b>			
Fasting blood glucose, mg/dl	105 (94 - 128)	106 (94 - 130)	0.652
Blood urea nitrogen, mg/dl	17 (13 - 22)	17 (13 - 23)	0.425
Serum creatinine, mg/dl	0.83 (0.70 - 1.07)	0.89 (0.70 - 1.09)	0.066
Hemoglobin, g/dl	13.0 (11.8 - 15.3)	12.1 (10.8 - 14.4)	0.041
Leukocyte, x10 <sup>3</sup> /μl	7.8 (6.6 - 9.2)	7.8 (6.6 - 9.4)	0.568
C-reactive protein, mg/dl	3.4 ( 1.8 - 7.0)	3.3 (1.8 - 7.2)	0.784
Ferritin, ng/ml	57 (26 - 94)	53 (25 - 95)	0.065
TSH, μIU/ml	1.4 (0.7 - 2.3)	1.4 (0.9 - 2.4)	0.562
Length of Stay (days)	7.9 ± 5.3	10.9 ± 7.3	0.001

### Comparison of octogenarians and non-octogenarians

For the analysis of the demographic characteristics and perioperative complications in octogenarians, patients who underwent surgery were divided into two groups: aged 80 and older (n = 170) and younger than 80 (n = 410) (Table 1). The prevalence of atrial fibrillation, hypertension, anemia, and coronary artery disease was significantly higher, and the prevalence of smoking was significantly lower in patients 80 and older than in younger than 80. Octogenarians had higher preoperative ASA scores, but lower body mass index and hemoglobin levels compared to their younger counterparts. Although there was no significant difference between the two groups as related to the type of fracture or type of surgical procedure (Table 2), octogenarians had had longer length of stay compared to patients younger than 80. Comparison of perioperative

complications and mortality of hip fracture patients undergoing surgery according to age are shown in Table 3. 43 of the non-octogenarians, and 42 of the octogenarians had experienced perioperative adverse medical events and/or mortality (10.5 vs 24.7%, respectively; p: 0.001). The most common cardiovascular complication was acute coronary syndrome, and the most common noncardiovascular complication was delirium in both groups. Octogenarians had higher in-hospital mortality ratio compared with younger patients (7.6 vs 2.4%, p <0.001). Data are presented as mean ± standard deviation, median and interquartile range, or number (%).

Abbreviations: ASA, American Society of Anesthesiologists; TSH, thyrotropin stimulating hormone.

**Table 2. Type of fracture and surgical procedure in patients younger and older than 80 years.**

	Age < 80 y (n =410)	Age ≥ 80 y (n=170)	p value
<b>Fracture type</b>			
Intertrochanteric	202 (49.3)	80 (47.1)	0.236
Femoral neck	182 (44.4)	80 (47.1)	0.514
Subtrochanteric	26 (6.3)	10 (5.8)	0.453
<b>Surgical Procedure</b>			
Internal fixation	185 (45.1)	80 (47.1)	0.514
Hemiarthroplasty	205 (50.0)	82 (48.2)	0.265
Total hip arthroplasty	20 (4.9)	8 (4.7)	0.289

**Table 3. Perioperative Complications and In-Hospital Mortality**

	Age < 80 y (n =410)	Age ≥ 80 y (n=170)	P value
<b>Cardiovascular complications</b>			
Acute coronary syndrome	7 (1.7)	6 (3.5)	0.035
Prolonged mechanical ventilation	5 (1.2)	4 (2.3)	0.254
Acute heart failure	4 (0.9)	3 (1.7)	0.042
Severe arrhythmia	3 (0.7)	2 (1.1)	0.069
Pulmonary embolism	1 (0.2)	1 (0.6)	0.086
Nonfatal cardiac arrest	1 (0.2)	2 (1.1)	0.045
Arterial thromboembolism	1 (0.2)	0 (0)	0.356
<b>Noncardiovascular complications</b>			
Delirium	7 (1.7)	10 (5.9)	<0.001
Wound infection	4 (0.9)	3 (1.7)	0.003
Acute renal failure	3 (0.7)	4 (2.3)	<0.001
Sepsis or septic shock	4 (0.9)	4 (2.3)	0.001
Minor bleeding	2 (0.5)	1 (0.6)	0.152
Pneumonia	1 (0.2)	1 (0.6)	0.165
Major bleeding	0 (0)	1 (0.6)	0.135
<b>Death</b>	10 (2.4)	13 (7.6)	<0.001

### **Predictors of complications in octogenarians**

There were no significant differences in octogenarians with and without complications in terms of type of fracture or type of surgical procedure. Univariate analysis showed that increased age and ASA status, presence of anemia, diabetes mellitus, coronary artery disease, and hypertension were all associated with perioperative adverse events and mortality. Multivariate analysis showed that age (OR 3.487, 95 % CI 1.578-6.785,  $p < 0.001$ ), presence of coronary artery disease (OR 3.589, 95 % CI 1.652–7.474,  $p = 0.001$ ) and presence of atrial fibrillation (OR: 1.786; 95% CI: 1.115–3.689;  $p = 0.004$ ) were independent predictors of primary outcomes (Table 4).

### **Discussion**

Our study showed that 29.8% of the adult patients with hip fractures were aged 80 and

older, and 5% of these patients were treated conservatively. Compared to their younger counterparts, octogenarians undergoing surgery for hip fracture were more likely to experience perioperative adverse events, especially if they had coronary artery disease and atrial fibrillation.

Patients with hip fractures are usually older, mainly women and have a high burden of comorbid diseases such as obesity, coronary artery diseases, diabetes mellitus, atrial fibrillation and cerebrovascular diseases resulting in increased mortality and morbidity<sup>(11)</sup>. Previous studies showed that age, comorbidities, general health status, and several biomarkers might influence and predict the prognosis of elderly patients after hip fracture<sup>(12-17)</sup>. Management strategy (conservative vs surgical therapy) and timing of surgery are also thought to play an essential role regarding



prognosis in elderly patients with hip fracture<sup>(18)</sup>. However, there are a few number of studies comparing the outcomes of surgical and conservative treatments for hip fracture, and the results of these studies are controversial<sup>(18-19)</sup>. Although we did not examine the outcomes in the conservative management group, our results showed that 3.5% of the study cohort were treated conservatively. We also showed that patient age significantly affected the preference for conservative care and rate of nonoperative management has been reached to 5% in octogenarians. These results suggest that physicians prefer conservative management in elderly and frail patients who had comorbidities which may lead to death or debility.

To decide whether to offer the same treatment to the extremely elderly hip fracture patients as younger patients, knowledge about the differences in preoperative characteristics, risk factors, and perioperative outcomes between older and younger patients are decisive. However, studies focused on octogenarians with hip fracture are rarely reported. A retrospective study from China evaluated 54 octogenarians and nonagenarians undergoing surgery for hip fracture<sup>(20)</sup>. They found that urinary tract infections were the most frequent complication after surgery, and the mortality at 2 years was higher in patients over 80 years old than those below (20.4 vs 6.7%, respectively;  $p < 0.05$ ). Bokshan and colleagues recently published a retrospective cohort study assessing mortality in 189 octogenarians and 95 nonagenarians surgically treated patients<sup>(7)</sup>. Mortality rates of octogenarians suffering a hip fracture was 3-times higher at one year compared to patients of the same age without a hip fracture. Age, preoperative Carlson Comorbidity Index, and 48-h surgical delay were independent predictors of 1-year mortality<sup>(7)</sup>. Our findings were in line with Bokshan et al. as we found that perioperative cardiovascular and noncardiovascular complications and mortality rates were 3 to 4-times higher in octogenarians compared to patients aged <80 years.

Lim et al. enrolled 58 patients whose age was over 80 years; 30 patients with femoral neck fracture and 28 patients with intertrochanteric fracture<sup>(21)</sup>. Similar to our findings, they found no significant differences between the two

groups in terms of length of hospitalization and postoperative complications.

Data on management and outcome of hip fractures in elderly patients are much more limited in our country. In a small retrospective study, 115 patients aged 75 and over, who suffered from proximal femoral fracture and underwent surgery were retrospectively evaluated<sup>(22)</sup>. Patients over 85 years old had higher rates of mortality than younger patients in this study. Age, more need to blood transfusions, and arthroplasty were risk factors for 1- year mortality<sup>(22)</sup>. In another study, 72 patients older than the age of 80, operated for hip surgery and monitored at intensive care unit postoperatively included<sup>(23)</sup>. The in-hospital mortality rate was 16.7%. The time before surgery, and need for mechanical ventilation or inotropic support were predictors of mortality in this study. The in-hospital mortality rate was much lower than this study with a ratio of 7.6% as we did not restrict our study with intensive care unit patients.

To our knowledge, our study is the largest study investigating the management of very old people suffering from hip fractures. Expanding knowledge about factors associated with adverse events in the very old population with hip fracture is essential to identify high-risk individuals in this age group. Determining preoperative risk factors for perioperative complications and mortality in surgically treated patients may develop effective strategies for the prevention of these adverse events.

### Limitations

Our study has several limitations. Basically the data of the study were obtained retrospectively. The second limitation is that because follow-up of the patients was disrupted at discharge in many cases, the long-term prognosis remained unclear. Our hospital is a referral center for peripheral hospitals, which may affect our results. Therefore, caution should be taken in extrapolating these results to other surgical populations. Finally, we do not have enough data about surgery time to evaluate its effect on complications. But we had no intraoperative unforeseen complications such as implant failure or periprosthetic fracture that prolongs and complicates the surgery.

## Conclusion

According to our findings; higher prevalence of lower body mass index, anemia, atrial fibrillation, hypertension, coronary artery disease, higher ASA scores, higher mortality rate and longer stay in hospital were observed in

octogenarian group and it was observed that these octogenarian patients are at increased risk for perioperative medical complications and mortality compared to non-octogenarians. Also, we observed that increased age, coronary artery disease, and atrial fibrillation predict perioperative adverse events in all patients undergoing hip fracture surgery.

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