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Original Article *Özgün Araştırma*

EARLY POSTOPERATIVE MORTALITY RATES IN ELDERLY PATIENTS WITH INTERTROCHANTERIC FEMORAL FRACTURE: COMPARISON OF THREE FIXATION METHODS

Geriatrik Femur İntertrokanterik Kırıklarda Üç Farklı Fiksasyon Metodunun Erken Mortalite Oranlarının Karşılaştırılması

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ABSTRACT

Objective: Several surgical options are available for the treatment of elderly intertrochanteric femoral fractures (IFF). This study aimed to compare the mortality rates in the first postoperative month between the intramedullary nail fixation (INF), cemented and cementless hemiarthroplasty (HA). Also, we aimed to analyze the factors that affect the mortality rates within the first postoperative month.

Material and Methods: Elderly patients who underwent INF (Group 1), cemented HA (Group 2), and cementless HA (Group 3) for IFF between 2012 and 2020 were selected for the study. Demographic data, pre, and perioperative variables were compared between the three treatment groups. The mortality rates in the first 24 h, 7 days, and 30 days were also compared as well. The patients were divided into survival and non-survival groups according to the outcome in the first postoperative month and factors affecting mortality rates were evaluated.

Results: A total of 526 patients were included in the study (194 men and 332 women; mean age, 82.71±6.92 years). The patients who received cemented or cementless HA had higher mortality rates on the first 7 days and 30 days after the operation than those treated with INF (p=0.022; 0.001, respectively). The patients who died within 30 days postoperatively were older (p=0.00) and had more comorbidities (p =0.015) and longer intervals from trauma to surgery (p=0.05) and operation times (p=0.013) than those who survived in the first postoperative month.

Conclusion: Intramedullary fixation should be the first option in elderly IFFs. The duration between trauma and surgery and operation time should be shortened to reduce mortality.

***Keywords**: Intertrochanteric fracture, proximal femoral nail, hemiarthroplasty, cement*

ÖZ

Amaç: İleri yaştaki femur intertrokanterik kırıkların tedavisinde çeşitli seçenekler mevcuttur. Mevcut çalışma intrameduller çivi, sementli ve sementsiz hemiartroplasti (HA) seçeneklerinin postoperatif ilk 30 gündeki mortalite oranlarını karşılaştırmayı amaçlamaktadır. Ayrıca bu periyotta mortaliteyi etkileyen faktörlerin incelenmesi amaçlanmıştır.

Gereç ve Yöntemler: İntertrokanterik femur kırığı için 2012-2020 arasında intrameduller çivi (Grup 1), sementli HA (Grup 2) ve sementsiz HA (grup 3) uygulanan hastalar çalışmaya dahil edildi. Demografik verilerle birlikte ameliyat öncesi ve ameliyat sırasındaki değişkenler analiz edilerek üç grup arasında karşılaştırıldı. İlk 24 saat, 7 gün ve 30 gün içerisindeki mortalite oranları her üç grup arasında karşılaştırıldı. Ayrıca 30 günün sonunda sağ kalan hastalar ve ölen hastaların değişkenleri karşılaştırılarak mortaliteyi etkileyen faktörler incelendi.

Bulgular: Çalışmaya 526 hasta dahil edildi (194 erkek, 332 kadın; ortalama yaş: 82.71±6.92/yıl). Sementli ve ya sementsiz HA uygulanan hastalarda ilk 7 ve 30 gündeki mortalite oranı intramedüller çivi fiksasyonu yapılan hastalardan daha yüksekti (sırasıyla, p=0.022; 0.001). İlk 30 gün içerisinde kaybedilen hastaların sağkalanlara göre yaşı (p=0.00), komorbidite sayısı (p=0.015), cerrahiye kadar geçen süresi (p=0.05) ve cerrahi süresi (p=0.013) daha yüksekti.

Sonuç: Yaşlı intertrokanterik kırık hastalarında intramedullar tespit ilk seçenek olarak düşünülmelidir. Cerrahiye kadar geçen süre ve operasyon süresinin kısaltılması mortaliteyi azaltmak için önemlidir.

***Anahtar Kelimeler**: İntertrokanterik kırık, proksimal femur çivisi, hemiartroplasti, sement*

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INTRODUCTION

Intertrochanteric femoral fractures (IFFs) are common causes of mortality and morbidity in the community (1). Most IFFs occur in the elderly population (2). As life expectancy has been increasing, the incidence of hip fractures was estimated to reach 6.26 million per year by 2050 (3). Despite the medical advances, geriatric hip fractures are still associated with high mortality rates. Mortality in the first postoperative week is significantly high (4).

The gold standard treatment for IFF is surgery (5). One of the treatment options is intramedullary nail fixation (INF), which provides a minimally invasive approach while protecting the native hip joint, although high failure and reoperation rates were reported in elderly patients because of poor bone quality and coexisting comorbidities (5,6). Hemiarthroplasty is another recognized treatment option for elderly IFF (7). Age, ASA score, and preexisting comorbidities were defined as the factors associated with mortality independent of the fixation method (8).

Both INF and HA are widely used for the treatment of elderly IFF (9). Many studies have focused on comparing the functional results of these treatment options, but the results are inconsistent (10). Apart from the midterm functional results, perioperative mortality is an important concern in elderly IFF.

In this study, we aimed to compare the mortality and morbidity rates in the first 30 days, between elderly patients with IFF treated with INF, cemented, or cementless HA. We also aimed to analyze factors that affect the mortality rate within 30 days after the operation.

MATERIALS AND METHODS

After ethical approval from the Institutional review board (Erciyes University Clinical Research Ethics Committee, date:12.10.2020, issue number: 2020/100), the medical records of patients who underwent surgery for IFFs between October 2012 and January 2020 were retrospectively evaluated. Patients treated with cemented or cementless HA or INF were selected. The inclusion criteria for this study were 1) patients admitted for IFFs who were ≥70 years of age at the time of surgery, 2) sustained low energy trauma and 3) AO/OTA type 31A2 fracture, 4) patients treated with either cemented or cementless hemiarthroplasty or INF. The exclusion criteria were 1) patients with pathological fractures, 2) patients who died before surgery, 3) patients who sustained high energy trauma, and 4) patients with incomplete medical records. The flowchart of patient selection process was shown in Figure 1.

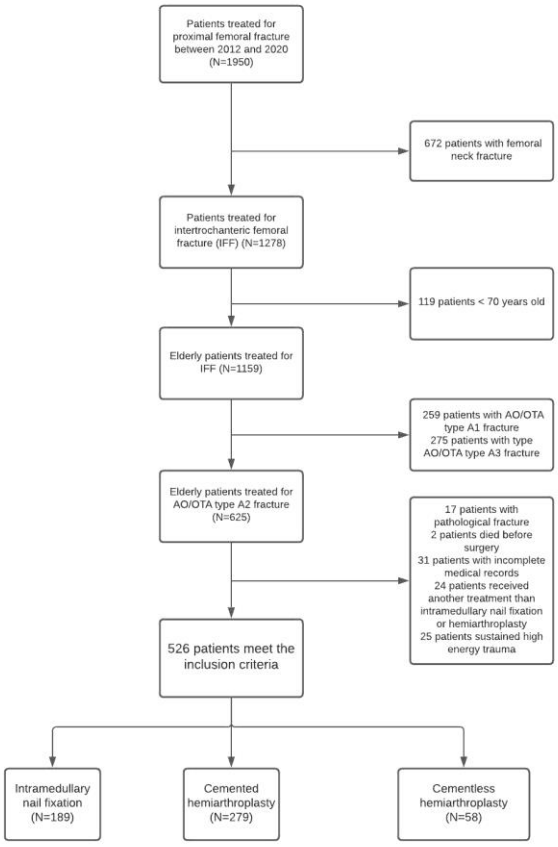

Figure 1: Flowchart of the patient selection process

Most of the operations were performed by fifth-year residents under the supervision of five senior surgeons. The choice of treatment was mainly based on surgeons' preference. Using cemented fixation was used in Dorr type C femurs and type A and B patients received

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cementless HA. At the early periods, most of the patients received HA; after 2017 INF was the first treatment choice whenever available.

Patient demographics, the time interval between injury and surgery, type of anesthesia, surgery duration, hospital stay duration, admission rate to the intensive care unit (ICU), death within the first 30 days after the operation, need for transfusion, and preoperative and early postoperative serum albumin levels, hemoglobin levels, and white blood cell counts were evaluated from the patients' medical records. Preoperative Parker Mobility Score was questioned retrospectively by a telephone call from the patient or his/her relatives. The patients treated with INF, cemented HA, and cementless HA were assigned to groups 1, 2, and 3, respectively. Morbidity and mortality rates were compared between the groups. Demographic data, surgery-related variables, and serum parameters were compared between the patients who died within 30 days after surgery and those who survived.

Statistical Analysis

Mean, standard deviation, median, range, frequency, and ratio were used in the presentation of descriptive statistics. The Kolmogorov-Smirnov test was used to evaluate the distribution of the variables. The chi-square and Fisher exact tests were used to compare independent qualitative data. Independent-samples T-test, Mann-Whitney U test, analysis of variance, and Kruskal-Wallis test were used to compare independent quantitative data. Logistic regression analysis was performed to evaluate independent risk factors for mortality. A *p* value of <0.05 was considered statistically significant. All statistical analyses were performed using IBM SPSS version 22 for Windows (IBM Corp., Armonk, NY).

RESULTS

A total of 526 patients were included in the study (194 men and 332 women). A hundred eighty-nine patients received INF (Group 1), 279 patients received cemented HA (Group 2) and 58 patients received cementless HA (Group 3) as well. The mean age was 82.71±6.92 years, and the time interval between the onset of injury and operation was 47.17±54.35 hours. Patient demographics, the time interval between trauma and surgery, hospital stay duration, amount of transfusion, and operation time in all the groups are presented in Table 1.

One hundred patients (52.9%) in group 1, 189 patients (67.7%) in group 2, and 32 patients (55.2%) in group 3 were admitted to the ICU after the operation (P = 0.03). Six (1.1%), 25 (4.8%), and 82 patients (15.6%) died within 24 hours, 7 days, and 30 days after surgery. A comparison of mortality rates is presented in Table 2. In the subgroup analysis, no significant differences in 24-hour, 7-day, and 30-month postoperative mortality rates (p=0.359, 0.119, and 0.865, respectively) were found between the cemented and cementless HA groups. Logistic regression analysis showed HA increased the risk of mortality 3.59 times within the postoperative first month (p=0.00). Surgery and hospital stay durations were longer in the cemented HA group than in the cementless HA group (p=0.00 and 0.01, respectively). The amount of transfusion and ICU admission rate was similar between the two groups (p=0.059 and 0.067, respectively). The etiologies of the deaths are shown in Table 3.

The comparisons of demographic variables and surgery-related factors, and blood parameter values between the survival and non-survival groups are presented in Tables 4 and 5, respectively.

Table 1: Patient characteristics

Parameters	**Group 1 (n=189)**	**Group 2 (n=279)**	**Group 3 (N=58)**	**P**
Sex (Male: Female)	76 (40.2%):113 (59.8%)	96 (34.4%):183 (65.6%)	22 (37.90):36 (62.1%)	0.436
Age (Years±SD)	81.92±6.62	84.74±6.69	82.06±5.69	0.053
Side (Right: Left)	82 (43.4%):107 (56.6%)	133 (47.7%):146 (52.3%)	33(56.9%):25 (43.1%)	0.055
Number of comorbidities	2.4±0.4	2.8±0.7	2.3±0.9	0.720
ASA Class				
1	5 (%2.6)	12 (4.3%)	7 (12%)	
2	66 (%34.9)	114 (40.9%)	23 (39.6%)	
3	104 (%55)	122 (43.7%)	21 (36.2%)	0.470
4	14 (%7.4)	31 (11.1%)	7 (%12)	
Fracture classification (AO/OTA)				
A2.1	74 (39.1%)	100 (35.8%)	21 (36.2%)	
A2.2	62 (32.8%)	92 (32.9%)	19 (32.7%)	0.360
A2.3	53 (%28)	87 (31.2%)	18 (31%)	
Parker's mobility score (Mean±SD)	5.15±2.02	5.04±1.76	4.95±2.33	0.480
Interval between trauma and surgery (hours±SD)	49.74±69.98	46.47±45.39	42.23±30.98	0.420
Operation time (minutes±SD)	61.16±7.23	79.83±9.94	69.61±6.29	0.000
Transfusion (Units±SD)	2.03±3.24	2.54±2.87	2.58±1.45	0.000
Hospital stay (Days±SD)	6.18±10.54	7.13±6.61	8.41±2.58	0.000

Table 2: Comparison of mortality rates between three groups

	Group 1 (n=189)	**Group 2 (n=279)**	**Group 3 (n=58)**	**P value**
Mortality within first day(n)	2 (1.05%)	4 (1.43%)	0 (0%)	0.640
Mortality within first 7 days (n)	4 (2.11%)	20 (7.16%)	1 (1.7%)	0.022
Mortality within first 30 days (n)	15 (7.93%)	55 (19.71%)	12 (20.6%)	0.001

Table 3: Causes of deaths in the study population

Etiology of mortality	**n (%)**
Pulmonary embolism	16 (19.5%)
Cardiac arrhythmia	6 (7.3%)
Multiple organ failure	18 (21.9%)
Acute renal failure	3 (3.6%)
Pneumonia	7 (8.5%)
Sepsis	11 (13.4%)
Heart failure	14 (17%)
Other	7 (8.5%)

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Table 4: Comparison of variables between dead and survived patients

Parameters	Death Group (N=82)	Survival Group (N=444)	P value
Age	86.92±7.27	81.94±6.58	0.000
Sex (Female: Male)	53 (64.6%): 29 (35.4%)	279 (62.8%): 165 (37.2%)	0.757
Number of comorbidities	3.26±1.19	2.42±2.05	0.015
Interval between trauma and surgery (hours±SD)	61.65±65.14	44.50±51.76	0.050
Type of anesthesia (G: R)	50(61%): 32(39%)	285(%64.2): 159(%35.8)	0.578
Operation time (minutes±SD)	74.08±11.03	71.60±12.65	0.013
Transfusion (Units±SD)	3.03±3.66	2.11±2.73	0.021

G: General anesthesia, R: Regional anesthesia

Table 5: Comparison of blood parameters between dead and survived patients

Parameters	Death Group (N=82)	Survival Group (N=444)	P value
Preoperative Hb(g/dL±SD)	11.56±1.79	11.89±1.73	0.113
Postoperative Hb(g/dL±SD)	9.65±2.04	9.78±1.76	0.754
Preoperative albumin (g/dL±SD)	3.52±0.47	3.76±0.42	0.000
Postoperative albumin (g/dL±SD)	2.67±0.61	3.04±0.87	0.000
Preoperative WBC (10^3/uL±SD)	10.687±3.92	9.734±4089.30	0.064
Postoperative WBC (10^3/uL±SD)	14.770±5.53	12.525±5.11	0.000

DISCUSSION

The principal finding of this study was that the patients who received HA (with or without cement) had higher mortality rates than those who underwent INF within the first postoperative week and month. Also, the surgery duration, hospital stay surgery, ICU admission rate, and the amount of transfusion were significantly higher in the patients treated with cemented HA. Age, the interval between the onset of injury and surgery, operation time, and amount of transfusion were significantly higher in the patients who died within the first postoperative month.

Golge et al. retrospectively analyzed 202 patients who underwent HA or INF after IFF with a minimum 3-year follow-up and reported 5.1 times higher mortality rate in patients treated with HA (11). Similar results were reported by Agar et al. (12). On the other hand, Kim et al. reported similar mortality rates within 2 years in elderly patients with IFF treated with either HA or INF and reported higher reoperation rates in the patients who received INF (13). Another study found similar mortality rates between the two treatment options but reported better functional results after INF (5). Our findings favor INF in terms of short-term mortality rate and shorter surgical time, less blood transfusion, and shorter hospital stay duration.

Many authors recommend cemented implantation in elderly patients during hip arthroplasty (14). Cemented stems have superiority over uncemented stems in terms of better stem fixation with lower periprosthetic fracture rates (15). Despite this mechanical advantage, cement use may cause BCIS, life-threatening complications (16). The mortality rates in grade 2 and 3 BCIS were previously shown to be increasing (17). On the other hand, in a recent systematic review, the authors compared cemented and cementless HA in the treatment of IFFs and reported similar mortality and complication rates, but a discrepancy in limb length, which was longer

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in the cemented group (18). We may speculate that the difference in mortality rate between HA and INF may be due to the more invasive nature of HA, which may cause a higher amount of blood loss and more inflammatory response than cement-related complications. Both cemented and cementless techniques have certain risks and benefits as well. In our series, we did not observe cement-related complications, but the number of the patients was heterogeneous. The risk of intraoperative fracture and cement-related complications should be evaluated in further studies.

The most common causes of death were multiple organ failure (21.9%) and pulmonary embolism (19.5%). Age and comorbidities were reported as risk factors of short-term mortality after cemented HA for femoral neck fracture (19). In our study, the patients who died within the first month after surgery were significantly older, had more comorbidities, and had longer operation durations than those who survived. The role of the type of anesthesia on short-term mortality after geriatric hip fracture is unclear. In their systematic review, Chen et al. concluded that general anesthesia is related to higher rates of mortality and systemic complications (20). Desai et al. suggested the use of regional anesthesia to reduce in-hospital mortality in geriatric hip fractures (21). In another systematic review, O'Donnell et al. showed no significant difference between the two anesthesia techniques in terms of mortality and systemic complication rates (22). Our results were consistent with those of O'Donnell et al., who reported similar mortality rates between general and regional anesthesia (22).

It was shown that preoperative mobility status is associated with postoperative mortality rates (23). Also, early postoperative mobilization has critical importance to reduce life-threatening complications (24). Pfeufer et al. showed that weight-bearing restrictions reduced postoperative mobility which may cause systemic complications such as pneumonia, urinary tract infections and thromboembolic diseases as well (25). In our study preoperative Parker mobility scores were similar between the three groups, therefore we did not analyze the effect of preoperative mobility status on the mortality rates. Since some surgeons allow partial weight-bearing after INF, early full weight-bearing may be considered as a superiority of HA over INF (26).

The timing of surgery may be one of the modifiable variables to reduce mortality. Many authors recommend early surgery for geriatric hip fractures (27). Our findings support the report that the interval between the onset of trauma and surgery was significantly longer in patients who died within 30 days postoperatively

Preoperative nutritional status is also a predictor of mortality in patients with geriatric hip fracture (28). In a recent meta-analysis, Li et al. concluded that hypoalbuminemia is the sole indicator of increased risk of in-hospital mortality (29). Many other studies have similar conclusions (8,30). Our findings were consistent with those in the literature. Within 30 days after operation, the patients who died had lower serum albumin levels than those who survived.

This study has some limitations. Its retrospective design is the main limitation, and we evaluated only deaths within 30 days after operation. However, mortality rates can change due to infection, reoperation, and other implant-related problems in the long term. The strength of the study was its relatively homogenous and large study population. We included only AO/OTA type 31A2 fractures and we observed similar age, the number of comorbidities and preoperative mobility score between the three groups which may affect the mortality rates.

The mortality rate was higher in the patients treated with cemented or cementless HA than in those treated with INF within 7 and 30 days after the operation. INF might be considered the first treatment choice for AO/OTA type 31A2 IFF in elderly patients. In addition, orthopedic surgeons should focus on reducing the preoperative time to surgery and the duration of surgery to decrease mortality rates.

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