PŮVODNÍ PRÁCE/ORIGINAL PAPER

The Effect of Bone Minerals Density on Mortality of Elderly Patients Applying with a Proximal Fracture of the Femur

Vliv kostní minerální hustoty na úmrtnost starších pacientů se zlomeninou horního konce femuru

ŞEYHMUS YIĞIT[1], EMIN OZKUL[1], NESIM ÇEVIK[1], AYHAN KAYDU[2], AYSEGÜL YIGIT[3]

[1] Department of Orthopaedic Surgery, Dicle University, Faculty of Medicine, Diyarbakır, Turkey

[2] Department of Anesthesia and Reanimation, Dicle University, Faculty of Medicine, Diyarbakır, Turkey

[3] Department of Family Medicine, Dicle University Faculty of Medicine, Diyarbakır, Turkey

Corresponding author:

Şeyhmus Yiğit MD
Department of Orthopaedic Surgery
Dicle University, Faculty of Medicine
Diyarbakır, Turkey

seyhmusygt@gmail.com

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ABSTRACT

Purpose of the study

This study aimed to evaluate the risk of mortality in elderly hip fracture patients within one year after surgery, and to compare it with DXA values and to evaluate the predictive value of DXA values.

Material and methods

This is a prospective study including data from 160 elderly hip fracture patients treated in our hospital. The patient data included the following; DXA values of spine, neck, intertrochanteric, total and ward's T-scores, age, blood values (preoperative CRP (mg/dl), CRP/Albumin ratio, albumin (g/dl), sex, creatine value (mg/dL), American Society of Anesthesiologists (ASA) scores, and type of surgery.

Results

The risk of mortality was 5.06 times higher in patients with neck DXA values ≤-2.2 cut-off value (DXA values of neck odds ratio (OR) = 5.06, 95%CI: 544-.723, P: 0.02). There was a statistically significant difference between the DXA values of spine, intertrochanteric, wards, creatine, and albumin values between the groups (respectively p=0.002, p=0.005, p=0.01, p=0.003, and p=0.01)

Conclusions

Biomarkers to assess mortality one year postoperatively in elderly patients undergoing surgery for hip fracture are lacking. The mortality rate was found to be 5.06 times higher in patients with DXA values of neck ≤-2.2 cut-off. Severe osteoporosis is a disease with high mortality. The initiation of osteoporosis treatment should be started earlier.

Key words: hip fracture, DXA values of neck, mortality, elderly patients.

INTRODUCTION

After the age of 75 years, there is a 25–50% risk of fracture in humans (28). The probability of osteoporosis-related fractures in older postmenopausal women has been found to be more than 75% (26). Mortality rates in the first 12 months range from 12% and 35% (20). Most deaths occur in the first 3–12 months after fracture (13). The causes of deaths are not clear. Risk factors that have been demonstrated increase mortality include elderly patients, osteoporosis, male gender, comorbidities, high American Society of Anesthesiologists (ASA) score, postoperative complications, and time to surgery.

There are many studies in the literature to determine mortality due to hip fracture in the elderly (3, 8, 16). In these studies, preoperative CRP (3), albumin (14), neutrophil (24), leukocyte (24), age (1), ASA (16), sex (8), creatinine (18), and bone mineral density (1) values were evaluated in relation to mortality. Currently, there are no clear biological indicators to effectively determine the postoperative mortality of elderly hip fracture patients.

Osteoporosis can be caused either primarily by a decrease in physiological reserves associated with aging (9) or secondarily by impaired functioning of other organ systems or various cancers (11). Osteoporosis reduces bone mass and strength, thereby increasing the risk of fractures caused by simple trauma (6). Dual-energy X-ray absorptiometry (DXA) is the gold standard for diagnosing osteoporosis (15). DXA can determine fracture risk by detecting bone mineral density (BMD) (27).

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The identification and treatment of risk factors in hip fracture patients can contribute to a reduction in mortality. An easily measurable biological value is needed to determine the risk of mortality after hip fractures in the elderly. To the best of our knowledge, no study has investigated the relationship between DXA and mortality risk. This study aimed to evaluate the risk of mortality in elderly hip fracture patients within one year after surgery, and to compare it with DXA values and to evaluate the predictive value of DXA values.

MATERIAL AND METHODS

This study is a prospective study including the data of 160 patients with elderly hip fractures treated in our hospital between February 2022 and February 2023.The study was initiated prospectively after the approval of the Ethical Evaluation Committee of our faculty (21.01.2022/90).

Patients were divided into two groups: Group 1; those who did not die within one year after surgery, Group 2; patients who died within one year after surgery. Inclusion criteria were;
(1) diagnosis of femoral neck or intertrochanteric fracture;
(2) age ≥ 60 years;
(3) able to walk without support before the fracture; and
(4) low-energy fracture (fractures caused by a simple fall).

Exclusion criteria were:
(1) patients with incomplete patient data;
(2) severe chronic disease (ASA 4 patients);
(3) pathologic fracture; and
(4) patients without osteoporosis.

Patient data included, DXA values of spine, neck, intertrochanteric, total and Ward's T-scores, age, blood values (preoperative CRP (mg/dl), CRP/Albumin ratio, albumin (g/dl)), gender leukocyte (10e3/uL), creatine value (mg/dL), American Society of Anesthesiologists (ASA) scores, and type of surgery (arthroplasty or proximal femoral nail).

DXA was performed on the second postoperative day and bone mineral density was determined in all patients. Medical treatment was started in all osteoporotic patients. On the first postoperative day, the drain was removed in patients without wound site problems and the patient was mobilized. Clinical and radiographic follow-up was performed at 2, 4, 8 and 12 weeks postoperatively. All patients were contacted by phone at 3, 6, 9, and 12 months after surgery. If any patients died, the time of death was noted.

Data has been organized by protecting personal identification information in accordance with the Declaration of Helsinki. Written informed consent was obtained from all patients.

The statistical software SPSS22.0 was used to evaluate the obtained data. The numerical data obtained in the study were presented as mean ± SD (min–max), while the categorical data were displayed as frequency and percentage values. Mann-Whitney test and Student test were employed to compare categorical data. Univariate binary logistic regression analysis was used to determine the effects of possible prognostic factors on death. ROC curve analysis was performed to determine the relationship between patient data and death (2). In statistical analysis, $P<0.05$ was considered statistically significant with 95% confidence interval and 5% margin of error.

RESULTS

Two hundred and twenty-one patients were admitted to our hospital with hip fracture. Sixty-one patients who did not meet the study criteria were excluded. Of 160 patients, 102 (63.7%) were male and 58 (36.2%) were female. There were 41 (25.6%) deaths. The number of patients who died in the first 3 months was 8, 8 in the second 3 months, and 11 in the third 3 months and 13 in the fourth 3 months. The distribution of patients is given in table 1 (Table 1).

Group 1 patients, the mean time to operation was 2.9 days (range: 1–12), while in Group 2 patients it was 3.2 days (range: 1–11) (p: 0.681). The risk of death increased statistically significantly as the time between trauma and operation increased (p = <0.001). The mean operation time was 79.8 minutes (range: 41–128) in Group 1 and 83 minutes (range: 36–139) in Group 2 (p = 0.896). There was a statistically significant difference between the DXA values of spine, intertrochanteric, wards, creatine, and albumin values between the groups (respectively p = 0.002, p = 0.005, p = 0.01, p = 0.003, and p = 0.01) (Table 2).

Binary logistic regression model and multivariate regression analysis:

The risk of mortality was 5.06 times higher in patients with neck DXA values ≤ -2.2 cut-off value (DXA values of neck odds ratio (OR) = 5.06, 95% CI: .544-.723, P: 0.02). The risk of mortality was 2.81 times higher in patients with intertrochanteric DXA values ≤ –2.51 cut-off value. There was no age difference between the two groups, but there was a significant

Table 1. **Patients data**

	GROUP 1	GROUP 2
Gender	60f/59m	22f/19 m
Age	73.13 ± 1.01years	78.56 ± 1.68 years
Proximal femoral nail	71	27
Partial bipolar prostheses	48	14
Length of hospitalization	4.9 days (range: 3-15)	5.3 days (range: 3-14)
ASA 1/2/3	14/45/60	4/17/20

Table 2. **Comparison of risk factors between groups**

	GROUP 1	GROUP 2	P VALUE
DXA values of spine	−1.84 ± 0.1	−2.49 ± 0.22	.002
DXA values of neck	−1.93 ± 0.11	−2.88 ± 0.16	< 0.0001
DXA values of intertrochanteric	−1.73 ± 0.1	−2.16 ± 0.18	.001
DXA values of total	−1.5 ± 0.98	−1.68 ± 0.28	.155
DXA values of ward's T-scores	−1.84 ± 0.11	−2.30 ± 0.28	.001
Creatinine	0.84 ± 0.03	1.15 ± 0.12	.003
CRP	36.42 ± 4.8	49.76 ± 9.9	.130
Albumin	37.38 ± 0.48	34.24 ± 0.98	.001
CRP/Alb	1.10 ± 0.15	1.6 ± 0.33	.091
ALP	86.88 ± 3.3	104.06 ± 10.48	.227

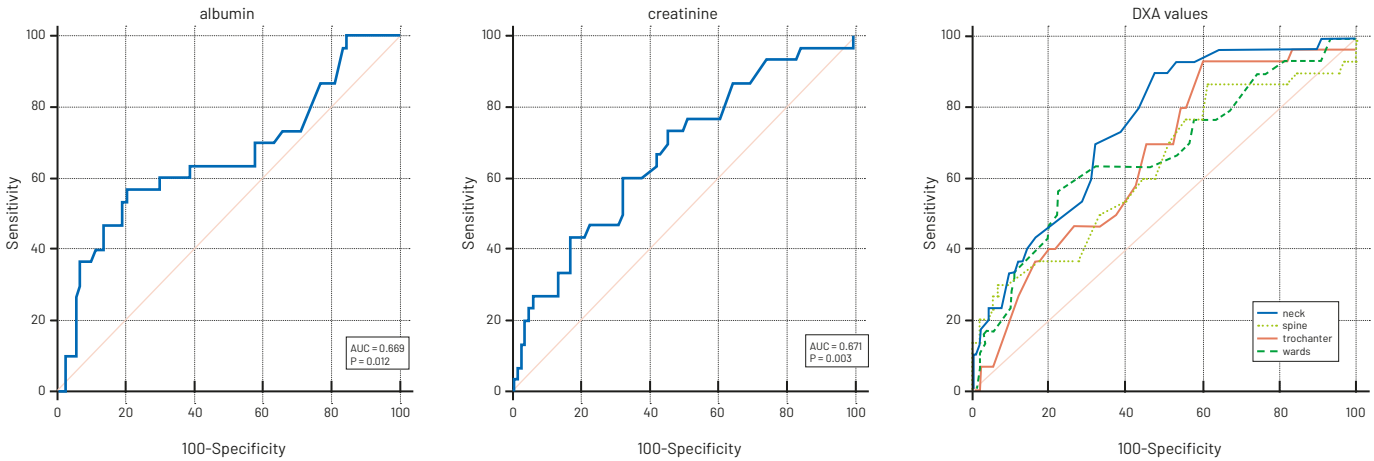

Table 3. **Diagnostic evaluation of death by ROC curve analysis**

	AUC: AREA UNDER THE ROC CURVE	STD. ERROR	ASYMPTOTIC SIG.	ASYMPTOTIC 95% CONFIDENCE INTERVAL		SENSITIVITY	SPECIFICITY	CUT-OFF VALUE	Z STATISTIC
				LOWER BOUND	UPPER BOUND				
Years	.651	.057	.008	.559	.736	60	70	>70	2.6
DXA values of ward's T-scores	.658	.064	.011	.566	.742	56.67	77.78	≤-2.5	2.51
DXA values of intertrochanteric	.656	.060	.005	.564	.740	93.33	40	≤-2.5	2.81
DXA values of neck	.746	.004	.002	.544	.723	90	52.22	≤-2.2	5.06
DXA values of spine	.637	.006	.002	.544	.723	30	93.33	≤-3.1	2.27
Albumine	.659	.006	.001	.567	.743	56.67	80	≤34.8	2.51
Creatinine	.671	.05	.003	.579	.754	73.33	54.44	>0.8	2.94

difference in mortality rate and BMI values in patients > 70 years (respectively p: 008, p: 002) (Table 3).

There was no difference between the complication rates (p: 0.749). There were wound site problems in fifteen patients in Group 1 and four patients in Group 2. Implant failure developed in eleven patients in Group 1 and four patients in Group 2. There was no significant difference between the mortality rates of patients with implant failure (p: 0.482).

DISCUSSION

To the best of our knowledge, no previous study has investigated the relationship between DXA scores and mortality rates. The primary finding of this study is that DXA values of the neck may be a useful marker in determining the risk of mortality after hip fracture in the elderly. The DXA values of the neck, spine, and trochanteric scores demonstrated a positive correlation with useful prognostic markers including albumin, creatinine, the ASA score, age, and sex.

Bone mineral density decreases as a result of primary (9) or secondary (11) osteoporosis. Bone health and general body health are parallel to each other. Paul stated that severe osteoporosis is a disease with high mortality (21). Mortality rates in the first 12 months are between 12% and 35% (20). The one-year mortality rate in our study correlated with the literature and was 25%. Today, patients over the age of 65 with a T score < –2.5 are treated with anti-osteoporotic drugs (22). In our study, we found that the risk of death increased 5.06 times in patients with a DXA value of neck ≤ –2.2 cut-off value. Perhaps anti-osteoporotic drug treatment should be started at lower T scores. Additional studies are needed on this subject.

Biomarkers to assess mortality one year postoperatively in elderly patients undergoing surgery for hip fracture are lacking. There have been many previous studies in the literature to identify biomarkers. Low albumin levels have been found to be associated with postoperative mortality in elderly patients with hip fracture (5). CRP/albumin ratio has also been accepted as a risk factor for 1-year mortality in hip fracture patients (16). A high neutrophil (7) and creatinine (10) levels have been shown to have a negative impact on 1-year survival rates. Fisher et al. showed that patients with high plasma creatinine levels had a mortality rate 2.5 times higher than normal patients (12). Increased risk factors consistent with the literature were found in our study. We found a 2.9 times increased mortality rate for creatinine, a 2.8 times increased mortality rate for DXA values of intertrochanteric, and a 2.5 times increased mortality rate for albumin.

Studies have been conducted to find the relationship between gender and mortality. There is a higher rate in female patients but being of male gender was found to be a risk factor (7). However, Niessen et al. (23) did not find a statistically significant relationship between gender and mortality. Age is a factor determining the prognosis in elderly patients undergoing surgery for hip fracture (25). This is due to the gradual decline in general body health with age (17). It has been shown to predict a 1.3 times increase in mortality in women aged ≥ 65 years (15). However, Jacques concluded that age does not affect the mortality of patients after surgery (4). In our study, there was a significant difference between the ages of both groups (p:0.008), there was no significant difference in terms of sex, and the one-year postoperative mortality rate was 2.6 times higher in male and female patients older than 70 years than in patients < 70 years. In a meta-analysis study, it was found that no matter which surgical technique was applied for hip fracture in the elderly, there was no effect on mortality (19). We also found no effect on mortality among patients who underwent proximal femoral nail or partial bipolar prosthesis surgery techniques.

This study has some limitations. First, since it is a prospective cohort study with a limited time frame, the study is conducted with a small number of patients. Second, although the relationship between DXA values of neck and prognosis of elderly hip fractures was determined, this will need to be confirmed in future studies. In addition, we did not look at whether fracture types were associated with mortality at one year after surgery. Mortality will be predictably high in fractures caused by high-energy trauma. Additional studies are needed.

CONCLUSIONS

Biomarkers to assess mortality one year postoperatively in elderly patients undergoing surgery for hip fracture are lacking. Mortality was 5.06 times higher in patients with DXA values of neck ≤ –2.2 cut-off. Severe osteoporosis is a disease with high mortality. Osteoporosis treatment should be started earlier. ■

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