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Does Bone Mineral Density Have an Affect on the Visual Analogue Scale Pain Score?

Kemik Mineral Dansitesinin Vizüel Analog Skala Ağrı Skoruna Etkisi Var mıdır?

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Abstract

Objective: The objective of this study is to evaluate the Visual Analogue scale (VAS) pain scale in elderly patients with obesity and without obesity, and determine whether the VAS pain score is associated with obesity in patients with osteoporosis.
Materials and Methods: We included 192 patients in this study (69 patients with body mass index (BMI) <30 and 99 patients with BMI ≥30). We determined the values of bone mineral density (BMD) by the dual-energy X-ray absorptiometry method. Importantly, we evaluated the VAS pain scores in the range of "without pain" (score=0) and "the worst pain" (score=10), and divided them into three groups according to the World Health Organization's pain severity scale: mild pain (score: <3), mild-moderate pain (score: 3-6), and moderate-severe pain (score: >6). Additionally, we used a multivariate logistic regression model to identify the independent risk factors of VAS pain score in patients with osteoporosis.
Results: The VAS pain score was higher in patients with obesity than the patients without obesity (4.49±2.76 and 3.49±.42, respectively. P=0.014). Advanced age [Odds ratio (OR)=1.094, 95% confidence interval (CI)=1.018-1.175, p=0.014] and obesity (OR=0.225, 95% CI=0.055-0.928, p=0.039) were associated with higher VAS pain score in patients with osteoporosis. Otherwise, only advanced age (OR=1.157, 95% CI=1.045-1.280, p=0.005) was associated with higher VAS pain score in patients with normal BMD. Advanced age (OR=1.141, 95% CI=1.093-1.192, p=<0.001) and osteoporosis (OR=0.001, 95% CI=0.00-0.014, p=<0.001) were associated with higher VAS pain score in all patients.
Conclusion: We believe that reducing obesity, which is a variable risk factor, will benefit in pain reduction and sedentary lifestyle, and improve BMD in patients with osteoporosis.
Keywords: Osteoporosis, VAS pain score, obesity

Öz

Amaç: Bu çalışmada, obez ve obez olmayan yaşlı hastalarda Vizüel Analog skala (VAS) ağrı skalasını değerlendirmeyi ve ayrıca VAS ağrı skorunun osteoporozlu hastalarda obezite ile ilişkili olup olmadığını belirlemeyi amaçladık.
Gereç ve Yöntem: Çalışmaya toplam yüz doksan iki hasta dahil edildi [vücut kitle indeksi (VKİ) <30 olan 69 hasta ve VKİ ≥30 olan 99 hasta]. kemik mineral yoğunluğu (KMY) değerleri, dual-enerjili X-ışını absorpsiyometrisi yöntemi ile belirlenmiştir. VAS ağrı skoru "ağrısız" (skor=0) ve "en kötü ağrı" (skor=10) olarak değerlendirildi ve Dünya Sağlık Örgütü'nün ağrı şiddeti ölçeğine göre 3 gruba ayrıldı: skor <3 hafif ağrı, 3-6 hafif-orta derecede ağrı ve >6 orta-şiddetli ağrı. Osteoporoz hastalarında VAS ağrı skorunun bağımsız risk faktörlerini belirlemek için çok değişkenli bir lojistik regresyon modeli kullanıldı.
Bulgular: Obez hastalarda VAS ağrı skoru obez olmayan hastalardan daha yüksekti (4,49±2,76 ve 3,49±2,42, p=0,014). Osteoporoz hastalarında ileri yaş [Olasılık oranı (OR)=1,094, %95 güven aralığı (GA)=1,018-1,175, p=0,014] ve obezite (OR=0,225, %95 GA=0,055-0,928, p=0,039), VAS ağrı skoru ile ilişkili idi. Normal KMY olan hastalarda sadece ileri yaş VAS ağrı skoru ile ilişkili idi (OR=1,157, %95 GA=1,045-1,280, p=0,005). Tüm hastalarda ileri yaş (OR=1,141, %95 GA=1,093-1,192, p=<0,001) ve osteoporoz (OR=0,001, %95 GA=0,00-0,014, p=<0,001) VAS ağrı skoru ile ilişkiliydi.
Sonuç: Değişken bir risk faktörü olan obezitenin azaltılmasının, ağrı ve sedanter yaşam tarzını azaltacağını ve osteoporozu olan hastalarda KMY'yi iyileştireceğini düşünüyoruz.
Anahtar kelimeler: Osteoporoz, VAS ağrı skoru, obezite

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Introduction

Osteoporosis is a serious health problem in the elderly population (1). Worldwide, osteoporosis was 27.5 million in 2010, and it is estimated to be 33.9 million in 2025 and increase by 23% (2). Risk factors of osteoporosis are advanced age, female gender, genetic, calcium-poor, vitamin D deficiency, protein-rich nutrition, smoking, alcohol and coffee consumption, immobilization, sedentary life and steroid-like drug use affecting bone resorption (3). Nowadays, sedentary life, which has increased as a result of the change in eating habits and technological developments, has caused obesity to become a significant health problem like osteoporosis (4). Hu et al. (5) reported that osteoporosis and obesity have some common pleiotropic genes. Neglia et al. (6) said that increased body mass index (BMI) was associated with the raised rate of osteoporosis. Also, when bone mineral density (BMD) was evaluated with dual-energy X-ray absorptiometry (DXA) and high-resolution peripheral quantitative computed tomography was not shown the difference between obese and non-obese elderly (7).

Pain is an important complaint in osteoporotic elderly population, especially in postmenopausal women (8). The findings of Ohtori et al. (9) support that increased back pain as a result of bone resorption occurs in patients with osteoporosis. Also, studies have shown that obesity is also associated with pain (10). Mohd Sallehuddin et al. (11) reported that the Visual Analogue scale (VAS) pain score was increased in obese older and younger women, and the VAS pain score was higher in obese older women than younger obese women.

Osteoporosis and increased age are manifested as the increase of pain, withdrawal from daily life, and transition to a sedentary life. In light of current findings, obesity may affect the severity of pain in the elderly population with osteoporosis. In our study, we aimed to evaluate the VAS pain scale in obese and non-obese elderly patients, and additionally determine whether the VAS pain score is associated with obesity in patients with osteoporosis.

Materials and Methods

A total of one hundred and ninety-two patients were included in the study. These patients were admitted to the outpatient clinic of Beyşehir State Hospital and whose BMD and T-scores were determined in the last year. Because, BMD scanning time varies according to the age of osteoporosis-related fracture risk factors such as pre-fragility fracture, steroid use, family history of hip fracture, age, low body weight, smoking and decreased vision. Eventually, the time of re-BMD changes according to the threshold value of BMD to evaluate the effectiveness of the treatment in osteoporosis (12). Also, DXA analysis showed no significant difference in BMD in the elderly without any risk factors within 24 months (13). In our study, when we look at the following exclusion criteria; patients without additional risk factors, without any medication, causing any change in bone density, and no indication for re-measurement of BMD. BMD values were determined by the DXA method (DXA, Stratos dR 2D Fan Beam Dexa, DMS GROUP). BMI was calculated by the formula of kilogram/height square meters. BMI ≥30 was accepted as obese and BMI <30 as non-obese according to the World Health Organization (WHO) classification. BMD was measured from the lumbar spine level (L1-L4), and the hips (femoral neck, trochanter, and intertrochanteric) and the unit was g/cm^2. Osteoporosis and osteopenia were determined according to the T-scores of the above specific localizations regions according to the WHO, T-score ≤-2.5 was accepted as osteoporosis and T-score between -2.5 and -1 were accepted as osteopenia.

Patients were excluded if any of the following disorders were present: spontaneous and/or post-traumatic fractures, ankylosing spondylitis, myasthenia graves, received chemotherapy and radiotherapy due to a history of bone tumor and/or systemic tumor, received medication such as biphosphonate, calcium, which could cause a change in BMD for at least one year or longer. All participants provided a written informed consent and the study protocol was approved by the Necmettin Erbakan University Meram Faculty of Medicine Local Ethics Committee (approval date: 05.04.2019, decision no: 1794).

All patients who participated in the study were evaluated at admission. Clinical histories were evaluated, and anthropometry measurements, clinical examinations were performed. VAS pain score was evaluated in the patients. Especially walking, standing, climbing stairs, squatting, pain status with sitting and/or staying were evaluated in pain assessment of VAS pain scores. The VAS pain score was assessed as " without pain" (score =0) and "the worst pain" (score =10) (14). VAS pain scale was divided into three groups according to the WHO's pain severity scale as follows: score <3 mild pain, 3-6 mild-moderate pain, and >6 moderate-severe pain (15). BMD measurements of patients who were admitted to our hospital within the last year were recorded. The study protocol was performed according to the principles of the Declaration of Helsinki and approved by the local Ethical Committee.

Routine laboratory automated techniques were used to determine serum biochemical markers of serum C-reactive protein (CRP), calcium, phosphorus, sodium, potassium and vitamin B12 [CRP (0-6 mg/L), calcium (8.2-10.2 mg/dL), phosphorus (2.5-5 mg/dL), sodium (135-145 mmol/L), potassium (3.5-5.1 mmol/L), vitamin B12 (210-915 pg/mL) and vitamin D (9.5-39.6 ng/mL). Complete blood count (CBC) parameters were measured by automated blood counter Cell-Dyn 3700 automated hemocytometer (Abbott, IL, USA).

Statistical Analysis

The sample size required for the study was performed with the G-Power program (16). A minimum sample size of one hundred and twenty-six was needed to detect anticipated effect size of 0.3 for the regression equation, at a power level of 0.95 (β=0.95) and a probability level of 0.05 (α=0.05).

BM SPSS Statistics for Windows, version 22.0 (IBM Corp., Armonk, NY, USA) was used for statistical analysis. Variables were tested for normality by the Kolmogorov-Smirnov test. Normally distributed data are presented as mean ± standard deviations. Categorical comparisons were performed using the χ^2 -test. We used the independent samples t-test for parametric variables between BMI <30 and BMI ≥30 groups. Univariate and multivariate logistic regression analysis was used to determine if a relationship between severe VAS pain score and obesity, serum biochemical and/or CBC parameters were present in patients with osteoporosis and normal BMD patients. A p value <0.05 was considered as significant.

Results

A total of 168 participants (69 BMI <30 and 99 BMI ≥30 patients) were enrolled in the study. The anthropometric and biochemical characteristics, CBC parameters, VAS pain score, and BMD measurements are given in Table 1. There were no statistically significant differences among age, CRP, calcium, phosphorus, sodium, potassium and vitamin B12, white blood cell counts, mean corpuscular volume, neutrophil lymphocyte ratio, platelet lymphocyte ratio values between groups. Osteoporosis and osteopenia distribution rates were not statistically significant between groups (Table 1). Serum vitamin D level was 10.49±3.12 ng/mL in the obese group, 9.09±3.06 ng/mL in the non-obese group, and was statistically significantly higher in the obese group (p=0.009). The median VAS pain score was 4.49±2.76 and 3.49±2.42 in BMI ≥30 and BMI <30 groups. VAS pain scores were higher in obese patients than non-obese patients (p=0.014) (Table 1).

Univariate and multivariate logistic regression analysis was then used to determine a relationship between VAS pain score and biochemical, CBC parameters, and BMI in osteoporosis and normal BMD patients. Advanced age [odds ratio (OR) =1.094, 95% confidence interval (CI) =1.018-1.175, p=0.014] and BMI ≥30 (OR =0.225, 95% CI =0.055-0.928, p=0.039) were associated with VAS pain score in osteoporosis patients (Table 2). Otherwise, only advanced age (OR =1.157, 95% CI =1.045-1.280, p=0.005) was associated with VAS pain score in normal BMD patients (Table 2).

Univariate and multivariate logistic regression analysis was then used to determine a relationship between VAS pain score and other variables in all patients. Advanced age (OR =1.141, 95% CI =1.093-1.192, p=<0.001) and osteoporosis (OR =0.001, 95% CI =0.00-0.014, p=<0.001) were associated with VAS pain score in all patients (Table 3). BMI and other variables were not significantly associated with VAS pain score in all patients (Table 3).

Table 1. Anthropometric and biochemical characteristics, laboratory parameters, and BMD measurements of BMI <30 and BMI ≥30 groups

		BMI <30 n=69	BMI ≥30 n=99	p*
Age (year)		57.38±9.36	55.49±9.09	0.194
VAS pain score		3.49±2.42	4.49±2.76	0.014
CRP (mg/L)		3.81±4.95	4.05±5.54	0.770
Sedimentation (mm/hr)		15.01±1.78	15.22±3.94	0.958
Calcium (mg/dL)		8.79±0.63	8.81±0.59	0.858
Phosphorus (mg/dL)		3.53±1.43	3.27±0.59	0.120
Sodium (mmol/L)		139.70±2.56	136.54±20.06	0.195
Potassium (mmol/L)		4.17±0.36	4.34±1.44	0.333
Vitamin B12 (pg/mL)		269.54±181.17	325.87±243.97	0.105
WBC (µl/mL)		7.45±1.89	7.58±1.89	0.676
MCV (fL)		80.23±10.66	80±6.49	0.857
Vitamin D (ng/mL)		9.09±3.06	10.49±3.12	0.009
NLR		2.07±0.93	2.11±1.01	0.834
PLR		108.95±42.08	111.64±51.43	0.720
BMD	**Osteoporosis**	21 (30.4%)	26 (26.3%)	0.785
	Osteopenia	18 (26.1%)	25 (25.3%)	
	Normal	30 (43.5%)	48 (48.5%)	

*p<0.05 is considered as statistically significant. Independent sample-test, mean ± SD, BMI: Body mass index, VAS: Visual Analogue scale, BMD: Bone mineral density, WBC: White blood cells, MCV: Mean corpuscular volume, NLR: Neutrophil lymphocyte ratio, PLR: Platelet lymphocyte ratio, BMD: Bone mineral density, SD: Standard deviation, n: Number, CRP: C-reactive protein

Table 2. Regression analysis of relationship factors with VAS pain score in osteoporosis and normal BMD patients

		VAS pain score							
		Osteoporosis				Normal BMD			
		Univariate		Multivariate		Univariate		Multivariate	
		OR (95% CI)	p	OR (95% CI)	p	OR (95% CI)	p	OR (95% CI)	p
Age (year)		1.107 (1.030-1.189)	**0.005**	1.094 (1.018-1.175)	**0.014**	1.134 (1.031-1.248)	**0.010**	1.157 (1.045-1.280)	**0.005**
CRP (mg/L)		0.923 (0.711-1.198)	0.549	-	-	0.992 (0.919-1.070)	0.831	-	-
Calcium (mg/dL)		0.473 (0.143-1.559)	0.219	-	-	1.714 (0.587-5.004)	0.324	-	-
Phosphorus (mg/dL)		2.221 (0.707-6.973)	0.172	-	-	1.199 (0.377-3.813)	0.758	-	-
Sodium (mmol/L)		1.184 (0.950-1.476)	0.132	-	-	1.067 (0.844-1.349)	0.586	-	-
Potassium (mmol/L)		0.904 (0.616-1.326)	0.604	-	-	2.254 (0.402-12.628)	0.355	-	-
Sedimentation (mm/hr)		0.991 (0.964-1.019)	0.522	-	-	1.034 (0.985-1.086)	0.177	-	-
Vitamin B12 (pg/mL)		1.002 (0.999-1.005)	0.131	-	-	1.000 (0.997-1.004)	0.869	-	-
WBC (µl/mL)		1.136 (0.868-1.487)	0.353	-	-	0.914 (0.691-1.211)	0.532	-	-
MCV (fL)		0.996 (0.952-1.043)	0.878	-	-	1.018 (0.891-1.163)	0.796	-	-
Vitamin D (ng/mL)		1.111 (0.930-1.328)	0.247	-	-	1.008 (0.815-1.247)	0.942	-	-
NLR		1.026 (0.724-1.454)	0.885	-	-	0.977 (0.541-1.766)	0.939	-	-
PLR		1.004 (0.993-1.015)	0.489	-	-	1.002 (0.994-1.010)	0.658	-	-
BMI	**BMI ≥30**	0.185 (0.051-0.677)	**0.011**	0.225 (0.055-0.928)	**0.039**	0.536 (0.159-1.804)	0.314	0.308 (0.074-1.285)	0.106
	BMI <30	0.971 (0.840-1.009)	0.077	-	-	1.111 (0.991-1.245)	0.070	-	-

*Logistic regression analysis (single and multiple categorical variables with Binary Logistik Regression analysis), *p value <0.05 is considered as statistically significant. BMI: Body mass index, VAS: Visual analogue scale, WBC: White blood cells, MCV: Mean corpuscular volume, NLR: Neutrophil lymphocyte ratio, PLR: Platelet lymphocyte ratio, BMD: Bone mineral density, OR: Odds ratio, CI: Confidence interval, CRP: C-reactive protein

Discussion

In our study, we found that the VAS pain score was higher in the elderly obese group than in a non-obese group. Additionally, in the present study, increased age and BMI ≥30 were found to be associated with VAS pain score in osteoporosis, and only increased age was found to be associated with VAS pain score in normal BMD patients.

Osteoporosis and obesity can be treated as the most important health problems worldwide. The aging of the world population, changes in dietary habits and increasing sedentary life, increases the rate of these diseases, and acute and chronic diseases such as heart disease, diabetes, and bone fractures. However, the rates of acute and chronic diseases such as diabetes, heart disease, and bone fractures are increasing because of osteoporosis and obesity (17). Nowadays, osteoporosis and obesity prevention and treatment are carried out to reduce treatment costs, minimize and prevent diseases worldwide. In the treatment of osteoporosis, drugs that inhibit bone resorption such as bisphosphonates, calcium, calcitonin, vitamin D, and regulate bone formation such as parathyroid hormone and strontium salts reused (18). Otherwise, lifestyle changes essential as much as the medications as mentioned above

Table 3. Regression analysis of relationship factors with VAS pain score in patients

	VAS pain score			
	Univariate		Multivariate	
	OR (95% CI)	p	OR (95% CI)	p
Age (year)	1.135 (1.088-1.185)	**<0.001**	1.141 (1.093-1.192)	**<0.001**
BMI (kg/m²)	1.051 (1.001-1.103)	**0.045**	1.38 (0.997-1.121)	0.064
Osteoporosis	0.003 (0.00-0.025)	**<0.001**	0.001 (0.00-0.104)	**<0.001**
CRP (mg/L)	1.049 (0.997-1.104)	0.68	-	-
Calcium (mg/dL)	0.743 (0.465-1.190)	0.216	-	-
Phosphorus (mg/dL)	0.952 (0.664-1.366)	0.789	-	-
Sodium (mmol/L)	1.001 (0.987-1.014)	0.918	-	-
Potassium (mmol/L)	0.930 (0.623-1.308)	0.590	-	-
Sedimentation (mm/hr)	1.003 (0.991-1.015)	0.635	-	-
Vitamin B12 (pg/mL)	1.001 (0.999-1.002)	0.335	-	-
WBC (µl/mL)	0.942 (0.809-1.097)	0.440	-	-
MCV (fL)	1.022 (0.967-1.080)	0.441	-	-
Vitamin D (ng/mL)	1.007 (0.904-1.121)	0.903	-	-
NLR	1.072 (0.846-1.358)	0.564	-	-
PLR	1.004 (0.998-1.010)	0.156	-	-

*Logistic regression analysis (single and multiple categorical variables with Binary Logistik Regression analysis), *: p value <0.05 is considered as statistically significant. BMI: Body mass index, VAS: Visual analogue scale, WBC: White blood cells, MCV: Mean corpuscular volume, NLR: Neutrophil lymphocyte ratio, PLR: Platelet lymphocyte ratio, BMD: Bone mineral density, OR: Odds ratio, CI: Confidence interval, CRP: C-reactive protein

for the prevention of osteoporosis (18). Chen et al. (19) reported that obesity was associated with low BMD and additionally showed a significant relationship between increased BMI and low BMD. Ilich et al. (20) observed that bone and muscle mass decreased with increasing fat content, and as a result, they stated that immobilization, bone fracture rate, and pain increased. However, some studies suggest that obesity may be protective against osteoporosis and osteopenia in the elderly population (21). Some research shown that pain and obesity were positively correlated in elderly patients, and obesity was a risk factor in the development of pain and decreased the quality of life (22). National Institute for Health and Care Excellence stated that weight loss is an important treatment for pain management. Pain leads to a decrease of mobilization, loss of walking, and balance (23), restricts physical activity and increases the risk of falling in elderly patients (24,25). Increased pain and bone fracture rates are serious morbidity and mortality reasons in patients with osteoporosis (26). In light of the studies as mentioned above, it is seen that osteoporosis and obesity are important factors in pain formation and also treating these diseases reduces pain and improves the quality of life in the elderly population.

Conclusion

As a result of our study, we found that obesity and age are important risk factors that increase VAS pain score in elderly osteoporosis patients. We think that decreasing obesity, which is a variable risk factor, will benefit reduction pain and sedentary lifestyle and improve BMD in patients with osteoporosis. Limitations of our study were the absence of other biochemical markers in which BMD was evaluated, and lack of assessment of elderly life quality scale.

Ethics

Ethics Committee Approval: The study protocol was approved by the Necmettin Erbakan University Meram Faculty of Medicine Local Ethics Committee (approval date: 05.04.2019, decision no: 1794).

Informed Consent: All participants provided a written informed consent.

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