Original Article / Araştırma Makalesi

Bone Mineral Density, Calcium, Phosphorus, Alkaline Phosphatase, Parathyroid Hormone Levels in Age Groups

Yaş Gruplarına Göre Kemik Mineral Yoğunluğu, Kalsiyum, Fosfor, Alkalen Fosfataz, Paratiroid Hormon Düzeyleri

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ABSTRACT

Aim: The aim of this study is to compare the levels of lumbar 1 - lumbar 4 total, femoral neck bone mineral density, calcium, phosphorus, alkaline phosphatase, parathyroid hormone and vitamin D values which are routinely used to evaluate bone health by age.
Methods: We retrospectively reviewed 713 patients over the age of 40 who underwent dual-energy x-ray absorptiometry. Patients with secondary osteoporosis were excluded. A total of 106 patients were included in the study. The patients were divided into four groups according to their ages: Group 1; 11 patients, 40-49 years, Group 2; 42 patients, 50-59 years, Group 3; 34 patients, 60-69 years and Group 4; 10 patients, 70-79 years. Lumbar 1–lumbar 4 total and femoral neck bone mineral density, calcium, phosphorus, alkaline phosphatase, parathyroid hormone and vitamin D values were extracted from the patient files and recorded. We examined the relationships between the groups.
Results: Calcium, lumbar 1 - lumbar 4 total and femoral neck bone mineral density were statistically significant between the groups; the highest calcium value was observed among group 4 patients, and the comparison between the groups was statistically significant. There was no difference, in vitamin D, phosphorus, alkaline phosphatase and parathyroid hormone levels between the groups. Vitamin D levels were low in all groups.
Discussion: Vitamin D levels were low in all groups. Older adults also observed low bone mineral density (BMD) and high calcium levels.
Conclusion: Lower bone mineral density in patients with advanced age was as expected. In addition, a high calcium value was observed in this group; this result may be thought to be due to the immobilization of elderly patients.

ÖZET

Bu çalışmanın amacı, total lomber1-lomber 4 ve femur boynu kemik mineral yoğunluğu, kalsiyum, fosfor, alkalen fosfataz, paratroid hormon gibi kemik sağlığını rutin değerlendirdiğimiz parametrelerin yaşa göre karşılaştırılmasıdır.
Gereç-Yöntem: Dual Enerji X-ray Absorbsiometri ile kemik mineral yoğunluğu ölçümü yapılmış olan, 40 yaş üstü 713 hasta retrospektif olarak tarandı. Sekonder osteoporozu olan hastalar çalışma dışı bırakıldı. Çalışmaya 106 hasta dahil edildi. Hastalar; Grup 1;40-49 yaş, Grup 2;50-59 yaş, Grup 3;60-69 yaş ve Grup 4;70-79 yaş olarak dört gruba ayrıldı. Hastaların Lomber 1-Lomber 4 total ve femur boynu Kemik mineral yoğunluğu, kalsiyum, fosfor, alkalen fosfataz, paratroid hormon ve D vitamini değerleri hasta dosyalarında çıkarılarak kayıt altına alındı. Gruplar arasında karşılaştırma yapıldı.
Bulgular: Kalsiyum, lomber 1-lomber 4 total ve femur boynu kemik mineral yoğunluğunda gruplar arasında istatistiksel anlamlı bulgular gözlenirken; ileri yaş hastalarda kalsiyum da yüksek gözlendi; D vitamini, fosfor, alkalen fosfataz, paratroid hormon değerlerinde, gruplar arasında fark saptanmadı. Fakat, tüm gruplarda, vitamin D seviyeleri normal değerin altındaydı.
Tartışma: D vitamini düzeyleri tüm gruplarda düşüktü. Yaşlı yetişkinlerde düşük kemik mineral yoğunluğu ve yüksek kalsiyum seviyeleri gözlemlemiştir.
Sonuç: İleri yaş olan hastalarda beklenildiği şekilde kemik mineral yoğunluğu daha düşük bulunmuştur. Ayrıca kalsiyum değeri bu grupta yüksek gözlendi; bu sonucun ileri yaş hastaların immobilizasyonuna bağlı olabileceği düşünülebilir.

1. Introduction

Dual-energy x-ray absorptiometry (DEXA) is commonly used for the diagnosis of osteoporosis and risk of fractures (1). DEXA is measured as mineral density per bone area in gr/m^2. The World Health Organization defines osteoporosis as a mean bone mineral density of less than 2.5 SD in the lumbar, femoral neck and forearm (2).

Calcium (Ca) is an important electrolyte for bone health parathyroid hormone (PTH) and vitamin D is among the hormones involved in bone metabolism (3,4). Serum ALP is a biochemical marker showing bone remodeling (5).

In our literature review, we did not find any study of the relationship between lumbar 1–lumbar 4 total (L1–L4) and femoral neck bone mineral density (BMD), Ca, phosphorus (P), alkaline phosphatase (ALP), PTH and body mass index (BMI) by age. The aim of this study is to compare the levels of L1 - L4, femoral neck BMD, Ca, phosphorus (P), alkaline phosphatase (ALP) and PTH which are routinely used to assess bone health by age.

2. Materials and Methods

The records of 713 patients whose BMD measurements were taken with DEXA were examined retrospectively. Patients who had inflammatory rheumatic, endocrine disease; who use drugs that increase the risk of osteoporosis, such as corticosteroids and anti-epileptics; and who had previously been treated for osteoporosis including Ca and vitamin D, were excluded from the study. 106 patients were included in the study. The patients were divided into four groups according to their ages: Group 1, ages 40–49, 11 patients; group 2, ages 50–59, 42 patients; group 3, ages 60–69, 34 patients; and group 4, ages 70–79, 19 patients. L1-L4 total and femoral neck BMDs of the patients were recorded as gr/cm2. Ca, P, ALP, PTH and vitamin D values were extracted from patient files and recorded. L1-L4 total and femoral neck BMDs, Ca, P, ALP, PTH and vitamin D values were compared between groups.

Serum calcium, phosphorus, alkaline phosphatase, and parathyroid hormone were analyzed on the Siemens Healthineers Atellica® CH. Serum vitamin D levels were assessed in our hospital using a Shimadzu HPLC system with the LC-MS/MS method and the normal reference range for vitamin D level was accepted as 25-80 ng/ml (6).

This study was approved by the ethics committee of the Harran University Faculty of Medicine (2019-02).

2.1. Statistical analysis

The SPSS 20.0 (SPSS® for Windows, Chicago, IL, USA) software program was used for statistical analysis. Numeric data were presented as means ± standard deviations. The Kolmogorov–Smirnov test was performed for evaluating the distribution of numeric data. The independent samples t-test was used when the distribution of the numeric data was normal, whereas the Mann-Whitney U test was used when it was skewed. The one-way analysis of variance (ANOVA) test was used for inter-group comparisons when the distribution of numeric data was normal. The Bonferroni test was used as a post hoc test. In addition, the Kruskal–Wallis H test was used for comparison when the distribution was skewed, whereas the Mann–Whitney U test was used for paired comparison if the results were significant. Results with a p-value < 0.05 were considered statistically significant.

3. Results

Group 1 consisted of 11 patients with a mean age of 44.5±1.09 years; group 2 included 42 patients, 55.47±0.45 years; group 3 had 34 patients, 64.94±0.59 years; and group 4 included 19 patients, 73.42±0.66 years. BMI for each group was measured as 30.57±1.35, 32.66±0.81, 32.08±1.07, and 29.85±1.12, respectively. Laboratory and BMD results of the patients are summarized in the table 1.

Table 1. Laboratory and BMD results of the patients

	Group 1 n=11	Group 2 n=42	Group 3 n=34	Group 4 n=19	p
L1-L4 BMD	0.87±0.14	0.81±0.14	0.73±0.08	0.67±0.06	0.001
Femur BMD	0.79±.014	0.74±0.12	0.64±0.12	0.68±0.15	0.001
Ca	9.53±0.63	9.56±0.38	9.42±0.54	9.94±0.73	0.026
P	3.55±1.01	3.49±0.57	3.52±0.53	3.33±0.66	0.787
ALP	79.54±20.73	90.09±31.42	86.33±32.88	83.57±33.73	0.712
PTH	83.28±32.72	61.94±22.81	79.31±39.05	76.37±40.23	0.051
Vitamin D	14.58±7.04	17.03±12.90	20.16±19.50	12.02±7.79	0.358
BMI	31.07±4.42	32.09±5.67	32.33±5.76	29.95±5.44	0.533

Group 1: 40–49 ages; Group 2: 50–59 ages; Group 3: 60–69 ages; Group 4: 70–79 ages, Ca: Calcium, P: Phosphorus, ALP: Alkaline phosphatase, BMD: bone mineral density, BMI: Body mass index p: The independent samples t-test was used when the distribution of the numeric data was normal, whereas the Mann-Whitney U test was used when it was skewed.

There were no significant differences in BMI between the groups. The highest Ca value was observed among group 4 patients, and the comparison between the groups was statistically significant (p = .026). There was a significant difference between the age groups in femoral neck BMD (p = .001). When groups 1 and 3 and groups 2 and 3 were compared, the differences between the groups were significant (p = .004 and p = .007). The lowest value was in the 70–80 year age range, while the highest was in the 40–50 year age range. For L1–L4 total BMD, when groups 1 and 3, groups 1 and

4, groups 2 and 3, and groups 2 and 4 were compared, statistically significant differences were observed (p = .006, p < .001, p = .028, and p = .002, respectively). The highest value was found in group 1, and the lowest value was in group 4, as expected (p < .001). The difference was significant between the groups. There were no significant differences between the groups in terms of the variables for vitamin D, P, ALP and PTH.

4. Discussion

In our study, vitamin D levels were low in all groups. Older adults also observed low BMD and high calcium levels.

DEXA is measured as mineral density per bone area in gr/m^2, and bone resorption measurement is required for the diagnosis of osteoporosis. Studies also show that BMD values decrease with age and fragility is associated with low BMD (7). The results of our study support this. Femoral neck and L1–L4 BMD values in group 4 patients were lower compared to other groups, and this difference was statistically significant.

Vitamin D has an important role in Ca level and bone metabolism. However, its effect on bone metabolism has not been fully clarified (3, 4). Many studies show that vitamin D deficiency increases the risk of fractures, and it is estimated that approximately 1 billion people in the world are vitamin D deficient (8,9). The amount of vitamin D may differ due to climatic changes in different cities of the same country. Although Turkey receives a lot of sunlight, vitamin D deficiency is common (10, 11). In our study, although vitamin D levels did not differ between groups, it was a deficiency in all groups. Despite the fact that the region where the study was conducted has a warm climate, the level of vitamin D in patients was found to be low. This may be because the socio-cultural structure dictates a clothing style where clothes are worn to cover much of the body.

An animal study researched the effect of vitamin D and Ca on BMD and fragility. It was concluded that these substances reduce the risk of breakage independent of BMD (12). In another study, this was not found between Ca intake and BMD relation (13).

There are many studies investigating the relationship between Ca intake and BMD but no study of Ca value for age.

In our study, the highest Ca value was seen in group 4 patients. Although this difference was statistically significant between groups, calcium levels were normal. It was thought that immobilization might occur in the group of patients over 70 years old. Likewise, group 4 had the lowest femoral neck and L1–L4 total BMD values. A negative relationship was observed between high Ca and BMD values.

In terms of bone health, a sufficient amount of Ca should be taken daily. The daily intake of Ca recommended by the National Osteoporosis Foundation is 1,000 mg/day between the ages of 50 and 70 and 1200 mg/day for people over 71 years (14).

Although calcium was found to be statistically high in patients over the age of 70, it was at normal levels.

Serum ALP is a biochemical marker showing bone remodeling. In recent research, increased serum supports that ALP is associated with low BMD (5). In our study, serum ALP levels did not differ between age groups.

High PTH activates osteoclasts, which are responsible for bone destruction (15). In our study, PTH was at normal levels, and there were no significant differences between groups.

Low body mass is a preventable risk factor for osteoporosis. In one study, it was emphasized that BMI negatively affects BMD after 35 kg/m2 (16) in our study; all of the patients were overweight or obese. There were no significant differences between the groups.

Due to the retrospective nature of our study, important information such as lifestyle and dietary data that could affect BMD could not be obtained. In addition, the small number of patients is another important limitation of our study. We think that important data can be obtained as a result of designing studies prospectively and using a larger number of patients.

5. Conclusion

Consequently, in our study, in accordance with the literature, BMD was lower in patients with advanced age. In addition, a high calcium value was observed in older age; this result may be thought to be due to the immobilization of elderly patients.

Conflict of Interest: There is no conflict of interest in this study.

Ethics Committee Approval: Ethical approval was obtained from Harran Univesity Ethics Committee (Date:11.02.20119 Decision No:19.02.04) to conduct the study.

Authorship Contribution:

SS: Study conception , design and data collection, analysis and interpretation of results, draft manuscript preparation.

AY: Analysis and interpretation of results, draft manuscript preparation.

KCK: Analysis and interpretation of results.

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