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Correlation between QUS of Phalanx and DXA in Assessment of Bone Structure of Postmenopausal Women

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Abstract

This study planned for finding the agreement DXA and quantitative ultrasound (QUS) of phalanx in osteoporosis diagnosis and cut off point of QUS for osteoporosis diagnosis in postmenopausal women. In 180 postmenopausal women, BMD of axial regions with DXA (DPX-MD, GE, Lunar, USA) and phalanx with QUS (DBM-Sonic 1200) measured. Agreement of methods and cut off for QUS in defining osteoporosis obtained. Prevalence of osteoporosis with DXA was 28.8% (18.3% in L2-L4 and 3.9%-7.8% in femoral regions) and in 28.9% with QUS. Agreement of them (Kappa score) was 0.317 for spine and 0.036-0.068 for femoral regions. *T*-score= -2.0 was the cut off of QUS in spinal osteoporosis diagnosis (sensitivity=78.8% and specificity= 55.9%). We could not find cutoff point for osteoporosis in femoral regions. This means that QUS of phalanx is not a good replacement for DXA, but it can be used as a screening method for osteoporosis.

Keywords: *QUS of phalanx, DXA, BMD, Osteoporosis*

Introduction

Osteoporosis is a systemic disease of bone that is determined by reduced bone density and is defined by reduction of BMD to 2.5 SD below bone mineral density of young normal population. DXA method (Dual X-ray Absorptiometry) is the gold standard method for diagnosis of it (1). However it seems that other factors (other than bone mineral density) like elasticity and biomechanical characteristics of bone are also important in bone fragility. DXA is not a good method for assessment of such characteristics, so methods like QUS (quantitative ultrasound of bone) with their ability in assessing of such characteristics are more appreciated now for assessing the bone (2, 3). There is not a good correlation between QUS methods and DXA in diagnosis of osteoporosis (an Iranian study showed it 0.29-0.35 and other studies as 0.2-0.8 (4- 8), but some studies showed QUS can differentiate between women with fragility fracture and without it (9) and predict the pathologic fractures (10, 11). QUS of phalanx is a novel kind of QUS, noninvasive, low cost and very portable method that can be used extensively for assessing quality and quantity of bone in different regions and conditions. It measures Ad-SOS (Amplitude dependent Speed of Sound, m/s). Ad-SOS of normal young population is used as reference data for applying *T*-score for prediction the fracture risk in different cases. There is little data about agreement of this method with DXA in diagnosis of osteoporosis and the optimum cut-off point in

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this method for defining that disease (12-14). So we planned this study for finding cut off point of this method for osteoporosis diagnosis that can cause the extensive use of this method for assessment of bone in different conditions and regions.

Materials and Methods

Patients one hundred eighty healthy post-menopausal women, referred to BMD center of Endocrinology and Metabolism Research Center of Tehran University of Medical Sciences (EMRC-TUMS) for routine examination, after giving consent entered the study. Mean±SD age of participants was 52.22± 7.85 and mean±SD of years passed of menopause was 10.06±8.64. Their characteristics are shown in Table 1.

DXA and QUS DXA measurements of the lumbar spine and left hip were performed using a Lunar DPX-MD densitometer (Lunar Corp, Madison, WI). DXA BMD values were shown as *T* scores. QUS measurements of phalanx were performed using a DBM-sonic 1200 device. Ad-SOS is the parameter that is measured with it.

(All done with skillful operators).

Statistical analysis For analysis, *T*-scores were used. Osteoporosis and osteopenia were diagnosed according to the WHO definitions (osteoporosis: *T*-score=<–2.5, osteopenia: *T*-score<–1 and >–2.5, normal: *T*-score>-1).

SPSS10 was used for statistical analysis. Events and non-events were defined by *T*-score of DXA ("osteoporosis" as events and "normal or osteopenia," as nonevents). ROC curve plotted for QUS *T*-score. The points on the fit curve closest to the left upper corner were defined as cutoff points for the diagnosis of osteoporosis and osteopenia or normal. From these cutoff points, sensitivity and specificity were assessed for Ad-SOS in diagnosing osteoporosis and normal or osteopenia as alternative end points. Other points selected from the results according to different desired sensitivity and specificity levels of the test.

Table 1: Characterisitic of patients

parameters	
Age	57.22+- 7.87
Age of menopause	47.77±5.44
Weight	67.42±11.71
Height	157.86±5.69
BMI	27.07±4.50

Results

According to the World Health Organization definitions, osteoporosis was found in 28.8% of cases with DXA method (18.3% in L2-L4 and 3.9%-7.8% in different region of femur) and in 28.9% of cases with Phalanx ultrasonography (Table2). Kappa score was 0.317 for lumbar region and 0.036-0.068 for different regions of femur (Table3). Using ROC curves for defining the cut off point of this method for osteoporosis diagnosis, 95% CI (confidence interval) of area under of curve for diagnosis of osteoporosis in neck, trochanter and total areas of femure contained diagonal line (*P*=0.150,0.179 and 0.050, respectively), so we only found a cut off level for diagnosis of osteoporosis in lumbar region.(Fig. 1) .We found *T*-score = -2.0, as the optimum cut off point where the sensitivity and specificity of QUS to diagnose osteoporosis was 78.8% and 55.9%, respectively. We also defined two other values for cut off point (Table 4), when it is used as an screening method (that needs higher level of sensitivity) or as an diagnostic method (that needs higher level of specificity) according to different conditions (*T*-score=-1.5 and *T*-score=-2.5, respectively).

Table 2: Prevalence of osteoporosis in different regions with different methods

Region	Osteoporosis (%)
L2-L4	18.3
Neck	7.8
Throchanter	3.9
Total of femur	6.1
Phalanx	28.9

Table 3: Agreement (Kappa) between QUS of phalanx and DXA of different regions

Kappa	Neck *T*-Score	Trochanter *T*-Score	Total *T*-Score	Spine *T*-core
Phalanx T-Score	0.068	0.036	0.064	0.317

Table 4: Sensitivity and specificity of different cut off points

Cut-off points	Sensitivity 95%CI	Specificity 95%CI
-2.5	60.6% (42.2%-76.6%)	78.2% (70.5%-84.4%)
-2.0	78.8% (60.6%-90.36%)	55.9% (47.4%-64.00%)
-1.5	93.9% (78.4%-98.9%)	36.1% (28.5%-44.4%)

CI= Confidence Interval

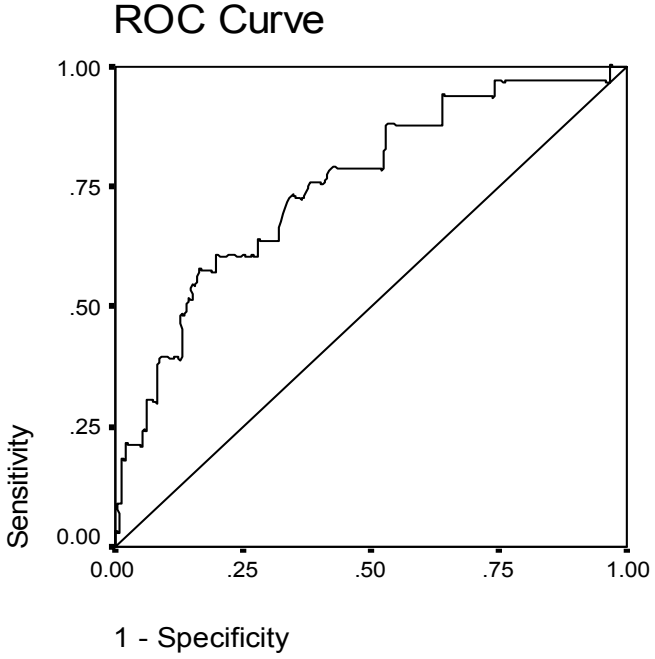

Fig. 1: ROC curve of diagnosis of osteoporosis in L2L4 region

Discussion

Osteoporosis is the most common metabolic disease of bone that cause low bone mass and microarchitecture changes of bone that can cause fragility fractures in different parts of the body

DXA is the standard method for bone mineral density (BMD) studies, but it is not widely available. As an alternative, quantitative ultrasound (QUS) is introduced as a portable, fairly inexpensive, easy to perform and radiation-free method. The mentioned advantages have suggested a role for QUS in screening studies. There is little data about agreement of this method with DXA in diagnosis of osteoporosis and the optimum cut-off point in this method for defining that disease (12-14). So we planned this study for finding cut off point of this method for osteoporosis. We also defined two other values for cut off point, because as a low cost and portable method QUS of phalanx, this method can be used in remote and district area, where DXA is not available, as an useful screening method. In this condition higher level

of sensitivity is needed for finding patients that are in risk of osteoporosis and refer them to higher levels health centers. But in big urban areas may be it is needed to use it with higher level of specificity to prevent excessive useless refer of patients for use of more expensive services like DXA methods.

However, our study show a weak to moderate agreement of two methods in diagnosis of osteoporosis. It means that QUS of phalanx can not be used as a replacement for DXA method, but it may be able to be used as a screening method for finding osteoporosis.

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