Bone mineral density of lumbar spine and femoral neck assessed by novel echographic approach-Radiofrequency Echographic Multi Spectrometry (REMS)

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Introduction

Bone mineral density (BMD) is used to diagnose osteoporosis. According to World Health Organization (WHO) osteoporosis was defined as a BMD value more than 2.5 standard deviations below the mean for normal young White women. X-ray absorptiometry (DXA) of proximal femur and lumbar spine is currently the gold standard used to confirm this diagnosis. Recent published studies introduced an innovative echographic approach, defined as REMS technology. The aim of this study is to compare REMS-based BMD values of lumbar spine and femoral neck between premenopausal and postmenopausal women.

Methods

In this study, a total of 165 women underwent echographic scan using REMS technology. Acquisitions of lumbar spine and femoral neck were done for each patient in two Bulgarian centers. The following characteristics of the women were recorded: age, weight, height, BMI and REMS-based BMD of lumbar spine L₁-L₄, total lumbar spine, femoral neck, trochanter and total hip.

Results

The mean REMS-based BMD measurements of postmenopausal group of L₁-L₄ and total lumbar spine were significantly lower than those of the premenopausal group (p=0.011). Femoral neck REMS-based BMD (p=0.007) and total hip REMS-based BMD (p=0.009) also differed significantly between the premenopausal and postmenopausal group.

Conclusion

Postmenopausal women showed significantly lower lumbar spine REMS-based BMD of L₁-L₄ and total lumbar spine REMS-based BMD compared to premenopausal women. Femoral neck REMS-based BMD of postmenopausal women was also significantly lower than those of premenopausal women.

KEY WORDS:

Original article

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Methods

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Statistical analyses

SPSS version 21.0 was used to assess the data. Descriptive statistic was used to present the characteristics of the women. The values of REMS-based BMD between premenopausal and postmenopausal group were compared by independent sample t test.

Results

The groups consisted of 25 premenopausal women (15.2%) and 140 postmenopausal women (84.8%). The mean age of the premenopausal and postmenopausal women was 43 years (range 24-50) and 65 years (range 38-86), respectively. The mean age of the postmenopausal women was significantly higher than those of the premenopausal women (p=0.000). Postmenopausal group was on average heavier (mean weight-70 kg) than premenopausal women (mean weight-66 kg) but the difference between the groups was not statistically significant. The mean height of postmenopausal women was significantly lower (154.7) compared to those of premenopausal women (159.8), (p=0.001). Premenopausal women had lower mean BMI (25.8) compared to postmenopausal women (29.2) and the difference between the mean BMI values of premenopausal and postmenopausal women was statistically significant (p=0.007) (Table 1). The mean REMS-based BMD measurements of premenopausal group of L₁-L₄ (BMD=0.720; 0.795; 0.854; 0.876) and total lumbar spine, as well REMS-based BMD values of femoral neck, trochanter and total hip were measured. The following characteristics of the women were recorded: age, weight, height and BMI. Women were divided into two groups: premenopausal and postmenopausal. Acquisitions were performed by certified operator who was the same for all assessments. Transducer focus and scan depth were set to appropriate centimeters to have each lumbar vertebral and femoral neck interface in the focal zone and in the central part of the image.

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Discussion

In this study, we assessed the values of lumbar spine and hip REMS-based BMD of premenopausal and postmenopausal women using novel echographic approach - Radiofrequency Echographic Multi Spectrometry (REMS). Furthermore, we compared lumbar spine and hip BMD values in premenopausal and postmenopausal group. Postmenopausal women had higher BMI as compared to premenopausal women and BMI values differed significantly between the two groups. In general, both groups had BMI in the overweight range (BMI>25 kg/m²). Postmenopausal women showed significantly lower REMS-based BMD of L₁-L₄ and total lumbar spine. REMS-based BMD as compared with premenopausal women. Other studies, which compared BMD values of premenopausal and postmenopausal women using dual-energy X-ray absorptiometry (DXA) technology, have reported similar results (9, 10). It is well known that bone loss accelerates in postmenopausal years. Menopause in women significantly increases bone resorption due to low levels of estrogens (11). In the current study, there was also significant difference of femoral neck REMS-based BMD values between premenopausal and postmenopausal women. In our study, premenopausal women showed relatively low femoral neck BMD (0.713), which was within the osteopenic range. Low femoral neck BMD value among premenopausal women could result from significant femoral neck bone loss among this group as reported in other studies, which used DXA technology. Femoral neck bone loss more than 0.5 standard deviations (SD) before menopause from age 30 through 50 years was supposed by Siu et al. (12). In addition, other study has found that femoral neck site is sensitive to bone loss in the perimenopausal period with a significant 3-year decline (1%) in BMD at the femoral neck, whereas the same study did not find significant annual change in the lumbar spine in premenopausal women (13). The presence of low femoral neck BMD in the premenopausal women could also explained.

Table 1 - Age, weight, height and BMI of premenopausal and postmenopausal women-mean, maximum, minimum and p-value.

<table>
<thead>
<tr>
<th>Characteristics of the women</th>
<th>Premenopausal (N=25)</th>
<th>Postmenopausal (N=140)</th>
<th>p-value</th>
</tr>
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<tbody>
<tr>
<td>Age</td>
<td>Mean, Maximum, Minimum</td>
<td>Mean, Maximum, Minimum</td>
<td></td>
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<td>Age</td>
<td>43, 50, 24</td>
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<td>Weight (kg)</td>
<td>66, 116, 43</td>
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<td>Height (cm)</td>
<td>159.8, 178.0, 148.0</td>
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<tr>
<td>BMI (kg/m²)</td>
<td>25.7536, 45.8800, 16.9000</td>
<td>29.2423, 47.2200, 18.5200</td>
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</tr>
</tbody>
</table>
Conflict of interest
Elena Kirilova, Nikola Kirilov, Iliya Popov and Stoyanka Vladeva declare that they have no conflict of interest.

References

with the peak of bone density. The peak bone density of the spine in premenopausal women was detected between 35 and 39 years of age, and that of femur before 20. This could be the reason why premenopausal women begin to lose bone mass earlier at femoral neck than at lumbar spine (14-17).

Limitations of the study
The present study suffered from some limitations associated with the novel approach. First of all, the physiological variability of the acoustic properties of the soft tissue from patient to patient was taken into account, but slight deviations could not be excluded. Secondly, REMS technology analyzed only the spectral features of ultrasound signals from the trabecular region, even if cortical region has been demonstrated to have important contribution to bone strength, especially at femoral neck (7). Despite of these limitations, recent published study showed highly correlation between DXA and REMS results.

Conclusion
This is the first study, which compared lumbar spine REMS-based BMD and hip REMS-based BMD values in premenopausal and postmenopausal women. Postmenopausal women showed significantly lower lumbar spine BMD values than premenopausal women and this tendency was also valid for femoral neck BMD.

<table>
<thead>
<tr>
<th>REMS-based BMD</th>
<th>Groups</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
<th>p-value (T test)</th>
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<td>L1</td>
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<td>0.843</td>
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<td>0.720</td>
<td>0.115</td>
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<td>0.922</td>
<td>0.102</td>
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</table>
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