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Original Article

Evaluation of biochemical and bone density parameters in premenopausal and postmenopausal women

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ABSTRACT

Osteoporosis is a bone disease of low bone mass and bone tissue deterioration resulting in an increased risk of fracture. The objective of this study was to analyse biochemical and bone density measurements on the dual energy X-Ray absorptiometry (DEXA) instrument among postmenopausal women in comparison to premenopausal women. A cross-sectional prospective study was carried including 20 premenopausal women of 25-40 years age and 20 postmenopausal women of 40-70 years age. Biochemical markers and bone density measures at the regions of lumbar spine (L1-L4), neck of the femur and forearm were assessed among all subjects. An unpaired student t-test was used to test differences between groups. The significance level was set at a statistical value, $p<0.05$. Serum phosphorus and alkaline phosphatase levels were low in l postmenopausal women in comparison to premenopausal group. There were significant differences between groups in bone mineral content, bone mineral density, T-score and Z-score measures. Among all the three regions studied for bone density, lumbar spine was found to be at increased risk. The present study results suggest that postmenopausal women are at increased risk for osteoporosis. We recommend that postmenopausal women should be screened for osteoporotic fracture risk which might be an important strategy in the management of postmenopausal osteoporotic risk.

1. Introduction

Osteoporosis is a disease of the bone characterized by low bone mass, deterioration of micro architecture of the bone tissue leading to increased skeletal fragility and an increased risk of fracture [1]. Osteoporosis is most common in women after menopause called postmenopausal osteoporosis. Menopause is associated with an imbalance in bone metabolism, and the first five to ten years after menopause is the period of higher bone turnover and bone loss [2]. Approximately 35% of postmenopausal women lose significant amounts of bone mineral during this period and are at a higher risk for osteoporosis and fragility fractures later in life [3]. The decline in ovarian estrogen

production is the main determinants of this imbalance, but estradiol serum levels explain only a small proportion of inter individual variance of bone mineral density and bone loss.

The occurrence of osteoporosis in postmenopausal women is a common problem in India. The disease is widely prevalent in India. Sixty-one millions in India were reported to be affected by it and hip fractures are common in osteoporosis [4, 5]. It was recently reported that Indians have lower bone density than their western and European counterparts [1]. It was also showed that the bone mineral density values in Indian population were 15% lower than the western population [6-8].

Biochemical markers of bone turnover reflect bone formation or resorption. Serum markers include alkaline phosphatase, serum ionised calcium, phosphorus and osteocalcin. Studies have shown that a high bone turnover is associated with low bone mass and increased risk of fractures. These markers may not diagnose osteoporosis or predict bone density but they are of use in predicting response to treatment [9]. Bone density is the major measurable determinant of the risk for osteoporotic fracture. Bone mass increases during childhood and adolescence, peaks in the third or fourth decade of life, remains stable for some years during menacme and declines progressively thereafter, with a sharp acceleration of bone loss during the five to ten years after menopause, ranging from less than 1% to more than 5% per year [10-13]. Measurement of bone mineral density is a preferred method to diagnose osteoporosis. The dual energy X-Ray absorptiometry (DEXA) is now the gold standard to detect osteoporosis even before a fracture has occurred.

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The purpose of this study was to evaluate the biochemical parameters such as serum calcium, phosphorus, alkaline phosphatase and bone density parameters including bone mineral area, bone mineral content, bone mineral density, T-score and Z-score measured at lumbar spine (L1-L4), neck of the femur and fore arm regions in postmenopausal women in comparison to premenopausal women.

2. Material and methods

Subjects

This study prospectively enrolled 40 subjects divided according to their menopausal status into two groups. Group I comprising of 20 premenopausal women aged between 25-40 years were considered as a control group. The other 20 subjects in group II were postmenopausal women aged between 40-70 years. Exclusion criteria involved smokers, alcoholics, subjects with diabetes mellitus, hepatic diseases, renal disorders, Cushing's syndrome and auto immune diseases such as rheumatoid arthritis. All subjects were recruited form the endocrinology and metabolism department of Sri Venkateswara Institute of Medical Sciences (SVIMS), Tirupati, India. The menopausal status was determined on the basis of clinical history, symptoms like cessation of menstrual cycles, hot flushes and irritability. The study was carried after obtaining permission by the institutional ethics committee.

Methods

Blood samples were drawn into tubes containg no anticoagulant. Blood specimens were centrifuged for 15 min at 3000rpm, and aliquots of serum samples were used for biochemical screening of total cholesterol (TC), triglycerides (TG), creatinine, calcium, phosphorus and alkaline phosphatase using commercial kits. In this study, the dual energy X-Ray absorptiometry (DEXA) is the method employed for bone mineral density measurements. Bone mineral area, bone mineral content, bone mineral density, T-score and Z-score were documented at three sites including lumbar spine (L1-L4), neck of the femur and fore arm (1/3rd of radius + ulna). The T-score is the measure of how many standard deviations the patient's measurement differs by from young healthy controls, while Z-score is a measure of how many standard deviations the patient's measurements differs by form age-matched controls.

Statistical analysis

Data were presented as mean ± standard deviation (SD). A two-tailed, unpaired student t-test was used to determine statistical differences between two groups. Statistical significance was assumed at $P<0.05$. Data were analyzed using SPSS for Windows 11.5 program (SPSS Inc, Chicago, IL, USA).

3. Results and discussion

The mean±SD of demographic and biochemical parameters studied are presented in Table 1. Various measurements of bone mineral density at three different sites such as lumbar spine (L1-L4), neck of the femur and fore arm (1/3rd of radius + ulna) are depicted in Table 2.

TABLE 1. The demographic and biochemical characteristics of premenopausal and postmenopausal groups

Variables (Mean ± SD)	Group I Premenopause (n=20)	Group II Postmenopause (n=20)
Age(Yrs)	39.50 ± 5.20	52.84± 10.0*
BMI(Kg/m^2)	27.63± 5.16	26.28± 4.57
SBP(mm of Hg)	114.0 ± 10.95	119.50 ± 8.26
DBP(mm of Hg)	75.50 ± 7.59	78.50 ± 3.66
Pulse rate(Beats/min)	74.45 ± 2.61	77.80 ± 7.05
Cholesterol (mg/dl)	159.75 ± 39.91	168.40 ± 34.96
Triglycerides (mg/dl)	121.40 ± 19.8	137.90 ± 45.8
Calcium (mg/dl)	10.03 ± 0.42	10.06 ± 0.38
Phosphorus (mg/dl)	3.58 ± 0.87	3.11 ± 0.54**
Alkaline phosphatase (IU/L)	100.0 ± 38.61	93.20 ± 18.41

(Statistical significance, *p<0.001, **p=0.04), SD: standard deviation, BMI: body mass index, SBP: systole blood pressure, DBP: diastole blood pressure

TABLE 2. The measurements of bone mineral density at several sites among premenopausal (Group I) and postmenopausal (Group II) groups

Variables (Mean ± SD)	lumbar spine (L1-L4)		Neck of the femur		fore arm (1/3rd of radius + ulna)	
	Group I	Group II	Group I	Group II	Group I	Group II
Bone mineral area	47.9±12.0	47.0±3.7	4.4±0.5	4.4±0.4	4.6±0.4	4.4±0.3
Bone mineral content	53.0±10.6	35.8±6.6*	3.9±0.6	2.9±0.4*	3.3±0.4	2.6±0.3*
Bone mineral density	1.0±0.1	0.7±0.1*	0.9±0.1	0.6±0.07*	0.7±0.06	0.6±0.08*
T-score	0.2±0.8	-2.6±0.9*	0.3±0.09	-1.7±0.6*	0.6±0.01	-1.7±1.1*
Z-score	0.4±0.08	-1.6±0.7*	0.6±0.9	-0.7±0.6*	0.99±1.0	-0.85±1.0*

*(statistically significant compared to group I, p<0.001), SD: standard deviation, Group I: premenopausal women (n=20), Group II: post menopausal women (n=20)

The results of our study showed that age was significantly increased in group II when compared to group I. There were no significant differences in BMI, serum levels of total cholesterol and triglycerides between groups which may probably indicate similar life style and nutritional habits of subjects in both groups. SBP, DBP and pulse rate were similar in both groups indicating normal functioning of cardio vascular system even with decreased ovary function in postmenopausal group. There were no significant

changes between groups in the biochemical indicators of bone metabolism such as calcium and alkaline phosphatase. However, serum alkaline phosphatase was found to be decreased in group II but the difference was not statistically significant when compared to group I. Moreover, phosphorus, the major content of bones was observed to be significantly decreased (p=0.04) in the serum of postmenopausal women compared to premenopausal women in group I (Table 1).

Bone density parameters were studied through bone mineral area, bone mineral content, bone mineral density, T-score and Z-score at the regions of lumbar spine, neck of the femur and fore arm comprising one-third of radius plus ulna. It was observed that bone mineral area data obtained at all three regions was similar between two groups. However, we found a significant decrease in both bone mineral content and bone mineral density at all three sites in postmenopausal women compared to women in the premenopausal group. In addition, it was also observed that there were significant differences in both T-score and Z-score values between premenopausal and postmenopausal subjects (Table 2). Furthermore, a much difference in T-score was documented at the region of lumbar spine compared to the other two sites such as neck of the femur and fore arm suggesting more osteoporosis risk at lumbar spine. In line with this, Krolner B et al [14] showed accelerated bone loss accounting to 67% immediately after the menopause with the lumbar bone fracture risk being inversely related to bone mineral content.

The current study findings are well in line with the previous studies reporting lower bone mineral density values that are continued to decrease after the onset of menopause. Nuti R and Martini G [15] showed that bone mineral density values in both healthy post menopausal and osteoporotic women were significantly lower than premenopausal values and continued to decrease significantly after the onset of menopause. Our study supports several previous reports in the literature by Madhuri V and Keerthi reddy M [1], Cranney A et al [16] and Ravin P et al [17]. Accordingly, our findings in this study indicate the risk for osteoporosis in the postmenopausal women. It is well known that estrogen deficiency associated with menopausal status may result in bone changes. Estrogen is vitally important in regulating osteoblast and osteoclast function and maintains a proper balance of activity between the two important cell types in bone tissue. Without adequate estrogen, osteoclast activity can start to overpower osteoblasts, and bones lose their density. However, Felson DT et al [18] studied the effect of postmenopausal estrogen therapy on bone density in elderly women and observed that bone density was 3.2 percent higher in women receiving estrogen than in women who had never taken estrogen. They concluded that women should take estrogen for at least seven years after menopause for long term preservation of bone mineral density. Recently, Harinarayan CV et al [19] recommended diet enriched with calcium and vitamin-D for postmenopausal women considering for hormonal therapy.

In conclusion, despite no significant difference in BMI, cholesterol, triglycerides and calcium levels between groups, our postmenopausal women showed a significant decrease in serum phosphorus levels with a non-significant decline in alkaline phosphatase values. Bone mineral content, bone mineral density, T-score and Z-score values in postmenopausal group indicates osteopaenia and osteoporosis risk. These findings of current study confirm the risk of osteoporosis among postmenopausal women. Our observation of much difference in T-score at the region of lumbar spine reflects the more susceptibility of osteoporosis risk at this site than neck of femur and fore arm regions.

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