ASSOCIATION OF URINARY CALCIUM AND PHOSPHATE WITH BONE MINERAL DENSITY AMONG POSTMENOPAUSAL WOMEN

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ABSTRACT

Introduction: Development of peak bone mass and premenopausal bone loss is determined by the menstrual status of a women. Objective of this study was to determine the association of urinary calcium and phosphate with bone loss in post-menopausal women. This study is cross sectional. It was carried out in the Department of Biochemistry, Basic Medical Sciences Institute, Jinnah Postgraduate Medical Centre, Karachi.

Method: Females (n = 90) were assessed with measurements of Body Mass Index, 24 hour urinary excretion of calcium creatinine ratio, Phosphate creatinine ratio. Bone mineral density of women was evaluated by Dual Energy X-ray Absorptiometrey (DEXA) and its association was analyzed with urinary calcium creatinine ratio and urinary phosphate creatinine ratio.

Results: Twenty two (44%) postmenopausal women were found to be osteoporotic while 24 (48%) were osteopenic on the basis of BMD measurements. The mean urinary calcium creatinine ratio and phosphate creatinine ratio was increased in postmenopausal women compared to pre-menopausal women ($p < 0.001$). A significant negative correlation was found between BMD (hip) and urinary calcium and phosphate ($r = -0.65$, $p < 0.05$) ($r = -0.58$, $p < 0.01$) respectively in post-menopausal osteoporotic women.

Conclusion: Urinary calcium and phosphate creatinine ratio appears to be a valuable markers for assessing bone loss in postmenopausal women.

Key Words: Postmenopausal women, Osteoporosis, Urinary Calcium Phosphate Creatinine ratio, Bone Mineral Density, Body Mass Index.

INTRODUCTION

Development of peak bone mass and premenopausal bone loss is determined by the menstrual status of a women.[1] Decline in bone mass with age becomes accelerated during menopause. Menopausal bone loss refers to the accelerated bone loss that occurs during the perimenopausal age and after the final menses.[2] Bone as a dynamic tissue constantly undergoes formation and resorption and the process is balanced in healthy adults, however the exceptions are growing children and menopause.[3]

Bone is a connective tissue that provides mechanical support to the body vital organs and act as reservoir of calcium and phosphate as 99% of calcium and 85% of phosphate are present in skeleton.[4] Peak bone mass is achieved during the third decade of life which gradually declines leading to osteopenia (low bone mass) which predisposes to osteoporosis.[5] Various risk factors are involved for the decline in Bone Mineral Density (BMD) including dietary deficiency of calcium, phosphorus and vitamin D.[6] Studies have shown the association of increased bone mineral density with higher calcium intake compared to those with low bone mass density due to lower calcium intake.[7] Similarly dietary intake of adequate phosphorus is required for bone growth and its deficiency results in decreased bone formation and mineralization.[8] Decline in bone mineral density is manifested by structural deterioration and low bone mass which ultimately leads to bone fragility and fractures, specially in elderly postmenopausal women where spine and hip fracture results in high morbidity and mortality.[9,10]

Bone formation and resorption is analyzed by measuring the concentration of bone turnover markers in blood or urine (or both). However bone resorption markers are considered as strong predictors of bone loss as compared to bone formation markers.[11,12] Bone mass can be determined by bone mineral density measurements for assessing fracture risk and diagnosing osteoporosis.[13] Many technologies are available for measuring bone mineral density but Dual Energy X-ray Absorptiometry (DEXA) has been reported by many investigators as gold standard for measurement of bone mass density.[14]

The aim of this study was to investigate the sig-

nificance of urinary calcium and phosphate excretion in assessing bone loss in postmenopausal women and to find out their association with bone mineral density.

PATIENTS AND METHODS

This cross sectional study was conducted in the Department of Biochemistry, Basic Medical Sciences Institute (BMSI), Jinnah Postgraduate Medical Centre Karachi, from Jan 2007 – July 2007 in collaboration with Karachi Institute of Radiotherapy and Nuclear Medicine (KIRAN). A group of 90 healthy females (40 premenopausal and 50 postmenopausal) were selected from general population belonging to different socioeconomic status and ethnicity. Age group of premenopausal women was between 20 – 35 years whereas postmenopausal women were in 46 – 75 years of age. All women had normal liver and renal function and were not taking any drug like bisphosphonates, calcium vit D supplements, Calcitonin, hormone replacement known to affect bone metabolism.

Twenty four hour urinary calcium was estimated by the spectrophotometric method using Kit Catalogue no. CA590 by Randox. Urinary phosphate was estimated by spectrophotometric method using Kit Catalogue no. 11508 by Biosystem SA. For 24 hour urinary calcium and phosphate analysis, urine samples were collected in clean plastic containers. The pH of urine was adjusted to > 2 by adding 2ml HCl and mixed thoroughly. Total volume measured and aliquotes were stored at -20°C until analysis. Calcium creatinine ratio and phosphate creatinine ratio per gram of creatinine were calculated to check the renal function. Height and weight was measured in meters and kilograms respectively and BMI was calculated by using the formula Wt/Ht^2 (weight in kilograms divided by height in (meters).[2]

Bone Mineral Density of subjects was analysed by Dual Energy X-ray Absorptiometry (DEXA) at two sites, lumber spines ($L_1 – L_4$) and hip bone. Hip bone measurements included at total hip, femoral neck, trochanter, intertrochanter and Ward's triangle.

Statistical Analysis

The data feeding and analysis was done on computer package SPSS version 11. Statistical comparison was performed using student t test. Pearson coefficient of correlation was calculated between BMD (postmenopausal females) and 24 hour urinary calcium and phosphate. In all statistical analysis p value < 0.05 was considered significant.

RESULTS

Table 1 shows the comparison of BMD and urinary calcium and phosphate in pre and postmenopausal women. There is significantly increased excretion of urinary calcium and phosphate in postmenopausal women ($p < 0.001$) compared to premenopausal women. BMD values were significantly lower in postmenopausal women compared to premenopausal women ($p < 0.001$).

Mean age of osteopenia cases was (54.38±1.69). The mean age of osteoporosis cases year was (59.18 ± 1.64).

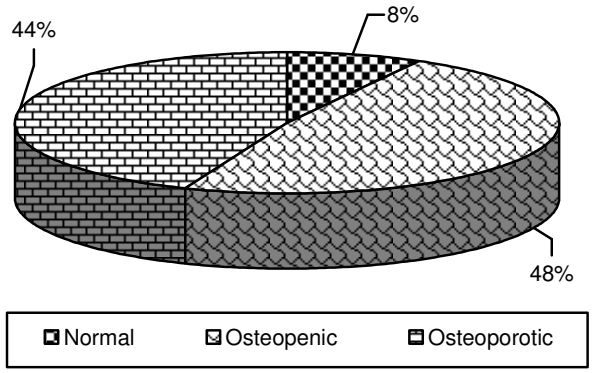

Fig. 1:

Table 1: *Comparison of Age, BMD, urinary Calcium and Phosphate in pre and postmenopausal women.*

	Premenopausal women n = 40 Mean (± SEM)	*Postmenopausal women n = 50 Mean (± SEM)*	*t*	*p-value*
Age	28.45 ± 0.806	56.06 ± 1.1.171*	2.027	.050
Biochemical parameters				
Urinary Calcium (mg/gm creatinine)	126.12 ± 4.975	216.80 ± 11.24*	7.680	.00
Urinary Phosphate (mg/gm creatinine)	463.08 ± 11.493	527.20 ± 18.02*	3.452	.001
Bone mineral density at Hip bone (gm/cm^2)	1.088 ± 0.026	0.774 ± 0.017*	-9.44	.00
Bone mineral density at Lumbar spine (gm/cm^2)	0.939 ± 0.016	0.794 ± 0.017*	-6.81	.00

Table 2: *Correlation coefficient of biochemical parameters with BMD in postmenopausal osteoporotic women.*

S. No.	*Biochemical Parameters*	*r Value at hip bone*	*r value at lumber spine*
1.	Urinary Calcium (mg/gm creatinine)	– 0.65**	– 0.13
2.	Urinary Phosphate (mg/gm creatinine)	– 0.58*	– 0.07

*P < 0.05, ** P < 0.01

Fig 1 shows distribution of postmenopausal women into normal, osteopenic and osteoporotic according to the finding of bone mineral density measured at hip and lumbar spine.

Significant negative correlation is observed between BMD at hip bone and urinary calcium, phosphate excretion in postmenopausal osteoporotic women. This correlation is shown in table II. No significant correlation was found between BMD at lumbar spine and hip bone with urinary calcium and phosphate excretion in postmenopausal osteopenic women.

DISCUSSION

Results of this study show no significant difference in body mass index in pre and postmenopausal women except age which was significantly higher among postmenopausal group. Higher mean values of urinary calcium: creatinine ratio and phosphate : creatinine ratio were found in the postmenopausal group compared to the premenopausal group as shown in table I. Similar results are reported in a study by *George BO,* which has highlighted the fact that biochemical parameters can be used to monitor bone loss in elderly persons.[4] Baseline levels of bone markers is not only helpful in diagnosing osteoporosis in early stage but also for predicting future bone loss in postmenopausal women.[15,16] Use of biochemical markers of bone turnover is beneficial for assessing changes in BMD during anti resorptive treatment and in population studies of osteoporosis.[15,17] Previous studies have shown that bone turnover is so enhanced in osteoporosis that even crude and nonspecific biochemical markers like alkaline phosphatase and urinary hydroxyproline levels have been considered as reliable index of bone turnover.[18]

The expression of urinary calcium and phosphate in relation to creatinine is due to relatively constant amount of creatinine excretion in urine proportional to the muscle mass of an individual and thus taken as reference standard.[4]

In this study bone mineral density observed at hip and lumbar spine in pre and postmenopausal women shows a significant reduction among postmenopausal women compared to premenopausal women. Similar results are given by a previous study.[19] Another study has reported variation in BMD values in women of different menstrual status and low BMD values which leads to the diagnosis of osteopenia and osteoporosis.[20]

There was a significant negative correlation of calcium and phosphate with bone mineral density at hip bone in postmenopausal women as compared to premenopausal women. Similar results has also been highlighted by *Deutschmann et al*[21] who has found association of hypercalciuria with severe osteoporosis. The significant correlation of urinary calcium, phosphate suggest that the factors that increases the urinary excretion of calcium and phosphate would affect the quality of bones both in males and females.[22] This significant inverse correlation of urinary calcium and phosphate with BMD at hip bone as seen in osteoporotic females in our study reveals, that in senile osteoporosis proportionate loss of both cortical and trabecular bone and increased risk of hip and vertebral fractures, compared to the osteoporosis occurring within 10 years after menopause in which there is more trabecular bone loss leading to vertebral crush fractures.[23] The irreversible nature of osteoporosis demands that it should be prevented by optimizing peak bone mass and minimizing bone loss specially in elderly individuals.[10,24]

It is thus, concluded that urinary calcium and phosphate can be used as valuable markers of bone loss in postmenopausal women and further studies are necessary to highlight their role in the diagnosis and prognosis of postmenopausal osteoporosis. These biochemical bone markers are inexpensive and valuable predictors of bone loss at all ages especially in the postmenopausal women. Evaluation of bone loss by these biochemical markers also decreases the risk of osteoporotic fractures which may be due to estrogen deficiency or nutritional deficiencies.

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