

Correlation of Common Biochemical Markers for Bone Turnover, Serum Calcium, and Alkaline Phosphatase in Post-Menopausal Women

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Abstract

The quality of life for women after menopause is one of the key health issues today, and osteoporosis is a silently progressing metabolic bone disease widely prevalent in post-menopausal women in India. Rapid bone loss occurs in post-menopausal women due to hormonal factors that lead to an increased risk of fractures. Thus, the present study was undertaken to observe the serum calcium and alkaline phosphatase (ALP) levels in post-menopausal women as these substances are biochemical markers of bone metabolism. In this small-scale cross-sectional study, 100 samples were taken. Of these, 50 were taken from post-menopausal women (experimental group) and 50 were taken from pre-menopausal women (control group). Serum calcium and serum ALP were measured in the blood samples of both groups. The findings demonstrated that the serum calcium level was significantly lower in the post-menopausal group than in the pre-menopausal group, while the ALP level was slightly higher. Therefore, an increase in bone turnover accelerates bone mass reduction in post-menopausal women, whereas a decrease in bone turnover is associated with the preservation of bone mass.

Keywords: alkaline phosphatase, calcium, menopause, osteoporosis

Introduction

The word 'menopause' is derived from two Greek words, 'meno' (month) and 'paus' (to stop). Clinically, menopause is said to have occurred when menstruation has ceased for twelve months (1). Physiologically, menopause is defined as the permanent cessation of menses resulting from reduced ovarian hormone secretion that occurs naturally or is induced by surgery, chemotherapy, or radiation (2). The post-menopausal stage in women is essentially an oestrogen-deficient state (1). Both menopause and aging are associated with an accelerated loss of bone mass. Menopause occurs when the balance between bone formation and resorption is upset and resorption is excessive, resulting in a negative remodelling balance (3). Osteoporosis is an important public health problem in middle-aged and older women.

Osteoporosis is more common in post-menopausal women and not only gives rise to morbidity but also markedly diminishes the quality of life in this population. There is lack of information regarding the risk factors of osteoporosis in developing countries (4). Serum alkaline phosphatase (ALP) is the most commonly used biomarker of bone formation. ALP is a ubiquitous enzyme that plays an important role in osteoid formation and bone mineralisation. The serum ALP pool consists of several dimeric isoforms that originate from various tissues, such as the liver, bone, intestine, spleen, kidney, and placenta (5). Thus, the aim of the present study is to evaluate the risk of accelerated bone mass loss by assessing bone markers, such as alkaline phosphatase (ALP) and serum calcium, in post-menopausal women.

Methods and Materials

This small-scale cross-sectional study was performed on a total of 100 subjects who were divided into an experimental group of 50 post-menopausal women (> 45 years old) and a control group of 50 pre-menopausal women (12–40 years old). The exclusion criteria for post-menopausal subjects included smoking, alcoholism, and calcium supplementation, whereas the exclusion criteria for pre-menopausal subjects were pregnancy, smoking, alcoholism, and oral contraceptive use. The results for continuous measurements are presented as the mean (SD) (min-max). The results were considered significant at $P < 0.05$. Student's t test (two tailed, independent) was used to determine the significance of study parameters on a continuous scale between two groups. The Pearson correlation coefficient was computed in the experimental group. The software package used for statistical analysis (SPSS) 15.0 (IBM Corporation, India) was used to analyse the data.

Results

Table 1 shows that serum calcium levels were significantly reduced ($P = 0.000$) in the post-menopausal group 8.73 (SD 0.60) when compared to the pre-menopausal group 9.65 (SD 0.68); however, the serum calcium levels in both groups were within the normal reference range. The serum ALP levels were slightly higher in ($P = 0.046$) in the post-menopausal group 111.86 (SD 66.5) when compared to the pre-menopausal group 82.40 (SD 78.50). The ALP values were also in the normal reference range. Table 2 shows a significant negative correlation between calcium and ALP ($r = -0.1496$), wherein serum ALP levels were elevated in post-menopausal women and serum calcium levels were reduced.

Discussion

Menopause is known to be associated with numerous physiological and biochemical changes affecting bone mineral metabolism. The results of various case control studies in pre- and post-menopausal women have shown that changes in the serum calcium levels in post-menopausal women are not statistically significant (6–8); however, in the present study, we found that the serum calcium levels were significantly reduced in the post-menopausal group 8.73 (SD 0.60) when compared to the pre-menopausal group 9.65 (SD 0.68) ($P = 0.000$) (Table 1). Ashuma et al. reported that aging and menopause lead to a decline in oestrogen and progesterone production, which has been implicated in the increased calcium levels of post-menopausal women (6).

Table 2: Pearson correlation coefficient of serum calcium and serum ALP levels in post-menopausal women

Correlation Coefficient	Case ($n = 50$)
r value between calcium and ALP in post-menopausal women	-0.1496

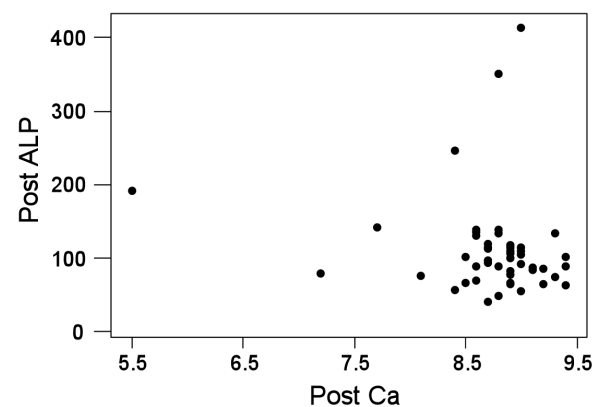


Table 1: Comparison of mean values of Ca (mg/dL) and ALP (U/L) between post and pre-menopausal women

Variable	Post-Menopausal				Pre-Menopausal				P	t
	Mean	SD	Mini	Max	Mean	SD	Mini	Max		
Calcium mg/dl	8.73	0.60	5.50	9.40	9.65	0.68	9.00	13.50	0.000	7.09*
ALP U/l	111.86	66.56	41.00	414.00	82.40	78.50	21.00	550.00	0.046	2.03*

* indicate the significant values at $P < 0.05$.

Conversely, the serum alkaline phosphatase (ALP) levels were significantly increased in the post-menopausal group 111.86 (SD 66.5) compared to the pre-menopausal group 82.40 (SD 78.50) ($P = 0.046$) (Table 1). It has also been shown that oestrogen deficiency, as occurs during menopause, induces the synthesis of cytokines by osteoblasts, monocytes, and T cells and thereby stimulates bone resorption by increasing osteoclastic activity. This action results in modification of the reabsorption, excretion, and resorption of calcium, which leads to increased circulating levels of this ion (9–12). Thus, we have reported a negative correlation between serum calcium and ALP levels in post-menopausal women (Table 2). Several studies have reported no significant correlation between serum calcium levels and ALP when assessing various years since menopause (YSM) (13–18). However, contrary to these findings, higher levels of calcium and ALP have been demonstrated in early post-menopausal women (≤ 10 YSM) compared with late menopausal women (≥ 10 YSM) (12).

Conclusion

In normal post-menopausal women, an increase in bone turnover accelerates bone mass reduction. The present study reveals that serum calcium levels are significantly reduced in post-menopausal women, whereas serum ALP levels are significantly increased. In addition, a significant negative correlation was observed between serum calcium and ALP levels in the experimental group.

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Conflict of Interest

None.

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Authors' Contributions

Conception and design, analysis and interpretation of the data: TB, KB, PC, PS

Drafting of the article: TB, KB, PS

Critical revision of the article for the important intellectual content: KB, PS

Final approval of the article: TB, KB, PC, PS

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