

Changes in Serum Calcium, Albumin and Alkaline Phosphatase Levels of Postmenopausal Women

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Abstract

A case-control cross-sectional study was carried out to observe the changes in serum calcium, albumin and alkaline phosphatase levels of postmenopausal women compared to their premenopausal counterparts. This is to enable us ascertain the relative risk of developing osteoporosis in postmenopausal women in Bangladesh. One hundred and eighteen (118) apparently healthy females (59 premenopausal=control and 59 postmenopausal=case) were selected for the study. The study was carried out in the Department of Biochemistry, Mymensingh Medical College in cooperation with the Department of Gynecology, Mymensingh Medical College Hospital and Community Based Medical College Hospital Bangladesh during the period from January to December 2009. Data were collected through clinical evaluation from pre-selected questionnaires. Fasting venous blood samples were taken for laboratory investigations. Serum calcium and albumin was determined using colorimetric method and enzymatic end point method was used to determine serum alkaline phosphatase levels. Statistical significance of difference between two groups were evaluated by using Student's unpaired 't' test with the help of SPSS software package. The results showed statistically significant decrease in serum calcium and albumin ($p < 0.01$) of menopausal women compared to reproductive age group. The postmenopausal women had significantly higher ($p < 0.01$) concentrations of serum alkaline phosphatase than the premenopausal women with regular menstruation. Therefore, it can be concluded that menopause leads to the increased risk of osteoporosis by decreasing serum calcium and albumin and by increasing alkaline phosphatase levels. The decreased serum calcium and increased alkaline phosphatase levels indicate that menopause is an independent risk factor for developing osteoporosis in women of Bangladesh.

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Introduction

Menopause is defined as the point in life when women experience permanent cessation of menstruation due to irreversible loss of ovarian activity. More precisely, the collective follicle capacity of the ovaries to secrete adequate estradiol diminishes to the point at which menstruation is no longer achievable.¹ At menopause the ability of the ovaries to function and capability of producing sufficient estrogen has also ceased. Healthy women are expected to spend in average 36 years in a reproductive life span. However, with increasing life expectancy, women spend one-third of their lifetime under menopause.² The hormonal changes associated with menopause are low plasma levels of estrogen and marked increase in leutenizing and follicle stimulating hormone levels.³ Changes in the concentrations of many

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blood constituents have been observed at the menopause and the number continues to grow. Some of these changes can be attributed to the accelerated loss of bone mass which accompanies the menopause. These include the alteration in serum calcium, albumin and alkaline phosphatase (ALP) levels.^{4,5}

Calcium (Ca) is the most abundant mineral in the human body. Bone contains about 99% of the body's entire supply of Calcium. However, blood, extra cellular fluid and other tissues also contain Ca.⁶ The cessation of cyclical estrogen production at the menopause induces changes in the skeletal metabolism leading to at least a doubling of the rate of bone loss from the appendicular skeleton.⁷ The decrease in bone mass reduces the mechanical strength of the skeleton and increases the liability to fracture.^{8,9} The changes in skeletal metabolism are accompanied by changes in calcium homeostasis.

Estimation of serum albumin is a test for biosynthetic functions of the liver.¹⁰ Alkaline phosphatase, an enzyme found in liver, bone, kidneys and placenta, is an indicator of osteoblastic activity.¹¹ Adverse changes in serum albumin and alkaline phosphatase due to estrogen deficiency have been implicated in the increased incidence of osteoporosis in post-menopausal women.¹² Menopause may alter serum calcium, albumin and ALP levels which can lead to increased risk of osteoporosis. So, it is imperative to know the changes in serum calcium, albumin and alkaline phosphatase levels of postmenopausal women. To the best of our knowledge a very few studies have been addressed this problem in the context of Bangladesh. Moreover, the present study will also facilitate the clinicians and gynecologists to update their knowledge regarding serum calcium, albumin and alkaline phosphatase levels in postmenopausal women.

Methods

The case-control cross-sectional study was carried out in the Department of Biochemistry, Mymensingh Medical College

in cooperation with the Department of Gynecology, Mymensingh Medical College Hospital and Community Based Medical College Hospital, Bangladesh during the period from January to December 2009. One hundred and eighteen samples were included in this study following inclusion and exclusion criteria. The subjects were divided into two groups on the basis of inclusion criteria. In group A: 59 menopausal women of same social class and status having the age range between 45-55 years were included. On the other hand, fifty-nine apparently healthy women aged between 30-40 years were selected as control in this study. The exclusion criteria for the samples were: i) Diabetes mellitus ii) Chronic renal failure iii) Thyroid disorder iv) Obstructive jaundice and v) Alcoholism. Data were collected through prescribed questionnaires. The questionnaire included clinical and historical information to evaluate exclusion criteria of the study. Finally, the subjects of this study were included on the basis of exclusion criteria. Fasting venous blood samples were collected from the respondents with all aseptic precautions between 8.00 AM to 9.00 AM. From each respondent 5 ml of venous blood was collected with a disposable syringe by antecubital venepuncture and transferred to a dry screw capped test tube. Then the test tubes were centrifuged at 3000 rpm for 5 minutes after formation of clot. The sera obtained were kept in micro-centrifuge tube after proper labeling. The chemical analysis was performed within two hours of sampling. Serum calcium was determined by using colorimetric method.¹³ Enzymatic end point method was used to determine serum alkaline phosphatase levels.¹⁴ Serum albumin was determined by using colorimetric method (Colorimetric method with Bromocresol Green).¹⁵ Serum calcium was adjusted by serum albumin. All biochemical values were calculated as mean \pm SD (standard deviation). Statistical significance of difference between two groups were evaluated by using Student's unpaired 't' test. The statistical analysis was done by using SPSS windows package.

Results

Serum calcium

Table 1 & Figure 1 show adjusted serum calcium of the subjects. The mean and \pm SD adjusted serum calcium in group A (control) and group B (case) is 8.85 ± 0.28 and 6.08 ± 0.59 , respectively. Mean values of adjusted serum calcium shows a highly significant difference between the groups (level of significance, $p < 0.001$).

Table 1: Serum calcium of the subjects

Biochemical variables	Group A	Group B	p value
Serum calcium mg/dl	n=59 Mean \pm SD 8.85 ± 0.28	n=59 Mean \pm SD 6.08 ± 0.59	<0.001

p value <0.05 taken as level of significance
Group A = Control, Group B = Case,

SD = Standard deviation & n= Number of subjects

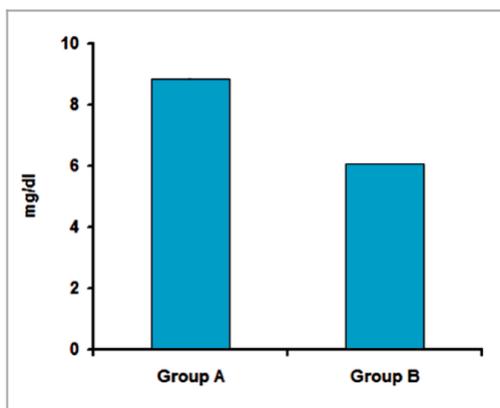


Figure 1: Showing mean \pm SD of serum calcium of the subjects

Serum albumin

Table 2 & Figure 2 show mean and \pm SD serum albumin in group A (control) and group B (case) is 4.36 ± 0.22 and 2.39 ± 0.29 , respectively. Mean values of serum albumin show a significant difference between the groups (level of significance, $p < 0.05$).

Table 2: Serum albumin of the subjects

Biochemical variables	Group A	Group B	p value
Serum albumin mg/dl	n=59 Mean \pm SD 4.36 ± 0.22	n=59 Mean \pm SD 2.39 ± 0.29	<0.05

p value <0.05 taken as level of significance

Group A = Control, Group B = Case,
SD = Standard deviation & n= Number of subjects

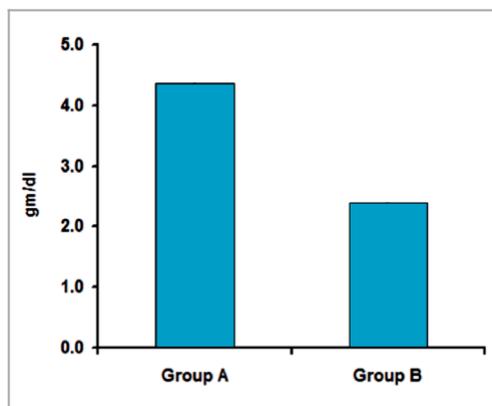


Figure 2: Showing mean \pm SD of serum albumin of the subjects

Serum alkaline phosphatase

Table 3 & Figure 3 show mean values with \pm SD alkaline phosphatase in group A (control) and group B (case) is 155.86 ± 33.30 and 349.58 ± 29.72 , respectively. Mean values of serum alkaline phosphatase show a significant difference between the groups (level of significance, $p < 0.05$).

Table 3: Serum alkaline phosphatase of the subjects

Biochemical variables	Group A	Group B	p value
Serum alkaline phosphatase U/L	n=59 Mean \pm SD 155.86 ± 33.30	n=59 Mean \pm SD 349.58 ± 29.72	<0.05

p value <0.05 taken as level of significance

Group A = Control, Group B = Case,
SD = Standard deviation & n= Number of subjects

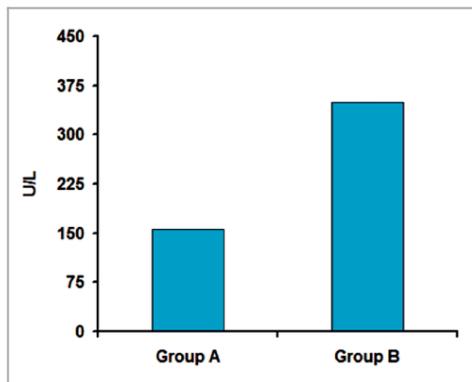


Figure 3: Showing mean \pm SD of alkaline phosphatase level of the subjects

Discussion

According to the present study, serum calcium level in group B (Case) was significantly lower compared to group A (Control). This finding is supported by the studies of D'Erasmus et al.¹⁶, Nordin et al.¹⁷, Price et al.¹⁸ and Marshall et al.¹⁹. This study was also in agreement with Hodgkinson et al.²⁰, Gallagher et al.⁵ and Selby et al.²¹. The decreased level of serum calcium in postmenopausal women might be due to lack of estrogen and with the advancement of age. The association of decreased calcium absorption in postmenopausal women, associated with a fall in calcium absorption, which is only in part attributable to a fall in calcitriol levels.²² Ageing and menopause, which leads to decline in estrogen and progesterone production has been implicated in the decreased levels of calcium in postmenopausal women.²³ However, contrary to this finding, higher calcium in postmenopausal women compared to premenopausal women was reported by Christiansen et al.²⁴, Suresh and Naidu²⁵, Nilas et al.²⁶ and Rogers et al.²⁷ Heterogeneity of older adults, variabilities in body chemistry and their unique rate of ageing may be responsible for the disparity in these results.

Our study also found significantly decreased serum albumin in postmenopausal women

compared to control which is in concurrence with those reported by D'Erasmus, et al.¹⁶ and Ragno and Delmas.²⁸ Adverse changes in total proteins and albumin found due to oestrogen deficiency in postmenopausal women.¹² Ragno and Delmas found lower serum albumin levels in postmenopausal women compared to premenopausal women. This was attributed to number of years since menopause and advancing age, since ageing is often associated with loss of height, weight and the development of stooped posture. It may be related to the reduction of bone mass only in subjects affected by diseases associated with a significant albumin reduction.^{28,29} However, contrary to this finding, serum albumin was also elevated in postmenopausal women when compared to premenopausal women might be due to early menopausal stage by Eastell et al.³⁰

A high alkaline phosphatase levels in postmenopausal women compared to control was observed in our study which is in agreement with Jane et al.³¹ and Schiele et al.³² Serum alkaline phosphatase (ALP), a gross marker of bone turnover, has been reported to be elevated after menopause, a period characterized by hallmark increases in follicle-stimulating hormone (FSH). Whether the ALP rise coincides with the perimenopausal transition when changes in FSH, estrogen levels, and menstrual cycles are first apparent is not known.³¹ The adverse changes in alkaline phosphatase level in postmenopausal women might be due to oestrogen deficiency.¹² This is in accordance with the findings of Ashuma et al.²³, Suresh and Naidu²⁵ and Masse et al.³³, who also reported higher levels of alkaline phosphatase in postmenopausal women. Ageing and menopause, which leads to decline in estrogen and progesterone production has been implicated in the increased levels of alkaline phosphatase in postmenopausal women.²³

Conclusion

From the overall results of this study, it can be concluded that the postmenopausal women have lower levels of serum calcium and albumin compared to the premenopausal women. The alkaline phosphatase levels are higher in postmenopausal women than the premenopausal women. These changes in serum calcium, albumin and alkaline phosphatase levels are related to the hormone changes and can be explained by the decreased level of estrogen in postmenopausal women.

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