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Original Research Article

A Study to Analyze Serum Alkaline Phosphatase, Total Calcium as Bone Turnover Markers among The Post-Menopausal Women – Case Control Study

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Abstract

Introduction: During menopause, bone resorption slightly exceeds, results in osteoporosis. A study was conducted to evaluate the various hematological parameters in post-menopausal women (PMW) compared to healthy pre menopause controls.

Materials and Methods: This was a prospective, case control study conducted in the department of Biochemistry, KMC, Warangal. Study was conducted from June 2012 to December 2014. Study protocol was approved by the institutional ethics committee. Informed oral consent was taken from all the members before considering into the study. Healthy postmenopausal women aged 50 – 70 years without history of smoking, alcohol intake were considered to be test group. Healthy PMW aged 25 – 40 years with no history of smoking and alcohol intake were considered in control group. Random blood samples were collected by venipuncture. Alkaline phosphatase (ALP), total proteins (TP) and albumin were estimated with serum. Chi square test was used to find the statistical significance.

Results: Total 30 samples each were included in each group. Age wise, among the groups, statistically there was significant difference. There was raise in serum calcium in test group, statistically there was significant difference. ALP and TP levels were also increased in test group; statistically the difference was significant.

Conclusion: Biochemical markers such as ALP, total calcium provide dynamic measure of bone remodeling and thus potentially useful in predicting the course of changes in bone mass and fracture risk in postmenopausal women. Markers also provide a representative index of overall skeletal loss compared to bone marrow density at specific skeletal sites.

Keywords: Menospuase, Levels, Resorption, Serum

Introduction

During the life time, continuous remodeling cycle of bone is actuated by the bone remodeling unit [1]. Bone resorption by osteoclasts and bone formation by osteoblasts are the two components of these units. From the fifth decade of life, resorption slightly exceeds the bone formation. These results in osteoporosis especially during menopause, normal aging process [2]. Osteoporosis is considered to be one of the important public health issues, worldwide, > 200 million people suffer from this [3].

Approximately 30% of all postmenopausal women have osteoporosis in the United States and Europe. There was a report that 40% women with osteoporosis and 15 – 30% men had one or more fragility fractures in their remaining lifetime [4]. Ageing is declared to be the responsible for major increase in the incidence of osteoporosis in postmenopausal women [5]. Menopause is the result of the eventual depletion of oocytes and ovarian follicles in the ovaries. This results in decreased production of estradiol and other hormones [6]. Biochemical markers of bone turnover in blood and urine reflect the relative activity of osteoblasts and osteoclasts that are produced or released during bone remodeling.

Menopause induces nearly 37 – 52% increase in bone markers and 79 – 97% increase of the markers of bone resorption. Higher increase of the markers of bone resorption is a risk factor for osteoporosis. With these, a study was conducted to evaluate the various heamotological parameters in post-menopausal women (PMW) compared to healthy pre menopause controls and to find out whether these changes have a direct association with the disease.

Materials and Methods

This was a prospective, case control study conducted in the department of Biochemistry, KMC, Warangal. Study was conducted from June 2012 to December 2014, 30 months. Study protocol was approved by the institutional ethics committee. Informed oral consent was taken from all the members before considering into the study. Healthy postmenopausal women aged 50 – 70 years without history of smoking and alcohol intake, chronic illness in the past, surgically induced menopause and those on hormone replacement therapy (HRT) were considered to be test group. Healthy premenopausal women aged 25 – 40 years with no history of smoking and alcohol intake, chronic illness in the past, surgically induced menopause and those on HRT were considered to be the control group.

Random blood samples were collected by venipuncture after taking aseptic precautions into two tubes which were properly labeled. The blood in the plain bottle was allowed to stand for about 30 to 45 minutes for the clot formation. Then it was centrifuged and serum collected in another plain tube. The serum is used for estimation of calcium, phosphorus, alkaline phosphatase (ALP), total proteins (TP) and albumin. O-Cresolpthalein Complexone, end point methods were used to estimate serum Calcium [6,7]. ALP was estimated by para-Nitrophenyl Phosphate, kinetic assay [8,9]. Modified Biuret, end point assay were used to estimate TP [10] and albumin was estimated by Bromocresol green, end point method [11].

Statistical Analysis

The data were analyzed using SPSS version 12. The results were represented in the form of mean, SD. Chi square test was used to find the statistical significance; P<0.005 was considered to be statistically significant.

Results

During the study period, total 30 samples each were included in the test and control groups. In the test group, the age was ranged between 50 – 69 years, 57.8±5.5 was mean± SD. In the control group, the age rage was 25 – 38 years and the mean ± SD was 30.8±3.9. Age wise, among the groups, statistically there was significant difference (P<0.001).When the serum calcium levels were compared, in the test group, it was ranged between 6.9 to 10.2 mg/dl and in control group it was 8.2 to 10.7 mg/dl. Mean ± SD were 8.4±0.8 mg/dl and 9.5±0.6 mg/dl, respectively in the groups. Statistically there was significant difference in serum calcium levels in the groups (P<0.001).

The mean ± SD of ALP for the test group was 124.6±4.6 IU/L and for the control group, it was 70.6±4.9 IU/L; the range was 118 – 132 IU/L and 57 – 79 IU/L, respectively for the test and control groups. Statistically the difference was significant between the groups (P<0.0001). The mean ± SD of TP for the test group was 6.1±0.9 gm/dl and for the control group, it was 6.7±0.7 gm/dl; the range was 3.3 – 7.4 gm/dl and 5.8 – 8.1 gm/dl, respectively for the test and control groups.

Statistically the difference was significant between the groups (P<0.01). The mean ± SD of serum albumin for the test group was 3.1±0.4 g/dl and for the control group, it was 3.5±0.4 g/dl; the range was 2.0 – 4 g/dl and 2.8 – 4.4 g/dl, respectively for the test and control groups. Statistically the difference was significant between the groups (P<0.01).

Discussion

Osteoporosis leads to considerable morbidity and mortality in PMW. Bone mass decreases with aging, and it is now well established that a low bone mass is the major determinant of all osteoporotic fractures. Imbalance between the formation of bone as well as resorption is responsible for the increased bone loss especially during the first year postmenopausal life. High bone turnover rate play an increasing loss of bone mass with increasing PMW [12]. Our study also showed that there was a correlation between age and serum parameters. These results demonstrate that biochemical parameters can give an idea for the rate of bone formation and resorption. This was statistically significant. It also suggests that simple, common, easy, biochemical markers such as UHP, total serum ALP, and total serum calcium could be used as indicators of increased bone turnover marker, to enable early intervention so as to minimize fractures due to osteoporosis.

Combination of biochemical and bone marrow density (BMD) screening provide better prediction of future fracture risk. If preventive measures are to be initiated prior to the onset of excessive bone loss, measurement of bone turnover through UHP could form a tool available to assist health care professionals to predict fracture risk. Approximately 99% of body calcium is present in bone. In elderly women, bone resorption is markedly increased because of reduced calcium intake and bone formation is also inhibited [13].

Our results showed that the level of serum total calcium was decreased in test group; this was statistically significant (P < 0.001). These findings were according to studies reported by Lee J *et al* [14] Baur DC *et al* [15] Indumati *et al* [16]. Serum albumin is a small globular protein, accounting for approximately half of plasma protein. In this

study, the mean ± SD of serum albumin for the test group was 3.1±0.4 g/dl and for the control group. Statistically the difference was significant between the groups (P<0.01). Albumin is code by a gene on long arm of chromosome 4, closely linked to the gene for α-fetoprotein and vitamin D binding globulin, both of which share extensive sequence homology with albumin. More than 80 genetic variants have been reported. Many isotypes have altered electrophoretic migration, resulting in so called bisalbuminemia [17]. Further studies on large sample size with bone specific ALP is recommended.

ALP is an important protein that plays an important role in bone formation and mineralization [18]. In this research, there was an increase in the serum ALP levels among the postmenopausal women; statistically the difference was significant. These findings are at par with the available research reported by Ashuma sachdeva *et al* [19] Gerdham *et al* [20] Gardeno *et al* [21] Ross *et al* [22]. Common metabolic bone disorders such as osteoporosis result from a derangement in birth or death of osteoclasts and osteoblasts. Osteoblast express relative high amount of ALP. At menopause, the rate of bone remodeling increases precipitously [23].

Conclusion

In this research, the biochemical markers such as ALP, total calcium provide dynamic measure of bone remodeling and thus potentially useful in predicting the course of changes in bone mass and fracture risk in postmenopausal women. Markers also provide a representative index of overall skeletal loss compared to BMD at specific skeletal sites.

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