CROSS SECTION STUDY

Biochemical Studies in Osteoporosis of Women in Central India

Ankita Kondhalkar[1], Ranjit Ambad[1]*, Nandkishor Bankar[2], Chandrasekhar Mahakalkar[3]

[1]*Department of Biochemistry, Datta Meghe Medical College, Shalinitai Meghe Hospital and Research Centre, Nagpur, Maharashtra, India*

[2]*Department Of Microbiology, Jawaharlal Nehru Medical College, Datta Meghe Institute of Medical Sciences Sawangi, Wardha, Maharashtra, India*

[3]*Department of Surgery, Jawaharlal Nehru Medical College, Datta Meghe Institute of Medical Sciences Sawangi Meghe, Wardha, Maharashtra, India*

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ABSTRACT

Background: Osteoporosis is a condition that can have a significant influence on many postmenopausal women's lives. As the population ages, osteoporosis with its potentially fatal consequence of fracture is becoming more common and assessing bone health is an important part of a woman's normal care. More tangible efforts are required for osteoporosis patient prevention, early diagnosis, and practicable and inexpensive management. We anticipated that biochemical markers could allow for dynamic and quick measurements of total body skeletal metabolism, which could be useful in the treatment of postmenopausal osteoporosis (PMO) as well as evaluating the effectiveness of antiresorptive therapy.

Aim: Biochemical Studies in Osteoporosis of Women in Central India.

Material and Method: The present study was conducted at the Department of Biochemistry, Datta Meghe Medical College and Shalinitai Meghe Hospital Nagpur and JNMC Sawangi Wardha. The postmenopausal women in the age group of 45 to 60 years and diagnosed as osteoporosis by clinician were selected as study group.

Results: This study demonstrates that osteoblastic activity as assessed by bone formation marker is elevated in PMO. Osteocalcin is a promising marker of bone turnover & it can provide dynamic status of bone remodeling. Simple, straightforward, low-cost biochemical markers such as blood calcium, ALP, albumin, and phosphorus could be employed as indicators of accelerated bone turnover in routine biochemical studies in osteoporosis of 150 women to enable early management to reduce fracture owing to osteoporotic changes. The combined use of bone mineral density (BMD) and these biochemical markers will be of great help to the treatment decisions and to monitor effect of therapy.

Conclusion: Acute variations in bone turnover rate are reflected by biochemical indicators of bone. Bone turnover lowers in PMO women on antiresorptive medication, as evidenced by lower levels of marker. Changes in the concentration of these indicators can be used to track how effectively a treatment is working. Antiresorptive therapy-induced decreases in marker levels may be an early indicator of eventual BMD increases and a reduction in fracture risk.

Keywords: Bone Mineral Density, Postmenopausal, parathyroid hormone (PTH), Osteoporosis, Tartrate-resistant acid phosphatase (TRACP).

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INTRODUCTION

Osteoporosis is a condition that can have a significant influence on many postmenopausal women's lives. With the growing population, osteoporosis and its potentially dangerous side effects, fractures, have become commonplace, and orthopedic testing is an important part of a woman's general treatment.[1] The World Health Organization (WHO) defines osteoporosis as a bone marrow transplant (BD) of 2.5 SD or higher compared to the price range for young adults (T score < - 2.5). As the risk of fracture grows, bone density declines with age. Each one (1) standard deviation drop in BMD increases the risk of fracture by two to three times.[2]

Osteoporosis is only second to cardiovascular disease as a major health concern, according to the World Health Organization.[3] Insufficient bone mass is now considered a major health problem in India, with an estimated 50% of healthy women and 36% of men over 50 years of age having it. Osteoporosis strikes Indians 10 years sooner than it does in

**Author for Correspondence: ambad.sawan@gmail.com*

the West.[4] Menopause is a physiological process that happens in healthy women between the ages of 45 and 55, with the average age being around 51. With today's life expectancy, the average woman will go 30 years without receiving oestrogen from her ovaries.[5] In postmenopausal women, a lack of oestrogen limits calcium absorption and utilization, and is the single most critical cause in the development of osteoporosis.[6]

A chemical marker of bone formation that may be clinically useful, including serum osteocalcin Specific bone proteins such as osteocalcin or Bone Gla protein are large and non-collagenous proteins in the matrix matrix, associated with the mineral process.[7] Another characteristic of bone formation includes serum alkaline phosphatase. High levels of serum ALP activity show increased activity of osteoblasts.[8] Determination of calcium, phosphorus, magnesium, albumin and vitamin C can provide information on bone metabolism.[9] We have also studied the symptoms of bone marrow transplantation especially hydroxyproline and tartrate antagonist phosphatase acid. Frequently, urinary symptoms of recurrent products or degeneration of collagen include hydroxyproline, which acts as an early predictor of changes in collagen metabolism.[10] Elevated levels of tartrate resistant acid phosphatase function indicate increased osteoclast activity.[11]

Because of the increased interest in osteoporosis, a lot of research initiatives are being done in industrialized countries to explore bone biomarkers. Similarly, there is a high priority in the care of osteoporosis in Western Maharashtra for the development of more quick assays and improvements in technological procedures for measuring these indicators. Therefore, in the present study, we planned to assess the sensitive and specific marker of osteoblastic and osteoclastic activity in osteoporotic women. The study's goal was to provide significant promise for better osteoporosis management and monitoring of antiresorptive drug response.

MATERIAL AND METHODS

This study was carried out at the Department of Biochemistry, Datta Meghe Medical College and Shalinitai Meghe Hospital Nagpur and JNMC Sawangi, Wardha. The patients with osteoporosis selected for the study, attended orthopedic OPD Shalinitai Meghe Hospital, Wanadongri, Nagpur In this study, total numbers of subjects are 150. The distribution of these subjects was as follows,

1) Study group – 75 subjects.
2) Control group – 75 subjects.

Selection of Patients:

Study Group

Clinicians identified 75 postmenopausal women in the age range of 45 to 60 years with primary osteoporosis. Clinical signs of decreased bone mass included backache, widespread weakness, or any fracture, as well as radiological evidence of osteoporosis at one or more locations and a lower BMD.

- *Inclusion Criteria*

a) Primary type of osteoporotic women.
b) Age group 45 to 60 years.
c) Cases diagnosed with the aid of bone mineral density by orthopedic surgeons.

- *Exclusion Criteria*

Patients with secondary type of osteoporosis, liver disease, renal disease, metastatic bone disease, severe ill patients, treatment with estrogen and progesterone were excluded from this study.

Control Group

It included 75 postmenopausal non-osteoporotic women between the ages of 45 and 60 who had normal bone density. Gathering of samples: Blood and urine samples were taken at baseline from the control group (non-osteoporotic postmenopausal women) and the osteoporotic postmenopausal women in the current investigation. After 3 months of antiresorptive medication, blood and urine samples of osteoporotic women were collected in the follow-up study. Venous blood was collected with the help of disposable syringe and needle and withdrawn in dry centrifuge tube by taking aseptic precautions. Separated non hemolyzed sera were processed for the assay of biochemical parameters. Fasting urine sample was collected in polypropylene tube.

METHODOLOGY

1. Serum calcium were analyzed by O-Cresolphthalein Complexone (o-CPC) method.[12]
2. Serum inorganic phosphorus were analyzed by Fiske & Subbarow Method.[13]
3. Serum magnesium were analyzed by Calmagite method.[14]
4. Assay of serum osteocalcin by enzyme amplified sensitivity immunoassay (EASIA) method.[15]
5. Assay of alkaline phosphatase by kinetic p-NPP method.[16]
6. Estimation of albumin by bromocresol green (BCG) method.[17]
7. Estimation of Vitamin C by photometric method.[18]
8. Assay of tartrate resistant acid phosphatase by King Armstrong method.[19]
9. Estimation of urine creatinine by Jaffe's method.[20]
10. Estimation of Cholesterol by Wybenga and Pileggi method.[21]

RESULT

Table 1 shows mean level of serum osteocalcin was found to be significantly elevated in PMO when compared with controls. Elevated levels of osteocalcin were found in osteoporosis, might be due to the increased activity of osteoblasts. When compared to controls, alkaline phosphatase activity was observed to be considerably higher in PMO. High levels of serum alkaline phosphatase activity seen in osteoporosis could be the result of osteoblastic cells attempting to restore bone that has been resorbed by uncontrolled osteoclast activity. When compared to controls, PMO had a significant increase in tartrate resistant acid phosphatase activity. TRACP activity is a direct reflection of osteoclast activity. As clear result of our findings, there is a large increase in osteoclastic activity, resulting in increased bone resorption.

Table 1: Comparison of bone formation markers (osteoblastic activity) between postmenopausal osteoporosis and control group.

Bone formation markers	*Postmenopausal non-osteoporosis women (Controls) n= 75* *Mean ± SD*	*Postmenopausal osteoporosis women n=75* *Mean ± SD*
Osteocalcin ng/ml	15.8 ± 5.2	32.21 ± 6.3
Alkaline phosphatase (IU/L)	82.04 ± 15.42	118.254 ± 31.47
Tartrate resistant acid phosphatase (TRACP) KA units.	2.11 ± 0.487	4.935 ± 0.761

Table 2: Comparison of biochemical parameters between postmenopausal osteoporosis women and control group.

Bone formation markers	*Postmenopausal non-osteoporosis women (Controls) n= 75* *Mean ± SD*	*Postmenopausal osteoporosis women n=75* *Mean ± SD*
Calcium (mg/dL)	12.412 ± 0.822	6.439 ± 0.10
Phosphorus (mg/dL)	5.245 ± 1.058	4.69 ± 0.630
Magnesium (mEq/L)	6.421 ± 2.148	3.087 ± 1.851
Total Proteins (gm/dL)	7.89 ± 0.768	6.421 ± 0.609
Albumin (gm/dL)	4.968 ± 1.048	4.988 ± 0.921
Vitamin 'C'(mg/dL)	3.059 ± 0.684	2.422 ± 0.539
Cholesterol (mg/dL)	185.278 ± 17.502	202.735 ± 38.105
Urine hydroxyproline (mg/g creatinine)	19.256 ± 6.111	39.752 ± 9.783

Table 2 shows in postmenopausal osteoporosis women, mean calcium, phosphorus, magnesium, total proteins, albumin, and vitamin C levels were considerably lower than in the control group. When compared to the control group, postmenopausal osteoporosis ladies had a highly significant increase in total cholesterol levels. Inadequate vitamin D intake may also contribute to low serum calcium levels.

Hypophosphatemia can lead to a reduction in bone mineralization. Magnesium deficit could be caused by a lack of magnesium in the diet. Our findings suggest that a drop in albumin levels is linked to a decrease in bone mass. Because albumin is a large calcium binding protein, it should have a more direct effect on bone metabolism. Vitamin C deficiency may affect the hydroxylation of lysine and proline in protocollagen. Increased cholesterol levels could be caused by a lack of vitamin D, which could disrupt lipid metabolism.

Measurement of calcium, phosphorus, magnesium was performed to provide information of the status of bone metabolism. Assay of serum albumin, vitamin C and alkaline phosphatase was done to get information about the synthesis of organic matrix and mineralization by the osteoblasts. The present study revealed significant increase in urinary hydroxyproline in PMO.

DISCUSSION

In the present study, we attempted to evaluate the activities of osteoblastic and osteoclastic markers pre and post antiresorptive therapy in postmenopausal osteoporotic (PMO) women. The study includes 75 postmenopausal osteoporotic women and Control group includes 75 postmenopausal non osteoporotic women.

Our findings were supported by Ones K *et al*.,[22] Verit FF *et al*.[23] The osteocalcin cycle is associated with changes in bone marrow value. Because of its tissue specification and being very low among human variables, we have evaluated serum osteocalcin as a clinical indicator of benefit in bone marrow metabolic disease ie postmenopausal osteoporosis. Osteocalcin or bone Gla protein is a specific protein and a large non-collagenous protein in the matrix.

Reid IR *et al*.[24] and Andrew YY *et al*.[25] support our findings. The activity of alkaline phosphatase can be easily measured and is a common chemical marker that can be used to determine bone gain. Even in urban areas, this mark can be tested in any clinical laboratory and used by doctors to better treat osteoporosis.

Our findings were supported by Indumati V *et al*.[26] and Sameer Batra *et al*.[27] Low serum calcium levels can also be caused by a lack of vitamin D. Calcium absorption in the intestine and, as a result, bone mineralization is affected by vitamin D insufficiency.

Reginster JY *et al*.[28] and Prince RL *et al*.[29] discovered Increased intestinal phosphorus absorption could explain the rise in serum phosphorus levels. Normalizing serum calcium and phosphorus levels will almost probably have a good impact on the development of hydroxy apatite crystals, which will lead to bone calcification. Our findings are supported by Gur *et al*.[30], and Brodowski *et al*.[31] Decreased level of magnesium might be due to the dietary deficiency of magnesium. Calcium absorption and transport may be hampered because of this. Lowering serum magnesium levels can result in vitamin D not being converted to its active form, calcitonin stimulation, and PTH suppression. Protein deficiency could be the reason of the PMO's low protein and albumin levels. Hypoalbuminemia may be linked to a decrease in bone mass. Lowered levels of vitamin C were also observed in PMO, which may impair cross linking of protocollagen into normal collagen fibrils. Raised cholesterol levels found in PMO were decreased post therapy, probably due to inhibit on farnesyl pyrophosphatase.

CONCLUSION

Finally, biochemical indicators of bone show rapid variations in the rate of bone turnover. Bone turnover lowers in PMO women on antiresorptive medication, as evidenced by lower levels of marker. Changes in the concentration of these indicators can be used to track how effectively a treatment is working. Antiresorptive therapy-induced decreases in marker levels may be an early indicator of eventual BMD increases and a reduction in fracture risk. As a result, bone markers should be employed in conjunction with BMD in the treatment of this bone metabolism disorder.

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