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Serum Total Proteins, Albumin and Magnesium Levels in Pre and Post Antiresorptive Therapy in Postmenopausal Osteoporosis. Can Magnesium Play a Key Role in Osteoporosis?

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Abstract

Postmenopausal osteoporosis is a very common disease, and approximately half of all women aged above 50 years will experience an osteoporotic fracture during the remainder of their lifetime. The degradation of bone tissue leading to osteoporosis is often silent and unrecognized until a postmenopausal women develops a bone fracture. The costs of medical treatment and subsequent changes in the quality of life of a patient are significant, and avoidance via proper nutrition, exercise and pharmacologic therapy may be the key to decreasing healthcare costs associated with this disease state. Aim: 1) to assess serum concentration of magnesium, total proteins and albumin in postmenopausal osteoporosis women at baseline level and postmenopausal non osteoporosis women. 2) The follow up study to evaluate the impact of specific antiresorptive therapy (Alendronate + calcitriol + calcium)) on bone metabolism in postmenopausal osteoporosis by assaying serum magnesium, total proteins and albumin. 60 postmenopausal women with osteoporosis in the age group 45-60 years and 60 healthy postmenopausal women (normal bone mineral density) in the same age group were included as a control in the study. Mean level of serum magnesium, total proteins & albumin were significantly decreased ($P<0.001$) in postmenopausal osteoporosis women at baseline level as compared to control group. These levels were increased significantly ($P<0.001$) post therapy in PMO patients. Trace minerals may be important in maintaining bone quality through their role as metalloenzymes in

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the synthesis of collagen and other proteins that form the structure of bone. Decreased level of magnesium might be due to the dietary deficiency of magnesium. Serum albumin was decreased in the course of aging particularly in osteoporosis women and inadequate intake of proteins might be the cause of lowered proteins and albumin. Data will be presented suggesting that magnesium and protein deficiency plays an important role in postmenopausal osteoporosis. Adequate protein and magnesium intake and reserve may be the cost- effective approach to the prevention and management of postmenopausal osteoporosis.

Keywords: Albumin, Postmenopausal Osteoporosis (PMO), Magnesium, Total proteins.

INTRODUCTION

Osteoporosis is a disease that may have a tremendous impact on the lives of many postmenopausal women. Osteoporosis and its potentially devastating sequelae of fracture are increasing as the population ages, and assessment of skeletal health is an important component of a women's routine care [1]. "It is a progressive systemic skeletal disorder characterized by low bone mass and micro-architectural deterioration of bone tissue, with a consequent increase in bone fragility and susceptibility to fracture"[2].

Osteoporosis is second only to cardiovascular disease as a leading health care problem, according to the World Health Organization. Worldwide, the lifetime risk for women to have an osteoporotic fracture is 30-40% [3]. Occurrence of osteoporosis is 10 years earlier in Indian people than in the west. It currently affects approximately one in three women and one in five men over age 50. Because of related morbidity, disability, diminished quality of life, and mortality, osteoporosis and fractures associated with it are major public health concern [4].

Many risk factors have been identified for osteoporosis including genetic factors, race, sex, age, menopausal state, smoking, alcohol intake, exercise and nutrition [5, 6]. The risk of nutritional disturbances, in particular trace element and vitamin deficiencies, is high during menopause. The participation of trace minerals in normal development and maintenance of the skeleton is related to their catalytic functions in organic bone matrix synthesis [7].

Trace elements are essential for normal growth and development of the skeleton and may be important in maintaining bone quality through their role as metalloenzymes in the synthesis of collagen and other proteins that form the structure of bone. Magnesium appears to be an important in bone cell activity. It is shown to be mitogenic for osteoblasts and its depletion causes cellular growth inhibition, in vitro [8, 9].

Although they are minor building components in teeth and bone, they play important functional roles in bone metabolism and bone turnover. Magnesium acts as a

surrogate for calcium in transport and mineralization processes. It also exerts a large number of other actions, including enzyme cofactor function and modulation of the action of hormones, growth factors and cytokines. Magnesium also has direct effects on bone formation processes and mineral aggregation [10].

Like any organ in the body, the skeleton needs a balanced diet containing both macronutrients (protein, fat, carbohydrate) and micronutrients (vitamins & minerals) for its normal development and maintenance. Proteins have been traditionally regarded as "body-building food".

To understand the status of trace elements and macronutrient such as proteins in PMO, we have planned to assess the concentration of magnesium, total proteins and albumin in PMO.

MATERIALS AND METHODS

Present study was conducted in the Department of Biochemistry, Government Medical College Miraj and P.V.P. General Hospital Sangli.

We performed a case control study of 60 osteoporotic postmenopausal women in the age group 45-60 years. Patients were selected who had clinical features suggestive of reduced bone mass viz- backache or generalized weakness or any fracture and radiological evidence of osteoporosis at one or more sites & lowered BMD. The study group was given alendronate 70 mg/week, tablet containing calcium citrate 1200mg (elemental calcium- 253) and calcitriol 0.25µg was taken as once a day. Patients were instructed to take bisphosphonate on an empty stomach with a glass of plain water. Avoid lying down, stay fully upright (sitting, standing or walking) and other food, beverages or medication to be avoided for at least 30 min for better absorption and to avoid side effects(esophagitis).

Control group included 60 postmenopausal non osteoporotic women with normal bone density in the age group 45-60 years.

Patients taking HRT and anticonvulsants, having a chronic debilitating illness (cancer, AIDS), renal diseases, liver diseases and secondary type of osteoporosis were excluded from this study.

The Institutional Ethical Committee approved the study and Informed Consent was obtained from each participant in the study.

In the present study blood samples were collected under aseptic condition from control group and from osteoporotic postmenopausal women at baseline level. In the follow up study blood samples of osteoporotic women were collected after 3 months antiresorptive therapy. Serum was separated and analyzed for magnesium by Calmagite method [11], Total proteins by Biuret method [12], albumin by Bromocresol green (BCG) binding method [13]

The results were expressed as means ± SD. Statistical analysis was done by using "Z test" and "Paired T test".

RESULTS AND DISCUSSION

Mean level of serum magnesium was found to be significantly decreased in PMO as compared controls (P<0.001, Table No.1)

Magnesium is present in bone, association with calcium and phosphorus. Decreased level of magnesium might be due to the dietary deficiency of magnesium. This may hamper the absorption, transport and utilization of calcium, extending to hypocalcaemia. Lowering of serum magnesium can cause failure in conversion of vitamin D to its active form and stimulation of calcitonin and suppression of PTH. This may also induce uncoupling of bone formation and resorption may result in a loss of bone mass.

Our findings were also supported by Gur et al [14], Brodowski et al [15], and Rude RK et al [16], Reginster JY et al [17].

Table No.1 shows that significant increase in magnesium level from baseline to post therapy of 3 months in postmenopausal osteoporosis women (alendronate + calcium + vitamin D).

It may be related to positive calcium balance achieved during therapy and may be due to processes related to interrelationship between calcium & magnesium metabolism.

Serum total proteins and albumin levels were found to be significantly decreased in PMO as compared to control. (P< 0.001, Table no.1)

Serum albumin was decreased in the course of aging particularly in osteoporosis women and inadequate intake of proteins might be the cause of lowered proteins and albumin. IGF-I production and circulating levels were reported to be decreased during low protein intake. Impairment of both systems may contribute to the occurrence of osteoporosis.

Our result indicates that decreased albumin level may be related to the reduction of bone mass. Albumin should have a more direct effect on bone metabolism because of its role as a major calcium binding protein. Thus albumin is essential for the synthesis of bone matrix and bone health. The study of Neetakumar etal [4] has shown that low calcium and protein diet enhances the rate of loss of 25 (OH) D from the circulation by destruction in liver.

Our findings were also supported by Batra S et al [18] , Narang APS et al [19], Schurch MA et al [20], Sokoll LJ et al [21] Erasmo ED et al [22] , Bonjour JP et al [23].

Table no.1 shows that serum total proteins and albumin levels were increased (P<0.05) from baseline to post therapy of 3 months in PMO (alendronate + calcium + vitamin D).

All the patients were advised by the clinicians to take balanced diet, with adequate calcium and first class proteins. Improvement of the nutritional status might have raised the serum protein levels. Finding of Arase Y et al [(24)] support our study.

Our data suggest that magnesium deficiency may be a risk factor for postmenopausal osteoporosis. Magnesium balance is very important in the prevention of osteoporosis. The result from this study suggests that routinely measured, low cost biochemical markers such as serum total proteins, albumin and magnesium can be used as indicators of increased bone turnover, to enable early intervention so as to minimize fracture due to osteoporotic changes. These biochemical parameters can be measured in any simple clinical laboratory and may help to identify women at greatest risk for bone loss, who would benefit most from therapeutic interventions.

Table No.1

Biochemical parameters of bone metabolism in control group and PMO women pre and post therapy.

Sr.No	**Biochemical Parameters**	**Postmenopausal non osteoporosis women (Controls) n=60 Mean ± SD**	**Postmenopausal osteoporosis women Baseline n=60 Mean ± SD**	**Postmenopausal osteoporosis women Post therapy n=60 Mean ± SD**
1	Magnesium (mEq/L)	3.127 ± 0.469	2.047 ± 0.376***	2.530 ± 0.391***
2	Total Proteins (Gms/dL)	6.59 ± 0.626	5.734 ± 0.708***	6.057 ± 0.602**
3	Albumin (Gms/dL)	3.762 ± 0.508	3.223 ± 0.414***	3.511 ± 0.429**

The statistical method used to compare data was **Z test & Paired t test**

* * * $P < 0.001$ - Highly significant.

* * $P < 0.05$ - Significant

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