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A Study of Bone Markers (Serum Calcium, Serum Phosphorus And Serum Alkaline Phosphatase) In Post Menopausal Women In East Godavari District, Andhra Pradesh, India.

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Abstract

Background: *The aim is to study the significance of serum calcium, serum phosphorus and serum alkaline phosphatase in postmenopausal women with osteoporosis.*

Method: *A total of hundred (100) cases of postmenopausal women with osteoporosis were included in the study. Fifty (50) healthy controls were also included in the study for comparison.*

Results: *Serum calcium levels were decreased in postmenopausal women with osteoporosis with 8.80±0.89 mg/dl (mean±SD) when compared to controls with 10.07±0.66 mg/dl (mean±SD) with a statistically significant 'p' value of <0.0001.Serum phosphorus levels were increased in cases with 4.07±1.09 mgs/dl (mean± SD) compared to that of controls with 3.72±0.56 mgs/dl (mean±SD) with a statistically significant 'p' value of <0.001.Serum alkaline phosphatase levels increased in cases with 200.10 ±52.15 mu/ml (mean±SD) compared to that of controls 64.9±19.3 mu/ml (mean±SD) with a statistically significant 'p' value of <0.0001.*

Conclusion: *In menopausal women decreased estrogen levels contribute to the abnormalities in the bone leading to osteoporosis.*

KeyWords: *Menopause, Osteoporosis, Calcium , Phosphorus, Alkaline phosphatase.*

I. Introduction

Menopause is the permanent cessation of menstruation, seen in women between 40-61 years of age. It is characterized by the menstrual changes that reflect oocyte depletion and subsequent reduction in ovarian hormone production. Menopause typically occurs in middle age[1] , during the late 40s or early 50s signaling the end of the fertile phase of life. It is considered as premature when it occurs before 40 yrs of age but is otherwise normal.According to WHO the term menopause is defined as dating from the final menstrual period, regardless whether the menopause was induced or spontaneous. The post menopause lasts about 10-15 years and is followed by senescence from about 65 yrs of age to the end of life. Characteristically it begins with the menstrual cycle irregularity and extends to one year after permanent cessation of menses. Beginning as early as 10-15 years before menopause there is shortening of the follicular phase of the cycle, and so the length of the menstrual cycle starts decreasing. Insufficient follicular development results in inadequate estrogen production with little estrogen available to stimulate the endometrium which results in amenorrhea. Menopause is not related to menarche, race, socio-economic status, number of pregnancies , lactation ,or taking of oral contraceptives. It is however directly associated with smoking and genetic disposition. Smoking induces premature menopause.[1]

Osteoporosis is a late complication of menopause. It is a degenerative bone disorder where there is thinning and weakening of the bone, and a general decrease in bone mass and density. So susceptible to fractures. Fractures related to osteoporosis are estimated to affect around 30% of women and 12% of men in developed countries and are a major health problem[2]. Normally bone will go through a process where old bone is replaced by new bone cells. Our body's ability to handle this process changes with age. Estrogen is involved in the process of calcium absorption into the bones. During menopause there is a drop in estrogen levels. All women will experience acceleration in bone density reduction as their estrogen levels drop.

Menopause in elderly women is associated with accelerated loss of cortical bone. Rapid bone loss occurs when the balance between formation and resorption is upset resulting in a negative remodeling balance and leads to osteoporosis. It is mainly due to imbalance in hormonal factors like estrogen, prolactin and changes in bone formation markers (calcium, phosphorus and ALP) and bone resorption markers (urinary calcium, urinary hydroxyproline).

The present study aims to see the significance of serum calcium, serum phosphorus and serum ALP in post menopausal women with osteoporosis.

II. Materials And Methods

The present study was conducted on hundred (100) patients of post menopausal women with a complaint of osteoporosis from the outpatient department of Obstetrics and Gynaecology Government General Hospital, Kakinada, East Godavari District, Andhra Pradesh, India. Their ages ranged from 46 to 65 years.
The study also included fifty (50) healthy controls of age group 25-45 years.

Inclusion criteria:
Post menopausal osteoporosis
Exclusion criteria:
1. Surgical menopause due to hysterectomy.
2. Post menopausal women on estrogen therapy.
3. Osteoporosis due to other causes.

Random blood samples were collected from patients in sterile bottles after obtaining their consent. Serum was separated taking precautions to avoid hemolysis. All samples were analysed immediately.
Estimation of serum calcium levels by Arsenazo 3 method.
Principle

Calcium with arsenazo3 at neutral pH yields a blue colored complex whose intensity is proportional to the calcium concentration in the sample. Interference by magnesium is eliminated by addition of the 8 hydroxyquinoline 5 sulphonic acid. Normal value is 8.4-11 mgs/dl.
Estimation of serum inorganic phosphorous by modified Metol method.

Principle

Ammonium molybdate under acidic conditions reacts with phosphorus to form phosphomolybdate complex which is reduced to blue colored complex by metol. The absorbance of color developed is proportional to the concentration of inorganic phosphorus .
Normal value is 2.5- 4.5mgs/dl.
Estimation of serum alkaline phosphatase by semiautoanalyser (Chemwell) - Bowers and Mc Comb.

Principle

Alkaline phosphatase catalyses the transphosphorylation of p-nitrophenylphosphate (p-NPP) to p-nitrophenol (p-NP) in the presence of the transphosphorylating buffer, 2-amino 2-methyl-1-propanol (AMP). The reaction is enhanced through the use of Mg and Zn ions. The change in absorbance at 405 nm due to the formation of p-NP is directly proportional to the ALP activity, since other reactants are present in non rate limiting quantities and is measured using a bichromatic (405, 510 nm) rate limiting technique. Normal value is 36-141mu / ml

III. Results And Observations

In the present study mean values of calcium among cases is 8.80$\pm$ 0.89 mgs/dl (mean$\pm$ SD) and that of controls is 10.07$\pm$0.66 mgs/dl (mean$\pm$ SD). The decrease in the serum calcium level among the cases is significant with a p value of <0.0001.

Mean value of serum phosphorus among cases is 4.07$\pm$1.09 mgs/dl (mean $\pm$ SD) compared to that of controls 3.72$\pm$ 0.56 mgs/dl (mean$\pm$ SD).The increase in phosphorus is significant with a p value of <0.001.
Mean value of serum ALP among cases is 200.10$\pm$52.15 mu/ml (mean $\pm$ SD) compared to that of controls 64.9$\pm$19.3 mu/ml (mean$\pm$ SD). The increase in serum ALP among cases is significant with a p value of <0.0001.

IV. Discussion

Hundred (100) postmenopausal women with osteoporosis were studied for serum calcium, phosphorus and ALP. Fifty (50) healthy controls were taken for comparison. In all the cases and controls serum calcium, phosphorus and ALP were measured by appropriate methods.

Post menopause is the most common cause of osteoporosis because of the effects of estrogen deficiency, which increases the rate of bone remodeling, resulting in high turnover bone loss[3]. After menopause, the woman loses an average 3% bone mineral density every year causing osteopenia and eventually osteoporosis. Osteoporosis occurs because of a defect in attaining peak bone mass and/ or because of accelerated bone loss. In normal individuals, bone mass increases during skeletal growth to reach a peak between the ages of 20 and 40 years but falls thereafter. In women there is an accelerated phase of bone loss after menopause due to estrogen deficiency, which causes uncoupling of bone resorption and bone formation; such that the bone removed by osteoclasts exceeds the rate of bone formation by osteoblasts.

Bone formation is a process in which deposition of inorganic mineral is controlled by an organic matrix. The mineral phase is composed of calcium and phosphorus. The concentrations of these ions in the plasma and extracellular fluid (ECF) influences the rate at which mineral is formed. When bone is resorbed calcium and phosphorus ions are released into the ECF and the organic matrix is resorbed. The fact that bone resorption takes place in the region of the osteoclast adjacent to the bone surface where the extracellular pH is low suggests that an acid environment is required for solubilisation of bone mineral.

Ageing and loss of estrogen leads to a significant increase in osteoclastic activity. In addition a decrease in calcium intake or impaired absorption of calcium from the gut lowers the serum level of ionized calcium. Decrease could be due to decline in either the active calcium transport or diffusion component of the calcium absorption system, probably a result of loss of direct effect of estrogen on calcium transport in gastro intestinal tract[4] Deficiency of calcium and malabsorption due to hormonal imbalance may lead to disorder of bone mainly osteopenia and osteoporosis.[5]

In the above study it was found that serum calcium levels have decreased in cases 8.80±0.89 mg/dl (mean± SD) when compared to controls10.07±0.66 mg/dl (mean± SD) with a 'p' value of <0.0001, which is statistically significant. The values in the present study are in consistent with the study of Indumati V, Vidya S.Patel et al.[6] Lack of estrogen causes bone resorption in post menopausal women preventing the absorption and utilization of bone calcium, hence the development of osteoporosis in these women. Thus serum calcium could be used as indicator of increased bone turnover, to enable early intervention so as to minimize factures due to osteoporotic changes.[3]

In the present study phosphorus levels increased significantly in cases 4.07±1.09 mgs /dl (mean± SD) compared to controls 3.72±0.56 mgs/dl (mean±SD) with a significant 'p' value of <0.001. Serum ALP levels increased among cases 200.10±52.15 mu /ml (mean ±SD) compared to that of controls 64.9±19.3 mu/ml. The values in the present study are in consistent with the study of Pratima D. Khatake et al.[5] The increase in ALP levels was as a result of hormonal changes and also due to the effect of parathyroid hormone on bone. ALP is the earliest bone marker in post menopausal women as it plays an important role in bone formation and resorption.

V. Conclusion

Osteoporotic fractures are one of the major causes of morbidity and mortality in Indian aged men and women. This risk is exaggerated in postmenopausal women, where there is a deficiency of calcium and raised ALP due to estrogen deficiency[6].

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