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A study to compare serum calcium level between diabetic and non-diabetic post-menopausal women with osteoporosis

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Abstract

According to WHO, Osteoporosis is second only to cardiovascular disease as a global healthcare problem. International Osteoporosis Foundation (IOF) estimates that the annual direct cost of treating osteoporosis fractures of people in the workplace in the USA, Canada and Europe alone is approximately USD48 billion. The present study comprises of clinically, diagnostically confirmed cases of Postmenopausal Osteoporosis both Diabetics and Non-Diabetics and attending the orthopaedic unit of KLES Dr. Prabhakar Kore Hospital and Medical Research Centre, Belagavi. All the cases were evaluated and selected by simple random technique after fulfilling the selection criteria. The cases of Osteoporosis reported to the Department of Orthopaedics unit of KLES Hospital and Medical Research Center were screened. After finding the suitability as per selection criteria they were requested to participate in the study and briefed about the nature of the study and interventions used. The mean serum calcium for diabetics was 8.22±1.13 mg/dL and for non-diabetics was 8.4 ± 1.27 mg/Dl. The mean serum calcium levels were lower in Diabetics but was not statistically significant (p=0.5564 for calcium).

Keywords: Serum calcium level, diabetics, post-menopausal women with osteoporosis

Introduction

Osteoporosis, which literally means "porous bone", is a disease in which the density and quality of bone are reduced. The loss of bone occurs "silently" and progressively with often no symptoms until the first fracture occurs. It is the commonest metabolic bone disease in clinical practice and is a major public health problem as commonly it is underdiagnosed [1]. Osteoporosis is defined as a disease characterised by low bone mass and micro architectural deterioration of bone tissue leading to increased bone fragility and therefore to an increase in fracture risk [2]. Dual X-ray absorptiometry (DXA) is considered the method of choice for measurement of low bone mineral density (BMD) associated with osteoporosis [3].

According to WHO, osteoporosis is second only to cardiovascular disease as a global healthcare problem. International Osteoporosis Foundation (IOF) estimates that the annual direct cost of treating osteoporosis fractures of people in the workplace in the USA, Canada

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and Europe alone is approximately USD48 billion. The worldwide cost burden of osteoporosis is forecast to increase to USD131.5 billion by 2050 [4].

Bone is a dynamic tissue that is remodeled constantly throughout life. Bone is generally classified into two types. Cortical bone is a dense and strong bone found primarily in the shaft of long bones. Trabecular bone is more porous or weak and typically occurs at the ends of long bones and within the interior of vertebrae and flat bones [5].

Osteogenesis, the process of bone formation, involves 3 main steps:

1) The production of the extracellular organic matrix-osteoid.
2) The mineralization of the matrix to form bone.
3) Bone remodeling by resorption and deposition.

The cellular activities of osteoblasts, osteocytes, and osteoclasts are necessary for this process[6].

Osteoid is the unmineralized organic matrix secreted by osteoblasts. It is composed of 90% type I collagen and 10% ground substance. The mineralization of osteoid by inorganic mineral salts provides bone with its strength and rigidity. The inorganic content of bone consists primarily of calcium phosphate and calcium carbonate, with small quantities of magnesium, fluoride, and sodium [7]. the ionic forms of calcium and phosphorus combine to form calcium phosphate. First as dicalcium phosphate and on through sequential synthetic reactions to become tricalcium phosphate or hydroxyapatite. During the process of bone hardening or aging, the Ca: P ratio gradually increases from 1:1 to 1.67 [8].

Peak bone mass may be impaired by inadequate calcium intake during growth among other nutritional factors (calories, protein, and other minerals), thereby leading to increased risk of osteoporosis later in life. Insufficient calcium intake in adults leads to secondary hyperparathyroidism and an increase in the rate of bone remodeling to maintain normal serum calcium levels [9].

Besides having a role in glucose and lipid metabolism, it is thought that insulin also has an anabolic effect on bone. There are conflicting results on bone involvement in patients with diabetes mellitus due to the pathogenesis complexity of the condition. Bone loss is one of the chronic complications of diabetic patients. Both type 1 and type 2 diabetes have been associated with the higher risk of fractures. While low bone BMD is consistently observed in Type 1 diabetes, the relationship is less clear in type 2 diabetes with some studies showing modestly increased or unchanged BMD. However clinical trials uniformly support the fact that new bone formation, bone microarchitecture and thus bone quality are altered in both types of Diabetes [10].

Biochemical bone markers are non-invasive, less expensive diagnostic tools for diagnosis and treatment follow-up of metabolic bone diseases and can be repeated often. Clinical questions that may be answered by these markers are in relation to diagnosing osteoporosis, identifying “fast bone losers” and patients at high risk of fracture, selecting the best treatment for osteoporosis, and providing an early indication of the response to treatment.

Methodology

Study design: A Cross-sectional study.

Source of data: The present study comprises of clinically, diagnostically confirmed cases of Postmenopausal Osteoporosis both Diabetics and Non-Diabetics attending the Orthopaedic unit of KLES Dr. Prabhakar Kore Hospital and Medical Research Centre, Belagavi

Sample size: 30 Diabetic and 30 Non-Diabetic Post-menopausal women with Osteoporosis in the age of group of 45 to 75 years

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Sample calculation

- According to previous hospital records the number of postmenopausal osteoporotic cases from Orthopaedic department confirmed by DEXA scan in KLES hospital has been around 80 cases per year
- The number of Diabetic patients with DEXA confirmed Osteoporosis was unknown.
- For my study to be statistically significant I have taken a minimum sample size of 30 Diabetic and 30 Non-Diabetic Post-Menopausal women with Osteoporosis.

Selection criteria

- The women were characterized as postmenopausal if they had not menstruated for at least 12 months.

Inclusion criteria for both groups

1. Clinically, Diagnostically DEXA confirmed cases of Post-Menopausal Osteoporosis
2. Age- 45-75 years
3. DEXA scan 'T' score < -2.5

Exclusion criteria for both groups

1. Surgical Menopause
2. Age<45 years and>75 years
3. Hypertensives
4. Those treated with Bisphosphonates, Calcitonin, and Anabolic Steroids, Harmone Replacement Therapy, Calcium, Vit D, Zinc previously at any point since the beginning of menopause.
5. Kidney Diseases
6. Smokers
7. Alcoholics

Criteria for diabetic subjects
Inclusion criteria

- Known cases of diabetes with at least 1 month diabetes duration
- Either type 1 or type 2 category

Exclusion criteria

- Patients with diabetic nephropathy
- Patients taking Insulin preparations containing Zinc
- Patients taking thiazolidinedione's

Criteria for non-diabetic women subjects
Inclusion criteria

- Fasting serum glucose less than 100 mg/dL

Exclusion criteria

- Diabetes

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Procedure

All the cases were evaluated and selected by simple random technique after fulfilling selection criteria. The cases of Osteoporosis reported to the Department of Orthopaedics unit of KLES Dr. Prabhakar Kore Hospital and Medical Research Center were screened. After finding the suitability as per selection criteria they were requested to participate in the study and briefed about the nature of the study and interventions used. A written informed consent was obtained. The consented patients were enrolled in the study. Further descriptive data of the participants like name, age, sex, detailed history were obtained by interviewing the participants and were recorded on a predesigned and pretested proforma.

Analysis of serum calcium

Serum Calcium was analysed using Erba reagents Manual Chemistry kits in Lyophilized form for Semi Auto Analyzers from ERBA Diagnostics Manheim Gmbh and analysed in Erba-Chem 5 semi auto analyser.

Results

The mean serum calcium for diabetics was 8.22 ± 1.13 mg/dL and for non-diabetics was 8.4 ± 1.27 mg/dL. The mean serum calcium levels were lower in Diabetics but was not statistically significant (p=0.5564 for calcium).
BMI of diabetics correlated positively with calcium but was not significant.

Table 1: Comparative analysis of serum calcium between diabetic and non-diabetic postmenopausal women with osteoporosis

	Diabetic		Non-Diabetic		
Parameter	**Mean**	**SD**	**Mean**	**SD**	**p-value**
Calcium in mg/dL	8.22	1.13	8.4	1.27	0.5564

Table 2: Correlation coefficient of BMI with calcium in diabetics

Diabetics	**Correlation coefficient between BMI with**	
	Correlation coefficient	**p-value**
Calcium in mg/dL	0.316	0.089

Table 3: Correlation coefficient of BMI with calcium in non-diabetics

Non-Diabetics	**Correlation coefficient between BMI with**	
	Correlation coefficient	**p-value**
Calcium in mg/dL	0.241	0.199

Discussion

Serum calcium levels are normally tightly controlled within a narrow range, usually 8.5 to 10.5 mg/dL. However, the serum calcium level is a poor reflection of overall total body calcium, because serum levels are only 0.1% to 0.2% of extracellular calcium, which, in turn, is only 1% of total body calcium. The remainder of total body calcium is stored in bone. Ionized calcium is physiologically active, whereas the non-ionized calcium is bound to albumin or anions such as citrate, bicarbonate and Pi. In the presence of hypoalbuminemia, there is a relative increase in the ionized calcium relative to the total calcium, thus total serum calcium may underestimate the physiologically active (ionized) serum calcium. Serum levels

of ionized calcium are maintained in the normal range by inducing increases in the secretion of PTH. PTH acts to increase bone resorption, increase renal calcium reabsorption and increase the conversion of 25(OH) D to 1, 25(OH) $_{2D}$ in the kidney, thereby increasing gastrointestinal calcium absorption. In individuals with normal homeostatic mechanisms, these interactions of PTH and vitamin D metabolites at Target organs, including the kidney, maintain the serum ionized calcium level within the normal range to ensure proper cellular function [11].

Relationship between serum Calcium along with several other parameters between 50 premenopausal and 50 postmenopausal women was evaluated in a study using colorimetric methods. The mean BMI, Calcium levels were significantly higher in the postmenopausal group compared to premenopausal women ($p<0.05$) [12].

However Vemuru M[13] showed no significant difference in the serum calcium between the two groups ($p<0.05$). Significantly high BMD scores in pre-menopausal women compared to post- menopausal women ($p<0.01$) was seen.

Verma M[14] evaluated serum Ca along with few other parameters in 40 type 2 DM postmenopausal women and 38 postmenopausal women without diabetes as controls. They found significant decrease ($p < 0.001$) in the serum calcium with an associated increase ($p < 0.001$) of urinary calcium and hydroxyproline levels in the study group. Blood sugar levels and HbA1c values were significantly high ($p < 0.001$) in the study group subjects. They concluded that the biochemical indices of bone turnover estimation show significantly increased bone activity in hyperglycemic postmenopausal women as compared to normal postmenopausal women.

Conclusion

- There was no significant difference in serum calcium level between the two groups though calcium was lower in the diabetic group.
- BMI correlated positively with calcium as well but was not significant.

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