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PREVALENCE OF OSTEOPOROSIS AMONG DIABETICS - A PROSPECTIVE STUDY

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Abstract: Summary: Diabetes mellitus patients were assessed based on the bone scan values and thereby it was found out that there is more risk of osteoporosis in type 1 diabetes mellitus patients in comparison to type 2 patients. Introduction: Amidst controversies, the degree of bone loss differs in type 1 DM and type 2 DM and hence it is indeed a debatable topic. The present study is aimed so as to understand the prevalence of osteoporosis among type 1 DM and type 2 DM patients and to analyze as to which type of diabetic patients are more prone to osteoporosis. Methods: A prospective, comparative study was conducted in 200 patients suffering from type 1 or 2 diabetes mellitus of either sex. Patients with fasting blood sugar greater than 126mg/dl or random blood sugar greater than 200mg/dl were diagnosed to have diabetes mellitus and was included in the study. Blood tests showing auto antibodies and presence of ketone bodies in urine were considered as type 1 diabetics and its absence were considered as type 2 diabetics. Bone mineral density (BMD) was obtained via dual x-ray absorptiometry (DXA). Results: Among the total number of 200 diabetic patients, males were 27.5% and females were 72.5%. 62 patients suffered from type 1 diabetes mellitus, in which males were 24.19% and females were 75.8%. Patients with type 2 diabetes mellitus was 138, in which 28.98% were males and 71.01% were females. Based on bone scan readings, patient with a T score < -2.5 were considered osteoporotic and thereby its prevalence among different diabetic patients were assessed. There was a significant difference in the prevalence of osteoporosis among the two types of diabetic patients ($p < 0.001$). Among the type 1 diabetics, 54.83% patients had osteoporosis and among the type 2 diabetics, 19.56% patients had osteoporosis. Conclusions: Both the types of diabetic patients showed prevalence of osteoporosis however patients with type 1 diabetes mellitus were comparatively more prone to osteoporosis than type II diabetic patients.

Keywords: Osteoporosis - Type 1 DM - Type 2 DM - Bone mineral density



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INTRODUCTION

Diabetes is a group of metabolic diseases characterized by hyperglycemia resulting from defects in insulin secretion, insulin action, or both. Diabetes is now one of the most common non-communicable diseases globally. It is the fourth leading cause of death in most developed countries and there is substantial evidence that it is epidemic in many developing and newly industrialized nations [1]. Diabetes is often associated with complications and comorbidities. The most common complications include cardiovascular disease, eye problems, diabetic neuropathy, itchy feet and kidney disease. However, the range of issues goes well beyond these including gum disease, amputations and osteoporosis. Diabetic osteoporosis (OP) is increasingly recognized as a significant comorbidity of diabetes mellitus (DM) [2]. Osteoporosis is a systemic skeletal disease characterized by low bone mass and micro architectural deterioration of bone tissue, with a consequent increase in bone fragility and susceptibility to fracture"[3]. It is a painless weakening of the bones that constitutes an enormous socioeconomic crisis, with a harmful impact on morbidity and mortality [4].

The association between diabetes mellitus and osteoporosis remains controversial. Although the metabolic abnormalities of diabetes potentially affect bone metabolism, structure, and mineral density, the extent of their contribution to the increase in fracture risk noted in individuals with type 1 and type 2 diabetes is still debated. Several diabetes-related complications such as retinopathy, neuropathy, and nephropathy have been linked to decreased BMD[5]. Bone deteriorations differ markedly between type 1 and type 2 DM and possibly stem from different cellular and molecular mechanisms[6]. The mechanism for the reduced bone turnover in type 1 diabetes is likely multifactorial[7].

Insulin deficiency is a primary causative factor for osteoporosis. Insulin deficiency leads to detrimental effects on the bone strength, bone mineralized surface area, and osteoblast activity.[8]. The effect of insulin seems not only limited to osteoblasts, but also involves osteoclasts as well since it contains insulin[9]. Osteoblasts also possess receptors for insulin like growth factor-1 (IGF-1). Accumulation of advanced glycation end products (AGEs) in bone collagen is thought to contribute to the reduction in bone strength for a given BMD [10]. Higher glucose levels in the blood are known to interact with several proteins to form advanced glycation end (AGE) products[11]. Accumulated AGE-products in the body may stimulate apoptosis of osteoblasts, thereby contributing to deficient bone formation[12]. AGE-products are specifically recognized by AGE receptors (RAGE). AGE-RAGE interaction is known to alter bone healing and bone turnover processes[13] as it enhances bone resorption by contributing to osteoclast maturation and function [14]. Glucose is the principle source of energy for osteoclasts[15] and high glucose concentrations can impair the ability of osteoblastic cells to synthesize osteocalcin, which is integral to bone formation [16]. Another indirect effect of

hyperglycemia is glycosuria, which causes hypercalciuria, leading to decreased levels of calcium in the body and poor bone quality[17].

There are also other biochemical and hormonal abnormalities that further contribute to the decreased bone strength observed in patients with type 2 DM. In patients with non-insulin-dependent DM with poorly controlled blood glucose levels, the loss of bone mineral content is worsened by negative calcium balance caused by a renal calcium leak[18]. Other factors, including advanced age, previous fracture and long-term corticosteroid use, might also predispose DM patients to osteoporosis and low-impact fracture, whereas physical activity/exercise and high body mass index are protective[19].

Hence by understanding the various hypothesis and mechanisms linking these two rapidly evolving medical conditions-diabetes mellitus and osteoporosis and considering the fatal consequences pertaining to such patients subjected to these, the present study was designed to assess the incidence of osteoporosis based on gender and also among the type 1 and 2 diabetes mellitus patients.

MATERIALS AND METHODS

Study design:

A prospective, comparative study was conducted in 200 patients with type 1 or 2 diabetes mellitus of either sex at a diabetic camp in a tertiary health care centre.

Patients with fasting blood sugar greater than 126mg/dl or random blood sugar greater than 200mg/dl were diagnosed to have diabetes mellitus and was included in the study. Blood tests showing autoantibodies and presence of ketone bodies in urine were considered as type 1 diabetics and its absence were considered as type 2 diabetics. Bone mineral density (BMD) was obtained via dual x-ray absorptiometry (DXA).

Study patients:

200 patients were recruited from various centres to a diabetic camp held at Trivandrum, Kerala, India. The study was approved by institutional ethics committee and informed consent forms were collected from the participants. BMD of the lumbar spine (L2 and L4) and proximal femur (femoral neck) was measured by Dual Energy X-Ray Absorptiometry (DXA). According to the WHO criteria by using T-Score of lumbar and femoral BMD, osteoporosis (T-score less than -2.5 of standard deviation in DXA densitometry) and osteopenia (T-Score between -1 to -2.5 of standard deviation in densitometry) were defined¹⁹. The demographic data including age, weight, height, and medical history such as endocrine disorders (DM and thyroid dysfunctions) was collected from the participants.

Inclusion criteria:

- Patients in the age of 18 years or older of either gender having type 1 or 2 DM

Exclusion criteria:

- Patients with systemic diseases like chronic obstructive airway disease, vasculitis
- Patients associated with inflammatory conditions like rheumatoid, psoriatic and gouty arthritis
- Patients on alcohol consumption
- those patients who are not willing to give informed consent

RESULTS

A total of 200 diabetic patients (62 type I and 138 type II diabetes) were included in the study. Out of which 55(27.5%) were males and 145(72.5%) were females. The diabetes type and bone scan values based on gender is shown in table 1 and 2 respectively.

Table 1 Diabetes distribution (n₁=62 n₂=138)

	Type 1 DM	Type 2 DM
Gender	Frequency(Percentage)	Frequency(Percentage)
Males	15 (24.19%)	40 (28.89%)
Females	47 (75.80%)	98 (71.01%)

It was observed that females were more prone to both type 1 and type 2 diabetes mellitus.

Table 2 Bone scan value distribution (n₁=62 n₂=138)

	Type 1 DM	Type 2 DM
Bone scan	Frequency(Percentage)	Frequency(Percentage)
normal	8 (12.9%)	64 (46.37%)
osteopenia	20 (32.25%)	47 (34.05%)
osteoporosis	34 (54.83%)	27 (19.56%)

There was a significant difference (p value<0.001) in the occurrence of osteoporosis between both the types of diabetes mellitus. Patients with type 1 diabetes mellitus had a higher prevalence of osteoporosis (54.83%) than type 2 diabetes mellitus patients (19.56%).

However, there was no significant difference in the occurrence of osteopenia between both the types of diabetes (p value=0.19)

Discussion

In the present study, it has been understood that incidence of osteoporosis in relation to diabetes mellitus is increasing with females being more vulnerable. It has also been observed that patients diagnosed with type 1 diabetes mellitus are more prone to osteoporosis as compared to patients with type 2 diabetes mellitus. Type 1 diabetes does appear to be a significant risk factor for osteoporosis. Currently, patients with type 1 diabetes should be monitored more carefully than persons without diabetes or those with type 2 disease, and should be encouraged to consume a diet high in both calcium (at least 1200 mg/day) and vitamin D (400-600 IU/day). It appears that intensive insulin therapy and a stable body weight in patients with type 1 diabetes is important in preventing bone loss.[12] Patients with diabetes and osteopenia or osteoporosis have successfully been treated with bisphosphonates, with similar bone density results as patients without diabetes [21].

The degree of bone loss differs between type 1 and type 2 diabetes. In some studies, type 2 diabetes has been associated with an increase in bone mineral density [22].

Studies conducted previously showed that elderly patients with type 2 diabetes mellitus are prone to develop osteoporosis. It has been understood from these previous studies that the insufficiency of insulin, the decreased insulin sensitivity and diabetic nephropathy are important causes for osteoporosis in the patients with type 2 diabetes [23]. Majority of the studies showed increased bone mineral density, while some articles revealed decreased bone mineral density; moreover, few articles revealed normal or no difference in bone mass among diabetics. There were conflicting results concerning the influence of type 2 DM on bone mineral density in association with gender, glycemic control, and body mass index. In general, most of the studies showed controversy over the effect of diabetes on bone mass in type 2 DM [8]. Because most of the studies involved a small number of patients, in order to correct for this limitation and increase the power, a meta-analysis [11] including 80 papers on bone mineral density and fracture risk in patients with type 1 and 2 DM was done and showed that in both genders there was an increased risk of fractures in both types of diabetes mellitus compared to non-diabetes mellitus. T-score in hip and spine was decreased in type 1 and increased in type 2 DM. A meta-regression showed that mainly BMI was the major determinant for bone mineral density, whereas HBA1C was not linked to bone mineral density. The increase in fracture risk was higher and bone mineral density was lower in patients with complications of DM [12].

The present study did have some limitations. The sample size of our study was small and number of patients included in each group was unequal. Hence, studies with larger sample size should be conducted to reveal the intricacies of the link between diabetes and osteoporosis.

Complications from diabetes are resulting in increasing disability, reduced life expectancy and enormous health costs for virtually every society. Diabetes is certain to be one of the most challenging health problems in the 21st century[24].Hence, screening, identification, and prevention of potential risk factors for osteoporosis in DM patients are crucial and important in terms of preserving a good quality of life in diabetic patients and decreasing the risk of fracture. Patient education about an adequate calcium and vitamin D intake and regular exercise is important for improving muscle strength and balance. Furthermore, adequate glycemic control and the prevention of diabetic complications are the starting point of therapy in diabetic patients.

CONCLUSION

In conclusion, the present study evaluated the association of osteoporosis with the types of diabetic patients and understood that patient with type 1 diabetes mellitus were more vulnerable to osteoporosis in comparison to type 2 diabetes mellitus patients.

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