Bone Mineral Density In Diabetes Mellitus: A Pilot Study

*RAJASHREE KHOT **SUSHRUT RAJAN *** Madhuri Paithankar

ABSTRACT:

Context: Low Bone mass or Bone mineral density (BMD) is a sequelae of Type I as well as Type II diabetes. Diabetes may affect bone tissue by different mechanisms .The exact prevalence and factors that influence development of osteopenia in diabetes are not well established.

Aims:

1. To study the Prevalence of osteopenia and osteoporosis in diabetic patients as compared to controls by assessment of bone mineral density.
2. To study the corelation between decreased BMD and other biochemical parameters like serum calcium, serum phosphorus, alkaline phosphatase and acid phosphatase.

Settings and Design:

This was a cross sectional study including 50 consecutive cases of Diabetes Mellitus (Type I and II) attending the diabetes clinic of Govt.medical College, Nagpur and 50 non diabetic age and sex matched controls.

Methods and Material:

Patients attending the diabetic clinic of our hospital, satisfying inclusion criteria were selected. All of them underwent BMD scan and assessment of bone mineral density (BMD) was done using bone mineral densitometry (USG-based) of calcaneum. Patients were categorized as normal, osteopenic or osteoporosis according to WHO criteria. Biochemical investigations like Serum Calcium, Phosphorus, Acid and Alkaline Phosphatase and Fasting and Post meal Blood glucose were also performed.

Results:

Mean BMD was significantly lower, in almost all the age groups, in cases having Type 1 DM as compared to controls. There was a age related decline in BMD in Type II DM but the difference was not significant in comparison with controls. Mean BMD in males with Type I DM was -1.84 $\pm$ 0.63 compared to controls (-0.99 + 1.12, p=0.04).Otherwise no significant difference in BMD in males and females. Out of the 17 patients of Type 1 DM, 10(58.83%) had osteopenia while 4(23.53%) had osteoporosis. Out of the 33 patients of Type 2 DM, 15(45.46%) had osteopenia while 7(21.21%) had osteoporosis. BMD declined more with increasing duration of DM and was significantly correlated with, both fasting as well as Post-meal Glucose in Type 1 DM. No significant correlation was observed in between BMD and glucose in Type 2 DM. The biochemical parameters were normal inspite of low BMD.

Conclusions:

Low Bone mineral density is observed in young male patients with Type I DM with poor glycaemic control. BMD goes on decreasing with increasing duration of Diabetes in Type I and Type II DM, thus predisposing them for development of Osteopenia and Osteoporosis.

Address for correspondence

*Associate Professor ** Intern *** Associate Professor

Dept. of Medicine
Govt. Medical College, Nagpur

Corresponding Author:
Dr.Rajashree Khot
Plot No.52, Jaineeta, New Ramdaspeth,
Nagpur- 440010
e-mail : rajashree.s.khot@gmail.com

INTRODUCTION

Osteoporosis is a bone condition defined by low bone mass, increased fragility, decreased bone quality, and an increased fracture risk. Bone mineral density is altered in Type I as well as Type II diabetes. Elderly persons are at a risk of fall and sustain injuries and fractures. The risk may be aggravated by presence of diabetes. Diabetes may affect bone tissue by different mechanisms like obesity, hyperinsulinaemia, deposit of advanced glycation end products in collagen fibres, reduced circulating levels of IGF-1, hypercalciuria, microangiopathy and chronic inflammation.[1]

Only a few studies in India have studied the prevalence of osteopenia in diabetes.

Factors that influence development of osteopenia in diabetes are not well established. Hence it is essential to evaluate the prevalence and magnitude of diabetic osteopenia and its association with clinical, metabolic and biochemical variables.

We studied the bone mineral density in both Type 1 and Type 2 diabetic patients, compared to age and sex matched nondiabetic controls and corelated the clinical, metabolic and biochemical variables associated with low BMD.

MATERIAL AND METHODS

Patients attending the diabetic clinic of GOVERNMENT MEDICAL COLLEGE, NAGPUR satisfying inclusion criteria were selected after informed consent of the patients. A detailed history was taken including diabetic history, on the record sheet. Then thorough clinical examination was done.

All of them underwent a bone density scan of calcaneum and assessment of bone mineral density was done using BONE MINERAL DENSITOMETRY ULTRASOUND MACHINE. Bone mineral density was measured in gm/cm2 and both T-score and Z-score were measured but only T-score was used for analysis based on World Health Organization criteria. Patients were categorized as Normal, Osteopenic or Osteoporosis according to WHO criteria. Blood samples were collected Age and sex matched non diabetic controls were selected and they also underwent a bone density scan at the same time and were categorized according to WHO criteria.

WHO CRITERIA FOR OSTEOPOROSIS

T-score	Category
> -1	Normal
< -1 and > -2.5	Osteopenia
< -2.5 (without fracture)	Osteoporosis
< -2.5 (with fracture)	Established Osteoporosis

Statistical Analysis:

Data was analyzed using Microsoft excel programme. It was quoted as mean with standard deviation. Comparison was done using Pearson's correlation tests and Student's t-test as appropriate. P-value </= 0.05 was considered statistically significant.

RESULTS

Total no.of cases studied = 50 of which Type I DM =17 and Type II DM = 33

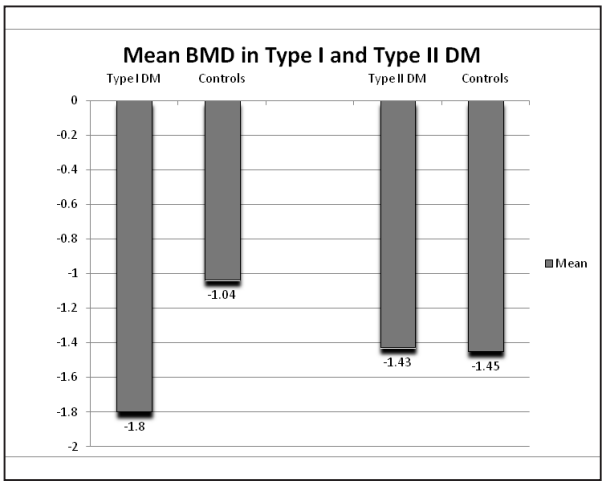
Controls = 50

BMD and DM

There was a significant decrease in the BMD in Type 1 diabetics as compared to the controls (p=0.020). The mean BMD was almost similar in Type 2 diabetic patients as compared to controls. There was no significant correlation in BMD, between Type 2 diabetics as compared to the controls.(FIGURE 1)

Prevalence of Osteoporosis and Osteopenia

The Prevalence of Osteopenia and Osteoporosis was again higher among patient with Type I DM as compared to controls. The prevalence of Osteoporosis was more in Type



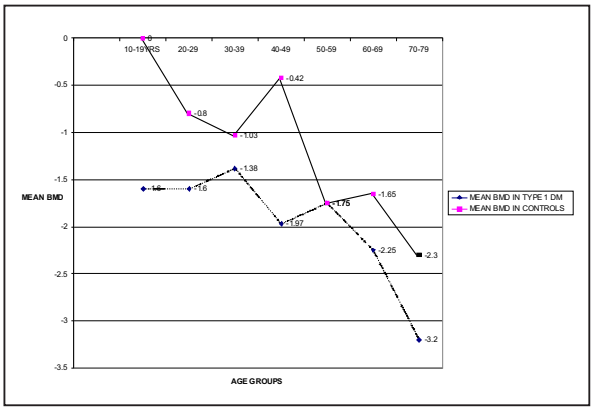
II DM especially in postmenopausal females. (Table 1)

TABLE 1

S. N.	BMD	TYPE I DM n - 17	CONTROLS n-17	p-value	TYPE II DM – 33	CONTROLS n-33	p-value
1	NOR-MAL	3 (17.64%)	9 (52.94%)	p-0.03	11 (33.33%)	8 (24.24%)	p-0.045
2	OSTEO PENIA	10 (58.83%)	8 (47.05%)		15 (45.46%)	22 (66.66%)	
3	OSTEO POROSIS	4 (23.53%)	nil		7 (21.21%)	3 (9.09%)	

BMD and Age

Mean BMD in Type I DM patients in the age group 10 -29 years was -1.6 and it declined significantly with advancing age.In Type II DM BMD decreased with age but the decline was similar to that of controls. In age 60-69 it was -2.04 + 0.94 (controls -2 + 1.19, p-0.9). (Figure 2)



BMD and Gender

BMD in Type I males was -1.84 + 0.63 (controls -0.99 + 1.12, p= 0.04) and females -1.71+ 0.01. BMD in Type II males was -1.44 + 0.44 and females -1.43 + 0.07, p= 0.98. No statistically significant gender difference in BMD in Diabetic patients. BMD and duration of diabetes Mean BMD in patients with duration of Diabetes 0-5 years was -1.33 + 1.03, 6-10 years was -1.38 + 1.37 and 11-15 years was -3.23 + 0.78 , p-value = 0.03.BMD declined significantly as the duration of Diabetes increased.

BMD and glycemic control Mean BMD was significantly lower in patients with post-meal Hyperglycemia (-2.03) as compared to the normoglycaemic (-1.05) cases but it was lowest in patients having fasting hyperglycemia. No significant difference in BMD is observed in those with and without Hyperglycemia in type 2 DM. Hence it can be said that BMD is corelated with glycaemic control in Type I DM but unrelated to Glycaemic control in patients with Type 2 DM.

BMD and Serum Calcium, Phosphorus,Acid phosphatase and Alkaline Phosphatase

No statistically significant correlation observed between BMD and Sr. Calcium,Phosphorus,Acid phosphatase and Alkaline Phosphatase in Type I as well as Type II DM patients.

DISCUSSION

When considering all of the risk factors, patients with diabetes generally have an increased risk of falling because of peripheral neuropathy, possible hypoglycemia, nocturia, and visual impairment. Bone quality changes may also be affected by microvascular events common in diabetes.

Type 1 diabetes has long been associated with low bone density. For patients with Type 1 diabetes, the initial onset of the disease often occurs at a young age, when bone mass is still being accrued. Thus, low bone mass is not a surprising complication of Type 1 diabetes.

Levels of glucose control among this population have not been correlated with the severity of osteoporosis. In some studies, however, investigators have shown that bone mineral loss is higher during the first few years of DM and subsequently stabilizes, in contrast to other typical complications. This stabilization may be related to the adequate insulin treatment of these patients, which normalizes the metabolic disorders that affect the bone.[2]

Lopez-Ibarra PJ et al[3] found reduced bone mass in patients with Type 1 DM at the time of the clinical diagnosis. They observed that high percentage of patients with DM had osteopenia, which may not, therefore, be a late complication of type 1 DM. These findings needed to be confirmed in larger studies, they concluded.

Hampson G et al.[4] observed that bone mineral density was lower at the femoral neck in the subjects with Type I diabetes ($p = 0.08$) as compared to controls.

However, it was unclear until recently whether this translated into increased fracture rates. Results from the Nord-Trondelag Health Survey from Norway [4] showed a significant increase in hip fracture rates among females with Type 1 diabetes (relative risk 6.9, confidence interval 2.2–21.6) compared to non-diabetic age-matched female control subjects. In the Iowa Women's Health Study, [5] women with Type 1 diabetes were 12.25 times more likely to report having had a fracture than women without diabetes. Diabetic retinopathy, advanced cortical cataracts, and diabetic neuropathy have all been associated with increased fractures.[6,7]

Only a few studies in India have studied the prevalence of osteopenia in diabetes.

In our study,there was a significant decrease in the BMD in Type 1 diabetics as compared to the controls ($p=0.020$). The mean BMD was decreased, in all the age groups, in Type 1 diabetes as compared to the controls.

Van Daele PL et al [8] found that men and women with this condition had substantially higher mean bone mineral density values than those with normal glucose tolerance.

Differences between Type 1 and Type 2 diabetes are probably influenced by the much greater body weight typical of the latter, because obesity per se is associated with increased bone density. Also, patients with type 1 diabetes may go through more frequent episodes of profound insulin deficiency and metabolic acidosis at an early age, when peak bone mass is being determined[9]. A greater peak bone mineral density would be anticipated for patients with Type 2 diabetes, whose disease generally starts later in life and who tend to be overweight. It is even possible that a low rate of bone turnover might help protect the skeleton from the development of overt osteoporosis in some older patients.[10]

Mean BMD was significantly lower in patients with post-meal Hyperglycemia (-2.03) as compared to the normoglycaemic (-1.05) cases but it was lowest in patients having fasting hyperglycemia. Our study confirms the results of previous studies in Type 1 diabetes mellitus.

Our study also correlate with the results of previous studies that reported similar BMD values in Type 2 diabetic and control subjects but contradicts earlier observations of higher BMD in Type 2 diabetes. These discrepancies may be explained by methodological differences and diverse patient selection criteria. For example, in the Rotterdam study, which showed higher than normal BMD in Type 2 diabetic subjects, many of the patients had relatively mild previously undiagnosed diabetes, whereas in our patients, Type 2 diabetes was of long duration and required insulin therapy.

CONCLUSION

Bone mineral density is significantly

decreased in Type 1 DM patients. However no significant correlation is observed in Type 2 DM patients. Thus Type 1 DM is at a greater risk of developing diabetes related osteoporosis. Bone mineral density goes on decreasing with increasing duration of diabetes.

Prevalence of Osteopenia and Osteoporosis is higher in Type 1 DM. In Type 2 DM, the prevalence of osteopenia is lower, but the prevalence of osteoporosis is higher especially in postmenopausal women. Low bone mineral density is associated with poor glycaemic control in Type 1 DM patients but not in Type 2 DM patients.

IMPLICATIONS OF STUDY

Young, male, Type 1 DM patients are at increased risk of osteoporosis. Poor glycaemic control is a major risk factor for development of diabetes related osteopathy. Hence detection of osteoporosis in diabetic patients would help in reducing the exposure of fracture risk factors by taking all the preventive measures. Optimization of metabolic control in diabetic patients may prevent further progress of osteoporosis.

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