Original Article

Bone mineral density in pediatric type 1 diabetic patients of southeastern Iran

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ABSTRACT

Diabetic patients are at risk of osteoporosis and its complications. The present study was designed and conducted with the aim of investigating bone density in type 1 diabetic patients. Due to the lack of insulin in type 1 diabetes, these patients are prone to osteoporotic fractures, which should be detected and treated early to prevent further complications. The present study was a descriptive-analytical study that was conducted on 50 diabetic patients referred to Ali Asghar Zahedan Clinic. software SPSS version 22 (IBM, Armonk, NY, USA) were used to analyze the data. The average age of the participants was 12.58 ± 3.35 years. Bone mass status was reported in 30% of low bone mass patients and 48% of osteoporosis. Bone mass status had a statistically significant difference with age and duration of diabetes, and it did not have a statistically significant difference with gender and HbA1c variables. A high percentage of patients with type 1 diabetes had low bone mass and osteoporosis. It does not seem that HbA1c as a measure of blood sugar control is related to BMD, also the decrease in bone density in type 1 diabetes patients with lower hips showed that BMD may decrease relatively early in the course of the disease.

Keywords: Bone density, Type 1 diabetes, Blood sugar.HBA1C

Introduction

Diabetes is considered as a common chronic disease all over the world, so it is estimated that one out of every 300-400 teenagers has type 1 diabetes [1]. The global incidence of type 1 is continuously increasing by about 2-5% per year. The majority of cases are diagnosed before the age of 18, and often between the ages of 3-6 and mid-teens. However, this disease can also appear in adulthood. The incidence of type 1 diabetes is very variable among different countries, even in different regions of the same country and different ethnic groups [2]. Type 1 diabetes is an autoimmune disorder that results in the destruction of the insulin-producing β-cells of the pancreas that appears in childhood or early adulthood. Also, this disease is associated with an increased risk of complications such as retinopathy, nephropathy, neuropathy and cardiovascular events in adults [3, 4].

It is known that diabetic patients are at risk of osteoporosis and its complications, including hip fracture [5-7]. The occurrence of these types of fractures in the United States is reported to be 1.3 million cases per year, which imposes a cost of up to 14 million dollars for maintenance and the resulting disability to the health structure. Also, the mortality rate due to hip fracture has been reported to be up to 20% [8]. In people with type 1 diabetes, insulin IGF1 deficiency damages osteoblastic bone formation and prevents peak bone mass accumulation during growth, which leads to Bone formation rates are markedly reduced and bone density is reduced [9]. The difference in bone density of type 1 and type 2 diabetics may be explained by the difference in the body mass index of these people, because in type 1 diabetes, most patients are thin, and in contrast, obesity is common in type 2 diabetes, which can increase the burden. bone and as a result stimulate bone metabolism [10]. Both type 1 diabetes and type 2 diabetes are associated with an increased risk of fracture, which is only partially explained by falls and bone density [9]. Comparison of bone mineral density (BMD) between people with type 1 diabetes and control group without diabetes has had different results [11-13]. A recent meta-analysis reported no difference in lumbar spine BMD and relatively lower femoral neck BMD in adults with type 1 diabetes compared with nondiabetic controls [14]. Similarly, a recent study of adults with

type 1 diabetes for more than 50 years found normal Z-scores at the lumbar spine and hip joint, suggesting no effect of long-term type 1 diabetes on bone mineral density. does not exist [15].

Catalina Biele *et al*. [16] showed that increasing body weight partially prevents the decrease of BMD in type 2 diabetes. Also, Westergaard *et al*. [17] reported that the risk of hip fracture was increased in type 1 diabetes and type 2 diabetes compared to people without diabetes. It seems that routine BMD assessment should be considered in all young people with type 1 diabetes. Also, considering the few studies conducted in the adolescent age group and type 1 diabetes, it is necessary to implement a low-cost follow-up program. Therefore, according to the stated content and the importance of type 1 diabetes and the impact that this disease has on the individual, family and society, and considering that bone growth in young people with type 1 diabetes is abnormal, we decided to conduct a study to investigate the situation Bone densitometry (BMD) should be performed in children under 18 years of age with type 1 diabetes. Most research shows that bone health is compromised when diabetes occurs. The key answer to this connection is the interaction between bone and insulin. People with type 1 diabetes are more likely to develop osteoporosis. According to this decrease in bone density is due to the lack of insulin levels in these patients. Insulin increases bone density. Insulin can increase the absorption of amino acids and the production of collagen by affecting bone cells.[18]

Due to the decrease in bone density of these patients, the probability of bone fractures is higher in these patients, and at the same time, in case of fracture, bone tissue repair is often delayed. In bone fractures, a lot of maintenance costs and the resulting disability are imposed on the health structure. Also, the mortality rate due to fracture has been reported up to 20%.

Considering the increase in the prevalence of diabetes in human societies and the accompanying complication of osteoporosis in these patients, it is recommended that in addition to proper blood sugar control, lifestyle changes, healthy eating, appropriate physical activity, smoking and alcohol cessation, these patients should be prevented from osteoporosis. , bone density should be done serially and in case of osteoporosis treatment should be done on time

Materials and Methods

The present cross-sectional study was descriptive-analytical in order to determine the frequency of bone density in patients with type 1 diabetes referred to Ali Asghar Zahedan Clinic in 2002-2003.

According to the latest version of Nelson[19] and Williams[20], ADA 2024[21] patients who have fasting blood sugar above 126 or postprandial blood sugar above 200 in two exams or once with symptoms or HBA1C above 6.5 are considered diabetic.

Z-scores, not T-scores, are preferred. This is particularly important in children. Z-score of -2.0 or lower is defined as "below the expected range for age," and a Z-score above -2.0 is "within the expected range for age." The term "osteopenia" is retained, but "low bone mass" or "low bone density" is preferred [22].

The experimental samples were selected as available and all people entered the study voluntarily, following the principles of medical ethics, after obtaining a consent letter and with full knowledge of the research process. The inclusion criteria included BMD of patients who had at least 1 year since the onset of diabetes, and the exclusion criteria included patients with a history of untreated hypothyroidism, hyperparathyroidism, malabsorption, celiac disease, IBD, liver, bone, kidney, and lung disease. , long-term use of corticosteroids. According to the purpose of the research, the following formula was used to determine the sample size:

Data gathering tools

A questionnaire containing demographic information including age, sex, height, weight, HbA1c level, disease duration, bone density was completed for each patient. BMD of all patients who were included in the study based on the criteria and at least 1 year had passed since the onset of diabetes, was done by DXA method using stratos dr device manufactured by Raouf company. This project was approved by the ethics committee of Zahedan University of Medical Sciences with code IR.ZAUMS.REC.1402.004.

Data analysis

After completing the questionnaires, the information was entered into SPSS software and analyzed. Statistical evaluation of the obtained data was performed using SPSS version 22 (IBM, Armonk, NY, USA). The normality of the data was checked by the Kolmogorov-Smirnov test. Descriptive statistics were presented in the form of mean values and standard deviation for numerical variables and frequency values for categorical variables. A p-value <0.05 is considered statistically significant.

Results and Discussion

In this study, 50 patients (21 men, 29 women) with an average age of 12.58 ± 3.35 among those who referred to Ali Asghar Clinic in Zahedan city were investigated. According to the results, 11 people had normal bone mass status (22%), 15 people had low bone mass (30%), and 24 people had osteoporosis (48 percent) Among the children with osteoporosis, 9 were male and 15 were female . The results of the independent t-test showed that the average age of people in both male and female groups had no statistically significant difference ($P = 0.78$)

Among patients with normal bone density, HBA1C was average 9.18 and HBA1C was 9.61 in low bone mass group and in osteoporosis was 9.96 . Also, the ANOVA test results showed that there is no statistically significant difference between bone mass status and HbA1C ($p=0.66$).

Osteopenia was more common in patients whose duration of diabetes was less than 3 years and osteoporosis in more than 3 years old . Based on the results, there is a statistically significant difference between the bone mass status and the duration of diabetes (p=0.01).

Chi-square test results showed that there is no statistically significant difference between bone mass status and gender (p=0.82) **(Table 1)**.

Table 1. BMD status of children under 18 years of age with type 1 diabetes by gender

P value	Sex			BMD
	All	Female	Male	
	11	6(54.5)	5(45.5%)	Normal
0.82	15	7(46.7)	8(53.3%)	Low bone mass
	24	15(62.5)	9(37.5%)	Osteoporosis

Table 2. BMD status of children under 18 years of age with type 1 diabetes based on duration of diabetes

P value	Diabetes duration			BMD
	Total	More than 3 years	Less than 3 years	
	10	2(20%)	8(80%)	Normal
0.01	15	4(73.3)	11(73.3)	Low bone mass
	24	16(66.7)	8(33.3%)	Osteoporosis

The relationship between type 1 diabetes and osteoporosis has been proven in various studies; However, the exact mechanism of this problem has not been fully determined. What emerges from the total results of the present study is that the incidence of osteoporosis and osteopenia in the group of diabetic patients is higher than in normal conditions. This hypothesis is proposed, in type 1 diabetes, changes in BMD begin at a young age. Insulin deficiency is known as one of the possible causes of bone formation disorders. In the present study, no correlation was found between HbA1c and BMD. In some studies, like the present study, researchers reported no correlation between BMD and HbA1c values. HbA1c as a measure of glycemic control does not appear to be associated with BMD. This may indicate that the level of metabolic control does not directly affect BMD over longer periods of time, as the main factor may be diabetes complications, which are fully mediated by HbA1c levels. are not considered, and other factors also play a role in this matter. The fact that long-term glycemic control is not associated with BMD suggests that reversible short-term changes in BMD may be seen around the time of diagnosis in type 1 diabetes, changes that are reversed by diabetes treatment [18]. Liu *et al*.'s study also found no association between HbA1c or duration of diabetes and BMD in analyzes limited to the subset of women, which may indicate that diabetes control does not play an important role in the development of bone loss in type 1 diabetes. However, this finding is limited by the fact that HbA1c at the time of dual-energy X-ray absorptiometry scanning only reflects short-term glycemic control [23].

Data reporting BMD values in type 1 diabetes and type 2 diabetes patients are very heterogeneous and relatively inconsistent with regard to BMD predictors. A meta-analysis reported negative Z-scores for patients with type 1 diabetes, the results of which showed that type 1 diabetes was associated with lower bone mass [18]. In the present study, a statistically significant difference was observed between BMD and patient age. The effect of type 1 diabetes on BMD seems to depend on the patient's age. Some of the studies published to date have focused on the association between type 1 diabetes and BMD values among middle-aged and older women, and others have focused on younger patients. In Penn *et al*.'s study, the effect of type 1 diabetes on BMD seems to depend on the patient's gender or age. This study found that type 1 diabetes was generally associated with significantly lower BMD, and BMD (including total body, spine, and femur) was also found to differ in patients younger than 20 years. However, bone loss in type 1 diabetes patients younger than 20 years showed that BMD may decrease relatively early in the course of the disease [24].

Of note, osteopenia has been reported to be present at the onset of type 1 diabetes, suggesting the existence of pathogenic mechanisms that operate before the overt manifestations of type 1 diabetes [25]. It is also known that the destruction of islet cells and insulinopenia begins several years before the onset and clinical diagnosis of the disease. Therefore, some autoimmune and autoinflammatory responses, which continue before and after the onset of diabetes, may contribute to bone loss [26].

Conclusion

A high percentage of patients with diabetes have osteopenia and osteoporosis. HbA1c as a measure of glycemic control does not appear to be related to BMD, and the reduction in bone mineral density in type 1 diabetic patients with lower hips suggests that BMD may decrease relatively early in the course of the disease. And it is better to do BMD at the beginning of diabetes so that we can follow the decrease in bone density.

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Conflict of interest: The authors declare that they have no competing interests

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