Bone Mineral Density (BMD) in patients with type 2 diabetes mellitus

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ABSTRACT

The purpose of this work was to determine the association between type 2 diabetes mellitus and bone mineral density (BMD) in men and women. This retrospective study was conducted between 2010 and 2013 at the Hospital of King Abdul-Aziz University. Records of the patients have been reviewed and data’s were collected from 550 patients who underwent bone mineral density scan. The study sample included 550 patients enrolled in the study. It is noticed that 87.7% i.e. 482 of patients were female. While 12.3% i.e. 68 of patients where male. There were 53.0% (i.e. 229) of patients with diabetes. While 47% (i.e. 204) of patients where non-diabetic. Bone mineral density was the same in diabetic patients compared to control and no significant difference between them. On chi-square analysis, Negative correlation was seen between BMD values with diabetic patient and health control subjects. This X² test value was (p=0.941). This study indicated that the insignificant correlation between type 2 DM and BMD values. According to our results, osteoporosis cannot be thought as type 2 diabetes complication.

INTRODUCTION

The correlation between type 2 diabetes mellitus (T2DM) and bone mineral density (BMD) has been debatable. In some scientific studies, patients with type two DM showed insignificant difference either in BMD or prevalence of osteoporosis from non-diabetic patients [1,2], while others have showed either higher BMD in patients with T2DM compared to non-diabetics [3,4]. Osteoporosis is a disorder that causes loss of bone mass. The affected bone is shaped like normal bone from the outside. However, the inside of the bones becomes more porous during the aging process due to low level of calcium and phosphate. The loss of these minerals caused the bones to be weaker and become prone to fracture even during routine activities. Very often, a person will sustain a fracture before he or she becomes aware of the presence of the disease [5]. In fact, it’s found that osteoporosis fractures are much more common in comparison to stroke, heart attack and breast cancer combined. At least fifth of men population and third of women during their life will suffer from an osteoporotic fracture. The vertebral fractures risk can be increased by the loss of 10% of bone, and likewise, the hip bone density loss has much higher risk than that of hip fracture [6]. By 2050, the total worldwide rate of hip fracture in men is expected to increase by 310% and 240% in women [7], While Peripheral artery disease is caused mainly by atherosclerosis [8]. There were almost no symptoms in more than 60% of people who were suffering from peripheral artery disease [9]. If symptoms of Peripheral artery disease are caused atherosclerosis, it is potential that other blood vessels are being affected, such as the arteries supplying the brain and heart. So this increases the risk of stroke and coronary artery disease such as heart attack and angina [10].

Objectives:
The purposes of this study are:
- To evaluate the degree of correlation between osteoporosis and atherosclerosis in diabetic patients.
- To evaluate bone mineral density, using Dual-energy X-ray absorptiometry (DXA), in type 2 diabetic patients.
MATERIAL AND METHODS

This retrospective study was conducted between 2010 and 2013 at the Hospital of King Abdul-Aziz University, department of diagnostic radiology. Records of the patients have been searched and data was collected from 550 patients who underwent bone mineral density scan (DEXA). The study was approved by ethical Committee by King Abdul-Aziz University Hospital.

Patient populations:
In total, 550 patients (age range from 40 to over than 70 years; mean 59.07) (482 female Min 35, Max 103 mean 58.6, 68 male Min 36, Max 85 mean 61.83). Among the total subjects 230 patients with DM type 2 while the remaining 204 were Non-diabetic who were fulfilled the criteria and registered in the study. Patients Referred from different clinics to radiology department (for DXA scan and arterial Doppler ultrasound) and to laboratory for blood investigation.

Dual-energy X-ray absorptiometry (DEXA) “Hologic discovery DXA scanner” was used to measure BMD of the femoral neck and lumbar spine. Arterial Doppler ultrasound was performed using “IUU22 Philips machine” with high-frequency linear array transducer.

Type 2-diabetes mellitus was diagnosed on the basis of laboratory findings “21 or 22 Gauge needle with evacuated tube” was used for blood aspiration and collected samples.

Arterial Doppler ultrasound is a noninvasive method of detecting blood flow and evaluating blood flow direction at the same time [11]. Using gray-scale technique, a significant atherosclerotic vascular lesion can be detected by wall thickening or segmental narrowing of the vessel lumen [12].

The arterial Doppler exam is performed with the patient in a supine position, preferably at rest, using longitudinal and transverse scans.

DEXA scan An X-ray machine emitted and directed X-rays in the direction of the detector [13].

The bones usually scanned are the vertebrae, hip and wrist. (These are the bones that most commonly fracture due to osteoporosis degenerative bone disease) The examination routinely takes between (10 - 20 minutes), depending on which part of the body is being scanned, and whether a central or peripheral DXA scanner is being used [14]. An operational definition based on the standard deviation or T-score (Fig. 1), beyond the young adult mean bone mineral density as measured by dual energy x-ray absorptiometry (DEXA) was determined by World Health Organization (WHO) [15].

Statistics:
Statistical analyses were performed using the IBM SPSS Statistics version 19.0 (IBM Company, NY, and USA) software package was used in this work. The Chi-square tests (X2), with likelihood ratio (LR) or Fischer’s exact test were used to analyze the frequency tables and explore the significance of the correlation between the variables. .

**Fig. 1:** T-score interpretation according to WHO

Results:
Type 2 diabetes mellitus is considered a chronic metabolic condition which is commonly increasing worldwide. This research evaluates the impact of diabetes mellitus type 2 on bone metabolism in patients.

550 people (patients) registered in the study sample, where 87.7% (482) of patients were female, While 12.3% (68) of patients where male. The percentage of Age groups was 22.8% (40-50), (51-60) 33.9%, (61-70) 25.9%, and (above 70) 17.4%, this characteristics of the study population is given in (Table 1 and Fig. 2). There were 53.0% (230) of patients with diabetes, While 47% (204) of patients where non-diabetic, the most common age group for diabetic patients in the age groups of (51-60) and (61-70) shown in Fig. 3 and Fig. 4 summarize the distribution of DEXA findings according to gender. The number of patients with normal DXA finding was
139 (25.3%) (Female 127, male 12) while the abnormal DXA findings were 411 (74.7%) (female 355; male 56). The number of patients with low vitamin D were 304 (65.4%), normal vitamin D were 96 patients (20.9%) while the patients with high vitamin D were 65 patients (14%) this distributions of vitamin D are shown in Table 2. According to Cholesterol & Vitamin D levels in diabetic patients, there were 61.3% of diabetic patients with normal cholesterol, while 38.7% have high cholesterol (Fig. 5). Table 3 demonstrate the associations between DXA outcomes and type 2 diabetes mellitus. Pearson Chi-Square was (p=0.941). This X2 test value indicates there was no significant association between DXA findings and diabetes mellitus. Otherwise, the study of relation between cholesterol and vitamin D findings in diabetic patients given Pearson Chi-Square (p=.028). This X2 test indicates There was significant association between cholesterol and vitamin D findings. However, we can’t specify where the strength of the association lies (Table 4). These results indicated that the insignificant correlation between type 2 DM and BMD.

Table 1: Distribution of age groups and gender of total (550) patients enrolled in the study

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Female</th>
<th>Male</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>40-50</td>
<td>115</td>
<td>14</td>
<td>129</td>
</tr>
<tr>
<td>51-60</td>
<td>165</td>
<td>20</td>
<td>185</td>
</tr>
<tr>
<td>61-70</td>
<td>127</td>
<td>14</td>
<td>141</td>
</tr>
<tr>
<td>Above 70</td>
<td>75</td>
<td>20</td>
<td>95</td>
</tr>
<tr>
<td>Total</td>
<td>482</td>
<td>68</td>
<td>550</td>
</tr>
</tbody>
</table>

Fig. 2: Distribution of age groups and gender of total (550) patients enrolled in the study.

Fig. 3: Distribution of age groups for diabetic and non-diabetic patients.
Fig. 4: Distribution of DXA findings according to gender.

Fig. 5: Cholesterol & Vitamin D levels in diabetic patients.

Table 2: Distribution of age according to vitamin D results:

<table>
<thead>
<tr>
<th></th>
<th>40-50</th>
<th>51-60</th>
<th>61-70</th>
<th>above 70</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Vitamin D</td>
<td>76</td>
<td>112</td>
<td>69</td>
<td>47</td>
</tr>
<tr>
<td>Normal Vitamin D</td>
<td>25</td>
<td>31</td>
<td>26</td>
<td>14</td>
</tr>
<tr>
<td>High Vitamin D</td>
<td>14</td>
<td>18</td>
<td>21</td>
<td>12</td>
</tr>
</tbody>
</table>

Table 3: Crosstabs type 2 diabetes mellitus and DXA outcome
Discussion:

Many studies have been done on bone mineral density in patients with diabetes, mellitus and osteoporosis but still, the relationship between type 2 diabetes mellitus and bone mineral density disorders has not been well proven. Some studies regarding patients with T2DM, have reported an elevated BMD [16,17,18], other studies have reported a decreased BMD [19,20,21], and some others have reported unaltered bone density [22,23], while some cross-sectional studies have even found normal BMD [24,25]. For diabetes-related osteoporosis several mechanisms have been proposed. In our study 550 patients with type-2 diabetes and a control group, the dual-energy X-ray absorptiometry (DXA) technique at the lumbar and femoral regions was used to examine the bone mineral density. Our results revealed that at the lumbar and femoral levels in the diabetic there is no significant difference between groups of bone mineral density subjects, when compared with the control group. The findings of this study are consistent with previous studies that reported no significant difference in mineral density of bone in type 2 diabetic patients than in healthy control subjects [22, 23]. These results clearly contradict some of the earlier research that has reported decreased BMD in patients with diabetes compared to control group [19, 20, 21]. Furthermore, we subsequently examined the relationship between BMD and vitamin D levels in diabetic patients and our results showed a positive association between vitamin D deficiency and low bone mass. These results confirm other studies that showed significant association between low vitamin D and decrease bone density [26, 27]. Although the number of Patients who underwent Doppler ultrasound was too small, there was no significant association results between atherosclerosis disease and BMD, and this result seen in our study are in agreement with findings of other previous studies [28]. On the other hand, we found that there is a significant association between age groups and DXA findings in diabetic patients (p=.004). However, we can't specify where the strength of the association lies.

Conclusion And Recommendations:

The results of our study indicated that the insignificant correlation between type 2 DM and BMD. According to our results, we cannot consider osteoporosis as a complication of type 2 diabetes. Our recommendations, future prospective studies must be taken with large number of patients, as well as assessments of bone quality at different skeletal sites, the span of diabetes in order to determine the possible association between diabetes mellitus type 2 and bone mineral density disorders also we recommend in any future study, it is far better to first determine the age in which patient had the diabetes, so that DM type (1 or 2) can accurately be determined.

REFERENCES

[5] Benjamin Ma, C., M.D., Assistant Professor, Chief, Sports Medicine and Shoulder Service, UCSF Department of Orthopaedic Surgery. Also reviewed by A.D.A.M. Health Solutions.