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BONE MINERAL DENISTY, 25-VIT D AND PARATHORMONE HORMONE SERUM LEVELS IN MALES WITH TYPE 2 DIABETES

By

Mohammed Moustafa Ali Moustafa, Ahmed Abdul-Monem Khoreba, El-Sayed El-Meghawry El-Sayed, Osama Mohammed Ahmed and Tarek Moustafa Emran*

Departments of Internal Medicine and Clinical Pathology*, Faculty of Medicine, Al-Azhar University

Corresponding author: Mohammed Moustafa Ali Moustafa,

Mobile: 01006101037, **E-mail:** dr.mohammedmoustafa4545@gmail.com

ABSTRACT

Background: Vitamin D (1,25(OH)2D3) is a steroid hormone that has a range of physiological functions in skeletal and non-skeletal tissues, and can contribute to prevent and/or treat osteoporosis, obesity, and type 2 diabetes mellitus (T2DM). Vitamin D is a topic of great interest for the scientific community as well as for the layman. The commonly-know function of vitamin D has been associated with skeletal tissue, in which vitamin D influences mineralization, bone turnover rate, and occurrence of fractures, contributing to the prevention and treatment of osteoporosis.

Objective: To assess vitamin D and parathyroid hormone serum levels, and correlate it with osteoporotic and fracture risk in males with type-2 diabetes.

Patients and methods: This was a prospective case-control study carried out at Department of Internal Medicine, (Damietta) Faculty of Medicine, Al-Azhar University between January 2018 to January 2021. It included 70 males with type-2 diabetes mellitus, and a comparison group (control group) of 70 healthy individuals. All were submitted to full clinical assessment by history taking, clinical examinations, laboratory investigations, and DEXA scan. Vitamin and parathormone hormones were assessed and correlated with the results of DEXA scan.

Results: There was no significant difference between study and control groups regarding total bilirubin or albumin. Regarding kidney function, both groups were comparable as regard to creatinine. However, serum uric acid significantly increased in study when compared to control group. In addition, fasting blood sugar and postprandial blood sugar significantly increased in study when compared to control group. There was no significant difference found between study and control groups regarding ionized calcium and phosphate. Insulin, fasting insulin and HOMA-IR significantly increased in study than compared to control group. Regarding vitamin D concentration, there was significant reduction in study when compared to control group. There was significant increase of patients with deficient vitamin D in study than control group. Regarding parathormone hormone, there was no significant difference between study and control groups. Regarding T-score, it ranged from -2.9 to 1.70, and there was a statistically significant reduction of T-score among study when compared to control group. Regarding bone disease, according to DEXA-scan, it was normal among 105 subjects. Osteopenia was reported among 12 subjects and osteoporosis in 23 subjects, and there was significant increase of osteoporosis in study than control group. There was an inverse and significant correlation between HOMA-IR from one side and each of total calcium, ionized calcium, vitamin D and DEXA scan.

Conclusion: There was an association between diabetes mellitus and bone mineral density, indicating the role of diabetes mellitus as a risk factor of decreased bone density which could be exerted by different

mechanisms: hyperglycemia, hypovitaminosis D, dyslipidemia and electrolyte disturbances were the major biochemical changes in this condition. All could play a role.

Keywords: Bone mineral state, 25-Vit D, Parathormone serum, Type 2 diabetes.

INTRODUCTION

Osteoporosis and diabetes mellitus are diseases with a high prevalence and both substantially contribute to the disability burden worldwide. Diabetes mellitus is currently the fourth leading cause of disability worldwide, and in 2016, diabetes mellitus was the fifteenth leading cause of early death, forecasted to be seventh by 2040 *(Koromani et al., 2021).*

Osteoporosis and type-2 diabetes mellitus (DM) are commonly observed in the elderly populations. Skeletal disorders in patients with DM have been reported but there is still controversy over the risk of osteoporosis and its clinical significance in patients with diabetes mellitus *(Zhang et al., 2021).*

Many studies have demonstrated osteopenia and increased fracture risk in patients with type-1DM; however the evidence for this risk in type-2 DM is controversial *(Romero-Díaz et al., 2020).*

Findings of increased bone mineral density (BMD) and body weight coupled with older epidemiological studies suggesting no increase or even decrease in fracture risk led to speculation that patients with type-2 DM could have a decreased risk of osteoporosis *(Papageorgiou et al., 2020).*

Kanazawa et al. (2018) reported that some epidemiological and clinical studies provide substantial evidence for an increased fracture risk in patients with type 2 DM despite an increased BMD or independently of BMD.

Alvarez and Ashraf (2010) reported that; type-2 DM and vitamin D deficiency considered common risk factors for osteopenia and increased fracture risk specially in American African race, obesity, aging and low physical activity.

In addition *Liu et al. (2020a)* also postulated that vitamin D replenishment improves glycaemia and insulin secretion in patients with type 2 diabetes with established hypovitaminosis D.

Ali and Ali (2020) reported that the mechanism of action of vitamin D in type-2 DM is thought to be mediated not only through regulation of plasma calcium levels, which regulates insulin synthesis and secretion, but also through direct action on pancreatic beta-cell function.

The aim of this study was to evaluate serum level of vitamin D and parathormone hormone serum levels, and correlate it with osteoporotic and fracture risk in male patients with type 2 diabetes mellitus.

PATIENTS AND METHODS

This was a prospective case-control study; carried out at Department of Internal Medicine, (Damietta) Faculty of Medicine, Al-Azhar University between January 2018 to January 2021. It had been completed on 70 male patients with type 2 DM as a study group, in addition to age matched healthy 70 males were included as a control group, the participant age ranged between 35 to 70 years.

Inclusion criteria: Male patients with type 2 diabetes mellitus to avoid estrogenic effect of females on diabetes and on different hormones, and the duration of diabetes was longer than 10 years.

Exclusion criteria: Female gender, patients with diabetes duration less than 10 years, chronic debilitating diseases (end stage disease), type 1 diabetic patients, and past history of fractures or operations in skeletal system and other endocrinal disorder.

Ethical considerations: All eligible patients and controls were informed about the study; their rights were assured. Informed consent was signed by each participant. The study protocol was also approved by the local research and ethics committee of Faculty of Medicine (Damietta), Al-Azhar University.

All patients were submitted to the following:

I. **Full history taking:** Personal history, duration of diabetes, symptoms of diabetes, symptoms related to diabetes complications, and type of received treatment.

II. **Clinical examination:** The clinical examination was principally directed to assess the presence of bone aches or fractures andthe presence of diabetes-related complications (retinopathy, nephropathy, and peripheral neuropathy). However, the clinical examination was performed in a systematic manner for each patient to discover any associated conditions.

III. **Laboratory assessment:** Blood samples were taken after 12 to 14 h overnight fasting andcentrifuged within 30 to 45min of collection.All blood analyses were done at the Al-Azhar University Hospital (Damietta Clinical Pathology Department Research Laboratory)on the day of blood collection.

The following laboratory investigations were carried out:

1. Liver function tests.
2. Renal function tests.
3. Complete blood count, especially to check hemoglobin concentration.
4. Fasting and postprandial blood sugar.
5. Inflammatory markers (erythrocyte sedimentation rate and high sensitivity C reactive protein (CRP) by nephelometry.
6. For lipid measurements, total cholesterol (TC) and triglycerides (TG) kits. Measurement of high-density lipoprotein cholesterol (HDL-C) was done. Inter- and intra-assay coefficients of variation were 2% and 0.5% for TC and 1.6% and 0.6% for TG, respectively.
7. Fasting insulin and HOMA-IR to estimate insulin resistance were measured by radioimmunoassay.
8. Hemoglobin A1C was determined to check for the control during the last period before inclusion in the study.
9. Electrolytes (especially total and ionized calcium levels, phosphate, and potassium).
   - Serum calcium levels were determined by atomic absorption spectrometry (CTA-2000, Chem

Tech, Analytical Co., Kempston, UK).

- Serum potassium &phosphate were measured after having treated a serum sample with trichloracetic acid (TCA) and in an alkaline medium, potassium ions precipitate with sodium tetraphenylboron (Na-TPB) giving rise to a turbid and stable potassium tetraphenylborate suspension.

10. 25-OH Vitamin D levels (values above or equal to 30ng/ml was considered normal; values between 20 and 29.9 were considered insufficient and values < 20ng/dm are deficient) *Gilani et al. (2019)* was measured by quantative chemiluminascenc immune-assay (CLIA).
11. Measurement of parathormone hormone by automated sandurich-type immunoassay method.

IV. Imaging studies were performed for all participants in the form of abdominal ultrasound, and bone dual energy X-ray absorbomerty (DEXA) scan.

Statistical analysis:

The collected data were coded, processed and analyzed using the SPSS (Statistical Package for Social Sciences) version 22 for Windows® (IBM SPSS Inc, Chicago, IL, USA). Data were tested for normal distribution using the Shapiro Walk test. Qualitative data were represented as frequencies and relative percentages. Chi square test ($\chi 2$) to calculate difference between two or more groups of qualitative variables. Quantitative data were expressed as mean ± SD (Standard deviation). The Mann-Whitney U test was used to compare differences between two independent groups. The Mann-Whitney U test using one of SPSS Statistics' procedures when the critical assumption of this test was violated (nonparametric data). P value < 0.05 was considered significant.

RESULTS

In the current work, 70 patients with diabetes mellitus were included as a study group. In addition, 70 healthy individuals were included as a control group. The participant age ranged between 35 to 70 years and their height ranged between 159 to 188 cm, with no significant difference between study and control group. On the other side, participant weight ranged between 65.5 to 135 kg, BMI ranged between 21.9 to 45.4 kg/ m^2 and there was significant increase of body weight and BMI in study when compared to control group (112.3±9.7, 38.6±3.3 vs. 78.8±9.1, 27.3±2.9, respectively). In addition, both systolic and diastolic blood pressures were significantly higher among study compared to control group. Also, the hypertension duration was significantly longer among study than control group.

Regarding the liver function test SGPT ranged between 21 to 66 IU/L, while GOT ranged between 20 to 67 IU/L, with significant increase of both GPT and GOT in study when compared to control group (42.9±9.0, 40.6±8.2 vs. 31.8±7.3, 34.5±12.4 IU/L, respectively). On the other side, there was no significant difference between study and control groups regarding total bilirubin or albumin.

Regarding kidney function, both groups were comparable as regard to creatinine. However, serum uric acid was significantly increased in study when compared to control group (5.31±1.60 vs. 4.77±1.07 mg/dl, respectively). In addition, fasting blood sugar and postprandial blood sugar were significantly increased in study when compared to control group.

In the current study, hemoglobin ranged between 10.10 and 15.0 gm/dl and there was significant decrease among study when compared to control group (12.26±1.06 vs. 12.82±1.23 g/dl, respectively). On the other side, there was significant increase of ESR among study than control group (40.19±14.58 vs. 20.05±7.95, respectively). Finally, 27.1% of patients in study group were positive for CRP, while none were positive in control group, with significant difference.

Regarding lipid profile, cholesterol and triglycerides were significantly increased in study when compared to control group (180.23 ± 61.30, 178.81 ± 64.89 vs. 100.70 ± 27.63, 99.56 ± 25.02 mg/dl, respectively), while HDL significantly lowered in study when compared to control group (34.04 ± 13.49 vs 61.60 ± 7.22 mg/dl, respectively).

In the present work, serum potassium significantly reduced in study than control group (3.90±1.0 vs 4.55±0.59, respectively). Similarly, magnesium significantly lowered in study than control group (1.54±0.39 vs. 3.28±0.83, respectively). Also, total calcium significantly reduced in study when compared to control group (9.38±0.84 vs 9.64±0.69, respectively). However, no significant difference was found between study and control groups regarding ionized calcium and phosphate.

In the current work, insulin, fasting insulin and HOMA-IR significantly increased in study than compared to control group (30.29±16.41, 6.11±0.77 and 8.31±4.39 vs. 12.10±5.92, 4.73±0.94 and 2.47±1.24, successively) **(Table 1)**.

Table (1): Age, anthropometrics, blood pressure, liver function tests, kidney function tests, blood sugar, hemoglobin levels, ESR, CRP, lipid profile, electrolyte profile, serum insulin, fasting insulin and HOMA-IR among study and control groups

Parameters \ Groups		Study group (n=70)	Control group (n= 70)	P value
Age (years)				
Mean±SD;		49.9±8.4	49.3±7.3	0.63
Range		35-70	22-63	
Weight (kg)				
Mean±SD		112.3±9.7	78.8±9.1	**<0.001**
Range		83.5-135	65.5-106	
Height (cm)				
Mean±SD		170.7±6.9	169.9±3.4	0.38
Range		160-188	159-178	
BMI (kg/m^2)				
Mean±SD		38.6±3.3	27.3±2.9	**<0.001**
Range		28.9-45.4	21.9-35.5	
Blood pressure:				
Systolic BP (mmHg)		147.7±8.5	123.0±12.7	**<0.001**
Diastolic BP (mmHg)		93.7±5.1	79.4±8.7	**<0.001**
HTN duration (year)		5.35±2.51	1.57±0.53	**<0.001**
Liver function tests:				
GPT (IU/L)		42.9±9.0	31.8±7.3	**<0.001**
GOT (IU/L)		40.6±8.2	34.5±12.4	**0.001**
Total bilirubin (mg/dl)		0.97±0.29	0.92±0.17	0.18
Albumin (g/dl)		3.81±0.38	3.84±0.29	0.62
Kidney function tests and blood sugar:				
Creatinine (mg/dl)		0.98±0.35	0.92±0.14	0.17
Uric acid (mg/dl)		5.31±1.60	4.77±1.07	**0.019**
FBS (mg/dl)		111.63±14.56	84.06±16.09	**<0.001**
PPBS (mg/dl)		145.28±14.57	139.37±13.39	**0.014**
Hemoglobin levels, ESR and CRP:				
Hemoglobin (g/dl)		12.26±1.06	12.82±1.23	**0.005**
ESR		40.19±14.58	20.05±7.95	**<0.001**
CRP (n,%)	Positive	19(27.1%)	0(0.0%)	**<0.001**
	Negative	51(72.9%)	70(100.0%)	
Lipid profile:				
Cholesterol (mg/dl)		180.23±61.30	100.70±27.63	**<0.001**
Triglycerides (mg/dl)		178.81±64.89	99.56±25.02	**<0.001**
HDL (mg/dl)		34.04±13.49	61.60±7.22	**<0.001**
Electrolyte profile:				
K		3.90±1.0	4.55±0.59	**<0.001**
Mg		1.54±0.39	3.28±0.83	**<0.001**
Total calcium		9.38±0.84	9.64±0.69	**0.039**
Ionized calcium		4.62±0.52	4.58±0.43	0.63
PO4		4.57±0.26	4.52±0.26	0.28
Insulin		30.29±16.41	12.10±5.92	**<0.001**
Fasting insulin		6.11±0.77	4.73±0.94	**<0.001**
HOMA		8.31±4.39	2.47±1.24	**<0.001**

Regarding vitamin D concentration, it ranged between 12 and 40 ng/ml, and there was significant reduction in study when compared to control group (21.56±4.45 vs 24.77±5.62 ng/ml, respectively). Regarding parathormone hormone, there was no significant difference between study and control groups. Regarding T-score, it ranged from -2.9 to 1.70 and there was statistically significant reduction of t-score among study when compared to control group (-0.6457 ± 1.52 vs. 0.3029±1.11. respectively) **(Table 2)**.

Table (2): Serum vitamin D, parathormone hormone and T-score of DEXA scanamong study and control groups (Mean+SD)

Groups / Parameters	Study (n=70)		Control (n=70)		P value
	Mean±SD	Range	Mean±SD	Range	
Serum vitamin D	21.56±4.45	12.00-33.00	24.77±5.62	15.00-40.00	**<0.001**
Parathormone hormone	49.91±8.38	35.00-70.00	49.27±7.34	38.00-63.00	0.63
T-score of DEXA scan	-0.6457±1.52	-2.90-1.10	0.3029±1.11	-2.80-1.70	**<0.001**

In the current work, there was a significant increase of patients with deficient vitamin D in study than control group (34.3% vs 14.3%) **(Table 3)**.

Table (3): Vitamin D status among studied populations

Groups / Vitamin D status	Study (n=70)		Control (n=70)	
	n	%	n	%
Sufficient => 30ng	5	7.1%	18	25.7%
Insufficient (20-29 ng/ml)	41	58.6%	42	60.0%
Deficient (< 20ng/ml)	24	34.3%	10	14.3%
Statistics	p < 0.002			

Regarding bone disease according to DEXA-scan, it was normal among 105 subjects (75.0%), osteopenia was reported among 12 subjects (8.6%) and osteoporosis in 23 subjects (16.4%), and there was significant increase of osteoporosis in study than control group (28.6% vs. 4.3%, respectively) **(Table 4)**.

Table (4): Incidence of bone disease among studied populations

Incidence of bone disease / Groups		Study		Control	
		n.	%	n.	%
Bone state	Normal BMD	45	64.3%	60	85.7%
	Osteopenia	5	7.1%	7	10.0%
	Osteoporosis	20	28.6%	3	4.3%
Statistics		**p < 0.001**			

In the current work, there was an inverse (negative), and significant correlation between HOMA-IR from one side and each of total calcium, ionized calcium, vitamin D and DEXA scan **(Table 5)**.

Table (5): Correlation between insulin resistance and studied variables

HOMA / Parameters	r	p
Fasting insulin	0.067	0.583
Total calcium	-0.411**	<0.001
Ionized calcium	-0.356**	0.002
PO4	0.108	0.373
PTH	-0.015	0.903
Vitamin-D	-0.276*	0.021
DEXA	-0.380**	0.001

DISCUSSION

Results of the current work revealed that, diabetic patients were significantly obese, with increased blood pressure and hypertensive patients. Also, waist circumference, hip circumference and ratio were significantly higher among study than control group. Hypertension was reported among 60.0% of study group and 10.0% of control group, with significant difference between study and control groups. These results were comparable to those reported by *Nguyen et al. (2011)* who reported that, in adult American populations, the mean age was 59 years (10 years older than patients in the current study),80.3% of diabetics were overweight and 49.1% of diabetics were obese (BMI≥30kg/m^2). In addition, they concluded that, prevalence of diabetes increased with increasing weight class, and nearly 25% of adults with diabetes had poor glycemic control. *Khadra et al. (2019)* also confirmed an increased incidence of obesity in diabetic patients especially in sarcopenic obesity.

Moradi et al. (2019) reported that, cardiovascular diseases (CVDs), are more prevalent among people with diabetes mellitus, and hypertension has been considered as the main risk factor for the development of those disorders. These results are in agreement with the current one in elevated blood pressure in diabetes. Additionally, *Madadi et al. (2019)* found a significant remission of diabetes after bariatric surgery. These data confirmed the association between diabetes and obesity and explains increased percentage of obese subjects in the current study group in diabetic group.

In the current study, liver enzymes were significantly higher among study than control group. However, total biliruin and albumin showed comparable results between study and control groups.

Chen et al. (2019) reported that, patients with diabetes had elevated levels of ALT (10.3%) and AST (6.1%). This elevation was gender-related. It was 13.8% in men and 7.5% in women for elevated ALT, and 7.4% in men and 3.1% in women for elevated AST. Also, *Chen et al. (2020)* reported that, people with metabolic syndrome (MetS) had a significantly higher liver enzyme (ALT) level than those without MetS. In addition, participants with higher ALT had a

tendency towards a higher prevalence of MetS.

In the current work, there were increased serum levels of uric acid in study than control group. These results were comparable to *Katsiki et al. (2021)* who reported that hyperuricemia is associated with the development of type 2 diabetes mellitus and could be used as a marker for cardiometabolic and cardiovascular diseases. Pathophysiologically, elevated serum uric acid (SUA) levels could be associated with abnormal lipid and glucose metabolism. A previous study has demonstrated that serum uric acid (SUA) is biologically active and can stimulate oxidative stress, endothelial dysfunction, inflammation, and vasoconstriction *(Kanbay et al., 2013)*.

In the current study, hemoglobin was significantly reduced, while erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) were significantly increased in diabetic than normal control group. Additionally, lipid profile reflected dyslipidemia state among patients with type-2 diabetes mellitus. *Nacer et al. (2020)* reported that, levels of glucose, glycated hemoglobin (HbA1c), kidney functions and liver enzymes in addition to markers of the inflammatory reactions interleukin-6 (IL-6) and tumor necrosis factor-alpha (TNF-α) increased significantly ($P < 0.05$) in diabetic animals. Moreover, undesirable alterations of oxidative stress markers of tissue and mitochondria isolated from the liver were noted in these animals. In addition, *Bahgat and Ibrahim (2020)* reported an increasing trend of CRP and a significant increase of IFN-γ in diabetic patients with no sex difference. A positive correlation between IFN-γ and both IL-4 and IL-5 in control, and a positive correlation between IL-4 and IL-5 in diabetic patients had been visualized. These results denoted that there may be an association of the pro-inflammatory cytokines in the etiology of diabetes mellitus type 2.

Vitamin D concentration ranged between 12 and 40 ng/ml, and there was significant reduction in study compared to control group (21.56±4.45 vs 24.77±5.62 ng/ml, respectively). There was a significant increase of patients with deficient vitamin D in study than control group (34.3% vs 14.3%). In addition, there was inverse (negative), and significant correlation between insulin resistance (HOMA-IR) and each of vitamin D, total calcium, ionized calcium and DEXA scan. These results were comparable to those reported by *Mansuri et al. (2015)* who found that low serum of 25(OH)D was significantly associated with an increased prevalence of dysglycemia and Metabolic Syndrome. Also, a cross-sectional study in Native American children at risk for obesity and diabetes found an inverse association between 25(OH)D with HOMA-IR and other markers of insulin resistance *(Nsiah-Kumi et al., 2012)*.

Results of the current work were in line with *Gilani et al. (2019)* who reported thateither vitamin D deficient 60.6% or insufficient 15.6%, while 23.9% were sufficient in vitamin D. There was statistically significant difference in vitamin D status in diabetic versus non diabetic patients. In addition, *Denos et al. (2021)* concluded that, lower serum 25(OH)D level was associated with an

increased risk of T2DM in Norwegian adults. Furthermore, *Aghamohammadzadeh et al. (2020)* reported that, serum 25-hydroxyvitamin D concentration was significantly lower in diabetic subjects in comparison with healthy controls. There was a significant reverse relationship between serum concentrations of 25-hydroxy-vitamin D with diastolic blood pressure in participants with DM II.

Results of the current study were in line with *Ali et al.(2019)* who reported that, vitamin D level was lower in diabetics (57.4%) compared to non-diabetics (42.6%). Low vitamin D level is associated with uncontrolled blood glucose as well as nephropathy and this was statistically significant. There was an inversed significant correlation with moderate strength between vitamin D levels and the participants' age, BMI, the HBA1C level and microalbuminuria. The correlation between vitamin D and socioeconomic scale was direct by significant of high strength.

In the current work, parathormone hormone showed non-significant difference between diabetics and healthy control. These results are comparable to those reported by *Brandtner et al. (2020)* who reported that, parathormone (PTH) at baseline did not differ significantly between patients with and without T2DM.

Results of the current work showed that, T-score was statistically significant reduction of T-score among study when compared to control group. In addition, bone disease was normal among 75.0%, osteopenia was reported among 8.6% and osteoporosis in 16.4%.There was significant increase of osteoporosis in study than control group (28.6% vs. 4.3%, respectively). These results were in line with *Liu et al. (2020b)* who reported that, higher lumbar spine and femoral neck T-scores were observed in participants with diabetes.

These results were in line with multiple studies, which have shown that patients with type 2 diabetes mellitus (T2DM) are more likely to suffer osteoporotic fractures than nondiabetics *(Yamamoto et al., 2011* and *Klisic et al., 2018)*.

Liu et al. (2020a) demonstrated that young and middle-aged male patients with T2DM showed a lower turnover state resulting from bone formation inhibition. HbA1c levels were positively correlated with PINP levels and inversely associated with PTH levels. These findings also revealed a negative correlation between TG and OC levels, even after adjusting for expected confounder factors. Glucose and lipid metabolism disorders may affect bone formation through different pathways. The study presented here provides evidence of T2DM influencing bone metabolism in young and middle-aged men. The improvement of blood glucose and lipids may be beneficial to bone metabolism and reduce fracture risk in patients with T2DM.

The overall results indicated a reciprocal relation between diabetes, and osteoporosis which could be partially due to low vitamin D. These results confirmed by the study of *Liang et al. (2019)* who suggested that 1,25-dihydroxy vitamin D3 treatment effectively attenuates osteopenia, and improves bone and muscle quality in type 2 diabetes model.

Previous research has confirmed that vitamin D3 plays an important role within

the bone remodeling process and it has been used in clinical practice for the prevention of disorders associated with bone health *(Battault et al., 2013)*. In addition, calcitriol decreased serum glucose and GSP and attenuated pancreas damage in T2DM model rats when compared to its effect in untreated rats, which suggest calcitriol not only has a beneficial role in improving bone and muscle health but also is involved in glucose metabolism *(Liang et al., 2019)*.

It has been observed that people with prediabetes and established diabetes have lower blood vitamin D concentrations than do patients with normal glucose tolerance levels. Epidemiological data have demonstrated that the active vitamin D3 levels in patients with T2DM is significantly lower than that in normal healthy people; therefore, vitamin D3 and calcium supplementation will help to protect the function of cells in the pancreatic islet of patients with T2DM and decrease related complications in T2DM *(Shehab et al., 2012)*.

Previous researchers have investigated whether vitamin D supplementation has a causal effect on glucose homeostasis and incident diabetes, ultimately leading to an improvement in the glucose homeostasis and preventing diabetes *(Zhang et al., 2019* and *Alvarez and Ashraf, 2010)*.

CONCLUSION

There was an association between diabetes mellitus and bone mineral density, which could be exerted by different mechanisms: hyperglycemia, hypovitaminosis D, dyslipidemia and electrolyte disturbances are the major biochemical changes in this condition. All could play a role.

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قياس الكثافة العظمية ومستوى هرمون الباراثرمون وفيتامين د في مصل الدم عند مرضى البول السكري النوع الثاني من الذكور

محمد مصطفى علي مصطفى, أحمد عبد المنعم خريبة, السيد المغاورى السيد, أسامة محمد أحمد, طارق مصطفى عمران*

قسمي الباطنة العامة والباثولوجيا الإكلينكية*, كلية الطب، جامعة الأزهر

Mobile: 01006101037, **E-mail:** dr.mohammedmoustafa4545@gmail.com

خلفيـــة البحـــث: فيتـــامين د هـــو هرمـــون ســـتيرويدي لـــه مجموعـــة مـــن الوظـــائف الفســـيولوجية فـــي الأنســـجة الهيكليـــة وغيـــر الهيكليـــة،ويمكن أن يســـاهم فـــي منـــع و/أو عـــلاج هشاشـــة العظـــام والســـمنة ومـــرض الســـكري مـــن النـــوع 2 فعلـــى ســـبيل المثـــال فـــي عمليـــة التمثيـــل الغـــذائي للعظـــام، يزيـــد فيتـــامين (د) مـــن مســـتويات الكالســـيوم والفوســـفور فـــي البلازمـــا، ويـــنظم نشـــاط بانيـــات العظـــم، ويكـــافح فـــرط إفـــراز هرمـــون البـــاراثرمون، ويعـــزز تكـــوين العظـــام ويمنـــع/ يعـــالج هشاشـــة العظـــام. فيتـــامين (د) هـــو موضـــوع ذو أهميـــة. ارتبطـــت الوظيفـــة المعروفـــة لفيتـــامين د بأنســـجة الهيكـــل العظمـــي، حيـــث يـــؤثر فيتـــامين د علـــى التمعـــدن، ومـــع دلـــدور االعظـــام، وحـــدوث الكســـور، ممـــا يســـاهم فـــي الوقاية من هشاشة العظام وعلاجها.

الهـــدف مـــن البحـــث: تقيـــيم مســـتويات فيتـــامين (د) وهرمـــون الغـــدة الجـــار درقيـــة فـــي مصـــل الـــدم وربطهـــا بهشاشـــة العظـــام ومخـــاطر الكســـور لـــدى الـــذكور المصـــابين بـــداء السكري من النوع الثاني.

المرضـــي وطـــرق البحـــث: هـــذه دراســـة مســـتقبلية للحـــالات والشـــواهد أجريـــت فـــي قســـم الأمـــراض الباطنـــة بكليـــة الطـــب (دمياط) بجامعـــة الأزهـــر فـــي الفتـــرة مـــن ينـــاير 2018 إلـــى ينـــاير 2021. وشـــملت 70 مـــن الـــذكور المصـــابين بـــداء الســـكري مـــن النـــوع 2 ومجموعـــة مقارنـــة (مجموعـــةالتحكم) مـــن70فـــردًا ســـليمًا. وقـــد تـــم إخضـــاعهم جميعًـــا للتقيـــيم الســـريري الكامـــل عـــن طريـــق أخـــذ التـــاريخ والفحوصـــات الســـريرية والتحقيقـــات المعمليـــة ومســـح ديكســـا. ثـــم تقيـــيم هرمونـــات فيتـــامي د والبـــاراثورمون وربطهـــا بنتـــائج مسح ديكسا.

نتـــائج البحـــث: لـــم يكـــن هنـــاك فـــرق معنـــوي بـــين مجموعـــة الدراســـة ومجموعـــة الـــتحكم فـــي مـــا يتعلـــق بإجمـــالي البيليـــروبين أو الألبومينـــو فـــي مـــا يتعلـــق بملـــف الـــدهون، زادت نســـبة الكوليســـترول والـــدهون الثلاثيـــة بشـــكل كبيـــر فـــي الدراســـة عنـــد مقارنتهـــا بمجموعـــة الـــتحكم، بينمـــا إنخفـــض الكوليســـتيرول عـــالي الكثافـــه بشـــكل ملحـــوظ فـــي الدراســـة عنـــد مقارنتهـــا بمجموعـــة الـــتحكم ولـــم يكـــن هنـــاك فـــرق معنـــوي بـــين الدراســـة ومجموعـــة الـــتحكم فيمـــا يتعلـــق بالكالســـيوم والفوســـفات المتـــأين. هنـــاك زيـــادة فـــي الأنســـولين, والأنســـولين الصـــائم, وتحليـــل مقاومـــة الإنســـولين بشـــكل ملحـــوظ فـــي الدراســـة مقارنـــة بمجموعـــة الـــتحكم. وفيمـــا يتعلـــق بتركيـــز فيتـــامين د، كـــان هنـــاك انخفـــاض معنـــوي فـــي الدراســـة بالمقارنـــة مـــع مجموعـــة الـــتحكم. وكانـــت هنـــاك زيـــادة كبيـــرة فـــي المرضـــى الـــذين يعـــانون مـــن نقـــص فيتـــامين (د), وفيمـــا يتعلـــق بهرمـــون البـــاراثرمون لـــم يكـــن هنـــاك فـــرق معنـــوي بـــين الدراســـة ومجموعـــات المراقبـــة. وفيمـــا يتعلـــق بنتيجـــة T، فقـــد تراوحـــت مـــن2.9 إلـــى 1.70 وكـــان هنـــاك إنخفاضـــاً معتـــداً بـــه إحصـــائيًا فـــي درجـــة T بـــين الدراســـة عنـــد مقارنتهـــا بمجموعـــة الـــتحكم. وفيمـــا يتعلـــق بـــأمراض العظـــام وفقًـــا لمســـح ديكســـا، فقـــد كـــان طبيعيًـــا بـــين 105 شخصًـــا، وجـــدت هشاشـــة فـــي العظـــام بـــين 12 شخصًـــا وهشاشـــة العظـــام فـــي 23 شخصًـــا، وكانـــت هنـــاك زيـــادة كبيـــرة فـــي هشاشـــة العظـــام فـــي الدراســـة مقارنـــة بالمجموعـــة الضـــابطة. وكـــان هنـــاك إرتباطـــاً عكســـياً ومعنويـــاً بـــين تحليـــل مقاومـــة الإنســـولين مـــن جانـــب وكـــل مـــن الكالسيوم الكلي والكالسيوم المتأين وفيتامين د وديكسا.

الاســـتنتاج: هنـــاك إرتبـــاط بـــين داء الســـكري ومعـــدل الـــدهون وكثافـــة المعـــادن فـــي العظـــام، والتـــي يمكـــن أن تحـــدث بآليـــات مختلفـــة: إرتفـــاع الســـكر فـــي الـــدم، نقـــص فيتـــامين د، ونقـــص فـــي الـــدهون واضـــطرابات الأيونـــات المعدنيـــة هـــي التغيـــرات البيوكيميائيـــة الرئيسية في هذه الحالة. ويمكن للجميع أن يلعبوا دورًا في ذلك.

الكلمـــات الدالـــة: الحالـــة المعدنيـــة للعظـــام، فيتـــامين د 25، مصـــل البـــاراثورمون، داء السكري من النوع الثاني.