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Study the Effects of Taurine Oral Supplement used for Type 2 Diabetic Patients on Body Weight; Glycemic Control and Some Bone Mineralization Biochemical Markers

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Abstract

Background: Taurine is sulfur containing semi-essential amino acid that has important roles in many biological processes, but; its effects on glucose homeostasis, weight; growth and bone mineralization were not well defined in human.

Objectives: evaluation the effects of oral taurine used for 3 months on bone mineralization biomarker; glycemic control and body weight in type II diabetic patients.

Methods: interventional double-blind placebo-controlled study in which 80 patients with type2 diabetes mellitus (age range 45–55) assigned in either control (n = 40) or study (n = 40) group. The last group received 1000 mg capsule of taurine once a -d for three months. Parameters measured were serum calcium, 25(OH) vitamin D and osteocalcin, NTX-1; HbA1C% and Fasting blood glucose before and after 3 months.

Results: Taurine led to significant ($p < 0.05$) rise in osteocalcin and significant lowering in Body weight and BMI and there were no significant changes in Serum Calcium; NTX-1; Vitamin D; HbA1C% and fasting blood glucose; all as compared with control values.

Conclusion: 3 months of oral Taurine used in type II diabetic patients may modulate bone mineralization represented by elevation of osteocalcin; and reduction of body weight, but has no significant effect on glycemic control and did not reduce HbA1C%

Keywords: Taurine, Diabetic patients, Osteocalcin, Body weight, Glycemic control

1. Introduction

Diabetes Mellitus is a pandemic metabolic health disturbance featuring chronic hyperglycemia and induce many pathological complications among both sexes in wide range of ages, these complications include microvascular complications like nephropathy, retinopathy, neuropathy and macrovascular complications like acute coronary syndrome and stroke [1,2].

In recent years several studies approved that patients with type 2 diabetes mellitus are prone to osteoporosis and they are at greater risk of developing bone fragility [3]. The main mechanism of osteoporosis is an imbalance between the activity of osteoblasts that form bone and osteoclasts that breakdown bone leading to bone microstructure deterioration and fractures. [4], other mechanisms by which diabetes affect bone include hyperglycemia, oxidative stress and accumulation of advanced glycation end products (AGEs) [5].

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Uncontrolled blood glucose level in type-2 diabetic patients can affect bone metabolism and its fragility directly or indirectly leading to the change in the level of bone biochemical markers in blood or urine. The most sensitive markers include osteocalcin (OC), the bone formation marker measured in serum, other biomarkers can be recommended is N-terminal telopeptide (NTX) as a reference marker for bone resorption [6,7]. The antidiabetic medications have variable effects on bone metabolism; may be positive or negative impact. Metformin, the most known biguanide, has positive effect on osteogenesis via activation of osteoblast-specific Runx2 (run-related transcription factor2) and activation of AMP-activated protein kinase [8,9]. At the same time has negative effect on differentiation of osteoclast [10]. Taurine is semi-essential or conditional amino acid, present in large amount in human and animal tissues [11], but its endogenous production is insufficient, therefore it must be provided by diet [12], or given as supplement. Taurine exhibit antioxidant and anti-inflammatory actions as well as has many beneficial roles in diabetes because it is able to block toxicity caused by oxidative stress [13], it also has role in osmoregulation, in counteracting inflammation and glucose homeostasis [14]. The novelty of this study is that Effects of taurine 100 mg orally for glycemic control, bone mineralization and body weight have not measured in human patients before.

1.1. Aims of study

Evaluation effect of oral taurine used for 3months on bone mineralization biomarker; glycemic control and body weight in type II diabetic patient.

2. Subjects and methods

2.1. Study design

Randomized double-blind placebo-controlled study; The study was carried out from October 2017 to December 2018 in Al Basra General Hospital. Basra city – southern of Iraq. After agreement of scientific and ethical committees in college of pharmacy and hospital.

2.2. Patients selection

2.2.1. Inclusion criteria

Adult patient; with age range 45–55 years old, diagnosed with diabetes Mellitus type 2; and each patient used medical diabetes treatment no more than five years.

2.2.2. Exclusion criteria

Diseases include malignancy, thyroid problems; parathyroid; pregnancy or breastfeeding, medications' use; like vitamin D; calcium supplements; ant obesity medications or blends; steroids, bisphosphonates and insulin at least one mo before starting study and for the next 3 months of study. Changes in any medication for diabetes control.

2.3. Sample size determination

Was determined using G power® V3.1 software assuming 1:1 subject division (control: study) the response within each subject group was normally distributed with standard deviation 5. If the true difference in the study and control means is 5, we will need, at least; to study 40 subjects for study and 40 control subjects to be able to reject the null hypothesis that the means of the study and control groups are equal with probability (power) 0.82. The Type I error probability associated with this test of this null hypothesis is 0.05.

2.4. Study groups

Each Diabetic patient that fulfilled the requirement of study is asked to sign a written consent and then be randomly allocated; by the use of simple randomization, into either control or study group. Only 80 patients completed the study successfully.

Control group (n = 40, age 50.2 ± 3.7 years; 24 males & 16 females) received placebo treatment once daily and.

Study group (n = 40, age 48.8 ± 3.1 years; 22 males & 18 females) received Taurine 1000 mg capsule (Jarrow's formulas) orally once daily. There was no significant difference in average ages and male: female ratio between groups.

Hospital's pharmacist informed Each patient informed about the goals of the study and full the taurine. Each patient included in the study after signing of a written consent.

Height of the patient was registered at the beginning of study in addition to Body weight, body mass index was measured for each patient before and after 3months.

2.5. Sampling

A venous blood sample was drawn from each participant, for measuring fasting blood glucose; HbA1C%; serum calcium; Osteocalcin; Serum NTX (N- terminal telopeptide); 25-(OH)Vitamin D level; before and three months after administration their assigned supplement.

2.6. Data analysis

Data analyzed using MedCalc® software V12. The data was expressed as mean $\pm$ Standard deviation. One-way anova was used to find the significant ($p < 0.05$) effects between the groups.

Independent sample *t*-test was used for comparison between groups and paired *t*-test was used to find the significant of difference between pre-and after treatment values within each group. P value < 0.05 was considered as significant (see Table 1).

3. Results

3.1. Demographic data of patients

As in Table 2 There were no significant ($p < 0.05$) differences between control and study group. In age (50.2 ± 3.7 Vs. 48.8 ± 3.1 ; p value = 0.072); male: female ratio (24:16 for control Vs. 22:18 for study; p value = 0.821); weight (kgs) (98 ± 14.5 Vs. 95.8 ± 13.3 ; p value = 0.324); Height (cm) (172.6 ± 7.5 Vs. 171 ± 6.2 ; p value = 0.326), Body mass index

(33.1 ± 5.8 Vs. 32.9 ± 5.1 ; p value = 0.821); obesity ratio (75% control Vs. 70% study. p value = 0.802); fasting Blood glucose (121.5 ± 9.8 for control Vs. 122.6 ± 12.2 for study group; p value = 0.544), Glycosylated hemoglobin (HbA1C%) (7.3 ± 0.6 for control Vs. 7.5 ± 0.6 for study group; p value = 0.168) and diabetes duration in years (2.7 ± 1.7 for control Vs. 3.1 ± 1.6 for study group; p value = 0.342).

3.2. Bone mineralization bio markers

Osteocalcin raised significantly ($p < 0.05$) in study group after using taurine for 3months as compared with its baseline value (28.9 ± 10.7 after treatment vs. 17.7 ± 12.3 for baseline); and also, it was significantly ($p < 0.05$) higher than values of control group (28.9 ± 10.7 after treatment for study group vs. 18.3 ± 5.9 for control). As in Table 3.

Serum Vitamin D elevated significantly ($p < 0.05$) in study group after using taurine for 3 months as compared with its baseline value (20.8 ± 6.8 after treatment vs. 18.8 ± 6.7 for baseline); this elevation

Table 1. Shows name and source of kits used to measure the parameters of study.

Parameters	Kit	Source
Fasting blood glucose	Glucose Assay Kit (Colorimetric)	Cell Biolab, INC
Serum calcium	Calcium Assay Kit	BD biosciences, USA
Osteocalcin	Osteocalcin (1–43/49) ELISA	ALPCO diagnostics
NTX-1 (N terminal telopeptidase of type1 collagen)	Human Cross linked N terminal Telopeptides of type I collagen ELISA Kit	MyBioSource, US
Serum 25-OH-Vitamin D	25-OH-Vitamin D direct ELISA	IBL INTERNATIONAL GMBH

Table 2. Demographic data of patients in the study groups. Some of data expressed as Mean $\pm$ standard deviation.

	Control group N = 40	Study group N = 40	P values
Age (years)	50.2 ± 3.7	48.8 ± 3.1	0.072
Male: female ratio	24:16	22:18	0.821
Weight (kg)	98 ± 14.5	95.8 ± 13.3	0.324
Height (cm)	172.6 ± 7.5	171 ± 6.2	0.326
Body mass index (kg/m ²)	33.1 ± 5.8	32.9 ± 5.1	0.821
Obesity ratio	30 (75%)	28 (70%)	0.802
Fasting Blood glucose (mg/dl)	121.5 ± 9.8	122.6 ± 12.2	0.544
HbA1c%	7.3 ± 0.6	7.5 ± 0.6	0.168
Diabetes duration (years)	2.7 ± 1.7	3.1 ± 1.6	0.342

P values < 0.05 considered as significant values.

Table 3. Comparison of bone mineralization biomarkers in both study groups; before and after treatment. Values are expressed as Mean $\pm$ standard deviation.

	Control group N = 40		Study group N = 40		P values
	Baseline	After treatment	Baseline	After treatment	
Osteocalcin (ng/ml)	17.4 ± 5.6	18.3 ± 5.9	17.7 ± 12.3	$28.9 \pm 10.7^{*a}$	0.00002
Serum Vit. D (ng/ml)	19 ± 5.3	$20.3 \pm 5.4^{*}$	18.8 ± 6.7	$20.8 \pm 6.8^{*}$	0.378
Serum Calcium (mg/dl)	7.1 ± 2	7.3 ± 1.9	7.1 ± 2.1	$7.6 \pm 2.5^{*}$	0.695
NTX-1 (ng/ml)	20.4 ± 7.1	20 ± 6.8	20 ± 8.9	18.3 ± 7.6	0.605

P values < 0.05 considered as significant values.

*significant ($p < 0.05$) as compared to its baseline values.

^asignificant ($p < 0.05$) as compared to control value.

was not significant ($p < 0.05$) as compared to control value (20.8 ± 6.8 for study vs. 20.3 ± 5.4 for control). As in [Table 3](#).

Serum calcium elevated significantly ($p < 0.05$) in study group after using taurine for 3 months as compared with its baseline value (7.6 ± 2.5 after treatment vs. 7.1 ± 2.1 for baseline); this elevation was not significant ($p < 0.05$) as compared to control value (7.6 ± 2.5 for study vs. 7.3 ± 1.9 for control). As in [Table 3](#).

N- terminal telopeptide (NTX-1) was not significantly ($p < 0.05$) changed in both groups even after treatment. As in [Table 3](#).

3.3. Glycemic control markers

Fasting Blood glucose was not significantly ($p < 0.05$) changed in both groups even after treatment. As in [Table 3](#).

Glycosylated hemoglobin (HbA_{1c}%) was not significantly ($p < 0.05$) changed in both groups even after treatment. As in [Table 4](#).

3.4. Effect on body weight

Percent change in Both body weight lowered significantly ($p < 0.05$) in study group after using taurine for 3 months as compared with control values (-2.5 ± 4.3 for study vs. 0.43 ± 5.8 for control). And same for **body mass index** was (-2.4 ± 4.3 for study vs. 0.41 ± 5.8 for control). As in [Table 5](#).

4. Discussion

Taurine contains sulfur amino acid that available in mammalian tissues. A lot of studies talked about its functions and its roles in many known biological processes, e.g., calcium metabolism, protein phosphorylation, energy extraction and etc. Despite the importance of taurine in these biological functions, its interaction in the regulation of glucose

homeostasis, weight; growth and bone metabolism remain not well defined [15].

In this study; taurine supplement used for 3 months in type 2 diabetic patients and used to study its effect on biochemical markers related to bones mineralization; diabetes control and effect on body weight.

Taurine administration as supplement was able to raise the serum level of osteocalcin significantly ($p < 0.05$); as in [Table 3](#). This finding was different from results of many studies that found the use of Taurine have not result in significant change in the level of osteocalcin [16–19].

Taurine stimulates osteoblast resulted in secreting osteocalcin [20,21]. Due to oral supplementation; taurine probably was available in blood in sufficient concentration to produce sustain raise in osteocalcin level in the blood of taurine treated group [20,21] that reflected as significant rising as compared to control group.

Taurine may enhance intestinal absorption of fat-soluble vitamins; like vitamin D [22] and studies found low taurine dietary intake may compromise vitamin D absorption [23]. In this study; taurine supplement did significantly enhance intestinal absorption of vitamin D; so that serum level of 25 (hydroxy)Vitamin D was elevated significantly in group used taurine. But unfortunately; these changes were not significant as compared to control group.

Serum calcium changes in this study was parallel to changes in vitamin D level.

In addition to that; Blood N- terminal telopeptide; a bone resorption biomarker; that secreted by the activity of osteoclasts [24] was not significantly changed by taurine supplement. This may indicate that Taurine may not stimulate osteoclast probably not enhance bone turnover activities.

Serum calcium was not also changed significantly as compared to control group.

Table 4. Comparison of changes in percentage of glycemic control parameters in both study groups. Values are expressed as Mean $\pm$ standard deviation.

	Control group N = 40	Study group N = 40	P values
% change Fasting Blood Glucose	-0.4 ± 15.2	-0.2 ± 2.2	0.934
% HbA _{1c}	1.1 ± 7.4	-1.5 ± 10.7	0.211

P values < 0.05 considered as significant values.

Table 5. Comparison of percentage changes in Body weight & BMI for both study groups. Values are expressed as Mean $\pm$ standard deviation.

	Control group N = 40	Study group N = 40	P values
% change in Weight (kg)	0.43 ± 5.8	-2.5 ± 4.3	0.014
% change in BMI	0.41 ± 5.8	-2.4 ± 4.1	0.015

P values < 0.05 considered as significant values.

Taurine may suppress insulin secretion in nondiabetic pancreatic islets, and may serve as a regulator factor for insulin secretion and blood glucose level. [25]; enhancer for peripheral insulin sensitivity [26], and taurine may have hypoglycemic effect [27].

There were no significant changes in the level of fasting blood glucose or HbA1C% measures during the study this in agreement with M. Zhang et al., 2004 that found no significant change in Fasting blood glucose after 7 weeks from using taurine supplement in non-diabetic individuals [28]. Although so Body weight and BMI index was significantly reduced after treatment with taurine but this was not significant as compared to control group. This finding was in agreement to M. Zhang et al., 2004 [28].

5. Conclusion

Taurine 1000 mg orally use in type II diabetic patients may modulate bone mineralization represented by elevation of osteocalcin; and may reduce body weight but has no significant effect on glycaemic control and did not reduce HbA1C%

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Declaration of competing interest

There is no conflict of interest; and the research is self-funded by researcher himself.

This original article; and the trial was approved by scientific and ethical committee in college of pharmacy-university of Basra

All Patients in this trial agreed to go within trial after explaining the purpose of trial and side effects of drugs used and then asked them to sign the written consent.

Author contributions

Authors are equally contributed in the research and article preparation. I(We) declare that this work was done by the author(s) named in this article and all liabilities pertaining to claims relating to the content of this article will be borne by the authors.

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