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Testosterone Level and Insulin Sensitivity among Sudanese Males Patients with Type 2 Diabetes Mellitus in Khartoum state

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Abstract:
Background: *Type 2 diabetes mellitusis the most common disease affecting the human,is a long term metabolic disorder that is characterized by high blood sugar, insulin resistance, and relative lack of insulin*
Objectives: *The aim of this study to asses' testosterone level and insulin sensitivity among Sudanese males patients with type 2 diabetes mellitus.*
Methods: *Cross sectional, case control study was conducted during the period from November to December 2016, sixty samples from known patients with type2 DM and sixty samples from healthy persons as control. The levels of testosterone, insulin and insulin sensitivity were measured using TOSOH 360. Data were collected using structural questionnaire. Data analysis was carried out by means of statistical package for social science (SPSS version 16).*
Results: *The mean level of testosterone showed significant decreased in case when compared with control group. Mean ± SD cases versus control group (3.70±2.02 verse 5.64±1.52ng/ml, P- value = 0.000). There were significant increased of insulin level and insulin sensitivity in type 2 diabetic patients when compared to control group. (10.43±8.34 verse 7.20±1.62 µ u/ ml, p- value = 0.000) (4.08±2.34 verse1.66±0.51, p- value = 0.003) respectively.*
The result showed there was significant weak negative correlation between testosterone level and insulin sensitivity (r=-0.271, p-value=0.036), also there was significant weak negative correlation between testosterone and insulin level(r=-0.235,p, value =0.23) . There was negative correlation between testosterone level and age group (r= -0.302 p, value =0.019) and there was negative correlation between testosterone level and duration of disease (r= -0.325 p, value =0.011) , while there was significant positive correlation between insulin levels and duration of type2 DM (r=0.320, p, value=0.013).
Conclusion*: It concluded that, the level of testosterone was decrease and the levels of insulin and insulin sensitivity were significant increase in type 2 diabetic patients.*
Keywords:*testosterone, insulin, insulin sensitivity and type 2* DM.

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I. Introduction

Diabetes mellitus type 2 (also known as type 2 diabetes) is a long term metabolic disorder that is characterized by high blood sugar, insulin resistance, and relative lack of insulin. [(1)] Common symptoms include increased thirst, frequent urination, and unexplained weight loss. Symptoms may also include increased hunger, feeling tired, and sores that do not heal. Often symptoms come on slowly.[(2)] Long-term complications from high blood sugar include heart disease, strokes, diabetic retinopathy which can result in blindness, kidney failure, and poor blood flow in the limbs which may lead to amputations.[(3,4)] The sudden onset of hyperosmolar hyperglycemic state may occur; however, ketoacidosis uncommon.[(5) (6)] Type 2 diabetes primarily occurs as a result of obesity and not enough exercise.[(1)] Some people are more genetically at risk than others.[(3)] Type 2 diabetes makes up about 90% of cases of diabetes, with the other 10% dueprimarily to diabetes mellitus type 1 and gestational diabetes.[(1)] In diabetes mellitus type 1 there is an absolute lack of insulin due to breakdown of islet cell in the pancreas.[(7)] Diagnosis of diabetes is by blood tests such as fasting and plasma glucose, oral glucose tolerance test, or A1C.[(4)] Rates of type 2 diabetes have increased markedly since 1960 in parallel with obesity. [(8)] As of 2013 there were approximately 368 million people diagnosed with the disease compared to around 30 million in 1985.[(9) (10)]. Typically it begins in middle or older age,[(3)] although rates of type 2 diabetes

are increasing in young people. [11] [12] Type 2 diabetes is associated with a ten-year-shorter life expectancy.[13] Diabetes was one of the first diseases described.[14] The importance of insulin in the disease was determined in the 1920s.[15]

Low testosterone level in men are associated with insulin resistance or reduced insulin sensitivity, when you have insulin resistance, your body produces insulin but doesn't use it properly. As a result, glucose builds up in your blood rather than being absorbed by cells. Insulin resistance can lead to type 2 diabetes. [11]Testosterone is a hormone that regulates many functions of the body. During puberty, testosterone is responsible for muscle growth, deepening a man's voice, and increasing the size of the genitalia. In adulthood, testosterone not only maintains a man's muscles and bones but also his interest in sex. Testosterone levels begin to decrease after 30 years old, which is followed by a decrease in sex drive. Many men mistake the decrease in sex drive as them simply getting older health problem.[11]

Men with type 2 diabetes are twice as likely to have lower testosterone levels as men without. 33% of males with type 2 diabetes have low levels of testosterone. Patients should be educated on the signs and symptoms of low testosterone levels and be tested, Testosterone treatment can reduce insulin resistance as well as decrease subcutaneous fat tissue as well as increase lean body weight, Men with type 2 diabetes who have low testosterone levels can benefit significantly from testosterone treatment.[11]

II. Materials And Methods

Study Population

Cross sectional, case control study was conducted at Omdurman Hospital during the period from November to December 2016. Sixty patients with type 2 DM aged from 20-65 years as case, and sixty healthy persons as control were enrolled in this study. The study was approved by hospital's ethics committee. Informed consent was obtained from patients before blood sampling, after explaining objectives of the study. Interview and questionnaire was used to collect data.

Inclusion criteria:-Sudanese males patients with type 2`DM and apparently healthy volunteers (matches age and sex with the cases) were included.

Exclusion criteria: Any patients with disease related to diabetes mellitus type2 and Androgen problems , any patients with disease can affect the results and any patients refuse to participate in the study were excluded

Blood sample and analysis: 5 ml of venous blood was collected from each participant. Serum was separated directly to the plain container by centrifugation at (300 rpm) for 5 minutes. Serum levels of testosterone, insulin and insulin sensitivity were measured using TOSOH 360. The internal control sera of two different levels were used to calibrate the instruments.

Statistical analysis was performed using statistical package for the Social Science (SPSS v16). Data was analyzed using SPSS computer program, the mean and standard deviation were obtained and the independent 't.test' used for comparison (p value of ≤ 0.05) was considered significant and person correlation was used for correlation.

III. Results

Sixty samples from known patients with type 2 diabetes mellitus as case and sixty samples from healthy persons as control were enrolled in the study.As shown in (Table 1),the mean level of testosterone showed significant decrease in case when compared with control group. Mean ± SD cases versus control group (3.70±2.02 verse 5.64±1.52ng/ml, P- value = 0.000). There were significant increase of insulin level and insulin sensitivity in type 2 diabetic patients when compared to control group. (10.43±8.34 verse 7.20±1.62 µ u/ ml, p-value = 0.000) (4.08±2.34 verse1.66±0.51, p- value = 0.003) respectively.

Table (1) mean comparison of testosterone, insulin levels and insulin sensitivity in males diabetic patients and control group

Variables	Case n=60 (Mean ± SD)	Control n=60 (Mean ± SD)	P-value
Testosterone level (ng/ml	3.70±2.02	5.64±1.52	0.041
Insulin level (µ u/ ml)	10.43±8.34	7.20±1.62	0.000
Insulin sensitivity	4.08±2.34	1.66±0.51	0.003

Results expressed as Mean ±SD and significant differences considered as p-value ≤ 0.05. The result showed there was significant weak negative correlation between testosterone level and insulin sensitivity (r=-0.271, p-value=0.036) as in fig (1), also there was significant weak negative correlation between testosterone level and insulin level(r=-0.235,p, value =0.023) as in fig (2). There was significant negative correlation between testosterone level and age group(r= -0.302 p, value =0.019) as in fig (3) and there was significant negative correlation between testosterone level and duration of disease (r= -0.325 p, value =0.011) as in fig (4),

while there was significant positive correlation between insulin levels and duration of type2 DM (r=0.320, p, value=0.013). as in fig (5).

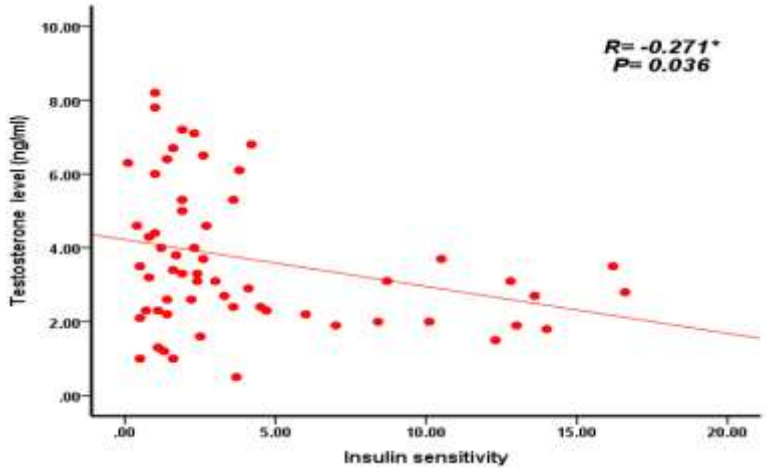

Figure (1) correlation between testosterone level and insulin sensitivity:

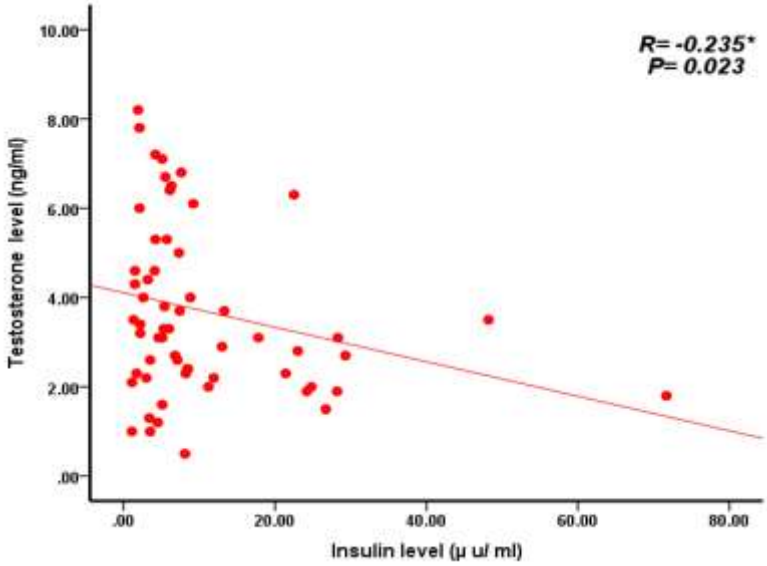

Figure (2) correlation between testosterone level and insulin levels:

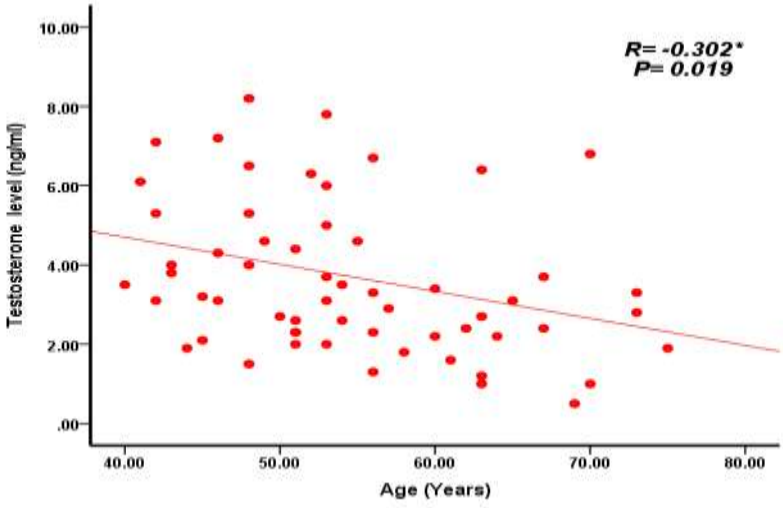

Figure (3) correlation between testosterone levels and age groups:

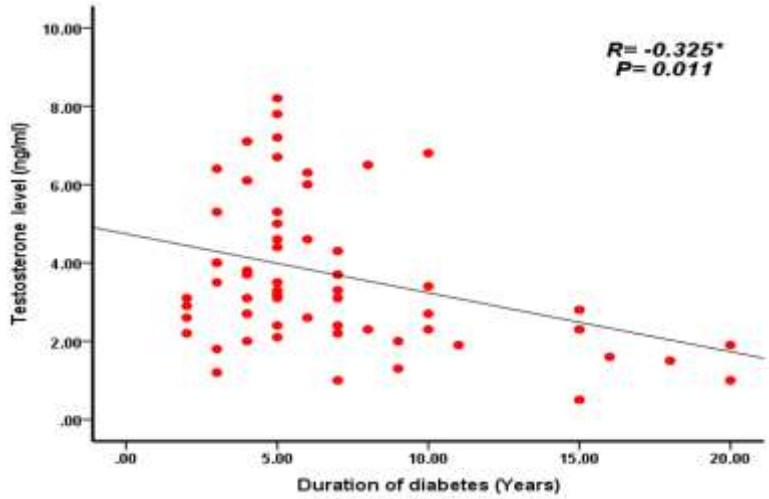

Figure (4) correlation between testosterone levels and duration time of type2 DM:

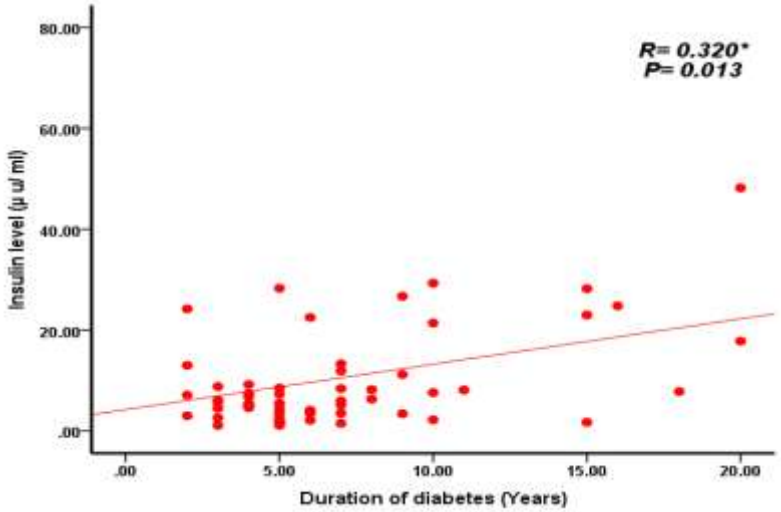

Figure (5) correlation between insulin levels and duration of type2 DM:

IV. Discussion

Diabetes mellitus type 2 (also known as type 2 diabetes) is a long term metabolic disorder that is characterized by high blood sugar, insulin resistance, and relative lack of insulin. [(1)]From the finding of this study it appears that, the level of testosterone showed significant decrease in males patients with type 2 diabetes mellitus when compared with control (P. value = 0.041) . The result is similar to another result which reported that, lower total testosterone levels found in the diabetics could be as a results of increased conversion of the testosterone to estradiol (E2) in the presence of insulin resistance and obesity.[(12,13,14)] Also this result in agreement with another result whish showed, 36.5% of patients with diabetes had testosterone level <3 ng/ml.[(15)]. Result of this study showed that, there was significant increase in insulin sensitivity in males patients with type 2 DM compared to control group, (P, value =0.003). This result is similar to another result which found insulin sensitivity was higher in diabetic participants than non-diabetic ones ($P < 0.01$)[(16)] .The previous study data indicated that, low serum testosterone level was associated with an adverse metabolic profile and suggest a novel unifying mechanism for the previously independent observations that low testosterone levels and impaired mitochondrial function promote insulin resistance in men. [(17)]Another result reported that, the high prevalence of hypogonadism in type 2 diabetes raises important issues about its possible consequences on libido, erectile dysfunction, body musculature, abdominal adiposity, bone density, mood, and cognition. [(18)] The result of this study found , there was significant increase in insulin level in type 2 DM males patients compared to control group, (p- value =0.000). The result in agreement with another study which reported that, there was significant increase of insulin level in type 2 diabetic patients when compared with healthy individuals (P .value = 0.004).[(19)] The result showed there was significant weak negative correlation between testosterone level and insulin sensitivity (r= -0.271, p-value=0.036), this result disagreed to another result which found ,Low testosterone levels in men are associated with insulin resistance or reduced insulin sensitivity.[(11)] Also there was

significant weak negative correlation between testosterone level and insulin level (r=-0.235,p, value =0.23). There was negative correlation between testosterone level and age group(r= -0.302 p, value =0.019) as in fig (3) .This result agreed with another result carried by (Ayman et al ., 2013) , which indicated that, age was significantly associated with a low total serum testosterone level.[20] This result is similar to another result which reported that, Testosterone inversely correlated with age (r=-.164, p= 0.008),[21] Another study showed . there was declining in testosterone hormone by increase in age[22] Result of this study showed, there was significant negative correlation between testosterone level and duration of disease (r= -0.325 p, value =0.011), this result disagreed with another result which showed, there was no significant correlation between duration of diabetes and male sex hormones (FSH, LH, and total Testosterone) [22] Also the result disagreed with another result which reported that, there were no correlation between testosterone hormone level and duration of diabetes. [23] There was significant positive correlation between insulin levels and duration of type2 DM (r=0.320, p, value=0.013).

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