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Research Article

Assessment of Hypogonadism in Sudanese Males with Type 2 Diabetes and its an Association with Obesity

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Abstract

Objective: the aim of this study was to assess the level of testosterone in Sudanese diabetic men and its association with obesity.

Research Design and Methods: a cross sectional study conducted on 300 males with type 2 diabetes mellitus aged > 40 years and 100 healthy volunteers in the same age as a control. Total testosterone, follicle stimulating hormone, luteinizing hormone was measured. Height and weight were measured then the BMI was calculated.

Results: significant proportion of diabetic men showed low levels of serum testosterone, where 79% had a testosterone level less than 300 ng/dL (10.4 nmol/L). Testosterone showed a highly significant inverse relationship with BMI (body mass index).

Conclusion: low serum testosterone levels are common in Sudanese males with type2 diabetes mellitus. Obesity is associated with low testosterone levels in those diabetic males.

Keywords: Type-2 diabetes mellitus, Testosterone, Obesity, BMI

Introduction

Diabetes mellitus type 2 is a long term metabolic disorder that is characterized by high blood sugar, insulin resistance, and relative lack of insulin [1]. The complications resulting from high blood sugar include heart diseases, strokes, diabetic retinopathy, which can result in blindness, kidney failure, and poor blood flow in the limbs which may lead to amputations [2]. Type 2 diabetes is primarily due to obesity and little physical exercise in people who are genetically predisposed [2].

Diabetes, the most common non-communicable disease in Sudan, is having an increasing impact on rates of morbidity and mortality in the country. The spread of sedentary lifestyles and adoption of western dietary habits high in refined carbohydrates and fat are driving an increase in the number of people with obesity-related type 2 diabetes [3].

It was reported that, men with type 2 diabetes are twice as likely to have low testosterone (hypogonadism) as men who don't have diabetes [4]. Hypogonadism is a medical term for decreased functional activity of the gonads. The gonads produce hormones such as testosterone, estradiol and gametes produce eggs or sperm [5].

In general, androgens promote protein synthesis and growth of those tissues having androgen receptors. Anabolic effects include growth of muscle mass and strength, increased bone density and strength, and stimulation of linear growth and bone maturation [6].

Epidemiological studies support a bidirectional relationship between serum testosterone and obesity as well as between testosterone and the metabolic syndrome. Low serum total testosterone predicts the development of central obesity and accumulation of intra-abdominal fat [7,8]. In male subjects total testosterone blood concentrations are inversely correlated with body weight [9]. Several factors have been proposed to account for the decreased plasma TT levels in obese patients, including decreased sex hormone-binding globulin (SHBG) synthesis and decreased pituitary gonadotropin secretion and pulse amplitude [10,11]. There is an inverse correlation between the amount of visceral fat and plasma insulin on the one hand and levels of testosterone and SHBG on the other [12,13].

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Overweight and obese individuals are at increased risk for many diseases and health conditions, including hypertension and Type 2 diabetes [14]. A study published in JAMA in 2005 showed that overweight people had a similar relative risk of mortality for normal weight people as defined by BMI, while underweight and obese people had a higher death rate [15].

BMI ", it is defined as the individual's body mass divided by the square of their height - with the value universally being given in units of kg/m^2 [16]. The Endocrine Society now recommends that men with type 2 diabetes be screened for low testosterone levels [8].

The study is aiming to assess the level of testosterone in diabetic men and it is association with obesity among Sudanese subject as these three parameters have interrelation and play roles in the overall well being of man. It is worth to mention that no data is available concerning the effect of diabetes in fertility in Sudan.

Research Design and Methods

The study was conducted in Alamal National Hospital, Khartoum, Sudan as a cross sectional study on 300 male Sudanese patients with type 2 diabetes mellitus who were coming to the hospital to check for their blood glucose and 100 healthy volunteers. Patients with a known history of hypogonadism, and those with chronic illness like chronic renal failure, HIV, cirrhosis, and those who were unwilling to participate in this study were excluded from the study. Demographic data were collected, weight and height were measured then BMI was calculated. Blood samples for testosterone, FSH, LH were drawn between 8.00 and 11.00 a.m. after overnight fasting. Clotted blood samples were centrifuged and serum was separated into aliquots and frozen at -20°C until analyzed. Testosterone was measured by ELISA (Omega diagnostic, UK) with a minimum detection limit 0.20 nmol/L, reference range of the assay kit is 300-1000 ng/dL (10.4-34.7 nmol/L). FSH and LH were measured by RIA (Institute of Isotopes CO, Ltd-izotop, Budapest), FSH reference range for the assay 1.0-10.5 mIU/mL, LH 1.9-9.4 mIU/mL, with a detection limit of 0.02 mIU/mL for the two hormones.

Statistical analysis

Data were analyzed using SPSS (statistical package for social science) software. Results are expressed as mean ± SD. The Independent t-test was used for comparison between groups. The impact of clinical variables on testosterone was determined by Pearson correlation. The Results were statistically considered significant at a P value < 0.05.

Results

Data collected from 300 diabetic male were analyzed by using SPSS software. The age of the study group ranged from 40 to 85 years with a mean of 61.6 years and a Standard Deviation (SD) of 9.5 years. Their weight ranged from 40-115 kg with a mean of 77.8 kg and SD of 14.2 kg. Their mean BMI was 26.2 ± 4.3 kg/m^2, ranged from 18 to 38.7 kg/m^2. Their mean serum testosterone concentration was found to be 240 ± 130 ng/dL (8.3 ± 4.5 nmol/L) with a range of 1.4 to 29.5 nmol/L. The mean FSH concentration was found to be 5.6 ± 3.7 mIU/mL with a range of 1.1 to 28.5 mIU/mL), and the mean LH level was 5.7 ± 2.8 mIU/mL, with a range of 0.8 to 16.1 mIU/mL (Table 1).

According to the definition of hypogonadism on basis of testosterone level (>300 ng/dL, 10.4 nmol/L), 78% (234 patients) of the diabetic patients were hypogonadal, 22% (66 patients) with normal testosterone levels (300-1000 ng/dL). In the control group 90% (90 healthy volunteers) had normal testosterone level, 10% (10 healthy men) were hypogonadal.

When classifying patients on basis of BMI, of the 300 diabetic patients 38.3% (115 patients) were found to be overweight (BMI; 25-30 kg/m^2), 16.3% (49 patients) were moderately obese (BMI; 30-34.9 kg/m^2), and 2.7% (8 patients) were severely obese (BMI; 35-39.9 kg /m^2). As shown in Table 2, Levels of serum testosterone decrease with increasing BMI and decreases markedly in a severely obese group with a testosterone level falling to178 ng/dL. The overall relation between the BMI and serum testosterone was strongly inverse (r = -0.12, p = 0.039) (Figure 1).

There were no relation between serum levels of FSH or LH hormones and BMI (r = 0.03, p = 0.58), (r = -0.04, p = 0.47) respectively (Figures 2 and 3).

Variables	Test group, N=300	Control group, N=100	p-value
Age	61.6 ± 9.5 (40-85)	61.6 ± 10.5 (40-81)	0.95
BMI	26.2 ± 4.3 (18-38.7)	26.4 ± 3.2 (19.2-33.2)	0.74
Weight	77.8 ± 14.2 (40-115	79.2 ± 10.5 (60-105)	0.38
Testosterone (ng/mL)	2.4 ± 1.3 (0.4 - 8.5)	4.8 ± 1.6 (0.5-9.6)	0.00
FSH (mIU/mL)	5.6 ± 3.7 (1.1-28.5)	4.5 ± 2.5 (0.9-15)	0.01
LH (mIU/mL)	5.7 ± 2.8(0.8-16.1)	4.9 ± 2.4 (1.5-14.8)	0.02

Table 1: Values of studied variables compares to control group values. Results are expressed as mean ± SD and ranges are shown between brackets.

BMI	Testosterone (ng/dL)
Overweight	328
Moderate obese	253
Severe obese	178

Table 2: shows mean testosterone level in ng/dL in different categories of BMI; overweight, moderately obese and severely obese.

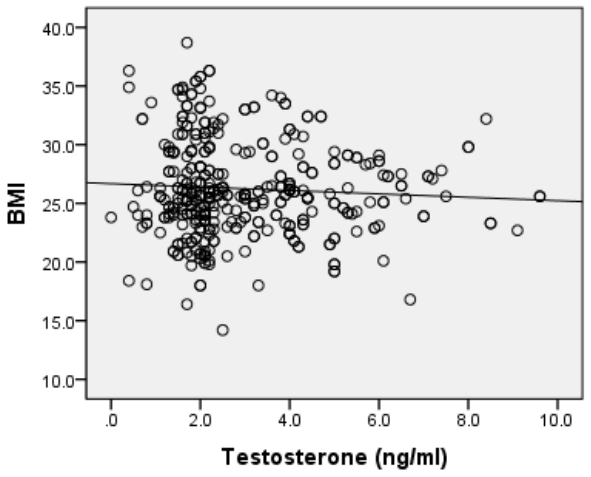

Figure 1: scatter blot shows relationship between testosterone hormone and BMI in the test group (r = - 0.12, p = 0.039).

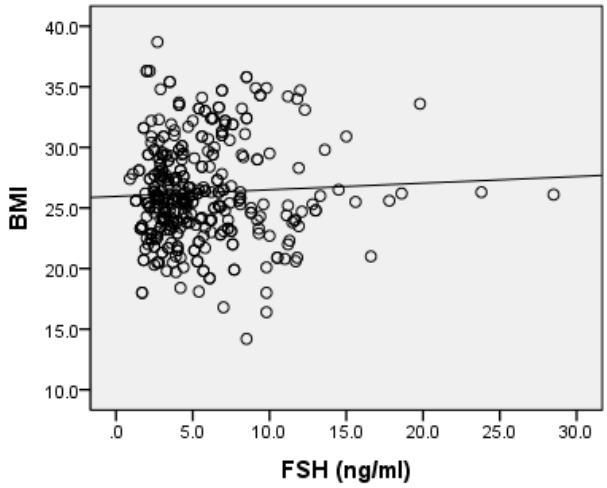

Figure 2: scatter blot shows relationship between FSH hormone and BMI in test group (r = 0.03, p = 0.58).

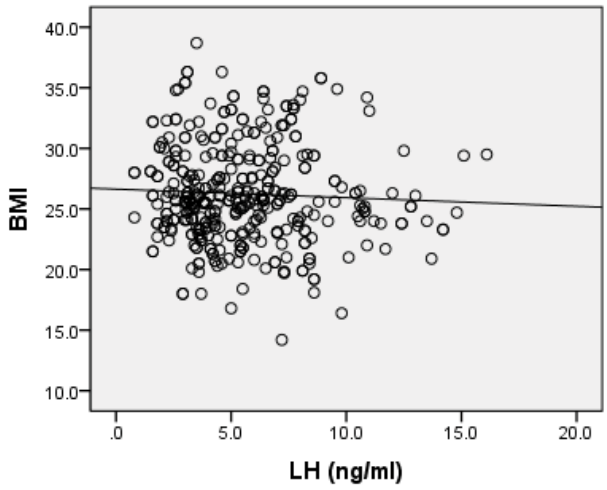

Figure 3: scatter blot shows relationship between LH hormone and BMI in test group (r = -0.04, p = 0.47).

Discussion

In this article we have studied the reproductive hormonal profile particularly testosterone, in a sample of diabetic Sudanese men and compare it with the healthy Sudanese male. We have also studied the effect of obesity on the level of serum testosterone. Hypogonadism is a serious problem in a community like a Sudanese one, as the culture play great role in the way that males should be strong and remain fertile as long as they live. Although this is the thought, most of the people with a few exceptions have no physical exercise activities, no balanced food, and no active participation in athletic activities. These factors added to diabetes may increase and escalate the effect of lowering down the testosterone level in males.

The testosterone hormone has great effect on general health and wellbeing of men. It promotes protein synthesis and growth of those tissues having androgen receptors and act as virilizing and anabolic hormone. It was reported that low total testosterone levels are associated with type 2 diabetes, independent of age, race, obesity [17,18]. Hypogonadism associated with alterations in body composition; diminished energy, muscle strength, and physical function; reduced sexual function; depressed mood; and decreased cognitive function [19].

Few studies in Sudan were conducted on diabetes mellitus. This disease is having an increasing impact on rates of morbidity and mortality in Sudan [3]. Knowledge of the diabetes epidemic in Sudan is limited. The most recent data come from a small-scale study that was carried out in 1996. The results of the study indicated a prevalence of 3.4% [20]. But recent estimates place the diabetes population at around one million – around 95% of whom have type 2 diabetes.

Besides its pathological effects; diabetes ketoacidosis which leads to more deaths each year than any other non-communicable disease, diabetes also affect men sexual performance greatly in Sudanese as reported by Lemya Naway et al. [21].

The Endocrine Society now recommends that men with type 2 diabetes be screened for low testosterone levels [8].

In this study, we aimed to assess the level of testosterone in diabetic men and its association with obesity in Sudanese community.

Our study revealed that testosterone levels were significantly lower in Sudanese male with type2 diabetes when compared with the testosterone level of the control group (p value < 0.01). This agrees with the studies conducted by Tajar et al. [8] and Dhindsa et al. [22], where they demonstrated that a significant number of men with type 2 diabetes have testosterone insufficiency and hypogonadotropic hypogonadism is a common defect in type 2 diabetes respectively [22,23].

Similar results were reported in the united states on 2650 random samples of primary care practices in which they reported that hypogonadism were significantly higher in men with diabetes, as well as in Austin Health Diabetes Clinic showing that testosterone deficiency is common in men with type 2 diabetes [24,25].

In this study it was found that there was a significant inverse linear relationship between testosterone hormone and BMI (P value <0.05) (Figure 1). Many research groups worldwide, studied the relation between the BMI and the concentration of total serum testosterone and reported similar results [26,27].

It was reported that correlation studies cannot unravel the cause and effect relationships between the correlates whether low testosterone induces visceral fat deposition or whether a large visceral fat depot leads to low testosterone levels. Prospective studies have confirmed that lower endogenous androgens predict central adiposity in men [28].

Because type 2 diabetes is often associated with obesity, which suppresses total testosterone levels, obesity represents an important confounding factor in the relationship between testosterone and type 2 diabetes. Obese men and men with type 2 diabetes can have secondary hypogonadism because of the peripheral and central insulin resistance and the effect of proinflammatory cytokines (TNFα and IL-6) on the hypothalamic-pituitary-gonadal axis [18].

'BMI' which considered the best proxy for body fat percentage

among ratios of weight and height it provides a simple numeric measure of a person's thickness or thinness, allowing health professionals to discuss overweight and underweight problems more objectively with their patients [29]. The WHO regards a BMI of less than 18.5 as underweight and may indicate malnutrition, an eating disorder, or other health problems, while a BMI greater than 25 is considered overweight and above 30 is considered obese.

Table 2 shows the level of testosterone in these ranges of BMI values where testosterone was significantly lower among the severely obese subjects.

Decline of testosterone production with age has led to interest in androgen replacement therapy [30]. Maintaining normal testosterone levels in elderly men has been shown to improve many parameters that are thought to reduce cardiovascular disease risk, such as increased lean body mass, decreased visceral fat mass, decreased total cholesterol, and glycemic control [31].

Conclusion

Diabetes mellitus type 2 is having effects on Sudanese male gonadal activity in terms of testosterone production. The obese Sudanese subjects have significantly low serum testosterone levels. So clinicians get use of this finding and correct for the complications of diabetes regarding the gonadal activity as testosterone replacement therapy is available.

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