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Original Research Article

STUDY OF TESTOSTERONE LEVELS IN MEN AMONG DIABETES MELLITUS

[1]Dr. Taha Mahboob Ali Khalid, [2*]Dr.Mohd Akbar Ali

[1, 2]Assistant Professor, Department of General Medicine, Bhaskar Medical College and General Hospital, Yenkapally Village, Moinabad Mandal Hyderabad, Telangana State.

Corresponding Author: Dr.Mohd Akbar Ali,

E-mail: akbar2424@gmail.com

Abstract

Background: Diabetes is a chronic health condition that affects how body turns food into energy. In Asia, the prevalence of diabetes is increasing rapidly. Testosterone is essential for health and well-being and its levels decreases with aging. Men with type 2 diabetes mellitus have low testosterone levels, but this concept has not received much attention because of the fact that both type 2 diabetes and hypotestosteronaemia are associated with aging.

Aim and Objectives: To make people aware and to know about testosterone level among type 2 diabetes patients.

Material and Methods: This is a case-control study was undertaken in which each of 50 cases of type 2 diabetes mellitus and 50 non-diabetic patients were studied for period of one year, in Department of General Medicine, Bhaskar Medical College and General Hospital, Yenkapally, Hyderabad after getting ethical approval from Institutional Ethical committee and following inclusion and exclusion criteria. Total testosterone in the early morning was measured using CLIA (Chemiluminescence enzyme immunoassay) method.

Results: Mean age of all the patients was 49.95 years with standard deviation of 8.12 years. We have observed that, overall maximum number of patients were from the age group of 46 – 55 years of age followed by 35 – 45 years of age. 76% of the patients had erectile dysfunction. mean difference of age, SBP, DBP, Hb level, Fasting Blood Sugar, Post Prandial Blood Sugar, level of urea, creatinine level, HbA1C level, Total Cholesterol level and Serum Testosterone Level between cases and controls was statistically significant (P-value<0.001%). Conclusion : We can conclude from overall observation that there was significant reduction in serum testosterone level among type 2 diabetic patients also it was significantly correlated with other parameters of the study.

Keywords: Diabetes Mellitus, Testosterone, Chemiluminescence enzyme immunoassay, hypotestosteronaemia

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Introduction

Diabetes is a chronic health condition that affects how body turns food into energy. Body breaks down most of the food we eat into sugar (glucose) and releases it into the bloodstream. When blood sugar goes up, it signals pancreas to release insulin. Insulin acts like a key to let the blood sugar into body's cells for use as energy. It's refers to a group of common metabolic disorders that share the phenotype of hyperglycemia. Based on current trends, the International Diabetes Federation projects that 592 million individuals will have diabetes by the year 2035. In Asia, the prevalence of diabetes is increasing rapidly, and the diabetes phenotype appears to be somewhat different from that in the United States and Europe, with an onset at a lower body mass index (BMI) and younger age, greater visceral adiposity, and reduced insulin secretory capacity.[1]

Testosterone a 19-carbon steroid secreted by the testis (Leydig cells) is the primary circulating androgen in the male human. Testosterone is essential for health and well-being and its levels decreases with aging. Men with type 2 diabetes mellitus have low testosterone levels, but this concept has not received much attention because of the fact that both type 2 diabetes and hypotestosteronemia are associated with aging. But studies have shown that young men with type 2 diabetes mellitus do suffer from low testosterone levels. As Diabetes Mellitus and Testosterone hormone dysfunction are two common endocrinopathies, both may be associated with insulin resistance and defective metabolism, there seems to be some significant relation between these two and they may have tend to mutually influence each other.

Many studies are there states the direct realtion between diabetes mellitus and low level of testosterone, the study by Rohwer and coworkers found that low testosterone level was associated with higher risk for T2DM among men but lower risk for T2DM among women [2]. Elabbay and coworkers found T2DM patients tended to have significantly lower testosterone level when compared with non-diabetic individuals [3]. However, evidence is less convincing and somewhat controversial for the impact of testosterone on T2DM risk among men. The study by Lakshman and coworkers reported that free testosterone level was not associated with risk of T2DM among men [4].

It is also found that there is an inverse correlation between serum testosterone and fasting insulin levels in men irrespective of age and obesity. The mitochondrial dysfunction is the key factor leading to insulin resistance in men. Lower total testosterone and sex hormone-binding globulin (SHBG) predict a higher incidence of metabolic syndrome. There is evidence that hypotestosteronemia should be an element in the definition of metabolic syndrome, since low levels of testosterone are associated with or predict the development of metabolic syndrome and of diabetes mellitus. In men with decreased serum levels of testosterone and type 2 diabetes mellitus, C-reactive protein concentration have found to be decreased which leads to increased risk of developing atherosclerosis and coronary heart disease independent of the risk associated with diabetes mellitus alone.

In our country most of the population are living in rural area, who are unaware about these facts and because of that infertility in men's is increasing day by day. And also very

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less documented data is available in our study area, thus we have undertaken this study to make people aware and to know about testosterone level among type 2 diabetes patients.

Material and Methods

This is a case-control study was undertaken in which each of 50 cases of type 2 diabetes mellitus and 50 non-diabetic patients were studied for period of one year, in Department of General Medicine, Bhaskar Medical College and General Hospital, Yenkapally, Hyderabad after getting ethical approval from Institutional Ethical committee and following inclusion and exclusion criteria.

Inclusion Criteria

- Patients with type 2 Diabetes Mellitus
- Patients having age group of 35-75yrs
- Patients with no H/O Diabetes Mellitus with FBS < 126 mg/dl

Exclusion Criteria

- Patients with Chronic Liver Disease
- Patients with chronic infections like HIV, TB
- Patient on anabolic steroids
- Patients on Chemotherapy or Radiotherapy
- Patients with Primary Hypogonadism

Methodology

Study included patients with cases(Diabetic) and controls (Non-Diabetic) those who followed inclusion and exclusion criteria, and after getting Informed consent a detailed history regarding the duration of diabetes, the patients other associated risk factors like hypertension, coronary artery disease was obtained. Anthropometric measurements like height, weight, waist and hip circumferences were measured. BMI was calculated by obtaining the ratio of the weight and the square of height (kg/m^2). Fasting blood sugar and postprandial blood sugar were measured using chromatography method. Total cholesterol was also measured. Total testosterone in the early morning was measured using CLIA (Chemiluminescence enzyme immunoassay) method. The normal range for early morning total testosterone in adult males is considered between 300ng/dl and 900ng/dl.

Statistical Analysis :

After data collection from the patients, entered in the Microsoft excel 2016 for further statistical analysis, Quantitative data were presented by mean and standard deviation for cases and controls. Mean difference of various parameter between cases and controls were asses with the help of t-test and correlation between testosterone level and other parameters were asses by correlation. P-value less than 0.05 considered as statistically significant at 5% level of significance. Statistical analysis were done with the help of software SPSS version 25.

Results and Observation:

In the present study we have included 50 cases of type 2 diabetes mellitus and 50 healthy controls with no diabetes status, study conducted for period of one years, in the department of medicine of our institute.

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Table 1: Demographic Profile of study population (Cases and Control)

Parameters	Cases	Controls	Chi-square/Fisher Exact	P-value
Age				
35 - 45 Years	12(24%)	15(30%)	20.68	<0.001**
46 - 55 Years	22(44%)	35(70%)		
56 - 65 Years	12(24%)	0(0%)		
66 - 75 Years	4(8%)	0(0%)		
BMI Intervals				
18 - 24.9	29(58%)	32(64%)	4.05	0.15
25 - 29.9	13(26%)	16(32%)		
> 30	8(16%)	2(4%)		
Hypertension				
Yes	41(82%)	6(12%)	49.17	<0.001**
No	9(18%)	44(88%)		
Alcohol Consumer				
Yes	27(54%)	22(44%)	1.004	0.317
No	23(46%)	28(56%)		
Erectile Dysfunction Status				
Yes	38(76%)	3(6%)	6.35	0.01*
No	12(24%)	47(84%)		

Mean age of all the patients was 49.95 years with standard deviation of 8.12 years. We have observed that, overall maximum number of patients were from the age group of 46 – 55 years of age followed by 35 – 45 years of age. Among cases 21(42%) patients were obese. 41(82%) of the patients were suffered with hypertension also, 54% of the patients were alcohol consumer and 76% of the patients had erectile dysfunction showed in the table no. 1.

Table 2 : Mean distribution of various parameter between cases and controls.

Parameters	Cases	Controls	t-test	P-value	Min	Max
Age	51.82±10.08	48.08±4.97	2.32	0.021*	35	75
Body Mass Index	25.0568±4.30	23.886±3.43	1.505	0.136	18.6	37.25
Systolic Blood Pressure	145±13.59	128±9.45	4.69	<0.001**	100	140
Diastolic Blood Pressure	90.3±8.38	87.5±6.345	6.19	<0.001**	60	90
Hb (g/dl)	12.39±1.68	14.116±1.24	-5.812	<0.001**	9.2	16.3
Fasting Blood Sugar (g/dl)	132.74±23.52	95.17±10.75	10.27	<0.001**	67	180
Post Prandial Blood Sugar (g/dl)	174.12±34.57	133.25±32.50	6.089	<0.001**	60	250

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Urea (g/dl)	38.76±9.49	33.58±7.02	3.101	0.003**	19	55
Creatinine (g/dl)	1.2±0.301	1.004±0.207	3.794	<0.001**	0.6	2.1
HbA1C	9.9248±1.68	4.6041±1.24	16.74	<0.001**	3.03	14.78
Total Cholesterol (mg/dl)	199.32±33.59	196±15.09	0.637	0.525	150	265
Testosterone Level (ng/dl)	345.28±150.514	660.56±104.09	-12.18	<0.001**	120	840

** P-value is significant at the 0.01 level (2-tailed).

We have observed that, mean difference of age, SBP, DBP, Hb level, Fasting Blood Sugar, Post Prandial Blood Sugar, level of urea, creatinine level, HbA1C level, Total Cholesterol level and Serum Testosterone Level between cases and controls was statistically significant (P-value<0.001%). Table No . 2

Also, we have observed correlation between serum testosterone level and other parameters like Fasting Blood Sugar, Post Prandial Blood Sugar, creatinine level, HbA1C level, Total Cholesterol level were statistically significant (P-value <0.001%) Table No. 3

Table 3 : Correlation between Serum Testosterone and biochemical parameters.

Parameter	Total Testosterone Level	
	Pearson Correlation	P-value
Fasting Blood Sugar	-.606**	<0.001**
Post Prandial Blood Sugar	-.482**	<0.001**
Creatinine Level	-.342**	<0.001**
Total Cholesterol	-.471**	<0.001**
HbA1C	-.784**	<0.001**

** P-value is significant at the 0.01 level (2-tailed).

Discussion:

Diabetes is one of the most common non- communicable diseases globally, with around 290 million people suffering from diabetes worldwide. The proportion of diabetes in India is steadily on a rise and in another fifteen years India would have the largest number of diabetics in the world. The testosterone hormone has a major impact on men's overall health and well-being. In our study we have taken 50 patients with type 2 diabetes mellitus and 50 Healthy controls and compared testosterone level and associated parameters with it. In our study mean age of the patients in cases group was 51.82±10.08 years and that of in control group was 48.08±4.97 years, so we found statistically significant difference in the age group between the cases and controls.

In present study we have observed that, mean serum testosterone level among cases was 345.28±150.514 ng/dl and that of in control group was 660.56±104.09 ng/dl, so it was found that there was significant low level of testosterone level among diabetic patients compared to healthy controls and this difference was statistically significant (P-value<0.001)

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In study conducted by Dinge et al[5], in which they have included 3825 patients, and they found lower level of serum testosterone level among type 2 diabetic patients. Another study conducted by Oh et al.[6] Also showed a reciprocal relationship between serum total testosterone and type 2 diabetes mellitus. Similar to our study, study by Yeap et al[7] observed that level of testosterone was lower in type 2 diabetic patients compared to patients with non-diabetes Mellitus. In one more study conducted by Corona et al[8] in their meta analysis they found that, testosterone level was lower among type 2 diabetes mellitus patients compared to non-diabetes mellitus patients and they found mean difference was 2.99nmol/litre.

In our study we have found that, systolic and diastolic blood pressure was higher among type 2 diabetic patients compared to non-diabetic patients and this difference was statistically significant(P-value<0.001)

Previous studies have asserted that the most adverse outcome of type 2 diabetes mellitus is hypertension because of the complications like diabetic nephropathy, increased exchangeable sodium, insulin resistance and peripheral vascular resistance associated with the disease [9, 10]. Other previous studies have also shown a significant mean difference in body mass index, systolic and diastolic blood pressures and fasting blood glucose between diabetic men and control groups [11, 12], but in our study we found no significant difference in mean BMI between diabetic and non-diabetic paktients. Also, a significant elevation of FBS and HbA1c levels was identified in the diabetic group compared to the non-diabetics. The elevated FBS and poor glycaemic control have been found to be directly proportional to the severity of the diabetes mellitus. The increasing FBS level and poor glycaemic control in the diabetic group were also in agreement with many other research findings [13 - 15].

Kupelian et al. conducted a study and suggested that low testosterone may be a marker in association of type 2 diabetes mellitus with insulin resistance [16]. Besides this several other evidences have also been given showing the role of lower testosterone in insulin resistance.

The correlation between the blood glucose level and serum testosterone was found to be significant and negatively correlated, indicating improvement in blood glucose levels with increase in serum testosterone. Studies have reported inverse relationship between blood glucose and testosterone [17]. We have also found significant correlation between BMI and testosterone level.

In our study we have found the negative correlation between HbA1C level and level of testosterone, but some other studies Grossmann et al [18] and Al Hayek et al [19] reported no significant correlation between HbA1c and testosterone levels, which is in contrast with those by Kapoor et al [20] in which testosterone level correlated positively with HbA1c level. One study on Japanese men revealed negative association between testosterone level and HbA1c which was similar to our study, possibly due to decrease in stimulatory effect of testosterone on red blood synthesis [21].

Erectile dysfunction (ED) rate was quite high in our study subjects irrespective of their diabetic status and it seems normal at this age group. According to a recent analysis on the prevalence of sexual dysfunction the prevalence of ED was 1%–10% in men younger than 40 years, 2%– 9% among men between 40 and 49 years, and it increased to 20%–40% among men between 60–69 years, reaching the highest rate in men older than 70 years (50%–100%)

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[22]. Similar erectile dysfunction rates were also found in France, where 39% of men aged 18 to 70 reported erectile dysfunction [23].

This study has some limitation which was, study was case-control study, which made it impossible to determine whether diabetes preceded or followed the decline in hormone levels. Also sample size of type 2 diabetes mellitus which is common now a days was very less to know, whether diabetic mellitus affect in reduction of testosterone level, thus we recommend further studies with parameter taken in this study and also with other related parameter on large sample size. Also we have not computed free testosterone level and we have not added duration of diabetes mellitus because of unknown duration.

Conclusion :

Thus from all observation and results we can conclude that, there is a significant reduction in the levels of serum testosterone in diabetic men as compared to that of non-diabetic men. Even though the declining trend of the testosterone levels occurs as the age increases, the reduction in the testosterone levels are more significant in the diabetic group as compared to that of the non-diabetic men. Thus from our study, we propose that age factor alone is not the cause of hypotestosteronemia in diabetic men.Different factors like cholesterol and other risk factors we have shown the influence of multiple factors on the levels of testosterone, in which most of them has an inverse correlation. Thus we can suggest in order to prevent diabetic complication and cardiovascular disease, every patients with diabetes should measure the testosterone level, as replacement of testosterone can have multiple benefits.

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Conflict of Interest : None

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