Research Article

PREVALENCE OF DYSLIPIDEMIA IN MEN WITH TYPE 2 DIABETES MELLITUS WITH LOW TESTOSTERONE LEVELS

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A B S T R A C T

Aims: To study lipid profile and testosterone levels in men with type 2 diabetes mellitus.
Material and Methods: An observational, cross sectional study was performed in 193 male blood samples were analyzed for Fasting plasma glucose, 2 hours post prandial plasma glucose, glycosylated hemoglobin (HbA1c) and lipid profile (Total Cholesterol, Triglycerides, Low density lipoprotein (LDL) and High density lipoprotein (HDL) levels).Serum Testosterone Levels was measured. Total Testosterone Levels and Free Testosterone Levels were measured based on chemilumiscence on Beckman coulter access 2 immunoassay system (time for collection of samples was between 7am to 11am).Statistical analysis was performed using Epi Info2000 and SPS student version 16.0.
Observations: In our study out of 193 patients. The mean fasting blood glucose of the patients was 183.72 ± 64.06 mg/dl. The mean post prandial blood glucose level of the patients was 242.32 ± 104.32 mg/dl. The average total triglyceride, cholesterol, LDL,HDL were 214.35 ± 98.58 mg/dl, 202.81 ± 50.68mg/dl, 132 ± 40.40mg/dl and 36.46 ± 7.43mg/dl. The incidence of hypertriglyceridemia was 53.60% in patients with low total testosterone levels. Hypercholesteremia was 61.36%in patients with low total testosterone levels and 56.81% in patients with low free testosterone levels. Increased level of LDL was reported in 30 patients (66.66%) with low total testosterone levels and 31patients (68.88%)with low free testosterone levels, and reduced HDL was found in 64 (52.03%) in patients with low testosterone levels. Out of 193 patients 67 (34.71%) had low total testosterone levels and 57 (29.53%) had low free testosterone levels and there is significant relationship between low testosterone levels and dyslipidemia.
Conclusion: Type 2 diabetes mellitus is associated with dyslipidemia and low testosterone levels. Those patients with low testosterone levels had elevated Total serum triglyceride, elevated cholesterol and elevated LDL and reduced levels of HDL levels than with normal testosterone indicating that these patients were more prone to get cardiovascular disease.

INTRODUCTION

Low serum testosterone level have been reported in men with type 2 diabetes mellitus.[1,2,3]This decrease is accompanied by changes in body composition including increases in fat mass and decreases in lean body mass, dyslipidemia, insulin resistance, and glucose metabolism dysregulation.[4]Testosterone deficiency and CVD are both associated with visceral fat accumulation, metabolic syndrome, type 2 diabetes, increased inflammatory cytokines, hyperlipidemia, and abnormalities of coagulation.[5]Low testosterone levels have been observed in association with dyslipidemia and hypertension. [6]Epidemiological data suggest that total testosterone levels are negatively associated with

total cholesterol, LDL-C, and triglyceride (TG)[7] , while in men testosterone levels appear to have complicated and controversial relationship with HDL-C levels and cardiovascular risk. In fact, androgen levels within the normal adult male range were found to have a suppressive effect on HDL[8]

MATERIAL AND METHODS

This observational, cross sectional study was performed in 193 male diabetic patients in tertiary health care center in IGMC Shimla who met the following inclusion criteria.

1. Patients with Type 2 Diabetes Mellitus, known cases or diagnosed for the first time.
2. Patients willing to give written consent to participate in the study.

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The Following Patients were Excluded from the Study

1. Type 1 diabetics
2. Secondary diabetes. (Chronic Pancreatitis, Drugs, Cushing's, Pituitary and thyroid disorder)
3. Prior or Present treatment for hypogonadism with testosterone replacement, with anti-androgens, chronic diseases. (HIV infection, COPD, ESRD) Critical illness Hyperprolactinemia, Medications. (e.g. opiates, anabolic steroids)
4. Patients not willing to give consent to participate in the study.

Study Period

1st July 2015 to 30th June 2016.

Investigations

Serum Testosterone Levels was measured. Total Testosterone Levels and Free Testosterone Levels were measured based on chemilumiscence on Beckman coulter access 2 immunoassay system (time for collection of samples was between 7am to 11am).

In addition, following laboratory investigations were done

- ✓ Fasting plasma glucose
- ✓ 2 hours Post Prandial Plasma glucose
- ✓ Lipid Profile
- ✓ Serum urea
- ✓ Serum creatinine.

All these Biochemical tests were done at IGMC Shimla on KONELAB-30 automatic analyser.

- ✓ HbA1c was measured in all patients by using high-performance liquid chromatography
- ✓ Urine examination for Micro albuminuria

Table 1 Reference Ranges for Chemical Variables Testosterone Levels in 30 to 40 Years of Age

Testosterone	Normal Range	Low
Total	241 - 827ng/dl	<241 ng/dl
Free	9.1 - 32.7pg/ml	< 9.1pg/ml

Table 2 Testosterone Levels in 41to50 Years of Age

Testosterone	Normal Range	Low
Total	241 - 827ng/dl	<241 ng/dl
Free	5.7- 30.7pg/ml	<5.7pg/ml

Table 2 Reference Ranges for lipid profile according to

National Cholestrol Education Program (Ncep) Atp (Adult Treatment Paneliii) Guidelines 2016

	Normal	Borderline	High	Very high
Total cholesterol	200	201–240	240	–
Hdl cholesterol	≥60	40–59	<40	–
Ldl cholesterol	<100–129	130–159	160–189	>190
Triglycerides	<150	150–199	200–499	>500

Statistical Analysis

Data was recorded on a Microsoft Excel spreadsheet. All discrete variables were expressed as percentages. Statistical analysis was performed using Epi Info2000 and SPS student version 16.0(SPSS Inc, Chicago, USA).

RESULTS

out of 193 patients who fulfilled the eligibility criteria,67 (34.71%) patients were having low total testosterone levels and 57 (29.53%) were having low free testosterone levels& total of 45 (23.31%) patients were having low both total and free testosterone levels. While comparing lipid profile of patients with low total and free testosterone levels with normal total and free testosterone levels following observations were found

Triglyceride Levels (Tg): TG levels >200mg/dl were high in 97 patients, out of which 52 (53.60%)patients were having low total testosterone levels and 45 (46.39%) patients were having normal total testosterone levels. (table 3)

Table 3 Triglyceride levels with normal and low total testosterone levels

Triglyceride levels	Number of patients with normal total testosterone levels (n=126)	Number of patients with low total testosterone levels (n=67)	Total number of patients (n=193)	p Value
<150	35 (89.74%)	4 (10.25%)	39 (20.21%)	
150 - 199	42 (82.35%)	9 (17.64 %)	51 (26.42%)	<0.0001
200 – 499	45 (46.39%)	52 (53.60%)	97 (50.26%)	
>500	4 (66.66 %)	2 (33.33%)	6 (3.11%)	

Total Cholesterol levels > 240 mg/dl were high in 44 patients, out of which 27 (61.36%) patients were having low total testosterone levels and 17 (38.63%) patients were having normal total testosterone levels. (table 4)

Table 4 Total Cholesterol with normal and low total testosterone levels

Total Cholesterol	Number of patients with normal total testosterone levels (n=126)	Number of patients with low total testosterone levels (n=67)	Total number of patients (n=193)	p Value
<200	73 (78.49%)	20 (21.50%)	93 (48.18%)	
200 - 240	36 (64.28%)	20 (35.71%)	56 (29.01%)	<0.0001
>240	17 (38.63%)	27 (61.36%)	44 (22.79%)	

Out of 44 patients, 25(56.81%) patients were having low free testosterone levels and 19(43.18%) were having normal free testosterone levels. (table 5)

Table 5 Total Cholesterol with normal and low free testosterone levels

Total Cholesterol	Number of patients with normal free testosterone levels (n=136)	Number of patients with low free testosterone levels (n=57)	Total number of patients (n=193)	p Value
<200	80 (86.02%)	13 (13.97%)	93 (48.19%)	
200 – 240	37 (66.07%)	19 (33.92%)	56 (29.02%)	0.0002
>240	19 (43.18%)	25 (56.81%)	44 (22.8%)	

HDL levels < 40mg/dl were reduced in 123 patients, out of which 64 (52.03%)patients were having low total testosterone levels and 59(47.96%) with normal total testosterone levels.(table 6)

Table 6 HDL with normal and low total testosterone levels

HDL	Number of patients with normal total testosterone levels (n=126)	Number of patients with low total testosterone levels (n=67)	Total number of patient (n=193)	p Value
<40	59 (47.96%)	64 (52.03%)	123 (63.73%)	
40 – 50	61 (95.31%)	3 (4.6%)	64 (33.16%)	<.0001
>50	6 (100%)	0 (0%)	6 (3.11%)	

LDL levels > 160 mg/dl were high in 45 patients, out of which 30(66.60%) patients were having low total testosterone levels and 15 (33.33%) were having normal total testosterone levels. Total 31 (68.88%) patients were having low free testosterone levels and 14 (31.11%) patients were having normal free testosterone levels.

LDL levels > 190 mg/dl were very high in 14 patients out of which 11 (78.57%) were having low testosterone levels and 3 (21.42%)were having normal total testosterone levels. Total 8(57.14%) patients were having low free testosterone levels and 6(42.85%) were having normal free testosterone levels.(table 7 and 8)

Table 7 LDL with normal and low total testosterone levels

LDL	Number of patients with normal total testosterone levels (n=126)	Number of patients with low total testosterone levels (n=67)	Total number of patients (n=193)	p Value
<100	29 (82.85%)	6 (17.14%)	35 (18.13%)	
100 – 129	64 (84.21%)	12 (15.78%)	76 (39.38%)	
130 – 159	15 (65.21%)	8 (34.78%)	23 (11.92%)	<0.0001
160 – 189	15 (33.33%)	30 (66.66%)	45 (23.32%)	
>190	3 (21.42%)	11 (78.57%)	14 (7.25%)	

Table 8 LDL with normal and low free testosterone levels

LDL	Number of patients with normal free testosterone levels (n=136)	Number of patients with low free testosterone levels (n=57)	Total number of patients n=193	p Value
<100	33 (94.28%)	2 (5.71%)	35 (18.13%)	
100 – 129	66 (86.84%)	10 (13.15%)	76 (39.38%)	
130 – 159	17 (73.91%)	6 (26.08%)	23 (11.92%)	<0.0001
160 – 189	14 (31.11%)	31 (68.88%)	45 (23.32%)	
>190	6 (42.85%)	8 (57.14%)	14 (7.25%)	

DISCUSSION

The study has demonstrated that there is a high prevalence dyslipidemia in patients with low testosterone levels than patients with normal testosterone levels in type 2 diabetes mellitus. This study is limited by the absence of a non-diabetic group. Despite the presence of vascular disease, the dyslipidemia in these patients may reflect the underlying androgen status, because there are reports of dyslipidemia associated with hypogonadism. [9,10]This study also showed an association between lipid profile and testosterone levels in men with type 2 diabetes. These finding is consistent with earlier research.[11,12] Increased abdominal fat leads to increased aromatase activity. The resulting low testosterone increases lipoprotein lipase activity, the main enzymatic regulator of triglyceride uptake in adipose tissue. This results in inhibition of triglyceride uptake, increased lipid mobilization leading to increased visceral adiposity, and insulin resistance. This, in turn, causes further hypogonadism and abdominal fat deposition. [11,13]Low testosterone levels have been observed in association with dyslipidemia and hypertension.[14]

CONCLUSION

This study demonstrates that patients who were having low total testosterone levels in patients with type 2 diabetes mellitus were having high TG (53.60%),total cholesterol (61.36%), reduced HDL (52.03%), High levels of LDL (66.60%).And those having low free testosterone levels were having high cholesterol (56.81%), High LDL (68.88%).The incidence of dyslipidemia is very high in patients having low testosterone levels in type 2 diabetes mellitus indicating that these patients were more prone to get cardiovascular disease.

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