

## To study the correlation of serum testosterone concentration with duration of diabetes and glycemic control at tertiary care hospital Bikaner

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### Abstract

Diabetes mellitus refers to a group of common metabolic disorders that share the phenotype of hyperglycemia. In recent years, androgen deficiency has captured interest of many researchers and they have associated not only with general health of men but also with certain common systemic disorders like abdominal obesity, type 2 diabetes mellitus and others. This was a cross sectional study. 150 cases of type 2 diabetes mellitus and 50 cases without type 2 diabetes mellitus matched for confounding factors were taken as controls. Serum total testosterone level is assessed by chemiluminiscence method. Mean serum total testosterone (ng/dl) in duration of diabetes group  $\leq 5$  years was  $298.44 \pm 68.13$  while in duration of diabetes group 6-10 years it was  $268.90 \pm 62.06$ , in duration of diabetes group 11-15 years, it was  $243.00 \pm 56.15$  and in duration of diabetes group  $>15$  years it was  $218.00 \pm 10.95$  ( $p=0.001$ ). Mean serum total testosterone (ng/dl) in HbA1C group  $\leq 7\%$  was  $526.37 \pm 141.58$  while in HbA1C group 7.1-9.0% it was  $292.46 \pm 71.68$ , in HbA1C group  $>9\%$  it was  $267.97 \pm 63.32$  ( $p<0.001$ ). We concluded that duration of diabetes and HbA1C level significant correlation with serum total testosterone level.

**Keywords:** Type 2 Diabetes Mellitus, Serum total testosterone, HbA1C.

### Introduction

Diabetes mellitus (DM) refers to a group of common metabolic disorders that share the phenotype of hyperglycemia,<sup>1</sup> in which a person has high plasma glucose, either because the body does not produce enough insulin, or because cells do not respond to the insulin that is produced. The high plasma glucose produces the classical symptoms of polyuria, polydipsia and polyphagia.<sup>2</sup> Type 2 diabetes mellitus is a metabolic disorder that is characterized by hyperglycemia in the context of insulin resistance and relative insulin deficiency.<sup>3</sup> Testosterone plays a significant role in obesity, glucose homeostasis and lipid metabolism. It has been reported that elderly male patients with type 2 diabetes have obviously reduced serum testosterone levels, which might promote insulin resistance, whereas elderly male patients with type 1 diabetes have normal serum testosterone level.<sup>4</sup>

Population studies have shown that the reduced level of serum testosterone is an independent risk factor for diabetes and metabolic syndrome in men.<sup>5</sup> The role of sex hormones in diabetes mellitus and diabetes mellitus combined with osteoporosis is attracting more and more attention. The relationship between low bone mineral density (BMD) and type 1 diabetes has obtained consistently reliable results, whereas it remains controversial in type 2 diabetes.<sup>6</sup>

### Materials and Methods

The cross sectional study was carried out in the department of medicine and diabetes care and research Centre, S.P. Medical College, Bikaner.

**Inclusion Criteria:** Healthy subjects (free from any other disease), Type 2 diabetic male, Patients giving informed consent.

**Exclusion Criteria:** Significant comorbidities like liver disease, tuberculosis, smoking, alcoholics, HIV etc, any

acute illness, Men on hormonal therapy. Men who had a surgical or chemical castration (for prostatic cancer), Type 1 diabetic male, Patients not willing to participate in the study or not giving consent.

### Diagnostic criteria for diabetes mellitus:<sup>1</sup>

1. Fasting blood sugar  $> 7.0$ mmol/L (126mg/dl) or
2. HbA<sub>1c</sub>  $> 6.5\%$  or
3. Two hour plasma glucose  $> 11.1$ mmol/L (200mg/dL) during an oral glucose tolerance test or
4. Symptoms of diabetes plus random blood glucose concentration  $> 11.1$  mmol/L(200mg/dL).

### Methods

1. Testosterone Assay- total testosterone level done by chemiluminiscence method.
2. HbA<sub>1c</sub> done by ion exchange chromatography.

### Methods of Data Collection

The data were collected on a specially designed proforma describing baseline demography and participants underwent detailed physical and laboratory testing. Written and informed consent was taken from the patients. Participants were asked to provide information about their age, occupation, medical history, smoking status, alcohol consumption habits, and participation in regular physical exercise.

### Statistical Analysis

All data were analyzed on SPSS 17.0 version of statistical software. Pearson's coefficient level of significance i.e., p value  $< 0.05$  kept as significant whereas  $< 0.001$  kept highly significant.

### Results

According to duration of diabetes, out of total 150 cases, 49, 98 and 3 cases had their serum total testosterone (ng/dl) level  $< 241$ , 241-400 and  $> 400$  respectively. In serum

total testosterone group <241, 22, 14, 8 and 5 patients had their duration of diabetes  $\leq 5$ , 6-10, 11-15 and >15 years respectively, in serum total testosterone group 241-400, 62, 32 and 4 patients had their duration of diabetes  $\leq 5$ , 6-10 and

11-15 years respectively while in serum total testosterone group >400 only 3 cases were found and they belonged to duration of diabetes group  $\leq 5$  years (Table 1).

**Table 1: Distribution of cases according to duration of diabetes (years) in relation to serum total testosterone (ng/dl) (n=150)**

Duration of Diabetes (years)	Serum Total Testosterone (ng/dl)					
	<241 (Low)		241-400 (Low Normal)		>400 Normal	
	No.	%	No.	%	No.	%
$\leq 5$	22	44.9	62	63.3	3	100
6-10	14	28.6	32	32.7	0	-
11-15	8	16.3	4	4.1	0	-
>15	5	10.2	0	-	0	-
Total	49		98		3	
Mean	7.57		5.02		4.00	
SD	4.97		2.87		0.00	
F	8.353					
P	<0.001					

Mean duration of diabetes in serum total testosterone group <241 was  $7.57 \pm 4.97$ , in 241-400 group it was  $5.02 \pm 2.87$  years and in >400 group it was  $4.00 \pm 0.00$  years

and this difference was found statistically highly significant ( $p < 0.001$ ) (Table 2).

**Table 2: Statistical analysis of serum total testosterone (ng/dl) in relation to duration of diabetes**

Duration of Diabetes	Serum Total Testosterone (ng/dl)		F	p
	Mean	SD		
$\leq 5$ (n=84)	298.44	68.13	5.614	0.001
6-10 (n=49)	268.90	62.06		
11-15 (n=12)	243.00	56.15		
>15 (n=5)	218.00	10.95		
Total	281.67	67.31		

Mean serum total testosterone (ng/dl) in duration of diabetes group  $\leq 5$  years was  $298.44 \pm 68.13$  while in duration of diabetes group 6-10 years it was  $268.90 \pm 62.06$ , in duration of diabetes group 11-15 years, it was  $243.00 \pm 56.15$

and in duration of diabetes group >15 years it was  $218.00 \pm 10.95$  and this difference was found statistically highly significant ( $p = 0.001$ ).

**Table 3: Distribution of cases according to glycated haemoglobin in relation to serum total testosterone**

HbA <sub>1c</sub> (%)	Serum Total Testosterone (ng/dl)					
	<241 (Low)		241-400 (Low Normal)		>400 Normal	
	No.	%	No.	%	No.	%
$\leq 7$	0	-	6	6.1	51	96.2
7.1-9.0	20	40.8	47	48.0	2	3.8
>9.0	29	59.2	45	45.9	0	-
Total	49		98		53	
Mean	9.07		8.85		4.99	
SD	1.11		1.23		0.91	
F	238.687					
P	<0.001					

Table 3 shows distribution of cases according to glycated haemoglobin in relation to serum total testosterone. Out of total 49 cases who had their serum total testosterone

(ng/dl) group <241, 20 and 29 cases had their HbA<sub>1c</sub> level 7.1-9.0 and >9.0% respectively in serum total testosterone group 241-400, 6, 47 and 45 cases had their HbA<sub>1c</sub> level

$\leq 7$ , 7.1-9.0 and  $>9.0\%$  respectively while out of total 53 cases who had their serum total testosterone group  $>400$ , 51 and 2 cases had their HbA<sub>1c</sub> group  $\leq 7$  and 7.1-9.0% respectively.

Mean HbA<sub>1c</sub> in group  $<241$  was  $9.07 \pm 1.11\%$ , in 241-400 group it was  $8.85 \pm 1.23\%$  and in  $>400$  group it was  $4.99 \pm 0.91\%$  and this difference was found statistically highly significant ( $p < 0.001$ ).

**Table 4: Statistical analysis of serum total testosterone (ng/dl) in relation to HbA<sub>1c</sub>**

HbA <sub>1c</sub>	Serum Total Testosterone (ng/dl)		F	P
	Mean	SD		
$\leq 7$ (n=57)	526.37	141.58	139.540	$<0.001$
7.1-9.0 (n=69)	292.46	71.68		
$>9$ (n=74)	267.92	63.32		
Total (n=200)	350.04	146.39		

Mean serum total testosterone (ng/dl) in HbA<sub>1c</sub> group  $\leq 7\%$  was  $526.37 \pm 141.58$  while in HbA<sub>1c</sub> group 7.1-9.0% it was  $292.46 \pm 71.68$ , in HbA<sub>1c</sub> group  $>9\%$  it was  $267.92 \pm 63.22$ . On applying ANOVA test, the difference was found statistically highly significant ( $p < 0.001$ ) (Table 4).

## Discussion

In present series, in serum testosterone group  $<241$ , 44.9%, 28.6%, 16.3% and 10.2% patients had their duration of diabetes  $\leq 5$ , 6-10, 11-15 and  $>15$  years respectively, in serum testosterone group 241-400, 63.3%, 32.7% and 4.1% patients had their duration of diabetes  $\leq 5$ , 6-10 and 11-15 years respectively while in serum testosterone group  $>400$  only 3 cases were found and they belonged to duration of diabetes group  $\leq 5$  years.

In our study, Mean serum testosterone in duration of diabetes group  $\leq 5$  years was  $298.44 \pm 68.13$  ng/dl while in duration of diabetes group 6-10 years it was  $268.90 \pm 62.06$ , in duration of diabetes group 11-15 years, it was  $243.00 \pm 56.15$  ng/dl and in duration of diabetes group  $>15$  years it was  $218.00 \pm 10.95$  ng/dl and this difference was found statistically highly significant ( $p = 0.001$ ). Al-Hayek et al<sup>7</sup> also observed similar results.

In present study, out of total 49 cases who had their serum testosterone group  $<241$ , 40.8% and 59.2% cases had their HbA<sub>1c</sub> level 7.1-9.0 and  $>9.0\%$  respectively in serum testosterone group 241-400, 6.1%, 48% and 45.9% cases had their HbA<sub>1c</sub> level  $\leq 7$ , 7.1-9.0 and  $>9.0\%$  respectively while out of total 53 cases who had their serum testosterone group  $>400$ , 96.2% and 3.8% cases had their HbA<sub>1c</sub> group  $\leq 7$  and 7.1-9.0% respectively.

Mean serum testosterone in HbA<sub>1c</sub> group  $\leq 7\%$  was  $526.37 \pm 141.58$  ng/dl while in HbA<sub>1c</sub> group 7.1-9.0% it was  $292.46 \pm 71.68$  ng/dl, in HbA<sub>1c</sub> group  $>9\%$  it was  $267.92 \pm 63.32$  ng/dl. On applying ANOVA test, the difference was found statistically highly significant ( $p < 0.001$ ). Similar results observed by Kim et al<sup>8</sup> where they found that glycated hemoglobin were significantly higher in the testosterone deficiency group than in the normal group ( $p = 0.038$ ). Corrales et al<sup>9</sup> observed that total testosterone was positively correlated with glycosylated haemoglobin (HbA<sub>1c</sub>) levels ( $r = 0.322$ ,  $P = .01$ ). Kapoor et al<sup>10</sup> and Al-Hayek et al<sup>11</sup> also showed similar results.

Testosterone stimulates erythropoiesis and thus glycated hemoglobin (A1C) values may be relatively low in male diabetic patients. Another reason in study of Rabijewski et al<sup>12</sup> find that high incidence of hypogonadotropic hypogonadism in type 2 diabetic men in Polish population is associated with poor glycemic control and can be secondary to an increase in estradiol concentrations.

## Conclusion

We concluded that duration of diabetes and HbA<sub>1c</sub> level significant correlation with serum total testosterone level.

**Conflict of Interest:** None.

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