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Association Between Serum Testosterone Levels and Metabolic Syndrome in Middle Aged Indian Men

KEYWORDS: serum testosterone, metabolic syndrome, obesity

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ABSTRACT *Background: Recent western studies suggest an association between serum testosterone and metabolic syndrome.*

Objective: To evaluate association between sex hormone levels and metabolic syndrome in adult Indian males.

Study design and setting: A cross-sectional cohort study conducted in a single center tertiary care hospital.

Subjects: Study included 31 adult males detected to have metabolic syndrome defined by standard criteria and 50 controls without metabolic syndrome.

Main outcomes: Serum levels of total, free and bound testosterone, and sex hormone binding globulin.

Results: The mean age of the study subjects and controls were 53 ± 6 and 53 ± 7 years, respectively. Men with metabolic syndrome had significantly lower levels of serum total testosterone, bound testosterone, free testosterone (8.7±3.1 versus 7.1±3.2,p=0.03) and sex binding globulin (38.2±12.3 versus 33.0±7.4,p=0.04).

Conclusions:

Low serum testosterone and sex binding globulin levels are associated with metabolic syndrome in middle aged Indian men.

Introduction

Metabolic syndrome is a cluster of potential risk factors for atherosclerotic cardiovascular disease that include insulin resistance, hypertension, dyslipidemia and visceral obesity. [1] Metabolic syndrome affects nearly 1/3 [rd] of the Indian population. [2] Several western studies have recently shown an association between serum testosterone and metabolic syndrome or its components. [3–6] However, a recent study suggested that sex hormone binding globulin levels, but not serum T levels, were independently associated with metabolic syndrome. [7] This study was done with an aim to evaluate the association of serum testosterone levels with metabolic syndrome in middle aged adult Indian men.

Materials and methods

This was a prospective cross sectional observational that included 31 adult men above the age of 40 years diagnosed to have metabolic syndrome, and 50 age matched controls (also men) without metabolic syndrome. The study was conducted between October 2013 and January 2015 in the Cardiology department of Christian medical College, Vellore. The exclusion criteria were history of hypogonadism, patients on anti androgens, liver/renal dysfunction, recent or current infection and refusal to provide informed consent. Written informed consent was obtained from all patients before sample collection and the study was approved by the local Ethics committee.

All patients underwent detailed clinical assessments and details regarding age, gender, smoking habits, hypertension, diabetes mellitus, dyslipidemia and presence of coronary artery disease were documented in a data table. Weight and height were recorded and body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared. Metabolic syndrome was diagnosed based on the recent statement from the American Heart Association (AHA) and the National Heart, Lung, and Blood Institute (NHLBI), which was a modification of the National Cholesterol Education Program (NCEP) Adult Treatment Panel III (ATP III) criteria. [8] Briefly, diagnosis of metabolic syndrome required the presence of 3 of the following parameters. 1. Elevated waist circumference ≥102 cm (40 inches) in men and ≥ 88 cm (35 inches) in women or BMI ≥30kg/m^2.

2. Elevated triglycerides ≥150 mg/dL or on drug treatment for elevated triglycerides.

3. Reduced HDL-C ≤40 mg/dL in men and 50 mg/dL in women or on drug treatment for reduced

HDL-C.

4. Elevated blood pressure ≥130 mm Hg systolic blood pressure or ≥85 mm Hg diastolic blood pressure or on antihypertensive drug treatment in a patient with a history of hypertension.

5. Elevated fasting glucose ≥100 mg/dL or on drug treatment for elevated glucose.

Blood samples were drawn after eight hours overnight fasting. The fasting blood glucose and lipid levels were derived by enzymatic methods on an automated analyser. Serum fasting testosterone was measured by automated chemiluminescence (CLIA) method, using Siemens Immulite 2000 Xp machine (Normal levels for men aged 20-49 years: 270-1030ng/dl;>50 years: 212-755ng/dl). Serum sex hormone binding globulin (SHBG) was measured by automated Electro Chemiluminescence (ECLIA) method, using Roche E170 Modular machine. Free and Bio available tes-

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tosterone were calculated from serum total testosterone and SHBG using an online calculator.

Statistical analysis

All continuous variables were expressed as mean ± standard deviation. Comparison between continuous variables were done using independent samples T test. Categorical variables were compared using chi square test. A 'p' value less than 0.05 was considered statistically significant for all tests. Data analysis was performed using IBM SPSS software version 18 (IBM SPSS Inc., Illinois, Chicago, USA).

Results

The mean age of the study subjects and controls were 53 ± 6 and 53 ± 7 years, respectively (table 1). Among the 31 patients diagnosed to have metabolic syndrome, 21 (67.7%) had hypertension, 24 (77.4%) had diabetes as well as presence of angiographically relevant coronary artery disease. Subjects with metabolic syndrome had statistically significant higher levels of BMI, blood sugars and serum triglycerides. They also had lower levels of HDL as compared to controls.

Place table 1 here

Serum levels of total testosterone was lower in the metabolic syndrome subjects (454.4 ± 169.7ng/dl for controls vs 344.7 ± 131.2, p=0.003) (table 2 and figure 1). **Place table 2 and figure 1 here**

Similarly, bound and free testosterones and sex hromone binding globulins were significantly lower in metabolic syndrome subjects as compared to controls (table 2).

Discussion and conclusions

The current study examined relationship between serum testosterone levels and metabolic syndrome in adult Indian men. Findings of the study suggested an association between low serum testosterone levels and metabolic syndrome. A large proportion of the study patients also had angiographically proven coronary artery disease, highlighting the importance of metabolic syndrome. Findings of this study have therapeutic implications. A randomized controlled trial of testosterone replacement in hypogonadal males and its effects on components of metabolic syndrome may identify role of testosterone as a modifiable risk factor. Although our study is limited by small sample size and recruitment bias, it provides some insights into relationship between serum testosterone and metabolic syndrome. Nevertheless, large scale population studies are needed to confirm the findings of our study.

Table 1. Baseline clinical characteristics

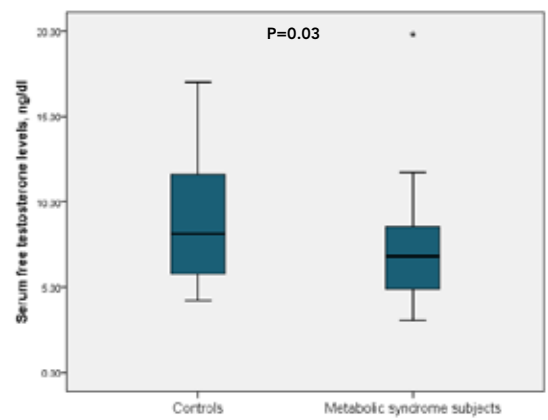
	Controls N=50	Metabolic syndrome subjects N=31	P values
Age, years	53 ± 7	53 ± 6	0.77
Body mass index, kg/m^2	25 ± 3	27 ± 4	0.03
Serum creatinine, mg/dl	1.0 ± 0.2	1.0 ± 0.2	0.24
Fasting lipid profile, mg/dl			
Total cholesterol	145 ± 31	157 ± 36	0.10
Triglycerides	129 ± 51	208 ± 105	<0.001
HDL	39 ± 9	34 ± 4	0.001
LDL	88 ± 25	94 ± 30	0.38
Fasting blood glucose, mg/dl	115 ± 36	144 ± 53	0.008
Post prandial blood glucose, mg/dl	156 ± 75	205 ± 79	0.008

Values are expressed as mean ± SD, median (interquartile range). HDL stands for high density lipoprotein. LDL stands for low density lipoprotein.

Table 2. Serum sex hormone levels

	Controls N=50	Metabolic syndrome subjects N=31	P values
Total testosterone, ng/dl	454.4 ± 169.7	344.7 ± 131.2	0.003
Sex hormone binding globulin, nmol/l	38.2 ± 12.3	33.0 ± 7.4	0.04
Bound testosterone, ng/dl	204.8 ± 71.9	166.5 ± 71.3	0.02
Free testosterone, ng/dl	8.7 ± 3.1	7.1 ± 3.2	0.03

Figure 1. Box plot showing serum free testosterone levels in metabolic syndrome subjects and controls



References

1. Grundy SM, Cleeman JI, Daniels SR, et al. Diagnosis and management of the metabolic syndrome. An American Heart Association/National Heart, Lung, and Blood Institute Scientific Statement. Executive summary. *Cardiology in review*. 2005;13(6):322–7.
2. Das M, Pal S, Ghosh A. Prevalence of the metabolic syndrome in people of Asian Indian origin: outcomes by definitions. *Cardiovasc J Afr*. 2011;22(6):303–5. doi:10.5830/CVJA-2010-070.
3. Brand JS, Tweel I van der, Grobbee DE, Emmelot-Vonk MH, Schouw YT van der. Testosterone, sex hormone-binding globulin and the metabolic syndrome: a systematic review and meta-analysis of observational studies. *Int J Epidemiol*. 2011;40(1):189–207. doi:10.1093/ije/dyq158.
4. Kupelian V, Page ST, Araujo AB, Travison TG, Bremner WJ, McKinlay JB. Low sex hormone-binding globulin, total testosterone, and symptomatic androgen deficiency are associated with development of the metabolic syndrome in nonobese men. *J Clin Endocrinol Metab*. 2006;91(3):843–50. doi:10.1210/jc.2005-1326.
5. Antonio L, Wu FC, O'Neill TW, et al. Associations between sex steroids and the development of metabolic syndrome: a longitudinal study in European men. *J Clin Endocrinol Metab*. 2015;100(4):1396–404. doi:10.1210/jc.2014-4184.
6. Canoy D, Barber TM, Pouta A, et al. Serum sex hormone-binding globulin and testosterone in relation to cardiovascular disease risk factors in young men: a population-based study. *Eur J Endocrinol*. 2014;170(6):863–72. doi:10.1530/EJE-13-1046.
7. Bhasin S1, Jasjua GK, Pencina M, et al. Sex hormone-binding globulin, but not testosterone, is associated prospectively and independently with incident metabolic syndrome. *Diabetes Care*. 2011;34(11):2464-70. doi: 10.2337/dc11-0888. Epub 2011 Sep 16.
8. Third Report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III) final report. *Circulation*. 2002;106(25):3143–421.