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LOW TOTAL TESTOSTERONE-COMPONENT OF METABOLIC SYNDROME

Prashant Goel [1,✉], ***Amorin R. Popa*** [2]

[1] University of Oradea, Romania
[2] Department of Diabetes and Internal Medicine, County Hospital Oradea, Romania

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Abstract

Background and aims: *To assess the levels of total testosterone in the metabolic syndrome patients.* ***Material and Methods:*** *We included ninety-six patients in our study, forty-nine with metabolic syndrome according to the definition of International Diabetes Federation (IDF) and forty-seven as control. Anthropometric measurements were registered and blood samples were taken after an overnight fast.* ***Results:*** *The mean values of different parameters showed significant differences between both groups. The total testosterone mean value was (338,97±91,2 ng/ml) substantially lower as compared to patients with metabolic syndrome to control group.* ***Conclusion:*** *There is an inverse relationship between total testosterone and metabolic syndrome. Low total testosterone can be a predictor of rising incidence of metabolic syndrome.*

key words: *Metabolic syndrome, testosterone, diabetes mellitus, insulin*

Background and aims

Metabolic syndrome is a stack of metabolic disorders leading to type 2 Diabetes Mellitus and cardiovascular diseases. The term metabolic syndrome was first used by Haller in 1977 [1] describing association between obesity, diabetes mellitus, hyperlipoproteinemia, hyperuricemia and hepatic steatosis as a risk factor for atherosclerosis. Later, in 1988, Reaven described metabolic syndrome as "a cluster of risk factors for diabetes and cardiovascular diseases" and introduced insulin resistance as its most important feature [2].

The risk factors for metabolic syndrome include: environment and life style genetic, metabolic defects and nutrient deficiency. Different groups and associations have been trying to establish the criteria for the diagnosis of metabolic syndrome, but the most accepted definition is to have present three out of the following five conditions: insulin resistance, increased waist circumference or central obesity (depending on population and country); raised triglycerides or decreased HDL-C levels; high blood pressure and impaired fasting glycaemic level.

Testosterone is one of the important male sex hormone and anabolic steroid which regulates fertility, muscle mass and fat distribution. Testosterone levels normally diminish as age advances by 1.2% per year [3]. The low testosterone levels in men are becoming more frequent, leading to muscle loss, decreased

✉ Str. Roman Ciorogariu nr.62, Oradea Zip code 410009, Bihor, Romania. Phone: 0040727794800.
corresponding author e-mail: drpg22@gmail.com

strength, fat deposition along with weight gain and development of insulin resistance. Low testosterone levels are also associated with cardiovascular diseases [4] and cancer [5]. Total testosterone levels in obese men are low due to increased body weight, especially men with central obesity [6]. According to Laaksonen et al. androgens regulate adipose tissue and insulin sensitivity and vice versa [7].

The main objective of this study is to assess the relationship between metabolic syndrome and testosterone.

Material and methods

The study was conducted on 96 men in total. Every participant was examined clinically and anthropometrics values were taken, BMI was calculated by using the formula (kg)/ height^2 (m^2). Participants were included after IDF definition of metabolic syndrome, presence of three out of five conditions: increased waist circumference or central obesity; raised triglycerides (>150mg/dl) or HDL-C levels (<50mg/dl); high blood pressure and impaired fasting glycaemic level and insulin resistance. Insulin resistance index was obtained by the homeostasis assessment model for insulin resistance (HOMA-IR), calculated by glucose and insulin levels. HOMA-IR was calculated by using the formula: HOMA-IR = [glucose (nmol/L) * insulin (µU/mL)/22.5], using fasting values. Blood samples were collected to analyse metabolic profile and total testosterone, after overnight fast between 07.00 – 08.00 am. References ranges are 245-1600ng/dl for total testosterone and 2.60-28.60 uIU/ml for insulin. The values are expressed as mean ± standard error of the mean (M ± SEM).

Results

We included ninety-six patients in our study and divided them in two groups: metabolic syndrome (49 patients) and non-metabolic syndrome (47 patients). The mean values for different parameters are the following:

Table 1. Baseline characteristics.

Parameters	Metabolic syndrome	Non-Metabolic syndrome
Age (years)	47,88±8,16	46,72±9,37
Waist circumference (WC-cm)	114,08±9,97	106,87±7,19
Body Mass Index (Kg/m^2)	33,26±5,03	30,57±4,53
Glycaemia (mg/dl)	141,26±40,43	96,94±9,79
Cholesterol (mg/dl)	226,99±48,15	171,34±25,73
Triglycerides (mg/dl)	230,37±88,20	126,47±41,65
Testosterone (ng/dl)	338,97±91,22	405,75±113,93
Insulin (uUI/ml)	18,50±8,36	17,24±7,16
HOMA	6,10±2,76	4,08±1,67

In patients with metabolic syndrome, the mean value of triglycerides was significantly lower than in patients without MS (230.37 vs 126.47, p<0.001).

In patients with metabolic syndrome, the mean value of testosterone was significantly lower than in patients without MS (338.97 vs 405.75, p=0.012).

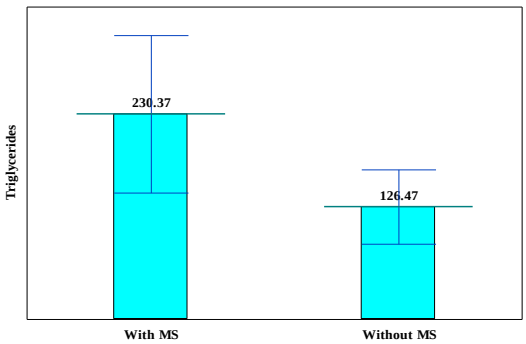

Fig. 1. *Triglycerides and Metabolic Syndrome.*

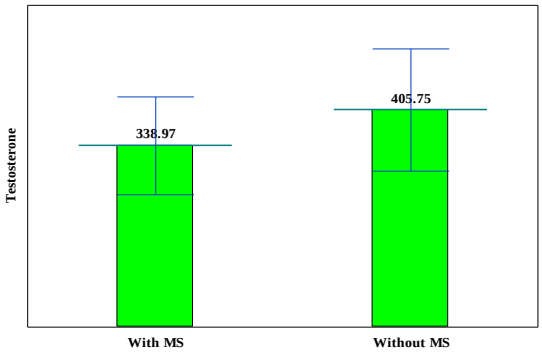

Fig. 2. *Testosterone level and Metabolic Syndrome.*

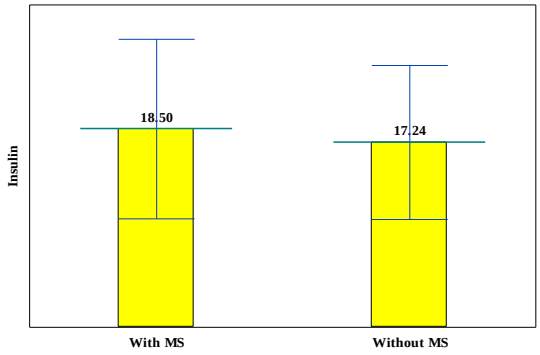

Fig. 3. *Insulin level and Metabolic Syndrome.*

In patients with metabolic syndrome, the mean value of HOMA was significantly lower than in patients without MS (6.10 vs 4.08, $p<0.001$).

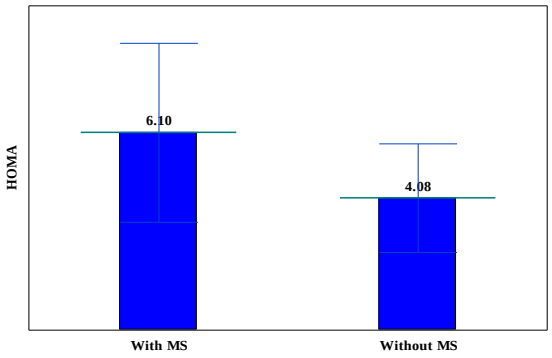

Fig. 4. *HOMA and Metabolic Syndrome.*

Discussion

Metabolic syndrome is one of the uprising leading public health concerns worldwide. The prevalence of metabolic syndrome is increasing globally, ranging from <10% up to 84% [8] and varies according to age, sex, ethnicity and environment of the population. On the other hand, low socio-economic status has been found to be associated with higher risk of MS [9]. MS is on rise in developing countries and patients having MS are two-times more risk of developing CVD and five-fold increased risk of diabetes mellitus [10].

The global prevalence of testosterone deficiency varies between 10-40%. The excess adipose tissue contributes to hypogonadism by increasing aromatase enzyme activity, transforming testosterone to oestrogen. Recently, a study conducted by Western Michigan Urological Associates showed that one out of four men, above 30 years, has low testosterone levels and one in twenty men presents symptoms of low testosterone. Numerous studies in Europe have reported decline in sperm count in the last 50 years and indirectly indicating the low levels of testosterone.

The relationship between metabolic syndrome and low testosterone is multifactorial. Low levels of testosterone might be the earliest marker in insulin and glucose metabolism disorders, leading to metabolic syndrome and frank diabetes mellitus [11]. Therefore, lower testosterone levels predict the occurrence of metabolic syndrome.

Our study has demonstrated the significant difference in the mean values of different parameters between the two groups. The results showed inverse relation between the increase of the insulin resistance in obese men and their testosterone levels. This is due to excess of adipose tissue, leading increased aromatase enzyme activity and to the transformation of testosterone to oestrogen. Kupelian et al. has also reported that the total testosterone is significantly related to metabolic syndrome [12]. Another significant difference was observed in the study was in triglycerides values in both

groups. Due to the obesity, persisting in both groups, insulin levels were not so compelling but the difference was observed in HOMA-IR.

It has been concluded that restoring value of serum total testosterone to its physiological concentration by testosterone treatment in abdominally obese men improves insulin sensitivity [13] and gives beneficial effects on well-being and decreases the risk for cardiovascular disease and diabetes. Lifestyle changes, combined with specific dietary recommendations and exercises, remain the initial choice as treatment.

Conclusion

According to our study, there is an inverse correlation between metabolic syndrome and testosterone level. Low testosterone is present in patients with metabolic syndrome, therefore, along with obesity and insulin resistance, testosterone should be considered as one of the components of metabolic syndrome.

Conflict of interest. Author has declared no conflict of interest.

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