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Original Research Article

Anthropometric Indices, Inflammatory & Oxidative Stress Markers in Metabolic Syndrome

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Abstract

The present study was undertaken to investigate the variations of anthropometric indices, inflammatory oxidative stress and anti-oxidant markers in subjects with metabolic syndrome (MetS) compared to their age & sex-matched controls, and to evaluate the correlations, if any of the anthropometric indices with the pro-oxidant state in subjects with MetS. One hundred and fifty-three subjects with MetS and one hundred and fifty-five controls were recruited for the study according to the NCEP ATP III (National cholesterol education program – Adult treatment panel III) criteria for MetS. Anthropometric characteristics of all subjects were recorded using clinical Proforma. Blood samples were collected after taking informed written consent from subjects. Plasma glucose, lipid profile analysis, malondialdehyde (MDA), total antioxidant capacity and C reactive protein (CRP) was estimated in all blood samples. This study clearly indicates that obesity measured by anthropometric measurements including BMI and WC were increased in MetS patients as compared to controls. Inflammatory marker CRP was found to be significantly high in patients with metabolic syndrome. The oxidative stress as assessed by serum MDA was significantly higher, whereas total antioxidant capacity (TAOC) was lower in MetS patients than that of age & sex matched controls.

Keywords: Metabolic syndrome, anthropometric indices, inflammatory markers, oxidative stress, total antioxidant capacity, malondialdehyde (MDA), C reactive protein.

INTRODUCTION

Metabolic Syndrome (MetS) is complex webs of metabolic factors that are associated with a 2-fold risk of cardiovascular disease (CVD) and a 5-fold risk of diabetes [1]. Individuals with MetS have a 30%–40% probability of developing Diabetes Mellitus and/or CVD within 20 years, depending on the number of components present. Early diagnosis is important in order to employ effectively lifestyle and risk factor modification [2].

MetS is a widely prevalent and multi-factorial disorder that presents in a distinct, albeit heterogeneous phenotype. The Third Report of the US National Cholesterol Education Program Adult Treatment Panel III (US NCEP ATP-III) has recommended appropriate measures to identify individuals with the MetS [3]. In 2005, the International Diabetes Federation (IDF) provided new modified criteria for the diagnosis of MetS, based on the following five features: waist circumference (WC), blood pressure (BP), fasting blood glucose (FBG) and serum triglyceride (TG) and high density lipoprotein cholesterol (HDL) levels [4].

MetS has become increasingly relevant in recent times due to the exponential increase in obesity worldwide. Useful anthropometric markers in MetS are body mass index (BMI) and waist circumference (WC). Obesity is closely associated with the components of MetS including hyperglycemia, dyslipidemia and hypertension [5]. Though (BMI) is the most common measure of obesity, it does not reflect body shape. WC is a more accurate measure of the distribution of body fat. The prognostic importance of high WC has been recognized within the diagnostic criteria to identify individuals with features of the MetS [6]. One of the defining features of MetS is atherogenic dyslipidemia, manifested by lipoprotein disturbances like elevated TG, diminished HDL and increased low-density lipoprotein cholesterol (LDL) levels. All of these abnormalities have been implicated as being independently atherogenic [7].

The pathogenesis of MetS involves both genetic and acquired factors that play a role in the final pathway of inflammation that leads to CVD. Inflammation plays an important role in the pathogenesis of CVD and various inflammatory

markers have been shown to be elevated in patients with MetS [8]. High sensitivity C reactive protein (hsCRP) is an acute phase reactant protein that the liver makes, when there is inflammation in the body and a sensitive marker of systemic inflammation, and has been found to be raised in the conditions like diabetes mellitus, cardiovascular disease, peripheral vascular disorders etc [9].

The clustering of metabolic abnormality is closely related to oxidative stress and inflammation, as well as the progression of atherosclerosis. Oxidative stress (OS) results due to disturbed equilibrium between pro-oxidants and anti-oxidants and plays a role in pathophysiology of T2DM and CVD. Some factors of MetS, such as hyperglycemia and a pro-inflammatory state may lead to increased production of reactive oxygen species (ROS) [10]. Malondialdehyde (MDA) is a lipid peroxidation by product that is used as markers in lipid per oxidation assay [11]. Antioxidants are reducing agents which inhibit the oxidation of other molecules and can be used not only to prevent but also to treat health complications of MS and atherosclerosis [12]. Antioxidants delay or inhibit cellular damage mainly through their free radical scavenging properties.

The present study was undertaken to investigate the variations of anthropometric indices, inflammatory oxidative stress and anti-oxidant markers in subjects with MetS compared to their age & sex-matched controls, and to evaluate the correlations, if any of the anthropometric indices with the pro-oxidant state in subjects with MetS.

Experimental Section

This study was conducted at Department of Biochemistry, SGT Medical College, Gurugram for a period of 9 months. A total of 308 samples were collected from subjects visiting the outpatient department (OPD) for normal health check up. All the subjects were classified according to the NCEP ATP III (National cholesterol education program – Adult treatment panel III) criteria for MetS. One hundred and fifty-three cases and one hundred and fifty-five controls were recruited for the study.

After obtaining Institutional Ethics Committee (IEC) approval, anthropometric characteristics of all subjects were recorded using clinical Proforma. Blood samples were collected after taking informed written consent from subjects. Plasma glucose was analyzed by glucose oxidase/peroxidase (GOD/POD) method, Lipid profile analysis based on enzymatic principle using commercially available kits obtained from ERBA diagnostics (Transasia Bio-Medicals Ltd,Germany). Serum LDL and VLDL levels were calculated.

MDA was analyzed colorimetrically by using Lipid Peroxidation Assay Kit. Total antioxidant capacity was estimated colorimetrically by using Randox Assay Kit. CRP was measured by immunoturbidometric method (Agappe Diagnostics). Comparison of data between the two groups was done by t test.

Results and Discussion

Anthropometric characteristics of the study subjects are given in the Table-1. Both WC and BMI were significantly high ($p < 0.01$) in subjects with metabolic syndrome than age and sex matched control group.

Table-1: Anthropometric characteristics of the study subjects

Parameters	Category		t test	p value
	Control(n=153)	Test (n=155)		
Height (cm)	166.01 ± 5.41	169.19 ± 5.85	-4.95	<0.01**
Weight (Kg)	68.3 ± 8.25	80.55 ± 8.49	-12.84	<0.01**
WC (cm)	83.52 ± 5.77	92.89 ± 5.28	-14.88	<0.01**
BMI (Kg/m2)	24.72 ± 2.03	28.13 ± 2.46	-13.23	<0.01**

Values are mean ± SD.

The comparison of biochemical parameters such as serum levels of glucose, TC, TG, LDL, HDL and VLDL are given in Table-2. The serum levels of glucose, TC, TG, LDL, HDL and VLDL were significantly higher, while HDL levels were not significantly lower in the MetS group.

Table-2: Biochemical parameters

Parameters	Category		t test	p value
	Control(n=153)	Test (n=155)		
FBS (mg/dL)	96.48 ± 27.2	114.74 ± 26.04	-6.02	<0.01**
TC (mg/dL)	178.61 ± 36.53	209.61 ± 39.81	-7.12	<0.01**
HDL (mg/dL)	49.48 ± 9.48	48.25 ± 9.64	1.13	0.262
LDL (mg/dL)	107.88 ± 35.22	122.04 ± 35.06	-3.54	<0.01**
TG (mg/dL)	103.77 ± 35.53	205.77 ± 91.97	-12.81	<0.01**
VLDL (mg/dL)	20.37 ± 7.17	40.85 ± 18.53	-12.75	<0.01**

Values are mean ± SD.

Comparison between the serum levels of marker of oxidative stress, total antioxidant capacity and inflammatory marker CRP are given in the Table-3. Serum MDA and serum CRP were found to be higher whereas TAOC was found to be lower in the MetS group than in the Control group. All these differences were statistically significant ($p< 0.05$).

Table-3: Inflammatory markers oxidative stress and TAOC in study subjects

	Category			
Parameters	Control(n=153)	Test (n=155)	t test	p value
CRP (mg/dL)	1.76 ± 0.55	3.64 ± 0.82	-23.56	<0.01**
MDA (nmol/L)	3 ± 0.75	3.88 ± 0.55	-11.72	<0.01**
TAOC (nmol/L)	1.11 ± 0.39	1.01 ± 0.33	2.4	<0.05*

Values are mean ± SD.

DISCUSSION

MetS is one of the major public health issues of this century which describes a constellation of physical conditions and metabolic abnormalities, commonly occurring together, that increases an individual's risk for development of T2DM and CVD [13].

Abdominal obesity is reported to be associated with metabolic abnormalities and increased risk of CVD [7]. Several authors reported that all cardiometabolic risk factors had a positive correlation with increasing waist, and the overall abdominal adiposity is a strong and independent risk factor for T2DM and MetS [5]. BMI and WC are widely accepted as the anthropometric indices of obesity. In the present study majority of the subjects with MetS had elevated measurements of WC and BMI which is in agreement with the previous studies [5, 6]. Studies unequivocally showed that serum TG, LDL and VLDL are elevated while HDL is decreased in persons with MetS [14]. Obesity, an invariable component of MetS, itself has been reported to reduce HDL levels and obese patients with MetS almost always have low HDL levels [7]. The observation in the present study of elevations in TG, LDL and VLDL in patients with MetS is in agreement with previous reports [14, 15].

Several studies have demonstrated a correlation between high CRP levels and the development of MetS, diabetes, and CVD. According to Esser *et al.*, systemic inflammatory markers are risk factors for the development of type 2 diabetes and its macrovascular complications [16].

Oxidative stress plays critical roles in the pathogenesis of various diseases. Furukawa et al. report that increased oxidative stress in accumulated fat is an important pathogenic mechanism of obesity-associated metabolic syndrome [17]. In the present study MDA levels which are the marker of oxidative stress was found to be high in metabolic syndrome subjects which is in agreement with the previous studies.

CONCLUSIONS

This study clearly indicates that obesity measured by anthropometric measurements including BMI and WC were increased in MetS patients as compared to controls. Inflammatory marker CRP was found to be significantly high in patients with metabolic syndrome. The oxidative stress as assessed by serum MDA was significantly higher, whereas total antioxidant capacity (TAOC) was lower in MetS patients than that of age & sex matched controls.

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