

A Study of Oxidative Stress and Antioxidant Defense in Subjects with Metabolic Syndrome



Medical Science

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ABSTRACT

Aims & Objectives:- To evaluate the role of oxidative stress and antioxidant status in metabolic syndrome.

Materials and methods:- This is a hospital based study carried out by simple random sampling technique in the general population in 18 to 60 years age group irrespective of their gender status. A pretested question was used for recording the information of each subject and their educational status, religion, physical activity, type of diet and substance abuse were enquired. Venous blood samples of each subject were taken and biochemical analysis was done in fully automated analyzer and semi-auto analyzer. Statistical analysis of the data was done using 'Z' test and two-way ANOVA. Results:- In the study, 24.6% of the subjects had Metabolic syndrome. Oxidative stress was highest in subjects with Metabolic Syndrome (MetS) and Antioxidant vitamin status of the subjects with MetS statistically lowered with increase in number of risk factors. Conclusion:- This type of study helps in the identification of risk factors in MetS subjects so that preventive measures can be taken.

Introduction:

The association of diabetes, hypertension and obesity with hyperlipidemia constitutes the metabolic syndrome. MetS was also given the name "Insulin Resistance Syndrome X" in the past. The presence of metabolic syndrome identifies a person at increased risk for atherosclerotic cardiovascular disease and/or type -2 diabetes mellitus^[1].

The cause of the metabolic syndrome continues to challenge the experts but both insulin resistance and central obesity are considered significant factors. Genetics, physical inactivity, ageing, a pro-inflammatory state and hormonal changes may also have a causal effect but the role these may play vary depending on ethnic groups[2]. The present study was conducted to evaluate the role of risk factors and oxidative stress and antioxidant status in metabolic syndrome subjects.

Materials and methods:- The present study was carried out in 264 subjects of 18 to 60 years age group taken randomly from general population irrespective of their gender status. A detailed personal and clinical history of each study subject was recorded by means of a structured and pretested questionnaire. All the subjects included in the study were enquired for any antioxidant vitamin and mineral supplements, smoking habit and drug intake which affect the antioxidant status, dietary habit, physical activity and tobacco or alcohol intake.

The study subjects were categorized depending on the basis of prevailing risk factors of MetS as:-

Subjects with no risk factors of MetS: 40 males and 29 females.

- Subjects with one risk factor of MetS: 42 males and 22 females.
- Subjects with two risk factors of MetS: 48 males and 18 females.
- Subjects with 3 or more risk factors of MetS: 45 males and 20 females.
- Metabolic Syndrome sufferers were identified by having three or more of the following components (according to ATP III guidelines^[3]):-
- Increased waist circumference; Men equal to or greater than 102 centimeters and women equal to or greater than 88 centimeters.
- Elevated triglycerides; Equal to or greater than 150 mg/dl.
- Reduced HDL cholesterol; Men less than 40 mg/dl and women less than 50 mg/dl.
- Raised blood pressure; Equal to or greater than 130/85 mm of Hg.
- Elevated fasting blood glucose; Equal to or greater than 110 mg/dl.

After taking venous blood samples, biochemical analysis were done and comparison of data was done statistically using 'Z' test and two-way ANOVA.

Results:- Out of 264 study subjects, 175 were males and 89 were females. 24.6% subjects (45 males and 20 females) were identified as having MetS, out of which 4.5% subjects had 4 risk factors and 1% subjects had 5 risk factors of MetS. 26.1% subjects were found to be without any risk factors. And due to the presence of risk factors, 73.9% were at health risk to develop CAD and diabetes in future.

Subjects with MetS level had highest oxidative stress measured by serum Malondialdehyde level and it increased with increase in number of risk factors. Subjects with risk factors of MetS had significantly low concentrations of vitamin A, C and E as compared to subjects with no risk factor. The decrease in concentration of antioxidant vitamins in subjects with risk factors of MetS may be due to quenching of free radicals produced as the components of MetS (Obesity, hyperglycemia, hypertension, hypertriglyceridemia) are associated with high oxidative stress^[4].

Discussion:- In the present study, out of 264 subjects, 24.6% had MetS, according to ATP III criteria[3]. Oxidative stress (MDA level) was highest in subjects with MetS and it increased with increase in number of risk factors. 61.5% subjects of MetS had impaired fasting glucose level as oxidative stress is a known pathogenic mechanism in diabetic complications.

High glucose levels have been shown to increase production of free radicals[6]. In the study, 73.8% subjects with MetS had hypertriglyceridemia and 64.6% subjects with MetS had low HDL cholesterol. Fatty acids mediate oxidative damage and metabolic disturbances in β cells of pancreas[7].

In the study, 50.7% subjects (53.3% males and 15.3% females) of MetS had hypertension. Antioxidants improve hypertension in subjects[7] with hypercholesteremia.

73.8% subjects with MetS had visceral obesity. An increased BMI, among overweight individuals seems to be associated with an increased oxidative stress on DNA in young healthy women (Hofer et al, 2006) and also a raised risk of CVD[8].

In the present study, subjects with risk factors of MetS had significantly low concentrations of serum retinol, ascorbic acid and α -Tocopherol levels as compared to subjects with no risk factors. The decrease in concentration of antioxidant vitamins in subjects with risk factors of MetS may be due to quenching of free radicals produced as the components of MetS are associated with high oxidative stress[1, 4].

Conclusion and recommendations:- Consumption of fruits and vegetables and foods rich in natural antioxidants, ascorbic acid, tocopherol and fibre in diet and increased physical activity can ward off MetS as they help in lowering oxidative stress and also calorie intake be reduced which helps in decreasing body weight, obesity, CVD and Type-2 diabetes mellitus in future.

Table No. 1
Sex wise distribution of study subjects

S. No.	Subjects	Males (%)	Females (%)	Total (%)
1	Subjects with no risk factors of MetS*	40 (15.1)	29 (10.9)	69 (26.0)
2	Subjects with one risk factors of MetS	42 (15.9)	22 (8.3)	64 (24.2)
3	Subjects with two risk factors of MetS	48 (18.1)	18 (6.8)	66 (24.9)
4	Subjects with three or more risk factors of MetS	45 (17.0)	20 (7.5)	65 (24.5)
Total		175 (66.3)	89 (33.7)	264 (100)

***MetS-Metabolic Syndrome**

Table No. 2
Comparison of serum oxidative stress (MDA) and antioxidant vitamins in subjects in different groups

S. No.	Parameter	No RF*	1RF	2 RF	With MetS
1	MDA (nmol/gm Hb)	0.05 ± 0.0	0.06 ± 0.00	0.07 ± 0.00	0.08 ± 0.01
2	Retinol (µg/dl)	55.88 ± 18.5	41.02 ± 11.15	29.07 ± 6.65	18.72 ± 6.95
3	Ascorbic acid (mg/dl)	1.22 ± 0.36	0.76 ± 0.11	0.52 ± 0.08	0.43 ± 0.17
4	α-Tocopherol (mg/dl)	1.07 ± 0.22	0.70 ± 0.09	0.49 ± 0.11	0.41 ± 0.14

***RF-Risk Factor**

Table No. 3
ANOVA of oxidative stress and antioxidant vitamins of the four groups

S. N.	Character	DF	SS	MSS	F	P
1	MDA (nmol/gm Hb)	3	0.03	0.01	228.9	**
2	Retinol (µg/dl)	3	51400.0	17133.3	118.26	**
3	Ascorbic acid (mg/dl)	3	25.6	8.5	176.4	**
4	α-Tocopherol (mg/dl)	3	17.5	5.8	246.6	**

**p < 0.01

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