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Research Article

ASSESSMENT OF OXIDATIVE STRESS PARAMETERS IN METABOLIC SYNDROME PATIENTS WITH AND WITHOUT HYPOTHYROIDISM

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ABSTRACT

T4 (Thyroxine) and T3 levels lower than normal, and TSH levels greater than normal level indicates hypothyroidism. In hypothyroidism, reactive oxygen species (ROS) cause an imbalance in an individual's antioxidant/oxidant status, resulting in oxidative stress. Antioxidants play a protective function in the pathophysiology of diabetes and cardiovascular disease in individuals at high risk, such as those with Metabolic Syndrome. It is crucial to know how antioxidant concentrations are affecting these diseases. In this study, oxidative stress parameters were measured in 100 patients with and without hypothyroidism; 50 patients (33 females and 17 males) had metabolic syndrome, while the other 50 patients had metabolic syndrome without hypothyroidism. Plasma concentrations of MDA (7.80±2.36 µmol/L), TAS (14.62±5.05 µmol/L), GPx (29.21±6.60 µmol/L) and Catalase (23.77±8.64IU/L) levels were significantly higher in metabolic syndrome patients with hypothyroidism when compared to without hypothyroidism. Levels of TC (297.28±34.40), HDL (35.4±4.58), LDL (260.48±36.92) were increased and TGL,VLDL level were not significant between the groups.
Malondialdehyde, a lipid peroxidation product, was found to be elevated in metabolic syndrome patients with hypothyroidism, while protein oxidation was absent.

INTRODUCTION

Obesity and heart disease are both associated with an imbalance between pro-oxidants and antioxidants called oxidative stress. As a result, much research has been done to see if antioxidants can help reduce the incidence of various diseases, but the results are still ambiguous [4, 5]. In order to better understand how antioxidants function in people at high risk of diabetes and heart disease, it's critical to examine their physiology. Lack of information on the subject is to be expected. [6, 7, 8] Diabetes and cardiovascular disease are more likely to occur in those with the metabolic syndrome.
MetS includes hypertension, atherogenic dyslipidemia, high blood sugar, prothrombotic, and proinflammatory disorders [9]. Type 2 diabetes and atherosclerotic cardiovascular disease (CVD) have been linked to this group of metabolic abnormalities. India and other South Asian countries have a high rate of metabolic syndrome [11].

When the body's normal metabolism produces too many reactive oxygen species (ROS) or the antioxidant defences aren't effective enough, it puts the body under a lot of stress that can lead to various chronic diseases, including cardiovascular diseases (CVDs). Hyperthyroidism and overt hypothyroidism are well-known thyroid disorders [13, 14].
The thyroid is one of the most frequent endocrine diseases in the globe. According to estimates from a number of studies, thyroid disease affects approximately 42 million people in India. Metabolic syndrome (MetS), hyperglycemia, blood pressure, and cardiovascular dysfunction (CVD) are directly linked to thyroid dysfunction (TD) since thyroid hormones regulate these illnesses [16]. This may be connected to obesity, insulin resistance, metabolic disorders such as high blood pressure, and cardiovascular disease. Obesity, hyperglycemia, hypertension, low HDL-C, and elevated triglycerides are all symptoms of the metabolic syndrome (MetS) (TG). Hypothyroidism is also linked to insulin resistance (IR), which has been found to be a primary mechanism for metabolic syndrome (MetS) [17]. Cardiovascular disease is more likely to occur if both conditions are present at the same time (CVDs). MetS and thyroid function have been linked in numerous studies. [18–21].

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The oxidative parameters of metabolic syndrome epidemiological data were examined in our study. Metabolic syndrome patients with and without hypothyroidism were studied for their clinical profile and risk factors associated with it.

MATERIALS AND METHODS

Study Settings and Participants

Patients with and without hypothyroidism who had a confirmed diagnosis of MetS were included in this investigation.

Group 1: MetS patients without hypothyroidism
Group 2: MetS patients with hypothyroidism

According to the principles of the Helsinki Declaration, Good Clinical Practice (GCP) recommendations of the International Council on Harmonization (ICH), and Indian regulatory norms, the research was carried out (Indian Council of Medical Research and Indian GCP guidelines). Patients with the metabolic syndrome (MetS) who are between the ages of 11 and 80. Patients who had undergone jejunoileal bypass, biliopancreatic diversion, extensive small bowel resection, total parenteral nutrition (TPN), chronic liver disease, hepatocyte carcinoma, patients taking weight loss therapies or steatogenic drugs, and those who were HIV-positive were excluded from the study. Medical records were used to collect data such as the following: demographics, anthropometric measurements, prior use of any obesogenic medicines and physical examination details (including SBP and DBP readings from patients' medical records). The patient's weight and height were also recorded in the case reports. This information was gathered during the screening appointment. Patients who passed the preliminary screening were asked to return after an overnight fast between three and ten days after giving their informed, signed agreement to take part in the study. USG was performed on the first visit to measure the patient's waist circumference. Triiodothyronine and thyroxine (T3), as well as thyroid-stimulating hormone and lipid profile (TG, HDLC, VLDL, low-density lipoprotein cholesterol and TSH) were measured in blood samples to determine thyroid function and lipid profile.

Physical body assessment and biochemical analysis

A height and weight machine was used to determine weight (kg) and height (cm), and an abdominal ultrasound examination was used to determine waist circumference (WC) (USG). Between 8 a.m. and 11 a.m. the following morning, venous blood samples were taken. Plasma was collected and kept at 4 °C for immediate lipid analysis after centrifugation (KDC-1044, Hangzhou, China) at 1000 g, 4 °C for 10 minutes. Storage at –80 °C was made for any residual plasma. The Medica Easy Ra - Fully Automated Biochemistry Analyzer was used to examine plasma lipids.

Assessment of thyroid function

Free thyroxine (FT4), radioimmunoassay (xh6080, Xi'an), and triiodothyronine (FT3) were all measured (FT3). Thyroid function was defined as normal when TSH (0.4–4.5 mU/L), FT4 (19–25.60 pmol/L), and FT3 (3.20–9.20 pmol/L) values were used (euthyroidism).

Evaluation of oxidative stress

Glutathione Peroxidase (GPx) and Catalase (CAT) were measured using the Libra Biochrom - Spectophotometry Analyzer following the manufacturer's instructions, as was total antioxidant status (TAS).

Statistical Methods

We used SPSS for Windows, version 18, to analyse all of the data (SPSS, Inc. Chicago, USA). In order to express the data, the mean and standard deviations were used. It was decided to compare the two means using an independent samples t-test. Multiple linear regressions were used to investigate thyroid stimulating hormone (TSH), thyroid hormones, and oxidative stress indicators. In order to be statistically significant, the p value had to be less than 0.001.

RESULTS

Demographics and Baseline Characteristics

100 patients with MetS participated in this research. Table 1 displays the demographics of these patients at their most basic. There were 50 patients with TD and 50 patients without TD (mean age (SD): 37.0 (16.97) years) among the enrolled participants.

Table 1 Assessment of the physical body of patients with metabolic syndrome and hypothyroidism

Parameters	Age ≤ 45(36)	Age > 45(14)	Total (50)
Age in year			
Mean (SD)	28.38(9.54)	61.22(11.53)	37.0(16.97)
Range	11.0-45.0	46.0-78.0	11.0-78.0
Gender			
Female, N (%)	27(75%)	6(42.85%)	33(66%)
Male, N (%)	9(25%)	8(57.14%)	17(34%)

SD: Standard deviation

Table 2 The evaluation of biochemical parameters in patients with and without hypothyroidism with metabolic syndrome

Parameters	Group I	Group II	p value
Height (cm)	160.7±17.12	157.56±18.02	0.043306*
Weight (kg)	64.96±10.20	66.68±9.91	0.027718*
Waist circumference (cm)	81.84±11.35	83.24±12.35	0.439295
SBP (mm of Hg)	126.04±11.10	126.68±12.26	0.847836
DBP (mm of Hg)	85.80±7.60	85.7±7.91	0.796575
FBS	128.9±37.40	123.3±35.27	0.058267
PPBS	184.68±63.65	177.08±46.64	0.148069
TC	262.94±26.52	297.28±34.40	0.000736***
TGL	234.6±45.06	234.22±46.63	0.432604
HDL	34.76±5.21	35.4±4.58	0.23896
LDL	227.52±27.54	260.48±36.92	0.001529**
VLDL	46.56±8.98	46.38±8.89	0.459886
MDA (µmol/L)	6.94±1.50	7.80±2.36	0.016715
TAS (µmol/L)	0.805±0.33	14.62±5.05	0.00001***
GPx (µmol/L)	11.89±2.18	29.21±6.60	0.00001***
Catalase (IU/L)	7.28±1.96	23.77±8.64	0 .00001***
T3	187.39±9.06	118.52±31.63	0.006887**
T4	11.04±0.77	10.31±13.53	0.056803
TSH	4.90±0.66	9.68±5.02	0.43349

Results are expressed Mean±SD; FBS: Fasting Blood Sugar, PPBS: Postprandial Blood sugar, TC: Total Cholesterol, TGL: Triglycerides, HDL: High Density Lipoprotein, LDL: Low Density Lipoprotein, VLDL: Very Low Density Lipoprotein, MDA: Malondialdehyde, TAS: Total antioxidant status, GPx: Glutathione Peroxidase , CAT: Catalase, SBP :Systolic blood pressure, DBP :Diastolic blood pressure, TSH: thyroid stimulating hormone; T4:thyroxine; T3:triiodothyronine. Significance by t-test*P<0.05 **p<0.01 ***p<0.001

Percentage of Patients

The most common MetS components associated with TD were high waist circumference (20 ;40%);women (>80 cm): (1; 2%;

men (>94 cm): 42%), 38% (19) patients with high systolic blood pressure than normal (14 (73.68%) female, 5 (26.31%) male),48%(24) patients having high diastolic blood pressure than normal 21 (87.5%)female and 3 (12.5%) male , fasting glucose 38(76%)) having more than the normal 12 (31.57%)male 23(60.52%) female, PPBS was observed more than 140 mg/dL in 35(70%) patients 11(31.42%) male 24(68.57%) female, Table 2 shows the details result of percentage of patients enrolled in this study.

Oxidative stress markers and thyroid function

The group with hypothyroidism showed elevated MDA (7.80±2.36µmol/L), TAS (14.62±5.05µmol/L), GPx (29.21±6.60 µmol/L) and catalase (23.77±8.64 IU/L) levels compared to group without hypothyroidism Table 2. The corresponding levels without hypothyroidism were 6.94±1.50 µmol/L, 0.805±0.33 µmol/L, 11.89±2.18 µmol/L and 7.28±1.96 IU/L respectively. T3 correlated with MDA in patients with hypothyroidism ($p<0.05$) but T4 and TSH did not show any correlation. T3, T4, and TSH each had a p-value0.014024, 0.061887, 0.405917.

TAS was found to be associated with T3 ($p<0.05$) but not with T4 or TSH ($p>0.05$). T4 correlated with GPx whereas T3,T4 and TSH, have no relationship ($p>0.05$) with catalase. Oxidative stress markers are more prevalent in patients with MetS and hypothyroidism than in metabolic syndrome patients without hypothyroidism, as shown in Table 3.

TSH and thyroid hormones were not associated with MDA, TAS, GPx, or catalase in patients without hypothyroidism ($p>0.05$). Oxidative stress markers were not linked to thyroid hormone levels in MetSpatients without hypothyroidism patients, as shown in Table 4.

Table 3 Thyroid hormone and oxidative stress markers in metabolic syndrome patients with hypothyroidism

Oxidative parameters	Thyroid hormones P value		
	T3	T4	TSH
MDA	0.014024*	0.061887	0.405917
TAS	0.001811*	0.878242	0.451861
GPx	0.830365	0.046233*	0.342875
Catalase	0.793588	0.087876	0.836629

Table 4 Thyroid hormone and markers of oxidative stress in patients with metabolic syndrome but without hypothyroidism

Oxidative parameters	Thyroid hormones P value		
	T3	T4	TSH
MDA	0.673893	0.686944	0.718618
TAS	0.209369	0.065592	0.057051
GPx	0.595914	0.562515	0.75891
Catalase	0.818485	0.347512	0.763634

DISCUSSION

Many chronic diseases, particularly cardiovascular disorders, are influenced by oxidative stress. Patients with hypothyroidism may have an increased risk of death from any cause and cardiovascular disease if they have oxidative stress. One of the many MetS indicators affected by thyroid hormone levels is HDL-C (a type of good cholesterol), followed by TG (a type of bad cholesterol), then hypertension (a type of blood pressure), and finally plasma glucose (a type of blood sugar). Obesity, cholesterol, and an increased risk of atherogenic CVD have all been linked to hypothyroidism [23]. When glucose intolerance is evident in hypothyroid patients, IR is indicated as a probable underlying pathophysiological explanation [24]. Metabolic syndrome (MetS) has been linked to oxidative stress, chronic inflammation, and angiogenesis. Reactive oxygen species (ROS) are formed when high blood sugar and inflammation, two of MetS' most important components, are present, leading to increased oxidative stress and an overactive NADPH oxidase [26, 27]. The superoxide anion, which is generated by NADPH oxidase [26], is the most important ROS.

The hypermetabolic condition of hyperthyroidism may increase the generation of free radicals in mitochondria and alter the antioxidant defence system. The antioxidative defense capacity is decreased in hypothyroidism, resulting in related oxidative stress.

High systolic and diastolic blood pressure were discovered in this study among patients with Type 2 diabetes, along with an increased waist circumference and decreased HDL-C. When waist circumferences were above the cutoff, more females had waist circumferences above 80 cm than males had waist circumferences above 90 cm. Although additional research have found a link between TD and MetS components, the evidence is still inconclusive. MetS was found to be strongly linked with increased T4 in a Nigerian study [28]. Present study showed oxidative stress increased in mets with HT.

TSH levels and TC, TG, LDL, and HDL levels were strongly associated in people in India who had subclinical hypothyroidism [29].

The TD pattern in MetS, as well as its relationship to its constituent parts, might change depending on one's location, age, food, and other factors.

CONCLUSION

The study's findings showed that oxidative stress was higher in patients with metabolic syndrome and hypothyroidism, as demonstrated by increased levels of the lipid peroxidation product malondialdehyde, but that protein oxidation was not evident. In order to prevent further difficulties in metabolic syndrome patients with hypothyroidism, measures must be done to reduce oxidative stress, which may be effective in reducing oxidative stress in these patients.

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