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To determine thyroid function test and oxidative stress markers in hypothyroidism patients.

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Abstract:

Background: Thyroid function tests **(**TFT) and oxidative stress markers are crucial diagnostic tools for understanding body processes, assessing thyroid gland performance, and identifying primary thyroid disorders like hypothyroidism. **Aim:** The aim of the present study was to determine thyroid function test and oxidative stress markers in hypothyroidism patients. **Materials & methods:** The Department of Biochemistry conducted the study, which involved 300 participants aged 30-60 years, dividing them into two groups: 150 healthy individuals and 150 hypothyroidism patients. The study aimed to identify clinically diagnosed hypothyroid patients aged 30–60 years who have been on medication within the last five years. The study excluded patients with established conditions, chronic illnesses, pregnancy, recent surgical interventions, and those under 30 or over 60 years old. **Results:** The levels of all thyroid profile measurements (T3, T4, fT3, fT4, and TSH) were significantly different between the control group subjects and the hypothyroid group patients after the comparison. In comparison to hypothyroid group patients, the MDA level was substantially lower in control group subjects. TAC decreases in hypothyroid groups in comparison to the healthy control group. In contrast, our investigation did not identify any substantial disparities in NO levels between hypothyroid and control subjects. **Conclusion:** Thyroid dysfunction, including hypothyroidism, significantly impacts health and oxidative stress markers, affecting hormone metabolism, antioxidant metabolism, and cardiac function. Early detection and management are crucial for reducing cardiac risk.

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Key words: Thyroid stimulating hormone; Thyroxine; Oxidative stress; Superoxide dismutase; Reactive oxygen species; Thyroid dysfunction.

Introduction:

Hypothyroidism, a common endocrine disorder, is defined as an underactive thyroid gland that causes a decrease in thyroid hormone production and a variety of metabolic disturbances. Thyroid hormones are critical for the regulation of metabolic processes, including the equilibrium of oxidative and antioxidative systems [1-4]. Oxidative stress, characterized by an imbalance between the body's capacity to detoxify free radicals through antioxidants and the production of these radicals, increasingly influences the pathophysiology of hypothyroidism [5,6]. Reduced thyroid hormone levels in hypothyroid patients can impair antioxidant enzyme activity, exacerbating oxidative damage to cells and tissues [7,8].

For diagnosing and treating hypothyroidism, thyroid function tests are essential. These tests measure serum thyroid-stimulating hormone (TSH), free thyroxine (FT4), and free triiodothyronine (FT3) [1,2]. However, these tests may not fully capture the full extent of oxidative stress in hypothyroid patients. Therefore, by assessing oxidative stress markers such as malondialdehyde (MDA) and superoxide dismutase (SOD) alongside thyroid function tests, we can gain a more comprehensive understanding of the metabolic disturbances in hypothyroidism [5-13]]. These thyroid function tests and oxidative stress markers in hypothyroid patients, providing a deeper understanding of the relationship between oxidative stress and thyroid dysfunction. This study's findings may have implications for the development of more effective diagnosis and management strategies. Hence, the aim of the present study was to determine thyroid function test and oxidative stress markers in hypothyroidism patients.

Materials & methods:

Ethical approval: The current study commenced after obtaining ethical clearance from the Institutional Ethics Committee. Study Design: Case-Control Study. Sampling: purposeful random sampling. The Department of Biochemistry conducted the current study as a prospective investigation. We divided a total of 300 participants, aged between 30 and 60 years, into two groups: Group 1: 150 healthy individuals. Group 2: 150 patients with hypothyroidism. The criteria

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 11, 2024

for Group 2 patients' inclusion are as follows: The study will involve clinically diagnosed hypothyroid patients of both sexes, aged 30 to 60 years, who have been on medication within the last five years. Exclusion Criteria for Patients in Group 2: Exclusion criteria include individuals with established cardiac disease, chronic renal failure, diabetes mellitus, hepatic disorders, rheumatoid arthritis, gout, chronic illnesses, pregnancy, recent surgical interventions, any other inflammatory conditions, and those aged under 30 or over 60 years. Methodology: We enrolled the subjects after obtaining written consent. Upon obtaining consent, we classified participants based on their thyroid dysfunction at the time of patient enrollment. We recorded the patient's medical history, familial history, and physical examination. We collected six milliliters of venous blood in a simple tube from hypothyroid patients and euthyroid participants to obtain serum. We used serum to assess the subsequent biochemical markers. Assessment of thyroid hormones (T3, T4, Free T3, Free T4, and TSH): Utilizing the chemiluminescence technique. These were acquired from Auto-bio-Laboratories, and the tests were conducted in accordance with the directions outlined in the manuals. Serum NO levels were determined by colorimetric method based on Griess reaction method [14]. Serum Malondialdehyde (MDA) by ELISA kit obtained from Abcam-Laboratories. Estimation of TAC was done by using the FRAP (Ferric Reducing Ability of Plasma) assay [15].

Statistical analysis:

The study used IBM SPSS version 29 for statistical analysis, analyzing demographics, age, biochemical parameters, and relationships between thyroid hormone levels and oxidative stress markers, and comparing patients with varying hypothyroidism severity.

Results:

Table 1: Thyroid function tests of the different study populations at baseline.

	Control group (n=150)	Hypothyroid group (n=150)	T test
T3 (µmol/L)	1.7 ± 0.66	1.3 ± 0.1	< **0.05**
T4 (µmol/L)	85 ± 32.1	66.8 ± 23.4	< **0.05**

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 11, 2024

FT3 (ng/dL)	2.4 ± 0.8	2.93 ± 0.18	< **0.05**
FT4 (ng/dL)	1.2 ± 0.3	1.92 ± 0.58	< **0.05**
TSH (µIU/ml)	2.32 ± 0.60	38.23 ± 18.2	< **0.05**

All values expressed as Mean±SE. Triiodothyronine (T3), Thyroxine (T4), Free-triiodothyronine (fT3), Free-thyroxine (fT4), Thyroid stimulating hormone (TSH).

T3, T4, fT3, fT4, and TSH levels are shown in table 1. All the thyroid profile tests were significant differed when compared between control group subjects and hypothyroid group patients.

Table 2: Oxidative stress parameters of the different study populations at baseline.

Variable	Control group (n=150)	Hypothyroid group (n=150)	T test
TAC (µmol/dL)	9.3 ± 5.4	6.2 ± 6.2	**< 0.05**
MDA (nmol/mL)	3.6 ± 1.1	6.7 ± 2.4[a]	**< 0.05**
NO (µmol/L)	12.9 ± 3.6	13.1 ± 8.3	> 0.05

All values expressed as Mean±SE. Compared with control group (t test $p<0.05$), Compared with hypothyroid group (t-test $P<0.05$). Total antioxidant capacity (TAC), Malondialdehyde (MDA), Nitric Oxide (NO).

MDA, TAC, and NO l evels are shown in table 2. The MDA level was significantly lower in control group subjects when compared with hypothyroid group patients respectively. Decrease of TAC in hypothyroid groups when compared with the healthy control group subjects Whereas our study did not observe significant difference in NO levels when compared between control and hypothyroid individuals.

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 11, 2024

Discussion:

TSH is an indicator of thyroid gland function [1, 2]. Persistent increases can influence the generation of ROS, which may lead to lipid peroxidation and glycation of proteins [4-7]. Various diseases, including hypothyroidism, exhibit membrane damage that results in lipid peroxides [4-7]. High blood MDA levels, which result in ROS attack on membranes, could cause this damage [5-7]. Hypercholesterolemia also induces the autoxidation of proteins and lipid molecules [11, 13]. In the present study, we observed an increase in MDA and TSH levels in the hypothyroidism group compared with healthy controls in the present study. Similarly, previous studies have shown elevated levels of MDA and TSH in both hypothyroid groups. A study [13] observed increased levels of MDA and TSH in patients with hypothyroid individuals. Researchers have also reported similar observations in animal and human models prior to thyroxine formulation supplementation [12]. Further, we observed a positive correlation between TSH and MDA in the hypothyroid group. These results indicate that prolonged exposure to oxygen is more likely to alter lipid membranes due to ROS and high cholesterol levels in the blood.

According to studies [4-7, 11–13], identifying early in the natural history of hypothyroidism can prevent progressive thyroid-cell failure. Effective thyroxine therapy should be based on the pathogenic abnormalities rather than just a simple reduction of TSH.

In the current study, we observed decreased levels of T3 and TAC in patients belonging to the hypothyroid group, which could potentially contribute to the risk relationship between oxidative stress and these conditions, as well as play a significant role in the development of oxidative stress. We observed similar alterations in oxidative stress variables, including TAC, in the individuals under study. The present observation on the status of antioxidants in hypothyroid group individuals is perhaps the first report of its kind, and no plausible explanations can be extended to explain these findings. Undoubtedly, additional research is necessary to elucidate these intriguing findings. s. However, the results of the study on T3 levels in hypo-thyroid patients could be because higher levels of antioxidants like TAC would get rid of ROS, especially hydrogen peroxide. It's also possible that this is because too much SOD and NO will get rid of other radicals to keep tissues in a reduced state, which will cause levels to drop. This could be why their values were not significant in the hypothyroid patients in this study.

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 11, 2024

Limitations:

The study explores the impact of thyroid dysfunction and oxidative stress markers, but has limitations like a cross-sectional design, inability to observe long-term progression, and potential limitations in capturing regional variations in genetics, diet, and lifestyle in India. Future research could address these limitations to improve understanding of thyroid dysfunction's impact on cardiac health and oxidative stress.

Conclusion:

A person's health and oxidative stress markers are substantially influenced by thyroid dysfunction, including hypothyroidism. The thyroid gland regulates hormones and metabolism, which in turn influences the metabolism of antioxidants and cardiac function. Hypothyroidism affects cardiac function by increasing free radicals, while it also reduces heart rate and cardiac output. The early detection and management of thyroid disorders are essential for the reduction of cardiac risk.

Conflict of interest:

There is no conflict of interest among the present study authors.

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ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 11, 2024

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