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Alterations in Biochemical Markers of Kidney Function of Thyroid Disorders at Vidharbha Region, India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Background: The thyroid gland is a major endocrine gland in the body that is located in the front of the neck. Thyroid disorders cause problems on kidney function in a variety of ways. Hyperthyroidism causes an increase in both RBF and GFR. The expression of cardiac beta-adrenergic receptors may be influenced by thyroid hormones. The increased catecholamine sensitivity of beta adrenergic coupled cardiac responses in hyperthyroid patients may be due to the increased number of receptors. ROS may be one of the main causes of kidney failure in thyroid disorders, although this needs to be confirmed in the lab.
Aim: The aim of this research was to look at the effects of thyroid disorders on kidney function and oxidative stress markers, as well as the relationship between them.
Materials and Methods: After visiting Shalinitai Meghe hospital in Nagpur for a health check-up, a

total of 350 people were chosen for the research. This was the place where the five groups were held. Subclinical Hypothyroidism: 70 subjects, Overt Hypothyroidism: 70 subjects, Subclinical Hyperthyroidism: 70 subjects, Overt Hyperthyroidism: 70 subjects. There are 70 patients in each household. Specific biochemical methods were used to quantify biochemical parameters such as T3, T4, TSH, Urea, Creatinine, and Cys C. Assay of Superoxide dismutase by Marklund and Marklund method

ResultS: In our work, we discovered a significant positive correlation between serum creatinine and TSH in hypothyroidism and hyperthyroidism, and a significant negative correlation between serum Cystatin C and TSH in hypothyroidism and hyperthyroidism. TSH was linked to oxidative stress markers as well. When the oxidative stress markers MDA and SOD were statistically analysed, they were found to be highly associated with markers of kidney function.

Conclusion: When the incidence of chronic kidney disease rises, all instances of hypothyroidism and hyperthyroidism should be regularly tested for worsening kidney functions, and since the study indicates that oxidative stress plays a role in nephropathy, current thyroid disorders treatment methods should include oxidative stress, which will aid clinicians in better managing kidney dysfunction.

Keywords: Thyroid gland; endocrine gland; kidney disease; infectious diseases.

1. INTRODUCTION

Thyroid problems are one of the major endocrine problems in the world. India is not the beginning of this. According to statistics from various studies, Thyroid Disease affects about 42 million people in India. In a developing and populous country like India, infectious diseases are a major health problem because of their significant contribution to the national burden of disease [1].

Thyroid disorders were previously classified in India as part of the iodine deficiency disorders family (IDDs). These IDDs were expressed by total goiter rates and urinary iodine concentrations, which are commonly measured in school-aged children [2]. Since India's adoption of a universal salt programmed in 1983 [3] goiter prevalence has decreased in several previously endemic areas of the region [4] India was listed as providing optimal iodine nutrition in a World Health Organization assessment of global iodine status in 2004 [5].

In recent years, several studies have shown that the prevalence of hypothyroidism and hyperthyroidism is extremely high. The prevalence of Subclinical hypothyroidism, Hypothyroidism, Subclinical Hyperthyroidism, and Hyperthyroidism was 8.02 percent, 10.95 percent, 1.27 percent, and 0.67 percent, respectively, in a cross-sectional, multicenter, epidemiological study conducted in 8 major cities in India on 5360 adults [6]. The Thyroid and Kidney have a very close relationship. Thyroid hormones are needed for kidney formation and growth. The kidney, on the other hand, is a target organ for certain iodothyronine activity as well as a metabolism and removal organ for thyroid hormones [7].

Thyroid hormones are also linked to the organism's oxidative and antioxidant status. An increase in the concentration of reactive oxygen species, which are involved in a variety of physiological and pathological situations, is characterised by oxidative stress [8]. In oxidative stress, free radicals such as nitric oxide (NO), hydroxyl radical (OH), superoxide anion (O_2), and hydrogen peroxide (H_2O_2) are published. Lipid peroxidation and cellular dysfunction are caused by an excess of NO, the formation of peroxinitrites, and/or the presence of defective antioxidants. The oxidation of lipids would be aided by the rise in lipid levels. Lipid peroxidation and cellular dysfunction are caused by free radicals produced during oxidative stress. TBARS is a lipid peroxidation index, and these are Reactive oxygen species activity indexes linked to membrane lipid destruction [9]. Studies have shown that oxidative stress plays a role in the pathophysiology of nephropathy [10].

Since thyroid disorders are so common in the general population, it's important to look into the risk factors for thyroid disorders in relation to kidney dysfunction and oxidative stress. The study's aim is to assess changes in biochemical markers of kidney function in thyroid disorders and their relationship to oxidative stress.

2. MATERIALS AND METHODS

The study was carried out by the Department of Biochemistry at Nagpur's Datta Meghe Medical

College. A total of 350 people participated in the study, including 70 control subjects, 70 Subclinical Hypothyroid, 70 Overt Hypothyroid, 70 Subclinical Hyperthyroid, and 70 Overt Hyperthyroid. Oral drugs were used by many of the thyroid patients. Age-matched stable control subjects were selected from existing families. A proforma is a document that collects information about a patient's clinical history and previous inquiries into their disorders.

2.1 Study Groups

The subjects were divided in following 5 groups:

i.	Control	70 subjects
ii.	Subclinical Hypothyroid	70 subjects
iii.	Overt Hypothyroid	70 subjects
iv.	Subclinical Hyperthyroid	70 subjects
v.	Overt Hyperthyroid	70 subjects

Place of study: The research was carried out in collaboration with SMHRC Hospital, Wardha, at the Department of Biochemistry, Datta Meghe Medical College and SMHRC Hospital, Deemed University, Nagpur.

2.2 Inclusion Criteria:

The study group included newly discovered cases between the ages of 21 and 55, whose diagnosis was verified following clinical and biochemical investigations.

2.3 Exclusion Criteria:

1. DM
1. HTN
2. Coronary Heart Disease
3. Endocrine Disturbances
4. Those who misuse alcohol
5. Patients who are already taking thyroid medication
6. Smokers
7. Vitamin supplement with antioxidants
8. Women who are expecting a child

2.4 Sample Collection

Venipuncture in clean test tubes was used to extract blood samples after a 12-hour overnight fast. The samples were centrifuged at 2500 rpm for 15 minutes, and serum aliquots were held at minus 20 °C for a period of four weeks.

3. METHODOLOGY

Serum T3 and T4 were performed using competitive ELISA technique [11]. Serum TSH was performed using immunoenzymometric technique using the reagent kit by Monobind, Lake forest, USA [12]. Serum urea was analyzed by enzymatic urease glutamate dehydrogenase method using the reagent kit by Erba diagnostics Mannheim Germany [13]. Creatinine was analyzed by modified Jaffe's method using the reagent kit by Autospan liquid gold creatinine [14]. Cystatin c was analyzed by quantitative turbidimetric immunoassay using the reagent kit by Quantia Cystatin C [15]. Assay of Superoxide dismutase by Marklund and Marklund method [16].

4. RESULT

Table 1 show that when euthyroid subjects were compared to subclinical hypothyroidism and overt hypothyroidism, there was a statistically significant rise in TSH levels. In subclinical hypothyroidism and overt hypothyroidism, however, T3 levels were significantly lower than in euthyroid subjects. When compared to euthyroid subjects, the level of T4 was also significantly lower in subclinical hypothyroidism and overt hypothyroidism.

Table 2 shows that when subclinical hypothyroid and overt hypothyroid cases were compared to controls, the level of serum urea increased statistically significantly. In subclinical hypothyroid subjects, serum Creatinine levels were also slightly higher, but the rise in overt hypothyroidism was highly important as compared to controls. A statistically significant improvement in serum Cystatin C was also observed. The amount of serum Cystatin C decreased significantly in cases of subclinical and overt hypothyroidism.

Table 3 indicates that subclinical and overt hypothyroid subjects have a statistically significant rise in MDA levels as compared to euthyroid subjects. However, as compared to euthyroid subjects, the amount of SOD was substantially lower in both subclinical and overt hypothyroid subjects.

5. DISCUSSION

Thyroid hormones play a crucial role in kidney growth and early renal function. Hypo- and hyperthyroidism affect glomerular filtration rate

Table 1. Different levels of thyroid biochemical parameters in Euthyroid, subclinical Hypothyroid, and overt hypothyroid patients

Parameters	Euthyroid subjects (1))	Subclinical Hypothyroid subjects (2)	Overt Hypothyroid subjects (3)
T3(ng/ml)	2.05±0.54	1.08±0.62	0.68±0.45
T4(µg/dl)	9.03±3.4	8.55±3.48	3.95±2.58
TSH(µIU/ml)	2.84±0.98	17.34±5.41	44.32±15.2

All values are expressed in mean ± SD.

Table 2. Levels of various biochemicals Kidney function parameters in euthyroid, subclinical hypothyroid and overt hypothyroid subjects

Parameters	Euthyroid subjects (1)	Subclinical Hypothyroid subjects (2)	Overt Hypothyroid subjects (3)
Urea (mg/dl)	21.98±6.78	23.54±5.12	29.92±6.85
Creatinine(mg/dl)	0.89±0.30	1.15±0.40	1.82±0.35
Cystatin C(mg/L)	0.93±0.25	0.78±0.28	0.48±0.19

All values are expressed in mean ± SD

Table 3. Level of biochemical parameters of oxidative stress in euthyroid, subclinical hypothyroid and overt hypothyroid patients

Parameters	Euthyroid subjects (1))	Subclinical Hypothyroid subjects (2)	Overt Hypothyroid subjects (3)
MDA (nmol/ml)	1.75±0.32	2.88±0.95	5.11±1.54
SOD(U/ml)	15.04±0.84	14.16±0.99	12.51±1.85

(GFR), renal blood flow, and tubular function, as well as water and electrolyte balance and kidney structure. Thyroid hormone levels influence the intrinsic contractile state of cardiac muscles as well as the cardiac muscles' responsiveness to inotropic agents [17]. RBF raises as a result of increased cardiac production from positive chronotropic and inotropic effects, as well as lower systemic vascular resistance.

Congenital hypothyroidism has been linked to a higher rate of congenital renal defects in children [18]. Thyroid hormones have an effect on neonatal renal function as well. The mitochondrial energy metabolism enzymes in the cells of the proximal convoluted tubules are affected by thyroid hormones in infants (PCT) [19]. According to a study, children with congenital hypothyroidism have higher creatinine levels in comparison to their hypothyroidism intensity [20]. When compared to serum creatinine, cystatin C is much more vulnerable to early and mild changes in kidney function [21]. Studies indicate that serum cystatin C levels normally trend in the opposite direction of creatinine levels [22] that is; cystatin C levels are often elevated in hyperthyroid patients and decreased in hypothyroid patients.

The study found that in both subclinical and hypothyroid subjects, there was a significant increase in MDA and a significant decrease in SOD, indicating oxidative stress. In subclinical and overt hypothyroid subjects, there was a significant negative correlation between T3 and T4 and MDA and a significant positive correlation between T3, T4 and SOD.

The level of serum malondialdehyde (MDA) is widely used as a marker for lipid peroxidation and oxidative damage in cells and tissues [23]. Various studies have shown that hyperlipidemia causes lipid peroxidation, which is a consistent biochemical function of hypothyroidism [24]. SOD and CAT enzymes decompose O2 and H2O2 before combining to form a more reactive hydroxyl radical, which is the first line of protection against oxidative injury in cells (OH). As a result, these enzymes protect red blood cells from lipid peroxidation caused by O2 and H2O2 [25,26]. It demonstrates that hyperthyroidism can damage kidney function both directly and indirectly through oxidative stress [27-30].

6. CONCLUSION

Thyroid hormones affect virtually all tissues, including the kidney. In reality, thyroid and kidney function are inextricably linked. Thyroid hormones have a variety of direct and indirect

effects on kidney growth, development, and function. Thyroid disorders are becoming more common every day, according to previous reports, and the number of undiagnosed chronic kidney disease cases in stage 1 is also that. As a result, all aspects of thyroid disorders that are linked to other organs should be investigated. So, in our research, we looked into the direct and indirect effects of hypothyroidism and hyperthyroidism on kidney function through oxidative stress.

When the incidence of chronic kidney disease rises, all instances of hypothyroidism and hyperthyroidism should be regularly tested for worsening kidney functions, and since the study indicates that oxidative stress plays a role in nephropathy, current thyroid disorders treatment methods should include oxidative stress, which will aid clinicians in better managing kidney dysfunction.

DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

CONSENT

Patients' informed consent was also received prior to the start of the analysis.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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