

Association between thyroid hormone disorders and renal dysfunction

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Abstract

Background: Thyroid hormones perform a wide range of metabolic functions. Relationship between thyroid diseases and kidney function initially described were clinically subtle. It has been suggested that patients of thyroid disorder can be associated with increased risk of renal diseases.

Aims and Objectives: To understand the effects of thyroid disorders on renal function and carbohydrate metabolism, we estimated and compared blood sugar, serum urea and serum creatinine levels with T3, T4 and TSH in thyroid dysfunction patients and euthyroid subjects.

Materials and Method: Case control study was done on 78 newly diagnosed thyroid disorder cases and 78 age and sex matched healthy controls, attending medicine OPD within the age group of 18 to 59 years.

Result: There is significant positive correlation between TSH and serum creatinine levels with $p < 0.001$, and there is positive correlation between TSH and serum urea levels and also with TSH and blood sugar levels.

Conclusion: It is evident from the study that there is an association between fasting blood glucose levels, creatinine levels and thyroid disorder.

Larger epidemiological research is required to find out the incidence of renal dysfunction in thyroid disorders.

Keywords: Thyroid Disorders, Renal Dysfunction, T3, T4 & TSH.

1. Introduction

The most important function of the thyroid gland is to maintain the homeostasis of the metabolism of the body. Thyroid hormones and TSH are also necessary for normal growth of the body. The most important effect of thyroid hormones is to maintain the metabolic rate and consumption of oxygen in all tissues of the body [1].

Thyroid hormones perform a wide range of metabolic functions such as regulation of carbohydrates, lipids and protein metabolism [2].

Relationship between thyroid diseases and kidney function initially described were clinically subtle but to date there are several reports of raised level of serum creatinine in the patients of thyroid disorder, and it has even been

suggested that patients of thyroid disorder can be associated with increased risk of renal diseases [3].

Thyroid hormone abnormalities cause marked changes in glomerular and tubular functions and electrolyte homeostasis. Thyroid dysfunction is accompanied by derangement in glomerular filtration, serum creatinine and alteration in the ability of water excretion [4].

Thyroid hormones are indispensable for the renal system growth and development. Metabolism and elimination of thyroid hormones is one of the functions where renal system is involved. Deranged homeostasis of renal system is accompanied by compensatory alteration in the normal level, synthesis and metabolism of thyroid

hormones [5]. Hence to understand the effect of thyroid disorders on renal function and carbohydrate metabolism, we estimated and compared blood sugar, blood urea and serum creatinine levels with T3, T4 and TSH in thyroid dysfunction patients and euthyroid patients.

2. Materials and Method

Present hospital based study was conducted jointly by Department of Biochemistry, Department of General Medicine and Department of Community Medicine of FH Medical College, Agra and its associated Hospital. After having ethical clearance from the institutional ethics committee, informed consent was taken from all the study participants. This case control study comprised of 78 newly diagnosed thyroid disorder cases and 78 age and sex matched healthy controls who attended OPD of General Medicine.

2.1 Inclusion criteria:

Patients with newly diagnosed thyroid disorders in the age group of 18 to 59 years of both genders were included.

Those having normal T3, T4 and TSH levels were categorized as euthyroid.

Those having low T3, T4 and high TSH levels were categorized as hypothyroid

Those having normal levels of T3, T4 and low levels of TSH were categorized as hyperthyroid with respect to the reference range.

2.2 Exclusion criteria

Patients with chronic renal failure

Patients of hypertension and Diabetes Mellitus

Patients of muscular dystrophies and gout

Pregnancy

Patients with H/o. drug intake prior to sampling that can affect the test parameters

Patients taking steroids

2.3 Method of sample collection

After overnight fasting 3 ml. of venous blood samples were collected in morning in plain vials under

aseptic conditions. Blood was allowed to clot and centrifuged at 3000 rpm for 15 minutes at room temperature. The supernatant serum was assayed for T3, T4 and TSH by enzyme linked fluorescent assay (ELFA) technique using Mini Vidas auto analyzer. The reference intervals for T3, T4 and TSH for our laboratory were as follows [6]:

T3:- 1.23 – 3.23 nmol/L

T4:- 59 – 135 nmol/L

TSH: - 0.4 – 4.2 mIU/L

Serum urea, serum creatinine and serum glucose were measured using semi auto-analyzer ERBACHEM – 7 and kits supplied by ERBA. Parameters were estimated by following methods:

a) Estimation of serum creatinine by modified Jaffe's method [7]

b) Estimation of serum urea by GLDH-Urease method [8,9]

c) Estimation of serum glucose by GOD-POD method [10]

2.4 Statistical analysis

The variables were presented in terms of mean and standard deviation. The data were analyzed using student's unpaired 't' test. Pearson's correlation coefficient test was done to see the correlation of serum urea and creatinine levels with the TSH levels. 'p' values <0.05 were considered significant.

3. Result

The age group of the participants was ranged between 18 and 59 years old with the mean age of 42 years (Table 1).

Table 1: Age and gender wise distribution (mean \pm SD) in the study participants (cases and healthy controls)

	Age (years)	Genders (M/F)
Cases	42.45 \pm 12.30	15/63
Controls	42.26 \pm 14.22	17/61

The values of thyroid hormones, TSH and biochemical markers of renal function and blood glucose is presented in Table 2.

Table 2: Comparison of mean \pm SD levels of T3, T4, TSH, Blood Urea, Serum Creatinine and Fasting blood sugar between cases and controls

Parameters	Cases	Controls	P value
T3 (ng/dl)	107.996 \pm 29.105	114.665 \pm 42.209	0.31
T4 (μ g/dl)	8.090 \pm 2.994	8.830 \pm 3.097	0.19
TSH (μ IU/ml)	16.226 \pm 24.065	2.253 \pm 0.841	<0.001 *
Urea (mg/dl)	20.828 \pm 4.896	20.021 \pm 9.727	0.807
Creatinine (mg/dl)	0.974 \pm 0.165	0.738 \pm 0.099	<0.001 *
Fasting blood sugar (mg/dl)	90.3 \pm 13	87.4 \pm 10	<0.001 *

We compared mean serum urea levels in cases and controls and we found there is slightly higher level in cases as compared to controls. Mean serum creatinine level were significantly increased in cases as compared to controls (p<0.001). Also mean fasting blood glucose level in

controls was slightly lower than cases. Table 3 shows significant positive correlation between TSH and serum creatinine levels with p<0.001, and also there is positive correlation between TSH and serum urea levels and with TSH and blood sugar as well in cases.

Table 3: Correlation of TSH with urea, creatinine and blood sugar of cases

Cases	P value	Pearson correlation ('r' value)
TSH vs. urea	P = 0.912	+ 0.0003
TSH vs. creatinine	< 0.001 *	+ 0.1865
TSH vs. blood sugar	P = 0.815	+ 0.0004

The study subjects were classified according to thyroid status as Hyperthyroid, Hypothyroid and Euthyroid with respect to the reference range of our analyzer.

Comparison of thyroid hormones levels and TSH as (Mean \pm SD) among various thyroid disorders is given below in Table 4.

Table 4: Mean \pm SD comparison of thyroid hormones levels among various thyroid disorders

Parameters	Euthyroidism	Hypothyroidism	Hyperthyroidism
T3	1.41 \pm 0.7	1.87 \pm 0.5	2.878 \pm 0.23
T4	78.84 \pm 26.6	88.53 \pm 36.7	123.75 \pm 69.2
TSH	1.90 \pm 0.8	8.93 \pm 0.7	0.29 \pm 0.2

4. Discussion

The present hospital based study evaluated the biochemical markers of renal function such as urea, creatinine in thyroid disorder patients as well as euthyroid subjects. We also evaluated level of glucose in these study participants and compared the results among them. Our study shows that there is marked increase in creatinine levels in patients of thyroid disorder as compared to euthyroid subjects which is in accordance with the study conducted by Tayal *et al* [11, 12].

Most of the studies done in thyroid disorder patients have shown deranged serum creatinine levels. The study of Nagarjappa *et al* [12] is also in accordance with our study which shows deranged serum creatinine levels in patients of thyroid disorders.

Mamatha *et al* [13] showed that there is significant increase in creatinine levels (0.974 \pm 0.165) in thyroid subjects as compared to euthyroid subjects (0.738 \pm 0.099). These changes may result due to decrease in GFR.

Gagandeep *et al* [14] in their study showed that there is significant increase in creatinine levels (1.61 \pm 1.37) in thyroid disorder patients as compared to euthyroid subjects (0.974 \pm 0.14) which is in accordance with our study which also shows similar results.

Our study is also in accordance with the studies done by Kaur *et al* and Saini *et al* [15, 16] which also showed that mean serum urea level was significantly higher in thyroid disorder patients as compared to euthyroid subjects.

Lyu *et al* [17] evaluated the effect of blood urea on the physiologic functioning of kidneys in subjects with abnormal carbohydrate metabolism. They conducted their study on 1495 patients and estimated their serum nitrogen levels, serum creatinine levels, serum triglycerides levels, serum cholesterol levels and serum blood urea levels. They concluded in their study that thyroid disorder is associated with renal dysfunction which is also in accordance with our study which shows deranged renal function in patients of thyroid disorder.

Also, an increase in the serum creatinine levels have been seen in patients of thyroid disorder in most of the studies conducted by different authors. [11, 18]

Thyroid disorder is a pathological state that adversely affects glucose metabolism and is commonly found in diabetes mellitus. Diabetes Mellitus appears to influence the function of thyroid gland at two stages; firstly, at the site of hypothalamic control of TSH release and secondly, at the conversion of thyroxine to T3 in the peripheral tissues. Marked hyperglycemia causes reversible reduction of the activity and hepatic concentration of T4,5 deiodinase, low serum concentration of tri iodothyronine, elevated levels of rT3 and low, normal or may be high levels of T4. [19]

A study conducted by Deuri *et al* [20] shows that there is a high prevalence of thyroid disorder and also the subjects have deranged glucose levels. Our study also shows deranged glucose levels in the cases and is in accordance with the above study.

In our study we have found that fasting blood glucose mean in controls and cases was 87.4 \pm 10 and 90.3 \pm 13 mg/dl respectively, which is in accordance with the study conducted by Sushma *et al* [21] who have found deranged fasting blood glucose levels in their study.

Various earlier studies conducted by different authors have also established a clear association between thyroid disorders and deranged glucose metabolism. [22-24]

5. Conclusion

In the present study, it is evident that there is an association between fasting blood glucose levels, creatinine levels and thyroid disorder. Therefore there should be regular screening and monitoring for the renal function in the patients of thyroid disorder. Larger epidemiological research is required to actually find out the incidence of renal dysfunction in thyroid disorders.

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