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THYROID STATUS IN PATIENTS WITH IRON DEFICIENCY

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ABSTRACT

Iron deficiency is one of the overlooked cause of thyroid dysfunction. This study was done to find out the effect of ferritin deficiency on thyroid hormonal activity. 186 subjects included in this study were divided into two groups, those with S. ferritin <20ng/mL as cases (n=91) and >20ng/ml (n=95) as controls. Thyroid stimulating hormone was also measured in all subjects. Values were expressed as mean ± SD. Unpaired't' test & Pearson's correlation test performed to see the level of significance. P value <0.05 taken as significant. Ferritin levels in cases and controls were 10.54±5.5 and 153.2±106.7 ng/mL respectively (p<0.0001). TSH levels in cases and controls were 5.23±3.5 and 3.27±2.25 µIU/mL respectively (p<0.0001).Serum. Ferritin & Serum.TSH showed negative correlation in controls and cases which was not statistically significant. Significant difference in thyroid hormone status in iron deficient people could be a reflection of disturbed activities of iron dependent enzyme, thyroid peroxidase. Iron deficiency lowers TPO activity. This will decrease circulating thyroid hormone concentrations and increase TSH levels.

KEYWORDS: **Iron deficiency, Serum Ferritin, Thyroid stimulating hormone, Thyroid peroxidase.**

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INTRODUCTION

Thyroid dysfunction is a common endocrine disorder affecting about 300 million people worldwide[1]. Several minerals and trace elements like iodine, iron, selenium and zinc are essential for normal thyroid hormone metabolism. Iron deficiency results in the depletion of iron-dependent intracellular enzymes participating in many metabolic pathways[2]. It impairs thyroid hormone synthesis by reducing activities of heme-dependent thyroid peroxidase. Thyroid peroxidase (TPO) is a membrane-bound glycosylated hemoprotein that plays a key role in the biosynthesis of thyroid hormones. This enzyme is responsible for the oxidation of iodide and binding of iodine to tyrosyl residue of thyroglobulin (organification). Two diiodotyrosine (DIT) molecules undergo an oxidative condensation for the formation of thyroxine (T4). Tri-iodothyronine (T3) is yielded from the coupling of one mono-iodotyrosine (MIT) and one di-iodotyrosine (DIT). A separate coupling enzyme has not been found and since this is an oxidative process, it is assumed that same TPO catalyzes this reaction. This hypothesis is supported by observation that the same drug which inhibits iodide oxidation also inhibits coupling [3] Under normal circumstances iron absorption slightly exceeds iron excretion. The daily iron requirement for haemoglobin synthesis is 20-25 mg. Body conserves its iron stores by reutilizing the iron derived from the breakdown of the haemoglobin from aged red cells. Progressive depletion and ultimate exhaustion of available tissue iron stores is followed by the development of anaemia.Iron deficiency is defined by a serum ferritin level less than 20 ng/mL. Anaemia is defined as a haemoglobin level of 110gm/L or less in women and 130gm/L or less in men[4]. Since iron deficiency is present before the onset of anaemia, detection of an iron depleted state is important for the control of anaemia[5]. Though low haemoglobin concentration is most readily available sign of anaemia, a significant fall in circulating haemoglobin cannot be detected until the final stage of iron deficiency[6]. Serum ferritin, a measure of iron stores is the best single test to confirm iron deficiency.Iron deficiency impairs thyroid metabolism in human studies. Martinez-Torres and co -workers[7] reported 10% lower T3 levels in human subjects with moderate to severe iron deficiency anaemia, and Beard and his co-workers[8] showed that in iron-deficient-anaemic subjects, serum T3 and T4 levels were significantly decreased.Iron deficiency anaemia is an advanced stage of iron depletion. Complete treatment of iron deficiency anaemia (IDA) will decrease the prevalence of iron deficiency and also decrease the burden of hypothyroidism from society. As iron deficiency is one of the most overlooked causes of thyroid dysfunction, the present study was taken up to find out the effect of ferritin deficiency on thyroid hormonal activity.

MATERIALS AND METHODS

This case-control study was carried out in the Department of Biochemistry, Nizam's Institute of Medical Sciences (NIMS), Hyderabad, India. In this study total 186 subjects were selected from outpatient department of the hospital. Patients with S. ferritin <20ng/ml were grouped as cases (n=91) & with S.ferritin >20ng/ml (n=95) were grouped as controls. Along with S.ferritin, thyroid stimulating hormone (TSH) was measured in all study subjects. Patients having pregnancy, known iodine deficiency, positive for Anti-TPO and Anti-TG, hepatic disorder and renal diseases were excluded from the study. Relevant information collected from history, physical findings and laboratory investigations were recorded on a predesigned data sheet. The whole procedure was explained to each patient and a written consent was taken. Ethical Committee approval was taken.With all aseptic precautions fasting sample was collected from the median cubital vein of all study subjects and 5ml of blood was drawn by disposable plastic syringe. Blood was transferred immediately into dry clean test tube and was allowed to clot. Then the test tube was centrifuged. Separated serum was aliquoted and stored at -20^0 C until analysis.Serum Ferritin and Serum TSH were estimated by immunoturbidometric method and electrochemilumini scentimmunoassay (ECLIA) respectively. Values were expressed as mean ± SD. Unpaired 't' test & Pearson's correlation test performed to see the level of significance & p value <0.05 was taken as significant.

RESULTS

To evaluate the thyroid hormone status in iron deficient patients, a total of hundred and eighty six subjects of both sexes were selected for this study of which ninety one were iron deficient patients and ninety five were normal healthy controls.Mean±SD values of serum ferritin concentrations in cases and controls were 10.54±5.5 ng/mL & 153.2±106.7ng/mL respectively .There was highly significant difference of serum ferritin between cases and controls (p<0.001) (Table I, Fig 1)

Table I

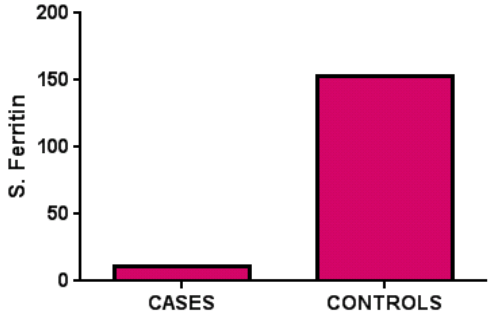
Serum Ferritin concentrations (ng/mL) in cases and controls

	Mean	SD
Cases	10.54	5.5
Controls	153.2	106.7

P value calculated by unpaired t test was <0.0001, which was found to be statistically significant.

Figure I

Serum Ferritin concentrations (ng/mL) in cases and controls



Mean±SD values of serum TSH concentrations in cases and controls were 5.23±3.5 µIU/mL and 3.27±2.25 µIU/mL respectively. There was highly significant difference of serum TSH between cases and controls (p<0.001) (Table II, Fig II)

Table II

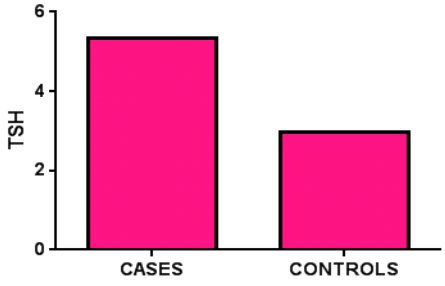
Serum TSH concentrations (µIU/mL) in cases and controls

	Mean	SD
Cases	5.23	3.5
Controls	3.27	2.25

P value calculated by unpaired t test was <0.0001, which was found to be statistically significant.

Figure II

Serum TSH concentrations (µIU/mL) in cases and controls



In control subjects there was a negative correlation between serum ferritin and serum TSH, but it was not statistically significant (r was -0.14, p>0.05). In iron deficient patients also there was a negative correlation between serum ferritin and serum TSH which was not statistically significant (r was -0.028 and p>0.05) (Table III)

Table III
Correlation between S. Ferritin and TSH in study subjects

	R	P
Cases	-0.028	>0.05
Controls	-0.14	>0.05

DISCUSSION

The thyroid gland is one of the most important organs for optimal growth. Normal thyroid status is dependent on the presence of many trace elements for both the synthesis and metabolism of thyroid hormones. Iodine is most important as a component of the hormones thyroxine and 3, 3', 5-tri-iodothyronine (T3). This case control study was conducted to find out the relationship between iron deficiency and thyroid hormone status. We have measured serum TSH level in iron deficient patients having low serum ferritin level and in healthy controls. Our study showed that the serum TSH levels were within normal reference range in healthy subjects. But in iron deficient patients the serum TSH level was found to be higher than the normal range. It was observed that serum TSH concentrations were significantly higher in cases compared to controls (p<0.001). This result is consistent with the study by Blum and Blum [9]. They showed that TSH level were significantly higher in the iron deficient group than the control though they remained within normal range. Our study showed that there was negative correlation of serum ferritin with serum TSH in both iron deficient patients and controls but that was not statistically significant (p>0.05).The two initial steps of thyroid hormone synthesis are catalyzed by heme–containing thyroid peroxidase[10-13].

Severe iron deficiency may lower thyroperoxidase activity and interfere with the synthesis of thyroid hormones [14] .Recently Hess and his co-workers [15] have shown that thyroid peroxidase activity is significantly reduced in iron deficiency anaemia.Discrepant views had been shown by some studies that the thyroid profile was not significantly affected in iron deficient patients. The survey in Turkey by Yavuz et al[16] showed no correlation between iron status and thyroid hormone levels in school children. Another study in Thailand by Tienboon and Unachak[17] showed that the thyroid hormones of IDA children before and after iron treatment were not significantly different from the control children. These variations may be due to different geographic distribution and different demographic characteristics of patients under study.

CONCLUSION

Iron deficiency lowers TPO activity. This will decrease circulating thyroid hormone concentrations and increase TSH levels as reflected by the negative correlation between ferritin and TSH levels. Based on our study results, we suggest thyroid hormone status evaluation in all patients with iron deficiency.

CONFLICT OF INTEREST

Conflict of interest declared none.

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