ORIGINAL RESEARCH ARTICLE

Evaluation of Serum Ferritin Levels in Patients of Hypothyroidism

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Abstract

Background: The thyroid gland is a bilobed endocrine gland that secretes two vital hormones: thyroxine (T4) and triiodothyronine (T3). The production and release of these hormones are regulated by the thyroid-stimulating hormone (TSH) from the pituitary gland.

Iron is an essential element for the normal functioning of the thyroid gland. In the body, iron is stored in the form of ferritin, an intracellular protein. The aim of the present study was to evaluate the serum ferritin levels in patients with hypothyroidism.

Materials and methods: This case-control study was conducted on 100 lab-diagnosed cases based on the thyroid profile. About 50 healthy controls were included in the study. Thyroid profile which includes estimation of serum T3, T4, and TSH was done. Serum ferritin levels were also estimated in both cases and controls.

Results: The mean ± SD value of serum TSH levels in study group and control group was 14.45 ± 12.96 µIU/mL and 1.27 ± 1.05 µIU/mL, respectively. The mean ± SD of Serum ferritin in study group and control group was 9.95 ± 6.36 ng/mL and 149.35 ± 103.16 ng/mL, respectively. Serum ferritin and TSH shows significant (p-value ≤ 0.001). A significant negative correlation was found between TSH and serum ferritin in hypothyroid patients.

Conclusion: This suggests that hypothyroid patients had higher levels of TSH and lower levels of serum ferritin compared to the control group, and that there is a negative correlation between TSH and serum ferritin in hypothyroid patients. Hence, the estimation of serum ferritin concentration among hypothyroid patients could be useful in the evaluation of thyroid hormone status.

Keywords: Enzyme linked Immunosorbent assay, Hypothyroid, Serum ferritin, Thyroid peroxidase, Thyroid-stimulating hormone, Thyroxine, Triiodothyronine.

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Introduction

Thyroid diseases are highly prevalent worldwide, and considered the second most common endocrinal disorders after diabetes.[1] The prevalence of subclinical hypothyroidism ranges from 4 to 10% in different populations, with reports suggesting higher instances.[2] In India, self-reported goiter or thyroid disorder prevalence was 2.2% in NFHS IV (2015–2016) and 2.9% in NFHS-V (2019–2021). Hypothyroidism, characterized by decreased thyroid hormone production, can be primary or secondary.[3] Overt hypothyroidism occurs with elevated serum thyroid-stimulating hormone (TSH) above 10 mIU/L and decreased thyroxine (T4) and triiodothyronine (T3) levels, while subclinical hypothyroidism presents with slightly elevated TSH (4–10 mIU/L) and normal T4 and T3 concentrations.[4]

Thyroid hormones produced by thyroid glands regulate many important metabolic pathways in the body.[5] Thyroid hormones are very important for cell growth, differentiation, metabolism and maintaining the body homeostasis.[6] Thyroxine is synthesized through the oxidative condensation of two diiodotyrosine (DIT) molecules, while triiodothyronine is formed by coupling mono-iodotyrosine and DIT.[7]

Many minerals and trace elements like iodine, iron, selenium, and zinc are needed for normal thyroid functioning. Iodine plays a role in thyroid hormone synthesis. Selenium helps in the conversion of T4–T3 as it is a component of deiodinase enzymes and also has protective action against excessive iodide exposure.[5]

All body tissues have ferritin as an iron storage protein. Thyroid dysfunction frequently disturbs the ferritin levels.[8] Thyroid peroxidase (TPO) has an iron acting as its cofactor.[9] Thyroid peroxidase is involved in two major steps of thyroid hormone synthesis.[10] Thyroid peroxidase acts as a membrane-bound enzyme involved in the oxidation of iodide. It also helps in the binding of iodide to the tyrosyl residue of thyroglobulin.[8]

Ferritin is considered a gold standard to confirm iron deficiency.[11]

We conducted the present study to find the correlation between serum ferritin levels in hypothyroid patients and compare them with those of normal, healthy controls.

Materials and Methods

The Department of Biochemistry at Government Medical college and Rajindra Hospital in Patiala conducted the present analytical study. The study group composed of 100 lab-diagnosed patients with hypothyroidism. Patients were diagnosed based on the

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biochemistry lab reports (TSH >4.2 µIU/mL). The control group consisted of 50 healthy, age and gender matched individuals.

The institutional Ethical committee granted clearance to initiate the study. The study group included cases who had given samples with their consent.

Inclusion Criteria

- Lab-diagnosed cases of hypothyroidism with serum TSH levels >4.2 µIU/mL (normal range = 0.4–4.2 µIU/mL).
- Subjects of either gender.
- Subjects in age-group of 20–65 years.

Exclusion Criteria

- Patients with age-group <20 years and >65 years.
- Patients of liver disease.
- Pregnant women.
- Patients of diabetes mellitus, renal diseases, blood transfusion.
- Patients of severe anemia (≤7 gm/dL).
- Patients on iron therapy.

Methods

- Serum T3 and T4 were done by the solid-phase competitive enzyme linked immunosorbent assay (ELISA) Method.
- Solid phase Sandwich ELISA method was used for estimating Serum TSH and Serum Ferritin.
- Serum sample was also be analyzed for the routine biochemistry investigations. These parameters were done on the XL-1000 fully auto analyzer by using the system pack.

Sample Collection

We collected 5–6 mL of venous blood under aseptic conditions from antecubital vein. We collected blood in red-topped vacutainers. After collection, we allowed blood to clot and centrifuged it at 2200–2500 rpm for 5–10 minutes to separate the serum. We stored the serum in aliquots under aseptic conditions at 2–8°C for 5 days and at –20°C for up to 1 month, and conducted the analysis after bringing the samples to room temperature.

Statistical Analysis

We conducted the data analyzing using Microsoft Excel 2016 and Epi Info™ 7 software. Results were expressed as mean ± SD. The statistical significance was calculated by using the student's *t* test; $p < 0.001$ was considered to be significant.

Results

There were 65 females (65.0%) and 35 males (35.0%) in the study group. About 31 females (62.0%) and 19 males (38.0%) in the control group. There was no statistically significant difference ($p = 0.718$) in gender distribution among the study group and control group (Table 1).

Table 1: Gender distribution

	Study group		*Control group*		
Sex	*N*	*%*	*N*	*%*	*Totals*
Female	65	65.0	31	62.0	96
Male	35	35.0	19	38.0	54
Total	100	100.0	50	100.0	150

Discussion

In recent years, research has focused on the connection between iron and thyroid hormone metabolism. Thyroid disorders are widespread on a global scale and pose a significant concern in India. Approximately 42 million people in India are impacted by thyroid disease, with a higher occurrence among women.[6] According to Table 1 we observed a female predominance in our cases of hypothyroidism. This can probably due to low serum ferritin levels in women due to menstrual blood loss and low dietary intake in, which affect the production of thyroid hormones.[12]

Hypothyroidism is a common endocrine disorder, resulting from in adequacy of the thyroid gland to produce a sufficient amount of thyroid hormones, leading to decreased metabolism in affected individuals.[13]

Iron deficiency can lead to decreased production of thyroid hormones as iron is an important constituent of TPO enzyme which involved in the iodization of tyrosine residues and formation of T3 and T4. This can result in an enlargement of thyroid gland.[10]

Thyroid hormone synthesis is effected by low ferritin levels (an indicator of body's iron stores). Decreased ferritin levels impact the production of thyroid hormones and also the process by which the dormant thyroid hormone T4 is transformed into the active thyroid hormone T3. The liver is the primary organ involved in this conversion, which needs enough iron to occur.[14]

According to Table 2, in this study the mean ± SD of serum ferritin levels was 9.95 ± 6.36 ng/mL in the study group, and it was 149.35 ± 103.13 ng/mL in the control group. This shows that the study group had significantly lower serum Ferritin levels than the control group (p-value <0.001). This finding aligns with a study by Kumar et al., where they reported Mean ± SD levels of serum ferritin were 12.30 ± 4.94 ng/mL in the study group and 48.10 ± 15.60 ng/mL in the control group, showing compatibility with our results.[15]

In Table 3, the study group had significantly increased serum TSH levels (14.45 ± 12.96 µIU/mL) as compared to the control group (1.27 ± 1.05 µIU/mL). Another study by Sarin M et al. found that the mean ± SD levels of serum TSH were (8.95 ± 1.14 µIU/mL) in study group and (2.68 ± 0.34 µIU/mL) in the control group.[16]

In Table 4, a highly significant correlation was observed between TSH and Ferritin Levels in hypothyroidism ($r = -0.496$). This outcome is consistent with findings from studies by Mahajan et al.[17] and Kumar et al.[18]

Conclusion

In the current study, we observed significantly lower levels of serum ferritin in cases of hypothyroidism compared to healthy controls. This Study will provide valuable insights into the interplay between thyroid function and iron metabolism, potentially influencing clinical practices in the management of hypothyroidism. Enhanced understanding of ferritin levels in these patients can lead to more comprehensive and personalized treatment approaches, ultimately improving patient outcomes.

Future Scope of the Study

- Longitudinal studies: Conduct extended follow-up studies to assess long-term changes in Serum Ferritin Levels and their relationship with thyroid function over time.
- Larger sample size: Expand the study to include a larger and more diverse population to validate findings and enhance generalizability.

Table 2: Serum ferritin levels in study group vs control group

Parameter	*Group*	*N*	*Range*	*Mean ± SD*	*'t' value*	*p-value*
Ferritin (ng/mL) (N.V = Male: 20–350 ng/mL)	Study group	100	2.10–38.00	9.95 ± 6.36	13.50	<0.001** (HS)
(N.V = Female: 10–200 ng/mL)	Control group	50	18.10–392.00	149.35 ± 3.16		

The difference in the serum ferritin levels in study vs control group was highly significant ($p < 0.001$) (Table 2)

Table 3: Comparison of serum TSH levels between study group and control group

Parameter	*Group*	*N*	*Range*	*Mean ± SD*	*'t' value*	*p-value*
TSH (μIU/mL)	Study group	100	2.69–40.00	14.45 ± 12.96	7.16	< 0.001** (HS)
	Control group	50	0.19–4.85	1.27 ± 1.05		

The levels of serum TSH were significantly increased ($p < 0.001$) in study group vs control group (Table 3)

Table 4: Correlation of TSH and serum ferritin levels in study group

Parameter	*Mean ± SD*	*r value*	*p-value*
TSH (μIU/mL)	14.45 ± 12.96	–0.496	< 0.001** (HS)
Ferritin (ng/mL)	9.95 ± 6.36		

As shown in Table 4, there was a statistically significant. So there was a negative correlation ($r = –0.496$) of serum TSH with serum ferritin

- Mechanistic insights: Investigate the underlying biological mechanisms linking thyroid function and iron metabolism to better understand the observed alterations in Serum Ferritin Levels.
- Treatments: Evaluate the effects of various hypothyroid treatments (e.g., different thyroid hormone replacement therapies) on serum ferritin levels to identify the most effective management strategies.
- Nutritional intervention: Explore the impact of dietary modifications and iron supplementation on serum ferritin levels in hypothyroid patients to develop comprehensive treatments plans.
- Clinical outcomes: Examine the correlation between changes in serum ferritin levels and clinical outcomes, such as symptom improvement and quality of life, in hypothyroid patients.
- Interdisciplinary research: Collaborate with researchers in endocrinology, hematology and nutrition to explore multiple-faceted approaches for managing hypothyroidism and associated iron metabolism issues.

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