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Original Research Article

A Cross-Sectional Study on Evaluation of Iron, Ferritin, TIBC, and LDH Levels in Hypothyroid Patients at a Tertiary Care Center

Madhav Kadam[1], Neeraj Chhari[2], Deepika Rathore[3], Piyusha Mahashabde[4]

[1]Assistant Professor, Department of Biochemistry, N.S.C. Government Medical College Khandwa, Madhya Pradesh, India

[2]Assiociate Professor, Department of Community Medicine, Peoples College of Medical Sciences and Research Center, Bhopal Madhya Pradesh, India

[3]Assistant Professor, Department of Community Medicine, Government Medical College Ratlam, Madhya Pradesh, India

[4]Assistant Professor, Department of Community Medicine, Government Medical College Ratlam, Madhya Pradesh, India

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Corresponding author: Dr Piyusha Mahashabde

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Abstract

Background & Objectives: This study aimed to examine the influence of hypothyroidism on serum ferritin, iron, total iron-binding capacity (TIBC), and lactate dehydrogenase (LDH) levels, considering their potential implications for thyroid function.

Methods: The study included 100 age and sex-matched cases and controls. Serum thyroid profile and ferritin levels were measured using chemiluminescent immunoassay (CLIA) on a Mindray analyzer. Serum iron, total iron-binding capacity (TIBC), and lactate dehydrogenase (LDH) levels were assessed using ERBA chem7. Statistical analysis was performed to determine correlations between these parameters.

Results: The study findings indicated a significant decrease in serum ferritin levels in hypothyroid patients compared to the normal control group ($p < 0.001$). Furthermore, hypothyroid patients exhibited significantly increased levels of total iron-binding capacity (TIBC).

Conclusion: The results of the study suggest a correlation between hypothyroidism and decreased serum ferritin levels. The measurement of serum ferritin can be valuable in the understanding, diagnosis, and monitoring of hypothyroidism.

Keywords: Iron, Ferritin, Hypothyroidism, TIBC, LDH.

Introduction

The thyroid gland, positioned in the lower part of the neck, is an endocrine gland characterized by its butterfly shape. It consists of follicular cells responsible for the synthesis of thyroid hormones, namely triiodothyronine (T3) and thyroxine (T4). In addition to follicular cells, the thyroid gland also contains parafollicular cells that produce calcitonin, contributing to the regulation of calcium levels. The thyroid gland's primary functions include controlling the basal metabolic rate, facilitating cell differentiation

and development, as well as maintaining optimal calcium levels.

Ferritin, a protein of significance, serves as an essential indicator of iron storage levels within the body. Research has revealed a positive correlation between ferritin levels and iron stores, underscoring its crucial role in monitoring iron reserves [1-3].

Iron serves as a crucial co-factor for enzymes such as Thyroid Peroxidase (TPO), which play a vital role in the synthesis of thyroid hormones. Specifically, iron facilitates the oxidation of iodine, which subsequently binds to the tyrosyl residues of thyroglobulin. When the iron status is compromised or decreased, it can lead to a disruption in the functioning of this enzyme, thereby affecting the synthesis of thyroid hormones [4-6].

Several studies have reported a decrease in iron storage levels in individuals with hypothyroidism, indicating a potential association between iron status and the development of this endocrine disorder [4]. Hypothyroidism encompasses a spectrum of conditions ranging from overt myxedema, characterized by systemic organ dysfunction and multisystem failure, to asymptomatic or subclinical states [7-10].

Hypothyroidism, a common thyroid disorder, has a prevalence of approximately 4-5% in the developed world [11,12]. Subclinical hypothyroidism, a milder form of the condition, has a prevalence ranging from 4% to 15% [13]. It is noteworthy that hypothyroidism affects individuals regardless of their age, sex, or socioeconomic status.

Overt hypothyroidism is characterized by decreased levels of serum thyroid hormones (T4 and T3) along with elevated levels of thyroid-stimulating hormone (TSH). On the other hand, subclinical hypothyroidism is defined by normal serum thyroid hormone levels within the reference range and an elevation in TSH levels [14]. The diagnosis of subclinical hypothyroidism primarily relies on biochemical assessments.

Extensive research has provided compelling evidence regarding the detrimental effects of iron deficiency anemia (IDA) on thyroid function. IDA is characterized by lower concentrations of plasma total thyroxine (T4) and triiodothyronine (T3), indicating a decrease in the levels of these crucial thyroid hormones [15]. Additionally, compromised peripheral conversion of T4 to T3 has been observed in individuals with IDA, further contributing to thyroid hormone imbalance. Furthermore, there is a possibility of an increase in circulating thyroid-stimulating hormone (TSH) levels, indicating an attempt by the body to compensate for the decreased thyroid hormone production caused by IDA [15]. These findings underscore the significant impact of iron deficiency anemia on thyroid function and the need to address iron status to maintain optimal thyroid health.

Materials and Methods

The current study was conducted as a cross-sectional investigation at the Department of Biochemistry in a tertiary care Medical College located in central India. The study specifically focused on patients visiting the medical outpatient department (OPD) for their healthcare needs. A total of one hundred (100) samples, matched in terms of age and sex, were collected for the purpose of estimating levels of Thyroid Profile, Iron, Total Iron-Binding Capacity (TIBC), Lactate Dehydrogenase (LDH), and Ferritin.

The participants were divided into two groups: the control group and the group consisting of individuals diagnosed with hypothyroidism. To evaluate the specified parameters, three milliliters of venous blood were collected from each participant. The measurement of Thyroid Profiling and Ferritin levels was carried out using a chemiluminescenceMindray hormonal auto

analyzer, while LDH levels were determined using an ERBA chem semi-auto analyzer.

Before conducting the study, ethical approval was obtained from the appropriate ethical committee. Additionally, written consent was obtained from all participants, and they were duly informed about their right to withdraw from the study at any given point.

Inclusion and Exclusion criteria: For this study, the inclusion criteria consisted of patients who met two specific conditions: they provided written consent and had received a diagnosis of hypothyroidism within the previous year. Patients who were unwilling to provide approval/consent were excluded from participating in the study.

The statistical analysis was conducted using Graph Pad version 6. The results were presented in a straightforward manner, indicating the mean value along with the standard deviation for the quantitative variables. A p-value of less than 0.05 was considered statistically significant, indicating a noteworthy association or difference.

Results

A total of 100 diagnosed hypothyroidism patients and same number of age- and sex-matched control was enrolled in our study.

Majority of the cases were 41-60 years age group (38%), predominantly females (61%), 55% residing at rural areas and 43% was belong to lower socio-economic status [table:1]

Significant association was seen between the serum iron , serum ferritin, TIBC and serum LDH level with the hypothyroid condition [table:2].

Table 1: Characteristic of the study participant

Characteristic of hypothyroid cases		Frequency (N=100)	Percentage (%)
Age groups (in years)	< 20	8	8%
	20-40	29	29%
	41-60	38	38%
	>60	25	25%
Gender	Male	39	39%
	Female	61	61%
Socio-economic status	Lower	43	43%
	Middle	37	37%
	Upper	20	20%
Residential status	Rural	55	55%
	Urban	45	45%

Table 2: Comparison of various parameters between cases and control of study participant

Parameter SEM	Cases(Mean± SD)	SEM	Controls(Mean± SD)	SEM	p value
T3	1.2± 0.16	0.010	0.51 ± 0.10	0.021	< 0.001*
T4	8.25 ± 1.26	0.160	4.41 ± 0.52	0.082	< 0.001*
TSH	2.20 ± 0.81	0.105	25.39 ± 5.96	0.079	< 0.001*
IRON	95.79 ± 27.38	9.38	49.05 ± 5.11	9.91	< 0.001*
FERRITIN	100.91 ± 42.76	5.71	23.09 ± 6.12	0.62	< 0.001*
TIBC	304.08 ± 30.01	8.36	470.37 ± 35.80	0.78	< 0.001*
LDH	298.72 ± 33.51	4.95	500.08 ± 74.36	4.43	< 0.001*

Discussion

In our investigation, we observed a notable reduction in levels of iron and ferritin, accompanied by an elevation in total iron-binding capacity (TIBC) among individuals exhibiting thyroid profile abnormalities. These alterations were indicated by diminished levels of T3 ($p<0.001$) and T4 ($p<0.001$) in the bloodstream.

These outcomes provide evidence of a positive association between iron deficiency and thyroid status. Our findings align with previous research [15]. Akhter *et al*. reported significant changes in thyroid hormone status in subjects with iron deficiency, influencing the enzymatic activity of thyroid peroxidase (TPO) and causing thyroid function disruptions [5].

Another study underscored that in instances of iron deficiency anemia, TPO activity diminishes, resulting in reduced transport of thyroid hormones into cells and the onset of hypothyroidism. Eftekhari *et al*. demonstrated a reciprocal relationship between plasma ferritin levels, thyroid hormones, and iron status.

Thyroid hormones play a pivotal role in governing transferrin gene expression, with T3 hormone capable of stimulating ferritin gene expression [16,17]. Furthermore, these hormones contribute to erythropoiesis and the development of erythroid colonies. Consequently, hypothyroidism may lead to bone marrow suppression and/or reduced erythropoietin production due to decreased oxygen demands [17].

In our investigation, we identified a rise in serum lactate dehydrogenase (LDH) activity in individuals diagnosed with hypothyroidism. This discovery aligns with previous research that reported increased LDH activity specifically in cases of primary hypothyroidism [18,19]. Thyroid dysfunction can exert an influence on the functioning of the liver, muscles, and kidneys, which are involved in the metabolism of thyroid hormones [20]. The observed elevation in LDH levels may potentially reflect alterations in hepatic clearance [21]. These changes could be attributed to a decrease in muscle mitochondrial oxidative capacity, reduced expression of β-adrenergic receptors, and the induction of insulin resistance [22]. Through our study, we established a correlation between LDH activity and the presence of hypothyroidism.

Our research aimed to establish a connection between the overall iron status of the body and alterations in thyroid function observed in hypothyroidism. The findings from our study provide valuable insights for medical professionals in assessing the iron profile of patients with thyroid disorders. To complement our objective, a study conducted by Hess SY *et al*. investigated the impact of iron (Fe) deficiency on the activity of thyroid peroxidase (TPO), an enzyme crucial for the synthesis of thyroid hormones.

In this study, male weanling Sprague-Dawley rats were arbitrarily assigned to different groups, each receiving varying levels of Fe in their diets. The findings of the study indicated that the groups characterized by iron (Fe) deficiency demonstrated decreased levels of hemoglobin, triiodothyronine (T3), and thyroxine (T4) in comparison to the ad libitum control group. This disparity in levels between the Fe-deficient groups and the control group was statistically significant ($P < 0.001$).

Multiple regression analysis indicated that food restriction significantly influenced T4 levels ($P < 0.0001$), whereas T3 levels remained unaffected. Moreover, the assessment of TPO activity using guaiacol and iodine assays demonstrated a significant reduction caused by both food restriction and

iron deficiency anemia ($P < 0.05$). Specifically, the ID-3, ID-7, and ID-11 groups displayed a substantial decrease in TPO activity per thyroid, as determined by the guaiacol assay, exhibiting reductions of 56%, 45%, and 33% respectively, in comparison to the ad libitum control group ($P < 0.05$). These findings strongly indicate that iron deficiency leads to a significant decline in TPO activity and suggest that this reduced TPO activity contributes to the adverse effects of iron deficiency anemia on thyroid metabolism [4].

Conclusion

In conclusion, our study highlights the impact of altered iron profile status and LDH levels on thyroid function. The findings provide valuable insights that can aid in the development of improved treatment strategies and enhance the overall comfort of patients with thyroid disorders.

However, further research with larger sample sizes is warranted to establish a more robust relationship and to eliminate potential confounding factors. The conducted research will foster a more comprehensive understanding of the intricate interplay among iron metabolism, LDH activity, and thyroid function. As a result, it will contribute to the enhancement of patient care and management practices.

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