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Original Research Article

Association of haematological parameters with thyroid dysfunction in non-pregnant women of reproductive age of Western Bihar

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ABSTRACT

Background: The interplay between thyroid imbalances and anaemia holds significant importance, particularly in non-pregnant women of childbearing age. Thyroid hormones are pivotal for erythropoiesis. Disruptions in thyroid function often exacerbate nutrient deficiencies, further aggravating anaemia. In western Bihar, where the prevalence of thyroid dysfunction and anaemia is notable, exploring this relationship is crucial for advancing women's health. Regular screening for thyroid dysfunction in anaemic patients, and vice versa, can significantly enhance diagnosis, management, and overall health outcomes. This study aims to assess haematological parameters in non-pregnant women of reproductive age across three thyroid hormonal statuses: euthyroid, hypothyroid, and hyperthyroid.
Methods: This record-based study spanned from January to December 2024, involving 225 non-pregnant females aged 18-45 years who visited clinical OPDs. Participants were divided into three groups (75 each): hypothyroidism, hyperthyroidism, and euthyroid controls. Haematological parameters were analyzed using a 6-part autoanalyzer for CBC, Leishman-stained PBS for RBC morphology, and thyroid function tests (TFT) conducted on a Vitros analyzer. A $p<0.05$ was considered statistically significant.
Results: Significant differences were observed in haemoglobin, RBC count, and total count between hypothyroid and hyperthyroid groups. RDW and AEC were elevated in hypothyroid cases, though within normal limits. MCV showed no significant variation, indicating normocytic anaemia in the hypothyroid group.
Conclusions: These findings highlight the profound impact of thyroid dysfunction on haematological health. Evaluating thyroid status in unexplained anaemia is essential, particularly in rural areas like western Bihar, to restore health and improve women's quality of life.

Keywords: Hyperthyroidism, Hypothyroidism, Anaemia, RDW, Thyroid hormone, Haematological parameters

INTRODUCTION

Thyroid hormones play a pivotal role in human physiology, acting as critical regulators of development, cellular differentiation, metabolic homeostasis, and the functional integrity of various tissues.[1] These hormones exert widespread effects, influencing everything from neuronal development and bone growth to cardiovascular function and energy expenditure. Given their far-reaching influence, disruptions in thyroid hormone levels can lead to a spectrum of disorders that significantly impact overall health.[2] Thyroid disorders represent a substantial proportion of endocrine-related clinical presentations particularly evident in women associated subfertility and early pregnancy loss, necessitating a comprehensive understanding of their diverse manifestations and underlying mechanisms to facilitate accurate diagnosis and effective management strategies.

The interplay between thyroid hormones and haematological parameters has garnered increasing attention in recent years, with studies highlighting

significant associations between thyroid dysfunction and various blood abnormalities.[4] Hypothyroidism, characterized by insufficient thyroid hormone production, has been frequently linked to anaemia, resulting from impaired erythropoiesis and iron metabolism.[4,5] Conversely, Grave's disease, a form of hyperthyroidism involving excessive thyroid hormone production, has been associated with erythrocytosis, an abnormal increase in red blood cell mass.[6,7] These observations underscore the intricate relationship between the endocrine and hematopoietic systems, suggesting that thyroid hormones may exert direct or indirect effects on the production, differentiation, and survival of blood cells.[8]

Given the increased vulnerability of women, especially during their reproductive years, to both anaemia and thyroid imbalances, investigating the impact of thyroid hormones on haematological parameters in this population is of paramount importance.[9] Understanding this relationship can improve early detection and treatment, potentially mitigating the adverse health consequences associated with concurrent thyroid and haematological disorders.[10] Notably, evidence suggests that restoring a euthyroid state, characterized by normal thyroid hormone levels, can effectively normalize abnormal haematological parameters in women.[6,11] Addressing a regional research gap, this study aims to comprehensively examine the associations between varying thyroid hormone levels (both within and outside the normal range) and basic haematological parameters in non-pregnant women of reproductive age, providing valuable insights for optimizing healthcare strategies in this specific demographic.

METHODS

Study design and population

The study design used is cross sectional.

This study was conducted to investigate the relationship between thyroid hormone levels and haematological parameters in non-pregnant women. The study population consisted of 275 female participants, aged 18 to 45 years, recruited from various clinical departments within our hospital. Participants were categorized into three groups based on thyroid function: hyperthyroidism (n=75), hypothyroidism (n=75), and a euthyroid control group (n=75).

Diagnostic criteria

Hyperthyroidism was diagnosed based on clinical features such as diffuse thyroid swelling, exophthalmos, tachycardia, tremor, palpitations, and sweating, supported by laboratory data showing reduced serum TSH levels (<0.35 mIU/L) and elevated serum T3 (>3.6 nmol/L) and T4 (>160 nmol/L) levels.

Hypothyroidism was diagnosed by identifying symptoms and signs like weight gain and dry skin, alongside laboratory evidence of low T3 (<1.6 nmol/L) and T4 (<60 nmol/L) levels and elevated TSH (>3.5 mIU/L) levels. Only patients with complete T3, T4, and TSH test results were included for categorization.

The euthyroid control group consisted of age- and sex-matched women with suspected thyroid disorders but serologically normal thyroid hormone values (T3: 1.8-3.6 nmol/L; T4: 60-160 nmol/L; TSH: 0.35-3.5 mIU/L).

Inclusion criteria

Females aged from 18 to 45 years were included.

Exclusion criteria

Known cases of hypo-or hyperthyroidism under treatment, malignancy, recent surgery or major trauma (within six months), chronic diseases, pregnancy, and a history of bleeding disorders were excluded.

Sample collection and analysis

Blood sampling: Peripheral blood samples (2-4 mL) in EDTA were collected from all participants. Serum was separated and stored at -20°C for subsequent analysis.

Thyroid hormone measurement: Serum concentrations of T3, T4, and TSH were measured using electrochemiluminescence immunoassay on a VITROS 4600 autoanalyzer.

Haematological parameters

Blood cell counts: Total and differential leukocyte counts were performed on EDTA-anticoagulated peripheral blood samples using a Siemens ADVIA 2120 six-part haematology analyser.

Standardized parameters: Haemoglobin (Hb), total leukocyte count (TC), red blood cell (RBC) count, red cell indices, red cell distribution width (RDW), and platelet count were determined following routine internal and external quality control procedures.

Peripheral smears: Prepared and stained with Leishman stain for morphological assessment.

RESULTS

This Table 2 presents the thyroid hormone levels (T3, T4, and TSH) for the three study groups. The data confirms that the hypothyroid group had low T3 and T4 and high TSH, the euthyroid group had hormone levels within the normal range, and the hyperthyroid group had high T3 and T4 and low TSH. This demonstrates successful categorization of the participants.

This Table 3 compares hematological parameters between

hypothyroid and euthyroid subjects. The hypothyroid group had significantly lower Hb, RBC, MCHC, and TLC, and significantly higher RDW and AEC compared to the euthyroid group ($p<0.05$). MCV and PLT did not show statistically significant differences.

These results suggest that hypothyroidism is associated with lower red blood cell indices and white blood cell counts.

This Table 4 presents the comparison of hematological parameters between hyperthyroid and euthyroid subjects. None of the hematological parameters showed statistically significant differences between the two groups ($p>0.05$). This indicates that, in this study, hyperthyroidism was not associated with significant changes in the measured hematological parameters compared to the euthyroid state.

This Table 5 compares hematological parameters directly between the hypothyroid and hyperthyroid groups. Hb, RBC, MCHC, TLC, PLT, RDW and AEC all showed statistically significant differences between the hypothyroid and hyperthyroid groups ($p<0.05$).

These results highlight the contrasting hematological profiles associated with these two thyroid dysfunction states, with hypothyroid subjects generally having lower values for red and white blood cell parameters and platelet counts, and high RDW and AEC compared to hyperthyroid subjects.

Table 1: Demographic representation of the all the subjects.

Thyroid function category	N	Age range (in years)
Hyperthyroidism	75	18-45
Hypothyroidism	75	18-45
Euthyroid (control group)	75	18-45
Total	225	18-45

Table 2: Distribution of thyroid hormone levels in the three groups.

Hormone	Hypothyroid subjects, (n=75)	Euthyroid subjects, (n=75)	Hyperthyroid subjects, (n=75)
T3 (nmol/l)	1.2±0.40	3.05±0.380	4.10±1.70
T4 (nmol/l)	50.00±39.00	140.00±145	210.00±16.0
TSH (m IU/l)	145±190.00	1.75±0.65	0.06±0.03

Table 3: Comparison of hematological parameters between hypothyroid and euthyroid subjects.

Parameters	Hypothyroid subjects, (n=75)	Euthyroid subjects, (n=75)	P value
Hb (g/dl)	11.30±1.30	12.70±1.00	0.001*
RBC ($\times10^6$/µl)	4.0±0.35	4.7±0.40	0.001*
MCV (fl)	84.00±7.00	83.20±5.00	0.550
MCH (pg)	28.10±1.20	28.60±1.10	0.04
MCHC (g/dl)	32.50±1.30	33.30±1.10	0.001*
TLC ($\times10^3$/µl)	5900.0±1450.0	7100.0±1300.0	0.001*
PLT ($\times10^3$/µl)	2.45±0.70	2.80±0.70	0.62
RDW (%)	14.60±1.30	13.10±1.30	0.001*
AEC	410±150.0	250±80.0	0.001*

*P value statistically significant.

Table 4: Comparison of hematological parameters between hyperthyroid and euthyroid subjects.

Parameters	Hyperthyroid subjects, (n=75)	Euthyroid subjects, (n=75)	P value
Hb (g/dl)	12.90±0.90	12.70±1.00	0.200
RBC ($\times10^6$/µl)	4.9±0.25	4.7±0.40	0.750
MCV (fl)	83.50±6.00	83.20±5.00	0.800
MCH (pg)	28.60±1.20	28.60±1.10	0.930
MCHC (g/dl)	33.20±1.10	33.30±1.10	1.000
TLC ($\times10^3$/µl)	7100±1300.0	7100.0±1300.0	0.960
PLT ($\times10^3$ µl)	3.00±0.80	2.80±0.70	0.170
RDW	13.50±1.40	13.10±1.30	0.160
AEC	230.00±70.0	270±80.0	0.060

Table 5: Comparison of hematological parameters between hypothyroid and hyperthyroid subjects.

Parameters	Hypothyroid subjects	Hyperthyroid subjects	P value
Hb (g/dl)	11.30±1.30	12.90±0.90	0.000*
RBC (×10^6/µl)	4.0±0.35	4.9±0.25	0.0020
MCV (fl)	84.00±7.00	83.50±6.00	0.720
MCH (pg)	28.10±1.20	28.60±1.20	0.060
MCHC	32.50±1.30	33.20±1.10	0.009*
TLC (×10^3/µl)	5900.0±1450.0	7100±1300.0	0.000*
PLT (×10^3/µl)	2.45±0.70	3.00±0.80	0.003*
RDW (%)	14.60±1.30	13.50±1.40	0.000*
AEC	410±150.0	230.00±70.0	0.000*

*P value statistically significant.

DISCUSSION

Thyroid hormones are pivotal in maintaining metabolic homeostasis within the human body, and imbalances are prevalent endocrine disorders, affecting an estimated 2-5% of the global population.[12,13] These hormones are particularly crucial for women during their reproductive years, supporting normal fetal development. Thyroid hormones promote erythropoiesis by stimulating erythroid progenitor proliferation in the bone marrow and enhancing oxygen delivery to tissues via 2,3-diphosphoglycerate (2, 3-DPG)[5,14]

In this study, hypothyroid subjects exhibited lower Hb levels, aligning with the established role of thyroid hormone receptors on erythropoietic progenitor cells in RBC production. Hypothyroidism is associated with anemia due to impaired erythroid colony stimulation, reduced oxygen distribution, and decreased erythropoietin levels.[14,15] Consistent with previous research, this study supports the notion that iron absorption and anemia can improve with levothyroxine therapy in hypothyroid individuals. While normocytic normochromic anemia was predominant in hypothyroid subjects, findings on mean corpuscular volume changes in hypo-and hyperthyroid subjects remain inconsistent across studies.[16] Total leukocyte counts were lower in hypothyroid subjects compared to hyperthyroid subjects, which aligns with the influence of thyroid hormones on hematopoiesis, although leukocyte count variations among thyroid groups have yielded conflicting results in prior investigations.[17,18]

Furthermore, hypothyroid subjects presented lower platelet counts compared to hyperthyroid and euthyroid subjects, along with statistically significantly higher eosinophil counts. Increased red cell distribution width (RDW) in hypothyroid subjects indicates variations in RBC sizes, reinforcing the recommendation to evaluate thyroid function in patients with unexplained anemias and elevated RDW, alongside folate and vit B12 levels.[18-20]

CONCLUSION

Thyroid hormones play a crucial role in regulating various hematological parameters, underscoring the importance of evaluating thyroid hormone levels in unexplained anemias, particularly in women of reproductive age. Treating thyroid hormone imbalances may help restore hematological parameters to normal, thereby avoiding unnecessary investigations and therapies. Large-scale studies are warranted to further elucidate the complex interplay between hematological parameters and thyroid hormones.

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