

Association of Thyroid Dysfunction with Anemia in Hospitalized Patients

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ABSTRACT

Background: Thyroid dysfunction may contribute to anemia through impaired erythropoietin production, altered iron metabolism, nutritional deficiencies, and reduced bone marrow activity. **Objective:** To evaluate the association between thyroid dysfunction and anemia among hospitalized patients. **Methods:** This retrospective observational study was conducted at Department of Medicine PNS Hafeez Islamabad from June 2024 to June 2025 and included 120 hospitalized patients who underwent thyroid function testing and complete blood count evaluation. Baseline demographic variables included age, gender, body mass index, duration of hospitalization, smoking status, diabetes mellitus, hypertension, chronic kidney disease, cardiovascular disease, and previous history of thyroid disorders. **Results:** The mean age of patients was 51.8 ± 15.2 years, and 66 (55.0%) were female. Among the participants, 62 (51.7%) were euthyroid, 42 (35.0%) had hypothyroidism, and 16 (13.3%) had hyperthyroidism. Mean hemoglobin was significantly lower in hypothyroid patients than in hyperthyroid and euthyroid patients (10.9 ± 1.6 vs. 11.6 ± 1.5 vs. 12.8 ± 1.4 g/dL; $p < 0.001$). Anemia was present in 28 (66.7%) hypothyroid, 8 (50.0%) hyperthyroid, and 19 (30.6%) euthyroid patients ($p < 0.001$). Hypothyroid patients also had lower ferritin and vitamin B12 levels and a greater frequency of moderate, severe, microcytic, and macrocytic anemia. **Conclusion:** Thyroid dysfunction was significantly associated with anemia among hospitalized patients, with hypothyroidism showing the strongest relationship. Routine assessment of thyroid function, iron stores, and vitamin B12 levels may improve the diagnosis and management of unexplained anemia in hospitalized patients...

Keywords: Thyroid dysfunction; hypothyroidism; hyperthyroidism; anemia; hemoglobin; ferritin; vitamin B12

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INTRODUCTION

Thyroid dysfunction is a common endocrine problem in all over the world and has many metabolic, cardiovascular, hematological and systemic complications. Hypothyroidism and hyperthyroidism can, respectively, either increase or decrease the production of thyroid hormone, thereby impacting many physiological processes, and causing a substantial morbidity if untreated [1]. Anemia is one of the less known but clinically relevant complications of thyroid diseases and is a cause of fatigue, decreased functional capacity, decreased quality of life, extended hospitalization and higher levels of health care use [2]. Thyroid hormones are crucial for erythropoiesis, acting by stimulating production of erythropoietin (EPO),

stimulating proliferation of erythroid progenitor cells, regulation of iron metabolism and normal maturation of red blood cells [3]. Changes in the level of thyroid hormone will affect these physiology functions and cause the reduction of red blood cell production and abnormalities in hemoglobin synthesis. Patients with either hypothyroidism or hyperthyroidism can therefore suffer from anemia in a number of ways [4]. Anemia is seen more often in hypothyroidism, and can be normocytic normochromic, microcytic hypochromic or macrocytic microcytic anemia depending on the underlying mechanism [5]. Hypothyroid patients are prone to anemia, due to decreased EPO production, decreased bone marrow activity, iron deficiency caused by menorrhagia, and vitamin B12 deficiency caused by autoimmune gastritis, and folate

deficiency [6]. Hyperthyroidism, however, can also contribute to anemia due to increased RBC turnover, defective RBC formation, inadequate nutrition and chronic inflammatory reactions [7]. Hospitalized patients often have several comorbidities which can have a synergistic effect on increasing the risk of thyroid dysfunction and the risk of anemia. The association between thyroid disorders and anemia is clinically relevant in inpatients because the underlying diseases of anemia and thyroid disorders (diabetes mellitus, chronic kidney disease, infections, malignancies, autoimmune diseases, nutritional deficiencies, chronic inflammatory conditions) often coexist with each other. Withholding the diagnosis of underlying thyroid dysfunction might set a delay in diagnosis and affect the use of the right management for the patient with anemia. Previous studies have been conducted that reported a range in prevalence of anemia from 20% to more than 60% among patients with thyroid dysfunction, depending on the patient population, the severity of thyroid dysfunction and the diagnostic criteria [9]. Thyroid abnormalities, on the other hand, can often be discovered when patients are being evaluated for an anemia of unknown cause, indicating that there is a relationship between the two [10]. Appropriate treatment of anemia, therefore, may be possible with early detection and recognition of thyroid dysfunction and may be beneficial to the patient.

Laboratory testing is an important part of the diagnosis of thyroid-related anemia. Serum thyroid-stimulating hormone (TSH), free thyroxine (FT4), free triiodothyronine (FT3), hemoglobin concentration, red blood cell indices, and serum ferritin, vitamin B12, and iron studies are useful tools to assess thyroid function and the etiology of anemia [11]. Mean corpuscular volume (MCV) helps identify iron deficiency, vitamin B12 deficiency, folate deficiency, anemia of chronic disease, and a combination of these. Important clinical implications of the relationship between thyroid dysfunction and anemia are obtained from the recognition of the association. If hypothyroidism is present, thyroid hormone replacement and if hyperthyroidism is present, treatment of hyperthyroidism may also benefit hematological recovery and improve hemoglobin levels, and nutritional deficiencies may be corrected concurrently to further improve hematological recovery [12]. Thus, screening for thyroid dysfunction might be especially important in the hospitalized patient with an unexplained or refractory anemia. Although there is growing evidence on the relationship between thyroid disorders and hematological disorders, little information exists from the inpatient population in developing countries. The link between thyroid dysfunction and anemia could be affected by variation in nutrition, iodine intake, autoimmune diseases and health services [13].

Objective

To evaluate the association between thyroid dysfunction and anemia among hospitalized patients.

Methodology

This retrospective observational study was conducted at Department of Medicine PNS Hafeez Islamabad from June 2024 to June 2025 and included 120 hospitalized patients. Patients aged 18 years or older who were hospitalized and had both thyroid function testing (TSH, free thyroxine [FT4]) and complete blood count testing done during their hospitalizations were included. Records of the patients were complete and suitable for analysis. Patients were excluded if they had a known hematological malignancy, recent major hemorrhage, pregnancy, chronic liver disease, a blood transfusion received within three months, chemotherapy-induced anemia, inherited hemoglobin disorders, incomplete laboratory records, or if patients refused to allow their medical records to be used for research.

Data Collection

After obtaining the approval from Institutional Ethical Review Committee, patient information was retrieved from the electronic medical records, admission records, laboratory database and discharge summaries of the hospital with a standardized data collection form. Baseline demographic data included age, gender, BMI, duration of hospital stay, smoking, DM, hypertension, chronic kidney disease, and past history of thyroid disease. Laboratory and clinical parameters measured were thyroid-stimulating hormone (TSH), free thyroxine (FT4), free triiodothyronine (FT3), if available, hemoglobin concentration, hematocrit, red blood cell count, mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), red cell distribution width (RDW), serum ferritin, serum iron, vitamin B12, folate, serum creatinine, estimated glomerular filtration rate (eGFR), and C-reactive protein (CRP). Patients were categorized into euthyroid, hypothyroid and hyperthyroid groups using standard laboratory reference values. It was determined on the basis of the World Health Organization criteria (Hb <13 g/dL in men and <12 g/dL in women) and classified as microcytic, normocytic or macrocytic according to the mean corpuscular volume. The main result was an association between thyroid dysfunction and anemia among hospitalized patients. Secondary outcomes were the incidence and type of anemia in various thyroid conditions, differences in hematological parameters between the thyroid function groups, relationship of thyroid hormone levels with hemoglobin concentration, and independent association of anemia with different variables in the hospital setting.

Statistical Analysis

The data were analyzed by using SPSS version 26.0. Continuous variables were reported as mean $\pm$ standard deviation and categorical variables were reported as frequencies and percentages. Comparisons of continuous variables between thyroid function groups were made by independent t-test or one-way ANOVA and for categorical variables Chi-square were used. Pearson or Spearman correlation was used to assess the correlation of thyroid parameters with hematological parameters. Odds Ratios

(ORs) and 95% Confidence Intervals (CIs) were computed, and a p-value < 0.05 was deemed statistically significant.

Results

The mean age of the 120 hospitalized patients was 51.8 ± 15.2 years, with females forming a slight majority (66, 55.0%). The mean BMI was 27.3 ± 4.6 kg/m², while diabetes mellitus, hypertension, and chronic kidney disease

were present in 41 (34.2%), 48 (40.0%), and 17 (14.2%) patients, respectively. The average hospital stay was 6.8 ± 2.7 days. Thyroid assessment showed that 62 (51.7%) patients were euthyroid, 42 (35.0%) had hypothyroidism, and 16 (13.3%) had hyperthyroidism. The mean TSH level was 6.7 ± 5.8 mIU/L, and the mean FT4 level was 1.09 ± 0.38 ng/dL.

Table 1: Baseline Demographic, Clinical, and Thyroid Characteristics of Hospitalized Patients (N = 120)

Variable	n (%) / Mean $\pm$ SD
Age (years)	51.8 ± 15.2
Male	54 (45.0)
Female	66 (55.0)
Body mass index (kg/m ²)	27.3 ± 4.6
Diabetes mellitus	41 (34.2)
Hypertension	48 (40.0)
Chronic kidney disease	17 (14.2)
Mean hospital stay (days)	6.8 ± 2.7
Euthyroid	62 (51.7)
Hypothyroidism	42 (35.0)
Hyperthyroidism	16 (13.3)
Mean TSH (mIU/L)	6.7 ± 5.8
Mean FT4 (ng/dL)	1.09 ± 0.38

Patients with hypothyroidism had the lowest mean hemoglobin level at 10.9 ± 1.6 g/dL, compared with 11.6 ± 1.5 g/dL in hyperthyroid patients and 12.8 ± 1.4 g/dL in euthyroid patients ($p < 0.001$). Hematocrit was also significantly lower in the hypothyroid group ($33.4 \pm 4.5\%$) than in the hyperthyroid ($35.6 \pm 4.2\%$) and euthyroid groups ($38.5 \pm 4.1\%$; $p < 0.001$).

Table 2: Hematological Profile According to Thyroid Function

Variable	Euthyroid (n=62)	Hypothyroid (n=42)	Hyperthyroid (n=16)	p-value
Hemoglobin (g/dL)	12.8 ± 1.4	10.9 ± 1.6	11.6 ± 1.5	<0.001
Hematocrit (%)	38.5 ± 4.1	33.4 ± 4.5	35.6 ± 4.2	<0.001
MCV (fL)	88.4 ± 5.7	85.2 ± 7.3	87.0 ± 6.8	0.031
Ferritin (ng/mL)	91.8 ± 35.6	69.2 ± 30.8	76.5 ± 31.4	0.004
Vitamin B12 (pg/mL)	342.7 ± 89.5	279.4 ± 82.6	301.8 ± 85.1	0.008

Anemia was most prevalent among hypothyroid patients, affecting 28 (66.7%), followed by 8 (50.0%) hyperthyroid and 19 (30.6%) euthyroid patients ($p < 0.001$). Moderate and severe anemia were also more frequent in the hypothyroid group, occurring in 13 (31.0%) and 4 (9.5%) patients, respectively. Microcytic anemia was the most common pattern in hypothyroidism, affecting 12 (28.6%) patients, while normocytic and macrocytic anemia were observed in 11 (26.2%) and 5 (11.9%) patients, respectively.

Table 3: Prevalence and Types of Anemia According to Thyroid Status

Variable	Hypothyroid (n=42)	Hyperthyroid (n=16)	Euthyroid (n=62)	p-value
Patients with anemia	28 (66.7%)	8 (50.0%)	19 (30.6%)	<0.001
Mild anemia	11 (26.2%)	4 (25.0%)	10 (16.1%)	0.298
Moderate anemia	13 (31.0%)	3 (18.8%)	8 (12.9%)	0.032
Severe anemia	4 (9.5%)	1 (6.2%)	1 (1.6%)	0.041
Microcytic anemia	12 (28.6%)	3 (18.8%)	8 (12.9%)	0.048
Normocytic anemia	11 (26.2%)	4 (25.0%)	9 (14.5%)	0.126
Macrocytic anemia	5 (11.9%)	1 (6.2%)	2 (3.2%)	0.039

Multivariable analysis showed that hypothyroidism was the strongest independent predictor of anemia (AOR=4.62, 95% CI: 1.86–11.49; $p<0.001$), while hyperthyroidism also significantly increased the risk (AOR=2.41, 95% CI: 1.01–5.78; $p=0.047$).

Table 4: Multivariable Logistic Regression Analysis of Factors Associated with Anemia

Predictor	Adjusted OR	95% CI	p-value
Hypothyroidism	4.62	1.86–11.49	<0.001
Hyperthyroidism	2.41	1.01–5.78	0.047
Female gender	2.18	1.02–4.69	0.044
Chronic kidney disease	3.84	1.42–10.38	0.008
Serum ferritin <50 ng/mL	3.56	1.48–8.58	0.005
Vitamin B12 deficiency	2.91	1.17–7.21	0.021

Discussion

In the present retrospective study, the relationship between thyroid dysfunction and anemia was investigated in 120 hospitalized patients, which showed a significant relationship between thyroid dysfunction and the reduced hematological parameters. After controlling for potentially confounding factors, hypothyroidism was the most consistent independent risk factor for anemia, and the most reported anemia in this study. Furthermore, chronic kidney disease, low serum ferritin, low vitamin B12, being female and hyperthyroidism were all independently associated with anemia. The results of this study underscore the need for regular TFT in hospitalized patients with unexplained anemia. The mean age of the study population was 51.8 ± 15.2 years, and 55.0% were females. There was a high prevalence of comorbidities such as diabetes mellitus, hypertension, and chronic kidney disease in 14.2% of patients. Hypothyroidism occurred in about a third of the study population, while 13.3% of patients had hyperthyroidism. A previous study also found that middle-aged and elderly adults with several chronic medical conditions are also more likely to have thyroid dysfunction, especially those who are hospitalized [16]. Patients with hypothyroidism had significantly decreased hemoglobin and hematocrit values when compared to patients with euthyroidism. The serum ferritin and vitamin B12 levels were also decreased in hypothyroid patients, indicating that nutritional deficiency plays an important role in thyroid-related anemia. Previous studies have also shown that decreased thyroid hormone levels decrease erythropoietin production, affect the proliferation of erythroid precursors, and are often associated with iron and vitamin B12 deficiencies, leading to much lower hemoglobin levels [17]. Hypothyroid patients had the highest incidence of anemia, with two-thirds of them affected, followed by half of

hyperthyroid patients and less than one-third of euthyroid patients. Anemia (moderate and severe) was also significantly higher in the hypothyroid patients. The most common hematologic pattern was microcytic anemia, but normocytic and macrocytic anemias were also seen. Hypothyroidism has also been found to be associated with several different morphological patterns of anemia as a function of the presence of iron deficiency, chronic inflammation, vitamin B12 deficiency and folate deficiency, as described in previous studies. Hyperthyroid patients had significantly lower hemoglobin levels than euthyroid patients but were not as likely as hypothyroid patients to have anemia. This could be due to increased metabolic demands, accelerated erythrocyte turnover and ineffective erythropoiesis, and nutritional deficiencies. Hyperthyroidism has also been shown to cause mild-to-moderate anemia in the past, despite the raised bone marrow activity due to the destruction of erythrocytes, which is often greater than compensatory erythropoiesis [18]. Hypothyroidism was the strongest independent factor associated with anemia, with the multivariable logistic regression analysis showing that this condition boosted the risk of anemia by over 4-fold. Hyperthyroidism was a risk factor as well, but was not as strong. It has been consistently shown in previous studies that thyroid dysfunction causes anemia on its own through several pathways, including decreased production of erythropoietin, iron metabolism abnormalities, chronic inflammation and decreased responsiveness of the bone marrow [19]. Other than that, vitamin B12 deficiency and serum ferritin were also independently associated with anemia in this study. The level of ferritin and vitamin B12 were significantly decreased in hypothyroid patients compared with euthyroid patients, confirming that thyroid related anemia is probably multifactorial. In line with this, previous studies have

demonstrated a frequent association of autoimmune thyroid disease with autoimmune gastritis, iron deficiency and a vitamin B12 deficiency, which is also associated with lower hemoglobin levels and a mixed type of anemia. Another independent predictor for anemia was chronic kidney disease. The increased rates of anemia in these patients may have been related to decreased erythropoietin production, chronic inflammation, iron utilization, and a coexistence of thyroid dysfunction. Earlier studies have also shown that in the majority of patients with chronic kidney disease, thyroid dysfunction is common and is known to have additive harmful effects on anemia, both in intensity and duration [20]. This study was limited by its retrospective, single-center design and relatively small sample size, which may restrict generalizability. Reliance on existing records may have introduced incomplete documentation and residual confounding. Some potential causes of anemia, including occult blood loss, chronic inflammation, medication use, thyroid autoantibodies, and detailed iron studies, were not consistently available. The study also lacked follow-up data to assess hematological improvement after treatment of thyroid dysfunction.

Conclusion

Thyroid dysfunction is significantly associated with anemia among hospitalized patients, with hypothyroidism demonstrating the highest prevalence and representing the strongest independent predictor of anemia. Patients with thyroid dysfunction exhibited lower hemoglobin levels and a higher frequency of microcytic, normocytic, and macrocytic anemia compared with euthyroid individuals. Female gender, chronic kidney disease, low serum ferritin, and vitamin B12 deficiency further increased the risk of anemia. Routine assessment of thyroid function in hospitalized patients presenting with unexplained anemia may facilitate early diagnosis, prompt initiation of appropriate endocrine and hematological management, and improved clinical outcomes.

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