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Original Research Article

Study of Types of Anemia in Patients Suffering from Hypothyroidism: A Cross-Sectional Study

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Abstract

Background: Hypothyroidism is frequently associated with hematological abnormalities, particularly anemia. Reduced erythropoietic activity and deficiencies of iron, vitamin B12 and folate may contribute to different morphological patterns of anemia.

Aim: To determine the prevalence and morphological types of anemia in patients with hypothyroidism and evaluate associated hematological and biochemical parameters.

Materials and Methods: This hospital-based cross-sectional study included 110 patients with hypothyroidism aged 18–65 years at Government Medical College and Associated Hospital, Datia. Clinical assessment and laboratory investigations, including complete blood count, thyroid function tests, serum iron, ferritin, vitamin B12 and folate, were performed. Anemia was classified according to morphological characteristics. Statistical significance was considered at $p < 0.05$.

Results: Anemia was present in 49 patients (44.55%). Normocytic normochromic anemia was the most common type (38.78%), followed by microcytic hypochromic (26.53%), macrocytic (20.41%) and dimorphic anemia (14.29%). Females constituted 59.09% of the study population. Ferritin concentrations were significantly lower in microcytic and dimorphic anemia, whereas vitamin B12 and folate concentrations were significantly reduced in macrocytic and dimorphic anemia ($p = 0.001$). Hemoglobin, RBC count and MCV differed significantly across anemia groups. No significant differences were observed in T3, T4 or TSH levels among the morphological types ($p > 0.05$).

Conclusion: Anemia was common among patients with hypothyroidism, with normocytic normochromic anemia being the predominant type. Differences in iron stores and vitamin levels were associated with distinct morphological patterns. Evaluation of hematological indices and relevant nutritional parameters may help identify underlying deficiencies and guide individualized management.

Keywords: Hypothyroidism; Anemia; Normocytic anemia; Iron deficiency; Vitamin B12; Folate; Ferritin.
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Introduction

Hypothyroidism is a common endocrine disorder characterized by reduced thyroid hormone production and widespread metabolic disturbances. Thyroid hormones regulate several physiological processes, including oxygen consumption, cellular metabolism and erythropoiesis. Their deficiency can affect multiple organ systems, including the hematopoietic system.[1] Hypothyroidism is more frequently diagnosed in women and older individuals, with considerable variation in prevalence across geographical regions.[2,3] In India, hypothyroidism represents an important health concern, with a multicentric study reporting a prevalence of approximately 10.95% among adults.[4] Anemia is a frequently encountered hematological abnormality in patients with hypothyroidism. Its development involves several mechanisms, including reduced erythropoietin

production, decreased bone marrow activity, impaired iron utilization and associated nutritional deficiencies. The resulting anemia may be normocytic normochromic, microcytic hypochromic or macrocytic, depending on the underlying mechanism.[5] Normocytic normochromic anemia is commonly associated with reduced erythropoietic activity, whereas microcytic hypochromic anemia is generally related to iron deficiency. Macrocytic anemia may develop due to vitamin B12 or folate deficiency, particularly in patients with associated autoimmune disorders. Previous studies have demonstrated that anemia occurs in both overt and subclinical hypothyroidism, although its prevalence and morphological characteristics vary across populations.[6] Thyroid dysfunction may also influence hematological indices, including hemoglobin concentration, red blood cell count and mean corpuscular volume. These alterations suggest a relationship between thyroid hormone status and erythrocyte production.[7] However, anemia in hypothyroid patients may have several contributing causes, making evaluation of hematological and nutritional parameters necessary. The present study was undertaken to determine the prevalence and morphological types of anemia among patients with hypothyroidism and to assess associated biochemical parameters, including serum iron, ferritin, and vitamin B12 and folate levels.

Materials and Methods

Study Design and Setting: This hospital-based cross-sectional observational study was conducted in the Department of General Medicine, Government Medical College and Associated Hospital, Datia, Madhya Pradesh, over 18 months. A total of 110 patients with hypothyroidism, aged 18–65 years, were enrolled using consecutive sampling.

Inclusion and Exclusion Criteria: Patients with newly diagnosed or previously established hypothyroidism, confirmed by elevated serum thyroid-stimulating hormone (TSH) levels with or without reduced free thyroxine (FT4), were included after obtaining written informed consent. Pregnant and lactating women, patients with known hematological disorders, chronic kidney or liver disease, malignancy, active infections, recent blood transfusion, acute hemorrhage or recent surgery were excluded. Patients receiving iron, vitamin B12 or folic acid supplementation before evaluation were also excluded.

Data Collection and Laboratory Investigations: A detailed clinical history and physical examination were performed for each participant. Venous blood samples were collected for complete blood count, thyroid function tests, serum iron, ferritin, vitamin B12 and folate estimation.

Hematological parameters were measured using an automated hematology analyzer, while biochemical investigations were performed using standardized laboratory methods. Peripheral blood smears and red cell indices were used to classify anemia into normocytic normochromic, microcytic hypochromic, macrocytic and dimorphic types.

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using SPSS version 21. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. The Chi-square test was used to assess associations between categorical variables, and Student's t-test was applied for comparisons of means between two groups. A p-value <0.05 was considered statistically significant.

Results: The present study included 110 patients with hypothyroidism, of whom 65 (59.09%) were female and 45 (40.91%) were male. Most patients belonged to the 31–40 years (30.91%) and 41–50 years (29.09%) age groups. Anemia was identified in 49 patients (44.55%), while 61 (55.45%) had no anemia. Among patients with anemia, normocytic normochromic anemia was the most common morphological type (38.78%), followed by microcytic hypochromic (26.53%), macrocytic (20.41%) and dimorphic anemia (14.29%).

Table 1: Demographic Characteristics of the Study Population (n = 110)

Characteristics	Number (n)	Percentage (%)
Age group (years)		
18–30	12	10.91
31–40	34	30.91
41–50	32	29.09
51–60	15	13.64
61–65	17	15.45
Sex		
Male	45	40.91
Female	65	59.09
Anemia status		
Anemia present	49	44.55
Anemia absent	61	55.45

Most patients were between 31 and 50 years of age, and females constituted a larger proportion of the study population. Anemia was observed in approximately 45% of patients with hypothyroidism.

Table 2: Distribution of Morphological Types of Anemia (n = 49)

Type of anemia	Number (n)	Percentage (%)
Normocytic normochromic	19	38.78
Microcytic hypochromic	13	26.53
Macrocytic	10	20.41
Dimorphic	7	14.29
Total	**49**	**100.00**

Normocytic normochromic anemia was the predominant morphological pattern, accounting for 38.78% of anemic patients. Microcytic hypochromic anemia was the second most frequent type, while dimorphic anemia was the least common.

Table 3: Distribution of Anemia Types According to Age and Sex (n = 49)

Characteristics	Normocytic n (%)	Microcytic n (%)	Macrocytic n (%)	Dimorphic n (%)
Age group (years)				
18–30	2 (40.00)	2 (40.00)	0 (0.00)	1 (20.00)
31–40	6 (37.50)	3 (18.75)	5 (31.25)	2 (12.50)
41–50	6 (42.86)	4 (28.57)	2 (14.29)	2 (14.29)
51–60	3 (42.86)	2 (28.57)	1 (14.29)	1 (14.29)
61–65	2 (28.57)	2 (28.57)	2 (28.57)	1 (14.29)
Sex				
Male	7 (33.33)	6 (28.57)	4 (19.05)	4 (19.05)
Female	12 (42.86)	7 (25.00)	6 (21.43)	3 (10.71)

Normocytic normochromic anemia remained the most frequent morphological type across most age groups. Microcytic anemia was relatively more frequent among patients aged 18–30 years, whereas macrocytic anemia accounted for a larger proportion of cases in the 31–40-year group. Normocytic anemia was the predominant pattern in both sexes.

Table 4: Comparison of Biochemical and Hematological Parameters across Anemia Types

Parameter	Normocytic (n=19)	Microcytic (n=13)	Macrocytic (n=10)	Dimorphic (n=7)	p-value
T3	1.41 ± 0.36	1.42 ± 0.31	1.39 ± 0.33	1.61 ± 0.35	0.28
T4	8.06 ± 1.88	9.37 ± 1.69	9.20 ± 1.93	8.74 ± 2.21	0.12
TSH	10.10 ± 1.25	9.88 ± 1.13	9.84 ± 1.39	10.32 ± 1.34	0.61
Serum iron	77.45 ± 30.67	52.34 ± 32.83	97.00 ± 37.03	51.68 ± 33.98	0.07
Ferritin	150.43 ± 83.47	7.68 ± 3.82	156.45 ± 83.67	7.39 ± 9.36	**0.001**
Vitamin B12	525.68 ± 210.32	495.50 ± 190.05	78.32 ± 76.11	93.26 ± 103.56	**0.001**
Folate	10.47 ± 5.76	10.58 ± 5.56	4.37 ± 1.90	4.35 ± 2.50	**0.001**
Hemoglobin	11.38 ± 2.00	10.46 ± 1.34	9.48 ± 1.44	11.63 ± 1.68	**0.01**
RBC count	4.54 ± 0.48	3.02 ± 0.38	2.13 ± 0.52	4.39 ± 0.58	**0.001**
MCV	84.69 ± 9.22	67.84 ± 7.26	115.00 ± 8.40	83.16 ± 8.80	**0.001**

Thyroid hormone parameters (T3, T4 and TSH) did not differ significantly across the four anemia groups ($p > 0.05$). Serum ferritin was markedly lower in patients with microcytic and dimorphic anemia ($p = 0.001$). Vitamin B12 and folate concentrations were substantially reduced in the macrocytic and dimorphic groups ($p = 0.001$). Significant differences were also observed in hemoglobin concentration, RBC count and MCV, consistent with the morphological characteristics of the respective anemia types.

Discussion: The present study evaluated the prevalence and morphological patterns of anemia among 110 patients with hypothyroidism. Anemia was identified in 49 patients (44.55%), indicating that hematological abnormalities are common in this population. Normocytic normochromic anemia was the predominant type (38.78%), followed by microcytic hypochromic (26.53%), macrocytic (20.41%) and dimorphic anemia (14.29%).

These findings suggest that anemia in hypothyroidism may arise through different mechanisms, including reduced erythropoietic activity and associated nutritional deficiencies. The predominance of normocytic normochromic anemia is consistent with the observations of Das et al.[8], who demonstrated reduced erythropoietin levels and decreased bone marrow erythropoietic activity in patients with hypothyroidism. Horton et al.[9] also reported different hematological

abnormalities in hypothyroid patients, including anemia associated with thyroid hormone deficiency. The relatively high proportion of normocytic anemia in the present study may reflect reduced erythropoietic stimulation, although erythropoietin levels were not directly measured.

Microcytic hypochromic anemia accounted for 26.53% of anemic patients. Serum ferritin concentrations were markedly reduced in the microcytic and dimorphic groups, suggesting depleted iron stores. Beard and Tobin[10] described the relationship between iron metabolism and thyroid hormone function, while Zimmermann[11] reported that iron deficiency may adversely affect thyroid hormone synthesis and metabolism. The present findings support the importance of assessing iron status in hypothyroid patients presenting with anemia.

Macrocytic and dimorphic anemia constituted 20.41% and 14.29% of cases, respectively. Both groups demonstrated substantially reduced vitamin B12 and folate concentrations compared with the normocytic and microcytic groups ($p = 0.001$). O'Leary and Samman[12] described the hematological consequences of vitamin B12 deficiency, including impaired DNA synthesis and megaloblastic changes. Soliman et al.[13] also discussed the relationship between chronic anemia and thyroid function, emphasizing the complex interaction between hematological and endocrine abnormalities.

Vitamin B12 deficiency may be particularly relevant in patients with autoimmune thyroid disorders. Jabbar et al.[14] reported a considerable frequency of vitamin B12 deficiency among patients with primary hypothyroidism. The reduced vitamin B12 concentrations observed in the macrocytic and dimorphic groups in the present study are consistent with this association. However, autoimmune thyroid markers and intrinsic factor antibodies were not evaluated, so the underlying cause of vitamin B12 deficiency could not be established.

Thyroid hormone parameters, including T3, T4 and TSH, did not differ significantly across the anemia groups ($p > 0.05$). In contrast, hemoglobin, RBC count, MCV, ferritin, vitamin B12 and folate showed statistically significant differences. Previous research has described alterations in thyroid function associated with iron deficiency anemia.[15] The absence of significant differences in thyroid hormone levels across morphological groups in the present study suggests that anemia classification may depend more on accompanying hematological and nutritional abnormalities than on thyroid hormone concentrations alone. The study has certain limitations. Its single-center, cross-sectional design and relatively small sample size limit the generalizability of the findings. Erythropoietin levels, autoimmune markers and detailed dietary factors were not assessed. Furthermore, the absence of follow-up prevented evaluation of hematological improvement after thyroid hormone replacement or correction of nutritional deficiencies.

Conclusion

Anemia was observed in 44.55% of patients with hypothyroidism, with normocytic normochromic anemia being the most common morphological type. Microcytic and dimorphic anemia were associated with reduced ferritin levels, whereas macrocytic and dimorphic anemia showed lower vitamin B12 and folate concentrations. Thyroid hormone levels did not differ significantly among anemia types. These findings support the assessment of complete blood count, iron status and relevant vitamin levels in hypothyroid patients with anemia to identify associated deficiencies and guide appropriate treatment.

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