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ORIGINAL ARTICLE

Anemia pattern in newly diagnosed hypothyroid patients presenting to Khyber Teaching Hospital Peshawar

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ABSTRACT

Background: Insufficient release of thyroid hormone can cause hypothyroidism; the etiology and manifestation are different among individuals. Both Anemia and thyroid disease are interconnected and highly prevalent disease. Beside substantial literature about anemia and thyroid function are present but the clear characterization about the anemia patterns in newly diagnosed hypothyroid patients remain unclear, specifically in South Asian population.

Methods: A cross-sectional study was conducted at the Department of General Medicine, Khyber Teaching Hospital Peshawar, from 25th December 2022 to 25th November 2023. A total of 229 newly diagnosed hypothyroid patients were enrolled using non-probability consecutive sampling. Anemia morphology was determined among 111 (48.5%) anemic patients and classified on the basis of mean corpuscular volume (MCV) into normocytic normochromic (MCV 76–96 fL), microcytic hypochromic (MCV <76fL), and macrocytic (MCV >96 fL). Stratification by age, gender, and socioeconomic status was performed. Chi-square test was applied; $p \leq 0.05$ was considered statistically significant

Results: The mean age was 51.108±8.15 years (range 18–70). Of 229 patients, 94 (41.0%) were male and 135 (59.0%) female. Anemia morphology was determined among 111 (48.5%) anemic patients. Among anemic patients, normocytic normochromic anemia was the most prevalent type (54.1%, n=60), followed by microcytic anemia (27.9%, n=31) and macrocytic anemia (18.0%, n=20). No statistically significant association was found between anemia pattern and age, gender, or socioeconomic status ($p>0.05$ for all).

Conclusion: Anemia is present in approximately half of newly diagnosed hypothyroid patients. Normocytic normochromic anemia is the predominant morphological type. Clinicians should perform routine hematological evaluation at the time of hypothyroidism diagnosis and Thyroid function testing may be warranted in patients with unexplained normocytic anemia.

Keywords: Anemia, Hypothyroidism, Microcytic Anemia, Macrocytic Anemia

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Introduction

An endocrine disorder termed as hypothyroidism resulting from deficiency of thyroid hormones, its etiology and clinical signs may vary among individuals (1). Generally, hypothyroidism is divided into Primary hypothyroidism and Secondary hypothyroidism (Central). Primary hypothyroidism results from the inability of the thyroid gland to produce sufficient hormones whereas Central hypothyroidism is

due to dysfunction of pituitary gland or hypothalamus (2). Its presentation may range from subclinical disease to evident clinical hypothyroidism which may lead to life-threatening emergency of myxedema coma (3). Untreated Chronic Hypothyroidism is associated with increased comorbidity and mortality ratio (1).Most common etiology of primary hypothyroidism is the insufficient iodine intake.

In contrast, in iodine-sufficient areas, autoimmune thyroid disease called as Hashimoto thyroiditis dominates (4). Generally in Pakistan and few South Asian countries, the combination of nutritional deficiencies and autoimmune mechanisms contributes significantly to the burden of thyroid disease (5). Particularly hypothyroidism is more prevalent among females and increases with advancing age (6). Study conducted in the KP quoted more thyroid dysfunctions among females as compare to males (75.8% vs. 24.2%). Similarly, 195 cases reported were with Hyperthyroidism (32.5%) and 191 hypothyroidisms (31.8%), respectively out of a total 600 cases (7).

Anemia is one of the most commonly observed hematological complications of thyroid dysfunction (8). Thyroid hormone plays an essential role in erythropoiesis by stimulating synthesis of erythropoietin, enhancing absorption of iron through intestine, and supporting normal bone marrow function (9, 10). Deficiency of these hormones impairs red blood cell production through multiple pathways, giving rise to diverse anemia morphologies: normocytic normochromic anemia from reduced erythropoietic drive, microcytic hypochromic anemia results from iron malabsorption and deficiency of vitamin B12 or folate lead to macrocytic anemia, menorrhagia cause blood loss anemia , (11, 12). Wopereis et al. demonstrated that overt hypothyroidism carries a pooled hazard ratio of 1.38 for the development of anemia (8).

Despite the well-recognized association between thyroid dysfunction and anaemia, data specifically characterizing the morphological pattern of anemia in newly diagnosed hypothyroid patients remain limited, particularly in South Asian and Pakistani populations. In a study by Anand et al., describe among newly diagnosed hypothyroid patients, macrocytic anemia accounts for 17%, microcytic anemia for 30% and normocytic normochromic anemia accounted for 53% people.(13) Understanding the prevalent anemia pattern in local populations has direct implications for targeted clinical investigation and management pathways.

This study was therefore conducted to determine the frequency and pattern of anemia in newly diagnosed hypothyroid patients presenting to Khyber Teaching Hospital (KTH), Peshawar, a major public sector tertiary care institution serving the Khyber Pakhtunkhwa region of Pakistan.

Methods

A descriptive cross-sectional study was conducted in the Department of General Medicine, Khyber Teaching Hospital Peshawar, Pakistan from 25-12-2022 to 25-11-2023. Ethical approval was obtained from the Institutional Ethical Committee prior to study commencement via letter no 880/DME/KMC dated 6.12.2022. Written informed consent was obtained from all participants. The study was conducted in accordance with the latest version of the Declaration of Helsinki (14). The sample size was calculated using the WHO sample size calculator at a 95% confidence interval and a 7% margin of error, applying an expected frequency of macrocytic anemia of

17% as referenced from Anand et al (13). The minimum required number of anemic subjects was 111. A total of 229 consecutive hypothyroid patients were enrolled to achieve this target. Non-probability consecutive sampling was employed.

Patients aged 18–70 years of both genders with newly diagnosed Primary hypothyroidism were included. Primary Hypothyroidism was operationally defined as serum TSH ≥10 mU/L and free thyroxine (FT4) <0.7 ng/dL (15). Patients who were pregnant, or had a history of hemolytic anemia, gastrointestinal or genitourinary blood losses, connective tissue disorders, haemoglobinopathies, bleeding disorders, renal insufficiency or failure, History of pituitary disease were excluded.

All enrolled patients underwent complete blood count (CBC) as the primary investigation using auto-analyzer (16). Hemoglobin <12 g/dL in women and <13 g/dL in men, is referred as anemic in accordance with WHO criteria (17). Patients identified as anemic were classified by MCV, MCHC, normocytic normochromic (76–96 fL), microcytic hypochromic (<76 fL) and macrocytic (>96 fL). Demographic data include gender, age and family socioeconomic status were recorded on a study questionnaire. All the data were analyzed using IBM SPSS Statistics version 26. For categorical variables frequencies and percentages were calculated while mean ± standard deviation (SD) was reported for age. Stratification of anemia pattern by age, gender, and socioeconomic status was performed and chi-square test were applied. Results with p-value of ≤0.05 was considered statistically significant.

Results

The age recorded was 18–70 years with a mean age of 51.1± 8.15 years. The majority of patients belonged to the age group of 41–70-years range. Out of 229 patients, 94 (41.0%) were male and 135 (59.0%) were female. On the basis of socioeconomic status, 109 (46.7%) patients were classified as poor, 107 (46.7%) belong to middle class, and 13 (13%) as rich (table 1).

Anemia was present in 111 patients out of 229 individuals after assessing hemoglobin level, giving an overall anemia prevalence of 48.5% among newly diagnosed hypothyroid patients. All further anemia pattern analysis and stratification was performed on this anemic cohort (n=111). Normocytic normochromic anemia was the most frequently observed type anemia among individuals presented with low Hb level, present in 60 patients (54.1%). Microcytic hypochromic anemia recorded in 31 patients (27.9%), and macrocytic anemia in 20 patients (18.0%) (figure 1).

Classification of normocytic normochromic anemia by age revealed that 6 (46.2%) patients in the 18–40 years group and 54 (55.1%) in the 41–70 years group had this anemia type. The result of this classification is not statistically significant (p=0.543). By gender grouping, normocytic normo chromic anemia was present in 23 (57.5%) male and 37 (52.1%) female. (p=0.585). Similarly, socioeconomic status showed rates of 64.2% (poor), 46.2% (middle), and 33.3% (rich), with no significant association (p=0.104) (Table 2).

Microcytic anemia was diagnosed in 3 patients (23.1%) of 18–40 years old and 28 (28.6%) of 41–70 years old anemic patients (p=0.678). Gender based classification showed microcytic anemia in 10 (25.0%) males and 21 (29.6%) females (p=0.606). The socioeconomic group were 47.6% (poor), 46.7% (middle), and 5.7% (rich) having no

significant association was present (p=0.741) (Table 3).

Macrocytic anemia was present in 4 (30.8%) patients aged 18–40 years and 16 (16.3%) patients aged 41–70 years (p=0.203). By gender, macrocytic anemia was present in 7 (17.5%) males and 13 (18.3%) females (p=0.915). Similarly, socioeconomic stratification gives value of 11.3% (poor), 23.1% (middle), and 33.3% (rich) among all no significant association was identified (p=0.177) (Table 4).

Overall, no statistically significant association was observed between anemia pattern age, gender and socioeconomic status (p>0.05 for all comparisons).

Table 1: Demographics of study population (n=229)

Variable	Mean/ frequency	SD/percentage
Age (years)	51.1	8.15
Male	94	41.0
Female	135	59.0
Poor	109	47.6
Middle	107	46.72
Rich	13	5.7

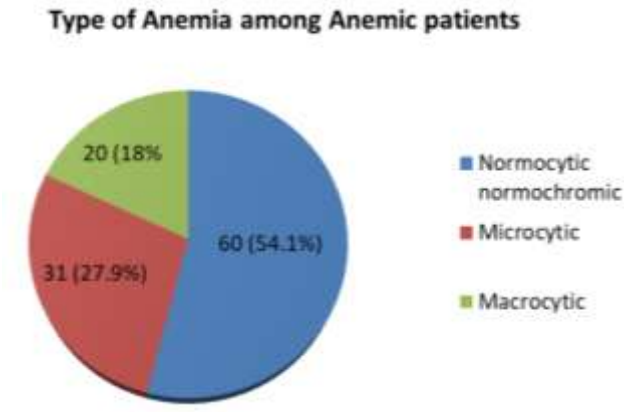

Figure 1: Types of anemia among anemic patients

Table 2: Association of study parameters with normocytic normochromic anemia

Age (years)	Yes n (%)	No n (%)	Total	p-value
18–40	6 (46.2%)	7 (53.8%)	13	0.543
41–70	54 (55.1%)	44 (44.9%)	98	
Male	23 (57.5%)	17 (42.5%)	40	0.585
Female	37 (52.1%)	34 (47.9%)	71	
Poor	34 (64.2%)	19 (35.8%)	53	0.104
Middle	24 (46.2%)	28 (53.8%)	52	
Rich	2 (33.3%)	4 (66.7%)	6	

Table 3: Association of study parameters with microcytic anemia

Age (years)	Yes n (%)	No n (%)	Total	p-value
18–40	3 (23.1%)	10 (76.9%)	13	0.678
41–70	28 (28.6%)	70 (71.4%)	98	
Male	10 (25.0%)	30 (75.0%)	40	0.606
Female	21 (29.6%)	50 (70.4%)	71	
Poor	13 (24.5%)	40 (75.5%)	53	0.741
Middle	16 (30.8%)	36 (69.2%)	52	
Rich	2 (33.3%)	4 (66.7%)	6	

Table 4: Association of study parameters with macrocytic anemia

Age (years)	Yes n (%)	No n (%)	Total	p-value
18–40	4 (30.8%)	9 (69.2%)	13	0.203
41–70	16 (16.3%)	82 (83.7%)	98	
Male	7 (17.5%)	33 (82.5%)	40	0.915
Female	13 (18.3%)	58 (81.7%)	71	
Poor	6 (11.3%)	47 (88.7%)	53	0.177
Middle	12 (23.1%)	40 (76.9%)	52	
Rich	2 (33.3%)	4 (66.7%)	6	

Discussion

This cross-sectional study has investigated about the prevalence and morphological pattern of anemia among 229 naive hypothyroid patients presenting to a tertiary care hospital in Peshawar, Pakistan. Patients with low hemoglobin was identified in 111 patients with a prevalence of 48.5%, a figure consistent with the reported international range of 20–60% (8). However Ali et al. reported an overall anemia prevalence of 67% in a prospective Pakistani cohort of primary

hypothyroid patients (18), a higher rate that may reflect differences in patient selection, and inclusion of subclinical hypothyroidism. Abdelnaser et al. documented significant hematological abnormalities in hypothyroid patients in an Egyptian population (19). The more conservative prevalence in our cohort is attributable to the strict operational definition of hypothyroidism (TSH ≥10 mU/L) and systematic exclusion of confounders of anemia.

The mean age of 51.108±8.15 years in our cohort was higher than the 42.19±8.43 years reported by Ali et al. (18), reflecting the well-established epidemiological pattern of increasing hypothyroidism prevalence with advancing age (6). Old age patients are more susceptible to chronic conditions and nutritional deficiencies that can independently influence hematological parameters (20). The predominance of the 41–70-year age group in our study likely contributed to the higher rate of normocytic normochromic anemia, characteristic of anemia of chronic disease rather than acute nutritional deficiency (21).

The female preponderance in our cohort (59.0%) is consistent with the known female predominance in autoimmune thyroid diseases (4). Ali et al. reported a 59.66% female proportion (18), whilst Abdelnaser et al. documented a notably higher female proportion of 82% (19). Mehmet et al. and Berta et al. have highlighted the interplay between female sex, thyroid autoimmunity, and anemia susceptibility, with hormonal, nutritional, and immune factors collectively contributing to increased anemia risk in women (22,23).

Among anemic patients the predominance of normocytic normochromic anemia (54.1%) in our anemic cohort aligns with the established pathophysiology whereby deficiency of thyroid hormones suppresses erythropoietin production and reduces erythropoietic drive, producing anemia of chronic disease morphology (24). Anand et al. reported an identical pattern (53% normocytic normochromic) (13), and Ali et al. documented 38.64% normocytic anemia in their cohort (18). Thyroid hormones directly stimulate erythropoietin synthesis; their deficiency therefore reduces overall erythropoietic drive without necessarily altering iron utilization or hemoglobin synthesis in the early stages of disease.

The 27.9% prevalence of microcytic hypochromic anemia in our cohort suggests concurrent iron deficiency in a substantial proportion of hypothyroid patients. Hypothyroidism impairs intestinal iron absorption through reduced gastric acid secretion and altered gastrointestinal motility (10). Moreover, increase menstrual bleeding a well know feature of hypothyroidism can also contribute to iron deficiency anemia. Abdelnaser et al. similarly identified microcytic hypochromic anemia as a prominent hematological feature in thyroid dysfunction (19). Evidence suggests that iron supplementation alone may be insufficient in the presence of untreated hypothyroidism, and that concurrent levothyroxine therapy is required to restore hematological parameters (25).

Macrocytic anemia constituted 18.0% of cases in this study, consistent with the 17% reported by Anand et al (13). The higher rate compared with Ali et al. (9.25%) (18) may reflect a greater prevalence of underlying autoimmune gastritis causing vitamin B12 malabsorption, given the well-documented co-occurrence of Hashimoto thyroiditis and pernicious anemia within the same autoimmune diathesis (12). Folate deficiency from dietary insufficiency in lower socioeconomic groups may also be a

contributing factor. Patients with hypothyroidism secondary to macrocytic anemia should be investigated for serum vitamin B12 and folate levels, as well as for anti-intrinsic factor antibodies and anti-parietal cell.

The absence of significant associations between anemia morphology with age, gender and socioeconomic status (all $p>0.05$) may reflect the small sample size of the anemic sub-cohort (n=111), limited statistical power for detecting small to moderate effects, and the only single centered tertiary care hospital gives similar demographic population.

Limitations of study: Key limitations in our study include, its single center cross-sectional design which limits our study to prove causality, and the absence of important nutritional biomarkers profiling to determine the specific etiology of different anemia type.

Strength of study: The study's strengths include rigorous exclusion criteria to minimize confounding from alternative causes of anemia, clinically diagnosed patients from a top public sector tertiary care hospital of Peshawar and the standardized operational definitions.

Conclusion

These findings help us to know the need for routine hematological evaluation right after hypothyroidism diagnosis. Contrarily thyroid function test (TFT) should be considered in patients presenting with unexplained normocytic anemia. Diagnosing and treating hypothyroidism early can help to reverse the anemia, highlighting why both conditions should be addressed together for better patient outcomes.

Future Recommendations: Larger and multi-center studies including nutritional biomarkers (serum ferritin, vitamin B12, folate) and autoimmune markers (anti-TPO antibodies) should help in better exploration of the determinants of anemia pattern in hypothyroid patients.

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Conflict of Interest: The authors declare no conflict of interest.

References

1. Chiovato L, Magri F, Carlé A. Hypothyroidism in context: where we've been and where we're going. Adv Ther. 2019;36 Suppl 2:47-58.
2. Almandoz JP, Gharib H. Hypothyroidism: etiology, diagnosis, and management. Med Clin North Am. 2012;96(2):203-21.
3. Jonklaas J, Bianco AC, Bauer AJ, Burman KD, Cappola AR, Celi FS, et al. Guidelines for the treatment of hypothyroidism: prepared by the American Thyroid Association task force on thyroid hormone replacement. Thyroid. 2014;24(12):1670-751.
4. Vargas-Uricoechea H, Mera-Mamian A, Bastidas-Sanchez B, Pinzon-Fernandez M, Murillo-Palacios J, Ramirez-Bejarano L. Population status of iodine and its potential effects on thyroid function and autoimmunity in Southwestern Colombia. J Clin Med Res. 2022;14(3):126-34.
5. Klubo-Gwiezdzinska J, Wartofsky L. Hashimoto thyroiditis: an evidence-based guide to etiology, diagnosis and treatment. Pol Arch Intern Med. 2022;132(3):16222.
6. Hollowell JG, Staehling NW, Flanders WD, Hannon WH, Gunter EW, Spencer CA, et al. Serum TSH, T4, and thyroid antibodies in the United States population (1988 to 1994): National Health and Nutrition Examination Survey (NHANES III). J Clin Endocrinol Metab. 2002;87(2):489-99.
7. Attaullah S, Haq BS, Muska M. Thyroid dysfunction in Khyber Pakhtunkhwa, Pakistan. Pak J Med Sci. 2016;32(1):111-5.
8. Wopereis DM, Du Puy RS, Van Heemst D, Walsh JP, Bremner A, Bakker SJ, et al. The

relation between thyroid function and anemia: a pooled analysis of individual participant data. J Clin Endocrinol Metab. 2018;103(10):3658-67.
9. Dorgalaleh A, Mahmoodi M, Varmaghani B, Kia OS, Alizadeh S, Tabibian S, et al. Effect of thyroid dysfunctions on blood cell count and red blood cell indices. Iran J Pediatr Hematol Oncol. 2013;3(2):73-8.
10. Cinemre H, Bilir C, Gokosmanoglu F, Bahcebasi T. Hematologic effects of levothyroxine in iron-deficient subclinical hypothyroid patients: a randomized, double-blind, controlled study. J Clin Endocrinol Metab. 2009;94(1):151-6.
11. Aon M, Taha S, Mahfouz K, Ibrahim MM, Aoun AH. Vitamin B12 (cobalamin) deficiency in overt and subclinical primary hypothyroidism. Clin Med Insights Endocrinol Diabetes. 2022; 15:11795514221086634.
12. Centanni M, Marignani M, Gargano L, Corleto VD, Casini A, Delle Fave G, et al. Atrophic body gastritis in patients with autoimmune thyroid disease: an underdiagnosed association. Arch Intern Med. 1999;159(15):1726-30.
13. Anand R, Mishra AK, Mahdi AA, Verma SP, Gupta KK. A study of prevalence and pattern of anemia in primary hypothyroidism. Int J Med Sci Public Health. 2018;7(2):153-60.
14. World Medical Association. World Medical Association Declaration of Helsinki: ethical principles for medical research involving human subjects. JAMA. 2013;310(20):2191-4.
15. Garber JR, Cobin RH, Gharib H, Hennessey JV, Klein I, Mechanick JI, et al. Clinical practice guidelines for hypothyroidism in adults: cosponsored by the American Association of Clinical Endocrinologists and the American Thyroid Association. Thyroid. 2012;22(12):1200-35.
16. Dacie JV. Dacie and Lewis practical hematology. Edinburgh: Elsevier Health Sciences; 2006.
17. Marn H, Critchley JA. Accuracy of the WHO Hemoglobin Colour Scale for the diagnosis of anemia in primary health care settings in low-income countries: a systematic review and meta-analysis. Lancet Glob Health. 2016;4(4): e251-65.
18. Ali SS, Khan MN, Zafar F, Adnan STA, Yusuf A, Hussnain M, et al. Frequency and types of anemia in primary hypothyroidism patients: a prospective observational study. Cureus. 2024;16(4): e58004.
19. Abdelnaser M, Rezk AA, Al Adl HA, Mahfouz KA-E-H. Pattern of blood cell parameters in thyroid dysfunction. Al-Azhar Int Med J. 2022;3(1):42-6.
20. Gadó K, Khodier M, Virág A, Domján G, Dörnyei G. Anemia of geriatric patients. Physiol Int. 2022;109(2):119-34.
21. Weiss G, Goodnough LT. Anemia of chronic disease. N Engl J Med. 2005;352(10):1011-23.
22. Mehmet E, Aybike K, Ganidagli S, Mustafa K. Characteristics of anemia in subclinical and overt hypothyroid patients. Endocr J. 2012;59(3):213-20.
23. Berta DM, Gelaw Y, Shiferaw E, Melkamu A, Legese GL, Adane T, et al. Hematological abnormalities and associated factors among patients with hypothyroidism at the University of Gondar Comprehensive Specialized Hospital. J Blood Med. 2024:157-69.
24. Szczepanek-Parulska E, Hernik A, Ruchała M. Anemia in thyroid diseases. Pol Arch Intern Med. 2017;127(5):352-60.
25. Ravanbod M, Asadipooya K, Kalantarhormozi M, Nabipour I, Omrani GR. Treatment of iron-deficiency anemia in patients with subclinical hypothyroidism. Am J Med. 2013;126(5):420-4.

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All the authors agree to take responsibility for every facet of the work, making sure that any concerns about its integrity or veracity are thoroughly examined and addressed.	