

Hematological Abnormalities in Thyroid Hormone Deficiency

Hamed Abdelaziz Deraz, Ayman Fathy Abdelhalim, Mostafa Ahmed Elmesallamy and Ahmed Salah Amin Elallam

Internal Medicine Department, Faculty of Medicine, Zagazig University, Egypt

*Corresponding author: Mostafa Ahmed Elmesallamy

Email: mustafaahmed7500@gmail.com,

Abstract:

Thyroid hormones play a fundamental role in regulating hematopoiesis through their effects on bone marrow activity, erythropoietin production, and cellular metabolism. Hypothyroidism is associated with a wide spectrum of hematological abnormalities affecting red blood cells, white blood cells, and platelets. Anemia is the most common manifestation, particularly in hypothyroid patients, with reported prevalence ranging from approximately 26% to 31%, most commonly presenting as normocytic normochromic anemia. Leukopenia, especially neutropenia and lymphopenia, may also occur, while platelet abnormalities are less frequent and usually mild. These hematological changes are primarily attributed to impaired bone marrow function, reduced erythropoietin levels, and associated nutritional deficiencies such as iron, vitamin B12, and folate. Importantly, many of these abnormalities are reversible following correction of thyroid dysfunction. Early recognition of these alterations is essential, as they may precede overt thyroid disease and contribute to increased morbidity if left untreated.

Keywords: Thyroid dysfunction; Hypothyroidism; Hyperthyroidism; Anemia; Leukopenia; Platelet abnormalities; Hematopoiesis.

Introduction:

Thyroid hormones play a fundamental role in regulating hematopoiesis through their effects on cellular metabolism, oxygen consumption, and bone marrow activity. Hypothyroidism is frequently associated with abnormalities in red blood cells, white blood cells, and platelets. These hematological changes may precede overt thyroid symptoms and often contribute to morbidity if unrecognized. Increasing evidence demonstrates that thyroid dysfunction is a reversible and under-diagnosed cause of anemia and other blood disorders, highlighting the importance of routine hematological evaluation in affected patients (Eram et al., 2024).

Pathophysiological Basis of Hematological Changes in Thyroid Disorders

Thyroid hormones influence hematopoiesis both directly and indirectly. At the bone marrow level, triiodothyronine (T3) stimulates erythroid progenitor proliferation and differentiation, while thyroxine (T4) enhances erythropoietin production, thereby promoting red blood cell synthesis. Thyroid hormones also modulate iron utilization, vitamin B12 and folate metabolism, and oxygen delivery through effects on 2,3-diphosphoglycerate levels. In hypothyroidism, reduced hormone availability leads to bone marrow hypoplasia and diminished erythropoietic drive, whereas hyperthyroidism may cause ineffective hematopoiesis due to increased metabolic demand and shortened cell lifespan (Al-Dewachi et al., 2025).

Anemia in Thyroid Disease

Anemia is the most prevalent hematological abnormality observed in thyroid dysfunction. Multiple studies report anemia in approximately one-quarter to one-third of patients with hypothyroidism, with prevalence rates around 26–31%. Normocytic normochromic anemia is the most common morphological type, followed by microcytic hypochromic anemia, while macrocytic anemia is relatively rare (Mandefro et al., 2025).

The mechanisms underlying anemia in hypothyroidism include reduced erythropoietin secretion, decreased bone marrow responsiveness, iron deficiency due to impaired absorption, and deficiencies of vitamin B12 and folate. Importantly, anemia in thyroid disease is not solely nutritional; hormonal deficiency itself plays a critical role. Clinical studies demonstrate that correction of thyroid hormone levels often leads to significant improvement in hemoglobin concentrations, particularly when combined with appropriate nutritional supplementation (**Berta et al., 2024**).

White Blood Cell Abnormalities

Leukocyte abnormalities are also frequently reported in thyroid dysfunction. Hypothyroidism is commonly associated with leukopenia, particularly neutropenia and lymphopenia, whereas hyperthyroidism may present with normal, reduced, or occasionally elevated white blood cell counts. Cross-sectional data show leukopenia in approximately 5–16% of patients with hypothyroidism, reflecting bone marrow suppression and altered immune regulation (**Berta et al., 2024**).

Thyroid hormones are essential for normal lymphocyte development, particularly B-cell maturation, and deficiency may impair immune cell production. These alterations may contribute to increased susceptibility to infections in hypothyroid patients, especially when combined with anemia and nutritional deficiencies (**Hagbin et al., 2024**).

Platelet Abnormalities

Platelet abnormalities are less consistent than red and white cell changes. Most studies indicate that platelet counts remain within normal limits in the majority of patients with thyroid dysfunction. However, thrombocytopenia and thrombocytosis have been reported in a small proportion of cases, generally below 5% (**Kumar & Prasad, 2025**).

The limited effect of thyroid hormones on platelet production may be explained by the short lifespan of platelets and their non-nucleated structure. Nonetheless, thyroid hormones may influence platelet survival and mean platelet volume, suggesting a subtle regulatory role rather than a primary effect on thrombopoiesis (**Meftah et al., 2024**).

Factors Associated with Hematological Abnormalities

Several clinical and behavioral factors modulate the risk of hematological abnormalities in thyroid disease. Female sex, alcohol consumption, inadequate meat and vegetable intake, and the presence of febrile illness have been independently associated with anemia in hypothyroid patients. These factors likely act synergistically with hormonal deficiency to exacerbate bone marrow dysfunction and nutritional imbalance (**Berta et al., 2024**).

Clinical Implications

Hematological abnormalities in thyroid disease are common, heterogeneous, and often reversible. Routine complete blood count evaluation should be an integral part of thyroid disorder assessment, particularly in patients presenting with unexplained anemia or cytopenias. Conversely, patients with anemia resistant to conventional therapy should be screened for thyroid dysfunction prior to initiating long-term hematinic treatment. Early identification and correction of thyroid-related hematological changes can significantly reduce morbidity and improve patient outcomes (**Kashiwagi et al., 2024**).

References:

1. Berta, D. M., Gelaw, Y., Shiferaw, E., Melkamu, A., Legese, G. L., Adane, T., & Mandefro, B. (2024). Hematological Abnormalities and Associated Factors Among Patients with Hypothyroidism at the University of Gondar Comprehensive Specialized Hospital. *J Blood Med*, 15, 157-169.
2. Eram, F., Quamri, M. A., Zaidi, A., & , S. (2024). "A Comprehensive Review of Anaemia Associated with Hypothyroidism". *New Emirates Medical Journal*, 5.

3. Haghbin, M., Razmjooei, F., Abbasi, F., Rouhie, R., Pourabbas, P., Mir, H., Roustazadeh, A., Mofazzal Jahromi, M. A., & Bagheri, K. (2024). Evaluation of the hematological parameters, inflammatory biomarkers, and thyroid hormones in hypothyroidism patients. *BMC Research Notes*, 17(1), 390.
4. Kashiwagi, H., Kuwana, M., Murata, M., Shimada, N., Takafuta, T., Yamanouchi, J., Kato, H., Hato, T., Tomiyama, Y., Committee for Reference Guide for diagnosis of adult, I. T. P. R. T. f. C., Other Intractable Diseases supported by the Ministry of Health, L., & Welfare Science Research Grant Project: Research on Health Care Policy for Intractable, D. (2024). Reference guide for the diagnosis of adult primary immune thrombocytopenia, 2023 edition. *International Journal of Hematology*, 119(1), 1-13.
5. Meftah, N., Sedaghat, S., Rabizadeh, S., Seifouri, S., Nasirimeh, K., & Nakhjavani, M. (2024). Graves' disease with pancytopenia: A rare case report. *Clinical Case Reports*, 12(1), e8312.