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CLINICOPATHOLOGICAL SPECTRUM AND DIFFERENTIAL DIAGNOSIS OF MICROCYTIC ANEMIA IN A TERTIARY CARE HOSPITAL

Hemato-Pathology

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ABSTRACT

Objective: This study aimed to assess the diagnostic utility of various laboratory investigations in patients with microcytic anemia and to examine their association with key hematological parameters. It also sought to identify the underlying etiology in each case and to analyze the distribution of different causes among the patients admitted at our hospital. **Methods:** Patients were evaluated using a comprehensive diagnostic approach that included complete blood count (CBC), examination of peripheral blood smears, assessment of iron parameters in selected cases, and hemoglobin values for definitive diagnosis where required. **Results:** Iron deficiency anemia was found to be more prevalent among younger female patients. Peripheral smear examination, along with serum ferritin estimation demonstrated significant value in distinguishing between different causes of microcytic anemia. **Conclusion:** peripheral smear evaluation (PBF) and alterations in serum ferritin levels serve as sensitive indicators in the diagnosis and differentiation of microcytic hypochromic anemia.

KEYWORDS

IDA, Microcytosis, Hypochromia, RDW and Serum Ferritin.

INTRODUCTION

Anemia is characterized by a reduction in hemoglobin concentration or hematocrit below the lower limit of the reference range, adjusted for age, sex, and geographic factors. Functionally, it reflects an inadequate red blood cell mass to meet the oxygen demands of peripheral tissues and serves as a clinical indicator of underlying disease rather than a diagnosis in itself.

The evaluation of anemia requires a systematic approach incorporating clinical assessment and laboratory investigations. Initial workup includes peripheral blood smear examination and analysis of hematological indices such as hemoglobin (Hb), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), red cell distribution width (RDW), and reticulocyte count. Further evaluation involves iron studies, including serum iron and total iron-binding capacity and specialized tests reserved for selected cases.

Microcytic anemia is primarily characterized by microcytosis and hypochromia, reflecting impaired hemoglobin synthesis. The degree of these morphological changes correlates with the severity and duration of the underlying condition. Accurate differentiation of its etiologies requires integration of routine and advanced diagnostic parameters.

The present study was undertaken to evaluate the differential diagnosis of microcytic anemia using appropriate laboratory investigations and to assess the clinical utility of hematological parameters, including their role in monitoring response to iron therapy.

AIMS AND OBJECTIVES

Aim

To assess the role of different laboratory investigations in microcytic anemia and their correlation with relevant hematological parameters.

Objectives

1. To identify the underlying etiology in patients diagnosed with microcytic anemia.
2. To evaluate the frequency and distribution of various causes of microcytic anemia among hospitalized patients.
3. To monitor the response to iron therapy in iron-deficient patients using serial erythrogram analysis.
4. To determine the diagnostic relevance and practical utility of hematological parameters in microcytic anemia.

MATERIALS AND METHODS

Study Setting:

This study was carried out at Government Medical College & Hospital, a tertiary care center located in Sawai Madhopur, Rajasthan, India.

Study Design:

This was a prospective observational study.

Sample Size:

200 cases

Study Duration:

September 2025 to February 2026

Inclusion Criteria:

- Samples from OPD/IPD with low Hb and abnormal RBC indices (MCV, MCH, MCHC, RDW, reticulocyte count)
- Peripheral smear showing microcytosis (MCV < 80 fL)

Exclusion Criteria:

- Normal peripheral smear
- Improper sample collection

RESULTS AND DISCUSSION

Etiological Distribution with Gender-wise Breakdown

The present study included 200 cases of microcytic anemia with diverse etiologies. Iron deficiency anemia (IDA) was the most common cause, accounting for 60.0% (n=120) of cases. This was followed by thalassemia (20.0%, n=40), anemia of chronic disease (ACD) (10.0%, n=20), sideroblastic anemia (6.0%, n=12), and malabsorption-related anemia (4.0%, n=8). The predominance of IDA reflects the significant burden of nutritional anemia in the study population.

A gender-wise analysis showed that females constituted 56% (n=112) of the total cases, while males accounted for 44% (n=88). A distinct variation in gender distribution was observed across different etiologies, indicating a strong association between gender and the underlying cause of anemia.

Iron deficiency anemia demonstrated a clear female predominance, with 70% of cases occurring in females. This pattern is likely due to increased physiological iron requirements, menstrual blood loss, and nutritional deficiencies commonly seen in women, particularly in the reproductive age group.

In contrast, anemia of chronic disease was more frequently observed in males, with 70% of cases occurring in men. This may be attributed to a higher prevalence of chronic inflammatory and systemic conditions among males in the study population.

Thalassemia also showed a male predominance, with approximately 70% of cases reported in males. Although it is a genetic disorder with no inherent gender bias, this distribution may reflect variations in healthcare access, diagnostic practices, or referral patterns.

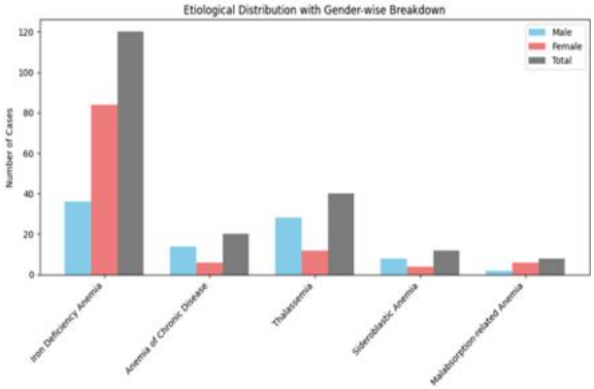
Sideroblastic anemia accounted for a smaller proportion of cases and

exhibited a male predominance. This finding may be related to acquired causes such as alcohol use, chronic illness, or drug exposure, which are more commonly reported in males.

Malabsorption-related anemia, on the other hand, was more frequently observed in females, comprising 75% of cases. This may be due to nutritional deficiencies and gastrointestinal conditions affecting nutrient absorption, particularly in women.

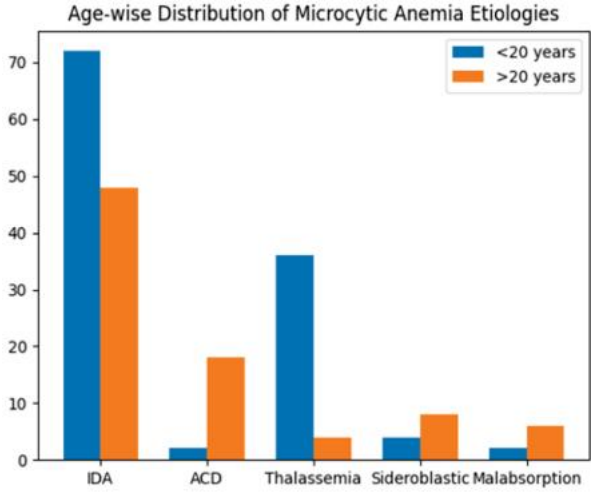
Overall, these findings highlight a significant association between gender and the etiology of microcytic anemia, emphasizing the importance of considering demographic factors in clinical evaluation and management.

Table 1: Etiological Distribution with Gender-wise Breakdown



Condition	Total Cases (n)	Percentage (%)	Male (n)	Female (n)
Iron Deficiency Anemia	120	60.0	36	84
Anemia of Chronic Disease	20	10.0	14	6
Thalassemia	40	20.0	28	12
Sideroblastic Anemia	12	6.0	8	4
Malabsorption-related Anemia	8	4.0	2	6
Total	200	100.0	88	112

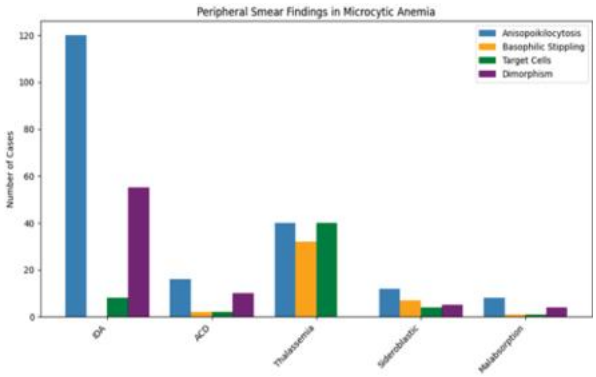
Table 2: Age Distribution: Distinct Age-related Trends Were Observed:



Condition	<20 years (n, %)	>20 years (n, %)
Iron Deficiency Anemia (n=120)	72 (60.0%)	48 (40.0%)
Anemia of Chronic Disease (n=20)	2 (10.0%)	18 (90.0%)
Thalassemia (n=40)	36 (90.0%)	4 (10.0%)
Sideroblastic Anemia (n=12)	4 (33.3%)	8 (66.7%)
Malabsorption (n=8)	2 (25.0%)	6 (75.0%)

Age-wise analysis demonstrated that iron deficiency anemia and thalassemia were more prevalent in individuals below 20 years of age, whereas anemia of chronic disease and sideroblastic anemia were predominantly observed in patients above 20 years. Malabsorption-related anemia showed a higher occurrence in individuals above 20 years, indicating its association with chronic gastrointestinal disorders and nutritional deficiencies. *A statistically significant association was observed between age group and etiology of microcytic anemia (χ^2 test, $p < 0.001$).*

Table 3: Peripheral Smear Findings in Microcytic Anemia



Condition	Anisopoikilo-cytosis	Basophilic Stippling	Target Cells	Dimorphism
IDA (120)	120	0	8	55
ACD (20)	16	2	2	10
Thalassemia (40)	40	32	40	0
Sideroblastic (12)	12	7	4	5
Malabsorption (8)	8	1	1	4

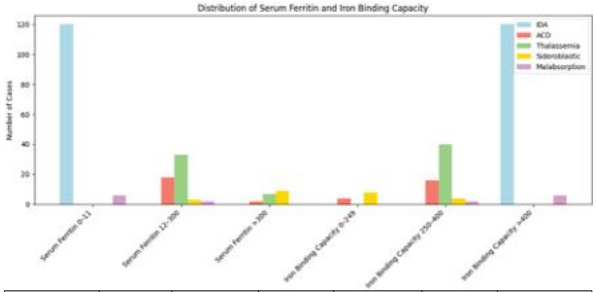
Peripheral smear evaluation revealed distinct morphological patterns:

- **IDA:** Marked anisopoikilocytosis with dimorphism; absence of stippling
- **Thalassemia:** Prominent target cells and basophilic stippling
- **ACD:** Mild morphological changes
- **Sideroblastic Anemia:** Presence of dimorphism and stippling due to abnormal iron utilization
- **Malabsorption:** Mixed morphological picture reflecting combined nutritional deficiencies

Iron Profile Findings

Biochemical parameters revealed distinct patterns across etiologies when compared with normal reference ranges (Serum ferritin: 30–300 ng/mL; Serum iron: 60–170 µg/dL; TIBC: 240–450 µg/dL). In iron deficiency anemia, ferritin was markedly decreased, serum iron was low, and TIBC was elevated, consistent with depleted iron stores. Anemia of chronic disease showed normal or increased ferritin due to sequestration, low serum iron, and normal to reduced TIBC, reflecting impaired iron utilization. Thalassemia cases demonstrated normal ferritin, normal serum iron, and unaltered TIBC, highlighting the genetic rather than nutritional basis. Sideroblastic anemia was characterized by increased ferritin and serum iron, often indicating iron overload, with TIBC normal or decreased. Malabsorption-related anemia showed decreased or borderline ferritin, reduced serum iron, and elevated TIBC, reflecting impaired absorption and secondary iron deficiency. These biochemical distinctions, in relation to normal values, provide critical diagnostic clues for differentiating nutritional, genetic, and chronic disease-related causes of anemia.

Table 4: Distribution of Serum Ferritin and Iron Binding Capacity in Microcytic Anemia



Parameter	Range	IDA (n=120)	ACD (n=20)	Thalas-semia (n=40)	Sidero-blastic (n=12)	Malab-sorption (n=8)
Serum Ferritin (µg/L)	0–11	120 (100.0%)	0	0	0	6 (75.0%)
	12–300	0	18 (90.0%)	33 (82.5%)	3 (25.0%)	2 (25.0%)

	>300	0	2 (10.0%)	7 (17.5%)	9 (75.0%)	0
Iron Binding Capacity (µg/L)	0–249	0	4 (20.0%)	0	8 (66.7%)	0
	250–400	0	16 (80.0%)	40 (100.0%)	4 (33.3%)	2 (25.0%)
	>400	120 (100.0%)	0	0	0	6 (75.0%)

CONCLUSION

The present study delineates the broad clinicopathological spectrum of microcytic anemia encountered in a tertiary care hospital setting. Iron deficiency anemia emerged as the predominant etiology, particularly among females of reproductive age, reflecting the ongoing burden of nutritional deficiency. Thalassemia was more commonly observed in younger individuals, whereas anemia of chronic disease and sideroblastic anemia were predominantly seen in older patients, highlighting the influence of underlying systemic and acquired conditions. Anemia due to intestinal malabsorption, although less frequent, represents a clinically significant and often under-recognized cause within the differential spectrum.

The findings underscore the importance of an integrated diagnostic approach combining clinical evaluation, peripheral smear examination, red cell indices, and iron profile parameters. Such a clinicopathological correlation is essential for accurate differentiation among various etiologies of microcytic anemia, including less common conditions like sideroblastic anemia and malabsorption-related anemia.

In a tertiary care setting, where a wide range of pathologies is encountered, a systematic and comprehensive evaluation is crucial for establishing an accurate diagnosis, guiding appropriate management, and improving patient outcomes. This study reinforces the pivotal role of routine hematological investigations in the effective differential diagnosis of microcytic anemia.

REFERENCES

1. Bain Barbara J. Interpretation of red cells and platelets . Blood cells – A practical guide , London. New York .
2. Barbara J.Wild and Barbara J. Bain , Investigation of abnormal haemoglobin and thalassemia , Dacie and Lewis , Practical Haematology , 9 th Ed, 2001, 12, 257.
3. Cuuningham LD, Rising JA: Erythrocytic microcytosis, Clinical implication in 100 patients.Am J Med Sci. 273 ,149.1977.
4. Dacie and Lewis , Practical hematology, 9th Ed, preparation and staining for blood and bone marrow 4:53,2001.
5. Dacie and Lewis, Practical hematology, 9th Ed, Iron deficiency anemia and iron overload 7:116, 2001.
6. Fairbanks VF, Beutler E : Iron deficiency in Williams WJ et al (eds) : Hematology, New York, MC Graw Hill, 1972, 4 th Ed, 7, 482-505; 1990.
7. G.Richard Lee : Microcytosis and the anemias associated with impaired hemoglobin synthtsis , Wintrobe's Clinical Hematology, 3, 791-807, Vol. 1, 1993.
8. John Bernard Henry: Clinical Diagnosis and management by laboratory methods, 20 ed 544, 645, 550, 554, 568-571, 2001.
9. Praful B Godkar, Determination of serum iron and TIBC : Text of Medical laboratory technology . 2 nd ed, 37, 817, 2003.