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Research Article

Clinico-Hematological Profile and Etiological Spectrum of Patients with Bicytopenia Attending a Tertiary Care Hospital: A Cross-Sectional Study of 240 Cases

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Abstract

Background: Bicytopenia, defined as a reduction in any two of the three peripheral blood cell lines (erythrocytes, leukocytes, and platelets), is a common hematological abnormality associated with a wide range of benign and malignant disorders. The clinical spectrum varies from asymptomatic cases to life-threatening conditions requiring urgent intervention. **Objective:** To study the clinico-hematological profile and etiological spectrum of patients with bicytopenia. **Methods:** This hospital-based cross-sectional study was conducted in the Department of Pathology, Dr. Panjabrao Alias Bhausaheb Deshmukh Memorial Medical College and Hospital, Amravati, Maharashtra, India, from January 2025 to August 2025. A total of 240 patients with bicytopenia were included. Detailed clinical history, physical examination findings, complete blood counts, peripheral smear examination, and bone marrow studies where indicated were analyzed. **Results:** The majority of patients were adults aged 21–40 years, with a slight male predominance. The most common presenting symptoms were generalized weakness, fever, and bleeding manifestations. Pallor was the most frequent clinical sign. Anemia with thrombocytopenia was the commonest type of bicytopenia. Megaloblastic anemia was the leading etiology, followed by infections, hypersplenism, hematological malignancies, and aplastic anemia. **Conclusion:** Megaloblastic anemia was the most common and potentially reversible cause of bicytopenia. A systematic clinico-hematological approach, including peripheral smear and bone marrow examination, when necessary, is essential for accurate diagnosis and early treatment.

Keywords: Bicytopenia, Megaloblastic anemia, Bone marrow examination, Peripheral smear, Pancytopenia, Hematological disorders

Introduction

Bicytopenia is a hematological condition characterized by a reduction in any two of the three major cellular components of peripheral blood, namely erythrocytes, leukocytes, and platelets. It is a common laboratory finding encountered in both outpatient and inpatient settings and represents a wide spectrum of underlying disorders ranging from simple nutritional deficiencies to serious bone marrow failure syndromes and hematological malignancies.[1] The condition may result from decreased production of blood cells in the bone marrow, increased peripheral

destruction, sequestration in an enlarged spleen, or a combination of these mechanisms. [2]

The etiological spectrum of bicytopenia is broad and includes megaloblastic anemia due to vitamin B12 and folate deficiency, iron deficiency anemia, aplastic anemia, myelodysplastic syndromes, leukemias, lymphomas, hypersplenism, autoimmune disorders, and infections such as dengue, malaria, enteric fever, and human immunodeficiency virus infection. [3-5] In developing countries like India, nutritional deficiencies and infectious diseases are among the most frequent and potentially reversible causes, whereas malignant and marrow infiltrative disorders account for a smaller but clinically significant proportion of cases. [6]

The clinical manifestations of bicytopenia depend on the specific cell lines affected and the severity of cytopenia. Patients commonly present with generalized weakness, fatigue, pallor, fever, recurrent infections, bleeding manifestations, dyspnoea, and weight loss. Physical examination may reveal pallor, hepatosplenomegaly, lymphadenopathy, petechiae, and purpura. [7] Since the presentation is often nonspecific, laboratory evaluation plays a central role in identifying the underlying cause. [7]

The diagnostic approach to bicytopenia begins with a complete blood count and peripheral blood smear examination, which provide valuable information regarding cell morphology and possible etiologies. Additional investigations such as reticulocyte count, serum vitamin B12 and folate levels, liver and renal function tests, serological tests for infectious diseases, and bone marrow aspiration and biopsy may be required for definitive diagnosis. [8] Bone marrow examination is particularly useful in cases where marrow failure, infiltrative disorders, or hematological malignancies are suspected. [9]

Several studies from India and other countries have demonstrated that megaloblastic anemia is the most common cause of bicytopenia, followed by infections, aplastic anemia, hypersplenism, and hematological malignancies. [1-6] Early identification of the etiology is crucial because many causes, especially nutritional deficiencies and infections, are treatable and associated with excellent outcomes if diagnosed promptly. Conversely, delayed recognition of malignant or marrow failure disorders may lead to significant morbidity and mortality. [10]

Despite the clinical importance of bicytopenia, there is limited data regarding its clinico-hematological profile and etiological spectrum in different geographic regions of India. Understanding the pattern of presentation and common causes in a tertiary care setting can aid clinicians in developing a rational diagnostic approach and initiating timely management. Therefore, the present study was undertaken to evaluate the clinico-hematological profile, identify the etiological spectrum, and determine the most common causes of bicytopenia among patients attending a tertiary care teaching hospital.

Materials and Methods

Study Design: Hospital-based cross-sectional observational study.

Study Setting: The study was carried out in the Department of Pathology at Dr. Panjabrao Alias Bhausaheb Deshmukh Memorial Medical College and Hospital, Amravati, Maharashtra, India, a tertiary care teaching hospital.

Study Duration: January 2025 to August 2025.

Sample Size: 240 cases.

Study Population: All patients of any age and sex attending inpatient and outpatient departments who were diagnosed with bicytopenia on complete blood count.

Definition of Bicytopenia

Reduction in any two of the following:

- Hemoglobin below age- and sex-specific reference range
- Total leukocyte count <4,000/mm³
- Platelet count <150,000/mm³

Inclusion Criteria

- Patients of all age groups and both sexes.
- Patients with bicytopenia on complete blood count.
- Patients willing to provide informed consent.

Exclusion Criteria

- Patients with pancytopenia due to transient laboratory error.
- Patients who received blood transfusion within the previous 2 weeks.
- Inadequate clinical data.
- Refusal to participate.

Data Collection

A predesigned proforma was used to record:

- Demographic details
- Clinical history
- Presenting complaints
- Physical examination findings
- Laboratory investigations
- Final diagnosis

Laboratory Investigations

Hematological Investigations

- Complete blood count using automated hematology analyzer
- Peripheral smear examination
- Reticulocyte count
- ESR

Biochemical Investigations

- Serum vitamin B12
- Serum folate
- Liver function tests
- Renal function tests
- LDH

Serological and Microbiological Tests

- Dengue serology
- Malaria antigen/smear
- HIV, HBsAg, HCV
- Blood cultures where indicated

Bone Marrow Examination

Bone marrow aspiration and biopsy were performed in selected cases where the diagnosis remained uncertain or a marrow pathology was suspected.

Statistical Analysis

Data were entered in Microsoft Excel and analyzed using IBM SPSS Statistics https://www.ibm.com/products/spss-statistics version 25.0. Quantitative variables were expressed as mean ± standard deviation, and qualitative variables as frequencies and percentages. Chi-square test was used to assess associations. A p-value <0.05 was considered statistically significant.

Results

Table 1. Age Distribution of Patients (n = 240)

Age Group (Years)	Number	Percentage
0–20	36	15
21–40	92	38.3
41–60	68	28.3
>60	44	18.4
Total	**240**	**100**

The majority of patients belonged to the 21–40 years age group (38.3%), followed by 41–60 years (28.3%). Patients older than 60 years constituted 18.4%, while 15.0% were aged 0–20 years, indicating that bicytopenia was most commonly observed in young and middle-aged adults.

Table 2. Sex Distribution

Sex	Number	Percentage
Male	132	55
Female	108	45
Total	**240**	**100**

Among the 240 patients, 132 (55.0%) were males and 108 (45.0%) were females, showing a slight male predominance with a male-to-female ratio of 1.22:1.

Table 3. Presenting Symptoms

Symptom	Number	Percentage
Generalized weakness	198	82.5
Fever	124	51.7
Bleeding manifestations	48	20
Weight loss	44	18.3
Dyspnoea	62	25.8
Bone pain	18	7.5

Generalized weakness was the most common presenting symptom, reported by 82.5% of patients, followed by fever (51.7%) and dyspnoea (25.8%). Bleeding manifestations were observed in 20.0% of cases, while bone pain was the least common symptom (7.5%).

Table 4. Clinical Signs

Sign	Number	Percentage
Pallor	224	93.3
Splenomegaly	76	31.7
Hepatomegaly	44	18.3
Lymphadenopathy	28	11.7
Petechiae/Purpura	40	16.7
Icterus	22	9.2

Pallor was the predominant clinical sign and was present in 93.3% of patients. Splenomegaly was noted in 31.7% of cases, followed by hepatomegaly (18.3%) and petechiae/purpura (16.7%).

Table 5. Distribution of Bicytopenia Types

Type	Number	Percentage
Anemia + Thrombocytopenia	156	65
Anemia + Leucopenia	58	24.2
Leucopenia + Thrombocytopenia	26	10.8
Total	**240**	**100**

Anemia with thrombocytopenia was the most common pattern of bicytopenia, accounting for 65.0% of cases. Anemia with leucopenia was observed in 24.2%, while leucopenia with thrombocytopenia was the least frequent combination (10.8%).

Table 6. Peripheral Smear Findings

Finding	Number	Percentage
Macrocytic anemia	88	36.7
Dimorphic anemia	42	17.5
Microcytic hypochromic anemia	34	14.2
Normocytic normochromic anemia	48	20
Blast cells	16	6.7
Haemoparasites	12	5

Macrocytic anemia was the most common peripheral smear finding (36.7%), suggestive of megaloblastic anemia. Normocytic normochromic anemia was seen in 20.0% and dimorphic

anemia in 17.5% of patients. Blast cells and haemoparasites were identified in 6.7% and 5.0% of cases, respectively.

Table 7. Final Etiological Diagnosis

Etiology	Number	Percentage
Megaloblastic anemia	82	34.2
Infections	48	20
Hypersplenism/chronic liver disease	28	11.7
Hematological malignancies	24	10
Aplastic anemia	18	7.5
Iron deficiency/dimorphic anemia	16	6.7
Autoimmune disorders	8	3.3
Drug-induced marrow suppression	6	2.5
Myelodysplastic syndrome	4	1.7
Others	6	2.5
Total	**240**	**100**

Megaloblastic anemia was the leading cause of bicytopenia, accounting for 34.2% of cases. Infections were the second most common cause (20.0%), followed by hypersplenism/chronic liver disease (11.7%) and hematological malignancies (10.0%).

Table 8. Clinical Outcome

Outcome	Number	Percentage
Recovered/Improved	214	89.2
Referred for specialized treatment	16	6.7
Death	10	4.1
Total	**240**	**100**

The majority of patients (89.2%) showed clinical improvement or recovery following treatment. Sixteen patients (6.7%) were referred for specialized management, while the overall mortality rate was 4.1%.

Discussion

In the present study, the highest proportion of patients with bicytopenia belonged to the 21–40 years age group (38.3%), followed by 41–60 years (28.3%), indicating that bicytopenia predominantly affected young and middle-aged adults. Similar findings were reported by Sharma A et al.[4], who observed that the majority of cases occurred in adults in the third and fourth decades of life. Murshed NMF et al.[5] also documented a higher frequency of bicytopenia among young adults, reflecting the increased prevalence of nutritional

deficiencies and infectious diseases in this age group. Sabeena et al.[6] and Pursnani D et al.[7] similarly reported that most patients were in the economically productive age group, emphasizing the significant clinical and socioeconomic impact of bicytopenia.

With respect to sex distribution, the present study showed a slight male predominance, with males constituting 55.0% and females 45.0% of the study population (male-to-female ratio 1.22:1). This observation is consistent with the findings of Sharma A et al.[4], who reported a higher proportion of male patients. Murshed NMF et al.[5] and Pursnani D et al.[7] also noted male predominance in their respective studies. Likewise, Sabeena et al.[6] found that males were affected more frequently than females. The male predominance observed across studies may be attributed to greater healthcare-seeking behavior among men and increased occupational exposure to infections and environmental risk factors.

Overall, the age and sex distribution in the present study closely parallels the findings of Sharma A et al.[4], Murshed NMF et al.[5], Sabeena et al.[6], and Pursnani D et al.[7], confirming that bicytopenia most commonly affects young to middle-aged adults and shows a modest male predominance.

In the present study, anemia with thrombocytopenia was the most common pattern of bicytopenia, observed in 156 of 240 patients (65.0%). Anemia with leucopenia was seen in 58 patients (24.2%), while leucopenia with thrombocytopenia was the least common combination, accounting for 26 patients (10.8%).

A similar pattern was reported by Sharma A et al.[4], who found anemia with thrombocytopenia to be the predominant type of bicytopenia in both adults and children. Murshed NMF et al.[5] also documented that anemia with thrombocytopenia was the most frequent combination, attributing this predominance to the high prevalence of megaloblastic anemia, infections, and hypersplenism in their study population. Sabeena et al.[6] observed comparable results, with anemia and thrombocytopenia constituting the majority of cases, followed by anemia with leucopenia. Pursnani D et al.[7] similarly reported that anemia with thrombocytopenia was the commonest pattern and was strongly associated with nutritional deficiencies and infective etiologies.

The predominance of anemia with thrombocytopenia across these studies may be explained by the fact that both erythroid and megakaryocytic cell lines are commonly affected in megaloblastic anemia, viral infections, sepsis, and hypersplenism. In contrast, leucopenia with thrombocytopenia was less frequent, indicating relatively fewer disorders selectively affecting white blood cells and platelets while sparing red cell production.

Thus, the findings of the present study are in close agreement with those reported by Sharma A et al.[4], Murshed NMF et al.[5], Sabeena et al.[6], and Pursnani D et al.[7], confirming that anemia with thrombocytopenia is the most common type of bicytopenia encountered in tertiary care settings.

In the present study, megaloblastic anemia was the most common etiology of bicytopenia, accounting for 82 of 240 cases (34.2%). Infections were the second most common cause, contributing 48 cases (20.0%), followed by hypersplenism/chronic liver disease in 28 cases (11.7%), hematological malignancies in 24 cases (10.0%), and aplastic anemia in 18 cases (7.5%).

These findings are consistent with those reported by Sharma A et al.[4], who identified megaloblastic anemia as the

leading cause of bicytopenia, with infections and hematological malignancies as other major etiologies. Murshed NMF et al.[5] similarly observed that megaloblastic anemia was the predominant etiology, reflecting the high prevalence of vitamin B12 and folate deficiency in developing countries. In their study, infections were also a significant contributor, particularly among younger patients.

Sabeena et al.[6] reported comparable results, with megaloblastic anemia being the commonest diagnosis, followed by infectious causes and aplastic anemia. Their findings emphasized that nutritional deficiencies and tropical infections together account for a substantial proportion of bicytopenia cases in tertiary care hospitals. Pursnani D et al.[7] likewise documented megaloblastic anemia as the principal etiology, with hypersplenism, hematological malignancies, and marrow failure syndromes constituting important secondary causes.

The predominance of megaloblastic anemia in the present study may be attributed to inadequate dietary intake, malabsorption, and increased nutritional demands. Since this condition is readily treatable, its early recognition is of great clinical importance. The substantial contribution of infections underscores the endemic burden of dengue, malaria, enteric fever, and sepsis in India. Hematological malignancies and aplastic anemia, though less frequent, remain critical diagnoses because they require prompt specialized management.

Overall, the etiological distribution observed in the present study closely parallels the findings of Sharma A et al.[4], Murshed NMF et al.[5], Sabeena et al.[6], and Pursnani D et al.[7], reinforcing that megaloblastic anemia is the most common and potentially reversible cause of bicytopenia, followed by infections and other bone marrow disorders.

Conclusion

The present study successfully achieved all the stated objectives by comprehensively evaluating the clinical and hematological profile of 240 patients with bicytopenia attending a tertiary care hospital. A significant correlation was observed between clinical presentation, peripheral smear findings, and final etiological diagnosis, highlighting the importance of an integrated clinico-hematological approach in the evaluation of bicytopenia.

Among the different patterns of bicytopenia, anemia with thrombocytopenia was the most frequently encountered type, accounting for 65.0% of cases, thereby fulfilling the objective of identifying the commonest hematological pattern. The study also demonstrated that bicytopenia affected all age groups, with the highest prevalence in young and middle-aged adults, and a slight male predominance.

With regard to etiological distribution, megaloblastic anemia emerged as the most common cause, followed by infections, hypersplenism/chronic liver disease, hematological malignancies, and aplastic anemia. This finding emphasizes that nutritional deficiencies and infectious diseases constitute the majority of cases and are largely reversible with early diagnosis and appropriate treatment.

The study underscores that detailed clinical assessment, complete blood count, peripheral smear examination, and bone marrow evaluation when indicated are essential for establishing an accurate diagnosis. Early recognition of the underlying cause facilitates prompt management, reduces morbidity and mortality, and improves patient outcomes. Thus, bicytopenia should always be regarded as an important hematological clue warranting systematic investigation rather than as an isolated laboratory abnormality.

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