

Clinicohematological Profile of Patients With Pancytopenia in A Tertiary Care Hospital in Western India

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ABSTRACT

Introduction: Pancytopenia is a hematological condition characterized by a reduction in red blood cells, white blood cells, and platelets. It is associated with a wide range of disorders, ranging from nutritional deficiencies to bone marrow disorders and hematological malignancies. This study aimed to evaluate the clinical profile, hematological findings, bone marrow morphology, and etiological spectrum of pancytopenia in patients attending a tertiary care hospital in Western India.

Materials and Methods: This retrospective cross-sectional study included 150 patients with pancytopenia evaluated over one year at a tertiary care hospital in Rajkot, Gujarat. Demographic details, clinical features, complete blood counts, peripheral blood smear findings, and bone marrow examination findings, wherever available, were analyzed.

Results: Among the 150 patients, 99 (66%) were males and 51 (34%) were females. Most patients were between 11 and 30 years of age. Pallor and weakness were the most common clinical features. Megaloblastic anemia was the leading cause of pancytopenia (44.7%), followed by alcoholic liver disease (13.3%) and hypersplenism (7.3%). Acute myeloid leukemia was the most common hematological malignancy. Macrocytic blood picture was the predominant peripheral smear finding, while hypercellular marrow was the most common bone marrow pattern.

Conclusion: Megaloblastic anemia remains the leading cause of pancytopenia in Western India, highlighting the continued burden of nutritional deficiencies. A systematic evaluation, including clinical assessment, peripheral blood smear examination, and bone marrow examination when indicated, is essential for establishing the diagnosis and guiding appropriate management.

Keywords: Pancytopenia; Megaloblastic anemia; Peripheral blood smear; Bone marrow examination; Etiology.

INTRODUCTION

Pancytopenia is a hematological abnormality characterized by a simultaneous reduction in erythrocytes, leukocytes, and platelets in the peripheral blood. It is not a disease by itself but a manifestation of a wide range of disorders affecting bone marrow function or the production and survival of blood cells. The underlying causes include nutritional deficiencies, infections, autoimmune disorders, hypersplenism, bone marrow failure syndromes, and hematological malignancies. As the treatment and prognosis vary considerably among these conditions, identifying the underlying cause is essential for appropriate management [1]. The clinical features of pancytopenia depend on the severity of the individual cytopenias. Patients commonly present with fatigue and weakness due to anemia, recurrent infections resulting from leukopenia, and bleeding manifestations caused by thrombocytopenia. Since these features are often nonspecific, a careful clinical evaluation supported by appropriate laboratory investigations is necessary for diagnosis [2,3]. The etiological spectrum of pancytopenia varies across different geographical regions because of differences in nutritional status, dietary habits, socioeconomic conditions, endemic infections, and healthcare accessibility. In developing countries, megaloblastic anemia due to vitamin B12 and folate deficiency remains one of the most common causes, although bone marrow failure syndromes, hypersplenism, infections, autoimmune disorders, and hematological malignancies also contribute significantly [4,5]. Peripheral blood smear examination provides valuable diagnostic clues and often helps narrow the differential diagnosis. However, bone marrow aspiration and trephine biopsy remain the cornerstone investigations in patients with unexplained pancytopenia, particularly for differentiating

nutritional disorders from bone marrow failure and hematological malignancies [6–8]. Several studies from different parts of India have reported megaloblastic anemia as the leading cause of pancytopenia, although the relative frequency of other etiologies varies among regions [9–11]. However, published data on the clinicohematological profile of pancytopenia from Western India remain limited. Therefore, the present study was undertaken to evaluate the clinical presentation, hematological parameters, peripheral blood smear findings, bone marrow morphology, and etiological spectrum of pancytopenia in patients attending a tertiary care hospital in Western India.

MATERIALS AND METHODS

Study Design and Setting:

This retrospective cross-sectional study was carried out in the Department of Pathology at the Central Clinical Laboratory (CCL) of a tertiary care teaching hospital in Rajkot, Gujarat, India. The study included patients evaluated over a one-year period from 15 June 2025 to 15 June 2026. The hospital serves a large population from both urban and rural areas of the Saurashtra region, with most patients admitted to the Department of General Medicine.

Study Population:

A total of 150 patients diagnosed with pancytopenia were included in the study. Patients of all age groups and both sexes who fulfilled the predefined diagnostic criteria were eligible for inclusion.

Inclusion Criteria:

Patients were included if they met all of the following criteria:

- Hemoglobin ≤ 10 g/dL
- Total leukocyte count $< 4,000/\text{mm}^3$
- Platelet count $< 150,000/\text{mm}^3$

Both newly diagnosed and follow-up cases were included.

Exclusion Criteria:

Patients were excluded if they:

- Had received multiple blood or blood component transfusions shortly before evaluation.
- Were too ill to undergo the planned diagnostic investigations.
- Were receiving erythropoietin or colony-stimulating factor therapy.

Data Collection: Clinical records were reviewed to collect demographic details, presenting complaints, medical history, and physical examination findings. Clinical information, including weakness, fever, breathlessness, bleeding manifestations, recent infections, and drug history, was recorded. Peripheral venous blood samples were collected in EDTA tubes for complete blood count (CBC) using a Mindray automated hematology analyzer. Peripheral blood smears were stained with Field's stain for morphological evaluation, and reticulocyte counts were determined manually using new methylene blue staining. Bone marrow aspiration and trephine biopsy were performed in selected patients whenever indicated using Salah's aspiration needle and a Jamshidi biopsy needle, respectively. Bone marrow smears were stained with Leishman stain and examined along with peripheral blood smears to establish the diagnosis.

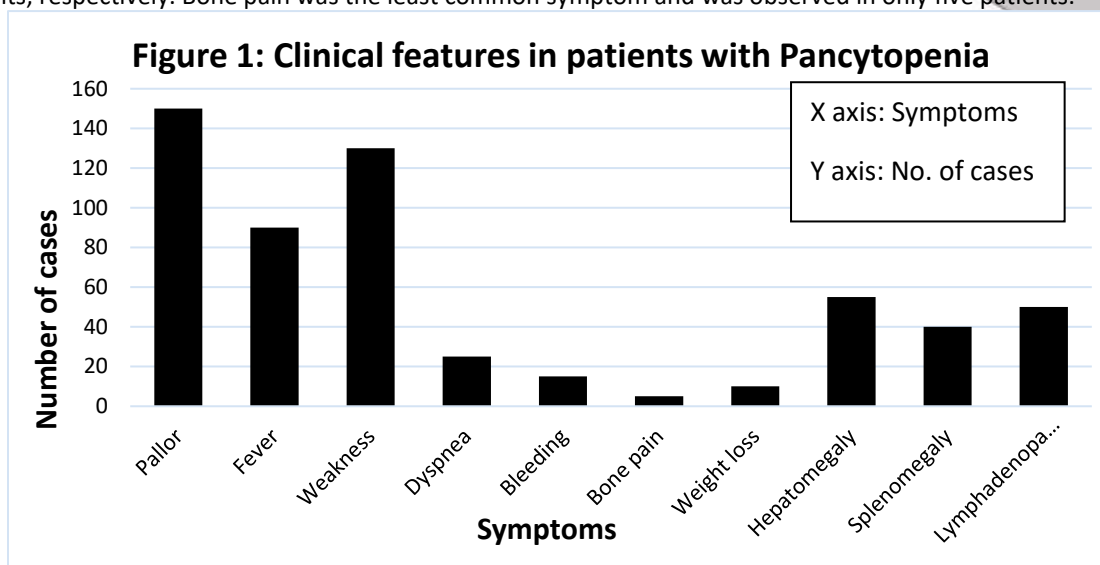
Statistical Analysis: Clinical, hematological, peripheral smear, and bone marrow findings were analyzed using descriptive statistics. Categorical variables are presented as frequencies and percentages.

RESULTS

A total of 150 patients with pancytopenia were included in the study. Of these, 99 (66%) were males and 51 (34%) were females, resulting in a male-to-female ratio of 1.9:1.

The clinical presentation of the patients is shown in Figure 1. Pallor was present in all patients and was the most consistent clinical finding. Weakness was the most common presenting symptom, followed by fever. Hepatomegaly, lymphadenopathy, and splenomegaly were observed in 55, 50, and 40 patients, respectively.

Dyspnea was reported in 25 patients, while bleeding manifestations and weight loss were seen in 15 and 10 patients, respectively. Bone pain was the least common symptom and was observed in only five patients.



Most patients belonged to the younger age groups. The highest number of cases was seen in the 11–20-year age group (40, 26.7%), followed by the 21–30-year (38, 25.3%) and 31–40-year (31, 20.7%) age groups. Megaloblastic anemia was the predominant cause among younger patients, whereas alcoholic liver disease was more frequently seen in patients aged 31–40 years. Hematological malignancies, including acute myeloid leukemia, lymphoma, multiple myeloma, and myelodysplastic syndrome, were more commonly observed in middle-aged and older patients (Table 1).

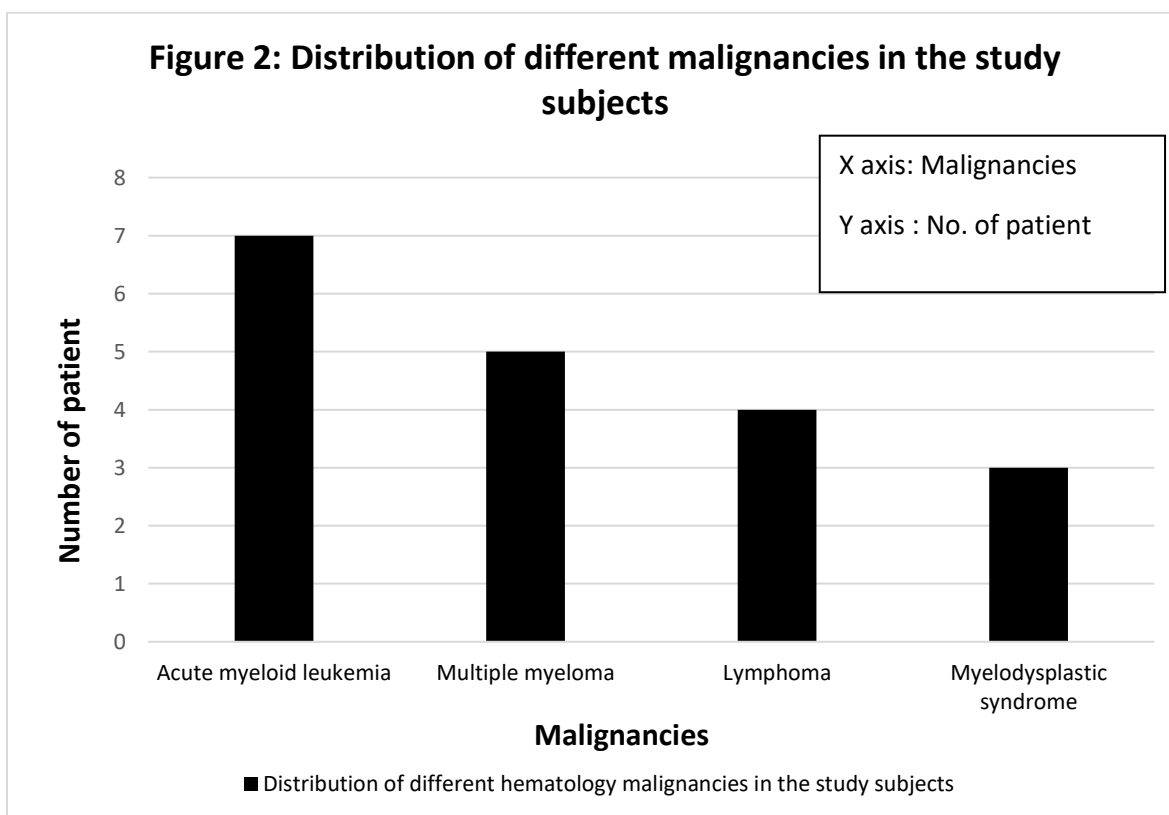
Table 1: Distribution of Pancytopenia causes according to Age and Sex

Pancytopenia etiology	Sex			Age Group (Years)						
	Female	Male	Total	1-10	11-20	21-30	31-40	41-50	51-60	>60
Megaloblastic anemia	26	41	67	16	33	16	1	1	0	0
Alcoholic liver disease	2	18	20	0	0	4	12	4	0	0
Hypersplenism	4	7	11	3	5	3	0	0	0	0
Aplastic anemia	3	4	7	0	0	3	3	1	0	0
Acute Myeloid leukemia	4	3	7	0	0	2	3	1	1	0
Chemotherapy	3	3	6	0	0	4	0	0	1	1
Severe sepsis	2	4	6	0	0	1	3	1	1	0
Multiple myeloma	1	4	5	0	0	0	2	2	1	0
Autoimmune hemolytic anemia	2	3	5	0	0	2	2	1	0	0
Lymphoma	2	2	4	0	2	0	1	1	0	0
Paroxysmal nocturnal hemoglobinuria	0	3	3	0	0	1	2	0	0	0
Myelodysplastic syndrome	1	2	3	0	0	0	0	1	1	1
ITP	1	1	2	0	0	1	1	0	0	0
Tuberculosis	0	2	2	0	0	0	1	1	0	0
P. vivax positive	0	1	1	0	0	1	0	0	0	0
Drug induced	0	1	1	0	0	0	0	1	0	0
Total	51	99	150	19	40	38	31	15	5	2

The etiological distribution of pancytopenia is presented in Table 1. Megaloblastic anemia was the most common

cause, accounting for 67 (44.7%) cases. Alcoholic liver disease was the second most common etiology and was identified in 20 (13.3%) patients, followed by hypersplenism in 11 (7.3%). Aplastic anemia and acute myeloid leukemia were diagnosed in seven (4.7%) patients each. Chemotherapy-induced pancytopenia and severe sepsis were seen in six (4.0%) patients each, while multiple myeloma and autoimmune hemolytic anemia accounted for five (3.3%) cases each. Lymphoma was diagnosed in four (2.7%) patients, whereas paroxysmal nocturnal hemoglobinuria and myelodysplastic syndrome were identified in three (2.0%) patients each. Two patients each had immune thrombocytopenia and tuberculosis, while isolated cases of *Plasmodium vivax* infection and drug-induced pancytopenia were also encountered.

Among the 19 patients with malignancy-associated pancytopenia, acute myeloid leukemia was the most frequent diagnosis, accounting for seven (36.8%) cases. This was followed by multiple myeloma in five (26.3%) patients, lymphoma in four (21.1%), and myelodysplastic syndrome in three (15.8%) patients (Figure 2).

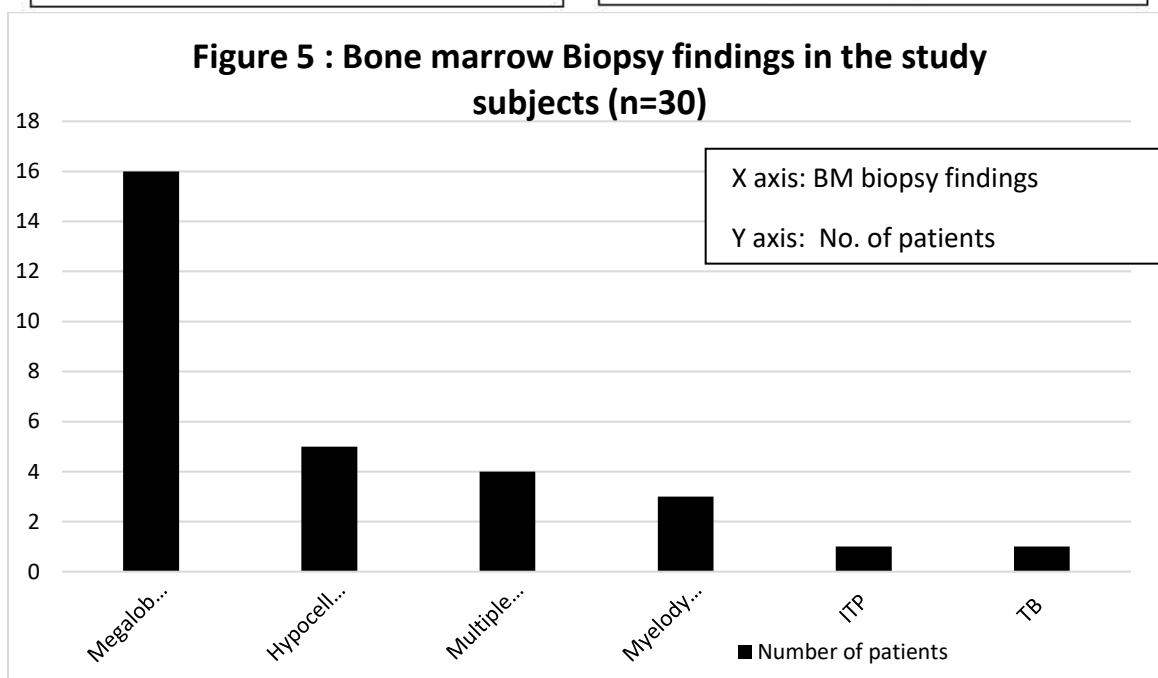
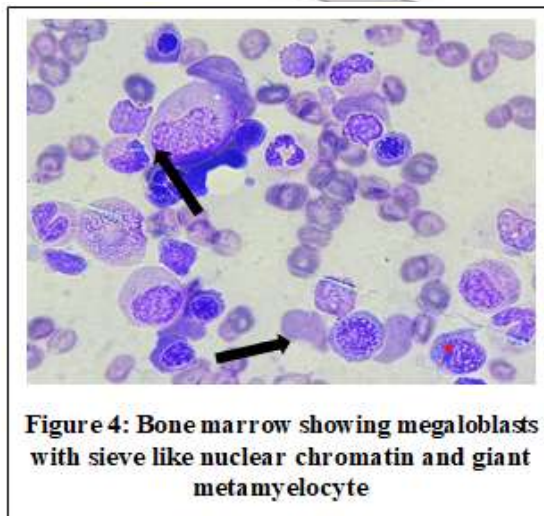
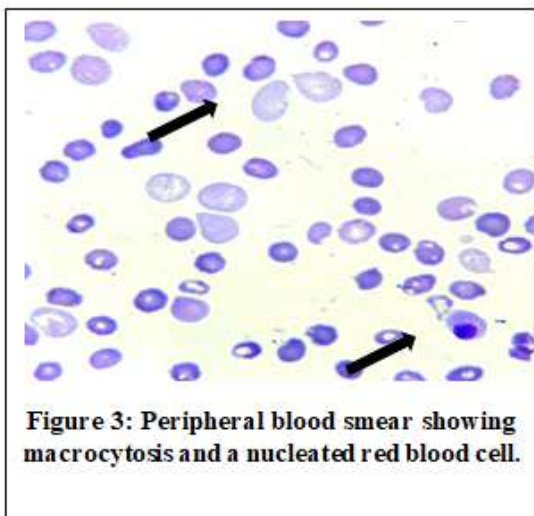


The peripheral blood smear findings are shown in Figure 3. A macrocytic blood picture was the most common morphological pattern and was seen in 71 (47.3%) patients. Microcytic hypochromic morphology was observed in 40 (26.7%) patients, while a dimorphic blood picture was noted in 22 (14.7%). Normocytic normochromic morphology was present in 15 (10.0%) patients, and only two (1.3%) patients had a normocytic hypochromic blood picture.

Bone marrow examination was performed in patients where it was considered clinically necessary. Bone marrow aspiration was carried out in 37 patients and trephine biopsy in 30 patients, with marrow evaluation available in a total of 42 patients.

Hypercellular marrow was the most common marrow pattern, seen in 21 (50.0%) patients. Hypocellular or acellular marrow was observed in 12 (28.6%) patients, while nine (21.4%) patients had a normocellular marrow.

Bone marrow biopsy findings were similar, with megaloblastic anemia remaining the most common diagnosis, seen in 16 (53.3%) patients (Figure 4). Hypocellular or aplastic marrow was observed in five (16.7%) patients, followed by multiple myeloma and myelodysplastic syndrome in four (13.3%) and three (10.0%) patients, respectively. Isolated cases of immune thrombocytopenia and tuberculosis were also identified (Figure 5).



The hematological findings are summarized in Table 2. Hemoglobin levels between 5.1 and 7.0 g/dL were seen in 79 (52.7%) patients, making this the most common category. Severe anemia (hemoglobin <5.0 g/dL) was present in 32 (21.3%) patients. Most patients had a total leukocyte count between 1,001 and 3,000/mm³ (91, 60.6%), whereas 21 (14.0%) patients had counts below 1,000/mm³. Platelet counts between 50,000 and 100,000/mm³ were observed in 72 (48.0%) patients, while 31 (20.7%) patients had platelet counts below 50,000/mm³.

Table 2: Hematological parameters in Pancytopenia

Parameters	Range	Number	Percentage (%)
Hemoglobin (g/dl)	<5.0	32	21.3
	5.1-7.0	79	52.7
	7.1-10.0	39	26
Total leucocyte count (/mm ³)	<1000	21	14
	1001-3000	91	60.6
	3001-4000	38	25.4
Platelets (/mm ³)	<50000	31	20.7

	50000-100000	72	48
	100000-150000	47	31.3

Among the 93 patients with neutropenia, moderate neutropenia (absolute neutrophil count 501–1,000/mm³) was the most common, accounting for 42 (45.2%) cases. Mild and severe neutropenia were present in 33 (35.4%) and 18 (19.4%) patients, respectively. Fever was recorded in 51 (54.8%) patients with neutropenia. The proportion of patients with fever increased as the absolute neutrophil count decreased. Fever was present in 13 of 18 (72.2%) patients with severe neutropenia, 23 of 42 (54.8%) patients with moderate neutropenia, and 15 of 33 (45.5%) patients with mild neutropenia (Table 3).

Table 3: Correlation between Absolute neutrophil count (ANC) and fever in patients with neutropenia (N=93)

ANC (x10 ³ /L)	Patients with fever	Patients without fever	N	Percentage (%)
Severe (0-500)	13	5	18	19.4
Moderate (501-1000)	23	19	42	45.2
Mild (1001-1500)	15	18	33	35.4
Total	51	42	93	100

Bleeding manifestations were more common in patients with lower platelet counts. Among those with platelet counts below 50,000/mm³, 23 (74.2%) patients had bleeding manifestations. This proportion decreased to 32 (44.4%) patients in those with platelet counts between 50,000 and 100,000/mm³ and to 10 (21.3%) patients among those with platelet counts between 100,000 and 150,000/mm³.

Reticulocyte count was available for 84 patients. Overall, 55 (65.5%) patients had a reticulocyte count below 1.5%, while 29 (34.5%) had a count above 1.5%. Among patients with megaloblastic anemia, 16 of 27 (59.3%) had reticulocyte counts below 1.5%. All patients with aplastic anemia had reticulocyte counts below 1.5%. In contrast, higher reticulocyte counts were more frequently observed in patients with infections and autoimmune disorders, where elevated counts were seen in five of seven (71.4%) and three of four (75.0%) patients, respectively.

DISCUSSION

Pancytopenia is a common hematological condition that reflects a wide range of underlying disorders rather than a single disease. The causes vary from reversible nutritional deficiencies to serious bone marrow disorders and hematological malignancies, making early diagnosis essential for appropriate treatment. In the present study, 150 patients with pancytopenia were evaluated to assess the clinical profile and etiological spectrum in a tertiary care hospital in Western India.

A male predominance was observed, with males accounting for 66% of the study population. Similar findings have been reported by Gajbhiye et al. and Rohira et al.[3,6] This may be attributed to greater alcohol consumption, occupational exposure, lifestyle factors, and differences in healthcare-seeking behaviour among males. Most patients belonged to the younger age groups, with the highest incidence in the 11–20-year age group. This differs from several Indian studies that reported the third decade as the most commonly affected age group.[6,10] The younger age distribution in our study may reflect the continued burden of nutritional deficiencies among adolescents and young adults in this region.

Pallor was present in all patients, while weakness and fever were the most common presenting symptoms. Similar clinical findings have been reported by Kumar et al. and Fazal et al.[2,4] Fever was more frequent in patients with neutropenia, which is expected because of their increased susceptibility to infections. Megaloblastic anemia was the most common cause of pancytopenia, accounting for 44.7% of cases. This finding is comparable to that reported by Rohira et al. (41.8%), although lower than the prevalence reported by Gayathri et al. (74%) and Jain et al. (68%) [6,12]. The variation among studies is likely related to differences in nutritional status, dietary habits, socioeconomic factors, and referral patterns. Despite these differences, megaloblastic anemia continues to be the leading cause of pancytopenia in India. More importantly, it is a potentially reversible condition, and early diagnosis with appropriate vitamin supplementation can result in complete hematological recovery.

Alcoholic liver disease was the second most common cause, accounting for 13.3% of cases. Chronic alcohol

consumption can lead to pancytopenia through direct bone marrow suppression, nutritional deficiencies, and hypersplenism secondary to portal hypertension. The relatively higher frequency observed in our study may reflect regional lifestyle patterns and the predominance of male patients. Hypersplenism accounted for 7.3% of cases and was comparable to the findings of Raphael et al. and Jain et al.[13,14]. Splenic sequestration and increased destruction of blood cells remain important mechanisms responsible for pancytopenia in these patients.

Aplastic anemia constituted 4.7% of cases. Although less common than nutritional causes, it remains an important diagnosis because of its association with severe bone marrow failure. The lower frequency observed in the present study may be due to differences in referral patterns and study populations. Malignancies accounted for 12.7% of cases, with acute myeloid leukemia being the most common malignant disorder, followed by multiple myeloma, lymphoma, and myelodysplastic syndrome. Similar findings have been reported by Ullah et al. and Ojha et al.[1,7] These observations highlight the importance of excluding hematological malignancies in patients presenting with unexplained pancytopenia, particularly when associated with constitutional symptoms or organomegaly.

Peripheral blood smear examination proved to be a useful initial investigation. Macrocytic morphology was the most common finding and correlated well with the high prevalence of megaloblastic anemia. Similar observations have been reported by Porwal et al. and Patel et al.[5,11] As an inexpensive and readily available investigation, peripheral smear examination provides valuable clues to the underlying diagnosis and helps identify patients who require further evaluation. Bone marrow examination played an important role in establishing the diagnosis in selected patients. Hypercellular marrow was most commonly associated with megaloblastic anemia, whereas hypocellular marrow was characteristic of aplastic anemia. Similar findings have been reported by Vargas-Carretero et al.[15]. These observations also support the recommendations of Weinzierl et al. and Chew et al., who consider bone marrow aspiration and biopsy essential in the evaluation of unexplained pancytopenia [16,17].

Comparison with previous Indian studies showed that megaloblastic anemia remained the most common cause of pancytopenia, although its prevalence varied across different regions (**Table 4**). The frequencies of malignancies and hypersplenism were similar to earlier reports, whereas aplastic anemia was less common in the present study. These differences are likely related to regional variations in nutritional status, patient characteristics, referral patterns, and study design.

Table 4. Comparison of the etiological spectrum of pancytopenia with previous Indian studies.

Etiology	Megaloblastic anemia (%)	Aplastic anemia (%)	Hypersplenism (%)	Malignancy (%)	Infection (%)
Present Study, 2026	44.7	4.7	7.3	12.7	6
Rohira et al. 2019 [6]	41.8	10.8	6	13	8
Gayathri et al. 2011 [12]	74	18	4	9	3
Jain et al. 2013 [14]	68	7	11	12	5

Overall, the present study shows that nutritional deficiency, particularly megaloblastic anemia, remains the leading and most treatable cause of pancytopenia in Western India. At the same time, aplastic anemia, infections, hypersplenism, and hematological malignancies continue to contribute significantly to the disease burden. A systematic approach that includes clinical evaluation, peripheral blood smear examination, reticulocyte count, and bone marrow examination, whenever indicated, remains essential for establishing the diagnosis and guiding appropriate management [18].

The present study has a few limitations. It was conducted at a single tertiary care centre with a relatively small sample size and a retrospective design, which may limit the generalizability of the findings. In addition, serum vitamin B12 and folate levels were not available for all patients. Larger multicentric prospective studies are needed

to further evaluate regional variations in the etiology of pancytopenia and their impact on clinical outcomes.

CONCLUSION

Pancytopenia is a common hematological condition with a wide range of underlying causes. In the present study, megaloblastic anemia was the most frequent cause of pancytopenia, followed by alcoholic liver disease, hypersplenism, aplastic anemia, and hematological malignancies. The high prevalence of megaloblastic anemia indicates that nutritional deficiencies continue to be an important health problem in Western India. The findings of this study emphasize the importance of a systematic approach in the evaluation of patients with pancytopenia. Clinical assessment, complete blood count, peripheral blood smear examination, reticulocyte count, and bone marrow examination, when indicated, together help in identifying the underlying cause and guiding appropriate treatment. Early diagnosis is particularly important because many causes of pancytopenia are treatable, and timely intervention can improve patient outcomes.

This study also provides useful information on the clinicohematological profile and etiological pattern of pancytopenia in Western India. Larger multicentric prospective studies are needed to further understand regional variations and strengthen the available evidence.

Conflict of interest:

There is no conflicts of interest related to this study or its publication.

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