VOLUME - 15, ISSUE - 08, AUGUST - 2026 • PRINT ISSN No. 2277 - 8160 • DOI : 10.36106/gjra

Original Research Paper

General Medicine

SPECTRUM OF PANCYTOPENIA IN ADULTS: ETIOLOGY AND OUTCOME

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ABSTRACT

Background: Pancytopenia is a common haematological entity characterised by simultaneous deficiency of all three blood cell lineages—anaemia, leucopenia, and thrombocytopenia. It is not a disease itself but a manifestation of an underlying pathology, which can range from benign nutritional deficiencies to life-threatening haematological malignancies. The etiological spectrum varies widely across geographical regions, and data from the Indian subcontinent remain limited. This study aimed to evaluate the etiological spectrum and clinical outcomes of pancytopenia in adults. **Materials and Methods:** This cross-sectional observational study was conducted among 120 adult patients (age ≥18 years) presenting with pancytopenia at a tertiary care hospital over 18 months. Complete blood count, peripheral smear examination, bone marrow aspiration/biopsy, and relevant biochemical and serological investigations were performed to determine the underlying etiology. Outcomes were classified as improved, stable, or deceased at discharge. **Results:** The mean age was 48.6 ± 16.2 years, with male predominance (56.7%). The most common etiologies were megaloblastic anaemia (35.8%), followed by aplastic anaemia (20.8%), haematological malignancies (15.0%), and hypersplenism (10.8%). Nutritional deficiencies (vitamin B12 and folate) accounted for 38.3% of cases. At discharge, 55.0% improved, 30.8% remained stable, and 14.2% expired. Mortality was significantly higher in patients with haematological malignancies (44.4%) and aplastic anaemia (32.0%) compared to nutritional causes (2.2%) ($p < 0.001$). **Conclusion:** Nutritional deficiencies, particularly megaloblastic anaemia, are the most common cause of pancytopenia in adults, with favourable outcomes. Haematological malignancies and aplastic anaemia, though less frequent, carry poor prognosis. Early diagnosis through bone marrow evaluation and prompt treatment of reversible causes significantly improves outcomes.

KEYWORDS : Pancytopenia, Megaloblastic Anaemia, Aplastic Anaemia, Bone Marrow Aspiration, Haematological Malignancies

INTRODUCTION

Pancytopenia is a clinically significant haematological condition characterised by a reduction in all three peripheral blood cell lines: haemoglobin (<10 g/dL), total leukocyte count (<4,000/μL), and platelet count (<100,000/μL).[1–2] It is not a disease entity itself but a manifestation of diverse underlying pathologies affecting the bone marrow, peripheral blood, or reticuloendothelial system.

The etiological spectrum of pancytopenia varies considerably across geographical regions, age groups, and socioeconomic settings. In developing countries like India, nutritional deficiencies—particularly vitamin B12 and folate deficiency—remain the predominant causes, whereas in Western populations, haematological malignancies and aplastic anaemia are more frequently encountered.[3–4]

The clinical presentation of pancytopenia is protean, ranging from asymptomatic laboratory findings to life-threatening complications such as severe anaemia, bleeding diathesis, and overwhelming infections. The diagnostic approach requires a systematic evaluation including complete blood count, peripheral smear examination, bone marrow aspiration and biopsy, and targeted investigations based on clinical suspicion.[5]

Early and accurate etiological diagnosis is crucial as it directly influences management and prognosis. While nutritional deficiencies are readily treatable with excellent outcomes, conditions like aplastic anaemia and haematological malignancies require aggressive intervention and carry significant morbidity and mortality.[6]

Data on the spectrum of pancytopenia from the Indian subcontinent are limited, with few large-scale studies. This study was undertaken to evaluate the etiological spectrum, clinical presentation, and outcomes of pancytopenia in adults at a tertiary care centre in North India.

MATERIALS AND METHODS

Study Population

This cross-sectional observational study was conducted at the Department of General Medicine, G S Medical College and Hospital, Pilkhuwa, Hapur, Uttar Pradesh, over 18 months (January 2024 to June 2025). Adult patients (≥18 years) presenting with pancytopenia (Hb <10 g/dL, TLC <4,000/μL, platelet count <100,000/μL) were enrolled. Patients with known haematological disorders on treatment, post-chemotherapy pancytopenia, and those refusing consent were excluded. The study was approved by the Institutional Ethics Committee, and written informed consent was obtained.

Sample Size

A total of 120 patients were enrolled based on convenience sampling over the study period.

Data Collection

Detailed clinical history, physical examination, and baseline

laboratory investigations were recorded. Complete blood count was performed using an automated haematology analyser. Peripheral smear examination was done for all patients. Bone marrow aspiration (BMA) and/or biopsy (BMB) were performed where indicated. Relevant investigations including vitamin B12, folate, ferritin, liver function tests, renal function tests, viral serology (HIV, HBV, HCV), and autoimmune markers were performed based on clinical suspicion.

Outcome Assessment

Outcomes at discharge were classified as:

- **Improved:** Resolution or significant improvement in blood counts
- **Stable:** No significant change in blood counts
- **Expired:** Death during hospitalisation

Statistical Analysis

Data were analysed using SPSS version 27.0. Categorical variables were presented as frequencies and percentages. Continuous variables were expressed as mean ± standard deviation. Chi-square test was used to compare categorical variables. A p-value <0.05 was considered statistically significant.

RESULTS

Baseline Characteristics

A total of 120 patients with pancytopenia were enrolled. The mean age was 48.6 ± 16.2 years (range 18–82 years). Male predominance was observed (56.7%, n=68). The most common presenting symptoms were easy fatigability (85.8%), followed by pallor (80.0%), fever (45.8%), and bleeding manifestations (25.0%). Splenomegaly was present in 30.8% and hepatomegaly in 18.3% of patients.

Table 1. Baseline demographic and clinical characteristics (N=120)

Characteristic	Value
Mean age (years)	48.6 ± 16.2
Male gender	68 (56.7%)
Female gender	52 (43.3%)
Presenting symptoms	
Easy fatigability	103 (85.8%)
Pallor	96 (80.0%)
Fever	55 (45.8%)
Bleeding manifestations	30 (25.0%)
Clinical findings	
Splenomegaly	37 (30.8%)
Hepatomegaly	22 (18.3%)
Lymphadenopathy	15 (12.5%)

Haematological Parameters

The mean haemoglobin was 6.8 ± 1.8 g/dL, mean total leukocyte count was 2,850 ± 890/μL, and mean platelet count was 42,500 ± 18,200/μL.

Etiological Spectrum

The most common etiology was megaloblastic anaemia (35.8%), followed by aplastic anaemia (20.8%), haematological malignancies (15.0%), and hypersplenism (10.8%). Nutritional deficiencies (vitamin B12 and folate) accounted for 38.3% of cases overall. The etiological distribution is shown in Table 2.

Table 2. Etiological spectrum of pancytopenia

Etiology	n	Percentage
Megaloblastic anaemia	43	35.8%
Aplastic anaemia	25	20.8%
Haematological malignancies	18	15.0%
- Acute leukaemia	10	8.3%
- Lymphoma	5	4.2%
- Myelodysplastic syndrome	3	2.5%
Hypersplenism	13	10.8%
Drug-induced	8	6.7%
Infections	7	5.8%
- Malaria	3	2.5%
- Dengue	2	1.7%
- HIV	2	1.7%
Autoimmune	4	3.3%
Idiopathic	2	1.7%

Outcomes

At discharge, 55.0% (n=66) showed improvement, 30.8% (n=37) remained stable, and 14.2% (n=17) expired (Table 3). Mortality was highest in haematological malignancies (44.4%) and aplastic anaemia (32.0%), while nutritional causes had excellent outcomes (97.8% improved) (Table 4). The association between etiology and outcome was statistically significant ($p < 0.001$).

Table 3. Overall outcome at discharge

Outcome	n	Percentage
Improved	66	55.0%
Stable	37	30.8%
Expired	17	14.2%

Table 4. Etiology-wise outcomes

Etiology	n	Improved	Stable	Expired
Megaloblastic anaemia	43	42 (97.7%)	1 (2.3%)	0 (0%)
Aplastic anaemia	25	6 (24.0%)	11 (44.0%)	8 (32.0%)
Haematological malignancies	18	2 (11.1%)	8 (44.4%)	8 (44.4%)
Hypersplenism	13	10 (76.9%)	3 (23.1%)	0 (0%)
Drug-induced	8	5 (62.5%)	3 (37.5%)	0 (0%)
Infections	7	1 (14.3%)	5 (71.4%)	1 (14.3%)
Autoimmune	4	0 (0%)	4 (100%)	0 (0%)
Idiopathic	2	0 (0%)	2 (100%)	0 (0%)

$p < 0.001$ (Chi-square test)

DISCUSSION

In this cross-sectional study of 120 adult patients with pancytopenia, we found that nutritional deficiencies, particularly megaloblastic anaemia, were the most common etiology (35.8%), followed by aplastic anaemia (20.8%) and haematological malignancies (15.0%). Outcomes were excellent for nutritional causes, with 97.7% improvement, while haematological malignancies and aplastic anaemia carried poor prognosis with mortality rates of 44.4% and 32.0%, respectively.

The predominance of megaloblastic anaemia as the leading cause of pancytopenia in our study is consistent with previous Indian studies. Khodke et al. (2017) reported megaloblastic anaemia as the most common cause (34.2%) in a study of 150 patients.[7] Similarly, Jain et al. (2018) found nutritional deficiencies in 36.5% of pancytopenia cases.[8] The high prevalence of nutritional deficiencies in our population reflects the socioeconomic conditions, dietary patterns, and widespread vitamin B12 and folate deficiency in the Indian subcontinent.

Aplastic anaemia was the second most common cause in our study (20.8%), which is comparable to findings from other Indian studies. Kumar et al. (2019) reported aplastic anaemia in 18.2% of cases.[9] The etiology of aplastic anaemia in our population was largely idiopathic, with a small proportion attributed to drug-induced or viral causes. The poor prognosis of aplastic anaemia in our cohort (32% mortality) underscores the need for early diagnosis and timely referral for immunosuppressive therapy or haematopoietic stem cell transplantation.

Haematological malignancies accounted for 15.0% of cases in our study, with acute leukaemia being the most common

(8.3%). This is consistent with the findings of Sharma et al. (2020), who reported haematological malignancies in 16.7% of pancytopenia patients.[10] The high mortality rate (44.4%) in this group reflects the aggressive nature of these disorders and the challenges in managing them in resource-limited settings.

Hypersplenism (10.8%) and drug-induced pancytopenia (6.7%) were other notable etiologies in our study. Drug-induced pancytopenia is particularly relevant in the Indian context, where self-medication and over-the-counter drug use are common. Infections (5.8%) including malaria, dengue, and HIV were also identified as causes, emphasising the need for a thorough infectious workup in endemic areas.

The overall mortality rate of 14.2% in our study is comparable to previous reports. We observed that outcomes were strongly correlated with the underlying etiology, with nutritional causes having excellent prognosis and haematological malignancies/aplastic anaemia carrying poor outcomes. This finding highlights the critical importance of early and accurate etiological diagnosis.

The diagnostic approach to pancytopenia should be systematic. Complete blood count and peripheral smear examination are essential first-line investigations. Bone marrow aspiration and biopsy remain the gold standard for diagnosis, particularly when haematological malignancies or aplastic anaemia are suspected. In our study, bone marrow evaluation was performed in 85% of patients and was instrumental in establishing the diagnosis.

LIMITATIONS

The study has several limitations. The single-centre design may limit generalizability. The cross-sectional nature precludes long-term follow-up assessment. Detailed subtyping of haematological malignancies and aplastic anaemia was beyond the scope of this study.

CONCLUSIONS

Pancytopenia in adults is a haematological manifestation with a diverse etiological spectrum. Nutritional deficiencies, particularly megaloblastic anaemia, are the most common cause with excellent outcomes. Haematological malignancies and aplastic anaemia, though less frequent, carry significant morbidity and mortality. Bone marrow evaluation remains the cornerstone of diagnosis, especially when the cause is not apparent from peripheral blood findings. Early diagnosis and prompt treatment of reversible causes significantly improve outcomes. Clinicians should maintain a high index of suspicion for nutritional deficiencies in this population and initiate appropriate therapy while awaiting definitive diagnosis.

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