Section: General Medicine

Original Research Article

ETIOLOGICAL PROFILE OF PANCYTOPENIA IN A TERTIARY CARE HOSPITAL

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Received : 13/05/2025
Received in revised form : 07/07/2025
Accepted : 28/07/2025

Keywords:
Pancytopenia, megaloblastic anemia, bone marrow aspiration, hypersplenism, etiology, India.

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DOI:10.47009/jamp.2025.7.4.231

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2025; 7 (4); 1221-1225

ABSTRACT

Background: Pancytopenia, which is marked by low levels of red blood cells, white blood cells, and platelets, can stem from a variety of causes that differ significantly across regions. In places like India, megaloblastic anemia is often a common culprit. This study set out to explore the causes, clinical features, and blood-related factors associated with pancytopenia at a major healthcare facility in Southern India. **Materials and Methods:** We conducted a cross-sectional descriptive study involving 78 patients with pancytopenia (aged 14 and older) at the Government General Hospital in Kurnool from October 2017 to September 2019. To be included, patients needed to have a hemoglobin level below 10 g/dL, a white blood cell count under 3.5 × 10⁹/L, and platelet counts below 1.0 × 10⁹/L. We carried out clinical assessments, hemograms, peripheral smears, and bone marrow aspirations. Descriptive statistics were used to analyze demographics, causes, and lab results. **Result:** The average age of participants was 37.8 years (ranging from 17 to 72), with a slight male predominance (1.22:1). The leading cause of pancytopenia was megaloblastic anemia (55.1%), followed by hypersplenism (11.5%) and aplastic anemia (9.0%). Fatigue was reported by 96.2% of patients, and pallor was present in all (100%); splenomegaly was noted in 24.3%. The hemogram showed a median hemoglobin level of 5–7.5 g/dL (46.2%), leukocyte counts of 1.5–2.5 × 10⁹/L (61.5%), and platelets below 50 × 10⁹/L (47.4%). Bone marrow hypercellularity (79.5%) was linked to nutritional deficiencies, while hypocellularity (16.7%) was associated with aplastic anemia. **Conclusion:** In Southern India, megaloblastic anemia stands out as the main treatable cause of pancytopenia. Evaluating the bone marrow is essential for accurate diagnosis, highlighting the importance of targeted nutritional support and infection control in areas where these conditions are prevalent.

INTRODUCTION

Pancytopenia is a condition characterized by the simultaneous occurrence of anemia (with hemoglobin levels dropping below 13 g/dL in men and 12 g/dL in women), leukopenia (where the white blood cell count falls below 4 × 10⁹/L), and thrombocytopenia (with platelet counts under 150 × 10⁹/L).[1-3]This critical hematological syndrome has various underlying causes, including bone marrow failure (like aplastic anemia), ineffective blood cell production (such as in megaloblastic anemia), infiltration of the bone marrow (due to malignancies), or peripheral sequestration (as seen in hypersplenism).[4,5]On a global scale, the incidence of pancytopenia ranges from 2 to 5 cases per million people each year, increasing to 5 to 12 cases per million in more industrialized countries, with a notably higher prevalence in Asia and two age peaks (15–25 and 65–69 years).[8]

The causes of pancytopenia can vary significantly depending on the region. In developing countries like India, common culprits include megaloblastic anemia, aplastic anemia, infections, hypersplenism, and drug toxicity. The clinical symptoms are often more influenced by anemia (like pallor and fatigue) or thrombocytopenia (leading to bleeding) rather than leukopenia.[6,7,9]Identifying the root cause is crucial, as it shapes both treatment and prognosis.[8]A bone marrow examination—consisting of aspiration for cytology and a trephine biopsy to evaluate cellularity, architecture, and infiltration—is essential for making a diagnosis.[10,11]

ISSN (O): 2687-5365; ISSN (P): 2753-6556

Even though there are established diagnostic methods, the patterns of causes can differ across various regions in India.[8,12-14]This highlights the importance of having localized data to inform clinical practices. Therefore, this study aims to Assess how often different causes of pancytopenia occur at Government General Hospital in Kurnool, Analyze the causes and clinical presentations of pancytopenia, Correlate the underlying causes with clinical features, hemogram parameters, peripheral smear findings, and results from bone marrow aspiration cytology.

MATERIALS AND METHODS

Study Design and Setting

We carried out a cross-sectional descriptive study at the Department of General Medicine in Government General Hospital, Kurnool, in partnership with the Department of Pathology at Kurnool Medical College. This study took place from October 2017 to September 2019.

Study Population

A total of seventy-eight patients diagnosed with pancytopenia through hemogram analysis were included in the study. The inclusion criteria were: age of 14 years or older, hemoglobin levels below 10 g/dL, total leukocyte count under 3.5 × 10^9/L, and platelet count below 1.0 × 10^9/L. We excluded individuals aged 13 years or younger, those with a pre-existing diagnosis of pancytopenia, and anyone who had undergone chemotherapy or radiotherapy previously.

Data Collection

Once we obtained informed consent, all participants went through thorough clinical and physical examinations. We used a pre-designed proforma to record demographic information, medical history, clinical features, and results from various investigations.

Laboratory Investigations

Blood samples were drawn in EDTA tubes for complete blood count (CBC) analysis using an automated hematology analyzer, and in plain tubes for biochemical tests. We prepared peripheral blood smears and examined them microscopically to confirm the automated CBC results. Experienced pathologists reviewed all slides.

Bone Marrow Examination

Bone marrow aspiration was performed when clinically necessary. The aspirates were stained with Leishman/Giemsa for cytomorphological evaluation and Perl's stain for detecting hemosiderin. We applied special stains, such as periodic acid–Schiff (PAS) and reticulin, when needed to assess specific pathologies.

Statistical Analysis

We compiled the data in Microsoft Excel (Office 365) and conducted descriptive analysis. We correlated clinical features, hemogram parameters, peripheral smear findings, and bone marrow aspiration results to identify etiological frequencies.

RESULTS

Study Population and Demographics

We evaluated a total of 78 patients with pancytopenia, with an average age of 37.8 years, ranging from 17 to 72 years. There was a slight male predominance, with a male-to-female ratio of 1.22:1. The largest group was those aged 30 to 39, making up 34.6% of the cohort. Most patients had hemoglobin levels between 5 and 7.5 g/dL (46.2%), leukocyte counts ranging from 1.5 to 2.5 × 10^9/L (61.5%), and platelet counts below 50 × 10^9/L (47.4%). The mean corpuscular volume (MCV) was mostly normocytic (80–100 fL; 50%) or macrocytic (100–120 fL; 32.1%) as shown in Table 1 and Figure 1.

Etiological Distribution

The primary cause of pancytopenia was megaloblastic anemia, accounting for 55.1%, followed by hypersplenism at 11.5% and aplastic anemia at 9.0%. Other causes included leukemia (5.1%), lymphoma (3.8%), and infections like tuberculosis and malaria, which together made up 7.7%. Megaloblastic anemia was typically diagnosed earlier, with a mean age of 35.5 years, while lymphoma and multiple myeloma were found in older patients, averaging 65 and 70 years, respectively. The gender distribution varied: megaloblastic anemia was nearly equally prevalent among males and females (51.2% female), while hypersplenism showed a strong male predominance (77.8% male), and systemic lupus erythematosus (SLE) was exclusively female (100% female), as illustrated in Table 2 and Figure 2.

Clinical and Laboratory Findings

When it comes to clinical and laboratory findings, fatigue (96.2%) and fever (82.1%) topped the list of symptoms, while bleeding manifestations were noted in 19.2% of cases. Key physical signs included pallor (100%) and splenomegaly (24.4%). A look at peripheral smear analysis showed macrocytic (35.9%) and normocytic (30.8%) patterns. Bone marrow aspiration revealed hypercellularity in 79.5% of cases, which was linked to ineffective hematopoiesis, such as megaloblastic anemia, or infiltration, like leukemia. On the other hand, hypocellular marrow (16.7%) was associated with aplastic anemia (Table 3, Figures 3–5).

Table 1: Baseline Characteristics of the Study Cohort (n=78)

Parameter	Value
Age (years)	Mean: 37.8; Median: 34.5
Sex, n (%)	Male: 43 (55.1%); Female: 35 (44.9%)
Hb (g/dL)	5–7.5: 36 (46.2%)

ISSN (O): 2687-5365; ISSN (P): 2753-6556

WBC (×10⁹/L)	1.5–2.5: 48 (61.5%)
Platelets (×10⁹/L)	<50: 37 (47.4%)
MCV (fL)	80–100: 39 (50.0%)

Table 2: Etiological Profile and Age/Gender Distribution

Etiology	n (%)	Mean Age (years)	Male:Female
Megaloblastic anemia	43 (55.1)	35.5	21:22
Hypersplenism	9 (11.5)	39.1	7:02
Aplastic anemia	7 (9.0)	45	4:03
Leukemia	4 (5.1)	44.5	2:02
Lymphoma	3 (3.8)	65	1:02
Infections	6 (7.7)	30.2*	5:01
Includes TB, HIV, malaria			

Table 3: Key Clinical and Diagnostic Findings

Feature	n (%)
Symptoms	
Fatigue	75 (96.2)
Fever	64 (82.1)
Bleeding	15 (19.2)
Signs	
Pallor	78 (100)
Splenomegaly	19 (24.4)
Peripheral Smear	
Macrocytic	28 (35.9)
Normocytic	24 (30.8)
Bone Marrow Cellularity	
Hypercellular	62 (79.5)
Hypocellular	13 (16.7)

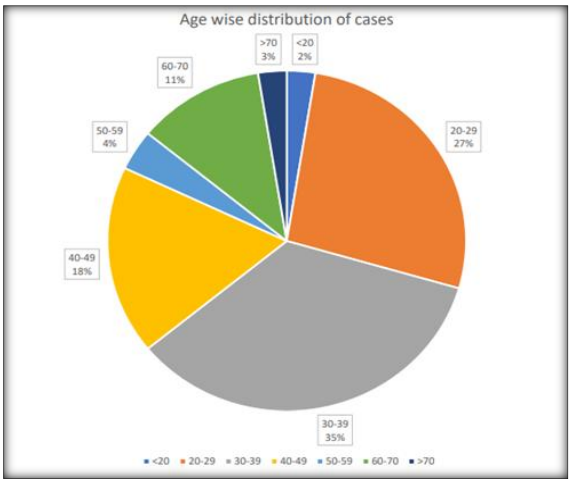

Figure 1: Age and sex distribution of patients

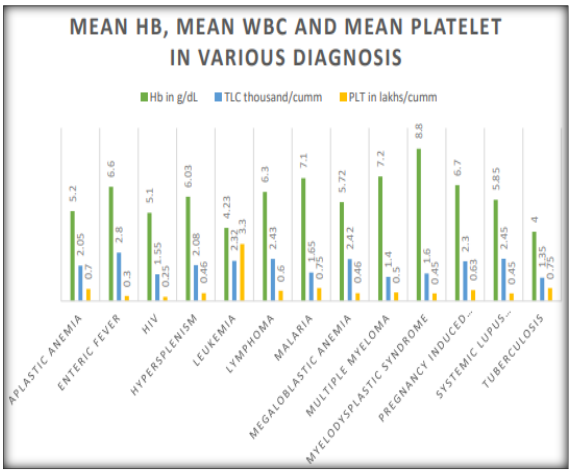

Figure 3: Hemogram parameter ranges (Hb, WBC, platelets)

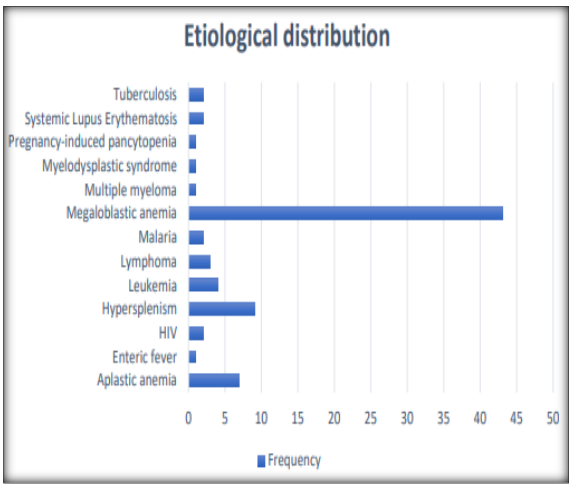

Figure 2: Etiological spectrum of pancytopenia

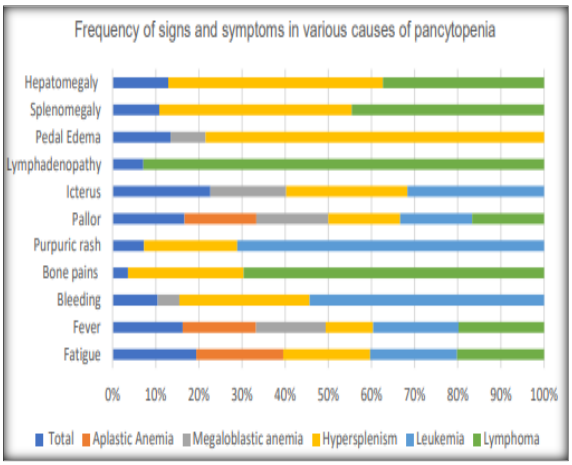

Figure 4: Symptom and sign frequencies

ISSN (O): 2687-5365; ISSN (P): 2753-6556

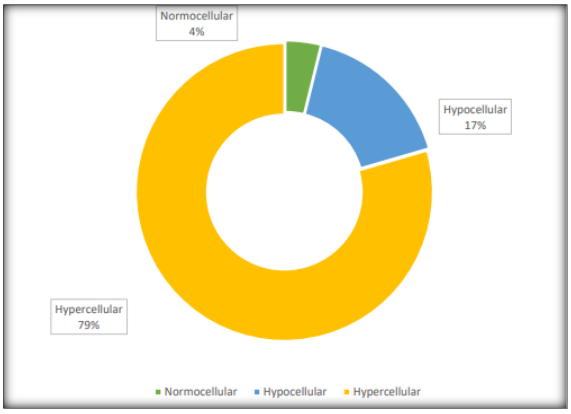

Figure 5: Bone marrow cellularity patterns

DISCUSSION

This study explores the various causes of pancytopenia in a tertiary care setting in India, highlighting megaloblastic anemia as the most common culprit at 55.1%. Following that, we see hypersplenism at 11.5% and aplastic anemia at 9.0%. The demographic details show a mean age of 37.8 years, with a slight male predominance (1.22:1), and the highest incidence occurring in the 30–39 age group, which is consistent with previous studies conducted in India.[8,14,35] The significant occurrence of megaloblastic anemia supports findings from Khunger et al. (72%),[3]Gayathri et al. (74%),[8] and Tariq et al. (72.7%),[7] highlighting nutritional deficiencies as a major public health issue in developing areas. In contrast, research by Kumar et al,[12] and Das Gupta et al,[13] pointed to aplastic anemia as the leading cause, showcasing the geographical differences in disease prevalence.

Hypersplenism was identified as the second most frequent cause, surpassing the rates reported by Sangwan et al. (4.2%),[15] yet still lower than those found by Jain et al. (29.2%).[14]This discrepancy might be due to regional variations in chronic liver disease, infectious diseases (like malaria and kala-azar), and alcohol use.[14,16-18] The underlying mechanisms—peripheral sequestration and splenic pooling—highlight the importance of thoroughly assessing splenic size in cases of pancytopenia. The incidence of aplastic anemia (9.0%) falls within the global range of 7.7 -- 52.7%,[8,19,20]while infectious causes such as tuberculosis (2.6%) and HIV (2.6%) reflect similar frequencies found in comparable groups.[6,7,21]

In clinical observations, fatigue (96.2%) and pallor (100%) were universally noted, aligning with presentations typically seen in anemia. Fever (82.1%) and splenomegaly (24.3%) were also common, with the latter being closely linked to hypersplenism (100% of cases). The peripheral blood smear mainly showed macrocytic (35.9%) and normocytic (30.8%) patterns, which support the idea of megaloblastic anemia and marrow infiltration as significant factors. Bone marrow hypercellularity (79.5%) was prevalent, contrasting with findings from Gupta et al. (12%),[22] but consistent with SwapnaKumari et al. (56.25%),[20] likely indicating a high occurrence of ineffective hematopoiesis in nutritional anemias.

The comprehensive assessment (clinical, hematological, and bone marrow) enhances the understanding of the underlying causes. However, there are some limitations, such as the single-center study design, the exclusion of pediatric and chemotherapy-treated patients, and resource limitations that restrict advanced diagnostic methods. Additionally, Berkesonian bias might lead to an underrepresentation of wealthier populations.[23,24] To confirm these findings, larger multi-center studies with long-term follow-up are needed.

CONCLUSION

This study sheds light on the fact that in the south-Indian context we looked at, pancytopenia is most commonly linked to megaloblastic anaemia, with hypersplenism and aplastic anaemia coming in second. More than half of the 78 cases we reviewed were either reversible or easily treatable, which really emphasizes the need for careful examination of peripheral smears and quick bone marrow assessments. With the rising rates of alcohol-related liver disease and infections like tuberculosis and HIV—which can lead to hypersplenism—it's crucial for clinicians to keep a wide range of possibilities in mind when dealing with pancytopenia. Identifying the root cause early and accurately allows for timely and targeted treatment, significantly lowering morbidity and mortality rates and enhancing the overall outlook for these patients.

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ISSN (O): 2687-5365; ISSN (P): 2753-6556

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ISSN (O): 2687-5365; ISSN (P): 2753-6556