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A RETROSPECTIVE STUDY OF PROFILE OF PANCYTOPENIA PATIENTS PRESENTING TO A TERTIARY HEALTH CARE CENTRE IN SOUTH INDIA

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ABSTRACT

Introduction: Pancytopenia is a commonly encountered haematological condition. It is not a disease but the manifestation of underlying pathology which may be malignant or non-malignant. The etiology of pancytopenia differs between age groups, and these differences are due to diverse geographical area where the study is conducted, genetic variations, the nutritional condition of children enrolled, the prevalence of various infections and exposure to myelotoxic drugs, among other factors. As a result, knowing the actual cause of pancytopenia is essential for determining treatment and prognosis. The aim of this study was to find the etiopathogenesis, common presenting symptoms, clinical signs and laboratory observations of pancytopenia in clinical practice, the frequency, severity and causes based on genetic, geographic, nutritional, and socioeconomic factors.

Materials & Methods: This was a retrospective observational study conducted over a period of 4 months which included 100 patients who were diagnosed as pancytopenia. Age, sex, presenting symptoms, clinical signs and relevant laboratory investigations like Peripheral smear, bone marrow aspiration and bone marrow biopsy reports were analysed and presented in the form of tables and descriptive form.

Results: Among the 100 individuals evaluated for pancytopenia, the largest proportion fell within the 41–50-year age range (24%). Male-to-female ratio was around 1.2:1. Fatigue, fever, weakness and body pain were the most common symptoms. Pallor & Splenomegaly are the most common clinical signs. Erythroid hyperplasia, Aplastic Anemia and Acute Leukemia were the most common causes of Pancytopenia in this study.

Conclusion: The findings of this study emphasize that many causes of pancytopenia are potentially treatable if identified at an early stage. By recognizing the common etiological patterns in pancytopenia within the studied population can aid clinicians in redirecting and prioritizing investigations and initiating timely & targeted therapy. The study also highlights the need for strengthening primary healthcare and awareness to facilitate early referral and intervention.

KEYWORDS: Pancytopenia, Megaloblastic Anemia, Acute Leukemia

INTRODUCTION:

Pancytopenia is a haematological condition characterised by the simultaneous decline in the number of red blood cells, white blood cells, and platelets. It is not a disease but the manifestation of underlying pathology which may be malignant or non-malignant. Pancytopenia is a symptom of various diseases that affect the bone marrow, directly or indirectly. Failure of stem cell production in bone marrow, infiltration of bone marrow, immune-mediated bone marrow suppression, increased destruction of blood cells, or sequestration of blood cells by the reticuloendothelial system are some of the mechanisms that cause cytopenia in these diseases (1). Some of these diseases would include malignancies like leukemia, lymphoma, metastatic cancers (lung, prostate, breast), multiple myeloma, myelofibrosis, myelodysplastic syndrome, storage disorders like Gaucher's disease, SLE, hypersplenism (as seen in portal hypertension, chronic liver disease, etc) infections like tuberculosis, malaria, HIV, Parvovirus-B19, Hepatitis, EBV. It may also be seen in patients taking therapeutic drugs such as antiepileptics, antithyroid drugs, chloramphenicol, therapeutic procedures like chemotherapy, radiotherapy and in chronic alcohol consumption.

The etiology of pancytopenia differs between age groups and these differences are due to variation in the geographical area where the study is conducted, genetic variations, the nutritional condition of children enrolled, the prevalence of various infections and exposure to myelotoxic drugs, among other factors (2).

As a result, knowing the actual cause of pancytopenia is essential for determining treatment and prognosis options. Detailed medical history, thorough physical examination, and complete blood count with a peripheral smear review are still necessary and provide useful information (3). Anemia can manifest in various ways, including fatigue, breathing difficulties, and signs of cardiac failure. Leucopenia combined with neutropenia can make you more vulnerable to infections that cause fever or sepsis. Patients with thrombocytopenia may experience bleeding in various places, including the skin mucosa, epistaxis, etc. The presentation of clinical symptoms in the patient depends on the degree of severity of anemia, leucopenia, and thrombocytopenia (4).

As the cause and clinical presentation largely dictate the investigations and disease prognosis, creation of a thorough analysis of the various clinical and etiopathological profile of patients with pancytopenia presenting to a tertiary health care centre is intended (5). This will enable better outcome of specifically curated therapeutic methods enlisted for a particular patient based on their unique clinical presentation.

The aim of this study was to find the prevalence of pancytopenia in clinical practice, the frequency, severity and causes based on genetic, geographic, nutritional, and socioeconomic factors. By conducting a retrospective study on the same using hospital records such as lab reports (CBC, peripheral smear, bone marrow biopsy and bone marrow aspiration in this case), we were able to further introspect into the clinical presentation and etiological trends of pancytopenia and the factors that affect its incidence and manifestations. This will hence help guide future diagnostic and therapeutic protocols.

MATERIALS & METHODS

This was a retrospective observational study conducted over a period of 4 months from September 2025 to December 2025 at the Department of Pathology in a tertiary care centre in South India.

We analysed peripheral smears, bone marrow aspiration, bone marrow biopsy forms, and other laboratory investigations of patients who were diagnosed with pancytopenia over a period of 2 years in Vydehi Institute of Medical Sciences and Research Centre. Patients who had hemoglobin values recorded <12 gm/dl (in males) and <11 gm/dl (in females) respectively, total leucocyte count <4000/mm3 and platelet count <1.5 lakh/mm3 (As per WHO guidelines) were taken into consideration, ensuring in prior that their complete medical records and investigations were available in VYKO. Patients undergoing chemotherapy or radiation therapy at the time of admission/ during the period of study and incomplete clinical records or missing investigation data were excluded from the study.

Based on the reference article (Suhas S. Gajbhiye et al, 2022) where 56% of patients had moderate anemia, with 95% confidence level and 10% absolute error, the minimum sample size required is approximately 95 patients (1).

The total number of patients diagnosed with pancytopenia included in the study was **100**. All data collected was anonymised, structurally organized, compiled into an Excel sheet, and analysed using SPSS version 23. Descriptive analysis of all the explanatory and outcome parameters was done using mean and standard deviation for quantitative variables, frequency, and proportions for categorical variables.

After organizing the data into the Excel Sheet, the patients were categorized based on their:
1) age distribution
2) distribution of symptoms
3) physical findings
4) severity of anemia
5) total leucocyte count
6) platelet distribution count
7) distribution of cellularity in bone marrow

Then, the peripheral blood smear, bone marrow aspiration findings and bone marrow biopsy findings were correlated and tabulated based on the patients' diagnosis and the prevalence of the same was considered.

Based on the clinical and biochemical analyses, the etiology of pancytopenia in each patient was evaluated.

RESULTS

This study was conducted in the Hematology section of the department of Pathology over a period of 4 months from September 2025 to December 2025.

Table 1: Age Distribution of Pancytopenia Patients

Age group	No. of Patients (N)	Percentage %
≤10	5	5
11–20	5	5
21–30	11	11
31–40	15	15
41–50	24	24

51–60	19	19
>60	21	21
Total	100	100

Gender: Male: 55; Female:45.

Among the 100 individuals evaluated for pancytopenia, the largest proportion fell within the 41–50-year age range (24%). Patients older than 60 years (21%) and those between 51 and 60 years (19%) were also frequently represented. Only 5% of cases occurred in children aged 10 years or younger. Overall, the distribution reflects a higher burden among middle-aged and elderly adults. Males made up 55% of the cohort, while females accounted for 45%, producing a male-to-female ratio of roughly 1.2:1.

Table 2: Distribution of Symptoms among Study Patients

Symptoms	N	%
Fatigue	32	32
Fever	31	31
Pain (back/chest/neck/body/myalgia)	25	25
Generalized weakness	22	22
Bleeding manifestations	16	16
Weight loss	14	14
Abdominal pain / discomfort	14	14
Loss of appetite	13	13
Swelling / Edema	10	10
Cough	7	7
Dizziness	6	6
Breathlessness	5	5
Rash / Skin lesions	5	5
Headache	3	3
Vomiting / Nausea	3	3
Joint pain	2	2
Diarrhea	1	1

Fatigue emerged as the most frequently reported symptom, noted in 32% of patients. Fever was nearly as common, affecting 31%. Pain complaints including back, chest, neck, or generalized body aches were documented in 25% of individuals, and 22% reported generalized weakness. Bleeding-related features were present in 16%, consistent with low platelet counts. Both weight loss and abdominal discomfort occurred in 14% of cases, while loss of appetite was seen in 13%. Respiratory complaints were less common, with cough and breathlessness occurring in 7% and 5%, respectively. Additional symptoms reported included dizziness (6%), skin rash (5%), headache (3%), vomiting (3%), joint pain (2%), and diarrhea (1%).

Table 3: Physical Findings in Study Patients

Physical findings	N	%
Pallor	66	66
Splenomegaly	18	18
Hepatosplenomegaly	8	8
Lymphadenopathy	5	5
Icterus	3	3
Tenderness	3	3
Pedal edema	2	2
Stomatitis / Tongue changes	2	2
Petechiae / Purpura	2	2
Eye changes (restricted movements / chemosis)	2	2

Oral candidiasis	1	1
Hyperpigmentation	1	1
Raised JVP	1	1

Pallor was the most frequently observed physical sign, present in 66% of patients. Splenomegaly was identified in 18%, whereas hepatosplenomegaly occurred in 8%. Lymph node enlargement was detected in 5%. Icterus and abdominal tenderness each appeared in 3% of the cohort. Less common findings, each reported in 2%, included pedal edema, stomatitis, petechiae or purpura, and ocular abnormalities. Rare findings such as oral candidiasis, hyperpigmentation, and elevated jugular venous pressure were each documented in 1% of cases.

Table 4: Severity of Anemia

Hb level	Severity of anemia	N	%
<7	Severe	40	40
7–10	Moderate	51	51
10–12	Mild	9	9
Total		100	100

More than half of the patients (51%) exhibited moderate anemia at presentation. Severe anemia, defined as hemoglobin less than 7 g/dL, was observed in 40%, while only 9% had mild anemia (10–12 g/dL). These results indicate that a substantial proportion of patients sought medical attention when anemia was already well advanced.

Table 5: Total Leukocyte Count (TLC)

Age Group	Mild (3000–4000)	Moderate (1000–3000)	Severe (<1000)
5–10	1	3	1
11–20	2	4	0
21–30	8	10	0
31–40	7	12	2
41–50	6	11	4
51–60	5	8	6
>60	3	9	6
Total	34	47	19

Moderate leukopenia was predominant, affecting 47 % of individuals. Mild leukopenia occurred in 34 %, while severe reductions in leukocyte count were documented in 19 % of cases. Moderate leukopenia was most frequently observed in patients aged 31-50 years. Marked leukocytosis was mostly seen above 51 years

Table 6: Platelet Count Distribution

Age group	Mild [1-1.5 lakh]	Moderate [20,000-1 Lakh]	Severe [<20,000]
5–10	0	5	0
11–20	0	3	0
21–30	1	9	1
31–40	2	9	4
41–50	1	17	5
51–60	1	15	3
>60	3	12	6
Total	8	70	19

The majority of patients demonstrated moderate thrombocytopenia (70%). Severe thrombocytopenia was recorded in 19%, whereas mild thrombocytopenia was noted in only 8% of subjects. Severe platelet depletion occurred most commonly among patients older than 60 years, followed by those aged 41–50 years, suggesting an age-related increase in bleeding risk.

Table 7: Distribution of Cellularity in Bone Marrow

Parameter (Cellularity)	N	%
Hypocellular	27	27
Normocellular	29	29

Hypercellular	33	33
Others (hemodiluted)	11	11

Bone marrow examination showed hypercellularity in 33% of patients. Normocellularity was noted in 29%, and hypocellularity in 27%. Hemodiluted aspirates accounted for 11% of samples.

Table 8: Distribution of Lineage Patterns in Bone Marrow

Parameter (Cellularity)	N	%
Erythroid Hyperplasia	61	61
Myeloid Hyperplasia	11	11
Plasmacytosis	6	6
Lymphocytic Hyperplasia	3	3
Blasts (>30%)	19	19

Regarding lineage patterns, erythroid hyperplasia was the most frequent abnormality, appearing in 61% of cases. Elevated blast counts (>30%) were seen in 19%. Myeloid hyperplasia in 11%, increased plasma cells in 6%, and lymphocytic hyperplasia were detected in 3% of individuals.

Table 9: Correlation of PBS, BMA, and BMB Findings

Diagnosis	PBF Findings (common)	BMA Findings (common)	No.	%	Mean age
Erythroid hyperplasia (non-megaloblastic) (n=30)	Normocytic normochromic anemia of moderate degree / dimorphic anemia of moderate degree with leucopenia and thrombocytopenia	Erythroid hyperplasia with normoblastic, micronormoblastic maturation / mild plasmacytosis	30	30	48.7
Aplastic / Hypoplastic marrow (n=11)	Dimorphic anemia / normocytic normochromic anemia with leucopenia and thrombocytopenia	Hemodiluted, hypocellular bone marrow for age / hypoplastic marrow with erythroid hyperplasia and eosinophilia	11	11	42.1
Acute Leukemia (n=11)	Normocytic normochromic anemia of severe degree / dimorphic anemia of severe degree with leucopenia and thrombocytopenia	Features of acute leukemia / features highly suggestive of acute leukemia	11	11	38.5
Megaloblastic Anemia (n=10)	Dimorphic anemia of moderate degree / macrocytic anemia with leucopenia and thrombocytopenia	Erythroid Hyperplasia with megaloblastic maturation / hypercellular marrow with megaloblastic hyperplasia	10	10	39.6
Myelodysplastic Syndrome (n=5)	Dimorphic anemia of moderate degree / dimorphic anemia with tear-drop cells and leukopenia and thrombocytopenia/ leucoerythoblastic blood picture	Mildly hypercellular marrow with erythroid hyperplasia with dysmegakaryopoiesis / erythroid hyperplasia with dyspoiesis/ MDP favouring - Myleofibrosis	5	5	57.6
Granulomatous Inflammation (n=3)	Normocytic normochromic anemia of moderate degree / dimorphic anemia of moderate degree with	Features suspicious of ill-formed granulomas / features suggestive of granulomatous inflammation	3	3	31.7

	leucopenia and thrombocytopenia				
Lymphoproliferative Neoplasm (n=3)	Dimorphic anemia of moderate /severe degree with leucopenia and thrombocytopenia	Hemodiluted marrow with lymphoproliferative neoplasm	3	3	51.7
Myeloid Hyperplasia (n=1)	Normocytic normochromic anemia of moderate degree with leucopenia and thrombocytopenia/	Myeloid hyperplasia with maturation arrest	1	1	15.0
Normocellular Marrow (n=1)	Normocytic normochromic anemia of moderate degree with leucopenia and thrombocytopenia	Normocellular bone marrow with normoblastic maturation	1	1	16.0
Plasmacytosis (n=2)	Normocytic normochromic anemia of moderate degree / dimorphic anemia with leucopenia and thrombocytopenia	Bone marrow plasmacytosis with erythroid hyperplasia / mild erythroid hyperplasia with normoblastic & megaloblastic maturation	2	2	56.5
Inadequate for opinion (n=23)	Normocytic normochromic anemia of severe degree/dimorphic anemia / dimorphic anemia of severe degree with leucopenia and thrombocytopenia	H emodiluted / hemodiluted; regret no opinion possible erythroid hyperplasia with micronormoblastic and megaloblastic maturation (suspicious for metastasis)	23	23	47.6

Non-megaloblastic erythroid hyperplasia appeared as the leading diagnosis and accounted for 30% of cases, with an average age of 48.7 years. Both aplastic/hypoplastic marrow patterns and acute leukemia contributed 11% each. Megaloblastic anemia made up 10% of the diagnoses. Myelodysplastic syndrome appeared in 5% of cases, primarily among older individuals (mean age 57.6 years). Less frequent diagnoses included granulomatous inflammation and lymphoproliferative neoplasms contributed 3% each and plasmacytosis 2% Normocellular marrow and myeloid hyperplasia each represented 1%. Diagnostic interpretation was not possible in 23% of cases due to inadequate aspirates.

Table 10: Comparison of Most Common Causes of Pancytopenia

Study	Country	Year of Study	No. of cases	Most Common Cause	2nd Most Common Cause
Present Study	India	2025	100	Erythroid hyperplasia	Aplastic anemia
Patel et al	India	2022	546	Acute leukemia	Megaloblastic anemia
Gajbhiye et al	India	2022	50	Aplastic anemia	Megaloblastic anemia
Javia Singh Raina et al	India	2020	60	Megaloblastic anemia	Aplastic anemia
Deepika Wadhera et al	India	2025	50	Megaloblastic anemia	Erythroid hyperplasia

In this study, erythroid hyperplasia was the most often identified cause of pancytopenia, followed by aplastic anemia. This pattern contrasts with reports such as those of Patel et al. (2022), where acute leukemia predominated. Studies by Gajbhiye et al. and Javia Singh Raina et al. identified aplastic anemia and megaloblastic anemia, respectively, as the principal etiologies. Deepika Wadhera et al. (2025) also reported megaloblastic anemia as the major cause, followed by erythroid hyperplasia. These interstudy differences highlight the influence of regional, nutritional, and demographic factors on the disease spectrum.

DISCUSSION

Pancytopenia is a hematological condition with multiple etiologies, requiring a systematic clinical and laboratory investigation for accurate diagnosis and management (1). In the present study, the clinico-hematological profile of 100 patients presenting with pancytopenia was analyzed to determine demographic patterns, clinical features, hematological parameters, and bone marrow findings were analyzed to understand the disease pattern in our region.

In this study, pancytopenia was predominantly observed among middle-aged and elderly individuals, with the highest incidence in the 41–50 years age group (24%), followed by patients above 60 years (21%). A slight male predominance (M: F = 1.2: 1) was noted. Similar age and gender distributions have been reported in several Indian studies, suggesting that adult and geriatric populations are more frequently affected, possibly due to long term nutritional deficiencies, chronic illnesses, and malignancies (6,9,17,20).

Fatigue (32%) and fever (31%) were the most common presenting symptoms, followed by pain (25%) and generalised weakness (22%). These findings correlate with the underlying anemia and leukopenia seen in pancytopenia patients. Bleeding manifestations were seen in (16%) of cases, indicating significant thrombocytopenia. Similar symptom patterns have been described in earlier studies (9). Most patients presented with non-specific symptoms, which may lead to delayed diagnosis.

Pallor was the most frequent physical finding (66%), which is consistent with the high prevalence of moderate to severe anemia in the study population. Splenomegaly and hepatosplenomegaly were noted in 18% and 8% of patients, respectively, indicating hypersplenism and infiltrative disorders as contributing factors. These findings are in agreement with previous studies where pallor and organomegaly were the most common clinical signs in pancytopenia (4,7,15).

Moderate anemia was the most common pattern (51%), followed by severe anemia (40%). Only (9%) had mild anemia, indicating that most patients presented at an advanced stage of disease. Moderate leukopenia (47%) and moderate thrombocytopenia (70%) were also predominant. increasing the risk of infections and bleeding. These results suggest delayed healthcare-seeking behaviour and limited early detection in the means studied population (4,5,8).

Bone marrow examination played an important role in the evaluation of pancytopenia. In this study, hypercellular marrow was observed in 33% of patients, followed by normocellular (29%) and hypocellular marrow (27%). Erythroid hyperplasia was the most frequent lineage abnormality (61%), indicating compensatory response to peripheral destruction or nutritional deficiency. Elevated blast counts were seen in (19%) of cases, indicating hematological malignancies. Similar marrow patterns have been reported in studies from developing countries (10,11,13,16,19).

Non-megaloblastic erythroid hyperplasia (30%) was the most common diagnosis , followed by aplastic/hypoplastic marrow (11%) and acute leukemia (11%). Megaloblastic anemia accounted for (10%) of cases. This distribution differs from several previous studies, where megaloblastic anemia or aplastic anemia was reported as the leading cause. Such variations may be attributed to regional nutritional status, socioeconomic conditions, prevalence of infections, and health care access in different regions (2,3,14,16,18).

In the present study considerable number of bone marrow samples were inadequate for proper diagnosis (23%). This may be related to technical difficulties, hemodilution, or patient-related factors. This highlights the importance of proper sampling techniques and combining bone marrow aspiration with biopsy whenever required.

When compared with other Indian studies, this study demonstrates diversity in etiological patterns. While Patel et al. reported Acute Leukemia as the most common cause and Gajbhiye et al. observed Aplastic Anemia predominance, the present study identified erythroid hyperplasia as the leading diagnosis. These interstudy differences highlight the influence of geographical, nutritional, infections, environmental, and demographic factors. Therefore, regional studies are important for understanding local disease trends (1,2,6,19)

Overall, the findings of this study emphasise the importance of comprehensive clinical evaluation, detailed hematological investigations, and timely bone marrow examination in patients with pancytopenia. Early diagnosis of reversible causes such as nutritional deficiencies and identification of malignant conditions can significantly improve patient outcomes (5,12,17).

This study has its own limitations like data has collected only for 2 years with sample size of 100 patients diagnosed with Pancytopenia. Further studies with more patient data conducted over a longer period of time may shed light on more diverse results, different etiopathogenesis and approach to pancytopenia.

CONCLUSION

Pancytopenia is a multifactorial condition requiring systematic evaluation. A comprehensive diagnostic approach helps in identifying the underlying cause and guides appropriate treatment, thereby improving patient prognosis. The findings of this study emphasize that many causes of pancytopenia are potentially treatable if identified at an early stage. By recognizing the common etiological patterns in pancytopenia within the studied population can aid clinicians in redirecting and prioritizing investigations and initiating timely & targeted therapy. The study also highlights the need for strengthening primary healthcare and awareness to facilitate early referral and intervention (1,4).

Ethical statement:

Ethical approval was obtained from Vydehi Scientific Research Committee (VSRC) of VIMS&RC with Ethical Reference No. VSRC/2025/64.

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There are no conflicts of interest.

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