Clinical Profile of Patients with Pancytopenia: An Observational Study

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ABSTRACT

Introduction: Pancytopenia is a hematological condition characterized by a reduction in at least two of three blood cell lines. It can be caused by bone marrow failure, nutritional deficiencies, infections, autoimmune diseases, and malignancies. This study aimed to evaluate the clinical profile and etiological spectrum of pancytopenia among adults in eastern Nepal.

Methods: A descriptive cross-sectional study was conducted at Nobel Medical College Teaching Hospital from December 2024 to November 2025. A total of 107 patients aged ≥18 years with pancytopenia were included. Detailed clinical history, examination, hematological parameters, peripheral smear, and bone marrow aspiration findings were recorded.

Results: The mean age of patients was 43.50±18.00 years, with the majority in the 31–40-year age group. Females constituted 61.68% of the study population. Fever 72 (67.29%), weakness 62 (57.94%), and loss of appetite 51 (47.66%) were the most common symptoms; pallor was observed in 80 (74.77%) of patients. Bone marrow examination showed hypercellular marrow in 54 (50.47%) of cases. Infections were the most common etiology 37 (34.58%), followed by vitamin B_{12} deficiency anemia 12 (11.21%), aplastic anemia 10 (9.35%), hematological malignancies 9 (8.41%), and autoimmune disorders 6 (5.61%).

Conclusion: Infections and nutritional deficiencies were the leading causes of pancytopenia.

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INTRODUCTION

Pancytopenia is the decrease in red cells, white cells, and platelet counts, two of three, or all three at once.[1] This could be caused by bone marrow suppression, infiltration, nutritional deficiencies, infections, or autoimmune processes.[2,3] The evaluation of laboratory parameters, peripheral smear, and bone marrow examination is essential to determine the underlying cause and guide management.[3]

Getting to the root cause is important, especially here in Nepal, where many cases can be prevented or treated with basic resources. A descriptive study by Vaidya et al. found megaloblastic anemia to be the most common cause i.e. 34.94%, followed by aplastic anemia.[4] Similarly, Ghartimagar et al. from western Nepal also reported megaloblastic anemia as the predominant etiology.[5] However, data from eastern Nepal remain scarce.

This study aimed to assess the clinical profile, presenting features, and etiological factors of pancytopenia among adult patients presenting to a tertiary care center in eastern Nepal.

METHODS

This was a descriptive cross-sectional study conducted in the Department of Internal Medicine, Nobel Medical College Teaching Hospital (NOMCTH), Biratnagar, Nepal, over a period of one year from December 2024 to November 2025. Ethical approval was obtained from the Institutional Review Committee of Nobel Medical College (Ref: 118/2024). Written informed consent was obtained from all patients before inclusion in the study. Confidentiality was maintained throughout the study.

Due to a rare diagnosis of pancytopenia, a definite sample size estimation and calculation was not performed; instead, all admitted patients aged 18 years and above presenting with pancytopenia were included. Patients with normal blood counts at first visit who subsequently developed pancytopenia, previously diagnosed cases of pancytopenia, patients in whom a final diagnosis could not be established, and those unwilling to participate were excluded. Final diagnosis could not be reached in 2 cases in which patients were referred to higher centers for further workup; follow-up could not be performed in either case. The two cases are acknowledged to be a potential source of selection bias during the study.

The attributes of pancytopenia were defined as decreased red cell

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count if hemoglobin <13 g/dL in males and <12 g/dL in females, decreased total leukocyte count if <4,000/µL, and decreased platelet count <150,000/µL, with the presence of either two or all three of the criteria to define pancytopenia.[1] The severity of anemia was classified based on hemoglobin (Hb) levels. Mild anemia was defined as Hb 11–11.9 g/dL in females and 11–12.9 g/dL in males; moderate anemia as Hb 8–10.9 g/dL; and severe anemia as Hb <8 g/dL.[6] Thrombocytopenia or low platelet count was defined as mild (100,000–149,999/µL), moderate (50,000–99,999/µL), and severe (<50,000/µL).[7]

In the present study, the etiology of pancytopenia was found by the evaluation of clinical features, laboratory parameters, peripheral smear examination, and bone marrow findings. Infectious causes were diagnosed based on clinical presentation supported by laboratory evidence. Sepsis was evaluated using prevalent guidelines.[8] For the bacterial origin of sepsis, blood cultures, or response to antimicrobial therapy, along with signs of sepsis, were evaluated. Enteric fever was diagnosed using the Typhoid serology Rapid Diagnostic Test (RDT) kit and related signs and symptoms. Dengue fever was diagnosed using the rapid serological dengue test kit and related clinical signs and symptoms. Scrub typhus was detected using rapid detection kit along with compatible symptoms. Vitamin B_{12} deficiency anemia was diagnosed in patients with low serum vitamin B_{12} and compatible hematological features. Aplastic anemia was defined by hypocellular bone marrow with pancytopenia in the absence of marrow infiltration or fibrosis.[9] Hematological malignancies were diagnosed based on bone marrow morphology and peripheral smear findings suggestive of leukemia or marrow infiltration. Autoimmune causes were considered in patients with compatible clinical features and exclusion of other etiologies. The use of RDTs was done due to lack of proper confirmatory test availability and is acknowledged as source of diagnostic bias due to their own sensitivity and specificity.

Being a relatively rare diagnosis, without an estimated required sample size, all cases of pancytopenia that were free of any excluding criteria were enrolled in the study. Sampling of the case was done by screening patients who were evaluated by the Department of Internal Medicine at the OPD clinic and the Emergency room. During the study period, over 20000 patients were screened by the Department, of which a total of 107 patients were enrolled until the end of data collection. Each patient underwent a detailed clinical evaluation, including demographic profile, history of presenting complaints, drug use, prior blood transfusions, and physical examination. Physical signs such as pallor, lymphadenopathy, and hepatosplenomegaly were also evaluated. Relevant laboratory investigations were performed, including complete blood count, peripheral blood smear, liver and renal function tests, vitamin B12 levels, and other investigations as indicated. Bone marrow aspiration was performed in all patients to assess marrow cellularity and identify the underlying etiology.

Data were collected using a predesigned proforma including demographic details, clinical presentation, hematological parameters, and bone marrow findings. The collected data were entered in Microsoft Excel and analyzed using IBM SPSS Statistics version 29. Descriptive statistics were used, and the results were expressed as mean, standard deviation, frequency, and percentage.

RESULTS

A total of 107 patients fulfilling the inclusion criteria were enrolled in the study. The mean age of the patients was 43.50±18.00 years, ranging from 18 to 82 years. There were 28 (26.17%) cases in the 31–40 years age group (Figure 1).

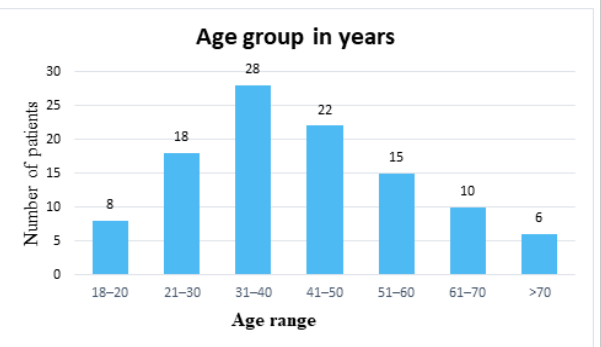

Figure 1. Age distribution of patients (n = 107).

There were 66 (61.69%) female and 41 (38.31%) male with females to males ratio 1.6:1 (Figure 2).

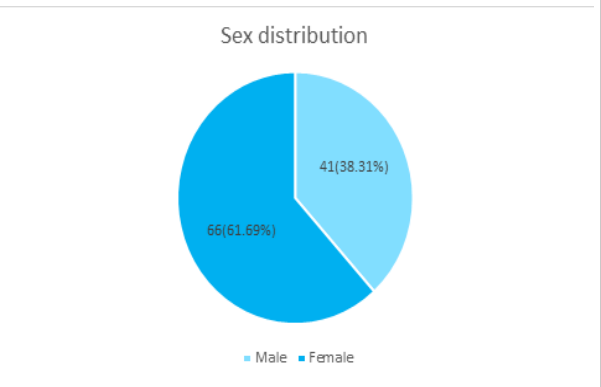

Figure 2. Sex distribution of patients (n = 107).

Fever was present in 72 (67.29%) cases, generalized weakness in 62 (57.94%) cases, loss of appetite in 51 (47.66%) cases, and abdominal pain in 32 (29.91%) cases. Other symptoms included weight loss, bleeding manifestations, and cough. On general examination, pallor was noted in 80 (74.77%) patients, hepatomegaly in 15 (14.02%), splenomegaly in 11 (10.28%), and hepatosplenomegaly in 9 (8.41%). Lymphadenopathy was present in 13 (12.15%) (Table 1).

Hematological evaluation showed moderate anemia in 57 (53.27%), severe anemia in 14 (13.08%), and mild anemia in 36 (33.64%). Severe neutropenia was observed in 5 (4.67%) and severe thrombocytopenia in 33 (30.84%). Peripheral smear revealed a normocytic normochromic pattern in 45 (42.06%), dimorphic in 30 (28.04%), macrocytic in 20 (18.69%), and

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microcytic hypochromic in 12 (11.21%) cases (Table 2).

Table 1. Presenting complaints and clinical findings (n=107).

Clinical features	n(%)
Fever	72(67.29)
Weakness	62(57.94)
Loss of appetite	51(47.66)
Abdominal pain	32(29.91)
Pallor	80(74.77)
Lymphadenopathy	13(12.15)
Hepatomegaly	15(14.02)
Splenomegaly	11(10.28)
Hepatosplenomegaly	9(8.41)

Table 2. Severity of cytopenias (n=107).

Parameter	Mild n(%)	Moderate n(%)	Severe n(%)
Anemia	36(33.64)	57(53.27)	14(13.08)
Neutropenia	43(40.19)	59(55.14)	5(4.67)
Thrombocytopenia	30(28.04)	44(41.12)	33(30.84)

Bone marrow aspiration revealed hypercellular marrow in 54 (50.47%), normocellular marrow in 32 (29.91%), and hypocellular marrow in 21 (19.63%). Out of 54 patients with hypercellular marrow, 35 (64.81%) patients presented with fever and systemic symptoms. Out of 21 patients with hypocellular marrow, severe anemia, bleeding manifestations, and organomegaly were seen in 16(76.19%). In 22 (68.75%) patients out of 32 had normocellular marrow, splenomegaly and lymphadenopathy were observed.

Among the etiological spectrum, infection was present in 37 (34.58%), vitamin B_{12} deficiency anemia was present in 12 (11.21%) and aplastic anemia was present in 10 (9.35%). Detailed etiological spectrum is tabulated (Table 3).

Table 3. Etiological spectrum of pancytopenia (n=107).

Etiology	n(%)
Infection	37(34.58)
Vitamin B12 deficiency	12(11.21)
Aplastic anemia	10(9.35)
Hematological malignancy	9(8.41)
Autoimmune disorders	6(5.61)
Chronic liver disease	5(4.67)
Drug induced	10(9.35)
Mixed disorders	18(16.82)

DISCUSSION

In this study involving 107 adults (18 years and older) admitted with pancytopenia at Nobel Medical College Teaching Hospital (NOMCTH), Biratnagar, Nepal between December 2024 and November 2025. Their average age came to 43.50±18.00 years, and the 31–40 age bracket had the most cases. This matches patterns seen in other Nepalese and Indian reports where younger adults often were the population with the highest burden of pancytopenia.[10,11] In our study, females were more than male with a ratio of 1.6:1. Vaidya et al. in their respective study found something similar to our study, where females were more affected by pancytopenia. The cause of this ratio of higher women diagnosed with pancytopenia could be because females have to suffer from more nutritional stress in poorer communities like ours.[4]

In our study, fever was the most common presenting symptom, followed by generalized weakness, and loss of appetite. Among the 107 patients we studied, during physical examination, pallor was the most frequent finding, followed by hepatomegaly, splenomegaly, and lymphadenopathy. Fever and pallor were the most common presentations of pancytopenia in the studies by Ghartimagar et al., Kumar et al., and Gayathri et al., which is similar to the findings of our study. The presence of organomegaly varied according to the underlying etiology.[5,12,13]

Hematological evaluation revealed moderate anemia as the most common presentation. Peripheral blood smear examination showed normocytic normochromic morphology as the most common. This predominance of normocytic cells likely indicates that a substantial number of patients presented relatively early in the disease course, before megaloblastic, microcytic, or other specific morphological changes became apparent. Comparable findings have been reported in regional studies such as in the study by Niazi et al.[14]

All 107 cases underwent bone marrow testing to determine the cause, regardless of the final etiology, so that a preliminary laboratory abnormality would not mask a different diagnosis. The bone marrow results showed that hypercellular marrow was most common, followed by normocellular and hypocellular. The hypercellular cases frequently presented with fever and systemic illness, which could likely reflect the marrow's reactive response to infection or ineffective hematopoiesis. Tilak and Jain described similar pattern in their study, with hypercellularity being common as the body attempts to compensate.[11] Hypocellular marrow was associated with severe cytopenias and bleeding tendencies which is classic for aplastic anemia. Normocellular marrow was associated with higher incidence of organomegaly. Bone marrow findings were helpful to rule out any mixed disorder where two causes were affecting the clinical outcome.

In terms of causes, infections were the leading etiology, followed by vitamin B_{12} deficiency anemia, aplastic anemia, hematological malignancies, autoimmune disorders, and chronic liver disease. Infections being the most common fits our eastern Nepal context where tropical diseases like enteric fever, TB, malaria, and sepsis are everyday common occurrences in this tropical belt. Jha et al., Khunger et al., and Basu et al., highlighted similar trends in their own respective studies which also were done in tropical areas like our center.[10,15,16] This highlights the importance of infection and nutrition specific screening, early diagnosis and improvement in management in the general population.

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Yet this differs from other Nepali regions. Vaidya et al. in central Nepal and Ghartimagar et al. in the west found megaloblastic anemia to be the most common cause of pancytopenia.[4,5] Similarly, Makheja et al., from Pakistan, also found megaloblastic anemia to be the most common cause of pancytopenia in their respective study.[17] Studies by Singh et al., and Singh et al., from various parts of India reported aplastic anemia as primary etiology of pancytopenia.[18,19] Why the variation? It likely comes down to diet differences, sanitation levels, which infections are rampant locally, and how easily people reach healthcare. In Biratnagar and surroundings, monsoon floodingg and vector issues probably push infection numbers higher, whereas central and western areas of Nepal may see more nutritional cases due to different food habits or better control of insects, and more access to healthcare in urban areas. This emphasizes the physician to be aware about the local prevalence of important causes of health issues.

Our vitamin B_{12} deficiency figure sits lower than those earlier studies by Vaidya et al., Ghartimagar et al., and Ojha et al., perhaps reflecting gradual dietary improvements or quicker treatment of anemias in Nepal.[4,5,20] Aplastic anemia at 9.35% seems steady in South Asia, as similar findings were observed in the studies of Vaidya et al. from Nepal and Khunger et al., from India.[4,15] Blood cancers and autoimmune issues, though fewer, remind us to investigate thoroughly when things don't resolve quickly.[21] In some places, megaloblastic anemia is the problem, and in other places, hypersplenism is the biggest problem. This shows that the cause of pancytopenia in South Asia depends on the diet, geography, sanitation, socioeconomic conditions, and the infections common in the area.

This work has several limitations and drawbacks. Single-center studies like ours cannot speak for all regions of Nepal. We relied on standard tests, without other advanced tools such as cytogenetics, flow cytometry, etc., so some early myelodysplastic cases might have been missed. The sensitivity and specificity of RDTs are also sources of bias. Reliant on simpler methods of investigations are diagnostic limitations of the study. Being a cross-sectional study, we lack follow-up data on outcomes of the cases and any late presenting feature that may have developed later on. We also lacked detailed further outcome of the cases and whether or not they responded to standard treatments. The two cases where a final diagnosis and follow up couldn't be done should be acknowledged as a source of selection bias. Even so, these findings add useful detail to pancytopenia in eastern Nepal. They call for a diagnostic path that targets our common culprits, such as infections and nutrition. In resource-limited environments, prioritizing common causes based on regional patterns can improve efficiency and patient outcomes and decrease economic burden.

CONCLUSION

Infection and vitamin B_{12} deficiency were the leading causes of pancytopenia in this study, followed by aplastic anemia and hematological malignancies. Most patients presented with fever, weakness, and pallor.

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Authors' contribution: **Surendra Prasad Shah:** Concept, Design, Data collection, Data analysis, Manuscript Preparation, Literature Review; **Saurav Poudel:** Design, Data collection, Data analysis, Manuscript Preparation, Literature Review; **Bivusha Parajuli:** Data collection, Data analysis, Manuscript Editing, Literature Review; **Shuvechchha Karki:** Data collection, Manuscript Review, Literature Review; **Rupak KC:** Data collection, Manuscript Review, Literature Review; **Sandip Kumar Sah:** Data collection, Manuscript Review, Literature Review.

Conflict of interest: None.

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Ethical Considerations: Ethical issues (including plagiarism, data fabrication, and double publication) have been completely observed by the authors.

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