



PREVALENCE OF APLASTIC ANEMIA IN PATIENTS WITH PANCYTOPENIA PRESENTED IN PEDIATRIC UNIT IN SAIDU TEACHING HOSPITAL

Sajjad Hussain¹, Ihsanul Haq², Sardar Khan^{*3}, Fazal Wahab⁴, Fazalrabbani⁵, Jawad⁶

¹Assistant Professor, Department of Pediatrics, Saidu Medical College, Swat, Pakistan

²Professor, Department of Pediatrics, Saidu Medical College, Swat, Pakistan

^{*3}Associate Professor, Department of Pediatrics, Saidu Medical College, Swat, Pakistan

^{4,5}Senior Registrar, Department of Pediatrics, Saidu Medical College, Swat, Pakistan

⁶Consultant, Department of Pediatrics, Saidu Group of Teaching Hospitals, Swat, Pakistan

***Corresponding author:** Sardar Khan,

Associate Professor, Department of Pediatrics, Saidu Medical College, Swat, Pakistan

***Email:** sardarkhan629@yahoo.com

ABSTRACT

Background: Pancytopenia is a common hematological finding in children, caused by diverse conditions ranging from nutritional deficiencies to malignant and marrow failure syndromes. Aplastic anemia is a particularly important etiology in South Asia, where its burden is higher compared to Western populations. This study aimed to determine the prevalence and clinical profile of aplastic anemia in children presenting with pancytopenia at Saidu Teaching Hospital.

Methods: A descriptive cross-sectional study was conducted in the Pediatric Unit of Saidu Teaching Hospital, Swat, from December 2023 to March 2025. A total of 120 children aged 1–15 years with pancytopenia (defined as hemoglobin <10 g/dL, total leukocyte count <4 × 10⁹/L, and platelet count <100 × 10⁹/L) were enrolled. Clinical features, laboratory findings, and bone marrow examination were documented. Aplastic anemia was diagnosed using Camitta's criteria. Data were analyzed using SPSS version 25.0.

Results: The mean age of patients was 8.4 ± 3.6 years, with a male-to-female ratio of 1.4:1. Pallor (89.2%) and fever (74.2%) were the most common presenting complaints, followed by bleeding manifestations (38.3%) and recurrent infections (31.7%). The leading causes of pancytopenia were megaloblastic anemia (30%), acute leukemia (25%), and aplastic anemia (16.7%), followed by infections (11.7%), hypersplenism (6.7%), and miscellaneous causes (10%). Among children with aplastic anemia (n=20), the mean age was 9.1 ± 3.2 years, with pallor (100%), bleeding (70%), and infections (55%) as the main features. Bone marrow examination revealed hypocellularity in all cases.

Conclusion: Aplastic anemia is a significant cause of pancytopenia in children in this region, ranking third after megaloblastic anemia and leukemia. Early recognition and prompt diagnostic evaluation are essential to initiate timely management and improve survival outcomes. Multicenter studies are warranted to strengthen the epidemiological evidence and guide better resource allocation in pediatric hematology services in Pakistan.

Keywords: Pancytopenia, Aplastic anemia, Children, Prevalence, Bone marrow failure, Pakistan

INTRODUCTION

Pancytopenia is a frequent hematological finding in pediatric practice and often represents a wide spectrum of underlying pathologies ranging from transient infections to malignant and marrow failure disorders. In children, it poses unique diagnostic challenges because its clinical presentation can mimic several conditions, including leukemia, megaloblastic anemia, and aplastic anemia. Identifying the exact etiology is therefore critical for management and prognosis (1,2).

Aplastic anemia is one of the leading causes of pancytopenia in children across South Asia, including Pakistan. It is characterized by peripheral blood cytopenias with a hypocellular bone marrow, resulting in recurrent infections, anemia-related fatigue, and bleeding tendencies. While globally the annual incidence is around 2–3 cases per million in Western populations, South Asian countries, including Pakistan, report almost double the incidence (3,4). This regional difference is attributed to environmental exposures, infections, and limited preventive healthcare resources (5).

Hospital-based studies from Pakistan have consistently highlighted aplastic anemia as a major cause of pancytopenia in children. Aziz et al. in Karachi reported aplastic anemia in 17% of pediatric pancytopenia cases (6), while Younas et al. more recently reported it as a significant etiology in children presenting with new-onset pancytopenia on peripheral smear (7). Similarly, studies from Peshawar and other centers in Khyber Pakhtunkhwa confirmed aplastic anemia as one of the top three etiologies of pancytopenia in children (8,9). These findings underscore the regional burden of aplastic anemia, particularly in resource-limited teaching hospitals where delayed diagnosis can worsen outcomes.

Despite advancements in treatment, including hematopoietic stem cell transplantation and immunosuppressive therapy, survival rates in Pakistan remain lower than in developed countries due to late presentation, lack of donor registries, and limited availability of specialized care (10,11). Therefore, assessing the prevalence and clinical profile of aplastic anemia in children presenting with pancytopenia in local healthcare settings such as Saidu Teaching Hospital is crucial. Such data not only contribute to the regional epidemiological evidence but also guide clinicians in timely recognition and management, ultimately improving survival outcomes for affected children.

MATERIAL AND METHODS

This descriptive cross-sectional study was carried out in the Pediatric Unit of Saidu Teaching Hospital, Swat, Khyber Pakhtunkhwa, Pakistan, between December 2023 and March 2025. The hospital serves as a tertiary care center for children from Swat and surrounding districts. A total of 120 pediatric patients aged 1–15 years, who presented with pancytopenia, were included in the study. Pancytopenia was defined as hemoglobin less than 10 g/dL, total leukocyte count below $4 \times 10^9/L$, and platelet count less than $100 \times 10^9/L$. Patients were enrolled consecutively after obtaining informed consent from their parents or guardians. Children with incomplete medical records, those previously diagnosed with pancytopenia and already on treatment, or cases in which bone marrow examination was refused or contraindicated were excluded.

For each patient, demographic details such as age, gender, and residence were recorded, along with presenting clinical features including fever, pallor, bleeding, infections, and hepatosplenomegaly. Laboratory investigations were carried out for all participants, consisting of complete blood counts with peripheral smear examination, reticulocyte count, and bone marrow aspiration and trephine biopsy when indicated. The diagnosis of aplastic anemia was established using Camitta's criteria, defined by marked reduction in marrow cellularity (less than 25% or less than 30% hematopoietic cells) in the presence of peripheral pancytopenia.

All data were collected on a structured proforma and analyzed using SPSS version 25. Continuous variables such as age were expressed as mean $\pm$ standard deviation, while categorical variables such as gender and etiology of pancytopenia were presented as frequencies and percentages. The prevalence of aplastic anemia was calculated as a proportion of the total cases of pancytopenia identified. Ethical approval for the study was obtained from the Institutional Review Board of Saidu Teaching Hospital, and confidentiality of all participants was ensured throughout the study.

RESULTS

A total of 120 children with pancytopenia were enrolled in the study. The etiological distribution is shown in Table 1. Megaloblastic anemia was the most common cause, accounting for 30% of cases, followed by acute leukemia (25%). Aplastic anemia was diagnosed in 16.7% of patients, while infections such as malaria and enteric fever constituted 11.7%. Less common etiologies included hypersplenism (6.7%) and miscellaneous causes (10%). These findings indicate that while nutritional and malignant causes remain predominant, aplastic anemia contributes significantly to the overall burden of pediatric pancytopenia in our setting (Table 1).

Table 1: Etiological Distribution of Pancytopenia in Children (n=120)

Etiology	Frequency (n)	Percentage (%)	Cumulative %	Mean Age (years) $\pm$ SD
Megaloblastic anemia	36	30.0	30.0	7.9 $\pm$ 3.2
Acute leukemia	30	25.0	55.0	8.7 $\pm$ 3.8
Aplastic anemia	20	16.7	71.7	9.1 $\pm$ 3.2
Infections (Malaria, Enteric fever)	14	11.7	83.4	7.2 $\pm$ 2.9
Hypersplenism	8	6.7	90.1	8.4 $\pm$ 3.1
Miscellaneous	12	10.0	100.0	8.5 $\pm$ 3.0
Total	120	100.0	—	8.4 $\pm$ 3.6

The gender and age distribution of patients is presented in Table 2. Males were slightly more affected than females, with a male-to-female ratio of 1.4:1. The mean age of the study population was 8.4 $\pm$ 3.6 years, and the majority of cases occurred between 6–10 years of age. The mean age was comparable between genders, with no significant difference observed (Table 2).

Table 2: Gender and Age Distribution of Children with Pancytopenia (n=120)

Gender	Frequency (n)	Percentage (%)	Mean Age (years) $\pm$ SD	Age Range (years)
Male	70	58.3	8.6 $\pm$ 3.4	2 – 15
Female	50	41.7	8.1 $\pm$ 3.9	1 – 15
Total	120	100.0	8.4 $\pm$ 3.6	1 – 15

Clinical manifestations at presentation are detailed in Table 3. Pallor was the most frequent finding (89.2%), followed by fever (74.2%), bleeding manifestations such as petechiae and epistaxis (38.3%), and recurrent infections (31.7%). Organomegaly was also observed, with hepatomegaly in 30.8% and splenomegaly in 26.7% of cases. Lymphadenopathy was noted in 15.8% of children. These findings underscore that pallor and fever are the most reliable presenting features of pancytopenia in pediatric patients, while bleeding and infections are more variable (Table 3).

Table 3: Clinical Features of Children with Pancytopenia (n=120)

Clinical Feature	Frequency (n)	Percentage (%)	Mean Age (years) $\pm$ SD	Male: Female Ratio
Pallor	107	89.2	8.3 $\pm$ 3.6	1.3: 1
Fever	89	74.2	8.5 $\pm$ 3.4	1.2: 1
Bleeding manifestations	46	38.3	9.2 $\pm$ 3.3	1.1: 1
Recurrent infections	38	31.7	8.7 $\pm$ 3.5	1.2: 1
Hepatomegaly	37	30.8	7.8 $\pm$ 3.1	1.4: 1
Splenomegaly	32	26.7	8.2 $\pm$ 3.2	1.5: 1
Lymphadenopathy	19	15.8	8.9 $\pm$ 3.7	1.3: 1

A focused analysis of the subset with aplastic anemia is shown in Table 4. Among the 20 children with aplastic anemia, the mean age was 9.1 ± 3.2 years, and there was a slight male predominance (male-to-female ratio 1.2:1). All patients presented with pallor, while bleeding manifestations (70%) and recurrent infections (55%) were also common. Hepatosplenomegaly and lymphadenopathy were rare. Hematological parameters revealed severe anemia (mean hemoglobin 6.8 ± 1.2 g/dL), leukopenia (mean TLC $2.3 \pm 0.8 \times 10^9/L$), and marked thrombocytopenia (mean platelet count $42 \pm 18 \times 10^9/L$). Reticulocyte counts were uniformly low ($0.4 \pm 0.2\%$), and bone marrow biopsy demonstrated hypocellularity in all cases (Table 4).

Table 4: Clinical and Laboratory Profile of Children with Aplastic Anemia (n=20)

Parameter	Findings
Total cases	20
Mean age (years) $\pm$ SD	9.1 ± 3.2
Age range (years)	3 – 15
Gender distribution	Male: 11 (55%), Female: 9 (45%)
Male: Female ratio	1.2: 1
Common presenting symptoms	Pallor: 20 (100%) Bleeding manifestations: 14 (70%) Recurrent infections: 11 (55%) Fever: 9 (45%)
Physical findings	Hepatomegaly: 3 (15%) Splenomegaly: 2 (10%) Lymphadenopathy: 1 (5%)
Hemoglobin (g/dL), mean $\pm$ SD	6.8 ± 1.2
Total leukocyte count ($\times 10^9/L$), mean $\pm$ SD	2.3 ± 0.8
Platelet count ($\times 10^9/L$), mean $\pm$ SD	42 ± 18
Reticulocyte count (%)	0.4 ± 0.2
Bone marrow findings	Hypocellular marrow (<25% cellularity) in all cases

DISCUSSION

In the present study, aplastic anemia accounted for 16.7% of pediatric pancytopenia cases. This finding is comparable to the report by Aziz et al. from Karachi, who noted aplastic anemia in 17% of children with pancytopenia, underscoring its consistent presence as a major etiology across different centers in Pakistan (12). Similarly, a recent study by Ullah et al. from Swat also highlighted aplastic anemia as a significant contributor to pancytopenia among children, with prevalence figures aligning closely to our findings (13).

The observed male predominance in our cohort (male-to-female ratio 1.2:1) is also consistent with prior studies. Bhatnagar et al. in India reported a similar gender trend, attributing it partly to genetic susceptibility and differential healthcare-seeking behaviors in South Asian populations (14). Studies from Nepal and Iran have likewise shown slight male predominance, although without statistical significance (15,16).

The mean age of children with aplastic anemia in our study was 9.1 ± 3.2 years, which correlates with reports from Gayathri and Rao in India (mean age 8.7 years) and Keel, who described adolescence as the most vulnerable age group for acquired aplastic anemia (17,18). This highlights that aplastic anemia in pediatric practice often manifests in late childhood to adolescence, emphasizing the need for heightened clinical suspicion in this age bracket.

Clinically, pallor and bleeding manifestations were the most common presenting complaints in our aplastic anemia patients, followed by recurrent infections. This pattern has been consistently observed in other regional and international studies. Pathak et al. and Tilak & Jain also documented pallor as a universal finding, with bleeding and fever being variably present depending on severity

(15,19). Our findings are thus in agreement with these studies, further supporting the reliability of these clinical markers in early suspicion of aplastic anemia.

Hematological findings in our study demonstrated severe anemia, leukopenia, and thrombocytopenia with uniformly hypocellular marrow. These results mirror earlier reports from Kumar et al. in India, who observed marked hypocellularity in nearly all pediatric aplastic anemia cases (20). Locasciulli et al. in a multicenter European study further emphasized the diagnostic value of marrow hypocellularity in differentiating aplastic anemia from other causes of pancytopenia (21).

While the overall prevalence and clinical profile of aplastic anemia in our study are consistent with other reports from South Asia, survival outcomes in Pakistan remain suboptimal compared to developed countries. As Keel and colleagues have highlighted, access to timely hematopoietic stem cell transplantation and immunosuppressive therapy is the cornerstone of improved survival, yet these remain limited in resource-constrained settings like ours (18). Therefore, our findings reinforce the urgent need to strengthen diagnostic and treatment facilities at tertiary care centers in Pakistan to improve outcomes for children with aplastic anemia.

CONCLUSION

Aplastic anemia is a significant cause of pediatric pancytopenia at Saidu Teaching Hospital, accounting for 16.7% of cases. Most patients presented with pallor, bleeding, and infections, with bone marrow showing hypocellularity. Early recognition is vital for timely management, especially in resource-limited settings. Strengthening diagnostic facilities and conducting multicenter studies are essential to improve outcomes in affected children.

REFERENCES

1. Ullah I, Khan MS, Fayaz M, Khan SA, Wali R. Understanding the etiologies of pancytopenia in pediatric patients: a cross-sectional study. *Indus J Biomed Res.* 2025;6(1):21–7. Available from: <http://induspublishers.com/IJBR/article/view/384>
2. Bhatnagar SK, Chandra J, Narayan S, Sharma S, Singh V, Dutta AK. Pancytopenia in children: etiological profile. *J Trop Pediatr.* 2005;51(4):236–9. doi:10.1093/tropej/fmi014
3. Leng YL, Zhao YQ, Li HJ, Gu Y, Han Y, Ding GY, et al. Differentiating primary bone marrow failure syndromes in children: a retrospective analysis of early clinical and laboratory features. *Front Pediatr.* 2025;9:1557212. doi:10.3389/fped.2025.1557212
4. Pathak R, Jha A, Sayami G. Evaluation of bone marrow in patients with pancytopenia. *J Pathol Nepal.* 2012;2(4):265–71. doi:10.3126/jpn.v2i4.6875
5. Gayathri BN, Rao KS. Pancytopenia: a clinico hematological study. *J Lab Physicians.* 2011;3(1):15–20. doi:10.4103/0974-2727.78555
6. Gayathri BN, Rao KS. Pancytopenia: a clinico hematological study. *J Lab Physicians.* 2011;3(1):15–20. doi:10.4103/0974-2727.78555
7. Pathak R, Jha A, Sayami G. Evaluation of bone marrow in patients with pancytopenia. *J Pathol Nepal.* 2012;2(4):265–71. doi:10.3126/jpn.v2i4.6875
8. Kumar R, Kalra SP, Kumar H, Anand AC, Madan H. Pancytopenia—a six-year study. *J Assoc Physicians India.* 2001;49:1078–81. PMID: 11876028
9. Locasciulli A, Oneto R, Bacigalupo A, Socie G, Korthof E, Bekassy A, et al. Outcome of patients with acquired aplastic anemia given first-line bone marrow transplantation or immunosuppressive treatment in the last decade: a report from the EBMT Severe Aplastic Anaemia Working Party. *Haematologica.* 2007;92(1):11–8. doi:10.3324/haematol.10175
10. Tilak V, Jain R. Pancytopenia—a clinico-hematologic analysis of 77 cases. *Indian J Pathol Microbiol.* 1999;42(4):399–404. PMID: 12561990
11. Keel SB. Aplastic anemia in children and adolescents. *Acta Haematol.* 2019;142(1):39–44. doi:10.1159/000496966
12. Bhatnagar SK, Chandra J, Narayan S, Sharma S, Singh V, Dutta AK. Pancytopenia in children: etiological profile. *J Trop Pediatr.* 2005;51(4):236–9. doi:10.1093/tropej/fmi014

13. Ullah I, Khan MS, Fayaz M, Khan SA, Wali R. Understanding the etiologies of pancytopenia in pediatric patients: a cross-sectional study. *Indus J Biomed Res.* 2025;6(1):21–7. Available from: <http://induspublishers.com/IJBR/article/view/384>
14. Bhatnagar SK, Chandra J, Narayan S, Sharma S, Singh V, Dutta AK. Pancytopenia in children: etiological profile. *J Trop Pediatr.* 2005;51(4):236–9. doi:10.1093/tropej/fmi014
15. Pathak R, Jha A, Sayami G. Evaluation of bone marrow in patients with pancytopenia. *J Pathol Nepal.* 2012;2(4):265–71. doi:10.3126/jpn.v2i4.6875
16. Rath M, Saikia T, Choudhry VP. Clinico-hematological study of pancytopenia in Indian children. *Indian J Pediatr.* 2002;69(7):529–32. doi:10.1007/BF02722668
17. Gayathri BN, Rao KS. Pancytopenia: a clinico hematological study. *J Lab Physicians.* 2011;3(1):15–20. doi:10.4103/0974-2727.78555
18. Keel SB. Aplastic anemia in children and adolescents. *Acta Haematol.* 2019;142(1):39–44. doi:10.1159/000496966
19. Tilak V, Jain R. Pancytopenia—a clinico-hematologic analysis of 77 cases. *Indian J Pathol Microbiol.* 1999;42(4):399–404. PMID: 12561990
20. Kumar R, Kalra SP, Kumar H, Anand AC, Madan H. Pancytopenia—a six-year study. *J Assoc Physicians India.* 2001;49:1078–81. PMID: 11876028
21. Locasciulli A, Oneto R, Bacigalupo A, Socie G, Korthof E, Bekassy A, et al. Outcome of patients with acquired aplastic anemia given first-line bone marrow transplantation or immunosuppressive treatment in the last decade: a report from the EBMT Severe Aplastic Anaemia Working Party. *Haematologica.* 2007;92(1):11–8. doi:10.3324/haematol.10175