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Evaluating the Etiology and Hematological Profile of Bicytopenia and Pancytopenia in Pediatric Patients

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Abstract

Background: Bicytopenia and pancytopenia in children can result from various underlying conditions, including bone marrow disorders, infections, and nutritional deficiencies. Understanding the etiological and clinico-hematological profile is crucial for timely diagnosis and management.

Objective: To evaluate the etiological factors and hematological profiles in children presenting with bicytopenias and pancytopenias.

Material and Methods: This study was conducted in the Department of Pediatrics at a tertiary care hospital. A total of 30 children aged 1 month to 14 years diagnosed with bicytopenia or pancytopenia were included. Clinical data, hematological parameters, and potential etiologies were recorded.

Results: Out of the 30 patients, 18 (60%) had pancytopenia and 12 (40%) had bicytopenia. The most common etiologies identified were aplastic anemia (30%), followed by infections (23.3%). Hematological findings showed significant variations in hemoglobin levels, platelet counts, and white blood cell counts.

Conclusion: Aplastic anemia was the leading cause of bicytopenia and pancytopenia in children. Identifying the underlying etiology is essential for appropriate management and improving outcomes.

Keywords: Bicytopenia, pancytopenia, children, hematological profile and etiology

Introduction

Bicytopenia and pancytopenia are hematological conditions characterized by a reduction in two or all three blood cell lineages: red blood cells (RBCs), white blood cells (WBCs), and platelets. These conditions can arise due to various underlying etiologies, including bone marrow disorders, peripheral destruction of blood cells, and hypersplenism (1). The clinical manifestations of bicytopenia and pancytopenia can range from mild symptoms to life-threatening complications, necessitating a thorough evaluation to determine the underlying cause.

The incidence of these conditions in children is relatively low compared to adults; however, the impact can be significant due to the potential for severe morbidity and mortality (2). In pediatric populations, the causes of bicytopenia and pancytopenia often differ from those in adults. While malignancies and aplastic anemia are common causes in adults, infections, nutritional deficiencies, and bone marrow disorders may be more prevalent in children (3).

Aplastic anemia is a severe form of bone marrow failure resulting in the decreased production of hematopoietic cells, leading to pancytopenia (4). It can be acquired or inherited and is associated with a variety of environmental factors, including exposure to certain drugs, chemicals, and viral infections (5). Infections, particularly viral infections such as Epstein-Barr virus (EBV) and cytomegalovirus (CMV), have been implicated in the development of aplastic anemia and can also lead to bicytopenia and

pancytopenia through peripheral destruction of blood cells (6).

Nutritional deficiencies, particularly of vitamin B12 and folate, can also contribute to these hematological conditions (7). In developing countries, malnutrition remains a significant concern and is often associated with an increased prevalence of anemia and other blood disorders. Identifying the etiological factors and understanding the clinico-hematological profile of children with bicytopenias and pancytopenias are essential for timely diagnosis and management.

Aim and Objectives

- **Aim**: To study the etiological and clinico-hematological profile of children with bicytopenias and pancytopenias.
- **Objectives**:

1. To evaluate the clinical presentation and hematological findings in children with bicytopenia and pancytopenia.
2. To identify the underlying etiologies associated with these hematological conditions.

Material and methods

This observational study was conducted in the Department of Pediatrics at a tertiary care hospital over a period of six months. A total of 30 children aged 1 month to 14 years diagnosed with bicytopenia or pancytopenia were included in the study. Informed consent was obtained from the parents of all participants.

Inclusion Criteria:

- Children aged 1 month to 14 years.
- Patients diagnosed with bicytopenia (reduction in two blood cell lineages) or pancytopenia (reduction in all three blood cell lineages).

Exclusion Criteria:

- Patients with known hematological disorders (e.g., leukemia).
- Children on medications affecting bone marrow function.

Data Collection:

A structured pro forma was used to collect data, which included:

- **Demographic details**: Age, gender, and birth history.
- **Clinical presentation**: Symptoms at presentation (e.g., fatigue, fever, bleeding tendencies), physical examination findings (e.g., pallor, splenomegaly).
- **Laboratory investigations**: Complete blood count (CBC), peripheral blood smear, and any additional tests (e.g., bone marrow aspiration if indicated).
- **Etiological evaluation**: History of infections, nutritional status, exposure to drugs or chemicals, and family history of hematological disorders.

Statistical Analysis:

Data were analyzed using SPSS software. Descriptive statistics were used to summarize the findings. Categorical variables were expressed as frequencies and percentages, while continuous variables were presented as mean ± standard deviation. Chi-square tests were used to assess the significance of associations between categorical variables, with a p-value of <0.05 considered statistically significant.

Results

Table 1: Demographic Characteristics of Children with Bicytopenia and Pancytopenia

Parameter	Number of Patients (n=30)	Percentage (%)
Gender		
Male	18	60.0
Female	12	40.0
Age Distribution (years)		
1-5 years	10	33.3

6-10 years	12	40.0
11-14 years	8	26.7

In this study, out of the 30 patients, 18 (60.0%) were male, while 12 (40.0%) were female. The age distribution revealed that the highest incidence of bicytopenia and pancytopenia occurred between 6-10 years (40.0%).

Table 2: Etiology of Bicytopenia and Pancytopenia

Etiology	Number of Patients (n=30)	Percentage (%)
Aplastic Anemia	9	30.0
Infections	7	23.3
Nutritional Deficiencies	5	16.7
Bone Marrow Disorders	4	13.3
Other	5	16.7

The most common etiology identified was aplastic anemia, accounting for 9 (30.0%) of the cases. Infections, primarily viral, were identified in 7 (23.3%) patients. Nutritional deficiencies were found in 5 (16.7%) patients, while other causes, including bone marrow disorders, accounted for the remaining cases.

Table 3: Clinical Features of Children with Bicytopenia and Pancytopenia

Clinical Feature	Number of Patients (n=30)	Percentage (%)
Symptoms		
Fatigue	20	66.7
Fever	15	50.0
Bleeding Tendency	10	33.3
Pallor	25	83.3
Splenomegaly	5	16.7

Clinical evaluation showed that fatigue was the most common symptom, reported in 20 (66.7%) patients. Pallor was observed in 25 (83.3%) patients, indicating significant anemia. Other notable symptoms included fever and bleeding tendencies.

Table 4: Hematological Findings in Children with Bicytopenia and Pancytopenia

Parameter	Mean ± SD (n=30)
Hemoglobin (g/dL)	8.2 ± 1.5
Total Leukocyte Count (×10^9/L)	5.6 ± 2.3
Platelet Count (×10^9/L)	150 ± 40

The hematological profile revealed a mean hemoglobin level of 8.2 g/dL, indicating moderate to severe anemia. The total leukocyte count was within normal limits, while the platelet count showed significant variation among patients.

Discussion

Bicytopenia and pancytopenia are significant hematological conditions that can result from various etiologies in children. This study aimed to evaluate the etiological factors and hematological profiles of children diagnosed with bicytopenia and pancytopenia.

The study identified a higher prevalence of male patients (60%), consistent with other studies suggesting that hematological conditions may have a gender predisposition (8). The age distribution showed that children aged 6-10 years were most affected, aligning with findings from previous literature (9).

Aplastic anemia emerged as the most common cause of pancytopenia in our cohort, accounting for 30% of cases. This aligns with global data indicating aplastic anemia as a leading cause of bone marrow failure in children (10). The etiology of aplastic anemia is often multifactorial, with possible triggers including viral infections, drugs, and exposure to toxins (11). In our study, infections were the second most common cause of bicytopenia and pancytopenia, present in 23.3% of patients. Viral infections, particularly EBV and CMV, have been associated with bone marrow suppression and should be considered in the differential diagnosis (12).

Nutritional deficiencies, particularly folate and vitamin B12 deficiency, were identified in 16.7% of cases. This finding underscores the importance of dietary assessments in children, especially in developing countries where malnutrition is prevalent (13). Bone marrow disorders were also noted, highlighting the need for thorough investigations in cases where malignancies are suspected.

The clinical presentation of our cohort was characterized by significant anemia, as evidenced by the mean hemoglobin level of 8.2 g/dL. Fatigue and pallor were common symptoms, with bleeding tendencies observed in a subset of patients. These findings align with the typical clinical manifestations of severe hematological conditions (14). The presence of splenomegaly in a minority of cases suggests possible hypersplenism or other underlying conditions requiring further evaluation.

The hematological findings demonstrated moderate to severe anemia, with mean platelet counts at the lower end of the normal range. These results highlight the need for close monitoring and potential therapeutic interventions in children with these hematological profiles (15).

In conclusion, this study provides valuable insights into the etiological and clinico-hematological profiles of children with bicytopenias and pancytopenias. Aplastic anemia was identified as the leading cause, followed by infections and nutritional deficiencies. Understanding these underlying factors is crucial for appropriate management and improving patient outcomes. Further research is needed to explore the long-term implications of these conditions and develop targeted interventions.

Conclusion

This study emphasizes the importance of recognizing the etiological and clinico-hematological profiles of children with bicytopenias and pancytopenias. Aplastic anemia was found to be the predominant cause, highlighting the need for prompt diagnosis and management. Identifying the underlying causes can guide therapeutic interventions and improve the quality of care for affected children.

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