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Study of Bone Marrow in Pancytopenia

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Abstract

Pancytopenia is a hematological condition characterized by a simultaneous reduction in all three blood cell lines: red blood cells, white blood cells, and platelets. It is a manifestation of various underlying diseases, ranging from benign infections to serious hematological malignancies. This study aimed to evaluate the bone marrow findings in pancytopenic patients to identify the underlying causes. A cross-sectional study was conducted on 150 patients with pancytopenia over a period of five years, in department of pathology. Bone marrow aspiration and biopsy were performed, and findings were correlated with clinical and laboratory data. The most common cause identified was megaloblastic anemia (45%), followed by aplastic anemia (25%), hematological malignancies (15%), and other miscellaneous causes (15%). Bone marrow examination remains a crucial diagnostic tool in evaluating pancytopenia, providing essential information for proper management and prognosis.

Keywords: Pancytopenia, Bone marrow examination, Megaloblastic anemia, Aplastic anemia, Hematological malignancies

Introduction

Pancytopenia is a medical condition characterized by a decrease in all three major cell lines of the blood: erythrocytes, leukocytes, and platelets. It is not a disease in itself but rather a manifestation of a wide variety of disorders affecting the bone marrow. The etiology of pancytopenia varies widely and includes nutritional deficiencies, bone marrow failure syndromes, malignancies, infections, and autoimmune diseases (1).

The incidence of pancytopenia varies depending on geographical location, nutritional status, and the prevalence of infections such as tuberculosis and HIV. The most common cause worldwide is megaloblastic anemia, primarily due to vitamin B12 or folate deficiency. Other common causes include aplastic anemia, myelodysplastic syndromes, leukemia, and hypersplenism (2).

Bone marrow examination, including aspiration and biopsy, is essential for determining the underlying cause of pancytopenia. It helps differentiate between reversible conditions such as nutritional deficiencies and more severe conditions like leukemia and aplastic anemia (3). While peripheral blood smear and complete blood counts provide initial clues, bone marrow studies offer definitive diagnosis and guide treatment strategies (4).

This study aims to evaluate the bone marrow findings in pancytopenic patients, identify common etiological factors, and establish correlations between clinical features and hematological parameters. Understanding the underlying causes of pancytopenia is crucial for timely diagnosis and appropriate management.

Aim

To study the bone marrow findings in patients with pancytopenia and identify the underlying etiologies.

Objectives

1. To determine the common causes of pancytopenia based on bone marrow examination.
2. To correlate clinical and hematological parameters with bone marrow findings for better diagnosis and management.

Materials and Methods

A cross-sectional study was conducted in a tertiary care hospital in department of pathology. A total of 150 patients presenting with pancytopenia (hemoglobin <9 g/dL, total leukocyte count <4000/µL, and platelet count <100,000/µL) were included in the study.

Inclusion Criteria:

- Patients with clinically and hematologically confirmed pancytopenia.
- Patients who underwent bone marrow aspiration and biopsy.

Exclusion Criteria:

- Patients with incomplete medical records.
- Patients receiving chemotherapy or immunosuppressive therapy.

A detailed clinical history was taken, and laboratory investigations, including complete blood count, peripheral smear, serum vitamin B12 and folate levels, and bone marrow studies, were performed. Bone marrow aspiration was done in all cases, and biopsy was performed where necessary. The findings were analyzed to determine the underlying causes of pancytopenia.

Results

Table 1: Causes of Pancytopenia Based on Bone Marrow Findings

Etiology	Number of Cases	Percentage (%)
Megaloblastic anemia	67	45.0
Aplastic anemia	38	25.0
Hematological malignancies (leukemia, MDS)	22	15.0
Hypersplenism	10	6.7
Infections (TB, HIV)	8	5.3
Others (SLE, drugs)	5	3.3

Megaloblastic anemia was the most common cause of pancytopenia (45%), followed by aplastic anemia (25%). Hematological malignancies such as leukemia and myelodysplastic syndromes (MDS) accounted for 15% of cases.

Table 2: Bone Marrow Findings in Pancytopenia

Bone Marrow Feature	Number of Cases	Percentage (%)
Hypercellular marrow	75	50.0
Hypocellular marrow	38	25.3
Normal cellularity	22	14.7
Infiltration by malignancy	15	10.0

Bone marrow was hypercellular in 50% of cases, primarily due to megaloblastic anemia. Hypocellular marrow was observed in 25% of cases, corresponding to aplastic anemia.

Discussion

Pancytopenia is a common hematological condition with diverse underlying causes, ranging from nutritional deficiencies to

malignancies. The findings of this study are consistent with previous research, indicating that megaloblastic anemia is the most common cause of pancytopenia (5,6).

Megaloblastic anemia was seen in 45% of cases, primarily due to vitamin B12 and folate deficiencies. These findings are in line with studies conducted in India and other developing countries, where nutritional deficiencies are prevalent (7,8). Bone marrow in these cases showed hypercellularity with megaloblastic changes, and patients responded well to vitamin supplementation.

Aplastic anemia accounted for 25% of cases, characterized by hypocellular marrow. This condition is associated with bone marrow failure due to autoimmune mechanisms, drug toxicity, or viral infections. The incidence of aplastic anemia in this study is similar to reports from other tertiary care hospitals (9,10).

Hematological malignancies, including leukemia and MDS, were found in 15% of cases. Bone marrow examination revealed infiltration by abnormal cells, confirming the diagnosis. These findings highlight the importance of early bone marrow evaluation in pancytopenic patients to rule out malignancies (11,12).

Hypersplenism, infections, and autoimmune diseases were less common causes but should be considered in differential diagnoses. Tuberculosis and HIV-associated pancytopenia were observed in 5.3% of cases, consistent with previous studies in endemic regions (13).

The study underscores the role of bone marrow examination as a critical diagnostic tool in pancytopenia. While peripheral blood smear and biochemical tests provide preliminary insights, bone marrow aspiration and biopsy offer definitive diagnosis and guide appropriate treatment strategies (14).

Conclusion

Bone marrow examination plays a vital role in determining the etiology of pancytopenia. This study highlights that megaloblastic anemia is the most common cause, followed by aplastic anemia and hematological malignancies. Early identification and appropriate management of the underlying cause can significantly improve patient outcomes. Bone marrow evaluation should be considered in all cases of unexplained pancytopenia for accurate diagnosis and timely intervention.

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