

Evaluation of bone marrow aspiration and biopsy findings in pancytopenia cases.

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Abstract

Background: Pancytopenia is a common hematological disorder characterized by a reduction in all three blood cell lines. It may result from diverse etiologies ranging from benign, reversible conditions to life-threatening malignancies. Bone marrow aspiration and biopsy remain the cornerstone for establishing an etiological diagnosis.

Objectives: To evaluate the spectrum of bone marrow aspiration and biopsy findings in patients presenting with pancytopenia and to correlate these findings with clinical and hematological parameters.

Methods: This prospective observational study was conducted on 100 patients presenting with pancytopenia over a period of 01 Year. Detailed clinical evaluation, complete blood counts, peripheral smear examination, bone marrow aspiration, and trephine biopsy were performed in all cases. Data were analyzed descriptively.

Results: The most common cause of pancytopenia was aplastic anemia (28%), followed by megaloblastic anemia (22%), acute leukemia (14%), myelodysplastic syndrome (10%), hypersplenism (8%), marrow infiltration (7%), infections (6%), and miscellaneous causes (5%). Bone marrow aspiration and biopsy were complementary in diagnosis, especially in hypocellular and infiltrative disorders.

Conclusion: Bone marrow examination plays a pivotal role in identifying the underlying cause of pancytopenia. A combined approach using both aspiration and biopsy enhances diagnostic accuracy and guides appropriate management.

Keywords: Pancytopenia, Bone marrow aspiration, Bone marrow biopsy, Aplastic anemia, Megaloblastic anemia

Introduction

Pancytopenia is defined as the simultaneous presence of anemia, leukopenia, and thrombocytopenia in peripheral blood. It is a common hematological problem encountered in clinical practice and often poses a diagnostic challenge due to its varied etiological spectrum. The condition is not a disease entity by itself but a manifestation of underlying bone marrow or systemic pathology[1].

The mechanisms leading to pancytopenia include decreased production of blood cells in the bone marrow, increased peripheral destruction, sequestration in an enlarged spleen, or a combination of these factors[2-3]. Causes range from nutritional deficiencies, infections, autoimmune disorders, and drug toxicity to bone marrow failure syndromes and hematological malignancies.

Bone marrow aspiration and trephine biopsy are essential diagnostic tools in the evaluation of pancytopenia[4]. Aspiration provides cytological details, while biopsy offers architectural assessment, cellularity estimation, and detection of focal lesions or fibrosis. Together, they provide comprehensive information necessary for accurate diagnosis[5].

This study was undertaken to evaluate the bone marrow aspiration and biopsy findings in patients presenting with pancytopenia and to analyze the frequency of various etiologies in a tertiary care setting[6].

Materials and Methods

A prospective observational study was conducted in the Department of Pathology in collaboration with the Department of Medicine at Index Medical College, Indore over a period of 01 Year.

Study Population

A total of 100 consecutive patients of all age groups and both sexes presenting with pancytopenia were included in the study.

Inclusion Criteria

- Hemoglobin <10 g/dL
- Total leukocyte count <4,000/ μ L
- Platelet count <100,000/ μ L

Exclusion Criteria

- Patients already diagnosed with hematological malignancy
- Patients receiving chemotherapy or radiotherapy
- Inadequate bone marrow samples

Clinical and Laboratory Evaluation

Detailed clinical history and physical examination findings were recorded. Complete blood count was performed using an automated hematology analyzer. Peripheral blood smears were examined using Leishman stain.

Bone Marrow Examination

Bone marrow aspiration and trephine biopsy were performed from the posterior superior iliac spine under aseptic precautions. Aspirate smears were stained with Leishman and special stains where indicated. Biopsy specimens were fixed in formalin, decalcified, processed, and stained with hematoxylin and eosin.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using descriptive statistics. Results were expressed as percentages and frequencies.

Results

Demographic Profile

Out of 100 patients, 58 were males and 42 were females, with a male-to-female ratio of 1.38:1. The age ranged from 6 to 72 years, with a mean age of 38.6 years.

Table 1: Age and Sex Distribution of Patients

Age Group (years)	Male	Female	Total
≤20	12	8	20
21–40	22	16	38
41–60	16	12	28
>60	8	6	14
Total	58	42	100

Clinical Presentation

The most common presenting symptom was generalized weakness (82%), followed by fever (46%), bleeding manifestations (32%), and weight loss (18%). Splenomegaly was observed in 26% of patients, while hepatomegaly was seen in 18%.

Hematological Findings

Table 2: Hematological Parameters in Pancytopenia

Parameter	Range	Mean ± SD
Hemoglobin (g/dL)	3.2–9.8	6.4 ± 1.6
TLC (/μL)	800–3,900	2,460 ± 820
Platelets (/μL)	12,000–98,000	46,500 ± 21,400

Peripheral smear examination revealed macrocytosis in 26% of cases, blasts in 14%, and hypocellular picture in 20%.

Bone Marrow Findings

Table 3: Bone Marrow Aspiration Findings

Diagnosis	Number of Cases	Percentage
Aplastic anemia	28	28%
Megaloblastic anemia	22	22%
Acute leukemia	14	14%
Myelodysplastic syndrome	10	10%
Hypersplenism	8	8%
Infections	6	6%
Others	12	12%
Total	100	100%

Table 4: Bone Marrow Biopsy Correlation

Diagnosis	Aspiration Diagnostic	Biopsy Diagnostic
Aplastic anemia	22	28
Marrow infiltration	4	7
Myelofibrosis	2	6
Megaloblastic anemia	22	22

Biopsy provided additional diagnostic information in cases with dry tap, hypocellularity, or focal marrow involvement.

Discussion

Pancytopenia represents a heterogeneous group of disorders with varied etiologies. In the present study, aplastic anemia was the most common cause, similar to findings reported in several Indian studies. Environmental factors, drug exposure, and viral infections may contribute to its higher prevalence[7-8].

Megaloblastic anemia was the second most common etiology, highlighting the importance of nutritional deficiencies in developing countries. Early diagnosis is crucial as it is a reversible condition with appropriate therapy[9-10].

Acute leukemias accounted for 14% of cases, emphasizing the need for prompt marrow evaluation in patients with unexplained cytopenias. Bone marrow biopsy proved especially useful in diagnosing infiltrative and fibrotic disorders where aspiration alone was insufficient[11-12]. The combined use of aspiration and biopsy increased diagnostic accuracy and helped in appropriate classification of disorders.

Conclusion

Bone marrow aspiration and biopsy are indispensable tools in the evaluation of pancytopenia. A wide range of etiologies was observed, with aplastic anemia and megaloblastic anemia being the most common. Performing both procedures simultaneously provides complementary information and enhances diagnostic yield, facilitating early and appropriate management.

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