HEMATOLOGICAL EVALUATION OF PANCYTOPENIA: A CROSS-SECTIONAL STUDY AT A TERTIARY CARE CENTRE, INDIA

Pathology

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ABSTRACT

Background: Pancytopenia, the reduction of erythrocytes, leukocytes, and thrombocytes, arises from various causes including nutritional deficiencies, bone marrow suppression, malignancies, and infections. **Objective:** To analyze peripheral hematological parameters and bone marrow findings in patients presenting with pancytopenia. **Methods:** This cross-sectional study included 185 pancytopenic patients over one year at a tertiary care centre in Rajasthan, India. Inclusion criteria were Hb < 13 g/dL (males), < 12 g/dL (females); TLC < $4B \times 10^9$/L; Platelets < 150×10^9/L. Patients underwent complete hemogram (SYSMEX), peripheral smear (Leishman stain), bone marrow aspiration/biopsy, serum vitamin B12, folate, ferritin, and LDH levels. Flow cytometry and special stains were used where necessary. Data analysis was performed using SPSS v25 with p < 0.05 considered significant. **Results:** The mean age was 34.2 ± 19.6 years with a male-to-female ratio of 1.01:1. The age group 20–40 years was most affected (37.3%). Weakness was the most common symptom (58.9%). Peripheral smear showed normocytic normochromic pattern in 68.1%, microcytic in 23.8%. Bone marrow findings revealed dimorphic anemia in 53.5%, marrow hypoplasia in 10.8%, and megaloblastic anemia in 9.7%. There was a statistically significant correlation between peripheral smear and marrow findings (χ^2=343.09, p<0.001). **Conclusions:** Nutritional causes such as dimorphic and megaloblastic anemia are predominant etiologies of pancytopenia. Comprehensive hematological and marrow evaluation is essential for diagnosis and appropriate management.

KEYWORDS

Pancytopenia, Bone marrow aspiration, Peripheral smear, Dimorphic anemia, Cross-sectional study

INTRODUCTION

Pancytopenia, a significant hematological abnormality characterized by a simultaneous reduction in red cells, white cells, and platelets in peripheral blood, presents diagnostic and therapeutic challenges worldwide. Pancytopenia has diverse etiologies, differing considerably by geographic and demographic characteristics. Global prevalence studies indicate varying frequencies, with aplastic anemia, nutritional deficiencies (especially vitamin B12 and folic acid), hypersplenism, leukemia, and infections as leading causes.[1]

The complexity of pancytopenia arises primarily from its multiple etiologies and the overlapping clinical presentations, complicating precise diagnosis and effective management. The interaction between nutritional deficiencies, infections, and hematological malignancies intensifies the overall health outcomes, increasing morbidity and mortality rates [2]

2. MATERIALS AND METHODS

Study Design and Duration:
Cross-sectional observational study conducted over 1 year.

Study Site:
Department of Pathology, Government Medical College, Kota, Rajasthan.

Sample Size And Criteria:
185 patients presenting with pancytopenia were included.

Inclusion Criteria:
* Hemoglobin<13 g/dL in males, <12 g/dL in females
* TLC <4×10^9/L
* Platelets <150×10^9/L

Exclusion Criteria:
* Patients with only bicytopenia or monocytopenia
* Patients receiving chemotherapy
* Patients refusing consent

Investigations Performed:
* Complete Blood Count using SYSMEX automated analyzer
* Peripheral smear examination (Leishman stain)
* Bone marrow aspiration and trephine biopsy
* Serum assays for B12, folate, ferritin, LDH
* Flow cytometry and special stains when indicated

Statistical Analysis:
Data were entered in Microsoft Excel and analyzed using SPSS version 25. Categorical data were compared using Chi-square test and continuous data using ANOVA. p-value < 0.05 was considered statistically significant.

3. RESULTS

Table 1: Age Distribution

AGE Group	Frequency	Percent
<20	52	28.1
20-40	69	37.3
41-60	36	19.5
>60	28	15.1
Total	185	100.0

In this study, age distribution predominantly present in 20–40 years age group (37.3%), followed by those aged <20 years (28.1%).

Participants aged 41–60 years comprised 19.5%, while those above 60 years accounted for 15.1

Table 2: Sex Distribution

Sex	Frequency	Percent
F	92	49.7
M	93	50.3
Total	185	100.0

The sex distribution of the study cohort is nearly balanced, with a slight male predominance (50.3%) compared to females (49.7%).

Table 3: Clinical Presentation

Clinical Presentation	Frequency	Percent
DIZZINESS	5	2.7
FATIGUE	2	1.1
HEADACHE	46	24.9
TINGLING SENSATION	23	12.4
WEAKNESS	109	58.9

Weakness emerged as the most prevalent presenting symptom (58.9%), often accompanied by headache in 24.9% cases then tingling sensations (12.4%).

Table 4: Descriptive Statistics Of Hematological And Biochemical Parameters

Variable	N	Minimum	Maximum	Mean ± SD
AGE (years)	185	2.0	84.0	34.19 ± 19.60
RDW CV (%)	185	15.0	28.1	19.61 ± 3.01
MCV (%)	185	57.0	113.0	83.77 ± 10.42
SERUM FERRITIN(ng/dl)	185	2.0	444.0	61.61 ± 87.27
VIT B12 (pg/dl)	185	58.0	900.0	147.31 ± 141.88

The mean age was 34.19 years (±19.60), consistent with the earlier noted demographic trend. The mean RDW-CV was 19.61%, indicating a substantial variation in red cell size suggestive of anisocytosis. The mean MCV was 83.77 %, within the normocytic range but with a broad range that includes microcytic and macrocytic values. Serum ferritin (mean: 61.61 ng/dL) and vitamin B12 (mean: 147.31 pg/dL) showed wide variability.
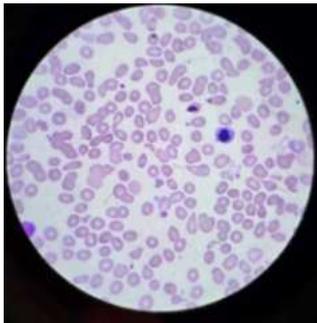
Micro-photographs

Figure 1: PBF showing Macroovalocytes, Megaloblast, Schistocytes (400x)
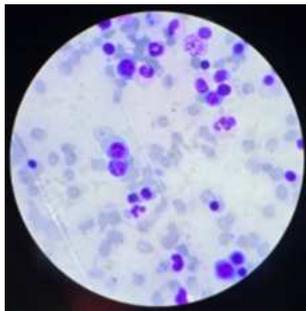

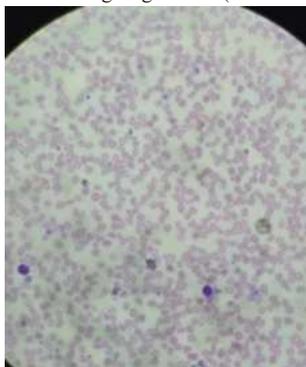**Figure 2:** Aspiration showing megaloblast (Oil Immersion Field)

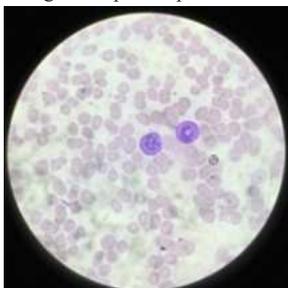**Figure 3:** PBF Showing Dimorphic Population Of RBC(400X)

Figure 4: PBF showing Hypersegmented neutrophils

4. DISCUSSION

In the present study, the majority of patients belonged to the 20–40 years age group, accounting for 37.3% of the total cases. Similar result reported by **Tlemçani I et al. (2024)**[3], who reported that 37.20% of their 164 patients fell within the 18–40 years category, indicating a comparable demographic distribution. Some studies report fatigue specifically, such as a 2018 Indian study where weakness/fatigue was the commonest mode of presentation at 55%. In the study by **Zulfiqar et al. (2023)**[4], fatigue and malaise were reported by 31.8% of patients. This study indicates that normocytic normochromic anemia was the predominant PBF finding, observed in 68.1% of cases Similar result reported by **Pandey et al. (2025)**[5] found normocytic normochromic RBCs in 46% of their cases. This study reports Dimorphic Anemia as the most frequent bone marrow finding at 53.5%. This is a very high prevalence. Similar result reported by **Munde et al. (2021)**[6] reported dimorphic anemia as a bone marrow finding in 20% of cases, which was the second most common cause in their study.

5. CONCLUSION

Dimorphic anemia emerged as the most frequent marrow finding, followed by marrow hypoplasia and megaloblastic anemia. Most cases had nutritional etiology. Peripheral blood findings provide clues, but bone marrow examination is essential to confirm diagnosis. Early identification and treatment can significantly improve outcomes in pancytopenia patients.

6. REFERENCES

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