A CROSS-SECTIONAL STUDY ON THE CORRELATION OF PERIPHERAL BLOOD SMEAR WITH RBC INDICES AND RBC HISTOGRAM IN THE DIAGNOSIS OF ANEMIA

Hematology

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ABSTRACT

Introduction: Anemia is one of the most prevalent health problems worldwide. Automated hematological analyzers have become an essential tool for the diagnosis of anemia. The combination of RBC histogram and RBC indices with peripheral smear offers major clues in diagnosis and management of anemia. **Aim & Objectives:** To correlate findings of peripheral smear, RBC indices and RBC histogram in diagnosis of anemia. **Materials And Methods:** A prospective study was conducted for three months, from February to April 2024, in 207 adult patients with hemoglobin levels below 11 gm/dl. Correlation between peripheral smear, RBC indices and RBC histogram was done. **Result:** Out of 207 cases, 54.37% identified as microcytic anemia, with the remainder as dimorphic (17.48%), macrocytic (18.45%) and normocytic (9.70%). For microcytic hypochromic anemia, 74.30% showed a left shift on the histogram, while 89.47% of normocytic normochromic anemia had normal histogram. Macrocytic anemia showed a right shift in 68.42% of cases. Dimorphic anemia showed bimodal curve in 47.22% of cases. **Conclusion:** Although automated analyzers provide helpful graphical representations of anemia types and reduce workload, they should not be relied upon solely for an accurate diagnosis. Peripheral blood smear findings are crucial for definitive diagnosis of anemia, with the histogram & RBC indices serving as a supplementary tool to enhance the overall diagnostic process.

KEYWORDS

Peripheral Smear, Histogram, RBC Indices

INTRODUCTION

Anemia is one of the most prevalent health problems worldwide. Anemia is defined as a reduction in hemoglobin concentration below the level that is expected for healthy persons of the same age, sex and in the same environment. Anemia is classified according to RBC indices such as hemoglobin, hematocrit, mean corpuscular volume (MCH), red cell distribution width (RDW), mean corpuscular volume (MCV), and mean corpuscular hemoglobin concentration (MCHC).[1] Automated hematological analyzers have become an essential tool for the diagnosis of anemia. Due to their precision and dependability, automated hematology analyzers have gained popularity over the past several years, greatly reducing subjective errors in the diagnosis of anemia.[2] An essential component of computerized hematology analysis that has raised precision and accuracy is the RBC histogram[3] The histograms provide major clues in the diagnosis and management of significant red cell disorders.[4] The peripheral blood smear has been the primary diagnostic tool in diagnosing anemia and establishing the etiology of anemia.[5] Routine peripheral blood smear examination has facilitated the interpretation of various hematological disorders. Therefore, peripheral smear examination and red cell indices are crucial for accurately diagnosing anemia using the RBC histogram.[4]

AIM & OBJECTIVES

To correlate findings of peripheral smear, RBC indices and RBC histogram in the diagnosis of anemia.

MATERIALS AND METHODS

The present study is a prospective study conducted in the Hematology Lab, Department of Pathology, Gadag Institute of Medical Sciences, Gadag.

- Study Design: Cross-sectional study
- Study Period: 3 months duration from February 2024 to April 2024
- Sample Size: 207
- Sampling Method: Universal sampling
- Statistical Data Analysis: A qualitative analysis of the data was done using Chi Square Test
- Inclusion criteria: All cases with age>18 years & hemoglobin <11 gm/dl were included.
- Exclusion Criteria: Patients with hematological malignancy were excluded.

Complete blood count including hemoglobin, total count, differential count, hematocrit value, RBC indices and histogram was obtained from Mindray BC 5300 automated analyser. Simultaneously, for each patient a Peripheral blood smear was prepared according to standard operating procedures and the same was stained by Leishman stain. The results obtained are further classified into 4 morphological types of anemia- Normocytic, Microcytic, Macrocytic and Dimorphic anemias. Correlation between peripheral smear, RBC indices and RBC histogram was done.
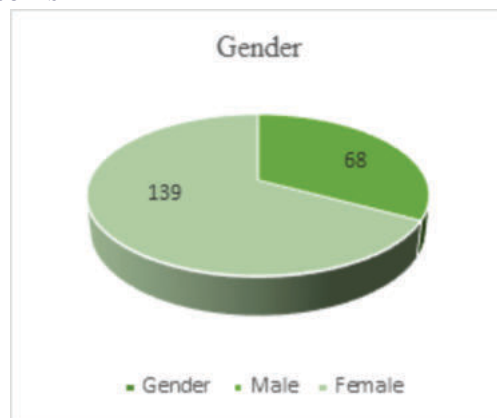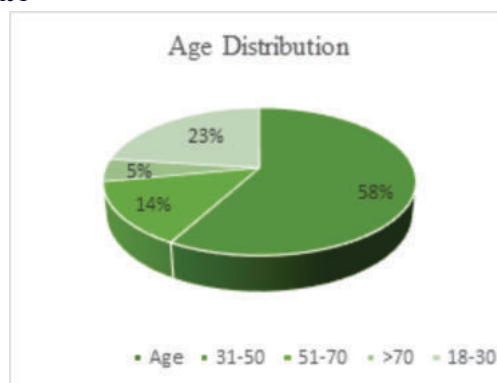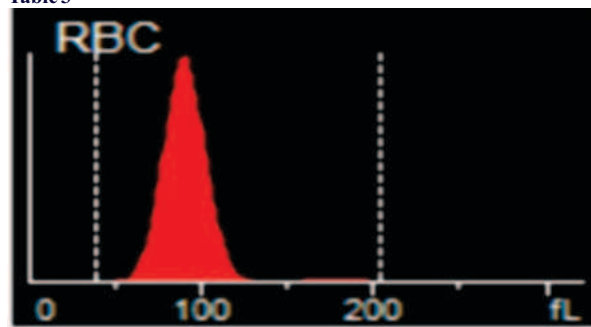
RESULTS

Table 1

Table 2

Table 3

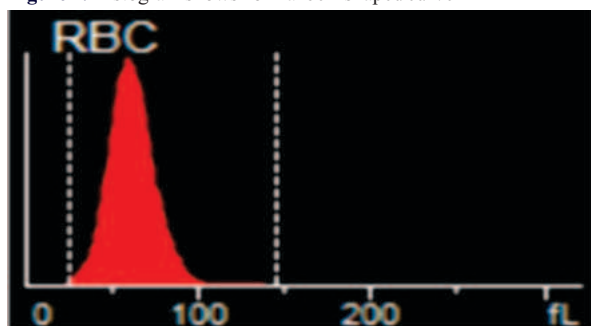**Figure 1:** Histogram shows normal bell-shaped curve
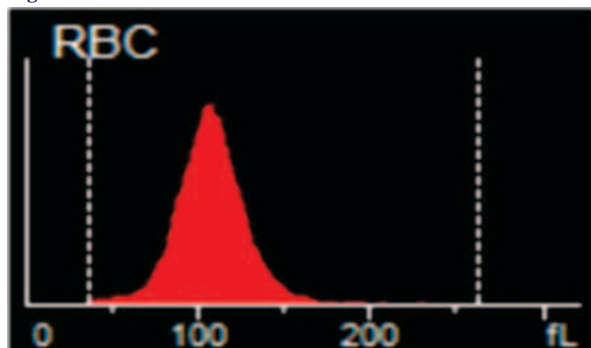

Figure 2: Shift to left

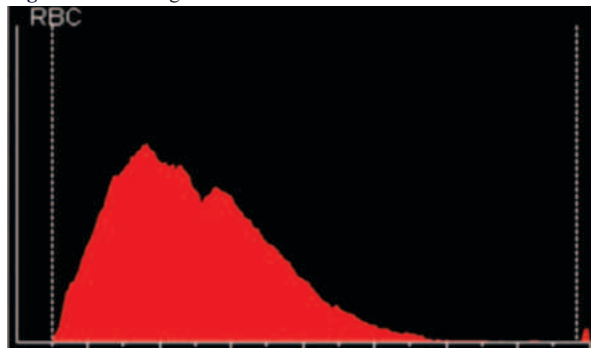**Figure 3:** Shift to right

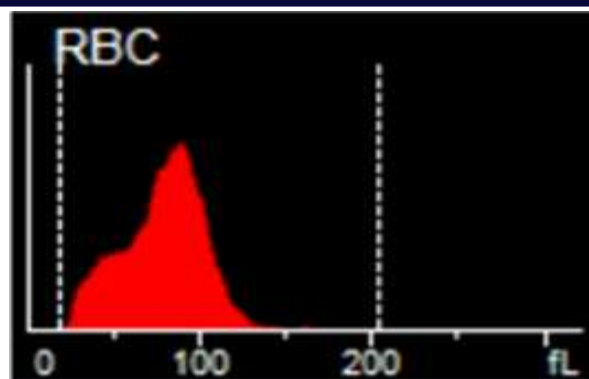**Figure 4:** Bimodal curve

Figure 5: Bimodal curve

Out of 207 cases, 54.37% identified as microcytic anemia, with the remainder as dimorphic (17.48%), macrocytic (18.45%) and normocytic (9.70%). For microcytic hypochromic anemia, 74.30% showed a left shift on the histogram, while 89.47% of normocytic normochromic anemia had normal histogram. Macrocytic anemia showed a right shift in 68.42% of cases. Dimorphic anemia showed bimodal curve in 47.22% of cases.

DISCUSSION
According to the World Health Organization (WHO), the global prevalence of anemia across all age groups in 2021 was estimated to be 24.3%, accounting for approximately 1.92 billion cases worldwide.[6] A significant proportion of these cases were observed among females aged 30 to 50 years. This demographic trend suggests that menstrual cycle-related disorders may contribute significantly to the predominance of microcytic anemia, as observed in our study. Menorrhagia and other menstrual irregularities often lead to chronic blood loss, which, in turn, results in iron deficiency anemia—a major cause of microcytic red blood cell (RBC) morphology.[3]

In our study, RBC indices and RBC histograms were generated using an automated hematology analyzer. A normal RBC histogram curve typically exhibits a symmetrical bell shape, reflecting a mean corpuscular volume (MCV) range of 80-100 fL.[2] The width of the RBC histogram curve is indicative of cell population heterogeneity; a wider curve corresponds to a more heterogeneous RBC population, while a narrower curve indicates a more homogeneous population.

Morphological variations in RBCs affect the histogram curve in specific ways. The presence of macrocytes in megaloblastic anemia causes a rightward shift in the histogram curve, whereas microcytosis, as seen in iron deficiency anemia, results in a leftward shift. Additionally, a bimodal histogram curve is characteristic of the coexistence of two distinct RBC populations, which may be indicative of conditions such as dimorphic anemia resulting from a combination of microcytic and macrocytic red cell populations. While automated RBC indices and histograms provide useful preliminary information, peripheral blood smear analysis remains indispensable in accurately determining RBC morphology and variations that may not be fully reflected in automated parameters such as MCV.[7]

In our study, anemia was classified based on peripheral smear findings. Among the total cases analyzed, microcytic anemia was the most prevalent, accounting for 114 cases (54.37%). This was followed by macrocytic anemia in 38 cases (18.45%), dimorphic anemia in 36 cases (17.48%), and normocytic anemia in 19 cases (9.70%). These findings are consistent with previous studies conducted by Ashok et al.[5] and Dhakar et al.[2], which also reported a predominance of microcytic anemia, highlighting its high prevalence in the studied population.

CONCLUSION
Automated hematology analyzers provide graphical representations of RBC populations that aid in the preliminary assessment of anemia types, thereby reducing the overall diagnostic workload. However, solely relying on automated histograms and RBC indices may not be sufficient for an accurate diagnosis. Peripheral blood smear examination remains a crucial diagnostic tool, offering definitive morphological insights that cannot always be captured by automated analyzers.

Our study highlights the importance of integrating RBC histograms and RBC indices with peripheral smear analysis to achieve a comprehensive and accurate diagnosis of anemia. This combined approach enhances diagnostic precision and aids in effective patient management by providing critical insights into the underlying etiology of anemia.

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