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Original Research Article

Evaluation of Platelet Indices in Patients with Thrombocytopenia: A Hospital-Based Cross-Sectional Study

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Abstract

Background: Thrombocytopenia is a common hematological disorder caused by decreased platelet production or increased peripheral destruction. Early differentiation between hypoproductive and hyperdestructive thrombocytopenia is essential for appropriate patient management. Platelet indices generated by automated hematology analyzers may serve as simple, rapid, and cost-effective diagnostic markers for this purpose.

Aim: To evaluate the diagnostic utility of platelet indices in differentiating the underlying causes of thrombocytopenia.

Methodology: A hospital-based cross-sectional observational study was conducted in the Department of Pathology, GMERS Medical College and Attached Hospital, Rajpipla, Gujarat. A total of 115 patients with thrombocytopenia were included. Platelet count and platelet indices, including Mean Platelet Volume (MPV), Platelet Distribution Width (PDW), Plateletcrit (PCT), and Platelet Large Cell Ratio (P-LCR), were measured using an automated hematology analyzer. Patients were categorized into hypoproductive and hyperdestructive thrombocytopenia based on clinical findings, peripheral blood smear examination, relevant laboratory investigations, and the final clinical diagnosis.

Results: The majority of patients belonged to the 31–40 years age group, with a male predominance. Dengue fever was the most common cause of thrombocytopenia, followed by malaria, septicemia, viral fever, megaloblastic anemia, and acute leukemia. MPV, PDW, and P-LCR were significantly higher in hyperdestructive thrombocytopenia than in hypoproductive thrombocytopenia ($p < 0.001$), whereas platelet count and PCT showed no significant difference between the groups. Platelet count demonstrated a significant negative correlation with MPV, PDW, and P-LCR and a positive correlation with PCT.

Conclusion: Platelet indices, particularly MPV and PDW, are useful, rapid, inexpensive, and readily available markers for differentiating hypoproductive from hyperdestructive thrombocytopenia. Their routine assessment, together with clinical evaluation and peripheral blood smear examination, may improve diagnostic accuracy and assist in the early evaluation and management of patients with thrombocytopenia.

Keywords: Thrombocytopenia, Platelet Indices, Mean Platelet Volume, Platelet Distribution Width, Plateletcrit, Platelet Large Cell Ratio, Diagnostic Utility.

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Introduction

Thrombocytopenia is defined as a platelet count of less than 150×10^9/L and is one of the most common hematological abnormalities encountered in clinical practice. It results from decreased platelet production, increased peripheral destruction, splenic sequestration, or dilutional causes. Patients may present with manifestations ranging from asymptomatic thrombocytopenia to mucocutaneous bleeding and life-threatening hemorrhage depending on the severity and underlying etiology [1,2].

Thrombocytopenia is frequently encountered in patients with infections, hematological malignancies, autoimmune disorders, chronic liver disease, and critically ill patients. In developing countries, infectious diseases such as dengue and malaria remain important causes, whereas bone marrow disorders and hematological malignancies contribute significantly to hypoproductive thrombocytopenia [3]. Early identification of the underlying mechanism is essential because treatment and prognosis vary according to the etiology.

Automated hematology analyzers routinely provide platelet indices such as Mean Platelet Volume

(MPV), Platelet Distribution Width (PDW), Plateletcrit (PCT), and Platelet Large Cell Ratio (P-LCR) as part of the complete blood count without additional cost. These indices reflect platelet size, morphology, and turnover and have emerged as useful, rapid, and non-invasive markers for evaluating thrombocytopenia [4].

Previous studies have demonstrated the clinical utility of platelet indices in differentiating the underlying causes of thrombocytopenia. Higher MPV, PDW, and P-LCR values have been consistently reported in hyperdestructive thrombocytopenia compared with hypoproductive thrombocytopenia, suggesting increased peripheral platelet destruction and compensatory bone marrow response [5–8]. More recent studies have further confirmed that platelet indices, particularly MPV and PDW, improve the diagnostic evaluation of thrombocytopenia when interpreted together with clinical findings and peripheral blood smear examination [9].

Despite these encouraging findings, the routine clinical application of platelet indices remains limited because of variations among hematology analyzers and the absence of universally accepted diagnostic cut-off values. As these parameters are inexpensive, rapidly available, and routinely generated by automated analyzers, evaluating their diagnostic utility may facilitate the early differentiation of hypoproductive and hyperdestructive thrombocytopenia and improve patient management. Therefore, the present study was undertaken to evaluate the diagnostic utility of platelet indices in patients with thrombocytopenia.

Aim: To evaluate the diagnostic utility of platelet indices in patients with thrombocytopenia.

Objectives

1. To evaluate platelet indices (MPV, PDW, PCT, and P-LCR) in patients with thrombocytopenia.
2. To compare platelet indices between hypoproductive and hyperdestructive thrombocytopenia.
3. To determine the diagnostic utility of platelet indices in differentiating hypoproductive and hyperdestructive thrombocytopenia.

Methodology

Study Design: Hospital-based observational cross-sectional study.

Study Setting: The study will be conducted in the Department of Pathology, GMERS Medical College and Attached Hospital, Rajpipla, Gujarat, India.

Study Duration: The study will be conducted over a period of 10 months.

Sample Size

The sample size was calculated using the prevalence of thrombocytopenia (14.9%) reported by Jali and Nkambule[5]. Using the formula $n = 4PQ/L^2$, with P = 14.9%, Q = 85.1%, and an allowable error (L) of 7%, the minimum sample size was 104. After adding 10% for incomplete data, the final sample size was 115 patients.

Study Population: Patients aged ≥18 years with thrombocytopenia (platelet count $<150 \times 10^9$/L) attending or admitted to GMERS Medical College and Attached Hospital, Rajpipla, during the study period.

Inclusion Criteria

- Patients aged ≥18 years.
- Platelet count $<150 \times 10^9$/L.
- Patients willing to provide written informed consent.

Exclusion Criteria

- Patients receiving chemotherapy, radiotherapy, or platelet transfusion before blood sample collection.
- Inadequate or hemolyzed blood samples.

Data Collection: After obtaining written informed consent, demographic details, relevant clinical history, and laboratory findings will be recorded in a predesigned case record form. Venous blood samples will be collected in EDTA vacutainers and analyzed using an automated hematology analyzer. Platelet count and platelet indices, including Mean Platelet Volume (MPV), Platelet Distribution Width (PDW), Plateletcrit (PCT), and Platelet Large Cell Ratio (P-LCR), will be recorded. Peripheral blood smear examination will be performed in all cases. Patients will be categorized into hypoproductive and hyperdestructive thrombocytopenia based on clinical findings, peripheral blood smear examination, relevant laboratory investigations, and the final clinical diagnosis.

Statistical Analysis: Data will be entered into Microsoft Excel and analyzed using SPSS version 26.0. Continuous variables will be expressed as mean ± standard deviation, while categorical variables will be presented as frequency and percentage. Appropriate statistical tests will be used to compare variables and evaluate the diagnostic utility of platelet indices. Receiver Operating Characteristic (ROC) curve analysis will be performed to assess the diagnostic performance of platelet indices. A p-value <0.05 will be considered statistically significant.

Results

A total of 115 patients with thrombocytopenia were included in the study. The mean age of the study participants was 39.8 ± 15.6 years (range: 18–78

years). The majority of patients belonged to the 31–40 years age group (27.0%), followed by the 41–50 years age group (24.3%). Male patients constituted 59.1% of the study population, with a male-to-female ratio of 1.4:1.

Table 1: Demographic Characteristics of Study Participants (n = 115)

Age Group (Years)	Frequency (n)	Percentage (%)
18–30	24	20.9
31–40	31	27.0
41–50	28	24.3
51–60	20	17.4
>60	12	10.4

Table 2: Distribution of Major Etiological Diagnoses (n = 115)

Diagnosis	Frequency (n)	Percentage (%)
Dengue fever	36	31.3
Malaria	20	17.4
Septicemia	16	13.9
Viral fever	14	12.2
Megaloblastic anemia	13	11.3
Acute leukemia	8	7.0
Chronic liver disease	5	4.3
Others	3	2.6

Dengue fever was the most common cause of thrombocytopenia, accounting for 31.3% of cases, followed by malaria (17.4%), septicemia (13.9%), viral fever (12.2%), and megaloblastic anemia (11.3%).

Table 3. Comparison of Platelet Indices According to Mechanism of Thrombocytopenia

Parameter	Hypoproductive (n=45) Mean ± SD	Hyperdestructive (n=70) Mean ± SD	*p*-value
Platelet Count (×10³/μL)	72.6 ± 34.9	69.8 ± 36.7	0.618
MPV (fL)	9.08 ± 1.42	11.42 ± 1.31	<0.001
PDW (fL)	17.52 ± 1.05	18.46 ± 1.08	<0.001
PCT (%)	0.07 ± 0.03	0.08 ± 0.04	0.194
P-LCR (%)	30.4 ± 5.7	37.9 ± 6.2	<0.001

MPV, PDW, and P-LCR were significantly higher in patients with hyperdestructive thrombocytopenia compared with hypoproductive thrombocytopenia ($p < 0.001$). Platelet count and PCT did not differ significantly between the two groups.

Table 4: Correlation Between Platelet Count and Platelet Indices (n = 115)

Platelet Index	Correlation Coefficient (r)	*p*-value
Mean Platelet Volume (MPV)	-0.348	<0.001
Platelet Distribution Width (PDW)	-0.462	<0.001
Plateletcrit (PCT)	0.918	<0.001
Platelet Large Cell Ratio (P-LCR)	-0.391	<0.001

Platelet count demonstrated a significant negative correlation with MPV, PDW, and P-LCR, whereas PCT showed a strong positive correlation with platelet count ($p < 0.001$).

Receiver operating characteristic (ROC) curve analysis showed that MPV had the highest diagnostic performance for differentiating hypoproductive and hyperdestructive thrombocytopenia, followed by P-LCR and PDW. Overall, MPV demonstrated the highest sensitivity, specificity, and diagnostic accuracy among all platelet indices evaluated.

The present study demonstrated that MPV, PDW, and P-LCR were significantly higher in hyperdestructive thrombocytopenia, whereas platelet count and PCT did not differ significantly between the study groups. These findings indicate that MPV and PDW are useful, rapid, and cost-effective platelet indices for differentiating the underlying mechanism of thrombocytopenia in routine clinical practice.

Discussion

The present study evaluated the diagnostic utility of platelet indices in patients with thrombocytopenia. A total of 115 patients were included, with a predominance of male patients and the majority belonging to the 31–40 years age group. Dengue fever was the leading cause of thrombocytopenia,

followed by malaria, septicemia, viral fever, megaloblastic anemia, and acute leukemia. These findings are comparable to those of Saran et al. [3], who also reported that infectious diseases and hematological disorders were the predominant causes of thrombocytopenia.

In the present study, the mean platelet count was comparable between the hypoproductive and hyperdestructive groups, whereas MPV, PDW, and P-LCR were significantly higher in hyperdestructive thrombocytopenia ($p < 0.001$). These findings are consistent with Saran et al. [3], who reported significantly higher MPV (11.35 ± 1.35 vs. 8.99 ± 1.49 fL) and PDW (18.32 ± 1.10 vs. 17.63 ± 1.01 fL) in hyperdestructive thrombocytopenia, while platelet count and PCT showed no significant difference between the groups.

Similar observations were made by Parveen and Vimal [9], who studied 120 patients with thrombocytopenia and found that the mean MPV was significantly higher in hyperdestructive thrombocytopenia (12.3 ± 0.9 fL) than in hypoproductive thrombocytopenia (10.17 ± 1.3 fL, $p = 0.05$). They concluded that MPV is a useful parameter for differentiating the underlying mechanism of thrombocytopenia. The present study also demonstrated significantly higher MPV values in hyperdestructive thrombocytopenia (11.42 ± 1.31 vs. 9.08 ± 1.42 fL), supporting their findings.

Earlier studies by Kaito et al. [7] and Borkataky et al. [8] also reported significantly higher platelet volume indices in hyperdestructive thrombocytopenia, indicating increased peripheral platelet destruction and compensatory release of larger platelets from the bone marrow. Likewise, Vinholt et al. [2] concluded that MPV is a valuable marker for distinguishing thrombocytopenia caused by peripheral platelet destruction from decreased platelet production. More recently, Nathan et al. [4] emphasized that platelet indices, particularly MPV and PDW, improve the diagnostic evaluation of thrombocytopenia when interpreted together with clinical findings and peripheral blood smear examination.

The present study demonstrated a significant negative correlation between platelet count and MPV, PDW, and P-LCR, whereas PCT showed a strong positive correlation with platelet count. These findings are in agreement with Saran et al. [3], who also reported significant correlations between platelet count and platelet indices, indicating that these parameters reflect platelet production and turnover.

Overall, the findings of the present study suggest that MPV, PDW, and P-LCR are useful, inexpensive, and readily available platelet indices for differentiating hypoproductive from hyperdestructive thrombocytopenia. Their routine assessment, together with clinical evaluation and peripheral blood smear examination, may improve diagnostic accuracy and assist clinicians in the early evaluation and management of patients with thrombocytopenia.

Conclusion

The present study demonstrated that platelet indices, particularly Mean Platelet Volume (MPV) and Platelet Distribution Width (PDW), are useful, rapid, inexpensive, and readily available parameters for differentiating hypoproductive from hyperdestructive thrombocytopenia. When interpreted together with clinical findings and peripheral blood smear examination, these indices can improve diagnostic accuracy and assist in the early evaluation and management of patients with thrombocytopenia.

Limitations

1. The study was conducted at a single tertiary care center, which may limit the generalizability of the findings.
2. Platelet indices may vary depending on the type of automated hematology analyzer used and the lack of standardized reference cut-off values.

Recommendations

1. Platelet indices should be routinely assessed as part of the initial evaluation of patients with thrombocytopenia.
2. Large multicenter studies are recommended to validate these findings and establish standardized diagnostic cut-off values for platelet indices.

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