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Assessing The Role of Platelet Function in Adult Thrombocytopenia: A Hospital-Based Cross-Sectional Study

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Abstract

Thrombocytopenia is a common hematological abnormality encountered in adult patients, particularly in hospitalized and critically ill populations. Conventional clinical practice relies predominantly on platelet count to assess bleeding risk; however, increasing evidence suggests that platelet function plays a decisive role in determining hemostatic competence. Functional platelet abnormalities may lead to bleeding even when platelet counts are within clinically acceptable ranges. To evaluate platelet function in adult patients with thrombocytopenia using routine hematological parameters and peripheral blood smear examination, and to correlate functional platelet abnormalities with clinical bleeding manifestations. A significant proportion of patients exhibited bleeding manifestations despite platelet counts above conventional transfusion thresholds. Elevated MPV and PDW values showed a statistically significant association with bleeding risk. Peripheral smear examination revealed morphological abnormalities such as giant platelets and hypogranular platelets, which correlated with functional impairment. Platelet count alone demonstrated limited predictive value for bleeding risk.

Keywords: Thrombocytopenia, Platelet Function, Mean Platelet Volume; Peripheral Blood Smear; Bleeding Risk; Adult Patients.

1. INTRODUCTION

Hemostasis is a tightly regulated physiological process that prevents excessive blood loss following vascular injury. Platelets play a pivotal role in primary hemostasis by adhering to damaged endothelium, undergoing activation, and aggregating to form a temporary hemostatic plug. In addition to their hemostatic function, platelets are increasingly recognized for their roles in inflammation, immune modulation, and vascular integrity.

Thrombocytopenia, defined as a platelet count below 150 × 10^9/L, is frequently observed in clinical practice and is particularly prevalent among hospitalized and critically ill adults. Traditionally, the assessment of bleeding risk in thrombocytopenic patients has been largely based on platelet count thresholds. However, clinical observations reveal significant variability in bleeding manifestations that cannot be explained by platelet count alone.

Patients with moderate thrombocytopenia may experience severe bleeding, whereas others with profound thrombocytopenia remain asymptomatic. This discrepancy highlights the importance of qualitative platelet abnormalities, including defects in adhesion, activation, and aggregation. Acquired platelet dysfunction is commonly associated with conditions such as sepsis, liver disease, hematological malignancies, renal failure, and drug exposure.

Despite its clinical relevance, platelet function testing remains underutilized in routine diagnostics, particularly in low-resource settings where advanced assays are unavailable. In such contexts, platelet indices and peripheral blood smear examination serve as accessible tools that may provide valuable insight into platelet functionality. The present study was undertaken to assess the role of platelet function in adult thrombocytopenia using routine hematological methods and to correlate these findings with clinical outcomes.

1.1 Platelet Structure, Lifespan, and Mechanisms of Action

Platelets are also known as thrombocytes, they are small in size (2–3 µm), anucleate cytoplasmic fragments derived from the cytoplasm of megakaryocytes in the bone marrow. Despite lacking nuclei, platelets are highly specialized, metabolically active. Platelet plays a pivotal role in hemostasis, vascular integrity, and immune modulation. An average adult produces about 100 billion platelets daily, maintaining a circulating count of 150–400 × 10^9/L.

1.2 Global and Regional Epidemiology of Adult Thrombocytopenia

Thrombocytopenia is a frequently encountered hematologic abnormality worldwide, affecting individuals across various clinical settings. Its prevalence and incidence vary significantly depending on geographical region, population characteristics, healthcare access, and underlying disease burdens.

Globally, mild to moderate thrombocytopenia is estimated to affect approximately 5–10% of the general adult population, with higher prevalence observed in hospitalized and critically ill patients, where rates can reach up to 44%, particularly in intensive care units (ICUs). In such settings, thrombocytopenia is often multifactorial, associated with sepsis, disseminated intravascular coagulation (DIC), liver dysfunction, and adverse drug reactions. Studies from Western countries report ICU-related thrombocytopenia in up to 67% of patients, reflecting its common occurrence in high-dependency medical care environments.

From a regional perspective, the prevalence of thrombocytopenia in South Asia, particularly India, is influenced by several endemic conditions. Infectious diseases such as dengue fever, malaria, leptospirosis, and viral hepatitis frequently cause transient or severe thrombocytopenia. A multicentric study conducted in North India found that up to 35% of patients presenting with acute febrile illness exhibited thrombocytopenia, with dengue being the most common etiology.

2. RATIONALE OF THE STUDY

Thrombocytopenia is a frequently encountered hematological condition, particularly in hospitalized and critically ill patients, where it significantly impacts clinical outcomes by increasing the risk of bleeding,

transfusion requirements, and mortality. Traditionally, the evaluation of thrombocytopenia has focused primarily on platelet counts; however, emerging evidence emphasizes that platelet function, independent of count, plays a pivotal role in hemostasis and thrombotic regulation. Patients may exhibit significant bleeding tendencies despite having borderline or near-normal platelet levels due to functional defects. Conversely, hyperactive platelets can contribute to thrombotic events, especially in inflammatory or septic conditions.

3. AIM & OBJECTIVES

Aim: To assess the role of platelet function in adult patients diagnosed with thrombocytopenia.

Objectives

1. To evaluate platelet counts in diagnosed thrombocytopenic patients using automated and manual methods (Hemocytometer/Neubauer chamber).
2. To assess platelet morphology and adequacy through Peripheral Blood Smear (PBS).
3. To analyze the coagulation profile (PT, aPTT, BT/CT) of patients diagnosed with thrombocytopenia.
4. To correlate clinical symptoms with platelet function outcomes.
5. To support clinical diagnosis and management through integrated hematological evaluation.

4. MATERIALS AND METHODS

4.1 Study Design and Setting

This hospital-based cross-sectional study was conducted over six months at SCPM Super Specialty Hospital and Trauma Centre, Gonda, Uttar Pradesh, India.

4.2 Study Population

A total of 116 adult patients aged 18–65 years with laboratory-confirmed thrombocytopenia were enrolled.

4.2.1 Inclusion Criteria

- Adult patients aged 18–65 years
- Platelet count $<150 \times 10^9$/L
- Informed consent obtained

4.2.2 Exclusion Criteria

- Known inherited platelet function disorders
- Patients receiving antiplatelet drugs
- Pregnant women and pediatric patients

4.3 Data Collection

Demographic data, clinical history, and bleeding manifestations (petechiae, purpura, epistaxis, gum bleeding, hematuria, gastrointestinal bleeding) were recorded using a structured proforma.

4.4 Laboratory Evaluation

4.4.1 Platelet Count

Platelet counts were determined using automated hematology analyzers and confirmed manually using a Neubauer hemocytometer.

4.4.2 Peripheral Blood Smear Examination

Peripheral blood smears were stained and examined microscopically for platelet morphology, adequacy, and distribution.

4.4.3 Platelet Indices

Mean Platelet Volume (MPV) and Platelet Distribution Width (PDW) were analyzed as indirect indicators of platelet function and turnover.

4.4.4 Coagulation Profile

Prothrombin time (PT), activated partial thromboplastin time (aPTT), bleeding time, and clotting time were assessed where clinically indicated.

4.4.5 Statistical Analysis

Data were analyzed using standard statistical software. Descriptive statistics were applied, and associations between platelet parameters and clinical outcomes were assessed. A p-value <0.05 was considered statistically significant.

5. DATA ANALYSIS & INTERPRETATION

Table 5.1: Clinical Symptom Distribution across Platelet Count Categories

Platelet Count (µL)	Symptomatic (n=83)	Asymptomatic (n=33)	Total
<50,000 (Severe)	38	6	44
50,000–99,000	28	11	39
100,000–149,000	17	16	33

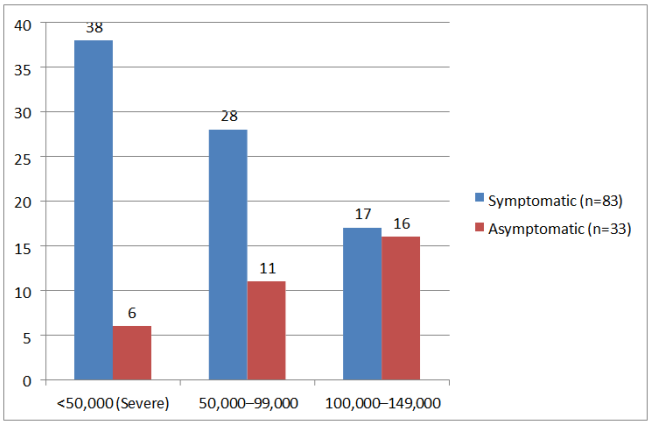

Fig 5.1: Clinical Symptom Distribution across Platelet Count Categories

Interpretation: This table examines the relationship between platelet count severity and the presence of clinical symptoms. Among the severely thrombocytopenic group (<50,000/µL), 86.4% (38 out of 44) were symptomatic, which is expected due to the higher bleeding risk at critically low platelet levels. Interestingly, in the moderate group (50,000–99,000/µL), 28 patients (71.8%) were symptomatic, and even in the mild group (100,000–149,000/µL), 17 patients (51.5%) showed bleeding symptoms. These findings clearly demonstrate that symptoms are not exclusive to severe thrombocytopenia, and that patients with mild to moderate counts may also present with clinical signs due to possible functional platelet defects.

Table 5.2: Association between Platelet Morphology and Clinical Symptoms

Platelet Morphology	Symptomatic	Asymptomatic	Total
Normal	24	22	46
Abnormal	59	11	70

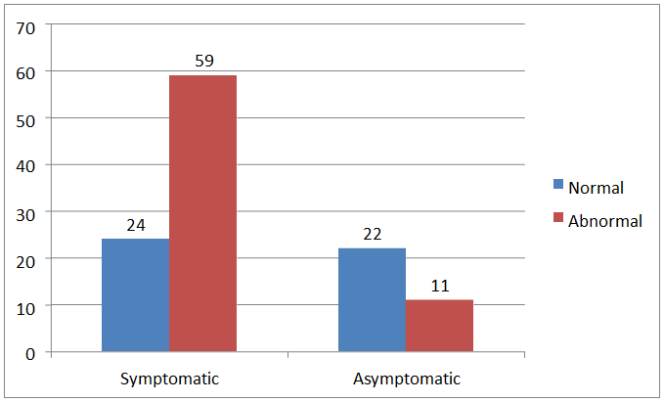

Fig 5.2: Association between Platelet Morphology and Clinical Symptoms

Interpretation: This table evaluates the correlation between platelet morphology, as assessed on peripheral blood smear, and clinical presentation. Out of 70 patients who had abnormal platelet

morphology, 59 (84.3%) were symptomatic, in contrast to only 24 symptomatic cases among 46 patients with normal morphology. This strong association implies that morphological abnormalities such as large, hypogranular, or anisotropic platelets could be indicative of functional impairment, which increases the likelihood of bleeding even when the quantitative count is not severely low. This supports the study's hypothesis that qualitative platelet abnormalities contribute significantly to clinical outcomes.

Table 5.3: Distribution of Suspected Functional Platelet Defects

Functional Defect Suspected	No. of Patients	Percentage (%)
Yes	46	39.7%
No	70	60.3%

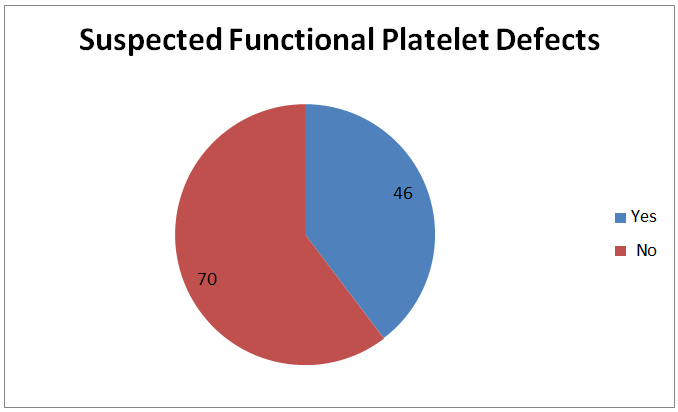

Fig 5.3: Distribution of Suspected Functional Platelet Defects

Interpretation: This table outlines the proportion of patients clinically suspected to have functional platelet defects. Among the total population, 46 patients (39.7%) were suspected to have dysfunctional platelets based on clinical symptoms disproportionate to their count and/or abnormal smear findings. These cases often involved patients with either moderate to mild thrombocytopenia or normal coagulation profiles, yet presented with overt bleeding signs. This underlines the clinical importance of recognizing functional platelet disorders, which may be underdiagnosed if diagnostic focus is limited to platelet count alone.

6. RESULTS

The analysis demonstrates that clinical bleeding symptoms are not confined solely to patients with severe thrombocytopenia. While 86.4% of individuals with platelet counts below 50,000/µL were symptomatic, a considerable proportion of patients with moderate (71.8%) and mild (51.5%) thrombocytopenia also exhibited symptoms, suggesting the influence of qualitative platelet dysfunction.

A strong association was observed between abnormal platelet morphology and symptomatic presentation, with 84.3% of patients showing morphological abnormalities experiencing bleeding manifestations. This indicates that structural platelet defects significantly impair hemostatic function.

Furthermore, 39.7% of the study population was clinically suspected to have functional platelet defects despite having platelet counts that were not critically low, reinforcing the importance of evaluating platelet quality in addition to quantity.

Overall, the findings highlight that platelet functionality and morphology play a vital role in clinical outcomes and should be considered essential parameters in the assessment of thrombocytopenic patients.

7. DISCUSSION

The discussion emphasizes that thrombocytopenia affects a wide adult population, with a slightly higher prevalence in middle-aged individuals and males. The strong concordance between automated and manual platelet counts reinforces the diagnostic reliability of both methods, particularly in low-resource settings.

A key finding of the study is the high prevalence of abnormal platelet morphology and its strong correlation with clinical bleeding. The presence of bleeding symptoms despite normal coagulation profiles highlights that platelet dysfunction, rather than coagulation factor deficiency, plays a central role in hemostatic failure in thrombocytopenia.

The observation that a substantial proportion of patients with mild to moderate thrombocytopenia were symptomatic challenges the traditional reliance on platelet count thresholds alone. Peripheral blood smear examination emerged as a cost-effective and valuable surrogate marker of platelet function, especially where advanced platelet function tests are unavailable.

8. CONCLUSION

The study concludes that platelet function plays a decisive role in the clinical manifestations of thrombocytopenia, independent of platelet count. A significant number of patients exhibited bleeding symptoms despite mild thrombocytopenia or normal coagulation profiles, largely attributable to qualitative platelet abnormalities.

Peripheral blood smear examination proved to be an indispensable diagnostic tool, while the strong agreement between manual and automated platelet counts validated the continued relevance of traditional methods. Approximately 40% of patients were suspected to have functional platelet defects, reinforcing the need for functional evaluation.

The study recommends that platelet transfusion decisions should not rely solely on count thresholds, and that platelet morphology and clinical symptoms must be incorporated into routine evaluation. Future research should involve multi-center studies, larger sample sizes, and advanced platelet function assays to strengthen diagnostic accuracy and improve patient outcomes.

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