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Predictive Role of Platelet Indices and Platelet Count in Dengue Infection: A Clinicopathological Analysis

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Abstract

Background: Dengue infection remains a significant health challenge in tropical and subtropical regions, presenting with a wide spectrum of clinical manifestations ranging from mild fever to life-threatening complications such as hemorrhage and shock. Identifying patients at risk of severe disease at an early stage continues to be difficult. While platelet count is routinely monitored, additional platelet-related parameters may provide further insight into disease progression.

Objective: To assess the usefulness of platelet count and platelet indices in predicting the severity of dengue infection and to evaluate their relationship with clinical outcomes.

Methods: This prospective observational study was conducted over one year (Jan 2011–Dec 2011) at Department of Pathology, People's College of Medical Sciences & Research Centre, Bhopal, Madhya Pradesh, India. A total of 100 serologically confirmed dengue cases were included. Clinical evaluation was performed at admission, and patients were categorized based on disease severity. Platelet count, mean platelet volume (MPV), and platelet distribution width (PDW) were measured and analyzed for their association with disease progression using appropriate statistical methods.

Results: A progressive decline in platelet count was observed with increasing disease severity. Patients with severe dengue demonstrated significantly higher MPV and PDW values, indicating enhanced platelet activation and turnover. Certain platelet indices showed a stronger association with severity compared to platelet count alone.

Conclusion: Assessment of platelet indices alongside platelet count may improve early identification of severe dengue cases. Incorporating these parameters into routine evaluation could enhance clinical decision-making and patient management.

Key words: Dengue, Platelet Count, Platelet Indices, Mean Platelet Volume, Platelet Distribution Width, Disease Severity.

INTRODUCTION

Dengue infection has emerged as a major contributor to morbidity in tropical and subtropical regions, with frequent outbreaks placing considerable strain on healthcare systems. The causative agent is an RNA virus of the *Flaviviridae* family, transmitted primarily by *Aedes aegypti* mosquitoes. The disease manifests in diverse

forms, ranging from self-limiting febrile illness to severe conditions involving plasma leakage, bleeding, and organ impairment.^{1,2}

One of the major clinical challenges is the unpredictable progression from mild to severe disease. Early warning signs are often subtle or absent during the initial stages, making timely identification of high-risk patients difficult.³

Consequently, laboratory investigations play a vital role in monitoring disease evolution and guiding treatment strategies.

Among hematological abnormalities, thrombocytopenia is consistently observed in dengue infection. The reduction in platelet count results from multiple mechanisms, including suppression of bone marrow activity, immune-mediated destruction, and increased peripheral utilization.^{4,5} However, platelet count alone does not always reliably predict disease severity or bleeding risk, as complications may occur even in patients with moderately reduced counts.⁶

Recent attention has focused on platelet indices as potential markers of platelet function and activity. Parameters such as mean platelet volume (MPV) and platelet distribution width (PDW) provide information regarding platelet size and variability, which reflect platelet production and activation status.^{7,8} These indices may offer additional insight into the pathophysiological processes involved in dengue. The pathogenesis of dengue involves a complex interaction between viral replication and host immune mechanisms. Endothelial dysfunction, cytokine release, and immune-mediated injury contribute to increased vascular permeability and alterations in hemostasis.^{9,10} Platelets actively participate in these processes by interacting with endothelial cells and immune components, thereby influencing disease progression.¹¹

Previous studies have investigated the association between platelet indices and dengue severity, yielding variable findings. While some studies report elevated MPV and PDW in severe cases, others show inconsistent correlations.¹²⁻¹⁴ These differences may be attributed to variations in study design, patient populations, and timing of sample collection.

In light of these considerations, evaluating platelet count in conjunction with platelet indices may

provide a more comprehensive understanding of disease dynamics. This approach could improve early risk assessment and contribute to better clinical management.

The present study was designed to examine the role of platelet count and platelet indices in dengue infection and to determine their relationship with disease severity and clinical outcomes.

AIMS AND OBJECTIVES

Aim:

To determine the clinical significance of platelet count and platelet indices in patients with dengue infection, with particular focus on their role in assessing disease severity and progression.

Objectives:

- To evaluate platelet count at the time of hospital admission in dengue patients
- To analyze platelet indices, including MPV and PDW
- To compare platelet parameters across different severity groups
- To assess the association between platelet parameters and clinical manifestations
- To determine whether platelet indices provide additional value beyond platelet count
- To evaluate their role in early identification of severe dengue cases

MATERIALS & METHODS

Study Design and Setting

This prospective observational study was conducted over one year (Jan 2011–Dec 2011) at Department of Pathology, People's College of Medical Sciences & Research Centre, Bhopal, Madhya Pradesh, India. Patients were enrolled from the inpatient services, where clinical evaluation was carried out, while hematological investigations were processed in the central laboratory.

Study Population

A total of 100 patients with a confirmed diagnosis of dengue infection were included in the study. Diagnosis was established using standard serological tests. Based on clinical assessment and course of illness, patients were categorized into groups reflecting varying severity of disease.

Inclusion Criteria

- Patients aged 18 years and above
- Serologically confirmed dengue infection
- Patients willing to participate in the study

Exclusion Criteria

- Patients with pre-existing hematological disorders
- Chronic liver disease or malignancy
- Patients receiving drugs known to affect platelet count
- Incomplete clinical or laboratory data

Data Collection

All enrolled patients underwent a detailed clinical evaluation at admission, including history, physical examination, and documentation of warning signs and complications.

Venous blood samples were collected under aseptic conditions. Laboratory investigations included:

- Platelet count
- Mean platelet volume (MPV)
- Platelet distribution width (PDW)

These parameters were analyzed using an automated hematology analyzer following standard laboratory protocols. Clinical findings were recorded alongside laboratory results, and patients were monitored throughout their hospital stay to assess disease progression and outcomes.

Outcome Measures

- Variation in platelet count and indices across different severity groups
- Association of platelet parameters with clinical manifestations

- Relationship between laboratory findings and disease progression

Statistical Analysis

Data was compiled and analyzed using appropriate statistical software. Continuous variables were expressed as mean \pm standard deviation, while categorical variables were presented as percentages. Comparisons between groups were performed using suitable statistical tests such as the Student's t-test and chi-square test. A p-value of <0.05 was considered statistically significant.

Ethical Considerations

The study protocol was reviewed and approved by the Institutional Ethics Committee prior to initiation. The study was conducted in accordance with established ethical principles for biomedical research involving human participants.

Informed Consent

Written informed consent was obtained from all participants or their legally authorized representatives before inclusion in the study. Confidentiality of patient information was strictly maintained, and all data was used exclusively for academic and research purposes.

RESULTS AND OBSERVATIONS

A total of 100 patients were studied and categorized into:

- Group I (Non-severe dengue): 60 patients
- Group II (Severe dengue): 40 patients

No statistically significant difference in demographic profile. Significant thrombocytopenia observed in severe dengue. Both MPV and PDW were significantly elevated in severe dengue. Lower platelet counts were strongly associated with increased severity. Platelet indices showed good predictive value for severe dengue. Severe dengue associated with higher complications and longer hospitalization. Bleeding manifestations correlated with lower platelet count and higher indices.

OBSERVATIONS

- Platelet count was significantly lower in severe dengue ($p < 0.001$)
- MPV and PDW values were significantly higher in severe cases ($p < 0.001$)
- Lower platelet counts correlated with increased severity
- Elevated MPV (>10.5 fL) and PDW ($>16\%$) showed good sensitivity and specificity
- Severe dengue was associated with increased bleeding, ICU admission, and longer hospital stay
- Patients with bleeding had lower platelet counts and higher MPV and PDW

Table 1: Baseline Characteristics

Parameter	Group I (n=60)	Group II (n=40)	p-value
Mean Age (years)	32.4 ± 11.6	35.8 ± 12.1	>0.05
Male (%)	36 (60%)	25 (62.5%)	>0.05
Female (%)	24 (40%)	15 (37.5%)	>0.05

Table 2: Platelet Count Comparison

Parameter	Group I	Group II	p-value
Platelet Count ($\times 10^3/\mu\text{L}$)	92.5 ± 28.4	48.2 ± 18.7	<0.001

Table 3: Platelet Indices

Parameter	Group I	Group II	p-value
MPV (fL)	9.1 ± 1.2	11.4 ± 1.6	<0.001
PDW (%)	13.8 ± 2.5	17.6 ± 3.1	<0.001

Table 4: Platelet Count vs Clinical Severity

Platelet Count ($\times 10^3/\mu\text{L}$)	Number of Patients	Severe Dengue (%)
>100	30	4 (13.3%)
50–100	40	14 (35%)
<50	30	22 (73.3%)

Table 5: Platelet Indices vs Severity

Parameter	Cut-off	Sensitivity (%)	Specificity (%)
MPV	>10.5 fL	82.5	75.0
PDW	>16%	80.0	72.0

Table 6: Clinical Outcomes

Outcome	Group I	Group II	p-value
Bleeding manifestations (%)	8 (13.3%)	18 (45%)	<0.001
ICU admission (%)	2 (3.3%)	12 (30%)	<0.001
Mean Hospital Stay (days)	4.6 ± 1.8	7.9 ± 2.7	<0.001

Table 7: Platelet Parameters and Bleeding

Parameter	No Bleeding	Bleeding	p-value
Platelet Count ($\times 10^3/\mu\text{L}$)	85.4 \pm 30.2	42.6 \pm 17.9	<0.001
MPV (fL)	9.5 \pm 1.4	11.2 \pm 1.7	<0.01
PDW (%)	14.2 \pm 2.6	17.1 \pm 3.3	<0.01

DISCUSSION

The present study highlights the importance of platelet-related parameters in assessing the severity of dengue infection. Although thrombocytopenia remains a consistent laboratory finding, its magnitude alone does not reliably reflect disease progression or predict complications.

The reduction in platelet count observed in severe dengue cases is consistent with established mechanisms involving both decreased production and increased destruction of platelets.^{4,5} Early suppression of bone marrow activity, followed by immune-mediated clearance of circulating platelets, contributes significantly to thrombocytopenia. However, several studies have demonstrated that platelet count alone has limited predictive value for bleeding risk, indicating that additional factors influence clinical outcomes.^{6,15}

A notable finding in this study is the significant elevation of mean platelet volume (MPV) in patients with severe dengue. Increased MPV indicates the presence of larger, more metabolically active platelets, suggesting enhanced platelet turnover in response to peripheral destruction. Similar observations have been reported in previous studies, where elevated MPV correlated with increased disease severity and platelet activation.^{12,16}

In addition, platelet distribution width (PDW) was significantly higher in severe cases, reflecting increased variability in platelet size. This variation is attributed to the release of immature platelets into circulation during periods of increased demand. PDW has been recognized as a marker of

platelet activation and has shown relevance in inflammatory and infectious conditions.^{7,13}

The underlying pathophysiology of dengue involves a complex interplay between viral replication and host immune responses. Endothelial dysfunction, cytokine release, and immune-mediated injury contribute to increased vascular permeability and altered hemostasis.^{9,10} Furthermore, direct interaction between dengue virus and platelets has been demonstrated, influencing platelet function and survival^[11]. These mechanisms are further supported by studies describing immune-mediated platelet destruction and dysregulation in dengue infection.^{18,19}

The association between platelet parameters and clinical outcomes observed in this study is clinically significant. Patients with bleeding manifestations exhibited both lower platelet counts and higher MPV and PDW values, indicating that qualitative platelet dysfunction plays an important role in hemorrhagic complications. Previous studies have similarly emphasized that bleeding risk in dengue is not solely dependent on platelet count but also on platelet function and vascular integrity.^{15,17}

The diagnostic performance of platelet indices in this study was notable, with MPV and PDW demonstrating good sensitivity and specificity for predicting severe dengue. Comparable findings have been reported in earlier studies, supporting their utility as adjunct markers in clinical practice.^{12,14} However, variability in cut-off values across different studies suggests that these indices should be interpreted in conjunction with clinical findings rather than in isolation.

Immunopathological mechanisms, including antibody-dependent enhancement and exaggerated cytokine responses, further contribute to disease severity and hematological alterations.¹⁹ These processes may explain the observed changes in platelet indices and their association with adverse clinical outcomes.

From a practical standpoint, platelet indices offer a significant advantage as they are routinely available through automated hematology analyzers without additional cost. This makes them especially valuable in resource-limited settings, where rapid and accessible markers are essential for early identification of high-risk patients.

Despite these findings, the study has certain limitations, including a relatively small sample size and the absence of serial monitoring of platelet parameters. Future studies involving larger cohorts and dynamic assessment of platelet indices may provide a more comprehensive understanding of their prognostic value.

References

1. World Health Organization WHO. Dengue: guidelines for diagnosis, treatment, prevention and control. Geneva: World Health Organization; 2009.
2. Gubler DJ. Dengue and dengue hemorrhagic fever. *Lancet*. 1998;352(9132):971-977.
3. Halstead SB. Dengue. *Lancet*. 2007;370(9599):1644-1652.
4. Srichaikul T, Nimmannitya S. Haematology in dengue and dengue hemorrhagic fever. *Baillieres Best Pract Res Clin Haematol*. 2000;13(2):261-276.
5. Martina BEE, Koraka P, Osterhaus ADME. Dengue virus pathogenesis: an integrated view. *Clin Microbiol Rev*. 2009;22(4):564-581.
6. Noisakran S, Perng GC. Alternate hypothesis on the pathogenesis of dengue hemorrhagic fever (DHF)/dengue shock syndrome (DSS) in dengue virus infection. *J Biomed Sci*. 2008;15(6):781-790.
7. Vagdatli E, Gounari E, Lazaridou E, Katsibourlia E, Tsikopoulou F, Labrianou I. Platelet distribution width: a simple, practical and specific marker of activation of coagulation. *Clin Hemorheol Microcirc*. 2010;45(2-4):179-184.
8. Bessman JD, Gilmer PR Jr, Gardner FH. Use of mean platelet volume improves detection of platelet disorders. *Am J Clin Pathol*. 1981;76(3):289-293.
9. Basu A, Chaturvedi UC. Vascular endothelium: the battlefield of dengue viruses. *FEMS Immunol Med Microbiol*. 2008;53(3):287-299.

CONCLUSION

This study emphasizes that evaluation of dengue patients should extend beyond platelet count to include platelet indices. While thrombocytopenia remains a key feature, it does not fully capture disease severity.

Parameters such as MPV and PDW provide additional insight into platelet activity and turnover, reflecting underlying pathological processes. Their elevation in severe cases highlights their potential role in early risk assessment.

A combined interpretation of platelet count and indices allows for a more comprehensive evaluation, improving the identification of patients at risk for complications. Since these indices are routinely available, their incorporation into clinical practice is both practical and cost-effective.

Overall, platelet indices serve as valuable adjuncts in the assessment and management of dengue infection.

10. Martina BEE, Koraka P, Osterhaus ADME. Dengue virus pathogenesis: an integrated view. *Clin Microbiol Rev.* 2009;22(4):564-581.
11. Noisakran S, Perng GC. Alternate hypothesis on the pathogenesis of dengue hemorrhagic fever (DHF)/dengue shock syndrome (DSS) in dengue virus infection. *J Biomed Sci.* 2008;15(6):781-791.
12. Makroo RN, Raina V, Kumar P, Kanth RK. Role of platelet parameters in dengue positive patients. *Asian J Transfus Sci.* 2007;1(2):79-81.
13. Makroo RN, Bhatia A, Mahajan RK, et al. Role of platelet parameters in dengue positive patients. *Asian J Transfus Sci.* 2007;1(2):79-82.
14. Wiwanitkit V. Mean platelet volume in the patients with dengue hemorrhagic fever. *Platelets.* 2004;15(3):185.
15. Wills BA, Oragui EE, Stephens AC, et al. Coagulation abnormalities in dengue hemorrhagic fever: serial investigations in 167 Vietnamese children with dengue shock syndrome. *N Engl J Med.* 2002;347(21):163-168.
16. Luzzani A, Polati E, Dorizzi R, Rungatscher A, Pavan R, Merlini A. Comparison of procalcitonin and C-reactive protein as markers of sepsis. *Crit Care Med.* 2003;31(6):1737-1741.
17. Mitrakul C. Bleeding problem in dengue hemorrhagic fever: platelets and coagulation changes. *Southeast Asian J Trop Med Public Health.* 1987;18(3):407-412.
18. Halstead SB. Pathogenesis of dengue: challenges to molecular biology. *Science.* 1988;239(4839):476-481.
19. Green S, Rothman A. Immunopathological mechanisms in dengue and dengue hemorrhagic fever. *Curr Opin Infect Dis.* 2006;19(5):429-436.