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Original Research Article

MEAN PLATELET VOLUME AND PLATELET DISTRIBUTION WIDTH IN FEBRILE THROMBOCYTOPENIA: A CROSS-SECTIONAL STUDY

M. M. Poornima[1], Chaitanya Damerla[2]

[1]Assistant Professor, Department of Pathology, Maheshwara Medical College and Hospital, Isnapur, Telangana, India

[2]Consultant Pathologist, Sprint Diagnostics, Jubilee Hills, Hyderabad, Telangana, India

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Corresponding Author: Dr. M. M. Poornima

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Abstract

Background: Thrombocytopenia is a common haematological abnormality encountered in acute febrile illnesses and is frequently associated with infections such as dengue, malaria, leptospirosis, and viral fevers. Platelet indices, particularly Mean Platelet Volume (MPV) and Platelet Distribution Width (PDW), may provide valuable information regarding platelet kinetics and the severity of thrombocytopenia. This study aimed to evaluate MPV and PDW in patients with thrombocytopenic febrile illness and determine their relationship with platelet count.

Materials and Methods: This hospital-based cross-sectional study contains a total of 102 adult patients presenting with acute febrile illness and thrombocytopenia (platelet count <150,000/μL) were enrolled. Clinical details were recorded, and blood samples were analyzed using an automated haematology analyzer for platelet count, MPV, and PDW. Peripheral smear examination was performed to exclude pseudo thrombocytopenia.

Results: The mean age of participants was 40.8 ± 13.7 years, with males constituting 59.8% of the study population. Dengue fever was the most common etiology (38.2%), followed by viral fever (27.5%) and malaria (14.7%). Mild, moderate, and severe thrombocytopenia were observed in 46.1%, 37.3%, and 16.6% of patients, respectively. MPV and PDW increased significantly with worsening thrombocytopenia ($p<0.001$). Platelet count demonstrated a significant negative correlation with MPV ($r = -0.641$, $p<0.001$) and PDW ($r = -0.587$, $p<0.001$). ROC analysis showed good predictive performance of MPV (AUC 0.846) and PDW (AUC 0.819) for severe thrombocytopenia.

Conclusion: MPV and PDW are simple, cost-effective, and readily available platelet indices that correlate significantly with thrombocytopenia severity in febrile illnesses. Their routine assessment may aid in early risk stratification and clinical monitoring of patients with febrile thrombocytopenia.

Keywords: Thrombocytopenia, Mean Platelet Volume, Platelet Distribution Width, Febrile Illness, Dengue Fever, Platelet Indices.

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Introduction

Thrombocytopenia, defined as a platelet count below 150,000/μL, is a common haematological abnormality encountered in clinical practice and is frequently associated with acute febrile illnesses in tropical and subtropical regions. It may

result from decreased platelet production, increased peripheral destruction, splenic sequestration, or a combination of these mechanisms. Infectious diseases such as dengue fever, malaria, leptospirosis, enteric fever, and viral infections constitute the major causes of febrile thrombocytopenia in India and other developing countries. The severity of thrombocytopenia ranges from mild reductions in platelet count to profound thrombocytopenia associated with spontaneous bleeding and life-threatening complications. Early identification of patients at risk for severe thrombocytopenia is therefore essential for appropriate clinical management and prevention of adverse outcomes [1-3]. Platelets play a pivotal role not only in haemostasis but also in inflammatory and immune responses. During infectious diseases, platelet activation and consumption contribute significantly to the pathogenesis of thrombocytopenia. Advances in automated haematology analysers have enabled the routine measurement of platelet indices such as Mean Platelet Volume (MPV) and Platelet Distribution Width (PDW), which provide additional information regarding platelet morphology and kinetics without incurring extra laboratory costs. MPV reflects the average size of circulating platelets and indirectly indicates the rate of thrombopoiesis, whereas PDW measures the heterogeneity in platelet size and serves as an indicator of platelet activation and anisocytosis [4-6]. Previous studies have suggested that platelet indices may assist in differentiating thrombocytopenia caused by peripheral platelet destruction from thrombocytopenia due to impaired bone marrow production. Elevated MPV values are generally associated with increased platelet turnover and enhanced marrow response, while increased PDW reflects variability in platelet size resulting from accelerated platelet release into the circulation. Several investigators have demonstrated significant alterations in MPV and PDW in conditions such as dengue fever, immune thrombocytopenia, sepsis, and malaria [7-9]. These parameters have also been proposed as potential markers of disease severity and prognosis in febrile illnesses. In resource-constrained healthcare settings, where advanced diagnostic facilities may not always be available, platelet indices derived from routine complete blood count analysis may offer a simple, rapid, and cost-effective approach for evaluating thrombocytopenia. However, data regarding the clinical utility of MPV and PDW in febrile thrombocytopenia remain limited and sometimes conflicting. Therefore, the present study was undertaken to evaluate thrombocytopenia in patients with acute febrile illness and to assess the relationship of MPV and PDW with platelet counts

Materials and Methods

This hospital based cross sectional observational study was conducted in the Department of Pathology in collaboration with the Department of General Medicine at Maheshwara Medical College and Hospital, Isnapur, Telangana, India from July 2020 to September 2021.Written informed consent was obtained from all participants and study protocol was approved from the Institutional Ethics Committee. A total of 102 consecutive patients presenting with acute febrile illness and thrombocytopenia were recruited. Patients admitted to the medical wards and intensive care units with documented fever and reduced platelet count during the study period were screened for eligibility.

Inclusion Criteria: Patients aged ≥18 years, with fever (body temperature ≥38°C) of less than 14 days duration, platelet count <150,000/µL at admission and willing to participate and provide informed consent.

Exclusion Criteria: Patients with known haematological malignancies, with chronic

liver disease, chronic kidney disease, autoimmune disorders associated with thrombocytopenia, under chemotherapy, radiotherapy, and drugs known to affect platelet counts, pregnancy, with inherited platelet disorders, Cases of pseudo thrombocytopenia identified on peripheral smear examination and who had received platelet transfusion before sample collection. A detailed demographic and clinical history including age, sex, duration of fever, presenting symptoms, bleeding manifestations, and provisional clinical diagnosis was noted in a predesigned proforma. Relevant laboratory and radiological investigations were reviewed to establish the etiology of febrile illness. Under aseptic precautions, 2 mL of venous blood was collected from each participant into ethylene diamine tetra acetic acid (EDTA) vacutainers. Samples were processed within two hours of collection. Complete blood counts were performed using a fully automated haematology analyser. The following platelet parameters platelet Count (PLT), mean Platelet Volume (MPV) and platelet Distribution Width (PDW)were recorded. To exclude spurious thrombocytopenia, peripheral blood smears stained with Leishman stain were examined microscopically in all cases. Platelet morphology, platelet clumping, and associated haematological abnormalities were assessed.

Classification of Thrombocytopenia: Based on platelet count, thrombocytopenia was categorized as: [10]

Severity	Platelet Count (/µL)
Mild	50,000–149,999
Moderate	20,000–49,999
Severe	<20,000

Statistical Analysis: Data were extracted into Microsoft Excel and analysed using SPSS v.25.0. Continuous variables were expressed as mean and standard deviation (SD), while categorical variables were presented as frequencies and percentages. Comparison of means between groups was performed using Student's *t*-test. Association between categorical variables was assessed using the Chi-square test. Correlation between platelet count and platelet indices (MPV and PDW) was evaluated using Pearson's correlation coefficient. A p value <0.05 was considered statistically significant.

Results

Table 1: Demographic and clinical profile of study population (n = 102)

Parameters	Total cases (n=102)	
	Frequency	Percentage
Age (Years)		
18-30	28	27.5%
31-40	24	23.5%
41-50	21	20.6%
51-60	18	17.6%
>60	11	10.8%
Gender		
Male	61	59.8%
Female	41	40.2%
Etiological distribution		
Dengue Fever	39	38.2%

Viral Fever	28	27.5%
Malaria	15	14.7%
Leptospirosis	11	10.8%
Enteric Fever	5	4.9%
Sepsis	4	3.9%
Severity of thrombocytopenia		
Mild	47	46.1%
Moderate	38	37.3%
Severe	17	16.6%

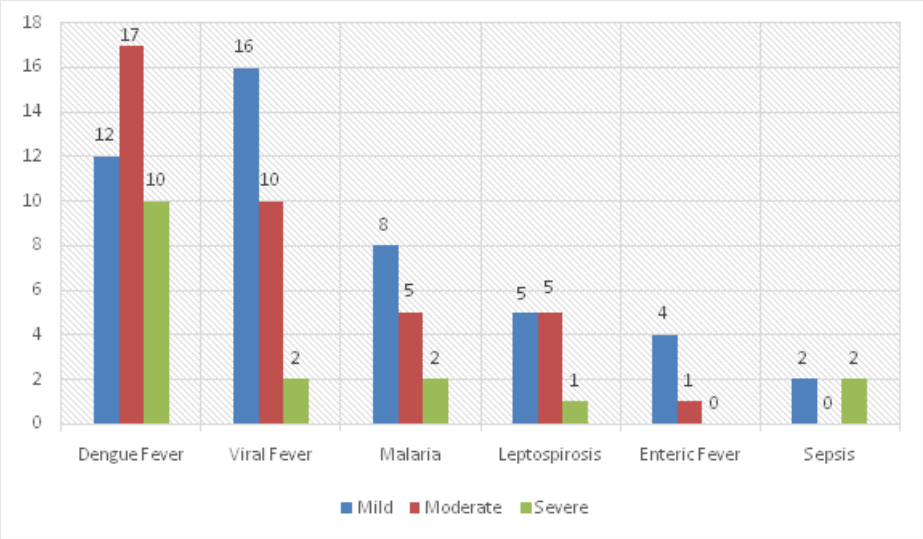

Figure 1: Severity of Thrombocytopenia According to Etiology

Table 2: Comparison of platelet parameters with severity of thrombocytopenia

Parameters	Mild	Moderate	Severe	F-value	P-value
	Mean±SD	Mean±SD	Mean±SD		
Mean PC(/µL)	89,420±18,640	36,580±8,920	14,850±3,940	412.7	0.001
Mean MPV (fL)	9.68±0.82	11.14±0.95	12.46±1.12	52.31	0.001
Mean PDW (%)	13.84±1.26	15.72±1.42	17.63±1.84	47.18	0.001

Table 3: Comparison of MPV Among Various Etiologies

Disease	MPV (fL)	Mean PDW (%)
Dengue Fever	11.92 ± 1.21	16.88 ± 1.72
Viral Fever	10.24 ± 0.88	14.52 ± 1.33
Malaria	10.82 ± 1.01	15.08 ± 1.40
Leptospirosis	10.95 ± 1.08	15.54 ± 1.25
Enteric Fever	9.84 ± 0.76	13.98 ± 1.10
Sepsis	12.11 ± 1.14	17.26 ± 1.96
ANOVA F-value	11.47	0.001
p-value	9.92	0.001

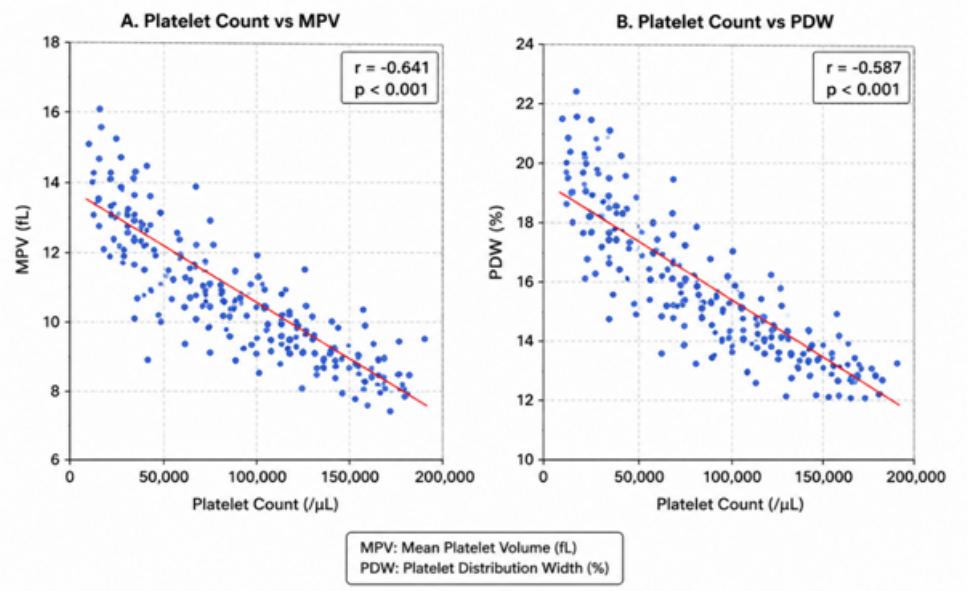

Figure 2: Correlation of platelet volume with MPV and PDW.

Table 4: Diagnostic Performance of MPV and PDW for Severe Thrombocytopenia

Parameter	AUC (95% CI)	Sensitivity (%)	Specificity (%)	Cut-off
MPV	0.846 (0.77-0.92)	82.4	78.8	>11.5 fL
PDW	0.819 (0.74-0.89)	76.5	80.0	>16.2%

Discussion

Febrile thrombocytopenia is a common clinical entity in tropical countries and poses a significant diagnostic challenge because of the wide spectrum of infectious etiologies associated with low platelet counts. Platelet indices such as Mean Platelet Volume (MPV) and Platelet Distribution Width (PDW) have gained increasing attention as readily available and cost-effective markers that may provide insights into the underlying mechanism and severity of thrombocytopenia. The present study evaluated 102 patients with acute febrile illness and thrombocytopenia and assessed the relationship between platelet count, MPV, and PDW.

The mean age of patients in the present study was 40.8±13.7 years, with a predominance of males (59.8%). Similar demographic patterns have been reported by Dhunputh Pet al., who observed that febrile thrombocytopenia predominantly affected young and middle-aged adults with a slight male predominance owing to greater occupational exposure to vector-borne infections and environmental pathogens in endemic regions [11]. Comparable findings were also documented by Gandhi and Akholkar PJ, who reported a higher incidence among males admitted with infectious thrombocytopenia [12].

Dengue fever was the leading cause of febrile thrombocytopenia in the present study, accounting for 38.2% of cases, followed by viral fever and malaria. This observation is consistent with studies from India where dengue has emerged as the most common cause of thrombocytopenia during seasonal outbreaks. Rekha et al. reported dengue and viral fevers as the predominant etiologies among hospitalized patients with thrombocytopenia [13]. Similarly, Jagdale et al. identified dengue fever as a major contributor to severe thrombocytopenia in tropical settings [14]. The high prevalence of dengue in the present study reflects the endemicity of arboviral infections in Telangana and neighbouring regions.

The majority of patients had mild thrombocytopenia (46.1%), whereas severe thrombocytopenia was observed in 16.6% of cases. Severe thrombocytopenia was more frequently encountered in dengue fever and sepsis. Similar findings were reported by Gamit et al., who observed that severe thrombocytopenia occurred predominantly in dengue fever and septicemia, while mild-to-moderate thrombocytopenia was more common in viral infections and enteric fever [15]. The mechanism of thrombocytopenia in dengue involves bone marrow suppression, immune-mediated platelet destruction, and peripheral consumption, resulting in profound platelet depletion [16, 17]. A major finding of the present study was the significant increase in MPV with increasing severity of thrombocytopenia. Mean MPV values increased from 9.68 ± 0.82 fL in mild thrombocytopenia to 12.46 ± 1.12 fL in severe thrombocytopenia ($p<0.001$). This observation supports the concept that accelerated peripheral platelet destruction stimulates the release of larger, younger platelets from the bone marrow. Kaito et al. demonstrated that elevated MPV values are strongly associated with increased platelet turnover and destructive thrombocytopenic disorders [7]. Bowles KM et al. similarly reported that MPV could effectively differentiate thrombocytopenia caused by peripheral destruction from marrow hypoproliferation [8].

PDW also increased significantly with worsening thrombocytopenia in the current study. Patients with severe thrombocytopenia exhibited the highest PDW values, indicating increased heterogeneity in platelet size. PDW is considered a marker of platelet activation and anisocytosis. Vagdatli et al. reported that activated platelets undergo morphological alterations leading to increased PDW values, which may reflect enhanced platelet consumption and regeneration [6]. Studies in dengue infection have also demonstrated elevated PDW values during the acute phase of illness, correlating with disease severity and platelet destruction [10].

The present study demonstrated significant negative correlations between platelet count and MPV ($r = -0.641$, $p<0.001$) as well as platelet count and PDW ($r = -0.587$, $p<0.001$). These findings indicate that platelet indices increase as platelet counts decline. Similar inverse relationships have been reported by Bashir et al. and Ahmed et al., who found that MPV and PDW were elevated in patients with severe dengue-associated thrombocytopenia [9, 17]. Such correlations suggest that platelet indices may serve as surrogate markers of platelet consumption and recovery. The ROC analysis further demonstrated good diagnostic performance of MPV and PDW for identifying severe thrombocytopenia, with MPV showing slightly superior predictive ability. Since these indices are generated automatically during routine complete blood count analysis without additional expenditure, their incorporation into clinical assessment may aid early risk stratification and monitoring of patients with febrile thrombocytopenia.

Conclusion

This study demonstrated that dengue fever was the most common cause of febrile thrombocytopenia, followed by viral fever and malaria. Mean Platelet Volume (MPV) and Platelet Distribution Width (PDW) showed significant elevation with increasing severity of thrombocytopenia and exhibited a strong negative correlation with platelet count. These findings indicate that platelet indices reflect enhanced platelet destruction and regeneration during acute febrile illnesses. Since MPV and PDW are routinely available through automated haematology analysers without additional cost, they can serve as valuable, rapid, and economical adjunctive markers for assessing severity and monitoring thrombocytopenic febrile patients in routine clinical practice.

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