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Role of Mean Platelet Volume in Differentiating the Causes of Thrombocytopenia

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ABSTRACT

BACKGROUND: Accurate evaluation of thrombocytopenic patients requires determination of the underlying etiology, specifically whether thrombocytopenia results from decreased platelet production or increased peripheral destruction, as this distinction has important implications for clinical management. The present study aims to assess the variations in Mean Platelet Volume and to analyze its relationship in patients with hypo-productive and hyper-destructive thrombocytopenia.

MATERIAL AND METHOD: 18 month cross-sectional study of 200 samples from thrombocytopenia patients. Mean Platelet Volume was recorded for all samples. Data were systematically entered into suitable software for analysis.

RESULT: Our study shows a male predominance with a mean age of 38.76 ± 14.1 years. The mean MPV was significantly higher in the hyper-destructive group (15.29 fl) compared to the hypo-productive group (9.49 fl). The difference in Mean Platelet Volume between the two groups was statistically significant.

CONCLUSION: Our study suggests that Mean Platelet Volume play a role in discerning the underlying cause of thrombocytopenia.

Keywords: Thrombocytopenia; Platelet indices; Mean Platelet Volume; Hypoproductive; Hyperdestructive

Introduction

Thrombocytopenia is one of the common findings among patients in a clinical setting. It is defined by platelet count below the normal values and has a significant role in both hospitalised and non-hospitalised patients. The counts below 1,50,000 / μL are considered as thrombocytopenia.[1] It is very important to know the cause of thrombocytopenia for correct patient management whereby unnecessary invasive procedures, transfusions, and medications can be avoided.[2] Thrombocytopenia may result from many mechanisms such as marrow hypoplasia, increased destruction of platelets, and splenic sequestration.[3] Bone marrow aspiration has continued to exist as the gold standard for diagnosing and evaluating the cause of thrombocytopenia. This invasive technique is time consuming and poses the risk of bleeding

especially in patients with severe thrombocytopenia. For a better assessment of these patients, innovative, non-invasive, and cost-efficient diagnostic techniques for the diagnosis of thrombocytopenia are required.[4] Automated cell counters are used widely these days which furnish us the valuable information of various blood cell parameters including red blood cells, white blood cells and platelets with platelet parameters. Recently platelet parameters like mean platelet volume (MPV), platelet distribution width (PDW), Platelet large cell ratio (P-LCR) and platelet crit (PCT) have been investigated as important platelet activation markers.[1] Mean platelet volume (MPV) indicates the average size of platelets in the blood that provides vital information for megakaryopoietic activity.[5] The proposed normal value of MPV is 7.2 to 11.7 fL.[6] A high MPV is associated with increased platelet production while a low MPV indicates decreased platelet production.[7] The biomarker role of MPV has been emphasized in different medical conditions including diabetes, metabolic syndrome, cancer, inflammatory bowel disease, preeclampsia, and ITP.[8]

MATERIAL AND METHOD

A total of 200 cases of thrombocytopenia were taken from may 2024 till may 2025. Venous blood samples (2 mL) were collected from each participant in tubes containing di-potassium EDTA to prevent clotting. Complete blood counts were performed using the SYSMEX XN-330 six-part cell analyzer, a validated automated haematology system. Mean Platelet Volume was recorded for all samples. Medical records were reviewed to obtain provisional or associated diagnoses established by primary physicians. These diagnoses were used to categorize thrombocytopenia into hyperdestructive (e.g., immune thrombocytopenic purpura, sepsis) or hypoproductive (e.g., bone marrow suppression, leukemia) groups based on the predominant mechanism.

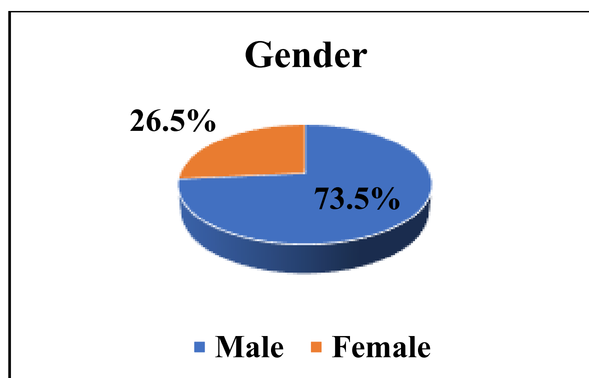
RESULT

The gender distribution of the 200 cases studied for platelet indices in differentiating the causes of thrombocytopenia shows a male predominance, with 147 (73.5%) being male and 53 (26.5%) being female.

Table 1: Distribution of the studied cases based on their gender

Gender	No. of cases (n=200)	Percentage
Male	147	73.5%
Female	53	26.5%

Figure 1: Distribution of the studied cases based on their gender



The age distribution of the 200 cases studied for platelet indices in differentiating the causes of thrombocytopenia shows a majority 72 (36%) of cases falling within the 41-55 age range, with a mean age of 38.76 ± 14.1 years.

Table 2: Distribution of the studied cases based on their age

Age in years	No. of cases (n=200)	Percentage
10-25	42	21.0%
26-40	64	32.0%
41-55	72	36.0%
>55	22	11.0%
Mean age in years	38.76±14.1	

In the study, megaloblastic anaemia was the most common underlying clinical condition, affecting 48% of cases, followed by chronic liver disease in 25%, renal failure in 20% patients, lymphoproliferative disorders in 3% patients, myelodysplastic syndrome (MDS) in 2% patients, and aplastic anaemia in 2% patients.

Table 3: Clinical conditions in the study participants in Hypo-productive

Clinical Profile	Hypo-productive (n=100)
Megaloblastic Anaemia	48 (48.0%)
Renal Failure	20 (20.0%)
Chronic Liver Disease	25 (25.0%)
Lymphoproliferative Disorder	3 (3.0%)
MDS	2 (2.0%)
Aplastic Anaemia	2 (2.0%)

In the study, dengue was the most frequent underlying clinical condition, accounting for 35% of cases, followed by sepsis in 31% of patients. Malaria was responsible in 16%, viral fever in 13%, while immune thrombocytopenic purpura (ITP) was seen in only 3% and enteric fever in 2% of the cases.

Table 4: Clinical conditions in the study participants in Hyper-destructive

Clinical Profile	Hyper-destructive (n=100)
Dengue	35 (35.0%)
Sepsis	31 (31.0%)
Malaria	16 (16.0%)
Viral Fever	13 (13.0%)
ITP	3 (3.0%)
Enteric Fever	2 (2.0%)

The study compared the mean platelet volume (MPV) between two groups, hypo-productive and hyper-destructive. The mean MPV was significantly higher in the hyper-destructive group (15.29 fl) compared to the hypo-productive group (9.49 fl). The t-value of 19.4 and p-value of <0.001 indicated that the difference in MPV between the two groups was statistically significant.

Table 5: Comparison of Mean Platelet volume in each group

	Group	N	Mean	Std. Deviation	Std. Error Mean	t statistic	p value
MPV (fl)	Hypo-productive	100	9.49	1.35	0.135	19.4	**<0.001**
	Hyper-destructive	100	15.29	2.66	0.266		

Figure 2: Comparison of MPV (fl) in both groups

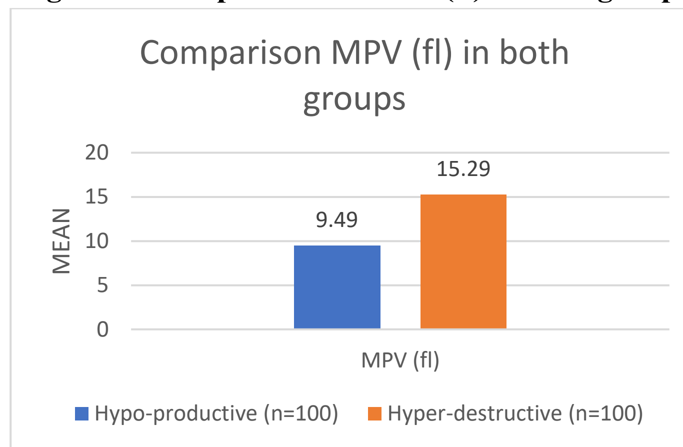


Table 6: Comparison of Mean Platelet Volume between hypo-productive thrombocytopenia and hyper-destructive thrombocytopenia

Platelet indices	Hypo-productive (n=100)	Hyper-destructive (n=100)	t-statistic	p-value
Mean Platelet Volume (MPV) (fl)	9.49±1.35	15.29±2.66	19.4	**<0.001**

DISCUSSION

In recent years, automated hematology analyzers have enabled routine measurement of platelet indices such as Mean Platelet Volume (MPV), Platelet Distribution Width (PDW), Platelet-Large Cell Ratio (P-LCR) and Plateletcrit (PCT). These parameters provide insights into platelet morphology and kinetics, thereby serving as potential surrogate markers for distinguishing between hypo-productive and hyper-destructive thrombocytopenia. For instance, elevated MPV is often associated with peripheral destruction, reflecting compensatory release of larger, younger platelets, whereas reduced MPV may indicate marrow suppression.[9]

In the present study, there was a male predominance (73.5%) in the studied population with females accounting for 26.5%, which was similar to the findings of Mittal M et al**Error! Bookmark not defined.**

In the present study, Megaloblastic Anaemia was a common complaint in hypo-productive cases, followed by Chronic Liver Disease (24.0%), and renal failure (19.0%), whereas in hyper-destructive cases, the

majority of the cases had dengue (35.0%) followed by sepsis (31.0%), malaria (16.0%) and viral fever (13.0%). Our findings were consistent with the findings of Shetageri SN et al[4] .
In the present study, the mean MPV was significantly higher in the hyper-destructive group (15.29 fl) compared to the hypo-productive group (9.49 fl). Our findings were similar to the findings of Shetageri SN et al[4], who reported that there was a significant difference in the mean values of MPV between hyperdestructive and hypoproductive groups. Vidyadhar S et al[10] and Norasethada L et al[11] also established a significant difference in MPV values between the two groups.

CONCLUSION

Our study suggests that Mean Platelet Volume plays a role in discerning the underlying cause of thrombocytopenia. It emerges as particularly reliable in distinguishing between different etiologies. Elevated MPV was consistently observed in conditions characterized by peripheral destruction or increased platelet turnover such as dengue, sepsis, malaria, viral fever, and immune thrombocytopenic purpura (ITP), reflecting the release of larger, heterogeneous platelets from the marrow. MPV provides valuable adjunctive information, enabling distinction between peripheral destruction and marrow failure syndromes. Incorporating Mean Platelet Volume into routine hematological evaluation can enhance diagnostic accuracy, guide clinical decision-making, and improve patient management in thrombocytopenic disorders.

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