



Original Article

Role of Mean Platelet Volume (MPV) in Categorising Etiology of Thrombocytopenia – A Cross-Sectional Study

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ABSTRACT

Background: Thrombocytopenia Is One Of The Most Frequently Encountered Hematological Abnormalities In Clinical Practice. It Can Arise Due To Decreased Platelet Production (Hypoproductive), Increased Peripheral Destruction (Hyperdestructive), Or Abnormal Splenic Pooling. Although Bone Marrow Examination Is Considered The Gold Standard For Determining The Underlying Mechanism, It Is Invasive, Painful, And Not Always Feasible In Critically Ill Patients. Mean Platelet Volume (Mpv), An Automated Platelet Index Generated During Routine Complete Blood Count (Cbc), Reflects Platelet Size And Activity And Indirectly Indicates Bone Marrow Response. Several Studies Have Reported That Mpv Is Significantly Higher In Hyperdestructive Thrombocytopenia Compared To Hypoproductive Causes. This Study Was Undertaken To Evaluate The Role Of Mpv In Categorizing The Etiology Of Thrombocytopenia And Its Potential Utility As A Non-Invasive Diagnostic Marker. (1–5).

Methods: A Prospective Cross-Sectional Study Was Conducted Over Six Months In The Department Of Pathology, S.V. Medical College And Svrrggh, Tirupati. A Total Of 226 Cases With Thrombocytopenia Were Included. Venous Blood Samples Collected In Edta Vacutainers Were Analyzed Within Three Hours Using An Erba-Mannheim Five-Part Hematology Analyzer. Platelet Count And Corresponding Mpv Values Were Recorded. Peripheral Smear Examination Was Performed In All Cases, And Bone Marrow Examination Was Done In Selected Cases. Statistical Analysis Was Carried Out Using Anova, And A P-Value <0.001 Was Considered Highly Significant. (6,7).

Results: Among 226 Cases, Thrombocytopenia Was Categorized Into Three Groups: Hyperdestructive (58.4%), Hypoproductive (34.5%), And Abnormal Pooling (7.1%). The Mean Mpv Was Significantly Higher In Hyperdestructive Thrombocytopenia (10.95 ± 1.12 Fl) Compared To Hypoproductive (8.58 ± 0.94 Fl) And Pooling Groups (8.20 ± 0.88 Fl) ($P < 0.001$). Infections And Immune Thrombocytopenic Purpura (Itp) Were The Most Common Causes In The Hyperdestructive Group. (8–10)

Conclusion:

Mpv Is A Simple, Cost-Effective, And Non-Invasive Hematological Parameter That Can Aid In Differentiating Hyperdestructive From Hypoproductive Thrombocytopenia, Thereby Reducing The Need For Invasive Bone Marrow Examination In Selected Cases. (11–13)

Keywords Mean Platelet Volume, Thrombocytopenia, Hyperdestructive, Platelet Indices.

INTRODUCTION

Marrow, Increased Peripheral Destruction, Or Abnormal Splenic Sequestration. Differentiating Between Hypoproliferative And Hyperdestructive Mechanisms Is Crucial For Appropriate Clinical Management And Prognostication. (1,2)

Bone Marrow Examination Remains The Gold Standard For Determining The Underlying Cause Of Thrombocytopenia; However, It Is Invasive, Painful, And Often Not Feasible In Critically Ill Or Unstable Patients. Additionally, It Requires Specialized Expertise Thrombocytopenia, Defined As A Platelet Count Below 1.5 Lakh/ Mm^3 , Is A Common Hematological Abnormality Encountered In Both Outpatient And Inpatient Settings. It May Result From Decreased Platelet Production In The Bone And Resources, Which May Not Be Readily Available In Many Healthcare Settings. With Advancements In Automated Hematology Analyzers, Platelet Indices Such As Mean Platelet Volume (Mpv), Platelet Distribution Width (Pdw), And Platelet Large Cell Ratio (P-Lcr) Are Now Routinely Available As Part Of The Complete Blood Count. (3,4)

Mpv Reflects Platelet Size, Which Correlates With Platelet Activity And Turnover. Larger Platelets Are Typically Younger, More Metabolically Active, And More Hemostatically Potent, Indicating Increased Bone Marrow Activity In Response To Peripheral Destruction. Conversely, Smaller Platelets Suggest Reduced Production, As Seen In Hypoproliferative Conditions Such As Aplastic Anemia, Leukemia, And Chemotherapy-Induced Marrow Suppression. (5–7)

Several Studies Have Demonstrated That Mpv Is Significantly Higher In Hyperdestructive Thrombocytopenia Compared To Hypoproliferative Causes, Supporting Its Role As A Surrogate Marker Of Bone Marrow Response. Mpv Has Also Been Evaluated As A Prognostic Indicator In Conditions Such As Dengue, Sepsis, And Immune Thrombocytopenia. (8–10)

Mpv Has The Potential To Serve As A Valuable Screening Tool In Resource-Limited Settings. The Present Study Was Undertaken To Assess The Role Of Mpv In Categorizing Various Causes Of Thrombocytopenia And To Correlate It With Peripheral Smear Findings And Clinical Diagnosis. (11–13)

MATERIALS AND METHODS

Study Design And Setting

This Was A Prospective Cross-Sectional Study Conducted In The Department Of Pathology, S.V. Medical College And Svrnggh, Tirupati, Over A Period Of Six Months After Obtaining Approval From The Institutional Ethics Committee.

Study Population

The Study Included Patients Of All Age Groups Presenting With Thrombocytopenia (Platelet Count <1.5 Lakh/ Mm^3) Evaluated In The Department Of Pathology, S.V. Medical College And Svrnggh, Tirupati. A Total Of 226 Consecutive Cases Fulfilling Inclusion Criteria Were Enrolled, And Clinical Details Were Recorded For Etiological Classification.

Inclusion And Exclusion Criteria

Inclusion: All Cases With Platelet Count <1.5 Lakh/ Mm^3 .

Exclusion: Inadequate Or Clotted Samples, And Samples Delayed Beyond Three Hours.

Data And Sample Collection

Venous Blood Samples Were Collected In Edta Vacutainers And Analyzed Within Three Hours Using An Erba-Mannheim Five-Part Hematology Analyzer. Platelet Count And Mpv Values Were Recorded. Peripheral Smear Examination Was Performed In All Cases. Bone Marrow Examination Was Done In Selected Cases Based On Clinical Indication.

Statistical Analysis

Data Were Analyzed Using Anova Test. A P-Value <0.001 Was Considered Highly Significant.

RESULTS

A Total Of 226 Cases Of Thrombocytopenia Were Included In The Present Study. The Demographic Profile, Etiological Classification, And Mean Platelet Volume Values Were Analyzed To Assess The Role Of Mpv In Differentiating The Underlying Mechanisms Of Thrombocytopenia.

Demographic Characteristics

The Majority Of Patients Belonged To The 18–30 Years Age Group (37.2%), Followed By 31–45 Years (24.8%), Indicating A Predominance Of Thrombocytopenia Among Younger And Middle-Aged Adults. Patients Above 60 Years Constituted 17.6% Of Cases.

A Slight Male Predominance Was Observed, With Males Accounting For Approximately 56% Of Cases And Females 44%, Reflecting Increased Exposure To Infectious And Environmental Risk Factors Among Males.

Table 1. Age And Sex Distribution (N = 226)

Age Group (Yrs)	Male	Female	Total (%)
18 – 30	48	36	84 (37.2)
31 – 45	32	24	56 (24.8)
46 – 60	26	20	46 (20.4)
> 60	22	18	40 (17.6)

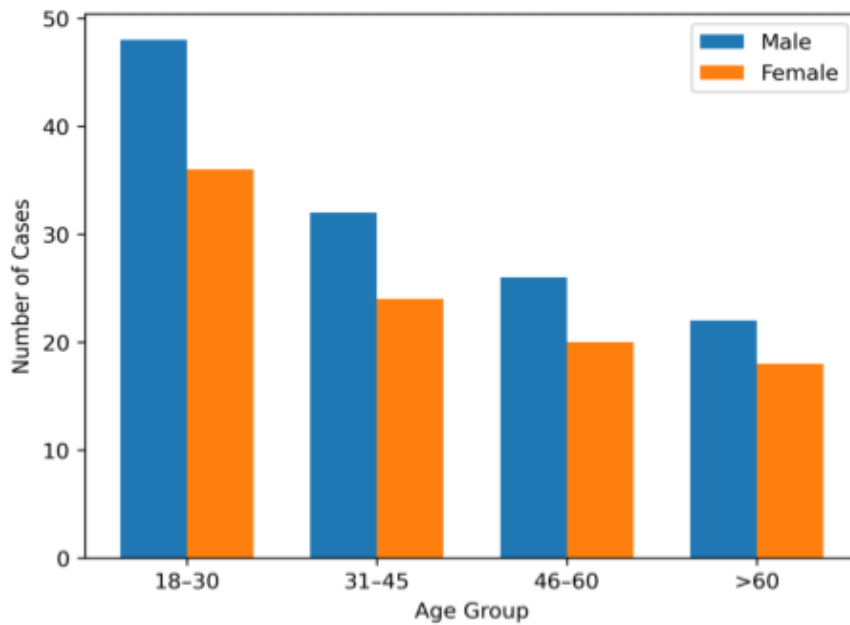


Figure 1. Age And Sex Distribution

The Higher Prevalence In Younger Adults (18 - 30 Years) May Be Attributed To Increased Incidence Of Infectious Causes Such As Dengue And Viral Fevers, Which Commonly Affect This Age Group.

Etiological Classification Of Thrombocytopenia

Based On Clinical Evaluation, Peripheral Smear Findings, And Laboratory Correlation, Thrombocytopenia Cases Were Categorized Into Three Major Groups:

- Hyperdestructive: 58.4%
- Hypoproductive: 34.5%
- Abnormal Pooling: 7.1%

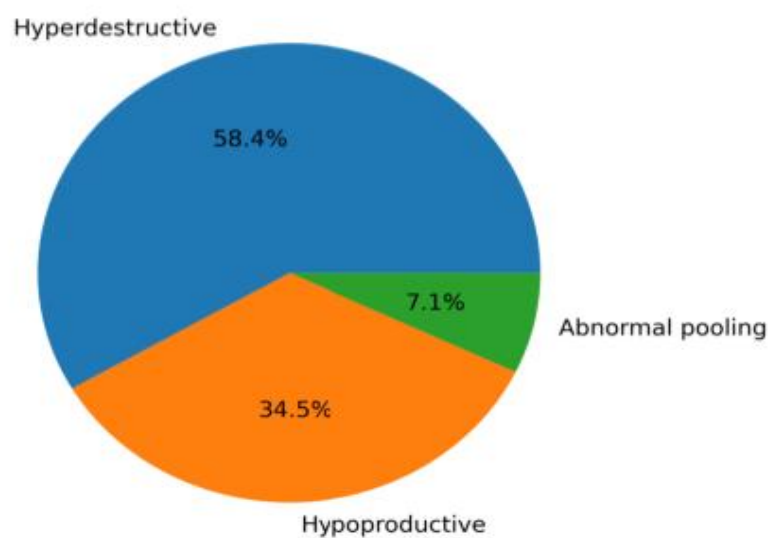


Figure 2. Etiological Classification Of Thrombocytopenia

Hyperdestructive Thrombocytopenia Constituted The Majority Of Cases, Indicating That Peripheral Platelet Destruction Due To Infections And Immune-Mediated Mechanisms Is The Predominant Cause In The Studied Population.

Mean Platelet Volume In Different Groups

A Significant Variation In Mpv Values Was Observed Across The Three Etiological Categories.

The Mean Mpv Was Highest In Hyperdestructive Thrombocytopenia (10.95 ± 1.12 fL), Followed By Hypoproductive Thrombocytopenia (8.58 ± 0.94 fL) And Abnormal Pooling (8.20 ± 0.88 fL). The Difference Was Statistically Highly Significant ($P < 0.001$).

Table 2. Mean Mpv Values

Etiological Group	Mean Mpv (fL)	Sd
Hyperdestructive	10.95	± 1.12
Hypoproductive	8.58	± 0.94
Abnormal Pooling	8.20	± 0.88

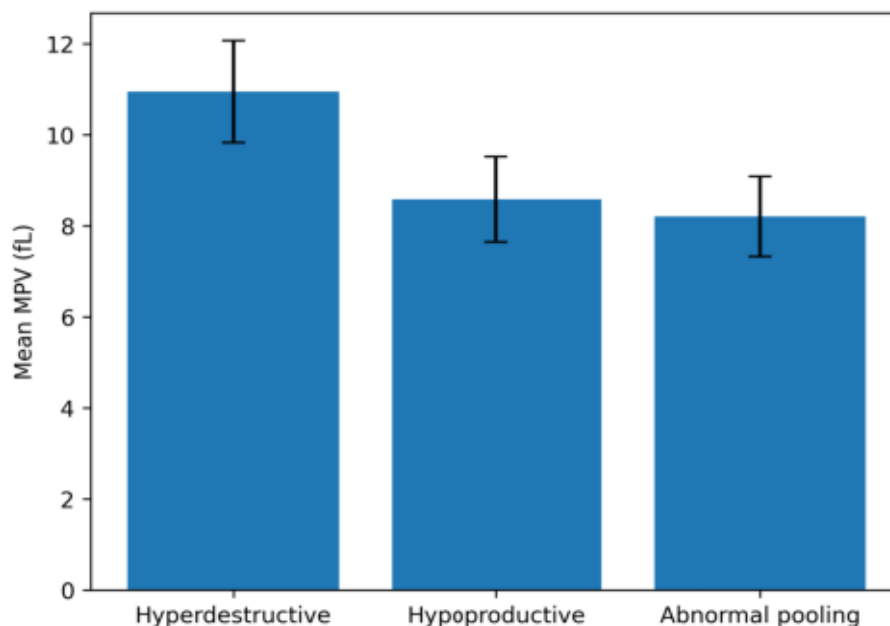


Figure 3. Mean Mpv With Standard Deviation

Higher Mpv Values In Hyperdestructive Thrombocytopenia Reflect Increased Bone Marrow Activity And Release Of Larger, Younger Platelets In Response To Peripheral Destruction. Conversely, Lower Mpv Values In Hypoproductive Conditions Indicate Impaired Megakaryopoiesis.

Etiological Causes Within Each Group

Among Hyperdestructive Thrombocytopenia Cases, Infections Accounted For The Majority (51.5%), Followed By Immune Thrombocytopenic Purpura (21.2%) And Dengue Fever (15.2%).

In Hypoproductive Thrombocytopenia, The Most Common Causes Included Aplastic Anemia (28.2%), Chemotherapy-Induced Marrow Suppression (25.6%), And Leukemia (23.1%).

All Cases In The Abnormal Pooling Category Were Associated With Splenomegaly.

Table 3. Causes Of Thrombocytopenia

Group	Cause	Percentage
Hyperdestructive	Infections	51.5
Hyperdestructive	Immune Thrombocytopenia	21.2
Hyperdestructive	Dengue Fever	15.2
Hypoproductive	Aplastic Anemia	28.2
Hypoproductive	Leukemia	23.1
Hypoproductive	Chemotherapy Induced	25.6
Abnormal Pooling	Splenomegaly	100

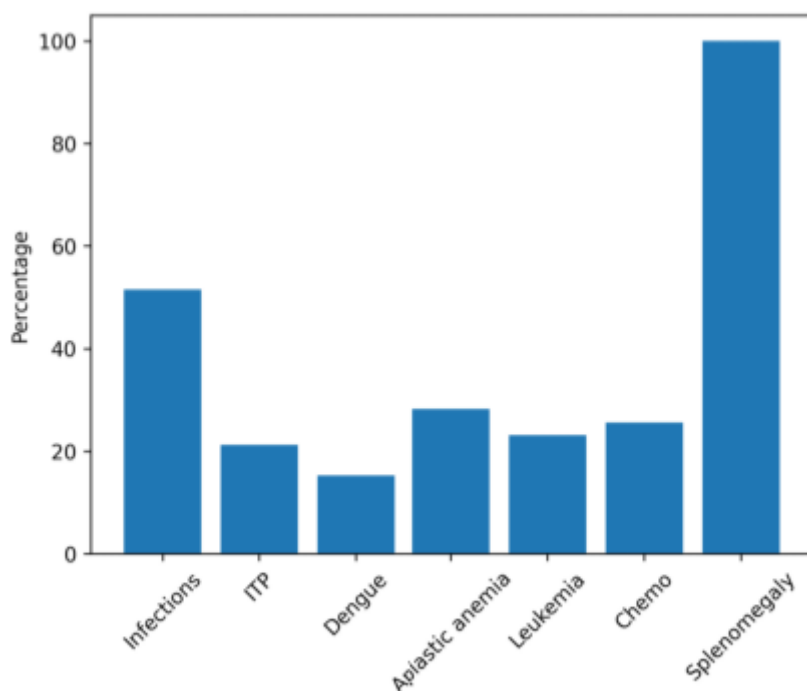


Figure 4. Causes Of Thrombocytopenia

The Predominance Of Infectious Causes Highlights The Significant Burden Of Infection-Related Thrombocytopenia In Tertiary Care Settings.

Correlation Between Platelet Count And Mpv

An Inverse Relationship Between Platelet Count And Mpv Was Observed In Hyperdestructive Thrombocytopenia, With Lower Platelet Counts Associated With Higher Mpv Values. This Finding Supports The Compensatory Bone Marrow Response Hypothesis.

DISCUSSION

The Present Study Evaluated The Role Of Mean Platelet Volume (Mpv) In Differentiating The Etiology Of Thrombocytopenia And Demonstrated Its Usefulness As A Simple, Non-Invasive Hematological Parameter. Among The 226 Cases Included, The Majority Belonged To The Hyperdestructive Category (58.4%), Followed By Hypoproliferative Thrombocytopenia (34.5%) And Abnormal Pooling (7.1%). These Findings Highlight The Predominance Of Peripheral Platelet Destruction As The Principal Mechanism Of Thrombocytopenia In Tertiary Care Settings.

Demographic Profile And Etiological Pattern

In The Present Study, The Highest Incidence Of Thrombocytopenia Was Observed In The 18–30 Years Age Group, With A Slight Male Predominance. Similar Demographic Patterns Have Been Reported In Several Indian Studies, Where Younger Individuals Were More Frequently Affected Due To Higher Exposure To Infectious Etiologies Such As Dengue, Viral Fevers, And Septicemia (6,7). This Observation Supports The Concept That Infectious Diseases Remain A Major Contributor To Thrombocytopenia In Developing Countries.

Hyperdestructive Thrombocytopenia Constituted The Majority Of Cases In The Present Study, Which Is Consistent With The Findings Of Borkatky Et Al. And Khanna Et Al., Who Also Reported A Higher Prevalence Of Peripheral Destruction Mechanisms Compared To Marrow Failure States (6,7). The Predominance Of Infections Within The Hyperdestructive Category Further Emphasizes The Significant Role Of Infectious Diseases In The Pathogenesis Of Thrombocytopenia.

Mean Platelet Volume And Etiological Differentiation

The Most Important Finding Of The Present Study Was The Significant Variation In Mpv Values Across Different Etiological Groups. The Mean Mpv Was Highest In Hyperdestructive Thrombocytopenia (10.95 ± 1.12 Fl), Significantly Higher Than In Hypoproliferative (8.58 ± 0.94 Fl) And Pooling Groups (8.20 ± 0.88 Fl). These Findings Are In Agreement With Previous Studies That Have Consistently Demonstrated Elevated Mpv Values In Peripheral Destruction States (8–10).

The Higher Mpv Observed In Hyperdestructive Thrombocytopenia Reflects Increased Bone Marrow Activity And The Release Of Larger, Younger Platelets Into Circulation. Larger Platelets Are Metabolically More Active, Contain Higher Rna Content, And Possess Greater Hemostatic Activity, Indicating Increased Platelet Turnover (2,3). This Compensatory Marrow Response Occurs In Conditions Such As Immune Thrombocytopenic Purpura (Itp), Infections, And Disseminated Intravascular Coagulation (4).

Conversely, Lower Mpv Values In Hypoproductive Thrombocytopenia Indicate Impaired Megakaryopoiesis And Reduced Platelet Production, As Seen In Aplastic Anemia, Leukemia, And Chemotherapy-Induced Marrow Suppression (5). These Observations Support The Concept That Mpv Serves As An Indirect Marker Of Bone Marrow Activity.

Correlation Between Platelet Count And Mpv

An Inverse Relationship Between Platelet Count And Mpv Was Observed In Hyperdestructive Thrombocytopenia In The Present Study. Similar Findings Have Been Reported By Levin And Bessman, Who Demonstrated That Mpv Increases As Platelet Count Decreases Due To Compensatory Release Of Larger Platelets From The Bone Marrow (3).

This Inverse Relationship Provides Further Evidence That Mpv Reflects Platelet Turnover Dynamics And Can Help Clinicians Differentiate Between Increased Destruction And Decreased Production Mechanisms.

Comparison With Previous Studies

The Findings Of The Present Study Were Comparable With Several Earlier Studies Evaluating Mpv In Thrombocytopenia.

Table 4. Comparison With Previous Studies

Study	Year	Hyperdestructive Mpv	Hypoproductive Mpv
Borkatky Et Al.	2009	10.8	8.4
Khanna Et Al.	2013	11.1	8.6
Khairkar Et Al.	2016	10.9	8.7
Bhat Al.	2020	11.0	8.5
Present Study	2025	10.95	8.58

The Consistency Of Mpv Values Across Multiple Studies Strengthens The Reliability Of Mpv As A Diagnostic Marker For Etiological Categorization Of Thrombocytopenia.

Pathophysiological Basis Of Mpv Changes

The Variations In Mpv Observed In Different Types Of Thrombocytopenia Can Be Explained By Underlying Pathophysiological Mechanisms. In Hyperdestructive Thrombocytopenia, Peripheral Platelet Destruction Stimulates Increased Megakaryocyte Activity, Leading To The Release Of Larger, Immature Platelets Into Circulation (1,2).

In Contrast, Hypoproductive Thrombocytopenia Results From Reduced Megakaryocyte Production Or Maturation Failure, Leading To Smaller Platelets And Lower Mpv Values (5).

Clinical Implications

The Findings Of The Present Study Highlight Important Clinical Implications. Mpv Is A Readily Available Parameter Included In Routine Complete Blood Count Reports And Does Not Require Additional Testing Or Cost. It Can Serve As A Rapid Screening Tool To Differentiate Between Hypoproductive And Hyperdestructive Thrombocytopenia, Especially In Emergency Settings (11).

Early Identification Of Hyperdestructive Thrombocytopenia Using Mpv May Reduce Unnecessary Bone Marrow Examinations, Thereby Minimizing Patient Discomfort And Healthcare Costs. Furthermore, Mpv Can Help Guide Clinical Decision-Making And Facilitate Timely Initiation Of Appropriate Treatment Strategies.

Limitations Of The Study

The Present Study Had Certain Limitations. It Was Conducted In A Single Tertiary Care Center, Which May Limit Generalizability. Additionally, Mpv Values Can Vary Depending On Analyzer Type And Pre-Analytical Factors Such As Sample Handling And Timing Of Analysis (11). Serial Mpv Monitoring Was Not Performed, Which Could Have Provided Additional Insights Into Disease Progression.

CONCLUSION

The Present Study Demonstrates That Mean Platelet Volume (Mpv) Is A Valuable, Simple, And Cost-Effective Hematological Parameter For Differentiating The Etiology Of Thrombocytopenia. A Significantly Higher Mpv Observed In Hyperdestructive Thrombocytopenia Reflects Increased Bone Marrow Activity And Compensatory Release Of Larger,

Younger Platelets In Response To Peripheral Destruction. In Contrast, Lower Mpv Values In Hypoproductive Thrombocytopenia Indicate Impaired Megakaryopoiesis And Reduced Platelet Production.

The Study Also Establishes An Inverse Relationship Between Platelet Count And Mpv, Further Supporting Its Role As An Indirect Marker Of Platelet Turnover Dynamics. Hyperdestructive Thrombocytopenia, Predominantly Caused By Infections And Immune-Mediated Mechanisms, Constituted The Majority Of Cases In The Present Study, Highlighting The Clinical Relevance Of Mpv In Routine Diagnostic Practice.

As Mpv Is Readily Available As Part Of Routine Complete Blood Count Reports, It Can Serve As A Rapid Screening Tool In Both Outpatient And Emergency Settings. Its Use Can Assist Clinicians In Early Etiological Categorization Of Thrombocytopenia, Thereby Reducing The Need For Invasive Bone Marrow Examination In Selected Cases. Incorporating Mpv Into Routine Clinical Interpretation May Facilitate Timely Diagnosis, Guide Appropriate Management Strategies, And Improve Patient Outcomes.

However, Mpv Values May Vary Depending On Analyzer Type And Pre-Analytical Factors Such As Sample Handling And Timing Of Analysis. Therefore, Mpv Should Always Be Interpreted In Conjunction With Platelet Count, Peripheral Smear Findings, And Clinical Correlation.

Further Large-Scale, Multicentric Studies With Serial Monitoring Of Platelet Indices Are Recommended To Validate Standardized Mpv Cut-Off Values And To Explore Its Prognostic Significance In Various Thrombocytopenic Disorders.

Conflict Of Interest

The Authors Declare **No Conflict Of Interest.**

Ethical Clearance

Ethical Approval Was Obtained From The **Institutional Ethics Committee, S.V. Medical College** (Lr.No.: 37/2025)

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