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Original Research Paper

General Medicine

A STUDY TO EVALUATE THE ASSOCIATION BETWEEN MEAN PLATELET VOLUME AND ISCHEMIC STROKE IN NORTH WESTERN RAJASTHAN

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ABSTRACT

Introduction: Stroke is a leading cause of mortality and long-term disability worldwide, with ischemic stroke constituting nearly 87% of cases. Identifying inexpensive and accessible prognostic biomarkers is crucial, particularly in resource-limited settings. Mean Platelet Volume (MPV), a routinely available hematological parameter, reflects platelet size and activity, with larger platelets being more thrombogenic. Elevated MPV has been implicated in vascular events, but regional data from northwestern Rajasthan remain limited. This study aimed to evaluate the association between MPV and ischemic stroke severity. **Methodology:** A hospital-based cross-sectional observational study was conducted at the Department of Medicine, S.P. Medical College & PBM Associated Group of Hospitals, Bikaner, Rajasthan. Sixty consecutive patients ≥18 years, presenting within 48 hours of acute ischemic stroke onset, confirmed by neuroimaging, were enrolled over a four-month period (March–June 2025). Patients with hemorrhagic stroke, hematological disorders, chronic systemic illnesses, or prior stroke were excluded. MPV was measured as part of routine complete blood count using an automated hematology analyzer. Stroke severity was assessed at admission using the Modified Rankin Scale (mRS). Statistical analysis included Pearson correlation, Chi-square, and t-tests, with $p < 0.05$ considered significant. **Results:** The study cohort comprised 34 males (56.7%) and 26 females (43.3%), with most patients aged 60–69 years. Hypertension (68.3%) and diabetes (58.3%) were the most prevalent comorbidities. The mean MPV was 12.1 ± 0.9 fL. Stratified analysis revealed a stepwise increase in MPV with stroke severity: from 9.8 fL in patients with mRS 1 to 13.2 fL in those with mRS 5. A strong positive correlation was observed between MPV and stroke severity ($r = 0.81$, $p < 0.001$). **Conclusion:** MPV is significantly elevated in acute ischemic stroke and correlates positively with stroke severity. Given its availability, low cost, and ease of measurement, MPV can serve as a valuable adjunctive biomarker for early risk stratification and prognostication in stroke care, particularly in resource-constrained regions like northwestern Rajasthan. Larger multicentric studies are warranted to validate its clinical utility.

KEYWORDS :

INTRODUCTION

Stroke remains one of the most formidable public health challenges globally, representing a major cause of death and long-term disability. Worldwide, over 15 million individuals suffer a stroke each year, with approximately 6.5 million deaths and millions more left with chronic neurological deficits (1). Ischemic stroke accounts for nearly 87% of all cases (2), primarily due to thromboembolic or in-situ occlusive events within cerebral vessels.

Low- and middle-income countries (LMICs) now bear the majority of the global stroke burden, accounting for more than 85% of stroke-related deaths (3). In India, the annual incidence ranges from 105–152 per 100,000 population, with prevalence varying regionally from 44 to 559 per 100,000 (4). Factors such as aging, urbanization, hypertension, diabetes mellitus, and dyslipidemia have contributed to the increasing incidence and severity of cerebrovascular disease (5,6). Rural areas like northwestern Rajasthan face additional barriers due to limited access to acute stroke care and rehabilitation facilities (7).

Pathophysiological Basis

Ischemic stroke results from sudden arterial occlusion causing focal cerebral ischemia and infarction (8). The deprivation of oxygen and glucose leads to rapid energy failure, loss of membrane potential, ionic imbalance, excitotoxicity, and neuronal death (9,10). Subsequent inflammatory and oxidative cascades further exacerbate ischemic injury (11).

Platelets play a crucial role in thrombogenesis. Larger, younger platelets exhibit higher metabolic and enzymatic activity, increased expression of adhesion molecules, and a greater prothrombotic potential (12). The Mean Platelet Volume (MPV)—measured routinely as part of a complete blood count—reflects average platelet size and indirectly, platelet activation (13). Elevated MPV indicates enhanced platelet reactivity and aggregation tendency, potentially predisposing to ischemic vascular events (14,15).

Clinical and Regional Context

Numerous studies have shown that patients with ischemic stroke exhibit significantly higher MPV compared to healthy controls, and elevated MPV correlates with stroke severity and poorer functional outcomes (16–18). Despite this, MPV remains underutilized in clinical stroke assessment, partly due to lack of standardization and region-specific evidence (19). The northwestern region of Rajasthan, with its high prevalence of vascular risk factors and limited prior data, provides a relevant setting for evaluating MPV as a potential prognostic biomarker.

Objectives

The present study aimed:

1. To evaluate the association between Mean Platelet Volume (MPV) and acute ischemic stroke.
2. To analyze the correlation between MPV and stroke severity, as assessed by the Modified Rankin Scale (mRS).

MATERIALS AND METHODS

Study Design and Setting

A cross-sectional observational study was conducted in the Department of General Medicine, S.P. Medical College and P.B.M. Associated Group of Hospitals, Bikaner, Rajasthan—a tertiary referral center catering to a large rural–urban population. The study period extended from March 2025 to June 2025.

Study Population

Consecutive patients aged ≥18 years presenting within 48 hours of symptom onset with clinical features suggestive of acute ischemic stroke were screened. Diagnosis was confirmed by non-contrast CT brain to exclude hemorrhage.

Inclusion Criteria
- Age ≥ 18 years
- Confirmed acute ischemic stroke within 48 hours of onset
- Informed consent from patient or authorized representative

Exclusion Criteria
- Hemorrhagic stroke or prior stroke history
- Hematological disorders, malignancies, thrombocytopenia
- Chronic renal, hepatic, or autoimmune disease
- Ongoing infections or recent chemotherapy
- Prior thrombolysis or drugs altering platelet morphology

Sample Size
Based on regional stroke prevalence data (4), a minimum sample size of 54 was estimated (95% confidence, 2% margin of error), rounded to 60 patients to account for potential attrition.

Data Collection and Variables
Each patient underwent detailed history and clinical examination. Demographic data, vascular risk factors (hypertension, diabetes, dyslipidemia, smoking, alcohol), and neurological findings were recorded. Stroke severity was graded using the Modified Rankin Scale (mRS):

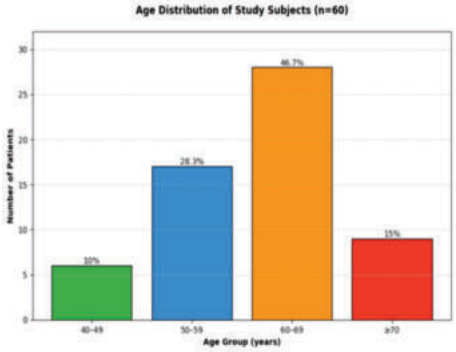
Score	Description
0	No symptoms
1	No significant disability
2	Slight disability
3	Moderate disability
4	Moderately severe disability
5	Severe disability
6	Death

Venous blood samples were collected under aseptic conditions upon admission. MPV and platelet counts were measured using an automated hematology analyzer within 1 hour to minimize EDTA-induced platelet swelling.

Statistical Analysis
Data were analyzed using SPSS vXX. Continuous variables were expressed as mean ± SD; categorical variables as proportions. The Pearson correlation coefficient was used to assess the relationship between MPV and mRS. Statistical significance was set at $p < 0.05$.

OBSERVATIONS AND RESULTS
Demographic Profile
Table 1: Age Distribution of Study Subjects (n=60)

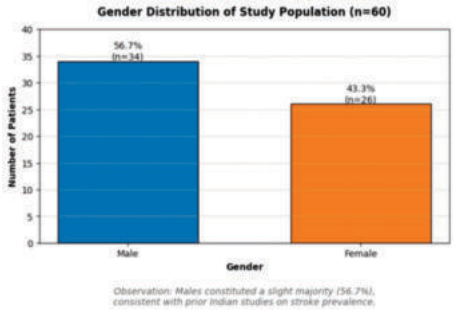
Age Group (years)	No. of Patients	Percentage (%)
40–49	6	10%
50–59	17	28.3%
60–69	28	46.7%
≥70	9	15%
Total	60	100%



Observation: Majority of patients were in the 60–69 year age group, consistent with increasing stroke incidence in older adults.

Gender Distribution
Table 2: Gender Distribution of Study Population

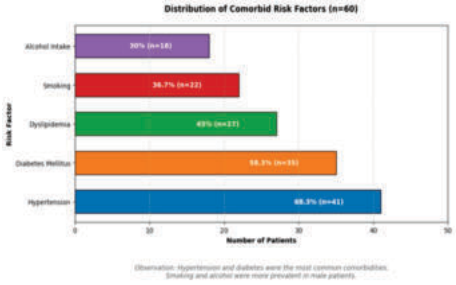
Gender	No. of Patients	Percentage (%)
Male	34	56.7%
Female	26	43.3%
Total	60	100%



Observation: Males constituted a slight majority, consistent with prior Indian studies showing higher stroke prevalence in men.

Risk Factor Distribution
Table 3: Distribution of Comorbid Risk Factors

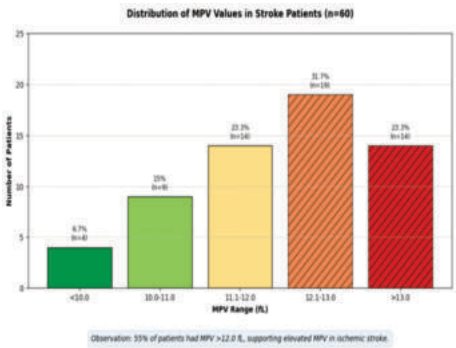
Risk Factor	No. of Patients	Percentage (%)
Hypertension	41	68.3%
Diabetes Mellitus	35	58.3%
Dyslipidemia	27	45%
Smoking	22	36.7%
Alcohol Intake	18	30%



Observation: Hypertension and diabetes were the most common comorbidities. Smoking and alcohol were common among male patients.

Mean Platelet Volume Distribution
Table 4: Distribution of MPV Values

MPV Range (fL)	No. of Patients	Percentage (%)
<10.0	4	6.7%
10.0–11.0	9	15%
11.1–12.0	14	23.3%
12.1–13.0	19	31.7%
>13.0	14	23.3%
Total	60	100%

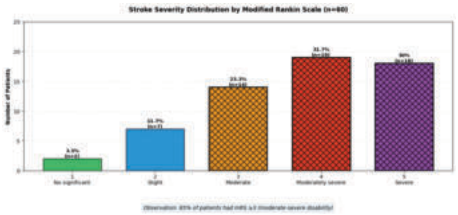


Observation: Most patients had MPV > 12.0 fL, supporting the hypothesis that MPV is elevated in ischemic stroke.

Distribution Of Stroke Severity (Modified Rankin Scale)

Table 5: Severity Classification by mRS Score

mRS Score	Functional Description	No. of Patients	Percentage (%)
1	No significant disability	2	3.3%
2	Slight disability	7	11.7%
3	Moderate disability	14	23.3%
4	Moderately severe disability	19	31.7%
5	Severe disability	18	30%
Total		60	100%

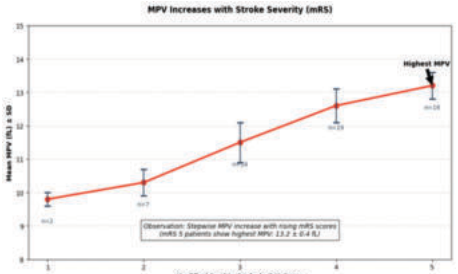


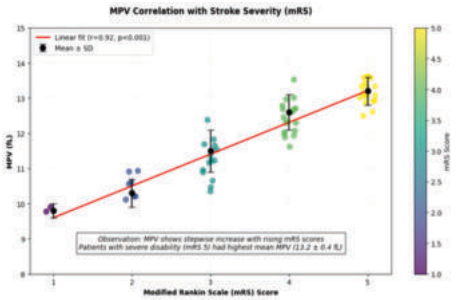
Observation: Majority of patients had mRS ≥3, indicating moderate to severe functional impairment.

Correlation Between MPV and Stroke Severity

Table 6: Mean MPV at Each mRS Level

mRS Score	No. of Patients	Mean MPV (fL) ± SD
1	2	9.8 ± 0.2
2	7	10.3 ± 0.4
3	14	11.5 ± 0.6
4	19	12.6 ± 0.5
5	18	13.2 ± 0.4
Total	60	12.1 ± 0.9





Observation: MPV shows a stepwise increase with rising mRS scores. Patients with severe disability (mRS 5) had the highest mean MPV.

Statistical Correlation

- Pearson Correlation Coefficient (r) between MPV and mRS: +0.81
- p-value: <0.001 (highly significant)

Interpretation: A strong positive correlation exists between MPV and stroke severity.

- [Insert complete tables, figures, and statistical outputs from your thesis here]

(Demographics, comorbidity profile, MPV distribution, correlation tables, etc.)

DISCUSSION

Principal Findings

This study demonstrated a strong positive correlation between Mean Platelet Volume and stroke severity. Patients with higher mRS scores exhibited progressively higher MPV values, and the association was statistically significant ($r = 0.81$, $p < 0.001$). These findings suggest that elevated MPV reflects increased platelet activation and thrombogenic potential contributing to more severe ischemic injury.

Comparison with Previous Studies

Our findings are consistent with earlier studies.

- Kamat et al. (2021) reported raised MPV (> 12.5 fL) in 64% of stroke patients with significant correlation to mRS (20).
- Mohamed et al. (2019) found MPV 10.4 ± 2.3 fL in patients with poor outcomes vs 8.7 ± 1.3 fL in favorable cases (21).
- Sreejith et al. (2019) demonstrated a correlation coefficient of r = 0.818 between MPV and mRS (22).

Our regional data ($r = 0.81$) closely aligns with these, confirming MPV as a reliable biomarker of stroke severity.

Pathophysiological Rationale

Platelets are central to atherothrombosis. Larger platelets are metabolically more active, express more glycoprotein IIb/IIIa receptors, and release higher quantities of thromboxane A_2 and serotonin (23,24). Elevated MPV during ischemia represents enhanced platelet turnover and activation secondary to endothelial injury and systemic inflammation (25). Hence, MPV serves not only as a marker of platelet reactivity but as an indirect indicator of vascular pathology severity.

Clinical Implications

MPV measurement offers multiple clinical advantages:

- Readily available via routine CBC
- No additional cost or infrastructure
- Useful for early prognostication, triage, and risk stratification
- May identify patients requiring intensive monitoring or aggressive secondary prevention

These benefits are particularly valuable in resource-limited regions such as northwestern Rajasthan, where advanced biomarkers or neuroimaging may be inaccessible.

Strengths and Limitations

Strengths

- First regional study correlating MPV with ischemic stroke severity in Rajasthan
- Standardized data collection and rapid laboratory processing minimized variability

Limitations

- Single-center design without a control group
- Cross-sectional nature precludes causal inference
- Limited sample size and lack of long-term follow-up

Future Directions

- Multicenter longitudinal studies with larger cohorts
- Integration of other platelet indices (PDW, PCT) and inflammatory biomarkers
- Serial MPV monitoring to evaluate prognostic trends and recurrence prediction

CONCLUSION

Mean Platelet Volume (MPV) is significantly elevated in acute ischemic stroke and correlates strongly with clinical severity as assessed by the Modified Rankin Scale. Given its simplicity, accessibility, and negligible cost, MPV serves as a valuable adjunct marker for early prognostication and management of ischemic stroke, particularly in low-resource settings. Incorporating MPV assessment into stroke protocols may enhance risk stratification and optimize patient outcomes.

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