

## Original Article

## Mean Platelet Volume as a Predictor of Severity of Acute Ischaemic Stroke Using Modified Rankin Score

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### Abstract

**Objective:** To determine the association of mean platelet volume in terms of predictor of severity of acute ischemic stroke using Modified Rankin Score (MRS).

**Methods:** From July 2019 to June 2021, this observational study was carried out at the Mayo Hospital Lahore's Departments of Medicine and Emergency. 225 patients in total were chosen utilizing the non-probability convenient sampling technique. Patients were divided into 2 groups according to their MRS scores (Group A: score 0 to 2, Group B: score 3 or higher). Blood samples were taken in order to test MPV. The MRS was used to determine the severity of an ischemic stroke.

**Results:** Out of 225 patients, 108 were assigned to Group A (MRS 0–2) and 117 to Group B (MRS 3 or higher). The mean±SD of MPV in Group B was 8.55 0.67, while it was 8.37 0.65 in Group A, which was statistically noteworthy ( $p=0.004$ ). The effect of MPV on ischemic stroke was still statistically significant (OR: 1.579,  $p=0.3$ ) after risk profiles linked to ischemic stroke were taken into account in the multivariate logistic regression model. The MPV had a significant discriminative value for predicting severe ischemic stroke based on  $MRS \geq 3$  from a mild stroke incidence ( $MRS < 3$ ), as evidenced by the area under the ROC curve of 0.592 (95% CI: 0.43-0.6).

**Conclusion:** Mean Platelet volume can be a useful preliminary indicator which can be utilized in primary acute ischemic stroke patients as a marker of severity using Modified Rankin Score.

**Keywords:** Mean Platelet Volume, acute ischemic stroke, Modified Rankin Score.

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### Introduction

After cardiovascular illnesses and cancer, stroke is the third most frequent cause of mortality in developing nations.<sup>1</sup> It is also the second most common cause of dementia. A neurological deficiency brought on by a cerebro-vascular cause that lasts more than 24 hours is referred to be a stroke.<sup>2</sup> It may either be ischemic or hemorrhagic and ischemic stroke accounts for 80% of cases.

Stroke incidence has increased during the past three decades in South Asian nations, while it has decreased in western regions.<sup>3</sup> Nearly 3.5 million new stroke patients are diagnosed annually in Pakistan, where the incidence of stroke is close to 250 per 100,000 people.<sup>4</sup> Males are at higher risk for developing stroke than females. Stroke can occur in any age group but the incidence grows exponentially with increasing age.<sup>5</sup>

Bone marrow is the site of production of blood cells. Among three major types of blood cells, platelets are the smallest. Platelets are small (1-4µm in diameter), discoid non nucleated structures, arising from the fragmentation of mega karyocytes. Its major function is to maintain hemostasis.<sup>6</sup>

Mean platelet volume (MPV), a measure with a normal range of 7.5-11.5 fL, is estimated and supplied by automatic blood cell count equipment during regular blood examination. Larger platelets are physiologically more active, create more thrombotic factors, and aggregate more readily since MPV is a measure of platelet function.<sup>7</sup>

Moreover, they have more dense granules and release more beta thromboglobulin and serotonin<sup>8</sup>. Larger platelets release more thromboxane A2 and exhibit stronger aggregation to adenosine diphosphate, collagen, or adrenaline. Consequently, platelets are crucial to the pathophysiology of ischemia events.<sup>7-9</sup>

The MPV is particularly helpful in a variety of clinical circumstances and can be utilized to track changes in the intensity of platelet stimulation and the speed at which it functions. Because enhanced platelet production in vascular illnesses is linked to disease severity and progression, MPV has broader clinical uses in the identification and management of various conditions. High MPV has been linked to increased platelet reactivity and aggregation, and can consequently play a significant role in hemostasis.<sup>6,7,9</sup>

In a study by Mohamed AA et al., it was discovered that worse clinical outcomes were associated with acute ischemic stroke patients with higher mean platelet volumes that were assessed soon after the beginning of symptoms.<sup>10</sup> The severity of an ischemic stroke was shown to be correlated with an increased mean platelet volume in a different investigation by Zheng YY et al.<sup>11</sup>

Different acute phase reactant increases in acute ischemic stroke other than MVP including CRP, ferritin, fibrinogen, and ESR. Among them Mean platelet volume is simple, readily available test in our emergency setting.

In various papers, the connection between MPV and ischemic stroke has been comprehensively investigated. Prior research had established a link between elevated platelet activation and cerebral infarction, but more recent investigations have produced conflicting findings regarding the link between MPV and stroke.<sup>11</sup>

MPV as a cheap and reliable prognostic marker in acute ischemic stroke has been demonstrated in few studies internationally but very little data is available in Pakistan. So, if this correlation is established between the two it would be very beneficial to the clinicians for further evaluation and long term management of the stroke patients.

Our research was conducted to determine the relationship between mean platelet volume and the severity of an new onset ischemic stroke.

## Methods

It was an observational study conducted in Department of medicine and Emergency department of Mayo Hospital Lahore from July 2018 to June 2021. A total of 225 patient were selected by using Non probability convenient sampling technique. Ethical approval was taken from Institutional Review Board (IRB) King Edward Medical University.

Patients aged 18 and onward, of either gender, who presented with acute ischemic stroke for the first time were included. Patients having hemorrhagic stroke, transient Ischemic Attack, Head Trauma, History of Previous Stroke, Cerebral infection like meningitis or meningoencephalitis, Brain space-occupying lesion (SOL), pregnant and lactating mothers, previous history

of Ischemic Heart Disease (IHD) and patients using drugs like Antiplatelet (e.g. Aspirin or Clopidogrel) Anticoagulants, Cytotoxic drugs were excluded.

According to clinical definitions, a stroke is a localized neurological impairment with an abrupt onset that lasts more than 24 hours or results in death and has no obvious nonvascular cause. Using the modified rankin score (MRS), the clinical severity at the time of presentation was determined. MRS is a tool for assessing the level of dependency or disability in daily activities in people who have experienced a stroke or other neurological disability. The range is 0 to 6, with 0 meaning no symptoms, 1 meaning no severe handicap and the capacity to perform all daily activities despite some symptoms. 2- Moderate disability, competent to manage affairs independently but unable to perform all previous activities, 3-Moderate impairment, needs some assistance, but can walk by themselves, 4-Moderately severe disability; unable to care for one's own physical requirements without help; unable to walk independently, a severe handicap. 5-Bedridden, incontinent, and needing regular nursing care and attention; 6 is dead.

All 225 patients presented in the department of Medicine and Emergency Department, Mayo Hospital Lahore and fulfilling the inclusion criteria were enrolled in the research after obtaining a informed consent. The detail history of patient including medical history, history of previous ischemic heart disease or prior stroke, and medications were obtained. Blood sample for MPV were taken following standard laboratory protocol within 24 hours of presentation. Then patients were treated accordingly and on the 7th day severity of stroke was assessed using modified rankin scale. Patients were divided into 2 groups i.e. group A with MRS score of 0-2 and group B with score of 3 or more. Values of MPV were compared in both groups.

The data was analyzed in the SPSS 26. Qualitative variables like age and sex were expressed in the form of frequency. Quantitative variable MPV was expressed in the form of mean. The association between different groups of MRS and MPV was compared using Chi Square. The study's conclusions were drawn in accordance with the inferences that were deemed significant by the study's p value of <0.05.

## Results

The study comprised 225 patients who had their first ischemic stroke, with a mean age of 64±10.4 years, and a range of 40-90 years old (131 men and 94 women). Of these, 117 participants were classified as having a poor stroke outcome (Group B, Rankin score 3), while the other 108 had a lower outcome score (Group A). Table 1 displays the two groups' demographic traits and baseline variables. Higher Rankin scale patients were older and

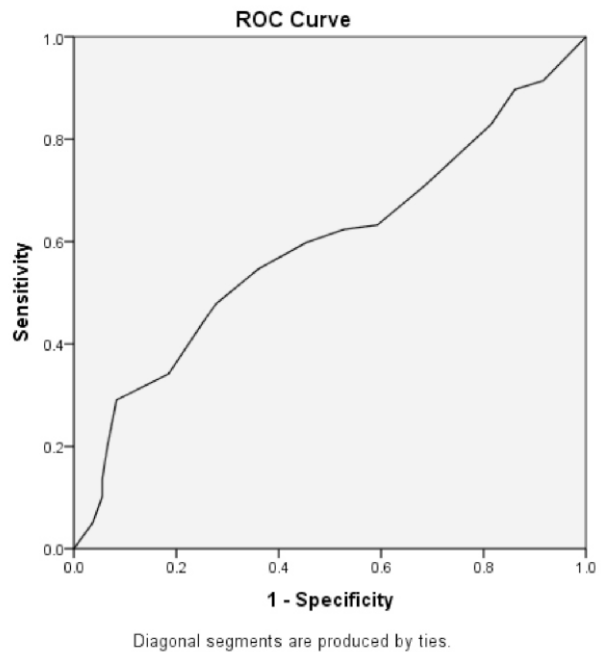
more likely to have experienced ischemic heart disease in the past.

The (mean±SD) MPV differed statistically (p=0.004) between the patients with lower scores (Group A: 8.370.65) and those with higher Rankin scores (Group B: 8.550.67). In Table 2, the distribution of MPV is shown.

The impact of MPV on acute stroke stayed statistically substantial (OR: 1.579, p=0.3) even if risk profiles linked to ischemic stroke were taken into account in the multivariate logistic regression model (Table 3).

The MPV had a significant discriminative value for predicting severe ischemic stroke based on MRS ≥ 3 from a mild stroke incidence (MRS < 3), as evidenced by the area under the ROC curve of 0.592 (95% CI: 0.43-0.6). (Figure 1).

**Figure 1:** Mean platelet volume's sensitivity and specificity in predicting the severity of ischemic stroke.



Standard error: 0.038, area under the curve: 0.592.

**Table 1:** Using the Modified Rankin Score (MRS), Baseline Traits and Clinical Information Categorized according to the Severity of Stroke.

	MRS Group A (n=108)	MRS Group B (n = 117)	P-value
Male, n (%)	61 (56.4%)	70(59.8%)	0.05
Female, n (%)	47(43.5%)	47(35%)	0.08
Age years (Mean ± SD)	64 ± 10.4	64±10.1	0.002
Albumin g/dL (Mean ± SD)	3.68 +0.31	3.57 +0.34	0.001
Mean Platelet Volume (MPV)	8.37±0.65	8.55±0.67	0.004

**Table 2:** Relationship between Mean Platelet Volume (MPV) and Stroke severity by using Modified Rankin Score (MRS)

MPV	MRS Group A	MRS Group B
<8 fL	24	24
8.1-9.0 fL	74	60
>9.0 fL	10	33

**Table 3:** Multivariate logistic regression analysis for defining the role of Mean Platelet Volume (MPV) in calculating Stroke severity

Characteristics	Regression coefficients (b)	SE	Odds Ratio	95% CI	P-value
		(b)			
Age (year)	0.089	0.034	1.09	0.021- 0.157	0.028
MPV	0.457	0.488	1.579	1.48-11.80	0.333
Constant coefficient	-6.186	2.533	--	--	0.004

**Discussion**

Studies on mean platelet volume levels in relation to inflammation and thrombosis have gained attention during the past few decades. According to recent research, stroke victims have significantly higher MPV readings. Among the most significant medical pre-conditions and stroke-related comorbidities are hypertension, diabetes mellitus, dyslipidemia, coronary artery disease, and smoking habits.<sup>12</sup> Multiple lines of research data point to a connection between MPV and these conventional cerebrovascular risk factors. In addition to being a separate predictor of coronary artery disease (CAD), a bigger infarct size in stroke with increase stroke severity, elevated MPV is viewed as an indication of healthy platelets.<sup>12,13</sup> In our study, acute ischemic stroke was associated with noticeably greater MPV.

In various papers, the connection between MPV and ischemic stroke has been comprehensively investigated. Increased platelet activation and stroke coupled with CAD have been linked in earlier studies, however more current research has shown conflicting findings about the connection between MPV and stroke.<sup>14</sup>

The development of stroke may be influenced by larger platelets, which would have a significant prognostic value. It is well recognised that platelets are essential for the change of a stable atherosclerotic plaque into an unstable one. According to studies, acute cerebral ischemia and transient ischemic episode increase platelet volume.<sup>6-10</sup>

Inconsistent findings have been found in certain research that assessed platelet volume in acute ischemic stroke. However, several studies were unable to substantiate this prognostic function for MPV. This might be as a result of the research' small patient populations and the utilisation of alternative outcomes. A rise in platelet aggregation during the acute period is also contradictory. In the present investigation, the ability of MPV to predict more severe and widespread acute ischemic brain stroke from its moderate stage was examined. Results of our study revealed that checking MPV levels at commencement of a ischemic stroke was significantly connected with the severity of the disease and could distinguish between a more serious condition and a lower degree of the disorder. In this study, people with acute ischemic stroke who had larger MPV had a worse outcome.

Kamat V. et al.<sup>15</sup> decided to investigate the relevance of mean platelet volume (MPV) as an sovereign risk factor in new onset ischemic stroke, as well as the association between MPV and outcome in patients with acute ischemic stroke. MPV upon admission was noted, and modified ranking score (MRS) was used to evaluate the severity of the stroke. Results showed an association between MPV and the severity of ischemic stroke that was statistically substantial. They conclude that MPV is an individual predictor of the risk of stroke and that it was enhanced in acute ischemic stroke. A worse prognosis and more severe stroke are associated with higher MPV. Our study came to similar conclusions.

In a study, Nayyar MW and colleagues used the mean platelet volume/platelet count (MPV/PC) ratio to evaluate the clinical severity and infarct volume of acute ischemic stroke (AIS) to control patients. According to the findings, bigger infarct size, MPV, and platelet count values were linked to raise scores on the Rankin scale. They came to the conclusion that larger infarct size and a worse prognosis are correlated with higher MPV and MPV/PC ratio values.<sup>16</sup> Findings of our study showed that elevated MPV values are present in patients of acute ischemic stroke with high modified Rankin scores which means bad prognosis.

A study on the function of MPV in the development, severity, and prognosis of ischemic stroke was conducted by Sreejith OT et al. The MPV was connected to the conventional risk factors of ischemic stroke and outcome using the modified Rankin scale (mRS). The study found

an association between MPV and carotid intima media thickness, type 2 diabetes, and hypertension that is statistically significant. In addition, there was a favourable connection between mRS and the MPV at presentation (correlation coefficient: 0.818), meaning that a higher MPV was linked to a more severe impairment.<sup>17</sup> The findings of the research above are supported by the findings of our study.

Numerous studies disclosed that mean platelet volume levels were not a trustworthy indicator of an acute ischemic stroke episode's prognosis or functional outcome.<sup>18-20</sup>

In persons with newly developed ischemic strokes, Lok U et al. investigated any potential impact of mean platelet volume on the short-term stroke prognosis and functional outcome. The functional outcome of a stroke were evaluated using the modified Rankin scores (MRS). Results showed median hospitalization ( $p=0.394$ ), and MPV levels ( $p=0.847$ ) shoeing that there were no statistically significant variations between subgroups based on MRS scores. Additionally, MPV levels did not differ across groups using MRS ( $p=0.527$ ). They got to the conclusion that MPV was not an accurate or highly correlated predictor of the prognosis or functional outcome of new onset ischemic stroke.<sup>21</sup> These findings run counter to the strong correlation we discovered in our study between MPV levels and the severity of new onset stroke.

This study has few limitations. Because the study was carried out in a single center and patient population is small, the findings cannot be generalized to the total community. Only at presentation was the stroke severity examined, and it was connected with MPV; however, the patients' functional recovery following discharge was not investigated. To extend these findings, multi-center research with a variety of demographics are require. Additionally, in vitro research is necessary to investigate strategies to control variation in platelet size and, by extension, the predisposition for ischemic episodes.

## Conclusion

Mean Platelet volume can be a useful preliminary indicator which can be utilized in primary acute ischemic stroke patients as a marker of severity using Modified Rankin Score.

**Conflict of Interest:** *None*

**Funding Source:** *None*

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