

# High mean platelet volume in patients of ischemic stroke.

Maria Islam <sup>1,\*</sup>, Syed Asim Ali shah <sup>2</sup>, Junaid -ur-Rehman <sup>3</sup>, Syed Furqan Ali Sherazi <sup>4</sup>,  
Muhammad Sohaib Azam<sup>5</sup>, Muhammad Ali Javed<sup>6</sup>

## ABSTRACT:

**Objective:** To determine the frequency of high mean platelet volume in patients presenting with ischemic stroke at POF, hospital.

**Methodology:** Included were 90 individuals with ischemic stroke who were between the ages of 40 and 70. Patients with a history of serious trauma or surgery, leukemia/lymphoma or any hematological illness, anemia, iron supplementation, vitamin B12/folate insufficiency, or using supplements containing these nutrients, as well as those with a diagnosed cancer and antiplatelet medications, were not included in the study. The institutional pathology laboratory then received a 5 ml blood sample from each patient to test their lipid profile and determine whether they had dyslipidemia.

**Results:** Mean age was  $58.36 \pm 8.36$  years. The majority of the 53 patients (58.89%) were in the 56-70 age range. The male to female ratio was 1.3:1, with 51 (56.67%) of the 90 patients being men and 39 (43.33%) being women. 49 (54.44%) of the patients in our research who presented with ischemic stroke had a high mean platelet volume.

**Conclusion:** This study found that patients who arrive with ischemic stroke frequently had large mean platelet volumes.

**Keywords:** Mean platelet volume, Ischemic stroke, MPV, High MPV.

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## Introduction:

Stroke has significant effects on both individuals and society as a whole, making it one of the main causes of long-term illness and mortality in the modern world.<sup>1</sup> According to a recent survey, 1.2% of people in Pakistan's KPK province have had a stroke.<sup>2</sup> The most frequent kind of stroke is ischemic, which happens when blood vessels in the brain or neck get blocked. Between 80 and 87 percent of strokes are ischemic. Embolism or thrombosis, which block the flow of cerebral blood vessels to a specific section of the brain, can be the cause of an ischemic stroke.<sup>3</sup> Thus, a significant contributing factor to ischemic stroke is an elevated risk of pathological thrombosis within the arteries.<sup>4</sup>

Hemorrhagic and ischemic stroke are the two main forms of stroke. "Brain, spinal cord, or retinal cell death attributable to ischemia, based on neuropathological, neuroimaging, and/or clinical evidence of permanent injury" is the definition of ischemic stroke, also referred to as central nervous system infarction. It happens across a range of clinical conditions.<sup>4</sup> varied populations may have varied distributions of pathological stroke types. According to reports, intracerebral hemorrhage (ICH) is more common in Asians, including Chinese. According to a recent comprehensive assessment, Chinese communities of European heritage had a twofold higher proportion of ischemic stroke (ICH) and a lower proportion of IS than white populations. Varia-

tions in the prevalence of risk factors (genetic and environmental) and the relationships between risk factors and various pathological types may be the causes of the disparate distribution of the primary pathological kinds of stroke.<sup>4</sup>

Mean Platelet Volume (MPV) is a physiological quantity of hemostatic significance and a measure of platelet function.<sup>5</sup> Compared to platelet count, very slight changes in MPV result in significant alterations in hemostasis.<sup>6</sup> When large platelets come into touch with substances like collagen and ADP (adenosine diphosphate), they become more reactive, create more prothrombotic factors, and aggregate more readily. Moreover, compared to smaller platelets, they have denser granules and emit higher levels of beta thromboglobulin and serotonin.<sup>7</sup> Hyperfunction of platelets can lead to vascular disease or an acute thrombotic event like an ischemic stroke. This is caused by conditions that disrupt the megakaryocyte platelet hemostatic axis (MPHA) and produce a greater number of newly generated platelets.<sup>6</sup> Acute cerebral ischemia and transient ischemic episodes have been linked to an increase in platelet volume.<sup>8</sup> Patients with acute ischemic stroke have been found to have higher MPV levels than control persons.<sup>9</sup> A research evaluating MPV in stroke patients found that 64% of ischemic stroke patients had very high MPV (>12.5fL).<sup>10</sup> The research has also documented the severity and poor prognosis of ischemic stroke patients with elevated MPV.<sup>11</sup>

Despite the fact that prior research has linked elevated MPV to cardiovascular events such as ischemic stroke. But our national literature is lacking. There is a need to test out new clinically measurable risk variables like MPV because of our population's distinct lifestyle and associated risk factors. Therefore, the purpose of this study is to ascertain the prevalence of high MPV in our population. If MPV is discovered to be high, the data will assist us in identifying the patients who are at risk earlier.

## Objective:

To determine the frequency of high mean platelet volume in patients presenting with ischemic stroke at POF, Hospital Wah Cantt.

## Methodology:

With approval from the ethical review commission, this de-

1. Post Graduate trainee; Internal Medicine, POF Hospital Wah Cantt
2. Professor of Medicine, POF Hospital Wah Cantt
3. Consultant Neurologist, POF Hospital Wah Cantt
4. House Officer, POF Hospital Wah Cantt
5. House Officer, POF Hospital Wah Cantt
6. House Officer, POF Hospital Wah Cantt

\*=corresponding author :

Email: mariaislamwmc@gmail.com

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scriptive cross-sectional study was carried out from July 2024 to December 2024 at the medical department of the POF hospital in Wah Cantt. The right sample size of 90 with a 95% confidence level, absolute precision of 0.1, and expected population proportion of 0.64.10 was calculated using the WHO sample size calculator. The study included all patients between the ages of 40 and 70 who had been diagnosed with an ischemic stroke (those who presented with stroke symptoms such as paralysis, slurred speech, and/or decreased consciousness) and who had a hypodense infarct in their brain on a CT scan within 48 hours of the onset, according to the radiologist's report. Patients with a history of major trauma or surgery, hospitalization for any infection within the previous three months, leukemia/lymphoma or any hematological disorder, anemia, iron supplementation, vitamin B12/folate deficiency, vitamin B12/folate supplementation, a diagnosed malignancy, or antiplatelet medication were excluded.

The patients were then asked for their informed agreement to participate in the trial. Patients with paralysis, speech slurring, and/or diminished consciousness who were diagnosed with an ischemic stroke based on CT scan results were chosen from the medical ward. In order to document several factors, such as name, age, gender, the occurrence of diabetes, ischemic heart disease, and hypertension, a formal history was obtained from patients or their attendants. Additionally, the patient's BMI was calculated. Within 24 hours of admission, the patients underwent a full blood count, and the MPV and report were recorded. Patients were classified as having high MPV if their MPV was greater than 12.5 fL. In contrast, patients whose MPV was less than 12.5L were classified as having normal MPV. Post-graduate resident physicians in the medical department employed a proforma to record the study's variables. The data was analyzed and interpreted using SPSS 26 software. Frequencies and percentages were used to display the qualitative characteristics, such as gender, the existence of high MPV, diabetes, hypertension, and ischemic heart disease. Age and BMI were quantitative variables that were displayed as mean ± SD. Stratification based on age, BMI, gender, presence or absence of diabetes, hypertension, and ischemic heart disease was used to regulate the effect modifiers. Following stratification, the existence of high MPV among the strata was compared using the Chi-square test; a p-value of less than 0.05 was deemed significant.

**Results:**

Mean age was 58.36 ± 8.36 years. According to Table I, the majority of the patients, 53 (58.89%), were between the ages of 56 and 70 years. The male to female ratio was 1.3:1, with 51 (56.67%) of the 90 patients being men and 39 (43.33%) being women. 2.98 kg/m<sup>2</sup> was the mean BMI. Table II displays the patient distribution by confounding variables.

Among 90 cases, 49 (54.44%) of the patients in current study having ischemic stroke had a high mean platelet volume, while in 41 (45.56%) MPV was normal or low. Table III displays the stratification of high mean platelet volume by age, BMI, gender, and whether or not diabetes, hypertension, and ischemic heart disease are present.

**Table No 1: Age distribution (n=90).**

Age (in years)	No. of Patients	%age
40-55	37	41.11
56-70	53	58.89
Total	90	100.0

**Table No 2: : Distribution of confounding variables (n=90)**

Variable		Frequency	%age
Gender	Male	51	56.67
	Female	39	43.33
BMI (kg/m <sup>2</sup> )	≤30	71	78.89
	>30	19	21.11
Diabetes mellitus	Present	44	48.89
	Absent	46	51.11
Hypertension	Present	57	63.33
	Absent	33	36.67
IHD	Present	12	13.33
	Absent	78	86.67

**Table No 3: Stratification of high mean platelet volume with respect to age, BMI, gender, presence or absence of diabetes, hypertension and ischemic heart disease.**

		Yes (n=49)	No (n=41)	P-value
Age (years)	30-50	22 (59.46%)	15 (40.54%)	0.423
	51-70	27 (50.94%)	26 (49.06%)	
Gender	Male	26 (50.98%)	25 (49.02%)	0.450
	Female	23 (58.97%)	16 (41.03%)	
BMI (kg/m <sup>2</sup> )	≤30	41 (56.34%)	30 (43.66%)	0.224
	>30	08 (42.11%)	11 (57.89%)	
DM	Present	22 (50.0%)	22 (50.0%)	0.408
	Absent	27 (58.70%)	19 (41.30%)	
HTN	Present	32 (56.14%)	25 (43.86%)	0.671
	Absent	17 (51.52%)	16 (48.48%)	
IHD	Present	04 (33.33%)	08 (66.67%)	0.115
	Absent	45 (57.69%)	33 (42.31%)	

*BMI=Body Mass Index, DM=Diabetes Mellitus, HTN=Hypertension, IHD=Ischemic Heart Disease.*

**Discussion:**

The purpose of this study is to ascertain how frequently patients who present with ischemic stroke have large mean platelet volumes. Participants in the study had a mean age of 58.36 ± 8.36 years, with ages ranging from 40 to 70. Of the 53 patients, most (58.89%) were between the ages of 56 and 70. Of the 90 patients, 39 (43.33%) were women and 51 (56.67%) were men, resulting in a male to female ratio of 1.3:1. 49 (54.44%) of the patients in our study had a high mean platelet volume when they presented with an ischemic stroke. 64% of patients with ischemic stroke had very high MPV of >12.5fL, according to one study evaluating MPV in stroke patients.<sup>10</sup> The research has also documented the severity and poor prognosis of ischemic stroke patients with elevated MPV.<sup>11</sup>

Du J et al has shown that the risk of ischemic and hemorrhagic stroke in MPV group (>13 fL) was 22.17 and 5.21

times higher compared with normal MPV group. The PLT count was positively correlated with the risk of ischemic stroke, but negatively correlated with the risk of hemorrhagic stroke. MPV and PLT count was not correlated with the prognosis of either stroke.<sup>12</sup> Choudhury Faisal Md et al has shown that after controlling the risk profiles associated with ischemic stroke by means of binary logistic regression model, the effect of MPV in ischemic stroke remained statistically significant (OR: 4.418, 95% CI 2.468-7.908,  $p=0.000$ ). ROC curve was 0.85 and standard error 0.039 (95% CI: 0.779-0.932;  $p<0.01$ ), which indicating that MPV is a good predictor of severe ischemic stroke from a mild one based on modified Rankin Score.<sup>13</sup> Zarmehri B and colleagues, in patients with elevated MPV, ischemic strokes are less prevalent than hemorrhagic strokes ( $P$ -value $<0.01$ ). The study group's incidence of stroke is 1.95 times higher than that of the control group, according to the odds ratio of 1.95.<sup>14</sup>

Sreejith OT and colleagues have demonstrated that patients with elevated MPV possess a twofold increased risk of ischemic stroke relative to the general population. The study group has a 2.3 times higher risk of stroke than the control group.<sup>15</sup> Choi et al. showed that people with high MPV were more likely to have cerebral white matter hyperintensities than the general population. This means that the study group had a 1.67-fold higher risk of having a stroke than the control group.<sup>16</sup>

Mahmood et al. also show that people with higher blood levels of MPV were more likely to have a stroke than healthy people.<sup>17</sup> Chaitanya et al. demonstrated that a high MPV correlates with stroke severity, supported by a statistically significant  $P$ -value of 0.002, indicating that MPV serves as a predictive marker for stroke.<sup>18</sup> Vivekan and Kamat et al. found that people who scored between 3 and 6 on the Modified Rankin Scale (MRS) had a greater MOV and were also more likely to have had a major stroke.<sup>19</sup> Yiqin Yao et al. and Aleksander Dbiec et al. found that people with major artery atherosclerosis stroke who had higher blood levels of MPV had worse outcomes after three months. ( $P$ -value: 0.05).<sup>20,21</sup>

However, there is another set of scholars that disagree with these findings. According to a study by Zheng et al., there is no significant relationship between cerebral infarction and MPV ( $p > 0.05$ ). Li et al.'s study and analysis of the platelet influence on the incidence of ischemic stroke found no discernible link.<sup>18</sup> Pavithran et al. did not find a direct link between high MPV and the prognosis of stroke, despite employing several blood indicators to predict the outcomes of early ischemic stroke.<sup>19</sup>

In a sub-study of the PROGRESS trial, Bath et al. tracked 3134 people for an average of 3.9 years. They evaluated the relationship between MPV and stroke risk and discovered that these patients had noticeably higher MPV.<sup>22</sup> increased MPV readings were associated with increased stroke rates in this investigation, both for ischemic stroke alone ( $p=0.01$ ) and overall ( $P$  for trend across fifths of MPV=0.01). The total correlation was strong enough that, after controlling for measurement error and the population of recruitment, every 1-fL increase in normal MPV was linked to a 12% (95% CI, 4% to 20%) higher relative risk of stroke. According to the study, MPV is a reliable indicator of stroke risk in high-risk patients. Clinical professionals who treat patients with a history of cerebrovascular disease may find that measuring MPV provides valuable prognostic information.<sup>22</sup>

Seventeen out of the 27 studies in Sadeghi et al.'s system-

atic review and meta-analysis showed that stroke patients had greater MPV than controls.<sup>6</sup> According to research by Staszewski et al., patients in the middle or upper tertiles (MPV  $>7.29$ fl) of MPV at admission are most likely to have greater infarcts at admission and have worse outcomes.<sup>23</sup>

Due to its single-center design and small patient group, the study cannot be broadly applied. In addition to not evaluating the patients' functional recovery upon discharge, the severity of the stroke was not measured at presentation and was not connected with MPV. Therefore, multicenter research including a variety of populations are required to extend these findings. Additionally, in vitro research is needed to investigate strategies to control thrombomegaly and, consequently, the risk of ischemic events.

MPV in environments similar to ours may be impacted by a number of factors that have already been identified. They have been divided into two categories: pre-analytical and analytical.

Among the analytical parameters are blood temperature, anticoagulant, and venipuncture technique. It has been suggested that EDTA itself may increase MPV and induce platelet swelling. Since thrombomegaly is time-dependent, irregularities in the interval between venipuncture and hematology analyzer analysis may potentially have an effect on MPV.<sup>24</sup> The hematology analyzer's approach, such as optical, impedance, combination, or other, is one of the analytical factors.<sup>25</sup> Other significant elements in this context include demographic characteristics. We made every effort to steer clear of many of these. Our patients' MPV was within range, but if there was a difference, including a control arm in the study could have helped to clarify it.

#### Conclusion:

According to the study's findings, patients who report with ischemic stroke frequently have high mean platelet volumes. Therefore, in order to manage patients who present with ischemic stroke and lower their morbidity, we advise that early and prompt identification of high mean platelet volume be performed.

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Authors' Contribution	
Maria Islam	Concept, Literature Search, Manuscript writing
Syed Asim Ali Shah	Oversaw the project, Concept
Junaid -ur-Rehman	Data collection, Proof reading
Syed Furqan Ali Sherazi	Data analysis, interpretation of data
Muhammad Sohaib Azam	Literature search
Muhammad Ali Javed	Validation of the data