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**Original Research Article**

# Mean Platelet Volume in Patients with Acute Ischemic Stroke: A Case Control Study

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**Abstract**

**Background:** *Cerebrovascular diseases (CVD) include some of the most common and devastating disorders. The important risk factors are hypertension, heart disease, atrial fibrillation, diabetes mellitus, cigarette smoking, and hyperlipidemia. In this context platelets play a crucial role in the pathogenesis of atherosclerotic complications, contributing to thrombus formation. Platelet size found to be elevated in individuals with hypertension and diabetes mellitus. Platelet size (mean platelet volume, MPV) is a marker and possibly determinant of platelet function.*

**Aims & Objectives:** *To determine mean platelet volume (MPV) and it's correlation with Ischemic stroke/TIA and role in severity of stroke.*

**Material and Methods:** *The study was a prospective case-control study conducted at tertiary care centre Jabalpur, including 50 cases and 50 controls.*

**Results:** *In this study MPV was found to be higher in older age group among cases and control.MPV is found to be higher in patients of Ischemic stroke as compare to controls. Comparing cases and control with respect to smoking shows significant high MPV among cases who smoke. Maximum no. cases with hypertension had MPV 9-10.9 fl. This finding is statistically significant suggesting that hypertension is associated with high MPV. Total 12 cases had MPV 11-12.9 with higher Rankin severity score (RSS).*

**Conclusion:** *Mean platelet volume (MPV) as a risk factor in cases of coronary artery disease is well known.MPV is higher in patients of acute ischemic stroke / TIA and is associated with more severe morbidity in patients with acute ischemic stroke / TIA.*

**Keywords:** *CVD- Cerebrovascular diseases, MPV -mean platelet volume, TIA- Transient ischemic attack, RSS-Rankin severity score, AIS-acute ischemic stroke.*

## Introduction

Cerebrovascular diseases include some of the most common and devastating disorders. They cause ~200,000 deaths each year in the United States and are a major cause of disability[1]. The incidence of cerebrovascular diseases increases with age and the number of strokes is projected to increase as the elderly population grows, with a doubling in stroke deaths in the United States by 2030[1]. Stroke is one of the major cause of human

morbidity and mortality. It is ranked as the sixth leading cause of disability-adjusted years (DALY; one DALY is one of the lost year of healthy life) in 1990 and is projected to rank fourth by the year 2020[2].

Several factors are known to increase the liability to stroke, the most important of these are hypertension, heart disease, atrial fibrillation, diabetes mellitus, cigarette smoking, and hyperlipidemia[3]. Platelet size is also found to be elevated in individuals with hypertension and diabetes mellitus[4], both conditions that predispose to the development of vascular disease. Since this is such a huge public health problem, other risk factors and possible preventive measures need to be identified. It is in this context that this study has Platelets play a crucial role in the pathogenesis of atherosclerotic complications, contributing to thrombus formation[5]. Platelets are a nucleate cells and are heterogeneous regarding their size, density and haemostatic potential. Platelet size (mean platelet volume, MPV) is a marker and possibly determinant of platelet function, large platelets being potentially more reactive. For example, large platelets contain more dense granules, undergo greater in vitro aggregation in response to agonists such as ADP and collagen, and release more serotonin and b-thromboglobulin (b-TG). In normal individuals the platelet count is inversely proportional to MPV; platelet mass (the product of MPV and platelet count) is a near constant. Although platelets are incapable of de novo protein synthesis they are very active metabolically and respond rapidly to vascular injury or trauma by undergoing a series of reactions (adhesion, release of granule contents, shape change and aggregation), which ultimately result in the formation of a platelet–fibrin plug. Thus there is evidence that platelet function is accentuated in acute ischaemic stroke[6].

**Aims & Objectives**

- To determine mean platelet volume (MPV) in patients of acute ischemic stroke/TIA.
- To study relation between mean platelet volume and Ischemic stroke/TIA.
- To study the effect of mean platelet volume on severity of stroke.

**Materials and Methods**

The study was a prospective study and data was collected at tertiary care centre Jabalpur. The study was carried out among fifty patients diagnosed with an acute ischemic stroke/TIA and presenting to the hospital within forty eight hours of onset of symptoms. Fifty age and sex matched controls were also recruited. The study protocol was approved by the institutional review board.

**Study Design:** A case control study.

**Methods of collection of data:** All stroke patients admitted to the hospital during study period were screened. Each patient was given a serial number and was formally included into the study as a case. Each patient was assessed and a modified Rankin's Scale assigned to them. A Blood sample was collected from cases and controls and analyzed using the automated analyzer (ABX pentra). Hypertension was defined based on JNC-7 criteria. Dyslipidemia was defined as NCEP ATP 3 guidelines.

Modified Rankin's scale used to assess clinical severity of stroke[7,8]

Score Description

0 - No symptoms at all

1 - No significant disability despite symptoms; able to carry out all usual duties and activities

2 - Slight disability; unable to carry out all previous activities, but able to look after own affair without assistance

3 - Moderate disability; requiring some help, but able to walk without assistance

4 - Moderately severe disability; unable to walk without assistance and unable to attend to own bodily needs without assistance.

5 - Severe disability; bedridden, incontinent and requiring constant nursing care and attention

6 - Dead

TOTAL (0–6).

**Observation & Results**

**Table No. 1** Gender Distribution of Cases and Controls

| Gender | Cases | % | Controls | % |
|---|---|---|---|---|
| Males | 32 | 64 | 22 | 44 |
| Females | 18 | 36 | 28 | 56 |
| **Total** | **50** | **100** | **50** | **100** |

There is no significant difference in MPV for males and females in both cases and controls. MPV was found to be higher in older age group among cases and control. MPV was lower in younger age groups among both cases and control.

**Table No. 2** Age Wise Distribution of MPV

| Age(Yrs) | 5-6.9 (%) | 7-8.9 (%) | 9-10.9 (%) | 11-12.9 (%) | Total | 5-6.9 (%) | 7-8.9 (%) | 9-10.9 (%) | 11-12.9 (%) | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| 30-39 | 1 (12.5) | 2 (25) | 2 (25) | 3 (37.5) | 8 | 5 (55.5) | 4 (44.4) | -- | -- | 9 |
| 40-49 | -- | 2 (18.1) | 7 (63.6) | 2 (18.1) | 11 | 3 (25) | 7 (58.3) | 2 (16.6) | -- | 12 |
| 50-59 | -- | 2 (20) | 5 (50) | 3 (30) | 10 | -- | 12 (92.3) | 1 (7.69) | -- | 13 |
| 60-69 | -- | 3 (17.6) | 10 (58.8) | 4 (23.5) | 17 | -- | 3 (3.55) | 5 (62.5) | -- | 8 |
| 70-79 | -- | -- | 3 (100) | -- | 3 | -- | 2 (25) | 4 (50) | 2 (25) | 8 |
| 80-89 | -- | -- | 1 (100) | -- | 1 | -- | -- | -- | -- | -- |
| Total | **1** | **9** | **28** | **12** | **50** | **8** | **28** | **12** | **2** | **50** |

In our study the maximum number of cases in this study were in the age group between 60-69 which was followed by age group of 40-49.64% of the cases and controls recruited were males and 36% were females.

**Table No. 3** MPV (Case Vs Controls)

| MPV | Cases | % | Control | % |
|---|---|---|---|---|
| 6-6.9fl | 1 | 2 | 8 | 16 |
| 7-7.9fl | 1 | 2 | 13 | 26 |
| 8-8.9fl | 8 | 16 | **15** | 30 |
| 9-9.9fl | 12 | 24 | 7 | 14 |
| 10-10.9fl | 16 | 32 | 5 | 10 |
| 11-11.9fl | 9 | 18 | 2 | 4 |
| 12-12.9fl | 3 | 6 | 0 | 0 |
| **TOTAL** | **50** | | **50** | |

Most No. of cases (56%) have MPV in the range 9-10.9 fl, Most No. of controls (56%) have MPV in the range of 7-8.9 fl.

MPV is found to be higher in patients of Ischemic stroke as compare to controls. In both groups maximum platelets count is in the same range i.e 2-2.99 lacs/Cmm.

**Table No 4** Risk Factors Assessment

| | Cases | % | Controls | % |
|---|---|---|---|---|
| Smokers | 12 | 24 | 7 | 14 |
| Hypertension | 28 | 56 | 8 | 16 |
| Dyslipidemia | 18 | 36 | 4 | 8 |

**Table No. 5** Risk factor Distribution of MPV

| | CASES (MPV) | | | | | CONTROLS (MPV) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| MPV | 5-6.9 (%) | 7-8.9 (%) | 9-10.9 (%) | 11-12.9 (%) | Total | 5-6.9 (%) | 7-8.9 (%) | 9-10.9 (%) | 11-12.9 (%) | Total |
| Smokers | 1 (8.3) | 4 (33.3) | 3 (25) | 4 (33.3) | 12 | 4 (50) | 2 (25) | 2 (25) | -- | 8 |
| Hypertension | -- | 5 (35.7) | 6 (42.8) | 3 (21.4) | 14 | 3 (33.3) | 3 (33.3) | 2 (22.2) | 1 (11.1) | 9 |
| Dyslipidemia | -- | 3 (30) | 4 (40) | 3 (30) | 10 | -- | 2 (50) | 2 (50) | -- | 4 |

Smoking has a significant influence on MPV among cases but it is not significant among controls. Comparing cases and control with respect to smoking shows significant high MPV among cases who smoke

Maximum no. cases with hypertension had MPV 9-10.9 fl. This finding is statistically significant suggesting that hypertension is associated with high MPV. Maximum no. of cases with dyslipidemia had MPV 9-10.9 fl while maximum no. of control was this dyslipidemia also had MPV 9-10.9 fl. So this shows that dyslipidemia has no significant correlation with MPV

**Table No. – 6** MPV V/S Clinical Severity

| RANKIN SCORE | 5- 6.9 fl | 7-8.9 fl | 9-10.9 fl | 11-12.9 fl | TOTAL |
|---|---|---|---|---|---|
| SCORE 0 | -- | -- | -- | -- | |
| SCORE 1 | -- | 1(11.11%) | -- | -- | 1 |
| SCORE 2 | 1(100%) | -- | -- | 1(8.33%) | 2 |
| SCORE 3 | -- | 2(22.22%) | 5(17.85%) | 2(16.66%) | 9 |
| SCORE 4 | -- | 2(22.22%) | 9(32.14%) | 4(33.33%) | 15 |
| SCORE 5 | -- | 1(11.11%) | 13(40.62%) | 3(25%) | 17 |
| SCORE 6 | -- | 3(33.33%) | 1(3.57%) | 2(16.66%) | 6 |
| Total | 1 | 9 | 28 | 12 | 50 |

Maximum no. of cases (28) had MPV 9-10.9 fl. Among those 40.62% cases had Rankin severity score 5.Total 12 cases had MPV 11-12.9 with 33.3% cases had RSS – 4 and 25% cases had RSS – 5. This shows that the higher the MPV, the more severe the outcome in patient of stroke.

**Discussion**

Previous studies have documented various platelet abnormalities in cerebrovascular disease. eg, circulating platelet aggregates, platelet aggregation, and increased release of platelet-specific α granule proteins, thereby indicating platelet activation. Others have shown that platelet aggregation is not increased in the acute phase but occurs several days after the event. This lack of detectable activation in the acute phase has been attributed to platelet consumption during the event. However, the lack of agreement between these studies may relate to specimen handling and different methodology.

As shown in table 3, most of cases (56%) have MPV in the range 9-10.9 fl. Most of controls (56%) have MPV in the range of 7-8.9 fl. In cases, MPV for 9-10.9 is statistically significant with P value = 0.001. In controls MPV for 7-8.9 is statistically significant is P value > 0.001.This shows that MPV is found to be higher in patients of Ischemic stroke as compare to controls. This finding is similar to study of Durdu Tamer et al;[9] who found MPV higher in patients of stroke as compare to controls.

Among cases, maximum no. of cases (24%) had platelet count 2-2.49 lacs/Cmm. Among controls, maximum no. of controls (32%) had platelet count in the range of 2.5-2.99 lacs/Cmm. In both groups maximum platelets count is in the same range i.e 2-2.99 lacs/Cmm. statistically this observation is

insignificant (P > 0.99). This finding is similar to the finding of Philip Bath et al;[10] who found same platelet mass in both cases and controls.

Maximum No. of smokers in cases had MPV 11-12.9 while maximum no. of controls had MPV 5-6.9. This show that smoking has a significant influence on MPV among cases but it is not significant among controls. Comparing cases and control with respect to smoking shows significant high MPV among cases who smoke. Maximum no. cases with hypertension had MPV 9-10.9 fl while maximum no. of controls with hypertension had MPV 7-8.9. For MPV > 7 this finding is statistically significant with P = 0.02 suggesting that hypertension is associated with high MPV. This finding is similar to the study of Coban et al;[11] who also found Positive correlation between MPV and hypertension. In our study dyslipidemia has no significant correlation with MPV (P = 0.99). This study is similar to Lippi G. et al;[12] who also found no significant association between metabolic syndrome and MPV.

Our study shows that the higher the MPV, the more severe the outcome in patient of stroke (P = 0.001 for MPV > 9, fl, statistically significant). This finding is similar to the finding of Greisenegger S. et al;[13] who also found that elevated MPV was associated with worst outcome in patients of stroke.

## Conclusions

Mean platelet volume (MPV) is a marker of platelet function. Its utility as a risk factor in cases of coronary artery disease is well known. This study shows that MPV is higher in patients of acute ischemic stroke / TIA, hence, it can be regarded as an independent risk factor for ischemic stroke / TIA. Elevated mean platelet volume is associated with more severe morbidity in patients with AIS / TIA. People with high MPV on routine blood tests should be considered at high risk for AIS /TIA. Whether these people should be started on anti-platelet drug prophylactically needs further clinical study.

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**Ethical approval:** taken from institutional ethical committee.

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