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Original Research Article

# ROLE OF MEAN PLATELET VOLUME AND PLATELET DISTRIBUTION WIDTH AS PROGNOSTIC MARKERS IN ACUTE ISCHEMIC STROKE: A PROSPECTIVE OBSERVATIONAL STUDY

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ABSTRACT

**Background:** Mean platelet volume (MPV) and platelet distribution width (PDW) are simple, low-cost haemostatic indices of platelet activation and reactivity. Platelets contribute to intravascular thrombus formation following atherosclerotic plaque rupture, making platelet indices a potentially useful prognostic tool in acute ischaemic stroke. The objective is to determine MPV and PDW among patients with acute ischaemic stroke, correlate them with stroke severity, and evaluate their usefulness in predicting short-term prognosis.
**Materials and Methods:** This prospective, cross-sectional observational study enrolled 75 consecutive patients admitted with acute ischaemic stroke to the Department of General Medicine, Thanjavur Medical College. Complete haemogram, glycaemic and lipid profile, MPV, and PDW were recorded, and stroke severity was graded using the Modified Rankin Scale (MRS) on day 1 and day 7. Data were analysed in SPSS v28 using the independent t-test, chi-square/Fisher's exact test, and ANOVA, with $p<0.05$ taken as significant.
**Results:** Mean age was 60.52 ± 7.33 years; 62.67% were male. MPV and PDW were 10.28 ± 0.99 fl and 14.91 ± 1.23% respectively. A poor MRS score (3–6) was seen in 53.33% of patients on day 1 and 61.33% on day 7. MPV was significantly higher among patients with a poor MRS score on both day 1 (10.67 ± 1.04 vs 9.83 ± 0.72, $p=0.001$) and day 7 (10.75 ± 0.94 vs 9.52 ± 0.47, $p=0.001$). PDW was significantly higher with a poor day-7 MRS score (15.19 ± 1.33 vs 14.47 ± 0.91, $p=0.013$) but not day-1 MRS score ($p=0.494$). Both MPV and PDW were significantly higher among patients with hypertension, diabetes, dyslipidaemia, older age, and obesity ($p<0.05$).
**Conclusion:** Elevated MPV and PDW are associated with greater stroke severity and poorer short-term outcome in acute ischaemic stroke. As components of the routine haemogram, these indices offer a rapid, inexpensive, and readily available prognostic tool.
**Keywords:** Acute ischaemic stroke; mean platelet volume; platelet distribution width; Modified Rankin Scale; prognosis.

## INTRODUCTION

Stroke is defined as clinical symptoms of focal or generalised disturbance of brain function lasting 24 hours or longer, or leading to death, with no apparent cause other than a vascular one.[1] It is the second leading cause of death and a major contributor to disability worldwide, and ischaemic stroke, more common than haemorrhagic stroke accounts for a greater share of mortality and disability-adjusted life-years lost.[2] Stroke was responsible for 6.2 million deaths globally in 2011 and remains the foremost cause of adult disability, forcing many survivors to live with lasting functional limitations.[3]

Stroke severity and patient age are the most reliable early indicators of outcome; severity is judged from the degree of neurological deficit and infarct size and location on neuroimaging, while the underlying

stroke mechanism, comorbidities, and complications also influence prognosis.[4] Early identification of prognostic factors in the acute phase is essential to guide haemodynamic management and improve outcomes, and helps clinicians counsel patients and families about the expected disease course.[5,6]

Platelets play a central role in the pathogenesis of ischaemic stroke by forming intravascular thrombus after erosion or rupture of an atherosclerotic plaque, making haemostatic parameters such as platelet indices clinically relevant to monitor. MPV and PDW, in particular, reflect platelet activation and reactivity more directly than platelet count, and their measurement inexpensive and already part of a routine haemogram could offer a practical prognostic marker in acute ischaemic stroke. This study was undertaken to assess the correlation of MPV and PDW with stroke severity and their usefulness as short-term prognostic markers among patients with acute ischaemic stroke.

## MATERIALS AND METHODS

**Study Design and Setting:** This was a prospective, cross-sectional observational study conducted in the inpatient wards of the Department of General Medicine, Thanjavur Medical College and Hospital, Thanjavur, Tamil Nadu, over a period of two years.

**Study Population:** Patients aged more than 18 years, admitted with a confirmed diagnosis of acute ischaemic stroke on the basis of history, neurological examination, and neuroimaging, and willing to provide written informed consent, were consecutively enrolled. Patients with haemorrhagic stroke or a previous ischaemic stroke, comorbidities likely to affect platelet function or morphology (chronic kidney disease, prior cardiac bypass surgery, chronic liver disease, leukaemia), current use of drugs affecting platelet morphology or function (aspirin and other NSAIDs, antihistamines, certain antibiotics), or presentation more than 48 hours after symptom onset were excluded.

**Sample Size:** Based on the standard deviation of PDW among stroke patients with comprehension deficit (18.68) reported by Sarkar et al,[7] and assuming a precision of 5 at 95% confidence, the calculated sample size was 54; after adding a 20% non-response margin, 75 patients were enrolled.

**Study Procedure:** After obtaining institutional ethics committee clearance and written informed consent, complete haemogram, fasting and postprandial blood sugar, HbA1c, fasting lipid profile, renal function tests and serum electrolytes, MPV and PDW, electrocardiogram, echocardiography, and neuroimaging (CT/MRI) were performed for each patient. Stroke severity was graded using the Modified Rankin Scale (MRS),[8] on day 1 and day 7 of admission, with scores of 0–2 taken as a favourable outcome and 3–6 as a poor outcome.

**Statistical Analysis:** Data were entered in Microsoft Excel and analysed using SPSS version 28. Numerical variables were expressed as mean, median, and standard deviation, and categorical variables as frequencies and percentages. The independent-samples t-test was used to compare numerical variables between two groups, one-way ANOVA for more than two groups, and the chi-square test (or Fisher's exact test where more than 20% of cells had an expected count <5) for categorical associations. A p value <0.05 was considered statistically significant.

**Ethical Considerations:** Institutional Ethics Committee approval was obtained prior to the study, and written informed consent was taken from every participant. Source of funding: nil. Conflict of interest: nil.

## RESULTS

A total of 75 patients with acute ischaemic stroke were studied. The mean age was 60.52 ± 7.33 years (range 43–75); 44.0% were aged 61–70 years and 40.0% were aged 51–60 years. Males comprised 62.67% of the cohort. Smoking and alcohol use were reported in 38.67% and 44.0% respectively. Hypertension was present in 80.0%, diabetes mellitus in 42.67%, and dyslipidaemia in 24.0% of patients. Baseline characteristics are summarised in [Table 1].

**Table 1: Baseline demographic and clinical characteristics (n = 75)**

| Characteristic | Category | n (%) / Mean ± SD | Range |
|---|---|---|---|
| Age (years) | — | 60.52 ± 7.33 | 43–75 |
| | 61–70 y | 33 (44.0%) | |
| | 51–60 y | 30 (40.0%) | |
| Gender | Male | 47 (62.67%) | |
| | Female | 28 (37.33%) | |
| Smoking | Yes | 29 (38.67%) | |
| Alcohol use | Yes | 33 (44.00%) | |
| BMI (kg/m²) | — | 26.40 ± 2.70 | 21.5–32.2 |
| Hypertension | Yes | 60 (80.00%) | |
| Diabetes mellitus | Yes | 32 (42.67%) | |
| Dyslipidaemia | Yes | 18 (24.00%) | |
| Fasting blood sugar (mg/dl) | — | 110.31 ± 21.00 | 86–151 |
| HbA1c (%) | — | 7.04 ± 0.62 | 6.0–8.5 |
| Mean Platelet Volume (fl) | — | 10.28 ± 0.99 | 8.7–12.4 |
| Platelet Distribution Width (%) | — | 14.91 ± 1.23 | 9.0–18.1 |

The mean MPV was 10.28 ± 0.99 fl (range 8.7–12.4) and mean PDW was 14.91 ± 1.23% (range 9.0–18.1). On the MRS, 53.33% of patients had a poor outcome (score 3–6) on day 1, rising to 61.33% by day 7.

MPV was significantly higher among patients with a poor MRS score on both day 1 (10.67 ± 1.04 fl vs 9.83 ± 0.72 fl, mean difference 0.84, p=0.001) and day 7 (10.75 ± 0.94 fl vs 9.52 ± 0.47 fl, mean difference 1.23, p=0.001). PDW showed a similar but weaker pattern: the day-1 difference (15.00 ± 1.34% vs 14.81 ± 1.11%) was not statistically significant (p=0.494), while the day-7 difference (15.19 ± 1.33% vs 14.47 ± 0.91%) reached significance (p=0.013) [Table 2].

**Table 2: MPV and PDW according to MRS score at day 1 and day 7**

| Parameter | MRS Score | n | Mean ± SD | Mean Difference | p value |
|---|---|---|---|---|---|
| MPV (fl) – Day 1 | 0–2 | 35 | 9.83 ± 0.72 | 0.84 | 0.001 |
| | 3–6 | 40 | 10.67 ± 1.04 | | |
| MPV (fl) – Day 7 | 0–2 | 29 | 9.52 ± 0.47 | 1.23 | 0.001 |
| | 3–6 | 46 | 10.75 ± 0.94 | | |
| PDW (%) – Day 1 | 0–2 | 35 | 14.81 ± 1.11 | 0.20 | 0.494 |
| | 3–6 | 40 | 15.00 ± 1.34 | | |
| PDW (%) – Day 7 | 0–2 | 29 | 14.47 ± 0.91 | 0.71 | 0.013 |
| | 3–6 | 46 | 15.19 ± 1.33 | | |

On univariate analysis, obesity (92.3% with poor MRS, p=0.002) and dyslipidaemia (83.3% with poor MRS, p=0.003) were significantly associated with a poor day-1 MRS score; age group, gender, smoking, alcohol use, hypertension, and diabetes were not significantly associated with MRS score distribution [Table 3].

**Table 3: Association of risk factors with MRS score at day 1**

| Risk factors | MRS 0–2, n (%) | MRS 3–6, n (%) | p value |
|---|---|---|---|
| Age group | 19 (50.0) | 19 (50.0) | 0.558 |
| Gender | 21 (44.7) | 26 (55.3) | 0.655 |
| Smoking | 12 (41.4) | 17 (58.6) | 0.466 |
| Alcohol use | 17 (51.5) | 16 (48.5) | 0.456 |
| Obesity | 1 (7.7) | 12 (92.3) | 0.002 |
| Hypertension | 27 (45.0) | 33 (55.0) | 0.583 |
| Diabetes mellitus | 11 (34.4) | 21 (65.6) | 0.066 |
| Dyslipidaemia | 3 (16.7) | 15 (83.3) | 0.003 |

MPV was significantly higher among patients aged >60 years, and those with obesity, hypertension, diabetes mellitus, and dyslipidaemia (p<0.05 for each). PDW was significantly higher only among patients aged >60 years and those with dyslipidaemia; associations with gender, smoking, alcohol use, hypertension, diabetes, and obesity were not statistically significant for PDW [Table 4].

**Table 4: Association of risk factors with mean platelet volume and platelet distribution width**

| Risk factor | Group | MPV (fl), Mean ± SD (p) | PDW (%), Mean ± SD (p) |
|---|---|---|---|
| Age | <60 y | 9.91 ± 0.81 | 14.52 ± 1.31 |
| | >60 y (p) | 10.65 ± 1.03 (0.001) | 15.31 ± 1.02 (0.004) |
| Obesity | Yes | 11.29 ± 0.91 | 15.18 ± 1.93 |
| | No (p) | 10.06 ± 0.87 (0.001) | 14.85 ± 1.05 (0.549) |
| Hypertension | Yes | 10.42 ± 1.03 | 15.07 ± 1.03 |
| | No (p) | 9.71 ± 0.51 (0.001) | 14.26 ± 1.74 (0.086) |
| Diabetes mellitus | Yes | 10.69 ± 1.08 | 15.21 ± 1.03 |
| | No (p) | 9.97 ± 0.80 (0.002) | 14.69 ± 1.33 (0.057) |
| Dyslipidaemia | Yes | 11.46 ± 0.70 | 15.88 ± 0.74 |
| | No (p) | 9.90 ± 0.74 (0.001) | 14.61 ± 1.20 (0.001) |
| Gender / Smoking / Alcohol | — | p > 0.05 for all | p > 0.05 for all |

## DISCUSSION

This study assessed the correlation of MPV and PDW with stroke severity and their value as prognostic markers in acute ischaemic stroke. The demographic and risk-factor profile of the study population: a mean age around 60 years, male predominance, and a high prevalence of hypertension and diabetes was comparable to that reported by Kamat et al,[9] who found 60% of their ischaemic stroke cohort were male with hypertension in 50% and diabetes in 41% of patients.

Both MPV and PDW were significantly elevated among patients with a poorer MRS-based outcome in the present study, consistent with a systematic review and meta-analysis by Zheng et al,[10] which found elevated MPV to be a predictive marker of adverse outcome in acute ischaemic stroke, particularly among non-thrombolysed patients, although PDW showed less consistent predictive value. Yao et al,[11] similarly reported that elevated MPV correlated with worse 3-month outcome, especially in large-artery atherosclerosis stroke, and that MPV correlated positively with PDW and the platelet-to-lymphocyte ratio. Sotero et al,[12] found a trend toward unfavourable 90-day prognosis with higher MPV, and an association between higher PDW and more severe haemorrhagic transformation.

Sharma and Goyal,[13] observed that diabetic patients with ischaemic stroke had higher PDW, MPV, and plateletcrit, associated with poorer outcome which is consistent with the significantly higher MPV and PDW seen among diabetic patients in the present cohort. Govind et al,[14] found a positive correlation between the platelet-to-lymphocyte ratio and NIHSS score, while Punekar and Shukla,[15] reported a direct relationship between MPV and stroke severity and an inverse relationship for PDW. Mohamed et al,[16] found MPV to be significantly higher in patients with unfavourable outcome (10.4 ± 2.3 fl vs 8.7 ± 1.3 fl, $p<0.001$), broadly in keeping with the present findings, whereas Gao et al,[17] reported the opposite direction for PDW, with higher PDW associated with good rather than poor outcome,a discrepancy that highlights inconsistency in PDW's prognostic value across studies.

Vyawahare and Dhonge,[18] found platelet indices, including MPV and PDW, to be higher among ischaemic stroke cases than controls and to increase further with stroke severity. Sarkar et al,[7] reported significantly higher PDW and MPV among stroke patients with comprehension deficit compared with controls, and Meena et al,[19] similarly documented a rise in mean MPV among ischaemic stroke cases. In contrast, Lok et al,[20] found no significant difference in MPV across MRS-based outcome groups, and Al Tameemi et al,[21] described a negative correlation between mean platelet count and MPV/PDW rather than a direct association with outcome, illustrating that the strength of these associations varies across populations and study designs. O'Malley et al,[22] reported higher MPV in acute stroke patients than controls (11.3 fl vs 10.1 fl, $p<0.001$) alongside a reduced platelet count in stroke patients, and Greisenegger et al,[23] found that patients in the highest MPV quintile were significantly more likely to have a severe stroke (MRS 3–6) than those in the lowest quintile. A meta-analysis of 27 studies by Sadeghi et al,[24] found higher MPV in stroke patients than controls in 17 of the included studies, underscoring an overall,though not universal association. Shah et al,[25] additionally found MPV to correlate with glycaemic control specifically in diabetic patients, consistent with the stronger MPV association seen among diabetics in the present study. Taken together, the present findings support MPV as a fairly consistent marker of stroke severity and short-term prognosis, while PDW's association appears more dependent on timing of measurement and patient subgroup — a pattern also reflected in the mixed findings across the studies discussed above.

## CONCLUSION

Higher MPV and PDW, reflected in a poorer MRS score (3–6), are associated with more severe stroke and worse short-term outcome. MPV was notably higher among patients with diabetes mellitus, consistent with the procoagulant state of diabetes predisposing to thrombotic events. As components of the routine haemogram, MPV and PDW represent a simple, inexpensive, and readily available means of assessing platelet reactivity, and may serve as a useful adjunct in predicting the severity and prognosis of acute ischaemic stroke.

## REFERENCES


1. World Health Organization. Global status report on noncommunicable diseases 2014. Geneva: WHO; 2014.
2. Katan M, Luft A. Global burden of stroke. Semin Neurol. 2018;38(2):208–11.
3. Kasper DL, Fauci AS, Hauser SL, Longo DL, Jameson JL, Loscalzo J, editors. Harrison's Principles of Internal Medicine.
4. Edwardson MA, Dromerick AW. Ischemic stroke prognosis in adults. In: UpToDate. 2018.
5. Bhatia RS, Garg RK, Gaur SPS, Kar AM, Shukla R, Agarwal A, et al. Predictive value of routine hematological and biochemical parameters on 30-day fatality in acute stroke. Neurol India. 2004;52(2):220–3.
6. Kannan R, Alex AG, Sudeep K. A clinical study of factors predicting prognosis in acute ischemic stroke in a tertiary care centre in north Kerala. Int J Res Med Sci. 2017;5(10):4344–7.
7. Sarkar RN, Das CK, Bhattacharjee U, Banerjee M. Platelet indices as a marker of severity in non-diabetic non-hypertensive acute ischemic stroke patients. J Assoc Physicians India. 2018;66(7):40–2.
8. Broderick JP, Adeoye O, Elm J. The evolution of the Modified Rankin Scale and its use in future stroke trials. Stroke. 2017;48(7):2007–12.
9. Kamat V, Kinagi S, Patil A. A study of mean platelet volume in acute ischemic stroke. Int J Adv Med. 2021;8(2):214–9.
10. Zheng YY, Wang L, Shi Q. Mean platelet volume (MPV) and platelet distribution width (PDW) predict clinical outcome of acute ischemic stroke: a systematic review and meta-analysis. J Clin Neurosci. 2022;101:221–7.
11. Yao Y, Cao X, Zou R, Wen H, Zhang S, Xu H, et al. Study on the baseline factors and platelet indices that predict outcome of acute ischemic stroke patients after thrombolytic therapy. Cerebrovasc Dis. 2022;51(3):357–64.
12. Dourado Sotero F, Calçada A, Aguiar de Sousa D, Dias M, Fonseca AC, Pinho e Melo T, et al. Mean platelet volume is a prognostic marker in acute ischemic stroke patients treated with intravenous thrombolysis. J Stroke Cerebrovasc Dis. 2021;30(6):105718.
13. Sharma S, Goyal S. Study of association of platelet indices with acute ischemic stroke in patients with type 2 diabetes mellitus – a hospital based study. Paripex Indian J Res. 2020;9(3):22–4.
14. Govind DD, Rao MM, Sudheer K. A study on the correlation between platelet indices and severity score in acute ischemic stroke. Int J Med Res Rev. 2020;8(5):363–8.
15. Punekar DJ. Study of platelet indices in ischemic stroke patients. J Med Sci Clin Res. 2019;7(11).
16. Mohamed AAB, Elnady HM, Alhewaig HK, Moslem Hefny H, Khodery A. The mean platelet volume and plateletcrit as predictors of short-term outcome of acute ischemic stroke. Egypt J Neurol Psychiatr Neurosurg. 2019;55(1):4.
17. Gao F, Chen C, Lyu J, Zheng J, Ma XC, Yuan XY, et al. Association between platelet distribution width and poor outcome of acute ischemic stroke after intravenous thrombolysis. Neuropsychiatr Dis Treat. 2018;14:2233–9.
18. Vyawahare M, Dhonge O. Correlation of platelet indices with severity and clinical outcome in patients with acute ischemic stroke. Int J Biomed Adv Res. 2018;9(10):338–44.
19. Meena P, Khare M, Airun A, Manohar, Saxena A. A study of platelet indices in patients of acute ischemic stroke: a prospective study. IOSR J Dent Med Sci. 2017;16:26–9.
20. Lok U, Gulacti U, Ekmekci B, Bulut T, Celik M. Predictive and prognostic role of mean platelet volume in patients with first-ever acute ischemic stroke. Neurosciences (Riyadh). 2017;22(2):119–26.
21. Al Tameemi W, Ameen A. Significance of platelet indices in patients with acute ischemic stroke. Iraqi J Agric Sci. 2012;10.

22. O'Malley T, Langhorne P, Elton RA, Stewart C. Platelet size in stroke patients. Stroke. 1995;26(6):995–9.
23. Greisenegger S, Endler G, Hsieh K, Tentschert S, Mannhalter C, Lalouschek W. Is elevated mean platelet volume associated with a worse outcome in patients with acute ischemic cerebrovascular events? Stroke. 2004;35(7):1688–91.
24. Sadeghi F, Kovács S, Zsóri KS, Csiki Z, Bereczky Z, Shemirani AH. Platelet count and mean volume in acute stroke: a systematic review and meta-analysis. Platelets. 2020;31(6):731–9.
25. Shah AB, Beamer N, Coull BM. Enhanced in vivo platelet activation in subtypes of ischemic stroke. Stroke. 1985;16(4):643–7.