

# Characteristics of platelets may be associated with mortality in patients with acute ischemic stroke

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## ABSTRACT

**Background:** This study investigated the relationship of mortality to mean platelet volume (MPV) and platelet distribution width (PDW) in acute ischemic stroke patients. **Materials and Methods:** A total of 68 patients with acute ischemic stroke were enrolled in this retrospective study, of whom 36 (52.9%) and 32 (47.1%) were survived and died, respectively. Demographical properties and complete blood counts of all patients were recorded. MPV and PDW values were compared. **Results:** A total of 68 elderly patients ( $n = 68$ ) with acute ischemic stroke who were admitted to the study received follow-up care in our hospital neurology intensive care unit (NICU). The mean PDW value of the patients who died ( $17.7 \pm 1.7$ ) was significantly higher than that of the living patients ( $15.2 \pm 2.2$ ) ( $P < 0.001$ ). There was no statistically significant difference between the MPV values of the dead patients ( $8.9 \pm 2.1$ ) and the living patients ( $8.5 \pm 1.9$ ) ( $P = 0.435$ ). **Conclusion:** This study indicates that MPV is not associated with mortality in elderly patients with acute ischemic stroke while PDW is.

**Key words:** Acute ischemic stroke, mean platelet volume, mortality, platelet distribution width

## INTRODUCTION

Platelets play an important role in the pathogenesis of atherosclerotic complications by contributing to thrombus formation. Mean platelet volume (MPV) and thrombocyte distribution width are predictors of platelet function. MPV and platelet distribution width (PDW), routinely measured by automated cell counters, are simple and inexpensive tests. MPV and PDW are indicative of platelet activation, a marker of practical and prognostic significance in some diseases.<sup>[1,2]</sup> Studies related to MPV and ischemic stroke have also investigated the relationship between stroke risk, severity, and prognosis, with differing results. Elevated MPV has been found to be related with some clinical conditions which are associated with ischemic stroke. Elevated MPV has been found in patients who smoke,<sup>[3]</sup> those with diabetes mellitus,<sup>[4]</sup> those who have experienced myocardial infarction<sup>[5]</sup> and renal artery stenosis,<sup>[6]</sup> and those with chronic obstructive pulmonary disease.<sup>[7]</sup> On the other hand, studies of PDW in ischemic stroke are limited and the results are inconsistent.<sup>[8]</sup> In this study, we investigated both

MPV and PDW in 68 acute ischemic stroke patients in our neurology intensive care unit (NICU).

## MATERIALS AND METHODS

Between October 2013 and July 2017, 68 patients being treated for acute ischemic stroke in our hospital NICU were studied. Patients who stayed at least 24 h in the NICU were studied, while patients with hemorrhagic stroke, malignancies, sepsis, thrombocytopenia, or thrombocytosis were excluded from the study. The demographic characteristics of the patients were retrospectively analyzed through hospital records. In all cases, complete blood counts (CBC) for MPV and PDW measurements were made at admission and before treatment. For CBC test, blood samples were taken in standard tubes containing ethylenediaminetetraacetic acid and stored at room temperature in our hospital. The Beckman Coulter LH 780 Hematology System was used. The measurements were made within 30 min of blood ingestion. According to our laboratory, normal MPV values were accepted between 6.9 and 10.8 fL and PDW values between 9 and 17 fL. The statistical analysis

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software program MedCalc 15.8 (MedCalc Belgium) was used for statistical evaluation. Mean and standard deviation values of the data were determined. The student's *t*-test was used to compare normal quantitative independent data and Mann–Whitney *U*-test was used to compare independent quantitative data without normal distribution. The chi-square test was used to compare qualitative data. Multiple regression test (backward method) was used to analyze the relationship between a dependent variable and one or more independent variables (predictor variables or explanatory variables). An odds ratio was used to analyze the degree of association between the two variables. Data were assessed at a 95% confidence interval and  $P < 0.05$  was considered to be statistically significant.

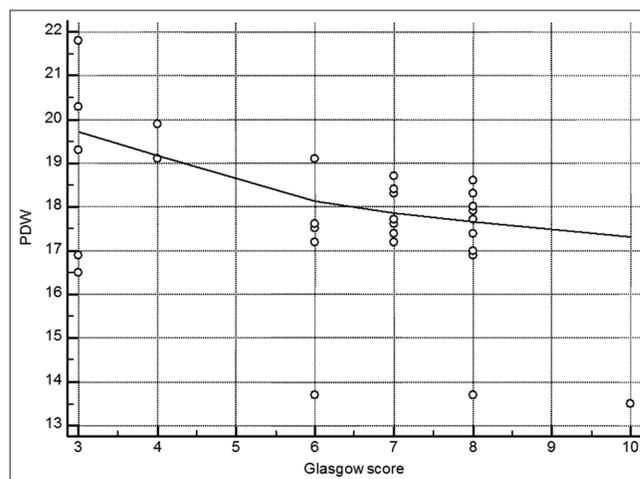
## RESULTS

A total of 68 elderly patients ( $n = 68$ ) with acute ischemic stroke were analyzed. There were 36 (52.9%) and 32 (47.1%) patients who were survived and died, respectively. The mean hospitalization time was  $7.3 \pm 16.2$  days for the deceased patients and  $6.9 \pm 5.8$  days for the surviving patients ( $P = 0.08$ ). The mean Glasgow Coma Score (GCS) was  $6.1 \pm 1.8$  for the deceased patients and  $9.3 \pm 1.1$  for the living patients ( $P < 0.001$ ). 19 (52.8%) of the surviving patients were female, and 19 deceased patients (53.4%) were female ( $P = 0.772$ ). The mean age of the living patients was  $72.2 \pm 7.6$  years, and the mean age of the deceased patients was  $75.8 \pm 8.7$  years. The mean age of the deceased patients did not differ statistically from that of the survivors ( $P = 0.073$ ). There was no statistically significant difference between the groups of patients who died and those who lived in terms of MPV values ( $8.9 \pm 2.1$  and  $8.5 \pm 1.9$ ,  $P = 0.435$ ). The mean PDW value of the patients who died ( $17.7 \pm 1.7$ ) was significantly higher than that of the living patients ( $15.2 \pm 2.2$ ) ( $P < 0.001$ ) [Table 1]. There was an association between the PDW levels and mortality (OR = 4.83, CI 95% 1.22–19.13,  $P < 0.024$ ). There was a negative correlation between PDW level and GCS in deceased patients ( $r = -0.506$ ,  $P = 0.031$ , Figure 1).

## DISCUSSION

In this study, we investigated the MPV and PDW values of elderly patients with acute ischemic stroke. We have not found

the statistically significant difference between survived and died patients according to the MPV values. It is thought that MPV is a marker of platelet activation, which is generally associated with systemic inflammatory responses. The relationship between ischemic stroke and MPV has been extensively reviewed in many publications.<sup>[9-17]</sup> Controversial results have been found concerning the relationship between MPV and stroke, while elevated platelet activation is associated with cerebral infarction and coronary heart disease. O'Malley *et al.* reported higher MPV in patients with acute and chronic ischemic stroke than in controls but found no significant difference in MPV between acute and chronic stroke stages. They concluded that the factors associated with stroke were the most significant variable; a rise in MPV was assessed as being independent of stroke.<sup>[9]</sup> They also concluded that changes in MPV could precede the vascular event. Muscari *et al.* observed higher MPV values in patients with stroke and severe neurological deficits.<sup>[10]</sup> D'Erasmuso *et al.* reported higher platelet volume in acute ischemic stroke patients than in control subjects.<sup>[11]</sup> Greisenegger *et al.* showed that patients with intense stroke had higher MPV levels and increased platelet reactivity just before stroke occurred.<sup>[12]</sup> Li *et al.* showed that individuals with high MPV had a higher prevalence of silent cerebral infarction.<sup>[13]</sup> Ha *et al.* stated that an MPV value higher



**Figure 1:** A scatter diagram shows the correlation between platelet distribution width and Glasgow score

**Table 1:** Shows the demographic, clinical and biochemical data of the groups

	Survived patients N=36	Died patients N=32	p
Age	72.2 ± 7.6	75.8 ± 8.7	0.073
Female N (%)	19 (52.8%)	19 (53.4%)	0.772
Hospitalization time (days)	7.3 ± 16.2	6.9 ± 5.8	0.08
Glasgow score	9.3 ± 1.1	6.1 ± 1.8	<0.001
MPV (fL)	8.5 ± 1.9	8.9 ± 2.1	0.435
PDW (fL)	15.2 ± 2.2	17.7 ± 1.7	<0.001

MPV: mean platelet volume, PDW : platelet distribution width

than 9.4 fL indicates a 4-fold higher risk for cerebral stroke.<sup>[14]</sup> Arévalo-Lorido *et al.* found an association between increased platelet volume and increased dependency rates when measured by the National Institutes of Health stroke scale score at admission.<sup>[15]</sup> Oji *et al.* reported that entry MPV values may be an independent biomarker and that more attention should be paid to ischemic stroke patients with MPV values higher than 10.1.<sup>[16]</sup> Tohgi *et al.* have suggested that MPV is significantly lower in patients with acute and subacute stroke than in control groups.<sup>[17]</sup> Ntaios *et al.* concluded that MPV was not associated with stroke severity or functional outcomes and did not differ between stroke subtypes.<sup>[18]</sup> The results of studies evaluating the relationship between MPV and stroke prognosis are quite contradictory, and some of the discrepancy may be explained by differing sample sizes and laboratory procedures. In our study, no significant relationship was found between MPV and mortality in acute ischemic stroke.

In this study, we found that PDW was higher in dying patients and significant in determining the risk of death. To the best of our knowledge, this is the first time the association of PDW value with mortality in adults with acute ischemic stroke has been presented. According to the literature, Zhang *et al.* have reported that the PDW value was valuable for predicting mortality in patients hospitalized in intensive care units.<sup>[19]</sup> On the other hand, Yilmaz *et al.* studied on 106 children with acute ischemic stroke. They reported that PDW was not associated with survival in these patients.<sup>[8]</sup>

This study has some limitations such as retrospective design and small sample size. To strengthen intensive care scoring systems with laboratory parameters, PDW and MPV need to be examined with larger sample size and prospective multicenter studies.

## CONCLUSION

MPV values were comparable both in survived and dead patients while PDW values were higher in dead patients. According to these results, we can say that MPV is not associated with mortality in acute ischemic stroke while PDW is. However, we need further studies.

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