

# Does MPV / Plt ratios support the diagnosis in acute ischemic stroke patients?

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## Abstract

**Aim:** It is whether MPV, Plt and MPV / Plt values of admission to the intensive care unit (ICU) in acute ischemic stroke (AIS) diseases can be used as a diagnostic factor in diagnosis or not.

**Material and Method:** MPV, Plt, MPV/PLT ratios of 70 patients with AIS diagnosis and 45 healthy control groups were recorded retrospectively between 2013-2014.

**Results:** No gender or age difference between the groups was detected. MPV / Plt ratio was significantly higher in the patient group ( $p < 0.05$ ). Although Plt and MPV values were different in two groups, it was not statistically different ( $p > 0.05$ ). There was no statistically significant difference in terms of specificity and sensitivity.

**Conclusion:** It is considered that high MPV / Plt ratios among the hematological values of AIS patients supports the diagnosis.

**Keywords:** Acute Ischemic Stroke; Mean Platelet Volume; Platelet Count; Mean Platelet Volume-To- Platelet Ratio.

## INTRODUCTION

Platelets are round or oval small discs of 1 to 4 microns in diameter. It consists of megakaryocytes that leave the bone marrow and do not circulate. Platelets are necessary for the formation of hemostasis and dysfunction leads to hemorrhage and coagulation disorders (1). The mean platelet volume (MPV) is an easily measured value and is an indication of platelet function and activation. MPV is one of the most widely studied molecules indicating inflammation. The platelet count and MPV are inversely correlated so that the total platelet mass remains approximately constant (2). High MPV was determined to be associated with various identified significant risk factors and was associated with cardiovascular, cerebrovascular diseases, and low-grade inflammation which causes arterial and venous thrombosis, and diabetes mellitus (3). Low MPV values were determined in rheumatoid arthritis or familial Mediterranean fever attacks associated with high-grade inflammation (4).

Cerebrovascular diseases is one of the third most common causes of death and morbidity in the world (5). In order to reduce deaths due to this disease, to minimize the sequelae of survivors and to sustain their lives without being dependent on others, diagnostic and therapeutic

approaches for the emergency department are required to be developed and properly regulated (6). It plays a key role in the radiological evaluation in the diagnostic and therapeutic process. The radiological method to be chosen firstly in cases of clinically diagnosed infarction, is usually (BT); however, the first BT scan may not have a pathologic appearance.

Our aim in this study is that patients admitted to the hospital with stroke clinic may have difficulties in reaching a center with BT scan or may appear normal in the early hours of the BTs. It is whether MPV, Plt and MPV / Plt values of admission to the intensive care unit (ICU) in acute ischemic stroke (AIS) diseases which we think may be guiding in these cases can be used as a diagnostic factor in diagnosis or not.

## MATERIAL and METHODS

Approval for the study was granted by the Local Ethics Committee. A retrospective examination was made of ischemic stroke patients in the Internal Medicine ICU in our hospital between 2013-2014. Patients meeting the following criteria were excluded: 1) Missing information on demographic and laboratory parameters; 2) with cancer, hepatitis, acute infection and renal diseases that may affect routine blood indexes; and 3) Following these

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exclusions, the remaining study population comprised 70 patients, age and sex matched 45 healthy controls.

### Statistical Analysis

All the data analyzed by using SPSS22.0 software (Statistical Package for Social Sciences) and statistical software packages R (<http://www.R-project.org>; The R Foundation). Data are presented as mean  $\pm$  standard deviation (SD) or median (interquartile range) for continuous variables, and as frequency and percentage for categorical variables. The independent t-test, Mann-Whitney U and Chi-Square test for categorical variables. was used to analyze the difference between the variables in the control group and in the patients. Receiver Operating Characteristic (ROC) curves were used to evaluate the diagnostic accuracy of selected parameters and the area under the curve (AUC) was evaluated with the Hanley and McNeil method. The difference between the groups was considered as statistically significant at a probability value of  $<0.05$ .

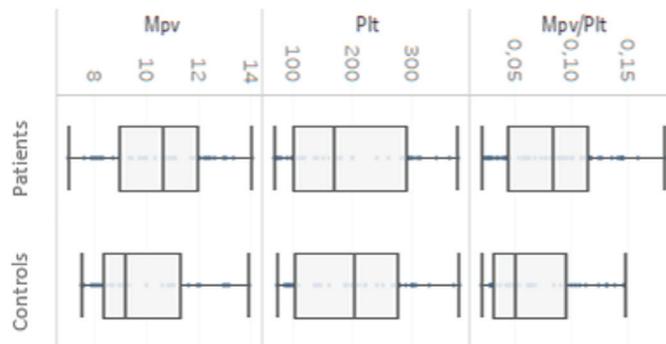
## RESULTS

The characteristics of 70 subjects in patients group and 45 subjects in controlled group are presented in Table 1. Baseline demographics and hematologic parameters were compared between the two groups. The median age of the Patients was 67 (43-86) years, while the median range of the control group was 65 (48-78) years, which was statistically not significant. The MPV/Plt ratio values was significantly higher in the patients group ( $p < 0.05$ ). There was'tnt any significant difference in the Plt and MPV values in two groups ( $p > 0.05$ ), (Figure 1).

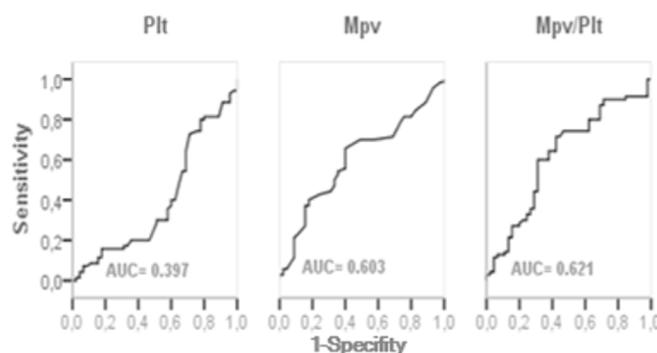
For all patients ROC curve analysis, AUC for Plt was 0.397 (95% confidence interval [CI], 0.288–0.507) ( $p > 0.05$ ), MPV was 0.603 (95% confidence interval [CI], 0.498–0.708) ( $p > 0.05$ ), MPV/Plt was 0.621 (95% confidence interval [CI], 0.514–0.728) ( $p < 0.05$ ). The cutoff value was determined  $\geq 0.061$  for MPV/Plt (Figure 2).

**Table 1. Baseline characteristics of study population.**

	Patients (n = 70)	Controls (n = 45)	p value
Age (years $\pm$ SD)	67 (43-86)	65 (48-78)	0.611
Sex ( Male)	40	24	0.689
PLT, $10^4/\mu\text{L}$	140 (69-375)	200 (74-377)	0.064
MPV, FL	10.65 (7-14)	9.2 (7.5-13.9)	0.063
MPV/PLT	0.081 $\pm$ 0.038	0.065 $\pm$ 0.037	0.030



**Figure 1.** Comparisons of patients and controls with Mpv, Plt, Mpv/Plt ratio values



**Figure 2.** ROC curves with Area Under the Curve (AUC) for Plt, MPV, MPV/Plt ratio predicting ischemic stroke

## DISCUSSION

It is known that all diseases have effects on different series of bone marrow (7). MPV is an indicator that reflects platelet size and platelet production rate in the bone marrow and demonstrates platelet activation and inflammation severity (8). Large platelets have enzymatically more active and higher homeostasis than smaller platelets. The changes in the volume parameters of platelets are of diagnostic importance in thrombotic and pre-thrombotic states (9).

Infarction is an ischemic necrosis caused by the obstruction of arterial flow or venous drainage in a tissue (10). The risk factors that cannot be changed in ischemic stroke can be classified as age, gender, race, family history; the interchangeable risk factors as hypertension, diabetes mellitus, heart disease, hyperlipidemia, smoking, alcohol, obesity, eating habits and physical inactivity (11). All of these cited risk factors are among the vascular risk factors.

Elevated MPV levels are usually associated with vascular risk factors, immune thrombocytopenic states, low-grade inflammatory status, and acquired giant platelet disorders (12). In patients with DM, hypertension, smoking, inflammation, obesity, metabolic syndrome and dyslipidemia which are among the vascular risk factors, MPV has been shown to be significantly high in many publications (13-14). MPV levels also increase in thromboembolic diseases. In the conducted studies, MPV

value (15) and MPV / Plt ratio have been determined to be high in patients with deep vein thrombosis (DVT) and it has been suggested that it can be a risk indicator for DVT (16).

Therefore, these results are explained by the presence of vascular risk factors constituting the main pathophysiology of AIS etiology, the high MPV, MPV/plt ratios of the AIS patient group included in our study.

In the literature, there are many parameters in which AIS and hematological parameters are studied. There are publications suggesting that the increased MPV and MPV / PLT ratio are associated with cerebrovascular stroke, which is consistent with our study results (17), MPV is an early and important indicator for the prognosis of ischemic stroke, (18) as well as suggesting otherwise (19).

In ischemia, neuronal death is delayed even if the ischemic process is immediately activated (20) and neurons do not show any signs of pathological necrosis up to 8 hours after the onset of ischemia (21). Of course, due to this pathological process, a pathological appearance may not be detected in the first BT scan. In the literature, it is reported that the infarction generally cannot be seen in BT taken within the first hours following ischemic stroke (22). Especially in order not to delay the diagnosis and treatment of this group of patients, the determination of hematological parameters to facilitate and support the diagnosis of AIS in this way will contribute to the literature. In this regard, the limitation of our study is that patients have not been classified into groups as those with lesions detected and / or not detected on BT during the initial admission as well as the number of patients is less.

## CONCLUSION

As a result; according to the result of our study, it is suggested that MPV, MPV / Plt ratios, which are among the routinely evaluated hematological values of patients during ICU admission, support the diagnosis. However, we believe that studies to be performed in patient groups with higher number of patients and classified by whether a lesion has been detected or not according to admission BT, will give better results.

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