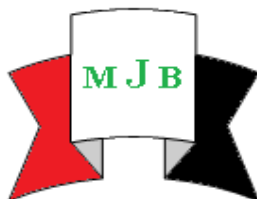# Mean Platelet Volume And Its Influence on The Severity of Acute Ischemic Stroke

Basim A. Abd

College of Medicine , University of Babylon , Babylon , Iraq

E-mail: basim6mol@gmail.com

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Abstract

Introduction and objective e: Mean platelet volume (MPV) values in association with both thrombosis and inflammation have become a point of interest in the last few decades, and some studies have reported MPV values significantly higher in patients with stroke. This study aims to determine if there is an association between elevated levels of MPV and the severity of acute ischemic brain stroke.

Patients and methods: Fifty acute ischemic stroke patients who were admitted to Merjan Teaching Hospital in Al-Hilla City, Babylon-Iraq; during the period from October 2013 to April 2014 were enrolled in this study. They included 22 males and 28 females, their ages ranged from 50-90 years, with a mean age of 70.52±11.264 years. Those patients were divided into two groups based on modified Rankin Scale (mRS): Group 1 (mRS 0-2), group 2 (mRS≥3). This scale was used to assess the severity of the disease. Blood samples were collected from the patients to measure MPV.

Results: The study demonstrated that the patients' group with mRS≥3 were significantly older than the other group regarding the age distribution, and MPV values for them were also significantly higher than the other group. Concerning the gender distribution and clinical history of ischemic heart disease and smoking, there were no significant differences between the two groups of patients.

Conclusion: Mean platelet volume is a strong and independent risk factor for acute ischemic stroke and high MPV values could be associated with a severe form of the disease.

Key words: Mean platelet volume, acute ischemic stroke.

معدل حجم الصُفيحات الدموية وتأثيره على شدة السكتة الدماغية الإقفاريّة الحادة

الخلاصة

المقدمـة والهدف: معدل حجم الصفيحات الدموية وبالمصاحبة مع كل من عمليتي التخثر والالتهاب أصبحوا موضع اهتمامٍ في العقود القليلة الأخيرة، وسجلت بعض الدراسات مستوياتٍ معنوية مرتفعة لمعدل حجم الصفيحات الدموية لدى مرضى السكتة الدماغية. تهدف هذه الدراسة إلى معرفة ما إذا كان هنالك ارتباطٌ بين المستويات المرتفعة لمعدل حجم الصفيحات الدمويّة وشدة السكتة الدماغية الإقفاريّة الحادة.

المرضى وطرق العمل: تضمنت الدراسة خمسين مريضاً مصابين بالسكتة الدماغيّة الإقفاريّة الحادة ممن أُدخلوا إلى مستشفى مرجان التعليمي في مدينة الحلة، بابل−العراق، خلال الفترة من تشرين الأول ٢٠١٣ إلى نيسان ٢٠١٤. ضمن المرضى كان هنالك ٢٢ ذكراً و٢٨ أنثى تراوحت أعمارهم بين ٥٠−٩٠ سنة، وبمعدل عمري هو ٧٠,٥٢±١١,٢٦٤ سنة. قُسِّم المرضى إلى مجموعتين استناداً إلى مقياس رانكين المعدّل: المجموعة الأولى (٠−٢) حسب مقياس رانكين، والمجموعة الثانية (٣ فأكثر) حسب نفس المقياس. استُخدم هذا المقياس لقياس شدة المرض. جُمعت عينات دمٍ من المرضى لقياس معدل حجم الصفيحات الدمويّة.

النتائج: أظهرت الدراسة أن مجموعة المرضى الثانية حسب مقياس رانكين كانت بصورةٍ معنوية أكبر عمراً من المجموعة الأولى، كذلك كانت مستويات معدل حجم الصفيحات الدمويّة لديهم أعلى معنوياً من المجموعة الأخرى. فيما يخص توزيع الجنس وكذلك التاريخ المرضي السريري لمرض القلب الإقفاري والتدخين فلم يكن هنالك فروقٌ معنويّة بين مجموعتيّ المرضى.

الاستنتاج: معدّل حجم الصفيحات الدمويّة عامل خطورة قوي ومستقل للسكتة الدماغية الإقفاريّة الحادة والمستويات المرتفعة لمعدل حجم الصفيحات قد تكون مرتبطة بشكلٍ حاد من أشكال المرض.

الكلمات الدالة: معدل حجم الصفيحات الدمويّة، السكتة الدماغية الإقفاريّة الحادة.

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Introduction

Stroke is one of the major healthcare problems; the third leading cause of death in developed countries and the leading cause of long-term disability [1]. Platelets play a major role in maintaining vessel integrity through hemostasis. The hemostatic efficiency of these circulating cells is directly dependent on some vasoactive factors and prothrombotic agents including thromboxane A2 and serotonin secreted from platelet granules [2].

It is clear that the larger platelets contain more granules and therefore produce and secrete greater amounts of these stimulators. In fact, platelet volume is associated with shorter bleeding time, and the mean platelet volume (MPV) has been considered as a determinant for the level of platelet activity [3]. Mean platelet volume is an important marker of platelet-related activities like platelet aggregation, thromboxane A2 generation, and platelet factor 4 and thromboglobulin secretion [2].

An increase of MPV has been confirmed after acute ischemic heart diseases. The MPV is directly associated with the risk of acute myocardial infarction, and subsequent life-threatening events [4]. Also in patients with risk factors for stroke, like diabetes mellitus or hypercholesterolemia, the MPV values were found to be higher than the control groups [5]. Patients with severe stroke significantly more often have higher MPV levels on admission to the hospital [6]. Although a relationship between the MPV values and the severity and prognosis of the ischemic stroke has been observed in some reports, other studies did not reveal such an interrelation [7].

The aim of the present study is to determine if there is a relationship existing between MPV and the severity of acute ischemic brain stroke.

Patients and methods

This study was conducted on fifty acute ischemic stroke patients who were admitted to Merjan Teaching Hospital in Al-Hillah City, Babylon-Iraq; during the period from October 2013 to April 2014. The study included 22 males and 28 females, their ages ranged from 50-90 years, with a mean age of 70.52 ± 11.264 years.

The diagnosis of stroke was made clinically in addition to the evidence of acute infarction determined by cranial computerized tomography (CT) within the first 24 hours of the disease appearance. Patients with subarachnoid hemorrhage, hemorrhagic stroke or prior attack of ischemic stroke were excluded. Baseline data including demographic (age and gender), clinical (history of ischemic heart disease (IHD) and smoking) and laboratory (mean platelet volume (MPV)) data were collected from the patients.

Blood samples for the measurement of MPV were collected into EDTA tubes and were analyzed in an automated hematological analysis system (Ruby analyzer, Abbott Diagnostic, USA) that measures platelets using aperture-impedance technology.

Severity of ischemic stroke was assessed by modified Rankin Scale (mRS) that scores patients on a scale from 0 to 6, with 0 being asymptomatic and 6 being dead. Scores of 0-2 are considered good stroke outcomes; in that these patients are able to have fairly self-governing lives and are able to return to their usual activities in almost all cases. Scores of 3 or more are considered poor stroke outcomes and indicate that the patient will need substantial help with their daily actions.

Few days following stroke, the patients were divided into 2 groups based on the mRS: group 1 included patients with mRS 0-2, and group 2 patients with mRS 3 and more [8].

Statistical analysis:

Continuous variables (age and MPV) were reported as mean ± standard deviation (SD), while the other categorical variables (gender and clinical history) were reported as percentages (no. (%)). The two groups of patients were compared using independent-samples t-test for the continuous variables and chi-square test for the categorical variables. All analyses were done with SPSS version 18.0 software (SPSS Inc., Chicago, IL, USA). $P<0.05$ was considered statistically significant.

Results

Tables (1) and (2) demonstrate demographic characteristics for the two patients' groups. Regarding the age distribution, the group of patients with poor disease outcome (mRS $\geq$3) were older than the other group, (p=0.043). On the other hand, there was no significant difference between the groups regarding the gender distribution, (p=0.385).

Table (1) Age distribution for the two groups of patients with acute ischemic stroke.

Groups \ Age	Group 1 (mRS 0-2) (n=6)	Group 2 (mRS ≥3) (n=44)	*P*-value
Age (Years) Mean ± SD	70.00±1.549	74.05±11.932	0.043

- mRS: Modified Rankin Scale.
- SD: Standard deviation.

Table (2) Gender distribution for the two groups of patients with acute ischemic stroke.

Groups \ Gender	Group 1 (mRS 0-2)	Group 2 (mRS ≥3)	*P*-value
Males No. (%)	4 (66.7)	18 (40.9)	0.385
Females No. (%)	2 (33.3)	26 (59.1)	
Total	6 (100)	44 (100)	50 (100)

- mRS: Modified Rankin Scale.

Concerning MPV values, they were higher in the second group of patients (mRS $\geq$3) than the first group, (p=0.002), as shown in table (3).

Table (3) Values of mean platelet volume for the two groups of patients with acute ischemic stroke.

Groups MPV	Group 1 (mRS 0-2) (n=6)	Group 2 (mRS ≥3) (n=44)	*P*-value
MPV (fL) Mean ± SD	6.3000±1.05326	7.5864±0.90399	0.002

- mRS: Modified Rankin Scale.
- MPV: Mean platelet volume.
- fL: Femtoliter.
- SD: Standard deviation.

Clinical history of IHD and smoking, shown in tables (4) and (5), reveals no significant differences between the two groups of patients, (p=0.075) and (p=0.327), respectively.

Table (4) History of ischemic heart disease in the two groups of patients with acute ischemic stroke.

Groups IHD	Group 1 (mRS 0-2)	Group 2 (mRS ≥3)	*P*-value
Present No. (%)	0 (0)	18 (40.9)	0.075
Absent No. (%)	6 (100)	26 (59.1)	
Total	6 (100)	44 (100)	50 (100)

- IHD: Ischemic heart disease.
- mRS: Modified Rankin Scale.

Table (5) Smoking history in the two groups of patients with acute ischemic stroke.

Groups Smoking	Group 1 (mRS 0-2)	Group 2 (mRS ≥3)	*P*-value
Smokers No. (%)	0 (0)	10 (22.7)	0.327
Non-smokers No. (%)	6 (100)	34 (77.3)	
Total	6 (100)	44 (100)	50 (100)

- mRS: Modified Rankin Scale.

Discussion

Mean platelet volume values in association with both thrombosis and inflammation have become a point of interest in the last few decades, and some studies have reported MPV values significantly higher in patients with stroke [9]. Increased MPV is considered an indicator of platelet function and an independent predictor of coronary artery

disease (CAD), severity of CAD, larger infarct volume in stroke patients and severity of strokes [10].

In this study, it was found that the values of MPV were higher in the group of patients with worse stroke outcome (mRS ≥3), meaning that there is a relation between the elevation of MPV value and the severity of stroke, and that MPV could possibly be used as a tool to predict more aggressive form of the disease. This was consistent with what was stated by Ghahremanfard et al. [11] in their study that measuring MPV within the first 24 hours of brain stroke appearance was strongly related to the severity of disease, and could effectively discriminate a severer situation from a milder degree of the disorder. Increased MPV was associated with a poorer outcome in patients suffering an acute ischemic cerebrovascular event. In another study done by Arikanoglu et al. [12], they found higher MPV values in the acute ischemic stroke patients in comparison to the control group.

However, Cho et al. [13] in their study did not find statistically significant difference between patients and controls regarding MPV values. This finding may indicate differences in environment, dietary habits or other co-morbidities that should play a role in MPV values, but most of the studies determined that MPV levels were higher in stroke patients [14][15].

Regarding age distribution, it was found that the mean age of the second group of patients was higher than that of the other one, this finding was supported by Ghahremanfard et al. [11] who mentioned that in their patients, those with higher Rankin Scale were older than the others. National Stroke Association [16] stated that a stroke can happen to anyone, but risk of stroke increases with age. After the age of 55, stroke risk doubles for every decade
a person is alive.

Gender distribution, clinical history of IHD and smoking showed no significant differences between the two patients'

groups, this may be attributed to the small sample size of the study, or may be due to conflicting genetic and environmental factors. Those results were inconsistent with the findings of similar studies: A study by Cho et al. [13] showed that MPV levels were higher in stroke female patients than males, also Salihovic et al. [17] demonstrated that in their study the frequency of ischemic stroke was higher in females and they were older than males. A study by Ghahremanfard et al. [11] reported that stroke patients with higher Rankin Scale had more prevalence of previous ischemic heart disease, also Arevalo-Lorido et al. [18] mentioned that higher MPV levels in stroke patients are associated not only with overall morbidity and mortality, but also their cardiovascular mortality. A study by Paul et al. [19] stated that smoking is a crucial independent determinant of cerebral infarction and subarachnoid hemorrhage.

Conclusion
Mean platelet volume is a strong and independent risk factor for acute ischemic stroke and high MPV values may be associated with a severe form of the disease. Further studies with larger sample size are essential to address more risk factors for ischemic stroke that can't be reached in this study.

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