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Original Article

Mean Platelet Volume and Acute Stroke Patient Characteristics

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Abstract

Objective: Platelet indices are considered as an important marker of inflammation and thromboembolism. Out of these platelet indices, mean Platelet volume (MPV) changes have been associated with cardiovascular diseases. The objective of this study was to compare MPV in patients with ischemic and hemorrhagic acute stroke. Additionally, correlation of MPV with gender, risk factors, severity of stroke, and outcome was also done.

Methods: This cross-sectional study was conducted from October 2018 to March 2019 at Rawalpindi Medical University Allied Hospitals. 94 acute stroke patients (ischemic or hemorrhagic- intracerebral or non-traumatic subarachnoid hemorrhage) were included. Patients with stroke mimicking conditions, hematological abnormalities associated with platelet number/quality, and on antiplatelet and anticoagulant drug etc. were excluded. At presentation blood sample was drawn for MPV determination by single automated hematology analyzer machine within 2 hours of venipuncture. Chi2 test, Fishers exact test, Student-t test, and ANOVA were used for finding significant association. P-value < 0.05 taken as statistically significant.

Results: 53.2% were female and the rest male. Mean patient age was 58.67±16.37 years. 59.75% patients had hemorrhagic stroke and 40.4% had ischemic stroke. Most frequently noted risk factors for stroke were hypertension (53.2%) and diabetes mellitus (16%). 94.7% patients at admission Modified Rankin Score was >3. Mean GCS of all patients was 9.9 ± 3.79. MPV of all the patients were 8.9±0.85 Similarly, mean platelet count was 268.26±76.06x103/l. On 7th day of admission, outcome wise, 88.3% patients were alive and rest expired. MPV among ischemic and hemorrhagic patients did not differ significantly. Correlation of patient's characteristics with MPV was also statistically insignificant.

Conclusion: MPV in ischemic and hemorrhagic acute stroke patients doesn't differ. MPV values are also not associated significantly with gender, risk factors, stroke severity and outcome.

Keywords. Mean Platelet Volume, Acute Stroke, Intracranial Hemorrhage.

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Introduction

Stroke is the second leading cause of death and a major cause of disability worldwide. Its incidence is increasing, and reason is directly related to increase in elderly population. Ischemic stroke accounts for 80% and hemorrhagic stroke accounts for about 20% of all strokes.[1] But hemorrhagic stroke is responsible for more deaths and disability.[2] Incidence and mortality of stroke differ between countries, geographical regions and ethnic groups. The incidence of stroke, adjusted to the WHO world standard population, ranged from 76 per 100,000 population per year.[3]

Platelet indices have gained importance in recent years as there is an intricate relationship between thrombosis and inflammation as both influence each other. Various markers have been used earlier to predict this inflammation and thrombosis, and platelet indices are one of these. Whenever there is rupture

of an atherosclerotic plaque, platelets start playing a very crucial role in pathogenesis of further thrombus formation and maintaining integrity of blood vessels hemostasis.

The large platelets are metabolically more active due to increased dense granules within them as compared to normal platelets. This thrombomegaly (diameter >2.5mm) which can be visualized under light microscope, has been described in earlier studies in association with acute ischemic stroke, myocardial infarction, diabetes mellitus, hypercholesterolemia, metabolic syndrome and smoking when compared with healthy controls. Other than light microscopy functional activation of these giant platelets can be assessed by measuring platelet volume known as Mean Platelet Volume (MPV). So, it can be safely said that MPV is a marker of platelet activity.[4]

MPV in previous studies have been found to predict cardiovascular events. High MPV values have been found to be directly associated with acute ischemic stroke and acute Myocardial Infarction.[5,6] Raised values of MPV are not only seen once the event has occurred but also in patients who are at risk of developing atherosclerotic vascular complications.[7] Association of MPV values with ischemic changes in ECG has also been documented in the literature. This relationship compared to normal individuals has been studied internationally.[8] Association of MPV in acute CVA and its morbidity in being reviewed in the studies internationally. Moreover, the role of MPV in predicting second event in patients with a history of stroke has also been studied.[9]

Knowing that MPV change in our acute stroke patients can help in its evaluation as marker for acute stroke. This study was planned to compare MPV in patients with ischemic and hemorrhagic acute stroke. Additionally, correlation of MPV with gender, risk factors, severity of stroke, and outcome was also done.

Methods

This cross-sectional study was conducted at Medical Unit- II, Holy Family Hospital Rawalpindi/ Rawalpindi Medical University (RMU) from October 2018 to March 2019 after approval from Institutional Research Forum/ Ethical Research Forum of RMU. The sample size was calculated by using Open Epi, Version 3, open source statistical calculator. With the estimated population of 280 sample size was 94 with a CI of 95% and absolute precision of 8.3%.

94 adult patients of both the genders (>18 years age) with newly diagnosed acute stroke were included in the study randomly from the pool of acute stroke patients presenting during the study period after informed consent from the patient or surrogate. Acute ischemic stroke was defined as acute neurological deficit within 24 hours of presentation.[10] The diagnosis and type of stroke either hemorrhagic (intracerebral or non-traumatic subarachnoid hemorrhage) or ischemic was confirmed by performing CT-Scan brain without contrast on the same day.

The patients with acute infections, inflammatory conditions like SLE, malignancy including brain tumor, transient ischemic attack, head injury, epidural/ subdural hematoma, acute coronary syndrome and acute limb ischemia were excluded from the study. Similarly, those who were on antiplatelet and anticoagulant drugs, having pre-existing thrombocytopenia and either inherited or an acquired cause of decrease platelet production and platelet dysfunction cases were also excluded from the study.

All patients were admitted after initial medical and neurological evaluation and managed as per protocol. At presentation blood sample was drawn and mixed with EDTA in standard way from each patient for MPV determination by single automated hematology analyzer machine (Mindray, BC-3000 plus) in the Department of Hematology within 2 hours of venipuncture.

The severity of stroke was assessed by using Modified Rankin Score at the day of their admission and was classified into two groups of disability. Group 1 from score <3 and group 2 from score >311. Similarly, we also used Glasco Coma Scale for assessment of conscious level. Patients with score 13-15 labelled as mild, 9-12 as moderate and 3-8 as severe brain insufficiency[12]. Risk factors like Diabetes, Hypertension, Ischemic Heart Disease, and Smoking were assessed in all patients. Outcome of each subject was noted on day 7th post stroke as expired, discharged or retained.

A specially designed Performa was used to record the patient's details (age, gender), type of acute stroke, MPV, platelet count, severity scoring of stroke, outcome and risk factors for cerebrovascular disease (i.e. diabetes mellitus, hypertension, ischemic heart disease and smoking).

SPSS Statistical package for Social Sciences was employed for statistical analysis. Quantitative variables (i.e. age, and MPV) were presented as mean±SD, while qualitative variables (gender, type of stroke, risk factors, and outcome) were presented as frequency and percentages. Chi-square test, Fishers exact test, Student-t test, and ANOVA were used for finding significant association between the variables. P-value < 0.05 taken as statistically significant.

Results

Of the ninety-four patients 53.2% were female and the rest were male. Most patients were between 61-70 years (31%). Patient's mean age was 58.67±16.37 years. 59.75% patients had hemorrhagic stroke and rest had ischemic stroke. Out of the risk factors for

stroke, hypertension and diabetes mellitus were most frequently noted.

Regarding severity of stroke is concerned, 89 (94.7%) patients at admission Modified Rankin Score was >3.

Table 1: *Patient Characteristics (n=94)*

Characteristic		Finding/Result
Mean Age (years)		58.67±16.37
Gender (n/%)		Male 44 (46.8%) Female 50 (53.2%)
Risk Factors (n/%)		
Diabetes		15 (16%)
Hypertension		50 (53.2%)
Smoking		16 (17%)
Ischemic Heart Disease		13 (13.8%)
Mean Platelet Volume (MPV)		8.9 ± 0.84
Platelet Count ×10^9/L		268.26±76.06
Type of Stroke (n/%)	Ischemic	38 (40.4%)
	Hemorrhagic	56 (59.5%)
At admission GCS Severity Scoring (n/%)	Mild	28 (29.8%)
	Moderate	35 (37.2%)
	Severe	31 (33%)
At Admission Modified Rankin Score (n/%)	Group I (0-3)	5 (5.3%)
	Group II (>3)	89 (94.7%)
Outcome at 7th Day (n/%)	Expired	11 (11.7%)
	Discharge	83 (88.3%)

Table II: *Mean Platelet Volume (MPV) Correlation with Patient Characteristics*

Characteristic		MPV value	P value
Gender			
Male	44	8.896±0.790	0.763
Female	50	8.92±0.90	
Risk Factors			
Diabetes	15	9.06±0.797	0.928
HTN	50	8.85±0.827	
Smoking	16	8.96±0.978	
Ischemic Heart Disease	13	8.82±0.864	
Type of Stroke			
Ischemic Stroke	38	8.97±0.857	0.48
Hemorrhagic Stroke	50	8.83±0.844	
At admission GCS			
Mild	28	9±0.777	0.850
Moderate	35	8.79±0.88	
Severe	31	8.92±0.88	
Modified Rankin Score			
Group I (0-3)	5	8.78±1	0.745
Group II (>3)	89	8.90±0.84	
Outcome			
Death	11	9.01±0.58	0.628
Discharge	83	8.88±0.877	

Mean GCS of all patients was 9.9 ± 3.79. Based on GCS score, 37.2% patients had moderate and 31% had severe brain insufficiency at admission. Mean MPV of all the patients was 8.9±0.85 (normal 7.2-11.7 fL).[13] Similarly mean platelet count was 268.26± 76.06×103/l (normal 150-350×103/l). On 7th day of admission, outcome wise, 88.3% patients were alive and rest expired. Details in these regards are given in Table I. Correlation of patient's characteristics (gender, risk factors, type of stroke, GCS and Modified Rankin Score, and outcome) with MPV are given in Table II. It is to be noted that no statistically significant correlation was found in this regard.

Discussion

This study included relatively older, acute stroke patients with slight female gender and hemorrhagic stroke predominance. Hypertension was most frequently noted risk factor. Our study is different compared to various studies focusing MPV and stroke in comparison to healthy controls i.e., we compared MPV in stroke patients with reference to age, gender, type, severity, and outcome among stroke patients, while the Mean MPV, and platelet counts of these patients were in normal limits. Although we expected but we did not found significant association between type of stroke, severity, and outcome with reference to mean MPV values.

Mean platelet volume (MPV) correspond with size of platelets. It ranges from 9.4–12.3 fL. Size of younger platelets is more compared to old. Increased production of platelets is thus associated with increase in MPV. Younger and larger platelets are more reactive as these contain comparatively more granules, and have more adhesion molecule expression. These are also activated quickly. These characteristics can potentially contribute to thrombosis. In thrombotic states platelets release Thromboxane A2, Serotonin, Glycoprotein III A etc that are prothrombotic and further initiate inflammatory process.[14] MPV measurements have been considered to predict inflammation and thrombosis.

Platelet counts and MPV relationship has been evaluated with reference to stroke. Increased MPV has been noted in acute stroke cases compared to controls.[15] According to Mayda-Domac and colleagues unfavorable outcome corelates with increased MPV in ischemic stroke patients.[15] Decrease platelet count correlated significantly with hemorrhagic stroke in the same study, such association with reference to MPV was not observed however.[15] In ischemic stroke patients thrombopoietin and MPV are increase and it has been suggested that these may have contributory effect to stoke progression.[16] In a study by Arikanoglu A et al, and Mohamed AB et al higher MPV values were

associated with poor outcome in stroke patients.[17] It has been considered that elevated MPV is stroke patients indicates inflammatory state prior to onset of stroke that improves with recovery from stroke.[18]

In a study by Ghahremanfard F et al., acute ischemic stroke patients with high MPV value on presentation had increased disease severity and poor prognosis. Elsayed AM et al., documented that higher MPV values in stroke patients with more neurological impairment in comparison with those with less neurological damage. In this study stroke severity was assessed by modified Rankin score.[19] Greisenegger S et al., divided acute ischemic stroke patients into five groups based on MPV value after one week of the acute event. Patients with highest MPV value had two times increased risk of having a severe stroke.[20]

Findings similar to ours have been noted earlier. Özgür Dogan & colleagues in a similar study did not find MPV difference in ischemic compared to hemorrhagic stroke.[21] In a study by Ugur Lok et al., MPV value were not significantly associated with stroke severity and poor functional outcome.[22] Sun Young Cho et al., noted that no significant difference between the MPV value of ischemic stroke patients and healthy controls. Similarly Ntaios et al also did not find statistically significant difference in MPV with reference to acute ischemic stroke severity and outcome.[23] Hemorrhagic stroke is however not generally associated with MPV change.[24]

A number of factors that may affect MPV in settings like ours have been noted earlier. These have been categorized to pre-analytical and analytical types. The way venepuncture is done, anticoagulant, blood temperature are few of the analytical factors. It has been considered that EDTA itself can cause swelling of platelets and increases MPV. Non uniformity of the time between venepuncture and analysis by haematology analyser may also have impact on MPV as thrombomegaly is time dependant.[24] Analytical factors include the methodology used in haematology analyser i.e., optical, impedance, combination or other.[25]

Demographic features are other noteworthy factors in this regard. We tried our best to avoid many of these.[24] MPV in our patients was within range, however adding control arm in this study may have further clarified the difference if it existed.

Conclusion

Acute ischemic and hemorrhagic stroke patients do not significantly differ in terms of MPV. Additionally, mean MPV in stroke patients does not differ statistically with reference to gender, severity, and outcome of stroke.

Conflict of Interest: None

Funding Source: None

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