STUDY OF SERUM MEAN PLATELET VOLUME IN ISCHAEMIC STROKE PATIENTS

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ABSTRACT

BACKGROUND

Stroke is one of the major healthcare problems; the third leading cause of death in developing countries and the leading cause of long-term disability. The Mean Platelet Volume (MPV) is one of the commonly used laboratory markers in relation to platelet functions. Some studies detected an increased MPV in different subtypes of brain stroke, both in the acute phase and long after disease. Higher mean platelet volume (MPV) values have been established in patients with acute myocardial infarction but very few studies have demonstrated association between platelet size and ischaemic stroke. Mean platelet volume has been identified as an independent predictor of the risk of stroke among high risk individuals with a history of prior cerebrovascular disease.

MATERIALS AND METHODS

This study will be conducted in R.L. Jalappa Hospital, Kolar in patients of 2 groups. Group 1 (cases) consists of patients with ischaemic stroke patients and group 2 (controls) consists of non-ischaemic stroke cases who fulfil inclusion and exclusion criteria. A comparative cross-sectional study comprised of 50 cases and 44 controls. Blood samples were taken to measure MPV, and the severity of ischaemic stroke was assessed by the Modified Rankin scale.

RESULTS

The ischaemic stroke patients had significantly higher MPV compared to the control group. Mean Platelet Volume among cases was 9.69±1.58 and among controls was 5.85±1.30. There was significant difference in mean platelet volume between two groups. The MPV value was higher and more significant in patients' group with higher scores in Rankin scale (P3) in comparison with those with lower scores. In the study area under the curve was 0.956. i.e. it was close to 1. Hence MPV was significantly predicting stroke subjects.

CONCLUSION

Increased MPV is related to acute cerebrovascular stroke. Also, the MPV can be considered as a simple, cost-effective and meaningful laboratory markers test for early detection and risk stratification of cerebrovascular stroke.

KEYWORDS

Mean Platelet Volume, Predictors of Ischaemic Stroke, Severity of Stroke based on Rankin score.

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BACKGROUND

Stroke is one of the major healthcare problems; the third leading cause of death in developing countries and the leading cause of long-term disability. Stroke results in more than 6 million deaths every year and at least 1 of 6 patients who survive will suffer another stroke within 5 years. The mean platelet volume (MPV) is one of the commonly used laboratory markers in relation to platelet functions.[1,2] Larger volume platelets are more reactive than normal volume platelets due to their more granule composition, they produce more pro thrombotic factors, aggregation and secrete more thromboxane.[3,4] Ischaemic stroke is thought to occur as a result of thrombotic occlusion of a stenosed atherosclerotic blood vessel.[5] In addition, there is evidence that an elevated MPV is associated with a poor outcome among survivors of myocardial infarction[6,7] and stroke and with an increased risk of restenosis after coronary angioplasty.[8] Furthermore, MPV has been shown to be predictive of stroke, in patients with previous cerebrovascular events, even 3.9 years before the original event.[9] Some studies detected an increased MPV in different subtypes of brain stroke, both in the acute phase and long after disease.[10] Stroke patients with high mortality have been found to have a low platelet count.[11] Higher mean platelet volume (MPV) values have been established in patients with acute myocardial infarction[6,7] but very few studies have demonstrated association between platelet size and ischaemic stroke. Among them there has been discrepancy regarding the sample size, methodology used and the final results. Mean platelet volume has been identified as an independent predictor of the risk of stroke among high risk individuals with a history of prior cerebrovascular disease.[12] The measurement of MPV may add useful prognostic information for clinicians managing

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patients with a history of cerebrovascular disease.[12] There are few documented studies in India comparing the association of mean platelet volume with ischaemic stroke. Hence, we have studied these variables using a precise methodology in an unselected group of stroke patients and compared them with data from age- and sex-matched control subjects.

Objectives

1) To compare the MPV between ischaemic cerebrovascular stroke patients and control subjects and to find out their diagnostic value in an acute setting to help risk stratification in patients with ischaemic stroke.
2) To determine the MPV as an independent predictor of the risk of stroke among high-risk individuals with a history of co-morbidities and prior cerebrovascular disease.

MATERIALS AND METHODS

This study was comparative cross-sectional study conducted on patients attending the general medicine outpatient section and inpatient of R.L. Jalappa hospital and research centre Tamaka, Kolar.

This study consists of 2 groups of patients. Group 1(cases) consists of 50 patients with acute ischaemic stroke patients and group 2 (controls) consists of 50 controls with no clinical evidence of any active or old cerebrovascular accidents, malignant causes and not on any drugs (medications) affecting the function of the platelets.

All data were collected, including demographics, medical history and previous history of ischaemic heart disease or cerebrovascular diseases, lab parameters, medications, 2D echocardiography, and neuroimaging scans. Exclusion criteria are for patients who had peripheral vascular disease, previous stroke patients, acute bacterial/viral infections, any inflammatory conditions, pregnancy, acute myocardial infarction, malignancies symptoms of cerebrovascular diseases.

The diagnosis of ischaemic stroke was made clinically with the evidence of acute lesions (infarct) confirmed by brain CT or MRI within the first 24 h of presentation of symptoms.

Each patient condition was assessed by Rankin Scale. Severity of ischaemic stroke was Modified Rankin scale that scores on a scale of 0–6, with 0 as patients with no symptoms and 6 being dead. Scores of 0–2 are considered less severe and these patients are able to lead normal independent lives without any support. Patient with Scores of 3 or greater considered as more severe and need support to lead their daily life.

No symptoms.	0
No significant disability. Able to carry out all usual activities despite some symptoms	1
Slight disability. Able to look after own affairs without assistance, but unable to carry out all previous activities	2
Moderate disability. Requires some help, but able to walk unassisted.	3
Moderately severe disability. Unable to attend to own body needs without assistance and unable to walk unassisted.	4
Severe disability. Requires constant nursing care and attention, bedridden, incontinent.	5
Dead	6

Table 1. The Modified Rankin Scale[13]

Statistical Analysis

The Data was entered into Microsoft excel data sheet and was analysed using software version SPSS 22. Categorical data was represented in the form of Frequencies and proportions. Chi-square test was used as test of significance for qualitative data. Continuous data was represented as mean and standard deviation. Independent t test was used as test of significance to identify the mean difference between two quantitative variables.

Graphical Representation of Data

MS Excel and MS word was used to obtain various types of graphs such as bar diagram and ROC Curve.

p value (Probability that the result is true) of <0.05 was considered as statistically significant after assuming all the rules of statistical tests.

RESULTS

		Age		P value
		Mean	SD	
Group	Cases (Stroke)	53.82	12.39	0.412
	Controls (Non-Stroke)	55.82	10.91	

Table 2. Age Distribution Comparison between Two Groups

Mean age of subjects in Stoke patients was 53.82±12.39 years and in control group was 55.82±10.91 years. There was no significant difference in age distribution between two groups.

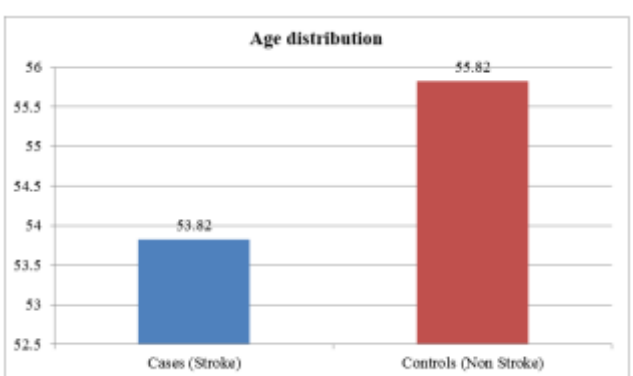

Figure 1. Bar Diagram showing Age Distribution Comparison between Two Groups

		Group			
		Cases (Stroke)		Controls (Non-Stroke)	
		Count	%	Count	%
Sex	Female	17	34.0%	17	38.6%
	Male	33	66.0%	27	61.4%

Table 3. Sex Distribution Comparison between Two Groups

$\chi 2 = 0.218$, df = 1, p = 0.641

Among cases, 66% were males and 34% were females and among controls 61.4% were males and 38.6% were females. There was no significant difference in sex distribution between two groups.

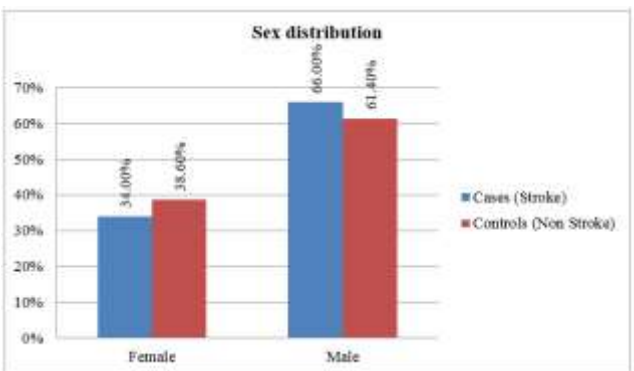

Figure 2. Bar Diagram Showing Sex Distribution Comparison between Two Groups

		Platelets count (cells/mm3)		P value
		Mean	SD	
Group	Cases (Stroke)	251300.00	86514.42	0.621
	Controls (Non-Stroke)	259386.36	69251.22	

Table 4. Platelet Count Comparison between Two Groups

Mean Platelet count among cases was 251300.00±86514.42 cells/mm3 and among controls was 259386.36±69251.22 cells/mm3.

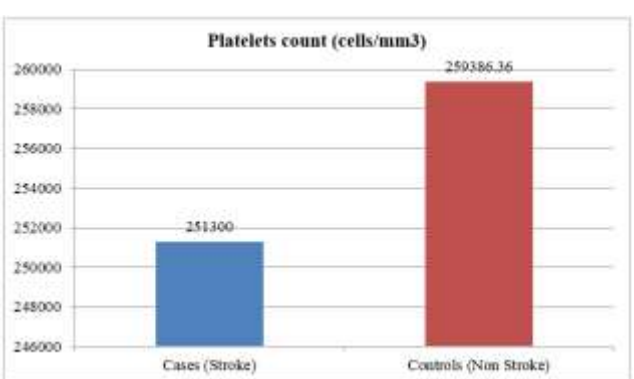

Figure 3. Bar Diagram showing Platelet Count Comparison between Two Groups

		MPV		P value
		Mean	SD	
Group	Cases (Stroke)	9.69	1.58	<0.001*
	Controls (Non-Stroke)	5.85	1.30	

Table 5. MPV Comparison between Two Groups

Mean Platelet volume among cases was 9.69±1.58 and among controls was 5.85±1.30. There was significant difference in mean platelet volume between two groups.

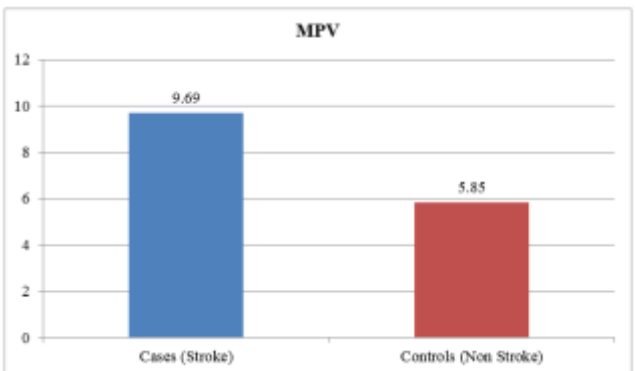

Figure 4. Bar Diagram showing MPV Comparison between Two Groups

		Group	
		Cases (Stroke)	
		Count	%
Modified Rankin score	2	7	14.0%
	3	19	38.0%
	4	15	30.0%
	5	9	18.0%

Table 6. Modified Rankin Score among Cases

Among cases, modified Rankin score was 2 in 14%, 3 in 38%, 4 in 30% and 5 in 18%.

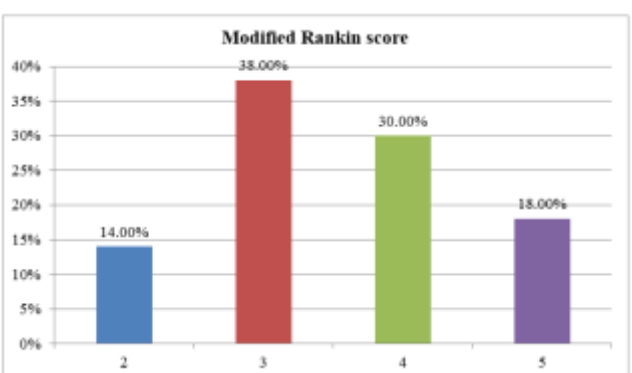

Figure 5. Bar Diagram showing Modified Rankin Score Among Cases

Area under the ROC curve (AUC)

Area under the ROC curve (AUC)	0.956
Standard Error	0.0251
95% Confidence interval	0.893 to 0.987
z statistic	18.170
Significance level P (Area=0.5)	<0.0001*

Table 7. Validity of MPV in Diagnosis of Stroke

In the study area under the curve was 0.956. i.e. it close to 1. Hence MPV was significantly predicting Stroke subjects.

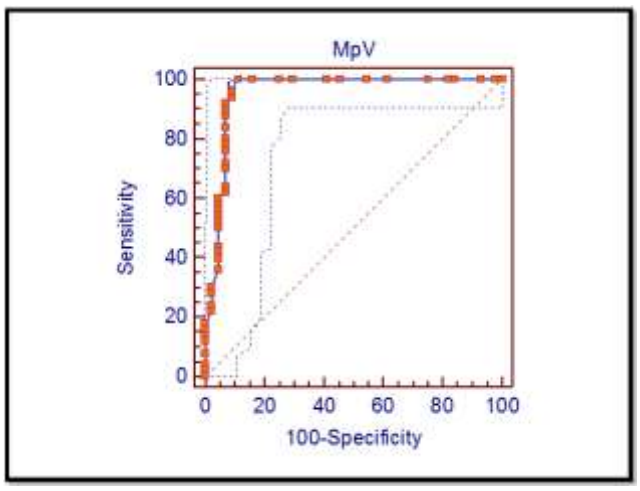

Figure 6. ROC Curve showing Validity of MPV in Diagnosis of Stroke

Youden index J	0.8891
95% Confidence interval	0.7755 to 0.9545
Associated criterion	>7
95% Confidence interval	5.9 to 7.5

Table 8. Youden Index

MPV of >7 had highest sensitivity and specificity in diagnosis of Stroke.

MPV >7	Estimate	Lower - Upper 95% CIs
Sensitivity	98.00%	89.4 - 99.9
Specificity	90.91%	78.3 - 97.5
Positive Predictive Value	92.45%	82.14, 97.03
Negative Predictive Value	97.56%	87.4, 99.57
Diagnostic Accuracy	94.68%	88.15, 97.71

Table 9

MPV of >7 had Sensitivity of 98%, Specificity of 90.91%, Positive Predictive Value of 92.45%, Negative Predictive Value of 97.56% and Diagnostic Accuracy of 94.68%.

		Group			
		Cases (Stroke)		Controls (Non-Stroke)	
		Count	%	Count	%
MPV	>7	49	98.0%	4	9.1%
	<7	1	2.0%	40	90.9%

Table 10. Association between MPV and Two Groups

χ 2 = 75.22, df = 1, p <0.001*

Among cases, 98% had MPV >7 and 2% had MPV <7. Among controls, 90.9% had MPV <7 and 9.1% had MPV >7. There was significant association between stroke and MPV.

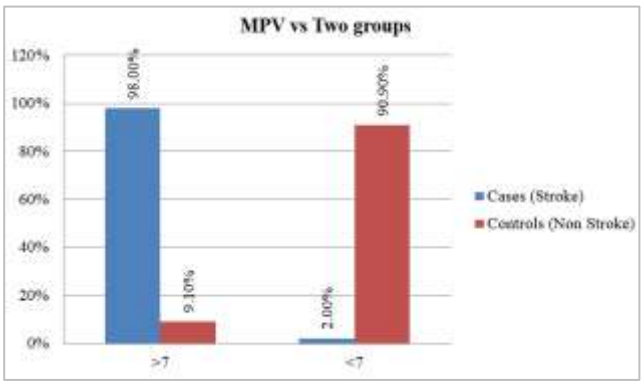

Figure 7. Bar Diagram showing Association between MPV and Two Groups

DISCUSSION

Mean platelet volume (MPV) has clinical importance in thrombo-embolic diseases. Increase in the mean platelet volume (MPV) level has been observed in patients with stroke[14] and acute myocardial infarction[7] than in controls. In this present study, we found that MPV was significantly higher in patients with acute cerebral ischaemic stroke compared to control groups. In the similar study by O'Malley et al. found greater MPV values in patients with acute ischaemic stroke than in controls. Conversely, Cho et al. did not find any significant difference between patients and controls in relation to MPV values,[15] but most of the studies proved that MPV levels were higher in stroke patients.[2] The current study evaluated the role of MPV for expecting severe and extensive acute ischaemic brain stroke from its mild status, and it showed that measuring MPV within the first 24 h of brain stroke occurrence was strongly associated with the severity of disease, and could effectively distinguish a severe condition from a milder degree of the disorder, this present study also revealed that MPV increases early in the strokes characterized by more neurological impairment in comparison with those with less compromised categories according to modified Rankin score. This may indicate more release of reactive platelets in the circulation in reaction to mediators coming from the peripheral ischaemic sites. In the PROGRESS study,[9] demonstrated that MPV may be raised before the acute event and also stated an 11% rise of the relative risk of stroke for every femtoliter of MPV increment in 3134 individuals with prior cerebrovascular disease, prospectively followed for a median period of 3.9 years. Thus, subjects with large platelets have an increased risk of ischaemic stroke. Cho et al.[15] showed that MPV levels were higher in female patients than in male. But our study did not show any significant difference in MPV according to gender. In a study by Elsayed AM et al 15 showed MPV value was higher and more significant (p= 0.011) in patients' group with high Rankin scale (P3) in comparison with those with lower scores, our present study also showed significant higher MPV values with Rankin scale ≥3 demonstrating severity of stroke has a strong association with increased

MPV. Our ROC analysis verified that MPV could be used as surrogate laboratory markers for detecting cerebrovascular stroke with MPV of >7 had Sensitivity of 98%, Specificity of 90.91%. In comparison Nurettin et al.[16] reported that an MPV cutoff value of 9.95 femtoliter had 46.2% sensitivity and 80.0% specificity.

CONCLUSION

Increased MPV is related to acute cerebrovascular stroke. Also, the MPV can be considered as a simple, cost-effective and meaningful laboratory marker for early detection and risk stratification of cerebrovascular stroke.

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