Original Article

Assessment of Platelet Indices in Ischemic Stroke and its Relation with Severity in a Tertiary Care

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Abstract

Introduction: Cerebrovascular disease is one of the most common causes of death and disability worldwide. Among cerebrovascular disease, ischemic stroke is more compared to hemorrhagic stroke. With each episode of cerebral infarction, about 15–30% of patients die and with cerebral hemorrhage, 16–80% die.

Aim: This study aims to analyze the association between platelet indices and severity of stroke assessed by the National Institute of Health Stroke Scale (NIHSS) and modified Rankin scale.

Methods: About 100 patients admitted with acute ischemic stroke in the general medicine wards of Kanyakumari Medical College were studied during the period from April 2019 to April 2020. Analysis was done on various risk factors, stroke subtypes and platelet indices were calculated using a blood sample and its relation with severity of stroke was assessed.

Results: The mean platelet count of the study participants was 2.72 and mean platelet volume (MPV) was 9.68. The mean platelet distribution width (PDW) was 15.18 and platelet count and plateletcrit (PCT) was 0.265, respectively. MPV was observed to be higher in patients with severe stroke. Low PDW and high PCT were also observed to associate with severity of stroke and disability pertaining to stroke.

Conclusion: Platelet indices are emerging as an important prognostic tool in patients with acute ischemic stroke since they are easily available and cheaper. Further researches are needed to study the exact utility of platelet indices in deciding about the early intervention and other treatment modalities in acute ischemic stroke

Key words: Ischemic stroke, Platelet indices, National Institute of Health Stroke Scale, Modified Rankin scale

INTRODUCTION

Cerebrovascular diseases account for one of the major causes of morbidity and mortality across the world. It includes both ischemic stroke (85%) and hemorrhagic stroke (15%). It is a preventable cause of long-term disability to an extent by modifying the risk factors and rapid evaluation of the patient and proper initiation of treatment such as thrombolysis in acute ischemic stroke and measures like lowering BP in case of hemorrhagic stroke. Ischemic stroke accounting for most cerebrovascular accidents is a

sudden neurological deficit due to focal ischemia resulting from various causes such as atherothrombotic occlusion of large arteries, embolism, lipohyalinosis or non-thrombotic occlusion of deep penetrating cerebral arteries, and watershed infarcts resulting from hypotension.[1]

The main concept in managing patients with acute ischemic stroke depends on the presence of an ischemic penumbra which is a potentially salvageable tissue. The only FDA-approved treatment for acute ischemic stroke is tissue plasminogen activator, the benefits of which are limited by the short therapeutic window of 4.5 h.[2]

The major risk factors for stroke include hypertension, diabetes mellitus, dyslipidemia, smoking, old age, and coronary artery disease.[3] The major step in primary prevention is by controlling the modifiable risk factors. The outcome of ischemic stroke also depends on a number of factors, the most important one determining the prognosis

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being the severity of stroke.[4] It is prudent to predict the outcome of stroke as it is liable for long-term neurological disability. Furthermore, there is a considerable difference in the extent of recovery among stroke survivors. Various scoring systems were elucidated to quantify the severity as well as disability caused by stroke-like National Institute of Health Stroke Scale (NIHSS) score[5] and modified Rankin scale.

The pathogenesis of acute ischemic stroke revolves around platelet activation and platelet aggregation. Platelet indices are an emerging tool for predicting the prognosis for an ischemic stroke. The parameters commonly used being mean platelet volume (MPV), plateletcrit, and platelet distribution width (PDW).[6] They are derived from the automated complete blood count hence serve the purpose as a cheaper prognostic tool in assessing the severity of ischemic stroke. The increased activity of platelet in the causation of ischemic stroke could be attributed to metabolic abnormalities such as hyperlipidemia, insulin resistance, hyperglycemia, or the underlying inflammation, endothelial dysfunction, and oxidative stress.[7]

The MPV is the widely used platelet parameter to study platelet activation.[8] It is elevated in acute ischemic stroke, myocardial infarction, and other thromboembolic conditions. This association between MPV and ischemic stroke helps in assessing the prognosis of stroke survivors.

Aim
This study aims to analyze the association between platelet indices and severity of stroke assessed by NIHSS and modified Rankin scale.

MATERIALS AND METHODS

The observational cross-sectional study was conducted in 100 patients with acute ischemic stroke at general medicine wards of KGMCH, Asaripallam.

Inclusion Criteria
First episode of acute ischemic stroke (confirmed by imaging studies) with or without risk factors, gender – males/females, age group – 18 years and above, the socioeconomic group – all socioeconomic groups.

Exclusion Criteria
Thrombocytopenia, known as hereditary disorders of large platelets and coagulation disorders, patients already on antiplatelet medication such as aspirin/clopidogrel or on anticoagulants, hemorrhagic stroke and recurrent stroke, medications reducing platelet count such as hydroxyurea, antineoplastic drugs, and peripheral smear showing platelet aggregates.

About 100 patients with acute ischemic stroke who fulfilled inclusion and exclusion criteria were studied. Written informed consent was obtained from patients or close relatives. History was taken according to a questionnaire and patients were subjected to thorough clinical examination and investigations. Investigation results were compared with normal reference values. Stroke severity was assessed based on NIHSS score. Platelet indices including MPV, PDW, and platelet count and plateletcrit (PCT) were assessed immediately (within 2 h) after admission. Platelet indices were analyzed in automatic cell counter Sysmex Xp100. After 3 months, functional outcome was assessed using the modified Rankin scale (MRS) to assess the relationship between platelet indices and stroke outcome. A platelet count above 2.5 L/cumm, MPV value above 9.5 Fl, PCT above 0.3%, and PDW below 14% are considered significant.

All data collected in the study were analyzed using the SPSS structured software (SPSS IBM) version 25. For comparing categorical data, the Chi-square test was used. In addition, the Kruskal–Wallis test was used for comparing more than 2 groups. Statistical significance is present if $P < 0.05$ was considered.

RESULTS

The mean age of the study participants was 68 ± 8.2 years in the study. The majority of the study participants belong to the age group of 61–70 years (40%) followed by 71–80 years of age (36%). About 65% of them were male and 35% were female. The majority of the ischemic stroke involved middle cerebral artery (MCA) (74%) vascular territory. In addition, 66% of the study participants had lacunar stroke type of stroke followed by 12% had partial anterior circulation and posterior circulation syndrome, respectively. About 10% of ischemic stroke were total anterior circulation syndrome type [Table 1].

Among the study participants, 48% were known about diabetes mellitus and 69% were known cases of systemic hypertension.

According to the NIHSS, 4% had a minor stroke. About 41% and 31% had moderate and moderate-to-severe stroke, respectively. About 24% of the study participants had a severe stroke [Table 2].

According to MRS majority of the study participants (42%) had a moderate disability and 29% had moderate-to-severe disability, respectively. However, 10% had severe disabilities. In addition, among the study participants, 6% expired during the study period [Table 3].

Among the study participants, 48% were known about diabetes mellitus and 69% were known cases of systemic

Table 1: Patient characteristics

Patient characteristics	Frequency	Percentages
Age group		
40–50	3	3
51–60	17	17
61–70	40	40
71–80	36	36
>81	4	4
Gender		
Male	65	65
Female	35	35
Vascular territories		
ACA	3	3
MCA	74	74
MCA-ACA	10	10
MCA-PCA	2	2
PCA	1	1
VBA	10	10
Subtypes of ischemic stroke		
LACS	66	66
PACS	12	12
POCS	12	12
TACS	10	10

MCA: Middle cerebral artery, LACS: Lacunar stroke, POCS: Posterior circulation syndrome, PACS: Partial anterior circulation, TACS: Total anterior circulation syndrome

Table 2: National Institutes of Health Stroke Scale

NIHSS	Frequency	Percentages
Minor	4	4
Moderate	41	41
Moderate-severe	31	31
Severe	24	24

NIHSS: National Institute of Health Stroke Scale

Table 3: Modified Rankin score

MRS	Frequency	Percentages
1	7	7.0
2	6	6.0
3	42	42.0
4	29	29.0
5	10	10.0
6	6	6.0

MRS: Modified Rankin scale

hypertension. About 56% of study participants had a history of dyslipidemia. 43% and 36% of the study participants were a smoker and alcoholic, respectively. About 95% of the study participants had no previous history of CVA [Table 4].

The mean platelet of the study participants was 2.72 and MPV was 9.68. The mean PDW was 15.18 and PCT was 0.265, respectively [Table 5].

Risk factors such as diabetes mellitus, systemic hypertension, dyslipidemia, CAD, old CVA, smoking, and alcohol have

Table 4: Risk factors

Risk factors	Frequency	Percentages
DM	48	48
HTN	69	69
Dyslipidemia	56	56
Smoking	43	43
Alcohol	36	36
CAD	20	20
Old CVA	5	5

HTN: Hypertension, DM: Diabetes mellitus, CAD: Coronary artery disease, CVA: Cardiovascular

Table 5: Platelet parameters

Platelet parameters	Mean	Standard deviation
Platelet	2.72	0.672
MPV	9.68	1.522
PDW	15.18	1.769
PCT	0.265	0.091

MPV: Mean platelet volume, PDW: Platelet distribution width, PCT: Platelet count and plateletcrit

no significant association with abnormal platelet count [Table 6].

The majority of the study participants with abnormal PCT PDW, MPV had moderate-to-severe and severe stroke, respectively ($P < 0.0001$) [Table 7].

The study participants with a mean platelet count above 3 lakhs/cumm had unfavorable outcomes such as severe disability and mortality and the difference was found statistically significant. The study participants with mean PDW within 9–13% had unfavorable outcomes such as severe disability and mortality and the difference was found statistically significant [Table 8].

DISCUSSION

Platelet abnormalities are noted in cerebrovascular diseases in various studies implying the role of platelet activation in an acute ischemic stroke. There was a preponderance of MCA territory infarcts among the study population and only 1% of the total study population had PCA infarct. The major stroke subtype observed was lacunar infarct and only 10% of the population had total anterior circulation stroke.

About 69% of the study population were observed to be hypertensives and diabetes and dyslipidemia, accounting for 48% and 56%. Hence, hypertension was the major risk factor observed in our study. In a population-based study conducted in Rochester, Minn using multiple logistic regression analysis, 74% of the study population were hypertensives, and the population attributable risk of hypertensives was 26%.[8]

Table 6: Abnormal platelet indices and risk factors

Risk factors	PCT	PDW	MPV	Platelet count
DM	14	32	30	30
HTN	19	48	37	41
Dyslipidemia	13	37	28	33
Smoking	12	30	22	28
Alcohol	12	21	23	23
CAD	8	14	11	13
Old CVA	1	2	3	3

MPV: Mean platelet volume, PDW: Platelet distribution width, PCT: Platelet count and plateletcrit, HTN: Hypertension, DM: Diabetes mellitus, CAD: Coronary artery disease, CVA: Cardiovascular

Table 7: NIHSS and platelet indices

NIHSS	PCT	PDW	MPV	Platelet count (>2.5 L/cumm)
Minor	0	0	0	3
Moderate	4	1	4	25
Moderate-severe	10	10	27	18
Moderate-severe	15	20	24	17
P value	<0.0001	<0.0001	<0.0001	0.735

MPV: Mean platelet volume, PDW: Platelet distribution width, PCT: Platelet count and plateletcrit

Table 8: Mean platelet indices and stroke outcome

MRS	PCT	PDW	MPV	Platelet count
1 – Significant disability	0.219	17.4	7.571	2.194
2 – Slight disability	0.183	16.33	8.617	2.167
3 – Moderate disability	0.228	15.85	8.933	2.567
4 – Moderate-to-severe disability	0.282	14.67	10.29	2.745
5 – Severe disability	0.346	13.1	11.62	3.03
6 – Expired	0.443	12.66	12.36	3.616
P value	0.052	<0.0001	0.045	0.028

MPV: Mean platelet volume, PDW: Platelet distribution width, PCT: Platelet count and plateletcrit

The mean platelet count of the study participants was 2.72 and MPV was 9.68. The mean PDW was 15.18 and PCT was 0.265, respectively. Thus, 37% of the study participants with ischemic stroke had platelets count within the normal limits. About 55% of the study participants had abnormal MPV and 31% had abnormal PDW, respectively. About 71% of the patients with ischemic stroke had PCT within the normal limits.

The two scoring systems used in our study were NIHSS and MRS scores and the study population was categorized accordingly and its correlation with the various platelet indices was analyzed. About 24% of the study population had severe stroke according to NIHSS and 41% had a moderate stroke with only 4% presented with minor stroke and the rest of the study population had moderate-to-severe stroke. Using the MRS scoring system, 5% had a severe disability, 42% had moderate disability, 29% had moderate to severe disability, and 6% of the patients expired during the study.

MPV was found to associate with NIHSS as most of the patients with abnormal MPV had moderate-to-severe and severe stroke. PDW was found to be between 9 and 14% in patients with moderate-to-severe and severe stroke, thus implying that low PDW range correlated with unfavorable outcomes and higher PDW values correlated with a better outcome than the prognostic score. PCT was also observed to be higher in patients with severe stroke, thus showing a direct correlation between PCT and NIHSS.

It was also observed that patients with abnormal MPV had moderate-to-severe disability according to the MRS scoring system; lower PDW and higher PCT were also observed among patients with severe disability. As a statistically significant association was observed between the platelet indices and both the scoring systems, these can be used for assessing the prognosis of acute ischemic stroke. In the study conducted by Butterworth *et al.*, MPV was significantly higher in patients with ischemic stroke than in the control group.[9]

In our study, the risk factors such as hypertension, diabetes mellitus, old CVA, dyslipidemia, smoking, and alcohol intake were not associated with platelet indices. In the study conducted by Patil *et al.*, higher percentile of patients showed a history of recurrent stroke in people with diabetes with a raised MPV.[10]

About 6% of the patients expired during the study period. The mean MPV for this subgroup of patients was 12.36, PDW was 12.66, and PCT was 0.433 showing a statistically significant relationship between the platelet indices and mortality.

CONCLUSION

In patients with acute ischemic stroke, the platelet indices were altered from their normal range, which shows the platelet reactivity playing a major role in the pathogenesis of ischemic stroke and showing its utility in the prognosis of stroke patients. The MPV was found to be elevated in patients with severe stroke according to NIHSS and showed a direct correlation with disability scored according to the MRS scoring. Lower PDW was found to have an unfavorable outcome when compared to patients with higher PDW. Patients with lower PDW had a severe stroke as well as suffered from severe disability in our study. PCT was found to directly correlate with both the severity of the stroke and the disability inflicted by the stroke. Platelet indices, therefore, can serve as a valuable tool in the prognosis of acute ischemic stroke patients. It is an easily available test with low cost and is of utmost value in assessing the burden of stroke.

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