Original Research Article

Neuro vascular injury profile in CVA patients: A study on correlation between hematological indices and severity score in acute ischemic stroke

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ABSTRACT

Acute ischemic stroke results from sudden loss of blood circulation to an area brain leading to irreversible injury and neurological deficits persisting for more than 24 hours or until death. It accounts for 80-87% of all strokes. In this study, we aim to find the association between various hematological indices such as Mean platelet Volume (MPV), Platelet distribution Width (PDW), Neutrophil to Lymphocyte Ratio (NLR), Platelet to Lymphocyte ratio (PLR) and National Institute of Health Stroke Scale (NIHSS).

Materials and Methods: It was a prospective study done at Department of Neurology at Meenakshi Medical College Hospital and Research Institute, Kancheepuram, Tamil Nadu in which 100 patients of Acute Ischemic stroke were divided into two groups based on NIHSS score. Proper Exclusion criteria were carried out and the patients' blood samples were taken. Various Hematological indices were measured and statistical analysis was done using SPSS Software.

Results: There is positive correlation between NLR, PLR and NIHSS score. It is statistically significant association. But there is no statistical significance between Platelet indices and NIHSS score.

Conclusion: Being Low cost and easy to measure NLR and PLR, these indices can be used in the prediction of the prognosis in the Acute Ischemic Stroke patients.

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1. Introduction

Acute ischemic stroke is not only a severe disabling cerebrovascular event¹ but also has a great impact on patient's life and socioeconomic burden.² Although it can be prevented by controlling relevant risk factors,³ its prevalence and incidence remain rising with aging and atherosclerotic process.⁴ It is the commonest cause of mortality after coronary artery disease and the commonest cause of chronic adult disability.⁵

Acute ischemic stroke results from sudden loss of blood circulation to an area of brain leading to irreversible injury and neurological deficits persisting for more than 24 hours or until death. It accounts for 80-87% of all strokes.⁶

Platelets activation and aggregation are critical in the pathogenesis of acute ischemic stroke. There exist parameters to monitor platelets and their changes, namely:

Mean Platelet Volume (MPV), Mean Platelet Count (MPC), Plateletcrit (PCT), and Platelet Distribution Width (PDW).⁷ Together, these are called Platelet indices. Studies have shown that these indices are good indicators of thrombotic states.⁸

MPV is a commonly used biomarker of platelet function and activation.⁹ Increased MPV has been associated with greater in vitro aggregation in response to ADP and Collagen thereby associated with Myocardial Infarction, Transient Ischemic Attacks and Ischemic Stroke.¹⁰⁻¹⁴ PDW represents variation in platelet size. Larger PDW also indicates prothrombotic status.¹⁵ These indices are cost effective and routinely available.

Since Acute Ischemic stroke is an inflammatory event where the ischemic tissue releases chemokines and cytokines, and recruit peripheral circulating leucocytes.¹⁶ Lymphocytes also infiltrate the ischemic tissues and mediate inflammatory responses.¹⁶ Among the leucocytes,

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neutrophils were found to be an important mediator and early neutrophilia was found to be associated with larger stroke volumes and poor prognosis.¹⁷

In recent years, the neutrophil to lymphocyte ratio (NLR) and platelet to lymphocyte ratio (PLR) have emerged as well accepted biomarkers for the assessment of overall inflammatory status. These are simple and cost effective biomarkers.¹⁸ Elevated levels of NLR and PLR have found to be related to with oxidative stress and increased cytokine production in patients.¹⁹ The NLR has been used as an indicator to reflect the prevalence of intracranial atherosclerosis²⁰ and is considered to be an independent risk factor for ischemic stroke and a poorer prognosis.²¹ The PLR has been used to predict poor prognoses, the rate of insufficient recanalization and the size of infarcted area following stroke.²²

1.1. Aim of the Study

The aim of our present study is to investigate the relationship between these indices and stroke severity score in acute ischemic stroke.

2. Materials and Methods

The study is conducted in Department of Neurology at Meenakshi Medical College & Hospital, Kancheepuram, Tamil Nadu after getting approval from institutional ethics committee.

2.1. Duration of Study

July 2018 to July 2019

2.2. Sample size

100 Consecutive subjects with ischemic stroke admitted to Department of Neurology

2.3. Type of study

Prospective Study

2.4. Method of collection of Data

After obtaining consent, the patients were subjected to detailed history, clinical examination and investigations as per the proforma. Each patient was assessed and NIHSS score was assigned to them.

2.5. Inclusion Criteria

1. Age more than 18 years
2. All patients with acute ischemic stroke confirmed by history, neurological examination and imaging modalities of both anterior & posterior circulation.
3. Patients who are willing to give written informed consent

2.6. Exclusion Criteria

1. Patients with hemorrhagic stroke and previous attack of ischemic stroke
2. Patients with comorbid medical illness likely to interfere with platelet function or morphology like chronic kidney disease, heart bypass surgery, chronic liver disease, leukemia, active infection without infection and autoimmune diseases.
3. Patients receiving medication likely to interfere with platelet morphology or function like aspirin and other NSAIDs, antihistamines, and some antibiotics.
4. Patients presenting 48hrs after onset of neurological symptoms

For the measurement of indices, blood sample was collected from the antecubital vein using 5cc syringe and transferred to an EDTA Test tube and analysed in an Automated cell counter system within 90 min after collection.

2.7. Statistical Analysis

The Data obtained from the hematological investigations was entered in Microsoft Excel and Statistical Package for Social Sciences- SPSS for window ver 18.5 software used for the statistical analysis. The results for each parameter for discrete data and averaged for each parameter were presented in tables.

3. Results

In our study, out of 100 patients, 72 were males and 28 were females. Most of the patients were in 50-70 years age group. Around 62% were in 45-60 years age group, 27% were in 61-70 years age group. 5% were in <45 years age group and 6% were in >70 years age group. (Table 1)

Among the risk factors, order of prevalence is Hypertension > Diabetes Mellitus > Smoking > Alcoholism > Dyslipidaemia. It is depicted in the Table 2.

In our study, these 100 patients are divided into two groups basing on National Institute of Health Stroke Scale (NIHSS) score. The set of patients whose NIHSS score is less than 6 is taken as 'Group 1' and the set of patients whose NIHSS score is more than or equal to 6 is taken as 'Group 2'. Number of patients under 'Group 1' are 56 and those under 'Group 2' are 44.

In our study, the laboratory findings showed that Leukocyte count, Neutrophil, Lymphocyte and Platelet count doesn't shown significant difference between these two groups of patients. (Table 3)

Data Expressed as Means $\pm$ standard deviation

In our study, the platelet indices doesn't differ significantly between these two groups of patients. (Table 4)

But Neutrophil-to-Lymphocyte ratio as well as Platelet-to-Lymphocyte ratio is significantly more in Group 2 thereby indicating positive correlation of NLR and PLR

Table 1: Distribution of Patients in different Age Groups

Age Group	Male	Female	%
<45 Years	3	2	5
45-60 Years	46	16	62
61-70 Years	19	8	27
> 70	4	2	6
Total	72	28	100

Table 2: Presenting Risk Factor Distribution in Study Population

Risk Factor	Male (n=72)		Female (n=28)		Total (n=100)	
	Number	%	Number	%	Number	%
Hypertension	62	86	22	79	84	84
Diabetes Mellitus	60	83	20	71	81	81
Dyslipidaemia	28	39	14	50	42	42
Smoking	63	87.5	6	21	69	69
Alcoholism	62	86	0	0	62	62

Table 3: Laboratory Data of Group 1 and Group 2 along with NIHSS score

Variables	Group 1 (n=56)	Group 2 (n=44)	Total (n=100)
Leukocyte count/1000/L	8.60±2.58	8.42±2.34	8.29±2.94
Neutrophil/1000/L	4.78 (3.62–6.94)	5.96 (4.20–7.38)	5.48 (3.64–7.82)
Lymphocyte/1000/L	2.02 (1.47–2.88)	1.61 (1.21–2.72)	1.35 (1.28–2.73)
Platelet count/1000/L	221.42±76.47	207.37±54.50	214.28±66.26
Stroke Severity Score			
Average NIHSS	2.80±1.96	15.04±8.12	8.42±8.78

Data Expressed is Means ± standard deviation, median (1st quantile to 3rd quantile)

Table 4: Platelet Indices in Group 1 and Group 2

Variable	Group 1	Group 2
Mean Platelet Volume (MPV)	12.56 ± 1.18	12.78 ± 1.32
Platelet Distribution Width (PDW)	18.39 ± 2.78	18.42 ± 2.96

Table 5: NLR and PLR in Group 1 and Group 2

Variables	Group 1	Group 2
Neutrophil-to-Lymphocyte Ratio (NLR)	2.06(1.38–3.81)	3.94(2.14–5.87)
Platelet-to-Lymphocyte Ratio (PLR)	98.7(76.8–126.2)	135.4(96.4–180.9)

with high Stroke Severity Score and poor prognosis.(Table 5)

4. Discussion

The study was conducted to investigate the correlation between various hematological indices in relation to Stroke Severity Score. The study mainly focused on Platelet indices, Neutrophil-to-Lymphocyte Ratio and Platelet-to-Lymphocyte Ratio in relation to NIHSS Score.

When assessing the risk factors for stroke in these patients, our study showed that Hypertension is the most prevalent risk factor with a percentage of 84 % which is

similar to study conducted by Lok U et al²³ with prevalence percentage of hypertension as 74% and A.Muscari et al²⁴ with prevalence of 84%.

Diabetes is the second prevalent cause which were in lines with studies conducted by Lok U et al,²³ George J et al²⁵ and Maydadomac F et al.²⁶ Dyslipidemia being least prevalent risk factor in our study which is 42% is similar to study by Muscari A et al²⁴ which is 40.1%.

The laboratory findings showed that the leukocyte,neutrophil,lymohocyte and platelet counts did not differ between these two groups of the patients. There is no significance of these findings since it is almost similar in both groups with NIHSS < 6 and those with

NIHSS > 6.

In our study, there is no significance of MPV in relation to Stroke Score which is consistent with the study conducted by Al-Tameemi et al²⁷ but studies conducted by Butterworth et al,²⁸ Ghahremanfard F et al²⁹ and Shah P et al³⁰ have shown significant raise in the MPV. There is also no significance of PDW in our study which is consistent with the study conducted by Al-Tameemi et al²⁷ but study conducted by Shah P et al³⁰ have shown significant raise in the PDW. Some studies have shown that there is increase in these platelet indices in stroke patients in comparison to healthy patients but these indices are not significant to differentiate the stroke severity score.

Our study showed a positive relationship between NLR, PLR and Stroke Severity Score. There is a significant raise in both NLR and PLR in patients with NIHSS score >6 i.e., Group 2. This is consistent with study conducted by Pei Hsun sung et al³¹.

5. Conclusion

Our study has shown significant difference in the values of NLR and PLR in relation to Stroke Severity Score. Therefore, NLR and PLR are strongly related to Stroke Severity Score thereby associated with prognosis of the stroke.

There is no significant difference in MPV and PDW in relation to Stroke Severity Score but these platelet indices can be used as biomarkers in stroke patients since there is significant raise in these indices in stroke patients in relation to healthy people. It is also found that Hypertension is the most predominant risk factor among the ischemic stroke patients.

6. Source of Funding

None.

7. Conflict of Interest

None.

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