



A study on association of platelet to lymphocyte ratio (PLR) with NIHSS (National Institute of Health Stroke Scale) for prediction of severity and prognosis in patients of acute ischemic stroke

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How to citation this article: Sahil Vij, T.P. Singh, Aqsa Jafri, Zeeshan Akhtar, Milind Agarwal, “A study on association of platelet to lymphocyte ratio (PLR) with NIHSS (National Institute of Health Stroke Scale) for prediction of severity and prognosis in patients of acute ischemic stroke”, IJMACR- November - 2024, Volume – 7, Issue - 6, P. No. 01 – 05.

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Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

Introduction: Strokes are one of the leading causes of mortality and morbidity. Although the incidence and mortality associated with strokes both have declined, long term prognosis still remains grim. Inflammation following ischemia worsens cerebral damage and thus platelet indices are crucial for monitoring thrombotic conditions and stroke severity.

Objectives: To examine the correlation between PLR and NIHSS scores and assess how PLR varies with stroke risk factors and demographics.

Methods: This cross-sectional observational study involved 100 acute ischemic stroke patients at SN Medical College, Agra, from September 2022 to March 2024. Inclusion criteria included confirmed acute ischemic stroke patients, while exclusion criteria ruled

out haemorrhagic stroke, hepatic or renal disease, connective tissue disorders, sepsis, and malignancy. Data were analysed using SPSS version 26.0, employing descriptive statistics and comparative analysis.

Results: The study included 100 patients of which 60% of patients had mild to moderate strokes, while 40% had severe strokes. Severe stroke patients had higher platelet counts, PLR, and lower lymphocyte counts. Also the mean PLR was significantly associated with smoking ($p < 0.001$).

Conclusion: A significant association was observed between PLR and NIHSS scores, with severe stroke patients exhibiting higher PLR. Smoking emerged as a dominant risk factor influencing PLR. Age-related variations in PLR were statistically significant.

Keywords: Acute Ischemic Stroke, Platelet-to-Lymphocyte Ratio, NIHSS, Stroke Severity, Inflammation.

Introduction

Acute cerebrovascular stroke is a group of conditions which have an absolute mortality of about 33% and severe morbidity of 65%. Although significant improvement has been made in the incidence and mortality associated with stroke, the overall prognosis still remains grim.¹

The Ischemia prone endothelium releases pro-inflammatory mediators, granules in platelets, as well as sluggish blood flow due to the activation of intravascular leukocytes, all contribute to post-ischemia inflammation, which is significant in different phases of cerebral ischemic damage.²

ADP and collagen cause exaggerated in vitro aggregation and have been linked to increased MPV, and are associated with Ischemic Stroke. Platelet size variation is represented by PDW. Additionally, a larger PDW suggests a prothrombotic state.

An increased number of thrombocytes in patients of stroke (ischaemic) have been linked with poor outcome.³ Severity scores can help categorise the patients inflicted with this diagnosis. The NIHSS can be used as a marker of neurological impairment which can help grade the defect, associated with stroke. NIHSS score between 1-4 depicts mild stroke, moderate when 5-15 and severe when 16-20, or extremely severe when 21-42. A severe stroke is linked to an NIHSS score of ≥ 16 , per Adams HP Jr et al.⁴ In individuals with ischemic stroke, the NIHSS score and the stroke volume also correlate.

Studies have earlier already demonstrated a positive association amongst mortality when the first month ends and deranged haematology values like - an elevated

platelet count, higher WBC count at the time of hospital admission as solid indicators of stroke severity. According to one another study indicated that an increased WBC count, increased neutrophil count, and plummeted count of neutrophils were linked to greater frequency of morbid stroke.⁵

Lately, the platelet-to-lymphocyte ratio (PLR) has gained widespread recognition as an important indicator for assessing and analysing the existing state of inflammation. Increased cytokine production and oxidative stress are associated with elevated PLR levels. A high proliferative index of the PLR has been linked to a poorer outcome in several of the conditions with already steady low grade inflammation, including end-stage renal disease, pulmonary thrombo embolism, myocardial infarction and other carcinomas.

Aim of The Study

To find out the role of platelet-lymphocyte ratio and its correlation with National Institute of Health Stroke Scale for the early diagnosis of the associated severity and thus the prognosis in patients of acute ischemic stroke

Objective of The Study

1. To calculate the PLR in patients with Acute Ischaemic Stroke.
2. Correlate the above calculated platelet to lymphocyte ratio with the NIHSS score to predict the gravity and prognosis of stroke.

Materials and Methods

This was an observational cross sectional study conducted over a 100 patients in P.G. Department of Medicine of S.N. Medical College between September 2022 to March 2024 after getting approval from the Institutional Ethics Committee.

Inclusion Criteria

1. All patients satisfying the WHO definition of stroke.

2. Confirmed acute ischemic stroke patients with CT/MRI brain findings.

Exclusion Criteria

1. Patients diagnosed to be suffering with hemorrhagic stroke.
2. Patients with either or both of liver or kidney impairment, or even any connective tissue disorders.
3. Patients with sepsis and malignancy.
4. Patients with unwillingness to participate in our study.

These patients were then inquired for anthropometric data like Age, Sex, Smoking, alcohol, diabetes, Hypertension, previous history of stroke. And then Platelet count, Lymphocyte count were then analysed and finally the NIHSS and PLR were then calculated.

The data which was obtained was entered in a systematic manner in an excel sheet and then analysed using statistical package for social sciences (SPSS). And then it was analysed using statistical terms of mean with standard deviation, and student’s t-test and a 95% confidence interval was taken.

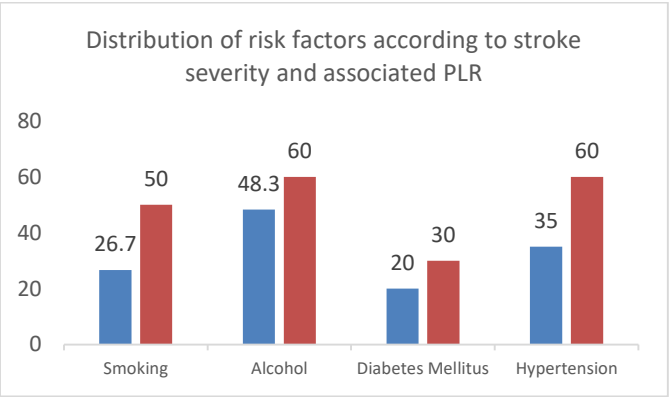
Observation and Result

A total of 100 patients were included in the study to study High Platelet to Lymphocyte Ratio in them. Age group with maximum patients was between 51-60 years. Mean Age+- SD in these patients was 57.68±12.1 years. 72% of study subjects were male and rest were female. And also about 60% of study subjects had mild to moderate stroke (NIHSS <16) and 40% had severe stroke (NIHSS>16).

Table 1 : Age wise categorisation of stroke severity and PLR

Age group	NIHSS		p-value	PLR
	<16 (n=60)	≥16 (n=40)		
≤30 year	1 (1.7)	1 (2.5)	0.082	1.90±1.38
31-40 year	8 (13.3)	1 (2.5)		1.33±0.36
41-50 year	10 (16.7)	3 (7.5)		1.50±0.86
51-60 year	20 (33.3)	22 (55.0)		1.97±0.84
61-70 year	9 (15.0)	10 (25.0)		1.81±0.48
71-80 year	8 (13.3)	2 (5.0)		1.39±0.66
>80 year	4 (6.7)	1 (2.5)		1.18±0.44

Graph 1



Patients with mild to moderate strokes (NIHSS <16) had a lower average platelet count (1.66±0.20) compared to those with severe strokes (NIHSS ≥16) (2.84±0.13). Patients with mild to moderate strokes had a higher average lymphocyte count (1.45±0.21) compared to those with severe strokes (1.14±0.17). Patients with severe strokes had a higher average platelet-to-lymphocyte ratio (255.22±43.1) compared to those with mild to moderate strokes (117.55±27.0). Overall, statistically relevant (p-value <0.001).

Table 2: Correlation between stroke severity and PLR

Laboratory findings	NIHSS		P-value
	<16 (n=60)	≥16 (n=40)	
Platelet count (in lacs)	1.66±0.20	2.84±0.13	<0.001
Lymphocyte count (in thousands)	1.45±0.21	1.14±0.17	<0.001

Platelet to lymphocyte ratio	117.55±27.0	255.22±43.1	<0.001
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Discussion

In the present study risk factors were correlated with NIHSS score categories, it was observed that smoking was present in 50% of patients with severe strokes (NIHSS ≥ 16) compared to mild to moderate stroke patients (NIHSS < 16 ; 26.7%) establishing significant difference. Patients having a more severe stroke i.e. 60% in our study and those with mild or moderate stroke i.e. 48.3% of the total in our study did not significantly vary in their alcohol intake patterns. Patients with severe stroke had a larger proportion of diabetes patients (30%) than patients afflicted by moderate to mild stroke (20%). In comparison with patients with mild to moderate strokes (35%), a considerably larger chunk of patients suffering with severe strokes (60%) had hypertension, the difference observed was statistically significant.

In the present study, we documented the laboratory findings with NIHSS, compared to patients with mild to moderate strokes (NIHSS < 16) had a lower average platelet count (1.66 ± 0.20) compared to those with severe strokes (NIHSS ≥ 16) (2.84 ± 0.13). Compared to patients who had suffered severe strokes (1.14 ± 0.17), patients with mild to moderate strokes had an average lymphocyte count that was higher (1.45 ± 0.21). Compared to patients with mild to moderate strokes (NIHSS < 16) was 117.55 ± 27.0 , patients with severe strokes (NIHSS ≥ 16) had an average platelet-to-lymphocyte ratio of 255.22 ± 43.1 . The difference was highly significant among the lab modalities. The difference was highly significant among the lab modalities. In accordance with the present study, **Lagishetti D et al**¹⁰ reported a significant correlation between PLR and NIHSS score.

They further added that increase in PLR was in proportion with the increasing NIHSS.

In AIS, platelets mediate the relationship between inflammation, thrombosis, and atherogenesis. Elevated platelet counts have the potential to trigger a deleterious inflammatory process by aggravating the production of inflammatory mediators and thrombocyte activation.⁶ Patients with elevated PLR levels have been associated with increased cytokine production and oxidative stress, PLR has the benefit of reflecting the state of thrombosis and inflammatory pathways, making it more significant than either of the two indices alone. In continuation of the above -the current study sought to determine how the PLR and NIHSS were related or not to the severity and prognosis prediction in patients of acute stroke of ischemic variety.

In our study, we observed a statistically relevant association amongst different age groups and PLR ratio. **Yang et al**⁷ reported that platelet count may be used as a qualified indicator for prediction for reCVA, associated mortality, and poor functional performance in patients of ischemic stroke or TIA patients with platelet count within the normal values. Lymphocyte cells play an important role in the development of atherosclerosis, they are thus implicated in the acceleration and development of atherosclerosis. Parasympathetic nerves control lymphocyte function, and lymphocytes contain cholinergic receptors. There is debate over lymphocytes' involvement in ischemic stroke. Due to their proinflammatory cytokine source, they have been shown to exacerbate the ischemia accident in addition to having healing and repair effects.⁸ There might be a relationship between lymphopenia and the gravity of stroke, as evidenced by research that demonstrated a significantly

negative connection between mortality and lymphocyte count in the blood following ischemic stroke.⁹

Conclusion

In this study we observed a significant association between PLR ratio and NIHSS scoring category, patients with severe stroke had a higher average platelet-to-lymphocyte ratio. Among risk factors, smoking was the most dominant which observed a higher PLR ratio mean. The association between different age groups and PLR ratios was statistically significant. Further, it was observed that Patients with mild to moderate strokes (NIHSS <16) had a lower average platelet & higher lymphocyte count compared to those with severe strokes.

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