



## Original Research Article

# PLATELET TO LYMPHOCYTE RATIO AND ITS CORRELATION WITH NIHSS FOR PROGNOSIS AND SEVERITY OF ACUTE ISCHEMIC STROKE

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### ABSTRACT

**Background:** Platelet-to-Lymphocyte Ratio (PLR) has emerged as an inflammatory marker in various conditions, including acute ischemic stroke (AIS). This study explores the correlation between PLR and the National Institutes of Health Stroke Scale (NIHSS) in patients with AIS to predict stroke severity and outcomes.

**Materials and Methods:** A cross-sectional observational study was conducted in PES Hospital, Kuppam, from October 2023 to March 2024. Sixty-five AIS patients were enrolled. Their PLR values were calculated and correlated with NIHSS scores to assess stroke severity.

**Results:** Among the participants, 58.5% were older than 60 years, and 58.5% were male. A significant portion had comorbidities such as diabetes (53.9%) and hypertension (56.9%). The median platelet count was 265,100 cells/mm<sup>3</sup>, mean absolute lymphocytes were 2,323.8 cells/ml, and mean PLR was 134.9. Higher PLR values were significantly associated with severe stroke (NIHSS 16-42, p=0.002).

**Conclusion:** PLR is a potential prognostic marker in AIS, correlating with stroke severity as measured by NIHSS. This easily obtainable and cost-effective marker could enhance early prognostic assessment in clinical settings.

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

## INTRODUCTION

Stroke is characterized by a sudden impairment in brain function due to hemorrhage or ischemia. Acute ischemic stroke (AIS) and hemorrhagic stroke are significant causes of mortality globally and present a growing challenge in India. The refinement of management protocols and risk stratification of stroke patients is essential. Reliable early prognostic markers are needed for clinical decision-making and resource allocation.

The pathophysiology of AIS, especially with large-artery atherosclerosis, is complex, with inflammation playing a central role. Platelet to Lymphocyte Ratio (PLR) has emerged as a potential

biomarker for various inflammatory conditions, including AIS. Elevated platelet counts may increase stroke risk by enhancing activation and release of inflammatory mediators, while lymphocytes play an anti-inflammatory role. This study aims to investigate the correlation between PLR and NIHSS in predicting the severity and prognosis of AIS.

## MATERIALS AND METHODS

A hospital-based cross-sectional observational study was conducted at PES Hospital, Kuppam, between October 2023 and March 2024. Sixty-five patients

diagnosed with AIS within 24 hours of symptom onset were enrolled in the study. Patients aged 18 years and older diagnosed with AIS were included. Patients with Hemorrhagic stroke, hematological malignancies or autoimmune diseases were excluded.

Baseline demographic and clinical data, including age, gender, comorbidities, and risk factors (hypertension, diabetes, smoking), were collected. Blood samples were analyzed for platelet count, lymphocyte count, and PLR was calculated as the ratio of platelets to lymphocytes. Stroke severity was assessed using the NIHSS at the time of admission.

### Statistical Analysis

The data were analyzed using IBM SPSS Statistics version 25. Continuous variables were expressed as mean  $\pm$  standard deviation (SD), and categorical variables were presented as frequencies and percentages. The association between PLR and stroke severity was assessed using the chi-square test, and a p-value  $<0.05$  was considered statistically significant

## RESULTS

The study included 65 participants with acute ischemic stroke (AIS) admitted to PES Hospital, Kuppam, over an 18-month period. The majority of the participants (58.5%) were older than 60 years, with a smaller proportion aged 46-60 years (29.2%) and under 45 years (12.3%). There was a slight male

predominance, with 58.5% of the participants being male.

Regarding medical history, 12.3% of the participants reported a previous stroke, 32.3% had a history of smoking, and 30.8% had a history of alcohol consumption. Comorbid conditions were common, with 53.9% of participants having diabetes mellitus and 56.9% having hypertension.

The clinical profiles of the participants indicated elevated mean systolic and diastolic blood pressures of 147.4 mmHg (SD = 30.6) and 87.9 mmHg (SD = 12.9), respectively. The laboratory results showed a median platelet count of 265,100 cells/mm<sup>3</sup> (IQR = 216,000-327,000), mean absolute lymphocyte count of 2,323.8 cells/ml (SD = 828.9), and a mean PLR of 134.9 (SD = 61.9).

The NIHSS scores indicated that 21.5% of the participants had minor strokes (NIHSS score 1-4), 60.0% had moderate strokes (NIHSS score 5-15), and 18.5% had moderate to severe strokes (NIHSS score 16-42). A significant association was found between higher PLR and stroke severity. [Table 1]

The mean PLR for patients with moderate to severe strokes was 153.6 (SD = 90.5) compared to 119.4 (SD = 30.9) for those with minor strokes (p=0.002). [Table 2]

Furthermore, platelet counts were higher in patients with more severe strokes, with a median count of 342,000 cells/mm<sup>3</sup> (IQR = 309,000-395,050) in the moderate to severe group, compared to 237,000 cells/mm<sup>3</sup> (IQR = 209,000-248,000) in the minor stroke group (p=0.006). [Table 3]

**Table 1: Clinical profile of the study participants of stroke (N=65)**

Variables	Mean	SD
Na+ (mmol/L)	136.2	5.1
K+ (mmol/L)	4.1	0.6
Cl- (mmol/L)	103.2	5.6
Urea (mg/dl)	33.0	19.5
Creatinine (mg/dl)	0.9	0.4

**Table 2: Distribution of NIHSS score among the study participants of stroke (N=65)**

NIHSS score	Frequency	Percentage (%)
Minor stroke (1-4)	14	21.5
Moderate stroke (5-15)	39	60.0
Moderate to severe stroke (16-42)	12	18.5
<b>Total</b>	<b>65</b>	<b>100</b>

**Table 3: Association of PLR with NIHSS score among the study participants of stroke (N=65)**

NIHSS score	PLR		P value*
	Mean	SD	
Minor stroke (1-4)	119.4	30.9	<b>0.002</b>
Moderate stroke (5-15)	134.8	59.7	
Moderate to severe stroke (16-42)	153.6	90.5	

\*One-way ANOVA

## DISCUSSION

This study aimed to investigate the correlation between Platelet-to-Lymphocyte Ratio (PLR) and the severity of acute ischemic stroke (AIS), as assessed by the National Institutes of Health Stroke Scale (NIHSS). Our findings demonstrate a

significant relationship between elevated PLR and greater stroke severity, supporting the hypothesis that PLR could serve as a useful inflammatory marker for assessing the prognosis of stroke patients.

Inflammation plays a critical role in the pathophysiology of ischemic stroke. During an

ischemic event, inflammatory processes are triggered, contributing to endothelial damage and promoting thrombosis. Platelets are key players in these processes, as they enhance thrombocyte activation and promote the release of cytokines, leading to further inflammation.<sup>[1]</sup> On the other hand, lymphocytes may exhibit anti-inflammatory effects, potentially inhibiting atherosclerosis development and regulating immune responses.<sup>[2]</sup> Therefore, the ratio between platelets and lymphocytes, as reflected in PLR, has gained interest as a marker of systemic inflammation, which could be predictive of disease severity.

Our study found that patients with higher NIHSS scores, indicating more severe strokes, had significantly elevated PLR compared to those with milder presentations. These findings align with prior studies that have highlighted the prognostic role of PLR in AIS.<sup>[3,4]</sup> For instance, Sha et al. demonstrated that elevated PLR was associated with poorer functional outcomes in stroke patients, while Zhang et al. found a significant correlation between PLR and stroke severity, as measured by the NIHSS.<sup>[5,6]</sup> Similarly, a study by Sharma et al. observed that patients with elevated PLR levels were more likely to experience worsened clinical conditions.<sup>[7]</sup>

The association between elevated PLR and worse stroke outcomes can be explained by the pro-thrombotic and pro-inflammatory roles of platelets, which are pivotal in the development of atherosclerosis and thrombus formation.<sup>[8]</sup> The relative reduction in lymphocytes, often observed during stress or systemic inflammation, further exacerbates the inflammatory state, contributing to increased stroke severity.<sup>[9]</sup>

While PLR has emerged as a useful marker in stroke prognosis, it is important to consider its performance relative to other inflammatory markers, such as the neutrophil-to-lymphocyte ratio (NLR) and the platelet-to-white blood cell ratio (PWR). Studies have shown that NLR is also strongly correlated with stroke outcomes.<sup>[10]</sup> However, PLR may have distinct advantages due to its ease of calculation and availability in routine blood tests. A meta-analysis by Yan et al. concluded that PLR, in combination with NLR, could provide a more comprehensive assessment of stroke severity and prognosis.<sup>[11]</sup> Additionally, Cao et al. highlighted that PWR was associated with long-term outcomes in AIS patients, although it was not as consistently reliable as PLR in predicting short-term stroke severity.<sup>[12]</sup>

Given its accessibility and cost-effectiveness, PLR may serve as a valuable adjunct to existing clinical tools, such as the NIHSS, in assessing stroke severity. The NIHSS, while a widely used and reliable measure of stroke severity, primarily focuses on neurological deficits and does not account for underlying inflammatory processes.

Incorporating PLR into routine stroke assessments could provide a more holistic view of a patient's condition and guide early intervention strategies.<sup>[13]</sup>

### Limitations

While our study provides important insights, there are some limitations. The sample size was relatively small, which may limit the generalizability of the findings. Additionally, we did not evaluate long-term outcomes, such as mortality or functional recovery, which could offer further evidence of the prognostic value of PLR. Future research should focus on larger, multicenter studies to validate our findings and explore the role of PLR in predicting long-term outcomes in stroke patients.

## CONCLUSION

This study supports the growing body of evidence that PLR is a significant marker of stroke severity in AIS patients. Elevated PLR levels correlate with higher NIHSS scores, indicating that PLR could be a useful tool in predicting stroke prognosis. Further research is warranted to confirm its role in clinical practice, especially in conjunction with other inflammatory markers and established stroke assessment tools.

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