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Correlation between Platelet to Lymphocyte Ratio as Predictive Factor of Neurological Deficit in Acute Ischemic Stroke Patients

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A R T I C L E I N F O

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A B S T R A C T

Acute ischemic stroke is the most common stroke type, with inflammation and thrombosis playing key roles. The platelet-to-lymphocyte ratio (PLR) has been proposed as a potential prognostic biomarker. To evaluate the association between PLR and neurological deficits or functional outcomes in acute ischemic stroke. A systematic review was conducted using multiple databases. Study quality was assessed with the Newcastle-Ottawa Scale (NOS), and outcomes were evaluated using NIHSS, mRS, and SSS. Ten studies were included, mostly from Asia. Elevated PLR was significantly associated with poor outcomes, especially in Chinese studies and those with NIHSS <8. One study reported a cutoff PLR of 162.92. PLR may be a simple, cost-effective prognostic tool in stroke, though further research is needed to validate its role.

INTRODUCTION

Stroke is a neurological disorder caused by a focal vascular injury in the central nervous system and remains one of the leading causes of death and disability worldwide. Among stroke subtypes, acute ischemic stroke is the most prevalent, accounting for approximately 80–85% of all cases. It poses a major public health burden due to its high rates of morbidity and long-term disability. In Indonesia, the prevalence of stroke has increased significantly from 7% in 2013 to 10.9% in 2018. The highest prevalence is reported in urban areas and continues to rise with age, particularly among those aged 75 years and older. The disease affects both men and women almost equally.

The pathophysiology of acute ischemic stroke involves a complex interplay between thrombosis, inflammation, and vascular injury. Platelets are central to thrombus formation at sites of vascular damage and play a crucial role in the progression of ischemic events. Upon activation, platelets release various inflammatory mediators, initiating and propagating the coagulation cascade. Simultaneously, lymphocytes key regulators of immune response may decline in number due to ischemia-induced apoptosis, a condition that has been associated with poor outcomes.

The platelet-to-lymphocyte ratio (PLR) has emerged as a novel biomarker reflecting both thrombotic and inflammatory responses. Elevated PLR has been linked to worse outcomes in several diseases, including cardiovascular disease and cancer. In the context of stroke, however, the prognostic significance of PLR remains unclear, with studies reporting conflicting results.

Given the lack of a comprehensive synthesis of existing evidence, this systematic review aims to evaluate the association between PLR and neurological deficits or functional outcomes in patients with acute ischemic stroke. Understanding this association may help improve early risk stratification and guide clinical decision-making in stroke management.

Objective

This article aims to evaluate the association between the platelet-to-lymphocyte ratio (PLR) and neurological deficits or functional outcomes in patients with acute ischemic stroke.

LITERATURE REVIEW

The platelet-to-lymphocyte ratio (PLR) has emerged as a promising inflammatory biomarker in acute ischemic stroke, reflecting both thrombotic activity and immune response. Previous studies have reported that elevated PLR levels are associated with greater stroke severity, larger infarct volumes, and poorer functional outcomes, suggesting its potential value in predicting neurological deficits. The biological plausibility lies in the pro-thrombotic role of platelets and the protective, regulatory functions of lymphocytes during ischemic injury. However, the literature shows variability in PLR cutoff values, timing of measurement, and outcome definitions, resulting in inconsistent findings across studies. Despite these limitations, accumulating evidence indicates that PLR could serve as a simple, cost-effective tool for early risk stratification in stroke patients. Further research is needed to clarify its predictive accuracy and to

determine how PLR integrates with established prognostic indicators in clinical practice.

METHODOLOGY

This study employed a systematic review design to evaluate published evidence regarding the association between platelet-to-lymphocyte ratio (PLR) and neurological deficits or functional outcomes in patients with acute ischemic stroke. The review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.

Search Strategy

A comprehensive literature search was conducted across several electronic databases, including PubMed, Science Direct, Scopus, and Google Scholar, to identify relevant articles published from January 2018 to December 2023. The search used the following keywords:

- "Platelet to lymphocyte ratio" AND "stroke"
- "PLR" AND "acute ischemic stroke"

Manual searches of reference lists from included articles were also performed to identify additional relevant studies.

Inclusion Criteria

Studies were included if they met the following criteria:

- Conducted on adult patients diagnosed with acute ischemic stroke;
- Reported PLR values measured either at admission or within 24 hours of hospital presentation;
- Assessed the association between PLR and neurological outcomes, such as functional status or mortality;
- Available in full-text format and published in English.

Exclusion Criteria

- Studies not reporting clinical outcomes of interest (e.g., mRS, NIHSS, END, or mortality);
- Reviews, editorials, case reports, conference abstracts;
- Animal studies or non-English publications.

Data Extraction and Quality Assessment

Data were extracted systematically from each eligible study, including:

- Author(s), year of publication
- Study location and design
- Sample size and patient characteristics
- Timing of PLR measurement
- Stroke severity (e.g., NIHSS) and functional outcome measures (e.g., mRS, END)
- PLR cutoff values, statistical outcomes (e.g., OR, CI, p-value)
- Newcastle-Ottawa Scale (NOS) scores

Quality and risk of bias for each included study were assessed independently using the *Newcastle Ottawa Scale (NOS)* for non-randomized studies. Studies were rated on three domains: selection, comparability, and outcome. Scores of 7–9 were considered high quality.

RESEARCH RESULTS

Study Selection and Characteristics

This systematic review included 10 eligible studies involving patients with acute ischemic stroke, mostly conducted in Asian countries. One study originated from Europe (Portugal). Most studies measured PLR at hospital admission and used the modified Rankin Scale (mRS) or NIHSS to assess outcomes. Nine of the ten studies focused on patients in the acute phase of stroke, while one study (Li et al.) evaluated patients in the recovery phase (3 months post-stroke).

The sample sizes ranged from 100 to 1,060 patients, and the mean NIHSS scores varied between 3.7 and 14.1. Most studies analyzed PLR as a continuous variable, while only one study (Zhang et al.) used a defined cutoff value (PLR = 162.92).

Study Quality

Based on the *Newcastle Ottawa Scale (NOS)*, all studies were of moderate to high quality, with scores ranging from 5 to 8.

Association Between PLR and Functional Outcomes

By Country: Chinese vs Non-Chinese Studies

- Chinese studies consistently found that elevated PLR was significantly associated with poor functional outcomes.
- Non-Chinese studies, however, did not show a significant association between high PLR and outcomes.

By Stroke Severity (NIHSS Score Grouping)

- In studies where the baseline NIHSS score was <8, there was a statistically significant correlation between high PLR and poor functional outcome.
- In contrast, studies with NIHSS ≥8 did not show a significant relationship.

By PLR Cutoff Definition (mRS >2 vs mRS ≥3)

- Studies that defined poor outcome as mRS >2 found a significant association between elevated PLR and poor outcomes.
- However, those using mRS ≥3 as the definition reported non-significant findings.

Association with Mortality and Early Neurological Deterioration (END)

- Mortality was reported in only one study (Sha et al.), which did not find a significant relationship between PLR and 6-month mortality.
- Zhang et al. (2023) identified PLR as an independent predictor of poor functional outcomes at discharge. The study reported an odds ratio (OR) of 1.003 (95% CI: 1.000–1.005; p = 0.018). The proposed PLR cutoff value was 162.92, yielding a sensitivity of 46.9% and a specificity of 70.6%. The

area under the receiver operating characteristic curve (AUC) was 0.587, indicating modest discriminative ability.

- Chen C (2021) and Chen CT (2021) reported conflicting results. While Chen C found a significant association between elevated PLR and poor outcomes at 3 months, Chen CT did not observe a statistically significant relationship in their analysis. These discrepancies may be attributed to differences in study design, sample size, population characteristics, or timing of PLR measurement.

DISCUSSION

This systematic review evaluated the prognostic value of the platelet-to-lymphocyte ratio (PLR) in patients with acute ischemic stroke, focusing on its association with neurological deficits and functional outcomes.

The majority of included studies demonstrated that elevated PLR was associated with poor functional outcomes, particularly when measured within 24 hours of stroke onset. Subgroup analyses revealed that this association was more prominent in studies from China and in patients with lower baseline stroke severity (NIHSS <8). These findings suggest that PLR may be a more sensitive marker in less severe strokes or in certain populations.

Only a few studies evaluated early neurological deterioration (END) and mortality, with mixed results. Some showed significant associations between high PLR and END, while others did not. Zhang et al. proposed a PLR cutoff of 162.92, which provided moderate specificity but low sensitivity, indicating that PLR alone may not be sufficient for outcome prediction.

The pathophysiological basis for PLR as a prognostic marker lies in its reflection of both thrombosis and inflammation. Activated platelets contribute to clot formation and vascular injury, while low lymphocyte counts are associated with immune dysregulation and poorer recovery. An elevated PLR may therefore reflect a heightened prothrombotic and inflammatory state that worsens stroke outcomes.

Although previous studies have also investigated the neutrophil-to-lymphocyte ratio (NLR) as a prognostic marker, this review specifically focused on PLR. The overlap in inflammatory markers highlights the potential utility of combining multiple hematological indices for more accurate risk stratification.

Despite promising findings, heterogeneity among studies (e.g., stroke severity, timing of measurement, outcome definitions) limits the generalizability of results. Additionally, the predictive power of PLR appears modest, and its clinical utility should be evaluated in the context of other established prognostic factors such as age, NIHSS score, and treatment modality (e.g., thrombolysis).

Key Takeaways:

- High PLR is associated with poor outcomes in acute ischemic stroke, especially in milder cases.
- Its prognostic value for END and mortality remains inconsistent.
- PLR may serve as a simple and inexpensive biomarker, but should not be used in isolation.

- Further research is needed to validate cutoff values and integrate PLR into clinical decision-making models.

CONCLUSION

The findings of this systematic review indicate that the platelet-to-lymphocyte ratio (PLR) may serve as a valuable prognostic biomarker for predicting functional outcomes in patients with acute ischemic stroke. Elevated PLR, particularly when measured during the early phase of stroke, was associated with a higher risk of poor outcomes—especially in patients with lower baseline NIHSS scores.

However, current evidence regarding the role of PLR in predicting early neurological deterioration (END) and mortality remains limited and inconsistent. The heterogeneity in study designs, outcome definitions, and cutoff values also highlights the need for standardization.

Given its simplicity, low cost, and biological plausibility, PLR could be considered as part of future clinical risk stratification algorithms in stroke care. Further well-designed prospective studies are needed to establish optimal cutoff values and to assess the additive predictive value of PLR when combined with other clinical and laboratory parameters.

Tabel 1

Study (Year, Country)	n	NIHSS	PLR Cutoff	Sampling Time	Outcome
Sharma (2021, in India)	100	10.8 ± 6.3	None	At admission	Not reported
Sha (2021, in China)	210	NR	None	NR	Death
Li (2021, in Taiwan)	277	9.2 ± 7.8	None	3-month recovery	mRS improvement ≥ 1
Lee (2021, in Korea)	282	14.1 ± 6.5	None	At admission	mRS ≥ 3
Gong (2021, in China)	1,060	7.2 ± NR	None	At admission	NIHSS ↑ ≥ 4 pts in 24h
Ferro (2021, in Portugal)	325	13.7 ± 8.2	None	Within 24h	END: clinical worseningOutcome: mRS ≥ 3
Chen C (2021, in China)	448	3.7 ± 2.2	None	At admission	mRS ≥ 3
Chen Y (2021, in China)	280	NR	None	Within 24h	mRS ≥ 3

Chen CT (2021, in Taiwan)	100	12.7 ± 6.5	None	At admission	mRS ≥ 3 (3–12 mo)
Zhang (2023, in China)	861	NR	162.92	At admission	mRS ≥ 3

NIHSS, National Institutes of Health Stroke Scale; mRS, modified Rankin Scale; NOS, Newcastle Ottawa Scale; END, early neurological deterioration; PLR, platelet lymphocyte ratio or comorbidities.

ADVANCED RESEARCH

Future research should focus on conducting well-designed, prospective studies to validate the prognostic utility of PLR in acute ischemic stroke. Standardization of PLR measurement timing, cutoff values, and outcome definitions is essential to reduce heterogeneity across studies. Additionally, investigations should explore the incremental predictive value of PLR when integrated with established clinical, imaging, and laboratory markers, as well as its potential role in forecasting early neurological deterioration and mortality. Such efforts will help clarify the clinical relevance of PLR and support its incorporation into comprehensive stroke risk stratification models.

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