Research Article

Evaluation of Neutrophil-Lymphocyte Ratio (NLR) and Platelet-Lymphocyte Ratio (PLR) as Prognostic Markers in Ischemic Stroke of Diabetic Patients: A Cross-Sectional Analysis

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Abstract

Introduction: Stroke remains a significant cause of morbidity and mortality worldwide, necessitating effective prognostic tools for optimal management. Inflammation plays a pivotal role in stroke pathogenesis, highlighting the importance of biomarkers such as Neutrophil-Lymphocyte Ratio (NLR) and Platelet-Lymphocyte Ratio (PLR) in prognostication.

Methods: A descriptive cross-sectional study involving 154 diabetic stroke patients admitted to a tertiary care hospital was conducted. Demographic, clinical, and laboratory data were collected, and Neutrophil-Lymphocyte Ratio (NLR) and Platelet-Lymphocyte Ratio (PLR) were calculated. Patients were categorized based on their NLR and PLR levels, and associations with stroke severity, functional outcomes, and mortality were assessed.

Results: Elevated NLR and PLR were significantly associated with increased stroke severity, decreased functional independence, and higher mortality rates. Patients with adverse outcomes exhibited higher NLR and PLR levels compared to those with favorable outcomes. For example, the mean NLR was 7.88 ± 1.45 in deceased patients compared to 2.23 ± 1.45 in discharged patients ($P<0.0001$). Metabolic parameters, particularly fasting blood sugar levels, also played a crucial role in determining stroke prognosis.

Conclusion: The Neutrophil-Lymphocyte Ratio (NLR) and Platelet-Lymphocyte Ratio (PLR) emerge as valuable prognostic markers in stroke patients, providing insights into disease severity and outcomes. Incorporating these biomarkers into clinical practice has the potential to enhance risk stratification and facilitate personalized treatment approaches. Further research is warranted to validate these findings and elucidate the underlying mechanisms linking inflammation to stroke outcomes.

Keywords: Stroke; Prognostic markers; Neutrophil-lymphocyte ratio; Platelet-lymphocyte ratio; Inflammation; Thrombosis.

Introduction

Stroke stands as a leading cause of both long-term disability and mortality on a global scale, necessitating an urgent comprehension of its multifaceted factors and the implementation of effective risk management strategies [1]. The intricate nature of stroke prognosis underscores the significance of accurate prognostic assessments to inform optimal treatment decisions [2].

Emerging evidence underscores the pivotal role of inflammation in the pathogenesis of acute ischemic stroke [3]. Within this context, the interplay between neutrophils and lymphocytes assumes considerable importance, as these cells actively contribute to the immune response in cerebrovascular diseases [4]. Mounting research indicates that elevated levels of white blood cells and neutrophils during the early stages of ischemic stroke correlate with larger infarct volumes and heightened stroke susceptibility [5]. Conversely, a reduced lymphocyte count has been associated with compromised functional outcomes post-stroke [6].

Furthermore, the Platelet-To-Lymphocyte Ratio (PLR) has emerged as a valuable marker indicative of both inflammation and the severity of atherosclerosis. Notably, PLR values exhibit significant elevation in patients diagnosed with transient ischemic attack and stroke [7].

Despite these advancements, a critical knowledge gap persists regarding the comparative predictive capabilities of the Neutrophil-Lymphocyte Ratio (NLR) and PLR in gauging ischemic stroke prognosis [8]. Consequently, there exists an urgent imperative to delve deeper into this realm to elucidate their respective prognostic merits.

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This study endeavors to address this pressing gap in knowledge by conducting a comprehensive comparative analysis of NLR and PLR as prognostic markers in ischemic stroke of diabetic patients. Specifically, it aims to evaluate the predictive value of NLR and PLR in determining functional outcomes and mortality rates post-stroke [9,10]. Additionally, it seeks to assess the potential utility of NLR and PLR in guiding therapeutic interventions and improving patient care strategies [10].

By accomplishing these objectives, this research aims to provide invaluable insights that can potentially revolutionize current approaches to ischemic stroke prognostication and foster the development of more personalized and effective treatment modalities.

Material and Methods

Study design and Setting

This descriptive cross-sectional study was conducted at the Department of Medicine, Shyam Shah Medical College&Sanjay Gandhi Memorial Hospital in Rewa, Madhya Pradesh. Ethical approval was obtained from the Institutional Ethics Committee (Reference number: 472, dated 08/01/2021). Data were collected from all stroke patients enrolled between February 1, 2021 and March 31, 2022.

Participants

Convenience sampling was employed to enroll diabetic ischemic stroke patients aged 18 years and above, who presented to the Department of Medicine within 72 hours of symptom onset. Patients with hematological diseases, a history of cancer, severe renal and hepatic insufficiency, and those with infections beginning within 72 hours of stroke onset were excluded. Additionally, patients with brain stem, cerebellar, and acute hemorrhagic strokes were excluded, as were those receiving antibiotics, immunosuppressive therapy, or non-steroidal anti-inflammatory drugs. A total of 154 patients met the study's inclusion and exclusion criteria.

Study procedure

Enrolled patients provided informed consent and underwent a detailed clinical history and physical examination. Routine blood investigations, including complete blood count and biochemical parameters, were conducted. The Neutrophil-to-Lymphocyte Ratio (NLR) was calculated upon admission and on day five. Patients were assessed daily using the National Institutes of Health Stroke Scale (NIHSS). Based on NLR values, patients were categorized into 'good' (NLR>3 to 5.9), 'fair' (NLR 6 to 8.9), and 'poor' (NLR>9) groups. Treatment included anticoagulants, antiplatelet, statins, and physiotherapy. Co-morbidities such as diabetes and hypertension were managed with appropriate medications.

Statistical analysis

The data were entered into an Excel spreadsheet and analyzed using MedCalc version 19.0. Categorical variables were expressed as percentages, while continuous variables were presented as mean ± standard deviation. One-way ANOVA analysis was employed to compare mean differences among the three groups, and Pearson's correlation analysis was conducted.

Results

Table 1 presents a comprehensive overview of the demographic and biochemical characteristics of the study participants. The average age of the study population is 55.59 years, with a standard deviation of 11.97 years. Gender distribution shows 51.66% males and 38.21% females, while the urban-rural split is evenly divided at 50% each.

Table 1: Demographic and biochemical profile.

Characteristics	Total patients N=154; n (%)
Mean Age (in Years)	55.59 ± 11.97 (Mean ± S.D.)
Sex	
Male	95 (51.66%)
Female	59 (38.21%)
Residence	
Rural	77 (50%)
Urban	77 (50%)
Hypertension	120 (77.92%)
Tobacco Chewing	89 (57.79%)
Smoking	108 (70.12%)
Alcohol	97(62.98%)
Atrial fibrillation	23(14.93%)
Mean N:L Ratio	2.49 ± 1.86
Mean P:WBC RATIO	36.42 ± 14.97
Mean NIHSS	6.57 ± 4.48
Mean BARTHEL INDEX	71.78 ± 15.94
Mean TLC	6918.68 ± 2351.85
Mean PLATELET COUNT	2.32 ± 0.81
Mean BMI	28.4 ± 4.96
Mean CRP (mg/dl)	37.98 ± 42.80
Mean HBA1C	7.42 ± 1.24
Mean FBS (mg/dl)	146.9 ± 34.01
Mean PPBS (mg/dl)	242.28 ± 39.72
Cholesterol (mg/dl)	179.09 ± 57.27
LDL (mg/dl)	197.38 ± 100.56
Triglycerides (mg/dl)TG	112.61 ± 34.14
Serum Urea	30.70 ± 7.84
Serum Creatinine	0.97 ± 0.27

A significant portion of participants has been diagnosed with hypertension (77.92%), and lifestyle factors such as tobacco chewing (57.79%), smoking (70.12%), and alcohol consumption (62.98%) are prevalent. Atrial fibrillation is reported in 14.93% of cases. Mean BMI was 28.4 ± 4.96.

The mean Neutrophil-to-Lymphocyte (N: L) Ratio is 2.49 ± 1.86. The mean Platelet-to-White Blood Cell (P: WBC) Ratio is 36.42 ± 14.97. The mean National Institutes of Health Stroke Scale (NIHSS) is 6.57 ± 4.48, measuring average stroke severity. The mean Barthel Index is 71.78 ± 15.94, representing the average level of functional independence among participants.

Laboratory parameters cover a range of health markers, including the mean Total Leukocyte Count (TLC) at 6918.68 ± 2351.85 and Platelet Count at 2.32 ± 0.81. Metabolic markers show mean C-reactive protein (CRP) levels of 37.98 ± 42.80 mg/dl, Glycated Hemoglobin (HbA1C) at 7.42 ± 1.24, Fasting Blood Sugar (FBS) at 146.9 ± 34.01 mg/dl, and postprandial blood sugar (PPBS) at 242.28 ± 39.72 mg/dl. In the study population, mean cholesterol was 179.09 ± 57.27, mean LDL was 197.38 ± 100.56, and mean triglycerides were 112.61 ± 34.14. The mean urea was 30.70 ± 7.84, and the mean creatinine was 0.97 ± 0.27.

Table 2 illustrates a comparison of various parameters between discharged and deceased groups. Significant differences were observed in NLR (2.23 ± 1.45 *vs.* 7.88 ± 1.45, P<0.0001) and PLR (35.52 ± 14.69 *vs.* 55.26 ± 8.32, P=0.0006) between the two groups, highlighting their prognostic value. Patients who succumbed exhibited higher NIHSS scores (21.28 ± 3.30 *vs.* 5.87 ± 3.14, P<0.0001) and lower Barthel Index scores (28.57 ± 11.07 *vs.* 73.84 ± 13.0, P<0.0001), indicative of increased stroke severity and decreased functional independence, respectively. Additionally, platelet counts (320142.85 ± 48649.86 *vs.* 227823.12 ± 80465.40, P=0.0031) and CRP levels (173.85 ± 71.52 *vs.* 35.38 ± 40.57, P<0.0001) were significantly elevated in deceased patients, suggesting a heightened inflammatory and thrombotic state associated with adverse outcomes.

Table 2: Biochemical parameter between groups.

Parameters	Discharged (N=144) (Mean ± S.D.)	Dead (N=7) (Mean ± S.D.)	P value
N: L ratio	2.23 ± 1.45	7.88 ± 1.45	P<0.0001
P: WBC ratio	35.52 ± 14.69	55.26 ± 8.32	P=0.0006
NIHSS	5.87 ± 3.14	21.28 ± 3.30	P<0.0001
Barthel index	73.84 ± 13.0	28.57 ± 11.07	P<0.0001
BMI	28.45 ± 4.95	27.52 ± 5.82	P=0.6307
Age (in years)	55.39 ± 11.86	59.85 ± 15.24	P=0.3391
TLC	6967.88 ± 2394.36	5885.71 ± 1077.69	P=0.2371

Metabolic parameters and blood sugar levels

Blood sugar parameters, including FBS (163.28 ± 19.42 *vs.* 127.41 ± 34.51, P=0.0072), demonstrated significant differences between discharged and deceased groups, underscoring the role of metabolic health in stroke prognosis. However, other metabolic parameters such as BMI, cholesterol, triglycerides, and LDL cholesterol did not show statistically significant differences between the two groups.

Discussion

The findings of our study contribute significantly to the growing body of evidence concerning the prognostic value of Neutrophil-Lymphocyte Ratio (NLR) and Platelet-Lymphocyte Ratio (PLR) in stroke patients. By exploring their associations with stroke severity, functional outcomes, and mortality, our research provides valuable insights into the potential utility of these biomarkers in clinical practice.

Prognostic value of NLR and PLR

Consistent with previous studies our findings revealed substantial differences in NLR and PLR between discharged and deceased groups. Elevated NLR and PLR levels were closely correlated with increased stroke severity, evidenced by higher NIHSS scores, and reduced functional independence, as indicated by lower Barthel Index scores [11,12]. These results underscore the potential of NLR and PLR as reliable prognostic indicators for identifying stroke patients at heightened risk of adverse outcomes.

Recent research corroborates our findings, demonstrating the prognostic significance of NLR and PLR in various clinical settings. For example, a study by Quan K et al., found that High level of NLR within the first 24 h after admission was associated with increased risks of both short- and long-term adverse clinical outcomes in patients with ischemic stroke, regardless of etiology [13]. Similarly, a meta-analysis by Sharma D et al., reported that higher PLR is associated with worse outcomes after stroke in terms of morbidity, mortality, and safety outcomes after stroke [14]. These studies support the notion that NLR and PLR can serve as valuable prognostic markers across different disease states.

A similar study conducted by Malviya et al., found that the NIHSS score was higher in the diseased group compared to the survived group [15].

In our study, we observed markedly elevated CRP levels in the deceased group compared to the discharged group. This finding aligns with the results reported by Yu B et al., suggesting that an elevated circulating CRP level is associated with an increased risk of all-cause mortality in acute ischemic stroke patients [16].

In our study Fasting blood sugar levels showed a notable increase among diseased patients compared to discharged patients (P=0.0072). This is consistent with findings reported by Yao T et al., suggesting that higher FBG levels are associated with unfavorable outcomes and mortality in Chinese patients with acute ischemic stroke and DM [17].

Limitations and future directions

Despite the promising findings, several limitations of our study must be acknowledged. The retrospective nature of the study design may introduce selection bias and limit the generalizability of the results. Additionally, the relatively small sample size

and single-center setting may restrict the robustness of the findings. Future research endeavors should aim to address these limitations by conducting prospective, multicenter studies with larger sample sizes to validate the prognostic utility of NLR and PLR across diverse patient populations.

Conclusion

In conclusion, our study highlights the prognostic significance of NLR and PLR in assessing stroke outcomes. Elevated NLR and PLR were associated with increased stroke severity and decreased functional independence, emphasizing the importance of inflammatory and thrombotic processes in stroke pathophysiology. Additionally, metabolic parameters such as CRP level and blood sugar levels played a crucial role in determining patient outcomes. These findings underscore the need for comprehensive risk stratification and targeted therapeutic interventions to improve stroke prognosis and patient care.

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