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Original Research Article

CORRELATION OF HEMATOLOGICAL PARAMETERS WITH STROKE SEVERITY IN ACUTE ISCHEMIC STROKE

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Abstract

Background: Acute ischemic stroke (AIS) is a leading cause of mortality and disability worldwide, requiring early risk stratification for effective management. While clinical scales like the National Institutes of Health Stroke Scale (NIHSS) are widely used, hematological parameters such as mean platelet volume (MPV) and platelet distribution width (PDW) are emerging as potential biomarkers for stroke severity. This study evaluates the correlation between hematological parameters and stroke severity in AIS patients. **Materials and Methods:** A hospital-based cross-sectional study was conducted at Government Medical College, Trivandrum, involving 118 AIS patients. Patients were included if they were ≥18 years old, had CT/MRI-confirmed AIS, and presented within 48 hours of symptom onset. Stroke severity was assessed using NIHSS. Hematological parameters, including MPV, PDW, red cell distribution width (RDW), neutrophil-lymphocyte ratio (NLR), and platelet-lymphocyte ratio (PLR), were analyzed. Pearson correlation and Receiver Operating Characteristic (ROC) analysis were performed. **Result:** MPV and PDW showed a significant positive correlation with NIHSS scores ($p < 0.001$), indicating their potential as markers of stroke severity. Other parameters, including RDW and PLR, did not show a statistically significant correlation. ROC analysis confirmed MPV and PDW as strong predictors of severity. **Conclusion:** MPV and PDW are promising, cost-effective biomarkers for assessing AIS severity. Their inclusion in routine stroke evaluation may aid in early risk stratification. Further multicenter studies are needed to validate these findings.

INTRODUCTION

Stroke is a leading cause of disability and mortality worldwide, with ischemic stroke accounting for approximately 80% of cases. The World Health Organization (WHO) defines stroke as a rapidly developing neurological deficit due to vascular causes, persisting for more than 24 hours or leading to death (WHO, 2017).[1] Acute ischemic stroke (AIS) occurs due to an occlusion in the cerebral vasculature, leading to neuronal ischemia and infarction. Early identification of prognostic markers is crucial for risk stratification, timely intervention, and improved patient outcomes.

Hematological parameters have gained interest as potential biomarkers for stroke severity and prognosis. Among these, mean platelet volume (MPV) and platelet distribution width (PDW) have been associated with increased platelet activation, which plays a key role in thromboembolic events (Greisenegger et al., 2004).[2] Neutrophil-to-lymphocyte ratio (NLR) and red cell distribution width (RDW) have also been linked to systemic inflammation, which contributes to the pathophysiology of stroke (Qun et al., 2017).[3] However, the predictive value of these hematological indices remains inconsistent across studies.

This study aims to assess the correlation between hematological parameters and stroke severity in AIS

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patients. Identifying cost-effective, easily accessible biomarkers can aid in clinical decision-making, particularly in resource-limited settings.

MATERIALS AND METHODS

Study Design and Population: This was a hospital-based cross-sectional study conducted at Government Medical College, Trivandrum. Study duration: One year. A total of 118 patients diagnosed with AIS were included in the study. Stroke severity was assessed using the NIHSS.

Inclusion Criteria
- Patients aged ≥18 years with CT/MRI-confirmed AIS.
- Admission within 48 hours of symptom onset.

Exclusion Criteria
- Patients with hemorrhagic stroke or prior ischemic stroke.
- Patients with hematological disorders, chronic kidney/liver disease, or active infections.
- Recent use of immunosuppressants or antibiotics before stroke onset.

Data Collection and Analysis
Demographic variables, clinical characteristics, and stroke severity (NIHSS scores) were recorded.

Risk factors such as hypertension, diabetes, dyslipidemia, and smoking were documented. Hematological parameters, including MPV, PDW, mean corpuscular volume (MCV), red cell distribution width (RDW), neutrophil-lymphocyte ratio (NLR), and platelet-lymphocyte ratio (PLR), were measured.

Blood samples were analyzed within 24 hours of admission. Statistical analysis was performed using SPSS (Version 27), with Pearson correlation and Receiver Operating Characteristic (ROC) analysis applied to assess predictive value.

RESULTS

The mean age of patients was 62.1 ± 12.6 years, with 58.3% aged above 60 years. Males constituted 67.8% of the study population, while females accounted for 32.2%. Hypertension was the most prevalent comorbidity, observed in 91.3% of cases. A significant correlation was found between increasing age and stroke severity ($p = 0.012$), with older patients exhibiting higher NIHSS scores. However, other comorbidities such as diabetes and dyslipidemia did not show a statistically significant correlation with stroke severity.

Table 1: Distribution of NIHSS Scores by Age Group.

Age Group	NIHSS <6	NIHSS ≥6	Total (%)
<40 years	4 (26.7%)	5 (5.0%)	9 (7.8%)
41-60 years	3 (20.0%)	36 (36.0%)	39 (33.9%)
>60 years	8 (53.3%)	59 (59.0%)	67 (58.3%)
Total	15 (13.0%)	100 (87.0%)	118 (100%)

Table 2: Correlation Between NIHSS Scores and Hematological Parameters

Parameter	Correlation Coefficient (r)	p-value	Significance
Mean Platelet Volume (MPV)	0.388	<0.001	Significant
Platelet Distribution Width (PDW)	0.378	<0.001	Significant
Red Cell Distribution Width (RDW)	-0.016	0.862	Not Significant
Neutrophil-Lymphocyte Ratio (NLR)	0.181	0.052	Borderline
Platelet-Lymphocyte Ratio (PLR)	0.007	0.938	Not Significant

Table 3: ROC Analysis for Predictive Value of Hematological Markers

Hematological Marker	AUC Value	p-value
MPV	0.794	<0.001
PDW	0.791	<0.001
NLR	0.595	0.052
PLR	0.581	0.938

DISCUSSION

This study explored the relationship between demographic factors, clinical characteristics, and hematological parameters with stroke severity in AIS patients. The findings revealed that MPV and PDW showed significant correlations with NIHSS scores, while other parameters such as RDW and PLR did not.

The mean age of participants was 62.1 years, with 58.3% being above 60 years, consistent with studies indicating that stroke risk increases with age (Feigin et al., 2017).[4] The significant association between higher NIHSS scores and advanced age is in line

with findings from Zhang et al. (2024),[5] which suggest that aging is associated with increased stroke severity due to comorbidities and vascular changes.

Hypertension was the most prevalent comorbidity (91.3%), but it did not significantly correlate with stroke severity. This aligns with previous studies that report hypertension as a major risk factor for stroke occurrence but not necessarily for severity (Yu et al., 2011).[6] Similarly, diabetes and dyslipidemia were highly prevalent but did not show significant associations with NIHSS scores, consistent with findings from Maida et al. (2022) and Lau et al. (2019).[7,8]

The hematological parameters analyzed in this study showed varying degrees of association with stroke severity. MPV and PDW demonstrated strong predictive capabilities, with significant positive correlations (p < 0.001). This supports previous research suggesting that increased MPV and PDW indicate greater platelet activation, contributing to a higher thrombotic burden (Butterworth et al., 1998), (Pikija et al., 2009).[9,10] Conversely, RDW and PLR did not show significant correlations, which is consistent with findings from Feng et al. (2017).[11]

NLR exhibited a near-significant association (p = 0.052), supporting its potential role as a prognostic marker in AIS, as suggested by Qun et al,[3] (2017) and Tokgoz et al. (2014).[12] Increased neutrophil counts and decreased lymphocyte counts have been associated with poor stroke outcomes, reflecting the inflammatory response associated with severe strokes (Furlan et al., 2014), (Xue et al., 2017).[13,14]

ROC analysis confirmed MPV and PDW as strong predictors of stroke severity, with AUC values of 0.794 and 0.791, respectively. These findings align with Greisenegger et al,[2] (2004) and Ghahremanfard et al. (2018),[15] who reported that elevated MPV is linked to worse outcomes in AIS patients.

Despite these findings, some hematological parameters, such as RDW, total WBC count, and PLR, did not show strong predictive value, in agreement with studies by Yilmaz et al,[16] (2017) and Sung et al. (2019).[17] While some studies have suggested a potential role for RDW in stroke prognosis, the results remain inconsistent across different populations (Feng et al., 2017).[11]

Overall, this study reinforces the role of MPV and PDW as reliable biomarkers of stroke severity while suggesting that parameters like RDW and PLR may have limited predictive value. These findings highlight the importance of platelet activation in AIS pathophysiology and the potential for hematological indices to aid in early risk stratification.

CONCLUSION

This study demonstrates that MPV and PDW are significantly associated with stroke severity, suggesting that they could serve as useful biomarkers in AIS assessment. Given their low cost and accessibility, MPV and PDW could be incorporated into stroke evaluation protocols, aiding in early risk stratification. Further multicenter research is required to validate these findings and assess their impact on clinical decision-making.

Limitations

Single-center study, limiting generalizability to broader populations.

Cross-sectional design, preventing assessment of long-term prognostic implications.

Potential variability in laboratory measurements affecting data accuracy.

Study establishes correlation but does not confirm causation, requiring further research.

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