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Neutrophil-to-Lymphocyte and Platelet-to-Lymphocyte Ratios as Predictors of Severity in Pancreatitis

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Abstract

Background:

NLR and PLR are inflammation markers derived from routine blood counts. While NLR is linked to poor outcomes in acute pancreatitis (AP), PLR's prognostic value in AP remains underexplored. This study assess the utility of neutrophil-to-lymphocyte ratio (NLR) and platelet-to-lymphocyte ratio (PLR) in predicting the severity of acute pancreatitis.

Methods:

A prospective observational study was conducted from 1st August 2022 to 29th February 2024. Seventy patients aged ≥18 years diagnosed with acute pancreatitis were included. Severity was classified as mild, moderately severe, or severe based on the Revised Atlanta Criteria.

Results:

NLR showed a significant decreasing trend over time in mild and moderately severe AP ($p = 0.033$, $p = 0.031$), but not in severe cases ($p = 0.442$). PLR changes were not statistically significant across all severity groups. APACHE II scores decreased significantly in mild and moderately severe groups and increased in severe cases ($p < 0.001$). NLR at admission demonstrated excellent diagnostic accuracy for severe AP (AUROC = 0.96, $p = 0.001$), with 100% sensitivity and 89% specificity at a cutoff ≥9. PLR showed poor diagnostic performance (AUROC = 0.655, $p = 0.254$).

Conclusion:

NLR and PLR are simple, cost-effective markers easily obtained from routine blood tests. In this study, NLR showed higher predictive value for severe AP than PLR. Admission NLR >7.08 or PLR <149.39 suggests MSAP/SAP, while NLR <7.08 or PLR >149.39 indicates likely MAP. These markers can aid early risk stratification and guide timely intervention..

Keywords: Acute pancreatitis; Gallstone; Neutrophil to lymphocyte ratio; Platelet to lymphocyte ratio.

Introduction

Acute pancreatitis (AP) is a rapidly progressing inflammatory condition resulting from dysfunction of pancreatic acinar cells and premature activation of digestive enzymes, particularly trypsin. This leads to self-digestion

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of the pancreas and worsening tissue damage. The most frequent causes of AP are alcohol consumption and gallstones. Over recent decades, the global incidence of AP has increased significantly, with reported rates ranging from 4.9 to 73.4 cases per 100,000 individuals(1).This trend has placed a growing burden on healthcare systems due to prolonged hospital stays, high treatment costs, and notable mortality rates.

Approximately 10–20% of patients with AP progress to severe acute pancreatitis (SAP), which is often associated with complications like organ failure and pancreatic necrosis—major factors contributing to poor outcomes(2). Several clinical scoring systems, such as the Ranson, Glasgow, APACHE II, BISAP, and CTSI scores, have been developed to assess AP severity. However, these tools often require numerous parameters and are not ideal for early assessment due to their complexity and delayed applicability(3-5).

The pathophysiology of AP involves a cascade of inflammatory responses that trigger the release of cytokines and proteolytic enzymes, further damaging pancreatic tissue. Emerging evidence suggests that hematological markers, particularly the neutrophil-to-lymphocyte ratio (NLR), may offer a rapid and accessible measure of inflammatory burden(6,7). A rising NLR has been associated with increased disease severity, while a decrease may indicate clinical improvement. Though some studies support NLR as a reliable predictor of AP severity, findings across the literature have been inconsistent(17).Recent studies suggest that simple hematological ratios such as neutrophil-to-lymphocyte ratio (NLR) and platelet-to-lymphocyte ratio (PLR), derived from routine blood tests, may serve as cost-effective, accessible predictors of AP severity(14).

Materials and Methods :

All patients aged over 18 years with a clinical diagnosis of acute pancreatitis will be considered for inclusion in the study.

The diagnosis will be established based on the presence of characteristic upper abdominal pain radiating to the back and relieved by leaning forward, along with tenderness and guarding in the epigastric region, plus at least one of the following:

1. Serum amylase or lipase levels elevated to more than three times the normal limit

   Imaging findings (ultrasound or contrast-enhanced CT) indicative of acute pancreatitis

   A total of 70 patients meeting the inclusion criteria will be enrolled. Each patient will undergo a thorough history-taking and physical examination. Appropriate laboratory and radiological investigations will be conducted to confirm the diagnosis.

The severity of acute pancreatitis will be categorized as mild, moderately severe, or severe using the Revised Atlanta Classification. Organ dysfunction will be evaluated using the Modified Marshall Scoring System on the day of admission (day 0) and again at 48 hours to determine disease severity.

Statistical Analysis :

Categorical variables will be expressed as frequencies and percentages (%), while continuous variables will be presented as mean ± standard deviation (SD) and median, as appropriate. Receiver Operating Characteristic (ROC) curve analysis will be performed to determine the optimal cut-off values of NLR and PLR for predicting the severity of acute pancreatitis. Diagnostic performance will be evaluated by calculating sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV). Comparison of the area under the ROC curves (AUC) for NLR and PLR will

be conducted to assess their relative predictive accuracy. A p-value of less than 0.05 will be considered statistically significant. Data entry will be done using Microsoft Excel, and statistical analysis will be carried out using the Statistical Package for the Social Sciences (SPSS), version 27.0.Categorical variables were compared using Fisher's exact test and chi-square tests. Continuous variables were analyzed using Student's t-test or Mann–Whitney U test. A p-value <0.05 was considered significant.

Results:

A total of 70 patients with acute pancreatitis were included in the study, comprising 48.6% males and 51.4% females. The mean age was 41.70 ± 10.04 years, with a median (IQR) of 42 (32–49.5) years. According to the Revised Atlanta classification, 80.0% of patients were classified as mild acute pancreatitis, 12.9% as moderately severe, and 7.1% as severe.

Neutrophil-to-Lymphocyte Ratio (NLR)

Significant differences in NLR were observed among the severity groups at admission and at 24, 48, and 72 hours ($p < 0.05$). In the mild group, mean NLR decreased significantly from 5.18 at admission to 4.75 at 72 hours (Friedman test, $x^2 = 8.7$, $p = 0.033$). Similarly, the moderately severe group showed a significant decline from 9.54 to 7.88 over the same period ($x^2 = 8.9$, $p = 0.031$). In contrast, the severe group's NLR decreased from 13.00 at admission to 10.89 at 48 hours but increased to 14.64 at 72 hours; this change was not statistically significant ($x^2 = 2.7$, $p = 0.442$). The overall temporal trend of NLR differed significantly between severity groups (Generalized Estimating Equations, $p = 0.003$).

Table:Association of neutrophil lymphocyte ratio with severity of acute pancreatitis

N/L Ratio	Severity			P value for comparison of the three groups at each of the timepoints (Kruskal Wallis Test)
	Mild	Moderately Severe	Severe	
	Mean (SD)	Mean (SD)	Mean (SD)	
Admission	5.18 (1.99)	9.54 (3.48)	13.00 (3.21)	<0.001
24 Hours	5.05 (1.85)	9.43 (2.88)	12.64 (3.90)	<0.001
48 Hours	4.96 (1.81)	8.90 (2.86)	10.89 (2.41)	<0.001
72 Hours	4.75 (1.51)	7.88 (2.68)	14.64 (8.91)	<0.001
P Value for change in N/L Ratio over time within each group (Friedman Test)	0.033	0.031	0.442	
Overall P Value for comparison of change in N/L Ratio over time between the three groups (Generalized Estimating	0.003			

N/L Ratio	Severity			P value for comparison of the three groups at each of the timepoints (Kruskal Wallis Test)
	Mild	Moderately Severe	Severe	
	Mean (SD)	Mean (SD)	Mean (SD)	
Equations)				

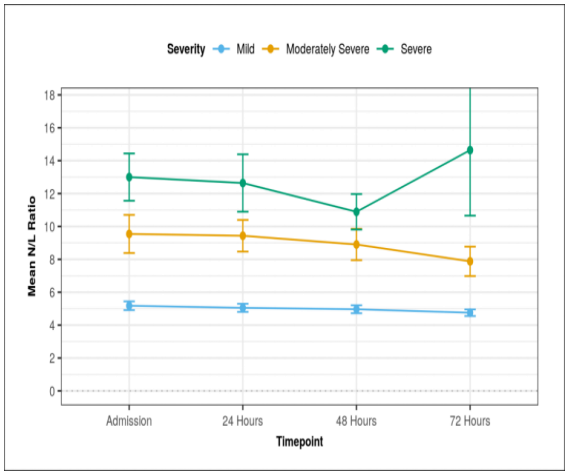


Figure :-Association of trend of neutrophil lymphocyte ratio at different time intervals with severity of acute pancreatitis.

Platelet-to-Lymphocyte Ratio (PLR)

PLR values differed significantly between severity groups at 24 and 48 hours. However, within-group changes over time were not statistically significant. The mild group showed a nonsignificant increase from 204.13 at admission to 210.64 at 48 hours, followed by a decrease to 207.09 at 72 hours (x^2 = 2.9, p = 0.402). The moderately severe group's PLR decreased initially from 157.96 to 151.47 at 24 hours and then increased to 173.94 at 72 hours (x^2 = 5.9, p = 0.115). The severe group's PLR decreased from 148.60 to 128.11 at 48 hours and rose to 189.41 at 72 hours (x^2 = 0.6, p = 0.896). No significant difference was found in the overall PLR trend between groups (p = 0.548).

Table:Association of platelet lymphocyte ratio with severity of acute pancreatitis

P/L Ratio	Severity			P value for comparison of the three groups at each of the timepoints (Kruskal Wallis Test)
	Mild	Moderately Severe	Severe	
	Mean (SD)	Mean (SD)	Mean (SD)	
Admission	204.13 (63.29)	157.96 (51.41)	148.60 (81.17)	0.088
24 Hours	205.14 (62.21)	151.47 (57.61)	148.36 (79.59)	0.014
48 Hours	210.64 (66.17)	168.63 (65.88)	128.11 (28.01)	0.008
72 Hours	207.09 (65.72)	173.94 (68.07)	189.41 (163.43)	0.113
P Value for change in P/L Ratio over time within each group (Friedman Test)	0.402	0.115	0.896	
Overall P Value for	0.548			

comparison of change in P/L Ratio over time between the three groups (Generalized Estimating Equations)		

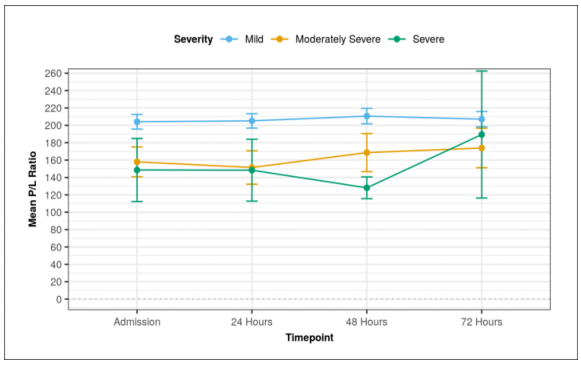


Figure:Association of Platelet lymphocyte ratio with severity of acute pancreatitis

APACHE II Score

APACHE II scores significantly differed among the groups at all time points (admission, 24, 48, and 72 hours). The mild group showed a significant decrease from 2.25 at admission to 0.54 at 72 hours (x^2 = 127.7, p < 0.001). The moderately severe group also showed a significant decline from 6.79 to 4.29 (x^2 = 21.8, p < 0.001). Conversely, the severe group exhibited a significant increase from 10.20 to 11.60 over 72 hours (x^2 = 13.0, p = 0.005). The overall trend of APACHE II scores differed significantly between groups (p < 0.001).

Table :-Association of APACHE II score with severity of acute pancreatitis.

APACHE 2	Severity			P value for comparison of the three groups at each of the timepoints (Kruskal Wallis Test)
	Mild	Moderately Severe	Severe	
	Mean (SD)	Mean (SD)	Mean (SD)	
Admission	2.25 (1.61)	6.79 (1.57)	10.20 (0.45)	<0.001
24 Hours	1.46 (1.78)	6.07 (2.20)	10.20 (0.45)	<0.001
48 Hours	0.71 (1.80)	5.00 (2.29)	11.20 (0.45)	<0.001
72 Hours	0.54 (1.81)	4.29 (2.04)	11.60 (0.55)	<0.001
P Value for change in APACHE 2 over time within each group (Friedman Test)	<0.001	<0.001	0.005	
Overall P Value for comparison of change in APACHE	<0.001			

2 over time between the three groups (Generalized Estimating Equations)		

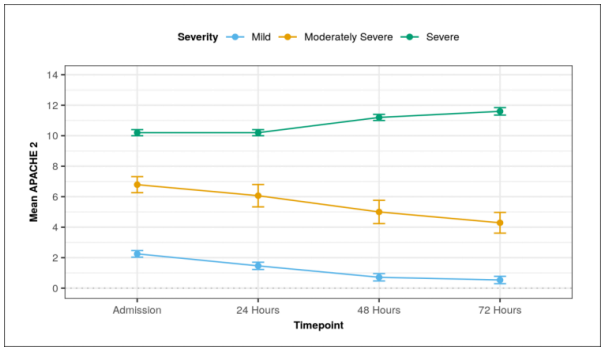


Figure :-Association of APACHE II score with severity of acute pancreatitis

Complications and Clinical Outcomes

Among participants, 81.4% experienced no complications, 11.4% had transient organ failure, and 7.1% developed persistent organ failure with pancreatic necrosis. The mean hospital stay was 7.51 ± 4.36 days (median 6, IQR 5–7, range 4–25 days). Mortality was observed in one patient (1.4%).

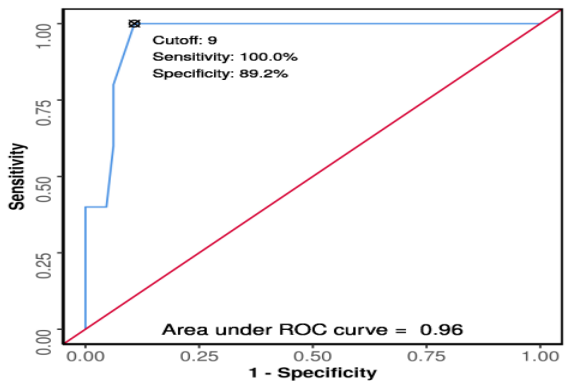
Summary of Outcomes

Outcomes	Mean ± SD || Median (IQR) || Min-Max OR N (%)
Severity	
Mild	56 (80.0%)
Moderately Severe	9 (12.9%)
Severe	5 (7.1%)
More Than Mild Disease (Yes)	14 (20.0%)
Severe Disease (Yes)	5 (7.1%)
Any Complication (Yes)	13 (18.6%)
Complication	
None	57 (81.4%)
Transient Organ Failure	8 (11.4%)
Persistent Organ Failure With Pancreatic Necrosis	5 (7.1%)
Length Of Stay (Days)	7.51 ± 4.36 || 6.00 (5.00-7.00) || 4.00 - 25.00
Mortality (Yes)	1 (1.4%)

Diagnostic Accuracy

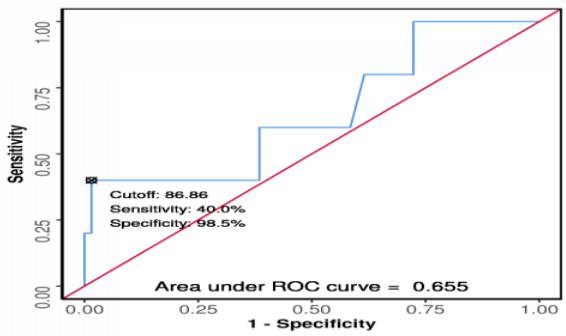
The area under the receiver operating characteristic (ROC) curve (AUROC) for admission NLR predicting severe acute pancreatitis was 0.96 (95% CI: 0.912–1.0), indicating excellent diagnostic performance (p = 0.001). Using a cutoff value of NLR ≥ 9, sensitivity and specificity for predicting severe disease were 100% and 89%, respectively.

Table : ROC Curve Analysis Showing Diagnostic Performance of N/L Ratio (Admission) in Predicting Severe Disease: Yes vs Severe Disease: No (n = 70)



In contrast, the AUROC for admission PLR was 0.655 (95% CI: 0.359–0.952), indicating poor diagnostic accuracy and was not statistically significant (p = 0.254). At a cutoff of PLR ≤ 86.86, sensitivity was 40% and specificity was 98%.

Table : ROC Curve Analysis Showing Diagnostic Performance of P/L Ratio (Admission) in Predicting Severe Disease: Yes vs Severe Disease: No (n = 70)



Discussion:

Acute pancreatitis (AP) is a highly variable clinical condition ranging from mild, self-limiting inflammation to a severe, necrotizing process with high morbidity and mortality. (20)The ability to predict the severity of disease at the time of admission is crucial, as it allows for early triage, optimized resource allocation, and targeted therapeutic intervention. While multifactorial scoring systems such as APACHE II, Ranson's, and Glasgow have traditionally been used to assess severity, they are often cumbersome and require multiple clinical and biochemical parameters that may not be readily available in the early phase of the disease(21).

This study evaluated the clinical utility of two easily accessible hematological markers—Neutrophil-to-Lymphocyte Ratio (NLR) and Platelet-to-Lymphocyte Ratio (PLR)—for predicting the severity of acute pancreatitis at the time of hospital admission. Our findings indicate that NLR is a highly sensitive and specific early predictor of disease severity, while PLR, though specific, lacks adequate sensitivity for use as an independent prognostic tool.

Demographics and Disease Severity Profile

The mean age of patients in our cohort was 41.7 ± 10.4 years, with a nearly equal male-to-female ratio (M:F = 48.6:51.4). These values are comparable to those reported in studies by Marco Simões et al.(9) and Suppiah et al.(5), although those studies noted higher mean ages (52.4 and 56 years, respectively). The proportion of patients with mild (80%), moderately severe (12.9%), and severe (7.1%) AP in our study is in contrast to the study by Shawnas Bhanou et al. , where mild cases constituted only 47.7%, and moderately severe and severe AP cases were significantly higher (22.4% and 29.9%, respectively). Similar higher proportions of severe AP were noted by Gravito-Soares et al.(16) and Suppiah et al.(5) , highlighting possible geographic, etiological, or referral bias variations.

Neutrophil-to-Lymphocyte Ratio (NLR)

Our analysis revealed that NLR is a robust and reliable early marker of disease severity in AP. The mean NLR at admission was significantly higher in patients with severe and moderately severe AP than in those with mild disease (13.0 vs. 5.2, respectively). Over time, NLR declined in patients with mild and moderately severe AP but remained persistently elevated in severe cases, indicating ongoing inflammation.

Receiver Operating Characteristic (ROC) curve analysis showed that NLR at admission had an excellent predictive performance (AUROC = 0.96, 95% CI: 0.912–1.0). At a cutoff value of ≥9.0, NLR demonstrated a sensitivity of 100% and specificity of 89.2% for predicting severe disease, with a negative predictive value (NPV) of 100%. This suggests that an NLR below this threshold can reliably rule out severe disease. Similarly, for predicting "more than amild" disease, a cutoff of ≥7.08 yielded a sensitivity of 93% and specificity

of 91%.

Our findings are in agreement with the study by Suppiah et al.(12), who reported that elevated NLR values in the first 48 hours were independently associated with severe AP. However, their proposed cutoff of 10.6 had lower sensitivity (63.6%) and specificity (56.7%), possibly due to different population characteristics or sample size.

Jeon et al. also identified NLR as an early marker of adverse outcomes in AP, with their optimal cutoff value being 4.76, considerably lower than ours. The variability in cutoffs across studies is likely due to differences in inclusion criteria, timing of blood sample collection, and definitions of severity(18).

Noor Md. et al. reported that NLR >8.5 at admission was associated with worse outcomes, including longer hospital stays and higher rates of organ failure. This value is similar to our cutoff of 9.0 and supports the clinical relevance of NLR as a predictor of disease progression(19).

Collectively, these findings underscore the role of NLR as an independent, inexpensive, and rapid marker that can be used in emergency settings to stratify AP patients early in the disease course.

Platelet-to-Lymphocyte Ratio (PLR)

The PLR was also assessed in our study to determine its utility as a predictive marker for AP severity. Unlike NLR, PLR showed limited diagnostic performance, with an AUROC of 0.655 (95% CI: 0.359–0.952). At a cutoff value of ≤86.86, PLR had a low sensitivity (40%) but high specificity (98.5%), and an NPV of 95.5%. This suggests that while a very low PLR may be associated with severe disease, its standalone use in clinical decision-making is limited due to poor sensitivity.

Although few studies have evaluated PLR in AP, our findings are consistent with the limited available data suggesting that PLR is inferior to NLR as a prognostic indicator. It may, however, serve as an adjunct marker, particularly in combination with NLR or other inflammatory indices(12,16,21).

Comparison to Gold Standard (APACHE II)

We used APACHE II scores as a benchmark for assessing disease severity. NLR correlated well with APACHE II and provided similar risk stratification capabilities. Given that APACHE II is often not feasible in all settings due to its complexity, NLR offers a more practical alternative for early identification of high-risk patients.

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