International Journal of Science and Research (IJSR)
ISSN: 2319-7064
Impact Factor 2024: 7.101

Early Prediction of Necrosis in Acute Pancreatitis Using Neutrophil-to-Lymphocyte and Platelet-to-Lymphocyte Ratios: A Prospective Study

Mohamed Ibrahim Maroof Saheb

Government Arignar Anna Memorial Cancer Hospital and Research Institute, Kanchipuram, Tamil Nadu, India

Abstract: ***Background: Acute pancreatitis (AP) is an inflammatory disorder with potential progression to pancreatic necrosis, which significantly increases morbidity and mortality. Hematological indices such as the neutrophil-to-lymphocyte ratio (NLR) and platelet-to-lymphocyte ratio (PLR) have emerged as potential early markers of systemic inflammation. This study aimed to evaluate the utility of NLR and PLR in predicting pancreatic necrosis in patients with AP. Methods: This prospective observational study included 130 patients with acute pancreatitis admitted to Government Royapettah Hospital, Chennai, India, from April 2019 to September 2020. Blood samples were collected at admission (Day 0), 24 hours (Day 1), and 48 hours (Day 2) to calculate NLR and PLR. Pancreatic necrosis was assessed using contrast-enhanced CT (CECT). Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of NLR and PLR were analyzed, and combined performance was evaluated. Results: The cohort comprised 121 males (93.1%) and 9 females (6.9%), with a mean age of 40.65 ± 7.5 years. Alcohol was the most common etiological factor (96%). Mild pancreatitis accounted for 77.7% of cases, while severe pancreatitis represented 22.3%. NLR demonstrated higher sensitivity and NPV compared to PLR at all time points. At 48 hours, NLR sensitivity and specificity were 62.2% and 91.2%, respectively, while PLR sensitivity and specificity were 59% and 80.2%. Combined assessment of NLR and PLR improved early detection of pancreatic necrosis, achieving the highest diagnostic accuracy. Conclusion: NLR and PLR are elevated in patients with necrotizing pancreatitis, with NLR showing superior predictive performance. Their combined use further enhances early identification of high-risk patients, offering a simple, inexpensive, and readily available tool for early prognostication in acute pancreatitis.***

Keywords: Acute pancreatitis, Pancreatic necrosis, Neutrophil-to-lymphocyte ratio, Platelet-to-lymphocyte ratio, Prognostic biomarkers

1.Introduction

Acute pancreatitis (AP) is an inflammatory disorder of the pancreas with a steadily increasing incidence over the past three decades. In the United States, AP accounts for approximately 270,000 hospital admissions annually, with an economic burden exceeding $2.5 billion. The disease is initiated by acinar cell injury and activation of pancreatic enzymes, resulting in local inflammation that may extend to peripancreatic tissues or distant organs. While most cases are mild and self-limiting, approximately 20% develop severe acute pancreatitis (SAP), often associated with pancreatic necrosis and organ failure. Mortality rates in SAP may reach up to 65%.

The severity and prognosis of AP largely depend on the systemic inflammatory response. Conventional biomarkers such as white blood cell (WBC) count and C-reactive protein (CRP) are routinely used to assess inflammation, while prognostic scoring systems like Ranson's criteria, Glasgow score, APACHE II, and BISAP include WBC counts [1,2,3]. However, total WBC can be influenced by physiological or pathological conditions, limiting its reliability.

Recently, haematological indices derived from differential counts, such as the neutrophil-to-lymphocyte ratio (NLR) and platelet-to-lymphocyte ratio (PLR), have gained attention as inexpensive, readily available markers of systemic inflammation. They reflect the balance between inflammation and immune regulation and have been associated with prognosis in cardiovascular, malignant, and inflammatory conditions. Although NLR and PLR have been studied in AP severity [4,5], limited data exist regarding their role in predicting pancreatic necrosis. This study aimed to assess NLR and PLR in patients with AP and evaluate their potential as early predictors of pancreatic necrosis.

2.Methodology

This prospective observational study was conducted in the Department of General Surgery, Government Royapettah Hospital, Chennai, India, from **April 2019 to September 2020**. Ethical clearance was obtained from the Institutional Research and Ethics Committee prior to commencement of the study. Written informed consent was obtained from all participants. A total of **130 patients** diagnosed with acute pancreatitis and admitted to Government Royapettah Hospital during the study period were included. The diagnosis of acute pancreatitis was made according to the **revised Atlanta classification [1]**, based on the presence of at least **two of the following three criteria**:

1. Abdominal pain consistent with acute pancreatitis (severe, persistent epigastric pain of acute onset, often radiating to the back).
2. Serum amylase or lipase levels at least **three times** the upper limit of normal.
3. Imaging findings characteristic of acute pancreatitis on **contrast-enhanced computed tomography (CECT)**, or when available, **magnetic resonance imaging (MRI)** or **abdominal ultrasonography**.

Blood samples were collected at the time of admission and analyzed for **serum amylase, urea, creatinine, and liver function tests**.

Total white blood cell (WBC) counts and differential counts were obtained at:

- Admission (Day 0)
- 24 hours after admission (Day 1)
- 48 hours after admission (Day 2)

The **neutrophil-to-lymphocyte ratio (NLR)** was calculated as the ratio of the absolute neutrophil count to the absolute lymphocyte count. The **platelet-to-lymphocyte ratio (PLR)** was calculated as the ratio of the platelet count to the absolute lymphocyte count. Additional parameters such as **serum creatinine, blood pressure**, and **oxygen saturation (SpO_2)** were monitored as clinically indicated to assess for evidence of **organ failure**. **Correlation with Imaging Findings** and All patients underwent **CECT abdomen** for evaluation of pancreatic necrosis, and NLR and PLR values were correlated with the radiological findings.

Inclusion Criteria

- All patients diagnosed with **acute pancreatitis** admitted during the study period.

Exclusion Criteria

- Patients with **chronic pancreatitis**.
- Patients with **recurrent pancreatitis**.
- Patients with **known hematological disorders**.
- Patients with **malignancy**.

Statistical Analysis

Data were analyzed using the **independent samples t-test** to compare NLR and PLR values on Day 0, Day 1, and Day 2 between patients with mild and severe acute pancreatitis. A **p-value < 0.05** was considered statistically significant. Statistical analyses were performed using **SPSS 21 software.**

3.Results

NLR at hr, 24 hr and 48 hrs

NLR		%		%		%
POSITIVE	48	39.9	42	32.3	35	26.9
NEGATIVE	82	63.1	88	67.7	95	73

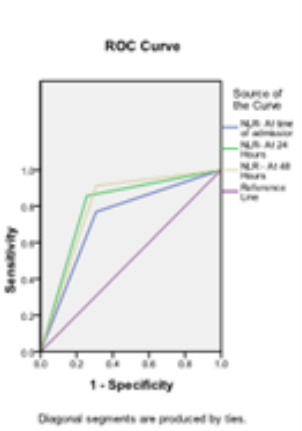
PLR at admission, 24 hrs and 48 hours

PLR		%		%		%
POSITIVE	56	43.1	46	35.4	41	31.5
NEGATIVE	74	56.9	84	64.4	89	68.5

Sensitivity and specificity of NLR and PLR

O HR 24 HR 48 HR

	NLR	PLR	NLR	PLR	NLR	PLR
SENSITIVITY	69.2	64.1	74.4	53.8	62.2	59
SPECIFICITY	76.9	65.9	85.7	72.5	91.2	80.2



Area Under the Curve

Test Result Variable(s)	Area	Std. Error[a]	Asymptotic Sig.[b]	Asymptotic 95% Confidence Interval	
				Lower Bound	Upper Bound
PLR- At time of admission	.650	.053	.007	.546	.754
PLR - At 24 Hours	.632	.055	.017	.525	.739
PLR - At 48 Hours	.696	.053	.000	.592	.800

The test result variable(s): PLR- At time of admission, PLR - At 24 Hours, PLR - At 48 Hours has at least one tie between the positive actual state group and the negative actual state group. Statistics may be biased.

a. Under the nonparametric assumption

b. Null hypothesis: true area = 0.5

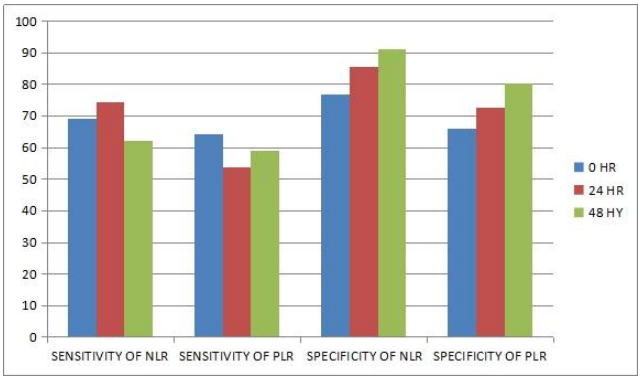
Area Under the Curve

Test Result Variable(s)	Area	Std. Error[a]	Asymptotic Sig.[b]	Asymptotic 95% Confidence Interval	
				Lower Bound	Upper Bound
NLR- At time of admission	.731	.050	.000	.633	.829
NLR- At 24 Hours	.800	.046	.000	.710	.891
NLR - At 48 Hours	.802	.048	.000	.709	.896

The test result variable(s): NLR- At time of admission, NLR- At 24 Hours, NLR - At 48 Hours has at least one tie between the positive actual state group and the negative actual state group. Statistics may be biased.

a. Under the nonparametric assumption

b. Null hypothesis: true area = 0.5

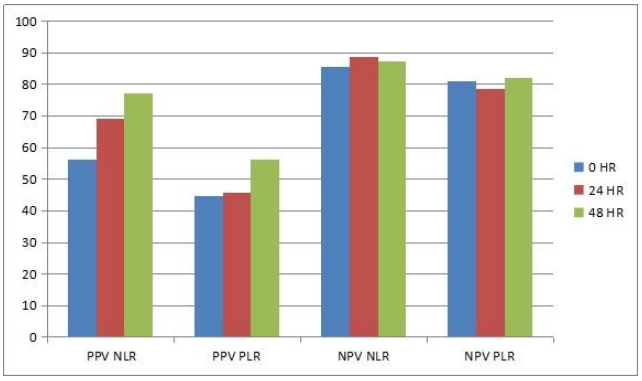


PPV and NPV OF NLR and PLR:

0 HR 24 HR 48 HR

	NLR	PLR	NLR	PLR	NLR	PLR
PPV	56.3	44.6	69.3	45.7	77	56.1
NPV	85.4	81.1	88.6	78.6	87.4	82

PPV and NLR and PLR



The present study concluded that, out of 130 patients 121 were male, which showed that male patients were most commonly affected by pancreatitis than female. Most common age group affected were between 31-40 years, comprising of 40 %Mean age affected was 40.65 with a standard deviation of 7.502. 30 % of patients were diagnosed as having pancreatitis by CT imaging. According to ATLANTA classification,77.7% were diagnosed as having mild pancreatitis,22.3% were categorized under severe pancreatitis. The sensitivity of NLR at admission,24 hours and 48 hours were 69.2%,74.4% and 62.2 respectively. The sensitivity of PLR at admission,24 hours and 48 hours were 64.1%,53.8% and 59% respectively. The specificity of NLR at admission,24 hours and 48 hours were 76.95,85.7% and 91.2% respectively. The specificity of PLR at admission ,24 hours and 48 hours were 65.9%,72.5%,80.2% respectively. The PPV of NLR and PLR at admission were56.3% and 44.6%, At 24 hours 69.3%& 45.7%, At 48 hours 77% & 56.1%.

The NPV of NLR and PLR At admissionà85.4% and 81.1% At 24 hours 88.6% and 78.6%, At 48 hours 87.4% and 82%. The sensitivity and NPV of NLR was higher than PLR in diagnosing acute necrotizing pancreatitis. NLR was also superior in terms of predicting intensive care admission and shorter hospital stay. When NLR and PLR were combined, both good statistical correlation as an early predictor of necrotizing pancreatitis. From the study it is concluded that the combination of NLR and PLR was found to have the highest AUC in terms of predicting necrosis earlier than other scoring systems.

4.Discussion

In this prospective study of 130 patients with acute pancreatitis (AP), the disease was found to be significantly more prevalent among males (93.1%) than females (6.9%). This observation is consistent with findings from studies by Rithin et al. and Savio G. Barreto et al., who also reported a marked male predominance. The higher incidence in males may be attributed to the greater prevalence of alcohol consumption among men in this region.

The majority of patients in this study were between 31 and 40 years of age (40%), followed by those aged 41–50 years (38.5%), with a mean age of 40.3 years. These results closely align with studies by Rithin et al. (mean age 40.9 years) and Barreto et al. (mean age 40 years), suggesting that acute pancreatitis predominantly affects individuals in the middle-age group.

Alcohol was identified as the most common etiological factor in this study, accounting for 96% of cases. This finding corresponds to previous reports by Barreto et al. (92.6%) and Kimmo et al. (79%), confirming alcohol as a major precipitating factor in the Indian subcontinent. Gallstones accounted for a smaller proportion of cases, consistent with global trends in alcohol-related pancreatitis.

Of the total patients, 77.7% had mild pancreatitis, while 22.3% were classified as severe according to the Revised Atlanta Classification. These proportions are comparable to the standard distribution reported in the literature, where 70–80% of cases are mild and 20–30% are severe. The overall mortality rate in this study was 7.7%, with all deaths occurring in patients with necrotizing pancreatitis and associated organ failure.

Interestingly, serum amylase levels were elevated to ≥3 times the upper normal limit in only 18% of patients, while 82% had lower values. Previous studies have shown that lower serum amylase levels are often associated with severe alcohol-induced pancreatitis, possibly due to extensive pancreatic tissue destruction and loss of enzyme-producing capacity. The predominance of alcohol-induced etiology in the present cohort likely explains this finding.

NLR and PLR as Prognostic Markers

The key finding of this study is that both the neutrophil-to-lymphocyte ratio (NLR) and the platelet-to-lymphocyte ratio (PLR) were significantly elevated in patients with acute necrotizing pancreatitis compared with those with non-necrotizing disease. NLR and PLR showed good correlation with CECT findings, particularly during the first 48 hours of hospitalization, indicating their potential as early prognostic markers.

The NLR was initially introduced as a simple and reproducible marker of systemic inflammation in critically ill patients in intensive care units. It reflects the balance

between neutrophil-driven inflammation and lymphocyte-mediated immune regulation. Similarly, PLR has been recognized as an inflammatory index that incorporates the role of platelets in linking inflammation to microvascular dysfunction, tissue ischemia, and organ failure. Elevated platelet counts in inflammatory states reflect cytokine-driven thrombopoiesis, whereas reduced lymphocyte counts indicate physiological stress and immune suppression.

Acute pancreatitis represents a dynamic inflammatory process involving both innate and adaptive immune mechanisms. Excessive activation of neutrophils and platelets leads to the release of proteolytic enzymes, reactive oxygen species, and proinflammatory cytokines, resulting in pancreatic injury, necrosis, and systemic inflammatory response syndrome (SIRS). Persistent elevation of NLR and PLR thus mirrors the intensity of this immune dysregulation [6,7].

While some prior studies have shown PLR to be superior to NLR in predicting outcomes in various malignancies and inflammatory disorders, few have investigated its prognostic role in acute pancreatitis. The present study demonstrates that although PLR correlates with disease severity, its predictive performance is lower than that of NLR. Nonetheless, when both indices were evaluated together, their combined use improved diagnostic accuracy for early detection of pancreatic necrosis.

Clinical and Research Implications

These findings emphasize the clinical utility of NLR and PLR as inexpensive, easily available, and rapid biomarkers derived from routine complete blood counts. Their application in the early phase of acute pancreatitis can facilitate timely identification of high-risk patients, guiding the need for intensive monitoring, early imaging, and targeted therapy.

Limitations

The limitations of this study include its single-center design and relatively small sample size, which may limit generalizability.

5.Conclusion

In summary, both NLR and PLR were elevated in patients with acute necrotizing pancreatitis, with NLR showing superior diagnostic accuracy. The combination of NLR and PLR further improved predictive performance, suggesting that these simple hematological indices can serve as valuable early markers of necrosis in acute pancreatitis.

References

[1] Acevedo-Piedra, Nelly G., Neftalí Moya-Hoyo, Mónica Rey-Riveiro, Santiago Gil, Laura Sempere, Juan Martínez, Félix Lluís, José Sánchez-Payá, and Enrique de-Madaria. 'Validation of the Determinant-Based Classification and Revision of the Atlanta Classification Systems for Acute Pancreatitis'. *Clinical Gastroenterology and Hepatology: The Official Clinical Practice Journal of the American Gastroenterological Association* 12, no. 2 (February 2014): 311–16. https://doi.org/10.1016/j.cgh.2013.07.042.

[2] Basit, Hajira, Gordon J. Ruan, and Sandeep Mukherjee. 'Ranson Criteria'. In *StatPearls*. Treasure Island (FL): StatPearls Publishing, 2019. http://www.ncbi.nlm.nih.gov/books/NBK482345/.

[3] Chatila, Ahmed T, Mohammad Bilal, and Praveen Guturu. 'Evaluation and Management of Acute Pancreatitis'. *World Journal of Clinical Cases* 7, no. 9 (6 May 2019): 1006–20. https://doi.org/10.12998/wjcc.v7.i9.1006.

[4] Cho, Seung Kook, Saehyun Jung, Kyong Joo Lee, and Jae Woo Kim. 'Neutrophil to Lymphocyte Ratio and Platelet to Lymphocyte Ratio Can Predict the Severity of Gallstone Pancreatitis'. *BMC Gastroenterology* 18, no. 1 (25 January 2018): 18. https://doi.org/10.1186/s12876-018-0748-4.

[5] 'Comparison of Ranson, Glasgow, MOSS, SIRS, BISAP, APACHE-II, CTSI Scores, IL-6, CRP, and Procalcitonin in Predicting Severity, Organ Failure, Pancreatic Necrosis, and Mortality in Acute Pancreatitis'. Accessed 26 October 2019. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3800571/.

[6] Garg, Pramod Kumar, Kaushal Madan, Girish Kumar Pande, Sudeep Khanna, Garipati Sathyanarayan, Narendra Prasad Bohidar, and Rakesh Kumar Tandon. 'Association of Extent and Infection of Pancreatic Necrosis with Organ Failure and Death in Acute Necrotizing Pancreatitis'. *Clinical Gastroenterology and Hepatology: The Official Clinical Practice Journal of the American Gastroenterological Association* 3, no. 2 (February 2005): 159–66.

[7] Han, B., and C. D. Logsdon. 'CCK Stimulates Mob-1 Expression and NF-KappaB Activation via Protein Kinase C and Intracellular Ca(2+)'. *American Journal of Physiology. Cell Physiology* 278, no. 2 (February 2000): C344-351. https://doi.org/10.1152/ajpcell.2000.278.2.C344.