ORIGINAL ARTICLE

Neutrophil-to-lymphocyte Ratio and Red Cell Distribution Width as Prognostic Marker for Severity in Acute Pancreatitis: An Observational Study

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Abstract

Introduction: Traditional scoring systems such as Ranson's, Glasgow, and APACHE II remain the cornerstone for assessing the severity of acute pancreatitis (AP), yet their early applicability is limited because they depend on multiple biochemical and clinical variables that may not be immediately available. In recent years, hematological parameters obtained from routine complete blood counts, particularly the neutrophil-to-lymphocyte ratio (NLR) and red cell distribution width (RDW), have emerged as promising inflammatory indicators. As these markers are inexpensive, readily measurable, and quickly obtainable, they may serve as useful adjuncts for early prediction of AP severity and patient outcomes.

Aim and objectives: This study evaluated the ability of NLR and RDW to predict disease severity in patients with AP. The primary objective was to determine the association between these inflammatory markers and clinical severity, while the secondary objective was to track their progression at 0, 24, and 48 hours following hospital admission.

Materials and methods: A prospective, hospital-based cross-sectional observational study was conducted at Fortis Escorts Hospital, Jaipur, Rajasthan, after institutional ethics approval. A total of 54 patients diagnosed with AP were enrolled and evaluated using standard clinical and laboratory parameters.

Results: The study population had a mean age of 41.96 ± 8.94 years; 18.5% were female, and 81.5% were male. Most participants presented with abdominal pain, nausea, and vomiting. A total of 40 patients (74.1%) had mild pancreatitis, whereas 14 (25.9%) had severe disease. The mean baseline NLR (7.57 ± 2.42) declined significantly over 48 hours. RDW values showed minimal temporal variation but were consistently higher among severe cases. All mild cases survived; four deaths occurred exclusively in the severe group.

Conclusion: NLR and RDW demonstrated significant prognostic value in assessing the severity of AP. Their early evaluation and serial monitoring can provide rapid risk stratification and guide timely clinical management.

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Introduction

Acute pancreatitis (AP) involves pancreatic inflammation ranging from mild, self-limiting episodes to severe systemic inflammation with potential organ failure and death.[1,2] While most cases are mild, characterized by interstitial edema and rapid recovery, approximately 15–20% progress to severe forms associated with significant morbidity and mortality.[3] The most frequent causes of AP include gallstones and alcohol use, with a smaller contribution from hypertriglyceridemia and other metabolic factors.[2,3]

AP severity is categorized as mild (no organ failure or complications), moderately severe (transient organ failure <48 hours, with or without complications), and severe (persistent organ failure >48 hours).[4] Approximately, one-fourth of AP cases progress to severe disease, characterized by a pronounced inflammatory response that may evolve into multi-organ dysfunction and elevated mortality rates.[5,6] In later stages, infected pancreatic necrosis and peripancreatic fluid collections further increase mortality risk.[7,8] Clinical warning signs include fever, hypovolemia, Grey-Turner's and Cullen's signs, hypercalcemic tetany, and fulminant pancreatitis; fever may indicate either infection or ongoing inflammation.[4,9] Diagnosis is based on the presence of characteristic abdominal pain, elevated serum amylase or lipase levels (≥3 times the upper normal limit), and imaging findings.[10]

Traditional scoring models provide useful guidance but are often less accurate when applied during the initial phase of patient assessment.[11,12] Therefore, simple and readily available biomarkers such as the neutrophil-to-lymphocyte ratio (NLR) and lymphocyte-to-monocyte ratio (LMR), derived from routine blood counts, are being explored as potential early indicators of disease severity, as they reflect systemic inflammation and immune response.[13–15]

The present study aims to assess the prognostic value of NLR and red cell distribution width (RDW) in predicting the severity of AP, with the goal of improving early risk stratification and clinical outcomes.

Aims and Objectives

The aim of this study was to evaluate the prognostic value of NLR and RDW in patients presenting with AP. The primary objective was to assess the severity of AP by analyzing these inflammatory markers. Additionally, the study sought to track the progression of NLR and RDW at three time points, at admission (0 hours), 24 hours, and 48 hours after hospital presentation, to better understand their role in disease progression.

Materials and Methods

The study was conducted on patients presenting with AP in the medicine and gastroenterology departments at Fortis Escorts Hospital, Jaipur. The study population included patients admitted with AP through the outpatient and emergency departments of medicine and gastroenterology who met the inclusion and exclusion criteria. This observational, prospective study was carried out at Fortis Escorts Hospital, Jaipur, over a duration of 1 year following approval from the Scientific Research Committee (SRC) and the Institutional Ethics Committee (IEC).

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Study Design and Type

This was a hospital-based, prospective, observational study.

Study Duration

From December 2022 to December 2023.

Sample Size

A total of 54 participants were studied.

Inclusion Criteria

The inclusion criteria for the study encompass patients over 18 years of age who meet the specified criteria for AP.

Exclusion Criteria

The exclusion criteria rule out patients with hematologic diseases, chronic infections, liver disease, or heart failure; those with hematological malignancies undergoing chemotherapy; pregnant patients; individuals who have had a COVID-19 infection within the past month; and those who do not provide consent.

Table 1: Distribution of study participants according to age-group and gender

Age-group	*Frequency*	*Percent*
≤30 years	6	11.1
31–40 years	17	31.5
41–50 year	27	50.0
>50 years	4	7.4
Total	54	100.0

Gender: females—10, males—44

Methodology

After obtaining written informed consent, patients underwent a detailed history and physical examination. Routine tests including complete blood count (CBC), serum amylase, lipase, creatinine, blood urea nitrogen (BUN), calcium, C-reactive protein (CRP), triglycerides, random blood sugar, liver function, arterial blood gas, electrolytes, and electrocardiogram (ECG) were performed. Radiological investigations such as ultrasound, computed tomography (CT) scan, and chest X-ray were done as needed. RDW and NLR were measured on days 0, 1, and 2 and correlated with clinical severity. The bedside index for severity in acute pancreatitis (BISAP) score was calculated using five parameters: blood urea nitrogen >25 mg/dL, impaired mental status, systemic inflammatory response syndrome, age >60, and pleural effusion. Diagnosis of AP required two of the following: continuous epigastric pain, elevated serum amylase/lipase ≥3 times normal, or characteristic imaging findings. After 48 hours, patients were classified as mild (no organ failure or complications) or severe (persistent organ failure or complications). RDW and NLR values were then correlated with severity.

Table 4: Distribution of study participants according to severity

Severity	*Frequency*	*Percent*
Mild	40	74.1
Severe	14	25.9
Total	54	100.0

Table 2: Comparison of NLR at different time intervals

	NLR	*NLR at 24 hours*	*NLR at 48 hours*
Mean	7.567	6.476	4.543
Median	7.200	5.900	4.300
Std. deviation	2.4156	1.9004	0.9338
Minimum	4.3	3.9	3.2
Maximum	13.5	11.3	7.1
p-value (ANOVA test)	0.0001		
p-value (compare to baseline)		0.0001	0.0001

Table 3: Comparison of RDW at different time intervals

	RDW baseline	*RDW at 24*	*RDW at 48*
Mean	13.967	14.111	13.769
Median	13.800	13.700	13.650
Std. deviation	1.1712	1.3155	1.8945
Minimum	12.2	12.4	7.1
Maximum	17.2	17.3	17.7
p-value (ANOVA test)	0.342		
p-value (compare to baseline)		0.156	0.477

Ethical Clearance

The study received approval from the Institutional Ethics Committee, reference number FEHJ/IEC/22/029, dated 20/12/2022.

Statistical Analysis

Predesigned proformas were checked for completeness and cleaned for errors and missing values. Cleaned data was entered into Excel using a master chart. After every 10 entries, one form was randomly rechecked for accuracy. Analysis was conducted with SPSS version 24.0. Univariate analysis results are shown in tables, text, bar graphs, and pie charts. Frequencies described categorical variables; central tendency and dispersion summarized continuous variables. Independent *t*-tests compared continuous variables, and Chi-squared tests analyzed categorical variables. Significance was set at $p < 0.05$.

Observation and Results

The study included 54 participants (81.5% male), aged 25–66 years (mean 41.96 ± 8.95), mostly aged 41–50 (50%). Mean weight was76.8 kg, height 1.71 m, BMI 26.44 kg/m^2 (Table 1). Common complaints were abdominal pain, nausea, and vomiting (87%), with fever in 59.3%. Comorbidities included hypertension (24.1%), diabetes (25.9%), CKD (13%), and CVD (11.1%). Smoking and alcohol use were reported by 22.2 and 25.9%, respectively.

The NLR decreased significantly over 48 hours (baseline 7.57 to 4.54, $p < 0.0001$), while RDW showed no significant change (Tables 2 and 3). Complications included pseudocyst (11.1%), pancreatic necrosis (5.6%), ARF, and MODS (each 3.7%). Severity was mild in 74.1% and severe in 25.9%; 13% required intensive care unit (ICU) stay (Table 4). Mean hospital and ICU stays were 7.93 and 2.86 days; mortality was 7.4%.

No significant differences in age, gender, symptoms, comorbidities, or habits were found between mild and severe cases (Tables 5 and 6). NLR and RDW values were significantly higher in severe pancreatitis at all time points ($p < 0.0001$), including at 48 hours (NLR $p = 0.015$, RDW $p = 0.012$) (Figs 1 and 2). Severe cases had higher mortality ($p < 0.0001$) and longer hospital stays ($p = 0.001$) (Table 7).

Discussion

Acute pancreatitis is an acute, potentially life-threatening inflammatory condition of the pancreas characterized by abdominal pain and systemic inflammation. Its severity ranges from mild, self-limiting forms to severe disease with necrosis and multiorgan failure. Accurate

Table 5: Comparison of severity of AP and complaints

Complaints	*Mild*		*Severe*		*p-value*
	Count	*%*	*Count*	*%*	
Pain abdomen	36	76.6%	11	23.4%	0.273
Nausea	35	74.5%	12	25.5%	0.864
Vomiting	36	76.6%	11	23.4%	0.273
Fever	25	78.1%	7	21.9%	0.413

Table 6: Comparison of severity of AP and comorbidities and history

Variable	*Mild*		*Severe*		*p-value*
	Count	*%*	*Count*	*%*	
Hypertension	8	61.5%	5	38.5%	0.237
CKD	5	71.4%	2	28.6%	0.864
CVD	5	83.3%	1	16.7%	0.583
DM	11	78.6%	3	21.4%	0.655
Smoking	9	75.0%	3	25.0%	0.934
Alcohol	10	71.4%	4	28.6%	0.069

Table 7: Comparison of severity of AP and final outcome, hospital and ICU stay

Outcome	*Mild*		*Severe*		*p-value*
	Count	*%*	*Count*	*%*	
Alive	40	80.0%	10	20.0%	0.0001
Dead	0	0.0%	4	100.0%	
Total	40	74.1%	14	25.9%	
Hospital stay (days)	4.512 ± 1.76		8.924 ± 3.6		0.001
ICU stay (days)	1.5 ± 0.271		2.6447 ± 1.6733		0.001

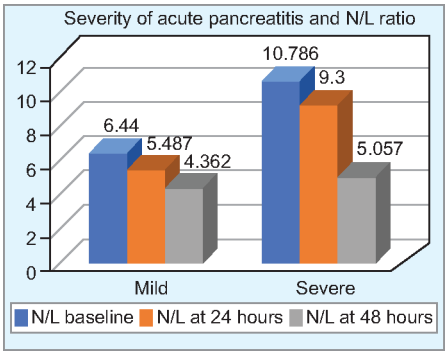

Fig. 1: Comparison between NLR and severity

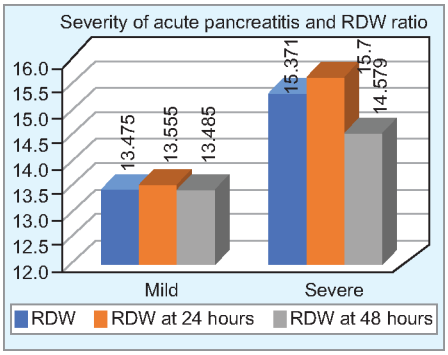

Fig. 2: Comparison between RDW and severity

early evaluation of disease severity is essential to guide prompt and appropriate therapeutic decisions. The NLR and RDW have emerged as useful, easily available prognostic markers for predicting disease severity and outcomes in AP.

In our cohort, NLR decreased over 48 hours but remained markedly higher among patients with severe disease, a trend comparable to previous studies reporting a correlation between elevated NLR and adverse outcomes.[16–20] RDW, on the other hand, was significantly higher in severe cases but did not vary substantially over time. These findings are partly in agreement with Raghavan and Ponraj,[18] who identified RDW cutoff values predictive of severity, and Goyal et al.,[21] who demonstrated its prognostic value, albeit with study limitations.

Comparable studies have also reported similar associations, further supporting the prognostic significance of these markers. O'Connell et al.[22] reported that elevated RDW and NLR at admission independently predicted ICU or high-dependency unit admission and increased mortality risk, highlighting their potential for early, cost-effective risk stratification compared with traditional scoring systems. Similarly, Jayalal et al.[23] found that both NLR and the platelet-to-lymphocyte ratio were independent negative prognostic indicators of AP severity. Jain et al.[24] further confirmed that inflammatory markers such as NLR and RDW performed comparably to established scoring systems in predicting disease severity.

In summary, this study reinforces NLR as a dynamic marker for monitoring AP severity, while RDW effectively distinguishes between mild and severe cases but lacks time-dependent predictive utility. Incorporating serial NLR assessments and RDW measurements into routine clinical evaluation can enhance prognostic accuracy and guide therapeutic decision-making, ultimately reducing morbidity and mortality. Taken together, our findings and prior evidence indicate that NLR and RDW are practical and economical indicators for assessing disease severity at an early stage.

Conclusion

This study highlights the prognostic importance of NLR and RDW in evaluating severity and predicting outcomes in AP. Although NLR values declined with time, they remained markedly higher among patients with severe disease, confirming their prognostic value. RDW was also notably elevated in the severe group versus the mild group, suggesting a potential role in forecasting severity, although evidence on RDW's predictive value is still inconclusive. Additionally, the study demonstrated a strong, statistically significant link between AP severity and mortality, with all fatalities occurring exclusively in the severe category.

Strength and Limitations of the Study

The study comprehensively assesses NLR and RDW as prognostic markers in AP, analyzing their changes over 0, 24, and 48 hours. It explores the relationship between disease severity, inflammatory markers, and clinical outcomes, including mortality, while evaluating how severity influences management decisions such as ICU admission and hospital stay duration. However, the single-center observational design limits generalizability, the relatively small sample size may reduce statistical power, and the lack of long-term follow-up restricts understanding of the extended prognostic value of NLR and RDW.

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