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NLR and Platelet Dynamics: Simple, Cost-effective Biomarkers for Stratifying Severity in Acute Pancreatitis

Zohreh Maghsoomi[1,2], Sadaf Shahbeigy[3], Fatemeh Tajik Rostami[4]*

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Abstract

Background: Acute pancreatitis (AP) is characterized by pancreatic acinar cell injury and trypsin activation. Early identification of severe cases remains critical to reduce morbidity, mortality, and healthcare burden. This study aimed to evaluate the utility of accessible hematological indices—neutrophil-to-lymphocyte ratio (NLR), platelet counts (PLT), platelet-to-lymphocyte ratio (PLR), and platelet-to-white cell ratio (PWR)—as prognostic alternatives to current complex scoring systems.

Methods: In this retrospective prognostic study, medical records of 150 patients (aged 18-70 years) diagnosed with AP based on the Atlanta criteria (2012) at Firouzabadi Hospital (February 2015-February 2017) were reviewed. Blood tests performed at admission, 48 hours, and 72 hours after admission were used to compute the NLR, PLR, and PWR for group comparisons. The association between these indices and prognostic scores (Ranson, Acute Physiology and Chronic Health Enquiry [APACHE-II], Glasgow, Sequential Organ Failure Assessment [SOFA], and Marshall) was assessed using independent t tests or Mann-Whitney U tests, as appropriate. To examine differences related to mortality, hematological indices were compared between survivors and nonsurvivors using the Mann-Whitney U test or independent samples t test based on normality.

Results: NLR showed significant differences with severity criteria and mortality. At 48 hours, in severe Bedside Index of Severity in Acute Pancreatitis (BISAP) cases, NLR was significantly higher (mean, 19.7 vs. 5.26; P = 0.001). Ranson admission scores also demonstrated elevated NLR (12.8 vs. 6.5; P = 0.030). Nonsurvivors had markedly higher NLR at 48 hours (10.69 vs. 5.26; P = 0.035). PLT was significantly reduced in severe AP and was inversely related to disease severity. Patients meeting the Ranson criteria for severe disease at admission, as well as those with Marshall organ failure persisting beyond 48 hours, exhibited significantly lower PLT at 72 hours (176.5 vs. 264.8 $\times 10^3/\mu L$; P = 0.001 and 161.0 vs. 260.5 $\times 10^3/\mu L$; P = 0.006, respectively). Similarly, PWR showed a significant inverse association with severity, reflected in lower mean PWR values at 72 hours for patients with higher APACHE-II scores at 48 hours (18.59 vs. 31.22; P = 0.009). In contrast, PLR demonstrated minimal prognostic utility, with no significant differences observed across any of the severity scores (all $P > 0.05$).

Conclusion: Significant differences between peripheral inflammatory markers across prognostic criteria suggest their potential as complementary tools for early risk stratification in AP. However, further prospective studies are warranted to confirm the prognostic utility of these indices for clinical endpoints, such as mortality and intensive care unit admission.

Keywords: Acute pancreatitis, NLR, Platelet, Ranson, APACHE-II, Glasgow, SOFA, Marshall

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Corresponding author: *Dr Fatemeh Tajik Rostami, tajikrostami.f@iums.ac.ir*

1. Research Center for Prevention of Cardiovascular Disease, Institute of Endocrinology and Metabolism, Iran University of Medical Sciences, Tehran, Iran
2. Endocrine Research Center, Institute of Endocrinology and Metabolism, Iran University of Medical Sciences, Tehran, Iran
3. Department of Obstetrics and Gynecology, School of Medicine, Mahdieh Hospital, Shahid Beheshti University of Medical Sciences, Tehran, Iran
4. Department of Hematology and Medical Oncology, School of Medicine, Iran University of Medical Sciences, Tehran, Iran

↑What is "already known" in this topic:
Prognostic scoring systems for acute pancreatitis are widely used but often complex and time-consuming, which may delay timely risk stratification in busy clinical settings. Simple hematological indices have been suggested as accessible alternatives for predicting disease severity.

→What this article adds:
This study shows that serial measurements of the neutrophil to lymphocyte ratio (NLR) and platelet count provide additional prognostic value for severity and mortality. These indices enable earlier identification of high-risk patients, supporting more efficient clinical decision-making and management.

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Introduction

Acute pancreatitis (AP), caused mainly by gallstones and alcohol, arises from pancreatic acinar cell dysfunction and inappropriate trypsin activation (1). With an annual incidence of 12 to 45 cases per 100,000 individuals, AP carries significant morbidity and mortality; overall mortality is approximately 5%, rising to 30% to 40% in necrotizing pancreatitis (2). Early identification of severe cases is critical to mitigate complications such as infected pancreatic necrosis, organ failure, and prolonged hospitalization (3).

Prognostic scoring systems, including Ranson, Acute Physiology and Chronic Health Enquiry (APACHE-II), Bedside Index of Severity in Acute Pancreatitis (BISAP), Glasgow, Sequential Organ Failure Assessment (SOFA), and Marshall, are widely used but face limitations. Ranson requires 48 hours for a complete assessment. The APACHE-II score is complex and primarily applied in critical care settings. While the BISAP is more straightforward and more practical than the Ranson or the APACHE-II, studies suggest it may have lower sensitivity (albeit higher specificity) for predicting mortality or severe disease (4). The Glasgow score necessitates multiple parameters within 48 hours of admission (5). SOFA scoring requires training to mitigate inconsistencies (6). The Marshall score could demonstrate organ failure, but it offers limited mortality prediction (7).

Beyond complex scoring systems, conventional serum inflammatory markers like C-reactive protein (CRP) and white blood cell (WBC) counts are nonspecific and influenced by numerous factors (8). Recent studies highlight hematological indices, such as the neutrophil-to-lymphocyte ratio (NLR), platelet-to-lymphocyte ratio (PLR), and platelet-to-white cell ratio (PWR), as promising alternatives. The NLR provides a more reliable assessment of inflammation than WBC, neutrophil, or lymphocyte counts and has demonstrated prognostic value for disease severity, poor outcome, and hospitalization length across various conditions (9-11). The PLR acts as an inflammatory marker and has been identified as a predictor of severe AP (1). The PWR shows predictive value for adverse outcomes across conditions, including cardiac surgery, coronavirus disease 2019, sepsis, and myocardial infarction, suggesting potential utility in inflammatory recovery (12). Platelet counts (PLT) themselves have also been recognized as independent prognostic indicators in systemic inflammatory states such as sepsis (13).

Given the limitations of conventional scoring systems in AP, readily available peripheral blood cell-derived indices offer a potentially inexpensive and accessible strategy for initial severity assessment and outcome prediction, guiding timely interventions. Therefore, this study aimed to evaluate the role of NLR, PLR, PWR, and PLT in determining the severity of AP and compare their prognostic performance with that of existing scoring systems.

Methods

Study Design and Population

This retrospective prognostic study reviewed medical records of 150 patients diagnosed with AP at Firouzabadi Hospital from February 2015 to February 2017. The diagnosis of AP was established using the 2012 revised Atlanta criteria, which require meeting at least 2 of the following 3 criteria: characteristic abdominal pain, elevated serum amylase or lipase levels to 3 times the upper limit of normal, or imaging findings indicative of AP(14). Included patients were aged 18 to 70 years and had a complete blood count with differential (CBC diff) performed at admission. The exclusion criteria were hematological disorders (pancytopenia or bicytopenia), autoimmune diseases, chronic inflammatory disease, end-stage renal disease (eGFR <15 mL/min/1.73 m²), heart failure (NYHA class III/IV), cirrhosis, or severe pulmonary disease.

Data Collection

Demographic information, cause of AP, and laboratory results (CBC diff, amylase, lipase, calcium, triglycerides, and arterial blood gases) were extracted from medical records. Prognostic scores (Ranson, BISAP, APACHE-II, SOFA, Marshall, and Glasgow) were calculated retrospectively using data within the first 48 hours of admission.

Stratification by Prognostic Criteria

Patients were stratified into severity categories (mild/moderate vs. severe) based on established cutoffs for each prognostic score:

1. Ranson: Assessed at admission and 48 hours. Scores 0–2 = mild/moderate; ≥3 = severe.

2. APACHE-II: Assessed at admission and 48 hours. Scores 0–5 = mild/moderate; ≥6 = severe.

3. BISAP: Assessed within 24 hours. Scores 0–2 = mild/moderate; ≥3 = severe.

4. Glasgow: Assessed at 48 hours. Scores 0–2 = mild/moderate; ≥3 = severe.

5. SOFA: Assessed at admission, 48 hours, and 72 hours. Scores 0–1 = mild/moderate; ≥2 in any organ system = severe.

6. Marshall: Organ failure assessed within and beyond 48 hours. Scores 0–1 = mild/moderate; ≥2 in any organ system = severe.

Hematological Indices

CBC obtained at admission, 48, and 72 hours were used to calculate the following indices:

NLR: Neutrophil count ÷ Lymphocyte count

PLR: PLT ÷ Lymphocyte count

PWR: PLT ÷ Total leukocyte count

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Statistical Analysis

Data were analyzed using SPSS Version 20 (IBM Corp). Continuous variables are presented as mean ± standard deviation or median interquartile range (IQR) based on the distribution. Categorical variables are presented as frequencies and percentages. Patient groups were classified based on prognostic scores (mild/moderate vs. severe AP). Patient groups (mild/moderate vs. severe AP), defined by the prognostic scores listed above, were compared with hematologic indices using unpaired t tests for parametric data and Mann-Whitney U tests for nonparametric data. The prognostic discriminative ability of NLR, PLR, PWR, and PLT measured at admission, 48 hours, and 72 hours for predicting severe AP was assessed using receiver operating characteristic (ROC) curve analysis. The area under the curve (AUC) was calculated for each hematological index. Optimal cutoff values for predicting severe AP were determined, and corresponding sensitivity and specificity values are reported. Statistical significance was defined as $P < 0.05$.

Results

Demographic and Clinical Characteristics

A total of 150 patients (mean age, 48 ± 7.5 years; 50% female) were included for analysis. Gallstones accounted for 42.7% of cases, while alcohol represented 12.7%, collectively comprising the majority of identified causes. All patients presented with abdominal pain, while jaundice was rare (6.7%) (Table 1 and Figure 1).

Temporal Dynamics of Hematological Indices

Serial measurements revealed dynamic changes in hematologic indices over time (Figure 2 and Table 2). The NLR showed a consistent decline from admission (median, 5.98; IQR, 3.3–10.8) to 72 hours (median, 4.11; IQR, 2.36–6.5). Similarly, the PLR decreased markedly from admission (203.74 ± 127.13) to 48 hours (161.43 ± 80.91), with minimal change thereafter. In contrast, the PWR exhibited a modest upward trend by 72 hours (27.23 ± 11.99), while PLT counts initially declined (244.54 ± 120.50 at 48 hours) and partially recovered by 72 hours (249.16 ± 104.47), remaining below admission levels. These patterns should be interpreted cautiously because CBC diff data are incomplete in some patients.

Prognostic Scores and Mortality

Prognostic scores demonstrated significant differences with mortality in AP ($P < 0.05$), as detailed in Table 3.

Ranson's and APACHE-II scores showed escalating mortality in severe cases at both admission and 48 hours. Glasgow and Marshall scores highlighted substantially higher mortality with organ failure, particularly beyond 48 hours (Marshall, 33.3% vs. 3.8%; $P = 0.001$). SOFA scores consistently predicted mortality across all time points ($P =$

Table 1. Demographic and Clinical Characteristics of Patients with Acute Pancreatitis

Age (Mean ± SD)	48 ± 7.5 years
Sex	Frequency (Percent)
Female	75 (50%)
Substance Use	Frequency (Percent)
Smoke	28 (18.7%)
Opium	15 (10%)
Alcohol	19 (12.7%)
Presenting Symptoms	Frequency (Percent)
Abdominal pain	150 (100%)
Nausea	104 (69.3%)
Vomiting	94 (62.7%)
Fever	17 (11.3%)
Jaundice	10 (6.7%)
Past Medical History	Frequency (Percent)
Hypertension	36 (24%)
Diabetes Mellitus	30 (20%)
Ischemic Heart Disease	13 (8.7%)
Hyperlipidemia	16 (10.7%)

Note: Data are presented as mean ± standard deviation (SD), or frequency (percentage), as appropriate.

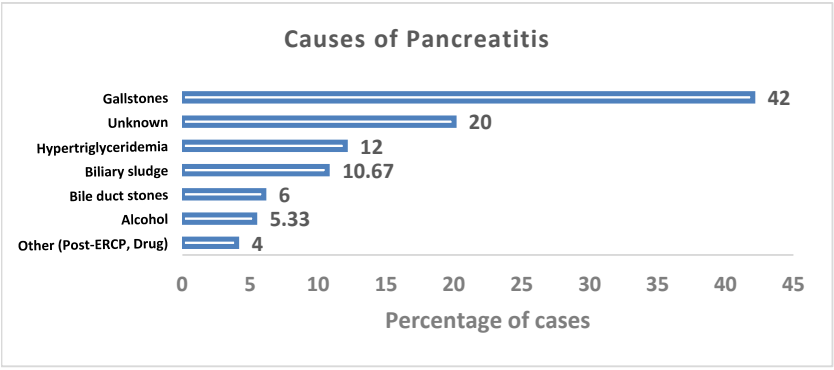

Figure 1. Distribution of causes of acute pancreatitis

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Table 2. Descriptive Statistics of Blood Cell Indices

Parameter	Time Point	Value (Median [IQR] or Mean ± SD)
Neutrophil-to-Lymphocyte Ratio (NLR)	Admission	5.98 (IQR: 3.3–10.8)
	48 Hours	5.04 (IQR: 2.8–8.80)
	72 Hours	4.11 (IQR: 2.36–6.5)
Platelet-to-Lymphocyte Ratio (PLR)	Admission	203.74 ± 127.13
	48 Hours	161.43 ± 80.91
	72 Hours	163.02 ± 94.59
Platelet-to-White Cell Ratio (PWR)	Admission	25.14 ± 12.52
	48 Hours	24.73 ± 11.76
	72 Hours	27.23 ± 11.99
Platelet Count (PLT)	Admission	261.48 ± 115.46
	48 Hours	244.54 ± 120.50
	72 Hours	249.16 ± 104.47

Note: Data are presented as mean ± standard deviation (SD), or median (interquartile range, IQR), as appropriate

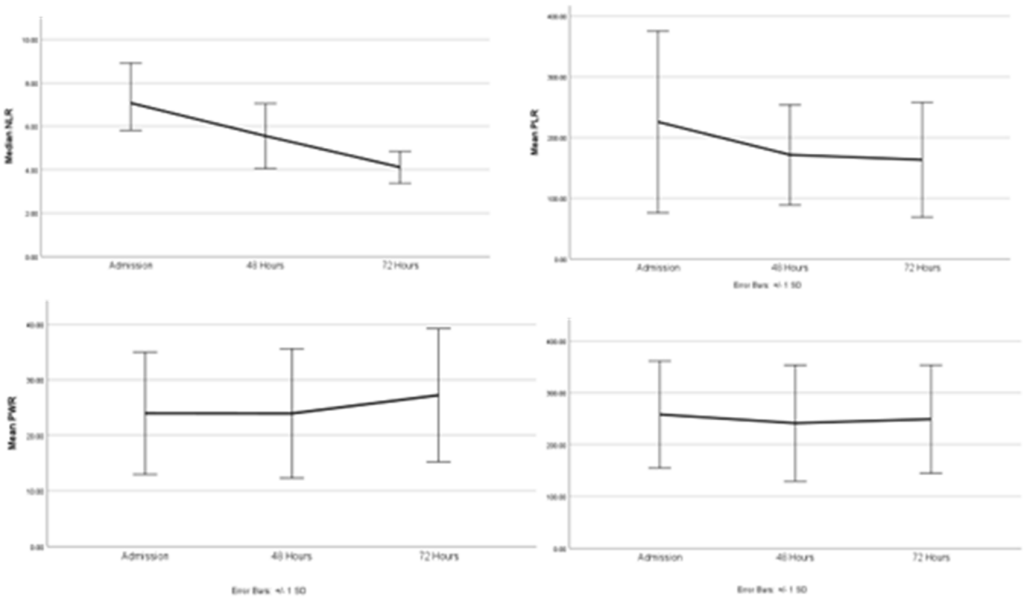

Figure 2. Trends in Hematologic Indices Over Time: Neutrophil-to-Lymphocyte Ratio (NLR), Platelet-to-Lymphocyte Ratio (PLR), Platelet-to-White Cell Ratio (PWR), Platelet Count (PLT)

0.001). In contrast, the BISAP did not reach statistical significance (P = 0.432). These findings confirm Ranson, APACHE-II, Glasgow, SOFA, and Marshall criteria as robust predictors, with persistent organ failure as a critical determinant of fatal outcomes.

Comparison Between Prognostic Scores and NLR

The NLR demonstrated significant differences across AP severity across multiple prognostic scores, with severity- and time-dependent patterns (Table 4). The most robust group differences were observed for BISAP, Ranson, and Glasgow scores, in which severe cases (score ≥3) exhibited markedly higher NLR values both at admission and at 48 hours (P < 0.050). In contrast, SOFA and Marshall scores showed weak or nonsignificant differences. These findings support NLR's role as a dynamic biomarker for systemic inflammation, particularly when integrated with Glasgow or Ranson criteria.

Comparison Between Prognostic Scores and PLT

The PLT demonstrated significant reductions in severe AP compared with mild cases across all prognostic scores (Table 5). Thrombocytopenia was persistently more severe in critical AP patients versus mild cases, particularly during later stages characterized by organ failure and pronounced systemic inflammation.

Comparison Between Prognostic Scores and PLR

The PLR demonstrated limited differences with disease severity across all prognostic criteria examined (P > 0.050 for all) (Table 6). However, trends toward lower PLR at admission for the Ranson score (48h; P = 0.078) and at 72 hours for the Glasgow score (P = 0.073) were observed, although these did not reach statistical significance. Overall, the PLR showed weaker discriminative utility than other hematological indices, such as NLR and PLT.

Comparison Between Prognostic Scores and PWR

The PWR exhibited significant inverse correlations with disease severity across multiple prognostic criteria (Table

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Table 3. Prognostic Scores and Mortality Outcomes

Prognostic scores		Score	Survivors (N(%))	Non-Survivors (N(%))	Total	*P*-value
RANSON	At Admission	0-2	128 (94.8%)	7 (5.2%)	135	
		≥3	12 (80%)	3 (20%)	15	0.029
	At 48 Hours	0-2	78 (97.5%)	2 (2.5%)	80	
		≥3	61 (88.4%)	8 (11.6%)	69	0.001
APACHE	At Admission	0-5	89 (97.8%)	2 (2.2%)	91	
		≥6	51 (86.4%)	8 (13.6%)	59	0.001
	At 48 Hours	0-5	90 (97.8%)	2 (2.2%)	92	
		≥6	31 (79.5%)	8 (20.5%)	39	0.001
BISAP		0-2	133 (93.7%)	9 (6.3%)	142	
		≥3	7 (87.5%)	1 (12.5%)	8	0.432
GLASGOW		0-2	129 (97%)	4 (3%)	133	
		≥3	10 (62.5%)	6 (37.5%)	16	0.001
SOFA	At Admission	0-1	79 (96.3%)	3 (3.7%)	82	
		≥2	59 (89.4%)	7 (10.6%)	66	0.001
	At 48 Hours	0-1	78 (97.5%)	2 (2.5%)	80	
		≥2	31 (81.6%)	7 (18.4%)	38	0.001
	At 72 Hours	0-1	59 (96.7%)	2 (3.3%)	61	
		≥2	20 (87%)	3 (13%)	23	0.001
MARSHALL	Organ Failure within 48 hours	0-1	130 (94.9%)	7 (5.1%)	137	
		≥2	10 (76.9%)	3 (23.1%)	13	0.001
	Organ Failure for more than 48 hours	0-1	128 (96.2%)	5 (3.8%)	133	
		≥2	10 (66.7%)	5 (33.3%)	15	0.001

Abbreviations: Ranson: Ranson's Scores for Acute Pancreatitis. APACHE: Acute Physiology and Chronic Health Evaluation. BISAP: Bedside Index of Severity in Acute Pancreatitis. Glasgow: Glasgow Imrie Score (for pancreatitis). SOFA: Sepsis-related Organ Failure Assessment. Marshall: Marshall Score for Organ Dysfunction.
Note: Group comparisons between survivors and non-survivors were performed using the Chi-square test or Fisher's exact test, as appropriate.
* indicates statistical significance ($P < 0.05$).

Table 4. Prognostic Scores and Neutrophil-to-Lymphocyte Ratio (NLR)

Prognostic scores		Score	NLR (median (IQR: 25-75))					
			At Admission	*P*-value	At 48 Hours	*P*-value	At 72 Hours	*P*-value
RANSON	at Admission	0-2	6.5 (3.9-12.84)	0.030	4.93 (2.78-9.38)	0.010	3.71 (2.32-5.93)	0.030
		≥3	12.8 (5.43-22.2)		7.9 (5.54-14.93)		7.26 (4.12-11.41)	
	at 48 Hours	0-2	4.86 (2.53-8.5)	0.000	3.72 (2.06-11.32)	0.029	3.16 (1.87-4.8)	0.068
		≥3	8.52 (5.63-16.12)		6.6 (3.66-9.49)		4.9 (2.95-8.72)	
APACHE	at Admission	0-5	5.83 (3.06-11.26)	0.198	4.29 (2.68-6.98)	0.016	3.39 (2.08-5.07)	0.060
		≥6	7.73 (4.1-16.1)		7.9 (3.23-13.57)		5.27 (3.06-9.55)	
	at 48 Hours	0-5	5.81 (3.43-9.7)	0.168	4.29 (2.53-7.04)	0.028	3.39 (1.93-5.2)	0.017
		≥6	9.67 (4.96-18.77)		9.36 (4.29-16.76)		6.34 (3.2-10.56)	
BISAP		0-2	6.56 (3.80–13.15)	0.003	5.26 (2.81–8.99)	0.001	3.97 (2.30–6.12)	0.014
		≥3	16.35 (10.4-25.02)		19.7 (9.82-19.83)		9.34 (5.83-14.36)	
GLASGOW		0-2	5.83 (3.26-13.53)	0.004	4.43 (2.55-8.62)	0.002	3.39 (1.90-5.62)	0.001
		≥3	9.67 (7.35-19.69)		11.30 (7.63-17.14)		8.30 (5.48-10.62)	
SOFA	at Admission	0-1	6.39 (2.55-13.31)	0.017	4.32 (2.49-8.48)	0.257	4.12 (2.34-6.27)	0.843
		≥2	7.52 (4.54-15.44)		6.78 (3.39-11.77)		4.16 (1.93-9.33)	
	at 48 Hours	0-1	7.33 (4.03-12.85)	0.461	4.51 (2.62-8.56)	0.032	4.12 (2.4-6.55)	0.950
		≥2	5.83 (3.43-16.34)		7.97 (3.97-14.43)		4.16 (1.82-9.48)	
	At 72 Hours	0-1	6.69 (3.53-12.85)	0.091	4.91 (2.77-8.85)	0.072	3.96 (2.4-6.55)	0.823
		≥2	7.76 (4.30-16.34)		7.97 (2.78-12.66)		4.71 (1.43-9.48)	
MAR-SHALL	Within 48 Hours	0-1	6.99 (3.3-13.53)	0.402	5.26 (2.67-9.21)	0.175	3.82 (2.24-6.75)	0.335
		≥2	6.27 (4.94-15.35)		7.6 (3.88-14.45)		4.82 (2.36-8.73)	
	More than 48 Hours	0-1	6.69 (3.4-13.01)	0.246	4.92 (2.71-8.93)	0.057	3.7 (2.26-6.47)	0.103
		≥2	7.76 (5.39-17.66)		11.77 (5.37-18.37)		6.25 (3.02-12.03)	

Abbreviations: Ranson: Ranson's Criteria for Acute Pancreatitis. APACHE: Acute Physiology and Chronic Health Evaluation. BISAP: Bedside Index of Severity in Acute Pancreatitis. Glasgow: Glasgow Imrie Score (for pancreatitis). SOFA: Sepsis-related Organ Failure Assessment. Marshall: Marshall Score for Organ Dysfunction. Note: Data are presented as median (IQR). Comparisons between mild/moderate and severe disease categories were conducted using the Mann–Whitney U test. * indicates statistical significance ($P < 0.05$).

7). Severe cases consistently demonstrated lower PWR values from admission through 72 hours compared with mild groups, with the most pronounced reductions observed for the Ranson score at 48 hours, APACHE-II at admission and 48 hours, as well as the BISAP and Glasgow scores ($P < 0.050$ for all). Patients meeting Marshall's criteria for organ failure beyond 48 hours exhibited markedly reduced PWR values, specifically at the 72-hour time point ($P = 0.014$). These findings position the PWR as a robust marker of worsening systemic inflammation and thrombocytopenia, particularly in the late phase of organ failure.

Hematological indices for Mortality in AP

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Table 7. Relationship Between Prognostic Scores and Platelet-to-White Cell Ratio (PWR)

Prognostic scores		Score	PWR (Mean± SD)					
			At Admission	*P*-value	At 48 Hours	*P*-value	At 72 Hours	*P*-value
RANSON	at Admission	0-2	25.68 ± 12.76		25.73 ± 11.66		28.91 ± 11.65	
		≥3	20.23 ± 8.92	0.110	17.28 ± 9.98	0.008	19.42 ± 10.71	0.006
	at 48 Hours	0-2	27.69 ± 13.85	0.008	28.17 ± 12.48	0.001	31.34 ± 11.95	0.003
		≥3	22.23 ± 10.19		21.54 ± 10.15		23.41 ± 10.83	
APACHE	at Admission	0-5	27.15 ± 13.08	0.014	27.60 ± 11.57	0.001	32.19 ± 10.86	0.000
		≥6	22.04 ± 10.99		20.72 ± 10.93		21.30 ± 10.60	
	at 48 Hours	0-5	26.39 ± 12.68	0.009	27.32 ± 11.84	0.000	31.22 ± 11.08	0.000
		≥6	20.31 ± 10.21		18.88 ± 9.34		18.59 ± 9.08	
BISAP		0-2	25.87 ± 12.42	0.002	25.51 ± 11.61	0.004	27.85 ± 11.75	0.072
		≥3	12.06 ± 4.45		13.12 ± 7.25		17.88 ± 12.86	
GLASGOW		0-2	26.03 ± 12.34	0.010	26.17 ± 11.58	0.000	29.48 ± 10.99	0.000
		≥3	17.51 ± 12.35		14.70 ± 7.56		11.68 ± 4.95	
SOFA	at Admission	0-1	26.01 ± 10.16	0.388	25.92 ± 11.29	0.162	29.73 ± 11.23	0.070
		≥2	24.20 ± 15.10		22.98 ± 11.91		24.75 ± 12.43	
	at 48 h	0-1	24.44 ± 10.24	0.841	26.07 ± 12.02	0.032	28.17 ± 11.62	0.226
		≥2	24.88 ± 13.11		21.10 ± 10.17		24.53 ± 12.78	
	At 72 h	0-1	25.30 ± 11.29	0.170	26.40 ± 12.63	0.070	28.36 ± 11.94	0.121
		≥2	21.60 ± 9.81		20.95 ± 10.47		23.54 ± 11.70	
MARSHALL	Organ Failure within 48 h	0-1	25.36 ± 12.70	0.474	24.86 ± 11.61	0.707	27.73 ± 11.57	0.332
		≥2	22.75 ± 10.49		23.56 ± 13.51		23.77 ± 14.79	
	Organ Failure more than 48 h	0-1	25.51 ± 12.53	0.377	25.45 ± 11.80	0.060	28.40 ± 11.75	0.014
		≥2	22.47 ± 13.24		19.37 ± 10.34		18.11 ± 10.28	

Abbreviations: Ranson: Ranson's Criteria for Acute Pancreatitis. APACHE: Acute Physiology and Chronic Health Evaluation. BISAP: Bedside Index of Severity in Acute Pancreatitis. Glasgow: Glasgow Imrie Score (for pancreatitis). SOFA: Sepsis-related Organ Failure Assessment. Marshall: Marshall Score for Organ Dysfunction. Note: Data are presented as mean ± SD. Comparisons between mild/moderate and severe disease categories were conducted using the unpaired t-test. * indicates statistical significance ($P < 0.05$).

Table 8. Hematological Indices in Survivors vs. Non-Survivors of Acute Pancreatitis

Parameter		Survivors	Non-Survivors	Total	*P*-value
NLR (median (IQR: 25-75))	at Admission	7.34 (6.35–16.21)	4.69 (2.19–9.77)	5.98 (3.3-10.8)	0.804
	at 48 Hours	5.26 (4.23–10.57)	10.69 (7.97–13.84)	5.04 (2.8-8.80)	0.035
	at 72 Hours	3.98 (3.12–8.19)	9.51 (6.93–11.95)	4.11 (2.36-6.5)	0.014
PLR (Mean ± SD)	at Admission	229.97 ± 152.39	144.20 ± 48.41	203.74 ± 127.13	0.315
	at 48 Hours	170.83 ± 83.36	177.60 ± 75.92	161.43 ± 80.91	0.287
	at 72 Hours	165.40 ± 96.20	121.33 ± 49.04	163.02 ± 94.59	0.368
PWR (Mean ± SD)	at Admission	23.86 ± 11.46	23.01 ± 6.62	25.14 ± 12.52	0.578
	at 48 Hours	24.50 ± 11.95	13.71 ± 3.63	24.73 ± 11.76	0.001
	at 72 Hours	27.83 ± 11.65	10.88 ± 1.95	27.23 ± 11.99	0.001
PLT (Mean ± SD)	at Admission	255.57 ± 105.35	243.50 ± 75.67	261.48 ± 115.46	0.243
	at 48 Hours	241.51 ± 114.22	177.25 ± 75.65	244.54 ± 120.50	0.021
	at 72 Hours	251.81 ± 103.07	130.00 ± 32.95	249.16 ± 104.47	0.008

Abbreviations: NLR: Neutrophil-to-Lymphocyte Ratio, PLR: Platelet-to-Lymphocyte Ratio, PWR: Platelet-to-White Cell Ratio, PLT: Platelet Count

Note: Data are presented as mean ± SD or median (IQR), as appropriate. Comparisons between survivors and non-survivors were performed using the unpaired t-test (for parametric data) or the Mann–Whitney U test (for non-parametric data). * indicates statistical significance ($p < 0.05$).

		≥3	201.03 ± 90.61		144.01 ± 64.71		113.20 ± 53.39	
	at Admission	0-1	188.91 ± 104.22	0.141	161.88 ± 75.07	0.710	169.71 ± 85.80	0.489
		≥2	219.72 ± 147.61		156.63 ± 78.81		154.12 ± 101.55	
SOFA	at 48 h	0-1	212.24 ± 142.95	0.921	157.27 ± 72.42	0.554	174.66 ± 109.19	0.141
		≥2	214.87 ± 112.78		166.85 ± 94.45		138.49 ± 64.07	
	At 72 h	0-1	217.28 ± 150.00	0.766	161.41 ± 67.00	0.361	172.83 ± 104.81	0.169
		≥2	227.88 ± 129.65		179.68 ± 107.64		138.17 ± 68.9	
	Organ Failure within 48 h	0-1	203.32 ± 129.16	0.896	158.81 ± 79.59	0.298	166.38 ± 97.84	0.444
MAR-		≥2	208.17 ± 107.56		183.59 ± 91.78		141.54 ± 70.55	

Key hematological indices differed significantly between survivors and nonsurvivors (Table 8), demonstrating their prognostic value for mortality. The NLR was markedly elevated in deceased patients at 48 and 72 hours, indicating progressive neutrophilia and lymphopenia in fatal cases. Conversely, the PLT and PWR were substantially lower in nonsurvivors at these time points, indicating thrombocytopenia accompanied by leukocytosis in fatal outcomes. By comparison, the PLR showed no significant difference in mortality ($P > 0.050$ at all-time points).

Cut-off Points of Hematologic Indices for Mortality Prediction

The elevated NLR (>6.26) at 48 hours served as an early mortality predictor with reasonable accuracy (AUC, 0.80;

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Table 9. Optimal Cut-Off Points for Mortality Prediction

Parameter		Cut-Off Point	Sensitivity	Specificity	AUC (95% CI)	*P*-value
NLR	at Admission	4.17	0.74	0.5	0.34 (0.12–0.57)	0.293
	at 48 Hours	6.26	0.80	0.68	0.80 (0.68–0.91)	0.047
	at 72 Hours	7.61	0.87	0.78	0.87 (0.78–0.95)	0.014
PLR	at Admission	122.92	0.75	0.74	0.32 (0.13–0.51)	0.223
	at 48 Hours	106.47	0.75	0.71	0.55 (0.26–0.84)	0.738
	at 72 Hours	90.26	0.5	0.79	0.36 (0.12–0.61)	0.364
PWR	at Admission	13.71	0.51	0.29	0.51 (0.29–0.73)	0.943
	at 48 Hours	10.88	0.20	0.07	0.79 (0.66–0.93)*	0.050
	at 72 Hours	9.51	0.06	0.00	0.94 (0.88–1.00)*	0.004
PLT	at Admission	167	0.41	0.19	0.41 (0.19–0.63)	0.487
	at 48 Hours	130	0.27	0.06	0.73 (0.51–0.94)*	0.091
	at 72 Hours	161	0.09	0.01	0.91 (0.83–0.99)*	0.002

Abbreviations: NLR: Neutrophil-to-Lymphocyte Ratio, PLR: Platelet-to-Lymphocyte Ratio, PWR: Platelet-to-White Cell Ratio, PLT: Platelet Count, AUC: Area Under the Curve, CI: Confidence Interval

Note: Prognostic discrimination for mortality was assessed using Receiver Operating Characteristic (ROC) curve analysis. Reported metrics include area under the curve (AUC), optimal cut-off value, sensitivity, and specificity.

*For indices where higher values are protective (e.g., PWR, PLT), reverse coding was applied to ensure accurate evaluation of prognostic performance.

sensitivity, 80%; specificity, 68%). The NLR at 72 hours further improved predictive performance (cutoff >7.61; AUC, 0.87), achieving 87% sensitivity and 78% specificity. In contrast, platelet indices initially exhibited paradoxical performance, with AUCs <0.5. Upon reverse coding, PLT at 72 hours (cutoff <161) and PWR at 72 hours (cutoff <9.51) demonstrated excellent AUCs (0.91 and 0.94, respectively), but extremely low sensitivity (≤9%) and specificity (≤1%), indicating an inverse association with mortality and limited standalone clinical utility. PLR values across all time points showed suboptimal discrimination (AUCs ≤0.55), further limiting their prognostic relevance (Table 9).

Discussion

This prognostic study evaluated the utility of simple, accessible hematological indices—NLR, PLR, PWR, and PLT—as practical tools for early risk stratification and mortality prediction in AP. Given the need for timely severity assessment and the inherent limitations of traditional, more complex scoring systems, these indices were explored as readily available, potentially effective alternatives.

In AP, as a potentially life-threatening condition (15), localized pancreatic damage leads to a widespread inflammatory response, indicating that both the innate and adaptive immune systems are critically involved in the disease's progression (16, 17). Timely assessment of disease severity and the initiation of proper treatment are vital. A 24-hour admission delay has been associated with a 4-fold increase in the risk of death. However, accurately predicting the severity of AP in its early stages remains challenging for clinicians (18). Given the critical need for early severity assessment, clinicians have traditionally relied on scoring systems with limitations, including time-consuming implementation and the potential to delay treatment or be overly complex (19-21). Such drawbacks underscore the necessity for faster, more precise, and more accessible tools to predict the severity of AP in its initial stages. To address these gaps, we investigated hematological indices as practical alternatives to traditional scoring systems. This study evaluated the utility of hematological indices—including NLR, PLR, PWR, and PLT—as accessible alternatives to conventional prognostic scoring systems for predicting disease severity and mortality. In our study, Nonsurvivors exhibited significantly higher NLR at both 48 hours (10.69 vs. 5.26, $P = 0.035$) and 72 hours (9.51 vs. 3.98; $P = 0.014$). In contrast, nonsurvivors were characterized by progressive thrombocytopenia (PLT 72hours in non-survivors: 130 vs. 251.8 $\times 10^3/\mu L$; $P = 0.008$) and reduced PWR (72h: 10.88 vs. 27.83; $P = 0.001$). The PLR demonstrated limited prognostic value, with no significant differences observed between nonsurvivors and survivors (all $P > 0.050$). Cutoff analyses underscored the criterion- and time-dependent predictive value of the NLR, whereas PLT and PWR served adjunctive roles despite suboptimal accuracy.

Among the evaluated indices, NLR emerged as the most robust predictor of disease severity and mortality in AP. Consistent with previous studies, our findings support NLR as a simple, inexpensive, and easily repeatable marker with substantial prognostic value. Since its introduction by Zahorec as an indicator of systemic inflammation, NLR has been validated across various clinical conditions and has shown superior sensitivity and practicality compared to other serum markers, such as WBC and CRP (22-26). In our study, NLR values were significantly higher in patients with severe AP than in mild cases across multiple scoring systems (Ranson score at admission: 12.8 vs. 6.5; $P = 0.030$; and Glasgow score ≥3: 9.67 vs. 5.83; $P = 0.004$). Notably, while NLR declined over time in mild cases, it remained elevated in severe cases, reflecting ongoing systemic inflammation (26). This dynamic responsiveness, along with its strong relationship with disease severity, underscores its advantage over more complex scoring systems. Pathophysiologically, an elevated NLR reflects neutrophilia driven by proinflammatory cytokines (eg, interleukin 1 and interleukin 6) and concurrent lymphopenia resulting from impaired lymphocyte function and early apoptosis, representing an immune imbalance that is particularly evident in severe acute pancreatitis (27, 28). These mechanisms further support NLR's utility in early risk stratification and its potential to outperform traditional scoring systems in both accuracy and clinical convenience.

Beyond NLR, platelet dynamics were significantly prognostic in AP. Consistent with the literature linking

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thrombocytopenia to disease progression and poorer outcomes (29), our study found lower PLT counts in severe AP compared to across multiple scoring systems (Ranson, APACHE-II, BISAP, Glasgow, SOFA, Marshall). Type 3 thrombocytopenia (defined as a failure of the PLT to rise above 100,000/μL within 5 days of admission) is associated with an unfavorable prognosis, with reported mortality rates approaching 60% (30). The reduction reinforces thrombocytopenia's role as a marker of systemic inflammation and organ dysfunction. Crucially, the platelet decline in patients with high SOFA/Marshall scores underscores its value not only for reflecting inflammatory burden and organ failure (a key SOFA component) but also as a practical, accessible tool for monitoring severity.

Beyond PLT, we explored other platelet-derived ratios, such as the PLR, which has emerged as a potential marker for thrombotic/inflammatory conditions and is an independent risk factor for decreased survival in malignancies such as pancreatic and colorectal cancers (31, 32). While our study found limited differences between PLR and AP severity across various prognostic scores, previous research reports conflicting results. Several studies indicate that elevated PLR significantly correlates with increased severity: one prospective study (n = 256) linked PLR >300 to higher intensive care unit admission, more extended hospitalization, and mortality (33), while another identified PLR >342.31 as a sensitive/specific predictor of severe AP (73.3%/99.2%). Elevated PLR was also associated with persistent organ failure in hypertriglyceridemia-induced and biliary AP (34). However, our results align with studies such as Ilhan et al, which found no significant difference in PLR between severity groups in pregnant patients assessed solely by Ranson criteria (35). These discrepancies may stem from differences in patient populations, AP causes, or PLR measurement timing. Further research is needed to clarify PLR's prognostic role and optimal clinical utility.

While PLR showed inconsistent prognostic utility, PWR demonstrated a clear inverse relationship with AP severity in our study. Lower PWR values consistently correlated with higher severity across multiple prognostic scores, suggesting its potential as a practical biomarker for risk stratification. Although previous studies have not directly associated PWR with AP prognosis, our findings align with its established role in other conditions. In cases of intracerebral hemorrhage, lower PWR has been linked to poorer outcomes (36), and in pyogenic liver abscess, it has been associated with complications and prolonged hospitalization (37). This cross-condition relevance supports PWR's biological plausibility as a simple, cost-effective prognostic tool in AP. Prospective studies are warranted to validate PWR and integrate it into existing AP prognostic models.

This study has several strengths, including the application of the standardized 2012 Atlanta classification for AP, early assessment using multiple prognostic scoring systems, and serial blood counts to track disease progression. Moreover, well-defined inclusion and exclusion criteria, along with objective laboratory parameters, enhance internal validity and reproducibility. However, the single-center, retrospective design may limit generalizability and affect data quality. Additionally, the relatively small sample size reduces the statistical power of subgroup analyses, and the exclusion of patients with significant comorbidities restricts real-world applicability. Furthermore, the study did not evaluate hospitalization duration, which could provide additional insights into disease severity and patient outcomes.

Conclusion

This study highlights the value of hematological indices—particularly NLR, PLT, and PWR—as accessible, cost-effective tools for early risk assessment in acute pancreatitis. The NLR proved to be the most reliable marker, showing a strong correlation with disease severity and outperforming traditional scoring systems in terms of practicality. PLT and PWR provided useful prognostic information, whereas PLR showed limited utility and warrants further investigation.

Authors' Contributions

S.S. and Z.M. collected and organized the data. Z.M. conducted the data analysis and interpreted the results. F.T. and Z.M. drafted the manuscript and incorporated feedback from all authors. F.T. supervised the project, provided critical revisions, and ensured the integrity of the research. All authors reviewed and approved the final manuscript.

Ethical Considerations

The study protocol received approval from the Ethics Committee of Iran University of Medical Sciences (IR.IUMS.REC 1396.8923496025). Patient confidentiality was strictly maintained throughout the study by anonymizing all data in accordance with institutional ethical guidelines.

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Conflict of Interests

The authors declare that they have no competing interests.

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