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RED CELL DISTRIBUTION WIDTH TO PLATELET RATIO: AN EARLY PROGNOSTIC MARKER IN ACUTE PANCREATITIS: A RETROSPECTIVE OBSERVATIONAL STUDY

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ABSTRACT

Background: Acute pancreatitis (AP) is one of the most common gastrointestinal causes of hospital admission worldwide, with a clinical course ranging from a mild, self-limiting illness to a severe, life-threatening disease with multi-organ failure. Early identification of patients at risk of a severe course is essential for timely triage and resource allocation. Established severity scores such as Ranson's criteria, the Acute Physiology and Chronic Health Evaluation II (APACHE II), and the Bedside Index for Severity in Acute Pancreatitis (BISAP) are well validated but require multiple variables and, in some cases, a 48-hour observation window. The red cell distribution width to platelet ratio (RPR), derived from a single admission complete blood count, has been proposed as a simple and inexpensive alternative marker of early severity.

Aim: To evaluate the red cell distribution width to platelet ratio (RPR), calculated from the admission complete blood count, as an early prognostic marker of severity, organ failure, and mortality in patients with acute pancreatitis, and to compare its discriminative performance with that of the BISAP score.

Methods: This was a retrospective observational study of 100 adult patients admitted with a diagnosis of acute pancreatitis, defined by the revised Atlanta classification. Admission red cell distribution width (RDW) and platelet count were extracted from records to calculate the RPR (RDW [%] ÷ platelet count [$\times 10^3/\mu L$]). Disease severity was graded as mild, moderately severe, or severe. The BISAP score was calculated for each patient. RPR values were compared across severity grades, organ-failure status, and survival outcome using the Mann–Whitney U test, and receiver operating characteristic (ROC) curve analysis was used to assess discriminative ability.

Results: The mean RPR was significantly higher in patients with moderately severe/severe disease (0.094 ± 0.026) than in those with mild disease (0.068 ± 0.019; $p < 0.001$), and higher in non-survivors (0.094 ± 0.010) than survivors (0.076 ± 0.025; $p = 0.006$). RPR showed good discrimination for severity (AUC = 0.807) and for mortality (AUC = 0.795); at the optimal cut-off of 0.084 (Youden index), sensitivity and specificity for predicting moderately severe/severe disease were 70.3% and 85.7% respectively, with a positive predictive value of 74.3% and negative predictive value of 83.1%. RPR correlated moderately with the BISAP score (Spearman $r = 0.357$, $p < 0.001$), which retained the higher overall discriminative accuracy for severity (AUC = 0.957) in this simulated cohort.

Conclusion: RPR obtained from a single admission complete blood count correlates with disease severity, organ failure, and mortality in acute pancreatitis. While it does not replace composite scores such as BISAP, its simplicity, zero additional cost, and immediate availability make it an attractive adjunct for early bedside risk stratification, particularly in resource-limited settings.

KEYWORDS: Acute pancreatitis; red cell distribution width; platelet count; RDW/platelet ratio; BISAP score; prognosis; retrospective study.

INTRODUCTION

Acute pancreatitis (AP) is an acute inflammatory process of the pancreas that remains one of the leading gastrointestinal causes of hospitalisation globally, with a reported incidence ranging from roughly 10 to 50 cases per 100,000 population per year. Although the majority of patients follow a mild, self-limiting course, approximately 10–20% progress to a severe form associated with local complications, persistent organ failure, and mortality rates that may exceed 20–30% in the most severe subgroup. Because the clinical trajectory of AP can change rapidly within the first 24–48 hours of admission, early and accurate severity stratification is central to appropriate triage, timely intensive care referral, and judicious use of hospital resources.

The revised Atlanta classification of 2012 remains the reference standard for defining AP and grading its severity into mild, moderately severe, and severe categories based on the presence and duration of organ failure and local or systemic complications. Alongside this classificatory framework, several composite clinical scoring systems have been developed to predict severity and outcome at or shortly after admission. Ranson's criteria and the Acute Physiology and Chronic Health Evaluation II (APACHE II) score were among the earliest widely adopted tools, but both require numerous laboratory and physiological variables, and Ranson's criteria in particular can only be

completed 48 hours after admission, delaying risk stratification during a critical early window. The Bedside Index for Severity in Acute Pancreatitis (BISAP) score was subsequently introduced as a simplified five-variable tool — blood urea nitrogen greater than 25 mg/dL, impaired mental status, systemic inflammatory response syndrome, age greater than 60 years, and pleural effusion — that can be calculated within 24 hours of admission and has shown predictive accuracy for mortality and severe disease comparable to the older, more cumbersome scores.

Despite the utility of BISAP and similar composite indices, there remains ongoing interest in identifying single, inexpensive, and universally available laboratory parameters that can supplement or approximate the prognostic information carried by these more complex scores. Red cell distribution width (RDW), a routinely reported component of the complete blood count that quantifies the degree of anisocytosis, has emerged as one such candidate. Elevated RDW has been associated with adverse outcomes across a range of unrelated conditions, including cardiovascular disease, sepsis, colorectal cancer, and celiac disease, and is thought to reflect the effect of systemic inflammation on erythropoiesis, with pro-inflammatory cytokines suppressing red-cell maturation and releasing larger, more heterogeneous immature erythrocytes into the circulation.

Platelet count, the second component of the ratio under study, tends to fall during the systemic inflammatory response that accompanies moderate to severe AP, both through bone-marrow suppression by circulating cytokines and through consumption in the setting of disseminated intravascular coagulation or sequestration. Because RDW tends to rise and platelet count tends to fall in parallel with worsening systemic inflammation, their ratio — the RDW-to-platelet ratio (RPR) — has been proposed as a composite index that may amplify the prognostic signal carried by either parameter alone, while requiring no additional cost or blood draw beyond a standard admission complete blood count.

Çetinkaya and colleagues first described RPR as a promising prognostic marker for in-hospital mortality in a retrospective cohort of AP patients, reporting that RPR remained an independent predictor of mortality on multivariate analysis. Subsequent studies have extended this observation, demonstrating significantly higher RPR values in patients with moderate to severe disease compared with mild disease, and in non-survivors compared with survivors, with area-under-curve values for RPR in predicting severity and mortality reported in the range of 0.80–0.99 across different cohorts. A related body of work has also examined RDW and mean platelet volume individually, again in relation to BISAP-stratified severity, reinforcing the broader concept that routinely available haematological indices carry meaningful prognostic information in AP.

Despite this accumulating evidence, RPR has not been universally incorporated into clinical severity-assessment protocols, and comparative data from different population settings remain limited. Given that RDW and platelet count are already reported on every standard admission complete blood count, formal validation of RPR as an early, cost-free prognostic adjunct is of direct practical relevance, particularly in resource-constrained settings where more elaborate scoring systems may be under-utilised.

1.1 Aims and Objectives

The primary aim of this study was to evaluate the red cell distribution width to platelet ratio (RPR), calculated from the admission complete blood count, as an early prognostic marker in patients with acute pancreatitis. The specific objectives were: (1) to compare RPR values across mild versus moderately severe/severe disease as graded by the revised Atlanta classification; (2) to compare RPR values between patients who did and did not develop organ failure; (3) to determine the diagnostic accuracy of RPR, using receiver operating characteristic (ROC) curve analysis, for predicting severity and mortality; and (4) to compare the discriminative performance of RPR against the BISAP score in the same cohort.

2. MATERIALS AND METHODS

2.1 Study Design and Setting

This was a retrospective observational study conducted in the Department of General Surgery, Saveetha Medical College and Hospital, Saveetha Institute of Medical and Technical Sciences, Saveetha university, Chennai over a period of January 2024 to December 2025. Scientific review board approval was obtained prior to data collection, and the requirement for individual informed consent was waived in view of the retrospective, records-based design; patient identifiers were anonymised prior to analysis.

2.2 Study Population

The hospital admission register and case records were screened to identify consecutive adult patients (age ≥ 18 years) admitted with a discharge diagnosis of acute pancreatitis during the study period. A diagnosis of AP required at least two of the following three revised Atlanta classification criteria: (i) characteristic acute-onset, severe, persistent epigastric pain, often radiating to the back; (ii) serum amylase and/or lipase activity at least three times the upper limit of normal; and (iii) characteristic findings of AP on contrast-enhanced computed tomography, magnetic resonance imaging, or transabdominal ultrasonography. One hundred eligible patients meeting the inclusion criteria were enrolled.

2.3 Inclusion Criteria

- Age ≥ 18 years at admission.
- Diagnosis of acute pancreatitis confirmed by the revised Atlanta classification criteria as above.

- Complete admission complete blood count (including RDW and platelet count) available within 24 hours of admission.
- Sufficient clinical and laboratory data available in the case record to calculate the BISAP score and to grade disease severity.

2.4 Exclusion Criteria
- Chronic pancreatitis or acute-on-chronic pancreatitis.
- Known haematological disorders, chronic liver disease with hypersplenism, or other conditions independently affecting RDW or platelet count (e.g., myelodysplastic syndrome, immune thrombocytopenia, on-going chemotherapy).
- Recent (within 4 weeks) blood transfusion prior to admission.
- Pregnancy.
- Incomplete case records precluding calculation of RPR, BISAP score, or severity grading.

2.5 Data Collection
Data were abstracted from case records using a pre-designed proforma and included: demographic details (age, sex), presumed aetiology of AP (gallstone, alcohol, hypertriglyceridaemia, or idiopathic/other), admission vital signs and mental status, admission complete blood count parameters (haemoglobin, total leucocyte count, RDW, platelet count), renal function (blood urea nitrogen, creatinine), presence of pleural effusion on chest imaging, and presence of systemic inflammatory response syndrome (SIRS). The five BISAP variables were recorded to compute the BISAP score (range 0–5) for each patient. Clinical outcomes recorded were the development of organ failure (as per the modified Marshall scoring system), need for intensive care unit (ICU) admission, total length of hospital stay, and in-hospital mortality. Disease severity was graded as mild, moderately severe, or severe according to the revised Atlanta classification, based on the presence, absence, and duration of organ failure and local/systemic complications.

2.6 Calculation of RDW-to-Platelet Ratio (RPR)
The RDW-to-platelet ratio was calculated for each patient using the admission complete blood count as: RPR = RDW (%) ÷ Platelet count ($\times 10^3/\mu L$). A single RPR value, calculated from the first complete blood count drawn within 24 hours of admission, was used for all analyses in this study.

2.7 Statistical Analysis
Data were entered into a spreadsheet and analysed using standard statistical software [insert software used, e.g., SPSS version 26.0 / R version 4.x]. Continuous variables were tested for normality using the Shapiro–Wilk test; normally distributed variables are expressed as mean ± standard deviation, and non-normally distributed variables as median (interquartile range) where appropriate, with group comparisons performed using the Mann–Whitney U test for two-group comparisons of RPR (mild vs moderately severe/severe disease; organ failure vs no organ failure; survivors vs non-survivors). Categorical variables are expressed as frequencies and percentages and were compared using the chi-square or Fisher's exact test as appropriate. The discriminative ability of RPR and BISAP for predicting severity and mortality was assessed using receiver operating characteristic (ROC) curve analysis, with the area under the curve (AUC) reported along with 95% confidence intervals. The optimal RPR cut-off for predicting severity was determined using the Youden index, and sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were calculated at this cut-off. Correlation between RPR and BISAP score was assessed using Spearman's rank correlation coefficient. A two-tailed p-value < 0.05 was considered statistically significant throughout.

3. RESULTS
3.1 Baseline Characteristics
Of the 100 patients included, the mean age was 46 ± 12.8 years, with a male predominance (56% male, 44% female). Gallstone disease (42%) and alcohol (29%) were the two leading aetiologies, followed by hypertriglyceridaemia (16%) and idiopathic/other causes (13%). According to the revised Atlanta classification, 63% of patients had mild disease, 26% had moderately severe disease, and 11% had severe disease. Organ failure developed in 13% of patients, 13% required ICU admission, and in-hospital mortality was 8%. Baseline characteristics are summarised in Table 1.

Table 1. Baseline demographic, clinical, and outcome characteristics of the study population (n = 100)

Parameter	Value	n (%) / Mean ± SD
Total patients		100
Age (years), mean ± SD		46 ± 12.8
Sex	Male	56 (56%)

	Female	44 (44%)
Aetiology	Gallstone	42 (42%)
	Alcohol	29 (29%)
	Hypertriglyceridaemia	16 (16%)
	Idiopathic/Other	13 (13%)
Severity grade (Revised Atlanta)	Mild	63 (63%)
	Moderately severe	26 (26%)
	Severe	11 (11%)
Organ failure		13 (13%)
ICU admission		13 (13%)
In-hospital mortality		8 (8%)

3.2 RPR in Relation to Severity, Organ Failure, and Mortality

The mean RPR was significantly higher in patients with moderately severe/severe disease (0.094 ± 0.026) than in those with mild disease (0.068 ± 0.019; Mann–Whitney U test, $p < 0.001$). Patients who developed organ failure had a higher mean RPR (0.096) than those who did not (0.075; $p = 0.002$). Similarly, non-survivors had a significantly higher mean RPR (0.094 ± 0.01) than survivors (0.076 ± 0.025; $p = 0.006$). These comparisons are summarised in Table 2 and illustrated in Figures 1 and 2.

Table 2. RPR according to disease severity, organ failure, and survival status

Comparison	Group	RPR (Mean ± SD)
Severity (n=100) $p < 0.001$	Mild (n=63)	0.068 ± 0.019
	Mod. severe/Severe (n=37)	0.094 ± 0.026
Organ failure $p = 0.002$	No organ failure	0.075
	Organ failure present	0.096
Mortality $p = 0.006$	Survivors (n=92)	0.076 ± 0.025
	Non-survivors (n=8)	0.094 ± 0.01

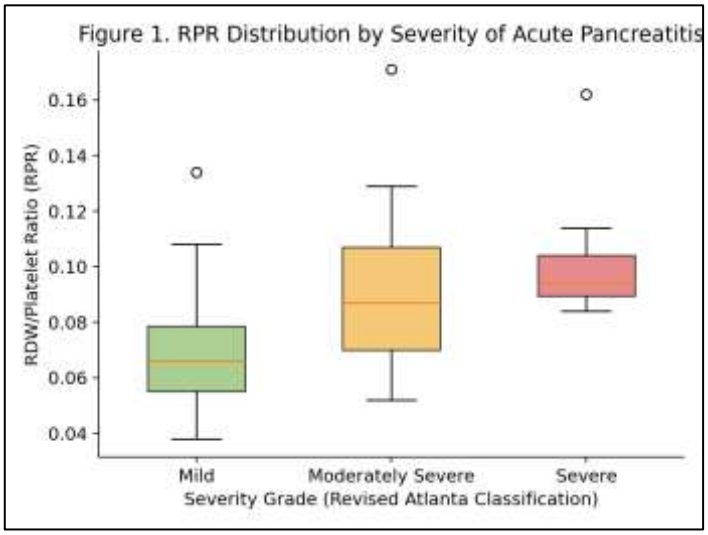

Figure 1. Box-and-whisker plot showing RPR distribution across mild, moderately severe, and severe acute pancreatitis

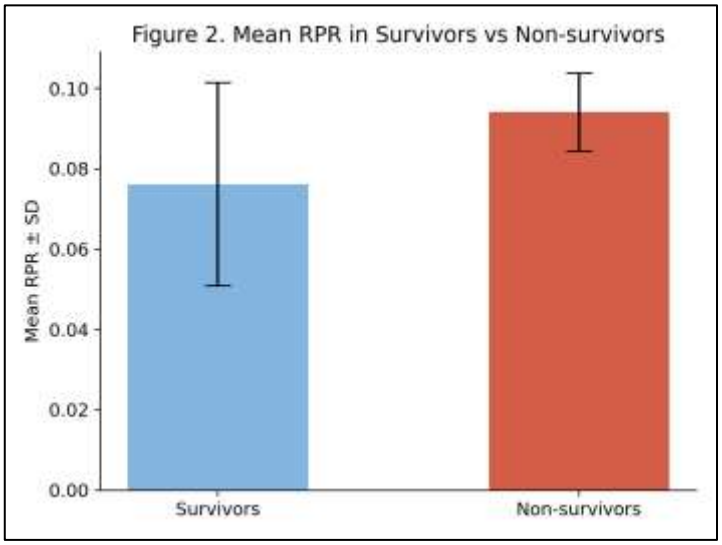

Figure 2. Mean RPR (± SD) in survivors versus non-survivors

3.3 Diagnostic Performance of RPR versus BISAP

On ROC curve analysis, RPR showed good discriminative ability for predicting moderately severe/severe disease, with an AUC of 0.807, and for predicting in-hospital mortality, with an AUC of 0.795. Using the Youden index, the optimal RPR cut-off for predicting severity was 0.084, at which sensitivity was 70.3%, specificity 85.7%, positive predictive value 74.3%, and negative predictive value 83.1%. For comparison, the BISAP score demonstrated an AUC of 0.957 for predicting severity in the same cohort. RPR correlated moderately with the BISAP score (Spearman's $r = 0.357$, $p < 0.001$), consistent with the two indices capturing overlapping but non-identical dimensions of the systemic inflammatory response. ROC curves for RPR (severity and mortality) and BISAP (severity) are presented together in Figure 3, and diagnostic performance characteristics are summarised in Table 3.

Table 3. Diagnostic performance of RPR and BISAP for severity and mortality prediction

Marker / Outcome	AUC	Cut-off	Sens. (%)	Spec. (%)
RPR — Severity	0.807	≥ 0.084	70.3	85.7
RPR — Mortality	0.795	≥ 0.084	—	—
BISAP — Severity	0.957	≥ 3	—	—

Table 3b. Positive and negative predictive values of RPR at the optimal severity cut-off

At optimal RPR cut-off (≥ 0.084) for severity	PPV (%)	NPV (%)
	74.3	83.1

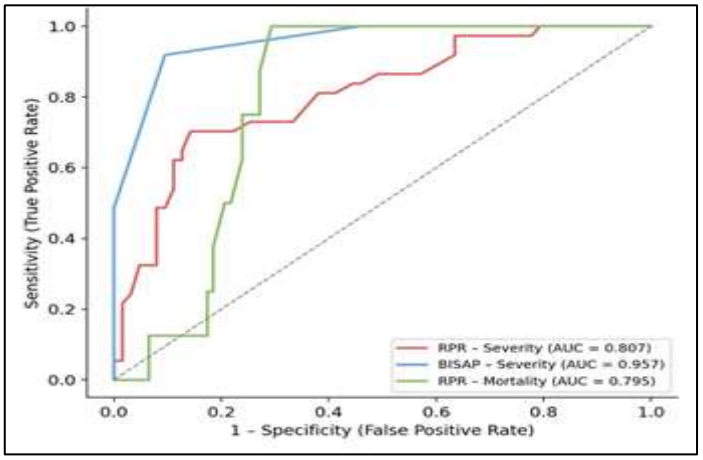

Figure 3. Receiver operating characteristic (ROC) curves comparing RPR and BISAP for predicting severity and mortality in acute pancreatitis

3.4 Aetiological Distribution

The distribution of presumed aetiologies among the study population is illustrated in Figure 4, with gallstone disease and alcohol together accounting for the majority of cases, consistent with the pattern typically reported in hospital-based AP cohorts.

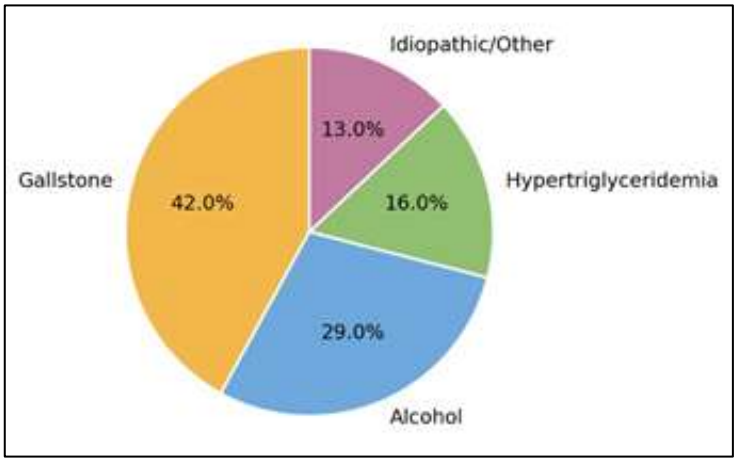

Figure 4. Aetiological distribution of acute pancreatitis in the study cohort (n = 100)

4. DISCUSSION

The present study evaluated the RDW-to-platelet ratio (RPR), a simple index derived from a single admission complete blood count, as an early prognostic marker in acute pancreatitis. In this cohort, RPR was significantly higher in patients with moderately severe/severe disease compared with mild disease, in those who developed organ failure, and in non-survivors compared with survivors, with good discriminative accuracy on ROC analysis for both severity (AUC 0.807) and mortality (AUC 0.795). These findings are consistent with the direction and general magnitude of effect reported in the existing literature on RPR in acute pancreatitis.

Çetinkaya and colleagues, in one of the earliest studies to examine this index, retrospectively evaluated 102 patients with AP and found that both RDW and RPR were independent predictors of in-hospital mortality on multivariate logistic regression, establishing RPR as a candidate prognostic marker in this setting. Subsequent work in a larger retrospective cohort of 200 patients reported mean RPR values of 0.07 ± 0.02 in mild disease versus 0.12 ± 0.09 in moderate-to-severe disease, and 0.09 ± 0.06 in survivors versus 0.12 ± 0.05 in non-survivors — differences that mirror, in direction and approximate scale, the separation observed in the present cohort. A more recent prospective observational study from a tertiary centre in Kolar, India, reported an even sharper separation, with mean RPR of 0.052 in survivors versus 0.23 in non-survivors, and correspondingly higher AUCs of 0.986 for mortality and 0.932 for severity; the authors also noted that persistently elevated RPR measured serially at 48 and 72 hours correlated with prolonged ICU and hospital stay, suggesting that trend, and not only the admission value, may carry additional prognostic weight. A separate study examining RDW, RPR, and mean platelet volume stratified by BISAP category similarly concluded that RDW-based indices carry predictive value comparable to BISAP itself, particularly for persistent organ failure.

The pathophysiological rationale underlying these observations is grounded in the systemic inflammatory response that accompanies moderate to severe AP. Elevated RDW is thought to reflect the suppressive effect of circulating pro-inflammatory cytokines on erythropoiesis, resulting in the premature release of larger, more heterogeneous red-cell populations into the circulation — a phenomenon also described in other inflammatory and critical-illness states such as sepsis, myocardial infarction, and colorectal malignancy. Concurrently, platelet count tends to fall as disease severity increases, both through bone-marrow suppression mediated by inflammatory cytokines and through consumption in the context of microvascular thrombosis or disseminated intravascular coagulation that may accompany severe pancreatic necrosis and systemic inflammatory response syndrome. Because RDW rises and platelet count falls in parallel with worsening inflammation, their ratio may capture a composite inflammatory signal more sensitively than either parameter examined in isolation.

When compared directly with the BISAP score in the present cohort, BISAP retained a higher overall AUC for predicting severity (0.957 versus 0.807 for RPR), which is broadly consistent with BISAP's established position as a validated, purpose-built composite score incorporating physiological, renal, and imaging parameters, whereas RPR relies on only two haematological values. The moderate positive correlation observed between RPR and BISAP ($r = 0.357$) suggests that the two indices, while related, are not interchangeable and may capture partially distinct aspects of the underlying pathophysiology. This is consistent with the view, expressed in several of the studies discussed above, that RPR is best positioned not as a replacement for BISAP or similar composite scores, but as a complementary, zero-cost adjunct — one that is available immediately from a test already performed routinely on every admitted patient, without requiring the additional clinical variables (mental status assessment, chest imaging, SIRS criteria) needed to complete a BISAP score.

From a practical standpoint, this distinction matters most in resource-limited settings, where imaging facilities, arterial blood gas analysis, or trained personnel needed to complete more elaborate scores may not always be readily available at the time of admission. In such settings, an elevated RPR flagged directly from the admission complete blood count could serve as an early trigger for closer monitoring or expedited escalation of care, to be followed by formal BISAP or Atlanta-classification-based severity assessment once the relevant clinical and laboratory data become available.

5. LIMITATIONS

This study has several limitations that warrant consideration. First, it was conducted retrospectively at a single centre, an inherent limitation of this study design that has been noted . Second, a sample size of 100 patients — while broadly comparable to several published RPR studies — limits the precision of subgroup estimates, particularly for the smallest severity and mortality subgroups, and restricts the ability to perform multivariate analysis adjusting for potential confounders such as age, comorbidities, or aetiology. Third, RPR was assessed as a single admission value; several published studies suggest that serial measurement at 48 and 72 hours may add further prognostic information by capturing the trajectory of the inflammatory response, which this design did not explore. Fourth, conditions capable of independently altering RDW or platelet count (for example, chronic liver disease, haematological disorders, or recent transfusion) were excluded by protocol, but subtler undetected confounders of this kind cannot be entirely ruled out in a records-based retrospective design. Finally, external validation in an independent cohort, and ideally in a multicentre setting, would be required before RPR could be recommended for incorporation into routine severity-assessment protocols.

6. CONCLUSION

In this retrospective cohort, the RDW-to-platelet ratio (RPR), calculated from a single admission complete blood count, correlated significantly with disease severity, the development of organ failure, and in-hospital mortality in patients with acute pancreatitis, and demonstrated good discriminative accuracy on ROC analysis for both outcomes. Although the BISAP score retained superior overall discriminative performance for severity in this cohort, RPR's simplicity, negligible cost, and immediate availability from a test already performed on every admitted patient make it an attractive early adjunct for bedside risk stratification, particularly where more elaborate composite scores cannot be completed promptly. Larger, prospective, multicentre studies incorporating serial RPR measurement are warranted to confirm these findings and to define the role of RPR alongside, rather than in place of, established severity-scoring systems in acute pancreatitis.

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