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Red cell distribution width to platelet count ratio as a predictor of severity in acute biliary pancreatitis

Kalpana Acharya [1], Amit Prajapati [2], Ekata Karna [3], Shanta Bir Maharjan [4]

[1] Department of General Surgery, Pokhara Academy of Health Sciences, Pokhara, Nepal
[2] Department of Internal Medicine, Bhaktapur Hospital, Bhaktapur, Nepal
[3] Department of General Surgery, Nepal Medical College, Kathmandu, Nepal
[4] Department of General Surgery, Patan Academy of Health Sciences, Lalitpur, Nepal

ORCID of the author(s)

KA: https://orcid.org/0009-0005-4113-6611
AP: https://orcid.org/0009-0003-7130-997X
EK: https://orcid.org/0009-0005-8127-0532
SBM: https://orcid.org/0000-0002-8738-2640

Corresponding Author
Kalpana Acharya
Department of General Surgery, Pokhara Academy of Health Sciences, Pokhara, Nepal
E-mail: dracharyakalpa@gmail.com

Ethics Committee Approval
The study was approved by the Institutional Review Committee of the Patan Academy of Health Sciences (IRC-PAHS; Ref: PSS2207121658). Written informed consent was obtained from all participants.
All procedures in this study involving human participants were performed in accordance with the 1964 Helsinki Declaration and its later amendments.

Conflict of Interest
No conflict of interest was declared by the authors.

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Abstract

Background/Aim: Acute biliary pancreatitis (AP) is an inflammatory condition of the pancreas with varying degrees of severity. Early detection of severe disease and timely intervention are crucial for improving outcomes. The red cell distribution width to platelet count ratio (RPR) is a proposed inflammatory marker that may be elevated in severe cases. This study aimed to evaluate the utility of RPR in predicting the severity of AP.
Methods: This cross-sectional analytical study was conducted among 35 patients diagnosed with AP over one year. Patients were categorized into mild acute pancreatitis (MAP) and severe acute pancreatitis (SAP) groups. RPR was calculated upon admission, and outcomes were evaluated at the time of discharge or death.
Results: Of the 35 patients, 14 (40%) had SAP. The mean RPR values for MAP and SAP were 0.05924 and 0.06525, respectively. There were four (11%) in-hospital deaths, all in the SAP group. The mean RPR for patients who died was 0.1291 (0.05208). The AUROC values of RPR for severity, ICU stay, and mortality were 0.609, 0.664, and 0.887, respectively.
Conclusion: RPR can predict in-hospital mortality and ICU stay in patients with AP, but it is not sensitive in predicting the severity of the disease.

Keywords: acute pancreatitis, platelet count, RDW-CV, RPR

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Introduction

Acute pancreatitis (AP) is a common cause of hospital admission, and its global incidence continues to rise [1,2]. The disease manifests with a spectrum of severity, from mild, self-limiting forms to severe cases that can lead to multi-organ dysfunction and death [3]. While the overall mortality in AP is reported to range between 3% and 6%, this rate can increase up to 30% in cases of severe acute pancreatitis (SAP) [4]. The primary driver of SAP is an exaggerated systemic inflammatory response, which may lead to organ failure [5].

Timely recognition of disease severity is crucial to reducing mortality and improving clinical outcomes. Early admission to intensive care units (ICUs), organ-specific therapies, and proactive management of complications are essential interventions [3,6,7]. Several biomarkers have been investigated for their potential to predict disease progression, and one such marker is the red cell distribution width to platelet count ratio (RPR). RPR, calculated by dividing the red cell distribution width (RDW) by the platelet count, is considered a reflection of systemic inflammation [8].

This study aims to evaluate the accuracy of RPR as a prognostic marker for disease severity in patients with AP. Findings from this study may help optimize care pathways by guiding decisions on hospital admission, imaging, early ICU transfer, discharge planning, and resource utilization.

Materials and methods

This was a cross-sectional analytical study conducted at the Department of General Surgery, Patan Hospital, from November 2022 to November 2023. Ethical clearance was obtained from the Institutional Review Committee of the Patan Academy of Health Sciences (IRC-PAHS; Ref: PSS2207121658). Written informed consent was obtained from all participants. For patients unable to provide consent due to altered mental status, intubation, or sedation, consent was obtained from a legal guardian. Participants could withdraw at any point without consequence. No additional costs or harm were incurred by any patient.

Data were collected confidentially and stored securely in both physical files and encrypted Excel spreadsheets on a password-protected computer. These records will be preserved for future research and auditing purposes. All identifying patient information was anonymized during dissemination. Patients admitted with a diagnosis of acute biliary pancreatitis within the study period were eligible. Exclusion criteria included alcoholic pancreatitis, pre-existing hematological or coagulation disorders, and withdrawal of consent.

Severity of AP was determined according to the Revised Atlanta Classification (RAC) and categorized as either mild acute pancreatitis (MAP) or severe acute pancreatitis (SAP), which included both moderately severe and severe presentations. RPR was calculated from complete blood count reports at admission using the formula:

RPR=(RDW-CV% / Total Platelet Count [in thousands/µL])

Statistical analysis

For analysis, patients were grouped into MAP and SAP categories. Outcomes were measured as either in-hospital death or discharge. Mortality was defined as death from any cause during hospitalization. ICU admission decisions were at the discretion of the attending physician.

Data entry and statistical analysis were performed using Microsoft Excel and MedCalc (v20.104). Variables were tested for normality using the Shapiro-Wilk test. Normally distributed data were reported as mean (standard deviation), while skewed data were expressed as median with interquartile range. Mann-Whitney U test and t-test were used for group comparisons as appropriate. A *P*-value <0.05 was considered statistically significant. The area under the receiver operating characteristic curve (AUROC) was plotted to evaluate the predictive accuracy of RPR for severity, ICU stay, and in-hospital mortality.

Results

A total of 35 patients were included in the study. Among them, 21 (60%) were classified as having mild acute pancreatitis (MAP). Table 1 summarizes the baseline characteristics of the study population.

Table 1: Baseline characteristics of study population (n=35)

Variables	MAP (n=21)	SAP (n=14)	Overall (n=35)
Age (mean (SD))	50.76 (16.20)	57.35 (19.83)	53.4 (17.76)
Female (n, %)	13, 61.90%	11, 78%	24, 68.50
Platelets (median/IQR)	243 (201 - 332)	235 (161-335)	242 (178 - 331)
RDW-CV (median/IQR)	13.50 (13.07 – 14.40)	16.05 (15.30 - 18)	14.30 (13.10 - 16)
RDW-SD (mean (SD))	44.38 (3.75)	50.38 (5.83)	46.78 (5.49)
RPR (median/IQR)	0.0592 (0.0416 - 0.0686)	0.0652 (0.0472 - 0.1046)	0.0603 (0.0437 – 0.0758)
Lipase (median/IQR)	2280 (1335 - 11257)	2651 (995 - 4050)	2537 (1148 – 7312)
Cr (median/IQR)	0.7 (0.6 – 0.925)	1 (0.6 – 2.1)	0.8 (0.6 – 1.17)
SBP (mean (SD))	124 (12.87)	104 (18.27)	116 (18)
PaO2/FiO2 (median/IQR)	389 (332 - 409)	249 (232 - 371)	355 (300-407)
Required ICU, N (%)	0	71%	28%
Mortality, N (%)	0	28%	11%
Hospital stay, days (median/IQR)	5 (3-6.25)	9.5 (6-12)	6 (4-9.75)

RPR and its individual components were compared to determine their predictive values for disease severity and in-hospital mortality (Table 2, 3).

Table 2: RDW-CV, platelet count and RPR to predict severity of acute pancreatitis. (n=35)

Severity	Mild n=21	Severe n=14	*P*-value
RDW-CV median (IQR)	13.50 (13.07 – 14.4)	16.05 (15.30 - 18)	0.0014
Platelet count median (IQR)	243 (201 - 332)	235 (161-335)	0.6017
RPR median (IQR)	0.0592 (0.0416 - 0.0686)	0.0652 (0.0472 - 0.1046)	0.2813

Table 2 compares RDW-CV, platelet count, and RPR values between MAP and SAP groups. RDW-CV was significantly higher in SAP (median: 16.05, *P*=0.0014), while platelet count and RPR did not differ significantly between groups.

Table 3: RDW-CV, platelet count and RPR as predictors of in-hospital mortality (n=35)

Mortality	Yes n=4	No n=31	*P*-value
RDW-CV median (IQR)	17.90 (16.50-18.50)	14.10 (13.10-15.80)	0.0127
Platelet count median (IQR)	131 (99-233)	243 (206-360)	0.0335
RPR (mean (SD))	0.0129 (0.0520)	0.0573 (0.0206)	0.0158

Table 3 presents the comparison of hematological parameters between survivors and non-survivors. RDW-CV and platelet count differed significantly between the two groups (P=0.0127 and P=0.0335, respectively). RPR also trended higher in non-survivors, although the P-value was 0.0158.

The AUROC for RPR in predicting AP severity was 0.609, for ICU admission 0.664, and for in-hospital mortality 0.887 (Figures 1 and 2). An RPR cut-off of 0.1045 predicted mortality with 75% sensitivity and 100% specificity. For ICU admission, a cut-off >0.0675 showed 60% sensitivity and 76% specificity.

Figure 1: AUROC of RPR in predicting severity of Acute Pancreatitis (n=35)

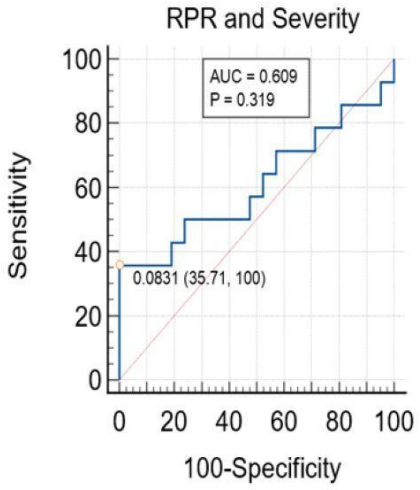
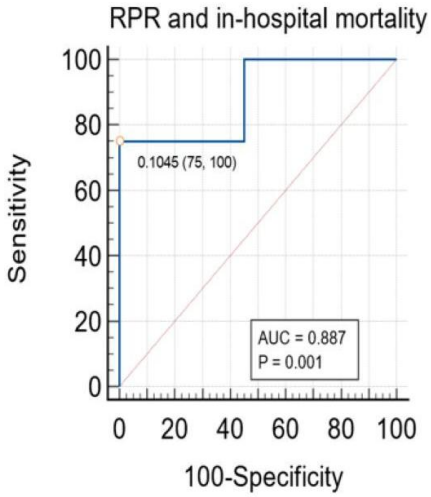


Figure 2: AUROC of RPR in predicting in-hospital mortality in Acute Pancreatitis (n=35)



Similarly, ROC analysis was performed to measure the accuracy of RDW-CV and platelet count on admission to predict the severity of AP. For SAP, the AUC of RDW-CV on admission was 0.821 with a cutoff of 14.7 (P<0.001). The AUC of platelet count on admission for SAP was 0.553 with a cutoff of 16100 (P=0.625). Thus, RDW-CV was useful in predicting both the severity and mortality of AP, whereas platelet count was only useful in predicting mortality.

Discussion

This study included 35 patients with acute biliary pancreatitis, ranging in age from 24 to 83 years. To minimize confounding variables, we excluded patients with alcoholic pancreatitis and known hematological or oncological disorders [9]. Of the total patients, 24 (68.5%) were female, likely reflecting the higher prevalence of gallstone disease among women [10]. Several studies support this finding, reporting an increased incidence of biliary pancreatitis in females [11,12]. In contrast to our observations, several studies have reported a higher prevalence of AP in men than in women [13,14]. Studies indicate that the age and sex distribution of AP varies based on its underlying causes, with different triggers influencing the demographics of affected individuals [15].

While AP is typically benign, severe cases carry high morbidity and mortality, requiring intensive care. In our study, 40% of patients were classified as having SAP, and the overall mortality rate was 11%, with all deaths occurring in the SAP group. These findings are consistent with earlier reports highlighting the significant morbidity and mortality associated with SAP [8]. Variation in mortality rates across institutions may reflect differences in ICU admission criteria, resource availability, and clinical protocols [4].

RDW has been increasingly recognized as a biomarker of systemic inflammation and disease severity. In our study, RDW-CV was significantly associated with both disease severity and in-hospital mortality, supporting existing evidence that elevated RDW correlates with worse clinical outcomes. RDW is influenced by multiple factors including alcohol consumption, iron and vitamin deficiencies, and sex, all of which may complicate its interpretation [8,16].

Platelet activation has also been implicated in AP pathogenesis. We found a statistically significant difference in platelet counts between survivors and non-survivors (median 243k vs. 131k; P=0.0335), indicating its potential role as a prognostic marker. However, platelet count alone did not significantly distinguish MAP from SAP [14,17].

Although RPR was elevated in SAP and in patients requiring ICU care or who died, its sensitivity for predicting disease severity was low (P=0.2813). This may be due to interindividual variability in platelet counts, as both thrombocytopenia and thrombocytosis were observed across severity groups, potentially blunting RPR's predictive power [18].

The AUROC for RPR in predicting in-hospital mortality was 0.887, indicating excellent discriminative ability. An RPR cut-off of 0.1045 detected 75% of mortality cases with 100% specificity. For ICU admission, RPR showed moderate predictive utility (AUROC=0.664). These findings align with previous research by Cetinkaya et al. [8], which demonstrated the prognostic value of RPR in AP.

Overall, while RPR is not a strong predictor of disease severity at presentation, it is a valuable marker for in-hospital mortality and ICU requirement. Its ease of calculation and availability from routine blood tests make it an attractive tool for clinical triage.

Limitations of this study include the small sample size and single-center design, which limit generalizability. Larger multicenter studies are recommended to further evaluate RPR's prognostic value and to establish standardized cut-off values.

Conclusion

RPR measured at hospital admission is a reliable predictor of in-hospital mortality and ICU requirement in patients with acute pancreatitis. Although it is less effective in identifying disease severity at presentation, RPR and RDW-CV are useful tools for early risk stratification and resource planning. Platelet

count alone is less predictive of severity but may contribute to mortality prediction. Incorporating RPR into routine evaluation can assist in early identification of high-risk patients requiring close monitoring and possible early ICU transfer.

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