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RESEARCH ARTICLE

C-reactive protein/albumin ratio as an early indicator of severe acute pancreatitis: A preliminary study

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Objective: To evaluate the prognostic accuracy of the C-reactive protein (CRP)/albumin ratio in predicting severe acute pancreatitis (SAP) and its correlation with clinical complications.

Methods: This retrospective observational study included 40 adult patients diagnosed with acute pancreatitis between January and August 2024. Patients were categorized by severity using the Revised Atlanta Classification into moderately severe or severe groups. Laboratory data, clinical characteristics, and imaging findings were compared. Receiver operating characteristic (ROC) analysis with Youden's Index evaluated the CRP/albumin ratio predictive performance and logistic regression identified independent predictors of SAP.

Results: The CRP/albumin ratio was significantly higher in SAP patients (median 5.0 [IQR 0.93–12.62]) compared to non-SAP (1.58 [IQR 0.28–8.6], p = 0.0187). ROC analysis showed an area under the curve (AUC) of 0.809 for the CRP/albumin ratio, superior to CRP alone (AUC 0.479) and comparable to the Ranson score (AUC 0.88). An optimal cut-off value of 4.22 provided 76.9% sensitivity and 85.2% specificity. Multivariable logistic regression identified absence of intestinal transit (p = 0.033) and splenic vein thrombosis (p = 0.026) as independent predictors of SAP. The CRP/albumin ratio correlated significantly with both these complications.

Conclusions: The CRP/albumin ratio is a valuable, non-invasive, and readily available prognostic marker for early identification of severe acute pancreatitis. Its predictive accuracy is comparable to established scoring systems and may aid in triage and clinical decision-making.

Keywords: acute pancreatitis, CRP, CRP/albumin ratio, severity

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Introduction

Acute pancreatitis (AP) is a common gastrointestinal disorder defined by sudden inflammation of the pancreas. It is among the leading causes of hospital admissions for gastrointestinal disease and carries a significant healthcare burden. Clinical severity varies widely, ranging from mild, self-limiting episodes to severe acute pancreatitis (SAP), which occurs in 20–25% of patients. SAP is associated with persistent organ dysfunction, systemic inflammatory response syndrome (SIRS), and local complications such as necrosis, pseudocyst formation, or peripancreatic effusions. These manifestations result in high morbidity and mortality, with death rates reaching 30% in patients with multi-organ failure [1–4]. Early identification of patients at risk for severe disease is therefore essential, as timely intervention improves outcomes [5,6].

Several diagnostic tests and scoring systems have been developed to predict severity and guide management. Common models include the Ranson criteria, Glasgow score, APACHE II, and the CT Severity Index (CTSI) [7,8]. While valuable, these tools have limitations: many require 48-hour data collection or advanced imaging, which may not be available in all settings. Their complexity also reduces practicality in emergency care, where rapid assessment is crucial.

As a result, attention has shifted toward simple, cost-effective biomarkers for early risk stratification. The C-reactive protein (CRP)/albumin ratio has emerged as a promising candidate. CRP reflects systemic inflammation, while albumin decreases in severe inflammatory states [9–12]. Together, their ratio may better distinguish mild from severe pancreatitis [13].

This study aims to evaluate the clinical utility of the CRP/albumin ratio as a prognostic marker for disease severity in patients with acute pancreatitis. By comparing this ratio with established clinical and imaging-based scoring systems, we seek to determine its diagnostic accuracy and potential role in clinical decision-making. Furthermore, we investigate its association with complications such as splenic vein thrombosis, peripancreatic effusions, and symptom severity, which may serve as additional indicators of disease severity.

Methods

Study Design and Patient Selection

This is a retrospective observational study conducted on patients admitted with acute pancreatitis (AP) to Bistrita County Hospital, Bistrita, Romania, between january 2024 and august 2024. A total of 40 adult patients were enrolled based on clinical, biochemical, and imaging criteria consistent with AP, as defined by the Revised Atlanta Classification (2012). Inclusion criteria were: (1) age ≥18 years, (2) diagnosis of AP established by at least two of the

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following: characteristic abdominal pain, serum amylase or lipase ≥3 times the upper limit of normal, or imaging evidence of pancreatitis.

Exclusion criteria included chronic pancreatitis, active malignancy, severe hepatic disease, or immunosuppressive therapy.

The study protocol was approved by the Institutional Ethics Committee of Bistrița County Hospital.

Data Collection

Demographic and clinical data were collected from electronic medical records, including age, sex, presenting symptoms (epigastric pain, nausea, vomiting, ileus), and etiology of AP (alcoholic, biliary, drug-induced). Laboratory parameters measured within the first 24 hours included C-reactive protein (CRP), serum albumin, complete blood count (CBC), liver function tests, and other standard biochemical markers. Radiologic findings were recorded from contrast-enhanced computed tomography (CECT), and the CT Severity Index (CTSI) was calculated. CT severity score was reported on a scale of 1-10, with 10 being most severe. Score above 7 was determined as severe pancreatitis, while moderate disease is considered between 3 and 6. Length of hospital stay, local complications, need for antibiotic therapy or major analgesia, as well as mortality were noted.

Disease severity was further categorized according to the Revised Atlanta Classification into mild or moderately severe acute pancreatitis (MAP/MSAP) and severe acute pancreatitis (SAP), based on the presence of persistent organ failure and/or local complications. The Ranson score was also determined within 48 hours of admission, which includes eleven different parameters.

Statistical Analysis

Statistical analyses were performed using SPSS Statistics for Windows, version 20.0 (SPSS Inc., Chicago, IL, USA). Continuous variables were tested for normality using the Shapiro–Wilk test. Normally distributed data are presented as mean ± standard deviation (SD), while non-normally distributed data are shown as median and interquartile range (IQR). Categorical variables are expressed as absolute frequencies and percentages.

Comparisons between MAP/MSAP and SAP groups were performed using the Mann–Whitney U test or Student's t-test for continuous variables, as appropriate, and the Chi-square or Fisher's exact test for categorical variables. Receiver Operating Characteristic (ROC) curve analysis was used to assess the discriminative ability of the CRP/albumin ratio for predicting SAP, with the area under the curve (AUC) reported. Optimal cut-off values were calculated using Youden's Index, and corresponding sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were derived. Logistic regression analysis was performed to identify independent predictors of SAP. A two-tailed p-value <0.05 was considered statistically significant.

Results

A total of 40 patients were enrolled, with a mean age of 56.3 ± 17.2 years and an equal distribution of males (50%) and females (50%). Epigastric pain was the most common presenting symptom (100%), followed by nausea (95%), vomiting (92.5%), and ileus (45%). The most frequent etiologies were alcoholic (60%) and biliary (37.5%) pancreatitis, with drug-induced cases being rare (2.5%). Baseline clinical characteristics are presented in Table 1.

When patients were stratified by severity (Table 2), moderate or moderately severe acute pancreatitis (MAP/MSAP, n = 27) was compared with severe acute pancreatitis (SAP, n = 13). The median Ranson score was significantly higher in the SAP group than in MAP/MSAP (5 [IQR 2–8] vs. 3 [IQR 1–5], p = 0.021), as was the median CTSI (8 [IQR 7–10] vs. 5 [IQR 2–9], p = 0.0036). Local complications were observed in 92.3% of SAP patients compared to 48.1% of those with MAP/MSAP (p = 0.0128). No significant differences were found regarding length of hospital stay (7 [IQR 1–11] vs. 5 [IQR 2–10] days, p = 0.287) or mortality (15.4% vs. 0%, p = 0.100).

Among laboratory parameters, the CRP/albumin ratio was significantly higher in the SAP group (5.0 [IQR 0.93–12.62]) compared to MAP/MSAP (1.58 [IQR 0.28–8.6], p = 0.0187). Albumin alone (p = 0.271) and CRP alone (p = 0.748) did not differ significantly between groups. Receiver operating characteristic (ROC) analysis demonstrated that the area under the curve (AUC) of the CRP/albumin ratio for predicting SAP was 0.809, outperforming CRP alone (AUC 0.479) (Figure 1). The discriminative ability of the CRP/albumin ratio was comparable to the Ranson score (AUC 0.88) and slightly lower than the CTSI (AUC 0.966). According to Youden's index, the optimal cut-off value for the CRP/albumin ratio to differentiate SAP from MAP/MSAP was 4.22, providing a sensitivity of 76.9%, specificity of

Table 1. Baseline clinical characteristics

Variable	N=40
Age (years), mean (±SD)	56.33 (±17.2)
Sex, n (%)	
Male	20 (50%)
Female	20 (50%)
Symptoms, n (%)	
Epigastric pain	40 (100%)
Nausea	38 (95%)
Vomiting	37 (92.5%)
Ileus	18 (45%)
Etiologies, n (%)	
Alcoholic	24 (60%)
Biliary	15 (37.5%)
Drug induced	1 (2.5%)
NGT, n (%)	12 (30%)
Local complications, n (%)	
Peripancreatic collections	6 (26.09%)
Splenic vein thrombosis	5 (21.74%)
Ascites	12 (52.17%)
ATB therapy, n (%)	13 (32.5%)
Analgesics, n (%)	24 (60%)

SD: standard deviation; NGT: naso-gastric tube; ATB: antibiotic

Table 2. Comparison of clinical outcomes and laboratory data by severity (MAP/MSAP vs SAP).

Variable	MAP/MSAP N=27	SAP N=13	P value
Ranson score, median (IQR)	3 (1-5)	5 (2-8)	0.02
CTSI, median (IQR)	5 (2-9)	8 (7-10)	0.00
Local complications, n(%)	13 (48.1%)	12 (92.3%)	0.01
Length of stay (days), median (IQR)	5 (2-10)	7 (1-11)	0.28
Mortality, n (%)	0	2 (15.4%)	0.10
Albumin (g/dl), median (IQR)	3.4 (2.1-4.4)	3.1 (2.6-3.9)	0.27
CRP (mg/l), median (IQR)	15.1 (3.1-65.3)	16.6 (0.3-50.1)	0.74
CRP/albumin, median (IQR)	1.58 (0.28-8.6)	5 (0.93-12.62)	0.01

IQR, interquartile range; CRP, C-reactive protein; CTSI, CT Severity Index.

85.2%, positive predictive value of 71.4%, and negative predictive value of 88.5%.

Logistic regression analysis including clinical, imaging, and laboratory variables identified the absence of intestinal transit (β = 2.54, p = 0.033) and the presence of splenic vein thrombosis (β = 2.61, p = 0.026) as independent predictors of SAP. None of the other factors evaluated, such as age, length of stay, nausea, vomiting, ascites, etiology, or presence of peripancreatic effusion, reached statistical significance in the multivariable model (p > 0.05).

Correlation analysis showed that the CRP/albumin ratio was positively associated with splenic vein thrombosis

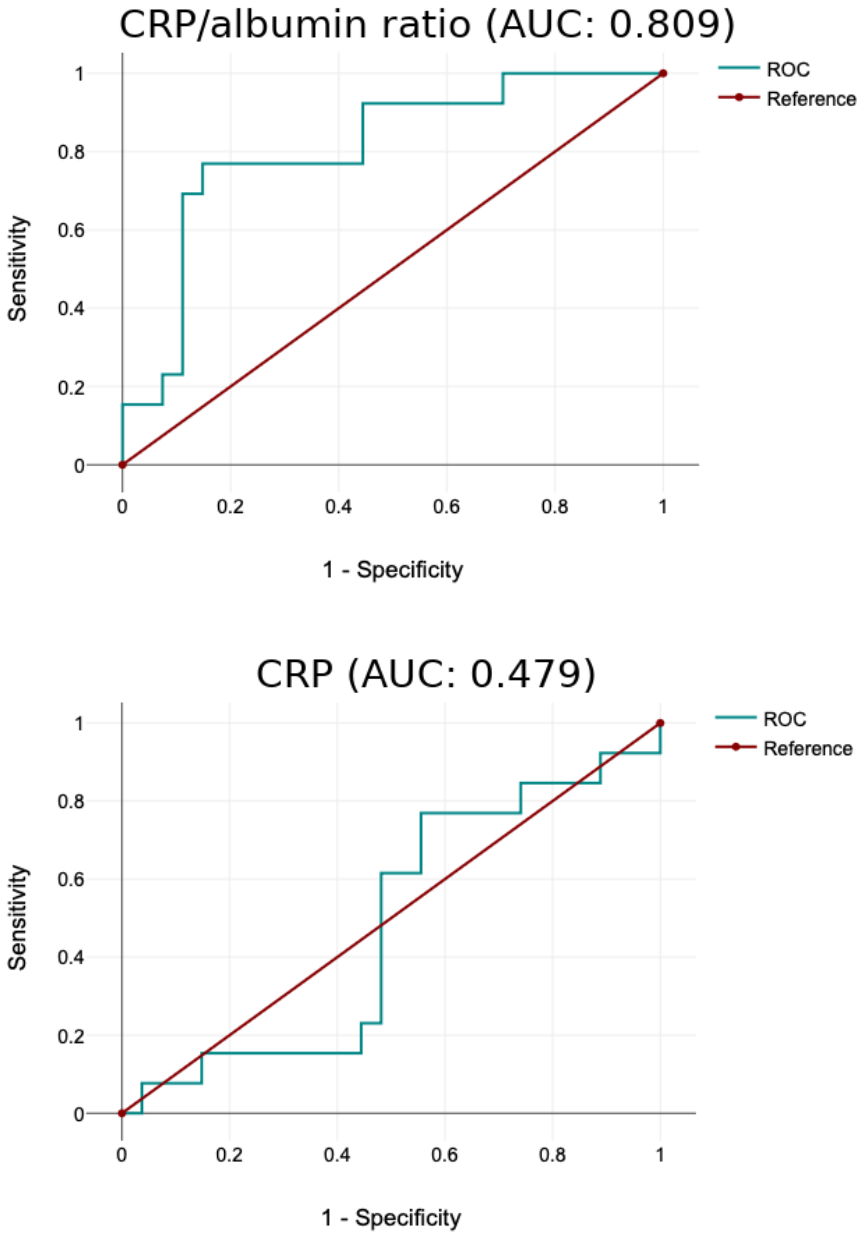

Fig. 1. ROC curve for CRP/albumin ratio vs CRP alone, predicting SAP

(point-biserial r = 0.40, p = 0.011) and with absence of intestinal transit (r = 0.32, p = 0.044). No significant correlations were observed with ascites (p = 0.556), peripancreatic collections (p = 0.314), nausea (p = 0.187), or vomiting (p = 0.094). Overall, the CRP/albumin ratio was significantly associated with disease severity in acute pancreatitis, correlated with key complications, and showed a strong discriminatory capacity for SAP comparable to established scoring systems.

Discussions

Our preliminary data affirms that the CRP/albumin ratio (CAR) measured at hospital admission is a robust, cost-effective predictor of severe acute pancreatitis (SAP), consistent with a growing body of evidence that validates its clinical utility. In particular, both sensitivity and specificity were enhanced compared to CRP or albumin alone, positioning CAR as a complementary tool alongside traditional scoring systems.

Previous studies have highlighted the CRP/albumin ratio (CAR) as a valuable prognostic marker in acute pancreatitis (AP). Mustafa K. et al. (2017) identified CAR as a novel, promising, easily obtainable, non-invasive, and reproducible inflammation-based score for prognostication in AP. The ratio has also been utilized to assess prognosis in emergency surgical patients requiring intensive care, and an animal model demonstrated its potential role in predicting survival outcomes in AP [13-15]. Kalafat et al. reported a CAR cut-off value of 1.08 with 97% specificity for diagnosing AP [16]. Additionally, a direct correlation between CAR and Ranson's score has been observed, and Zhao et al. found that CAR was independently associated with mortality in AP patients [17].

Recent large-scale studies further support the clinical relevance of these findings. A comprehensive retrospective Turkish cohort of 580 patients identified a CAR > 15.59 as predictive of severe acute pancreatitis (SAP), with a sensitivity of 96.8%, specificity of 75.3%, and AUC of 0.89. In logistic regression, CAR was significantly associated with disease severity (OR: 1.04 per unit increase; 95% CI: 1.03–1.06; p < 0.001). Similarly, Kaplan et al. reported that CAR outperformed CRP alone in predicting both severity and mortality, a finding confirmed by Behera et al., who observed stronger predictive value for CAR compared to CRP or albumin alone in a cohort of 116 AP patients. A systematic review by Tarar et al. corroborated these results, showing consistent associations between elevated CAR and severe disease, longer hospitalization, and higher mortality [13, 18- 21].

In our study, CAR also demonstrated significant prognostic value. Among patients stratified by severity, those with SAP exhibited a significantly higher median CAR (5.0 [IQR 0.93–12.62]) compared to those with moderate or moderately severe AP (MAP/MSAP, 1.58 [IQR 0.28–8.6]; p = 0.0187), while neither CRP alone (p = 0.748) nor albumin alone (p = 0.271) differed significantly between groups. ROC analysis showed that CAR had an AUC of 0.809 for predicting SAP, outperforming CRP alone (AUC 0.479) and approaching the predictive accuracy of the Ranson score (AUC 0.88). Although slightly lower than the CT severity index (CTSI, AUC 0.966), CAR showed substantial discriminative capacity. A cut-off value of 4.22, derived via Youden's index, provided a sensitivity of 76.9%, specificity of 85.2%, positive predictive value of 71.4%, and negative predictive value of 88.5%.

Furthermore, multivariable logistic regression identified two independent predictors of SAP: absence of intestinal transit (β = 2.54, p = 0.033) and the presence of splenic vein thrombosis (β = 2.61, p = 0.026). Other clinical and imaging features, including age, etiology, length of hospital stay, ascites, collections, nausea, and vomiting, did not reach statistical significance (p > 0.05). Importantly, correlation analysis showed that CAR was positively associated with both splenic vein thrombosis (point-biserial r = 0.40, p = 0.011) and absence of intestinal transit (r = 0.32, p = 0.044), suggesting a link between systemic inflammation, as reflected by CAR, and specific vascular and gastrointestinal complications in severe AP. No significant correlations were found between CAR and other features such as ascites, peripancreatic collections, nausea, or vomiting. Similar trends were noted across other studies: Behera et al. reported elevated CAR in non-survivors; Tarar et al. and Yogesh et al. linked high CAR to longer LOS and mortality [20-22].

These findings are consistent with existing literature and further support the utility of CAR as a rapid, cost-effective, and non-invasive marker for early identification of severe disease in AP. Given its ease of calculation and superior performance over individual markers, CAR may serve as a valuable adjunct in risk stratification, particularly in settings where advanced imaging or scoring systems are not immediately available.

Another compelling advantage of CAR lies in its accessibility and affordability. Ghaffar et al. emphasize that CRP and albumin testing costs are minimal, contrasting sharply with CT imaging costs—often prohibitive in low-resource settings—and CT-based grading systems such as Balthazar scoring. Considering that severe AP can escalate mortality significantly when diagnosis is delayed, accessible markers like CAR can meaningfully improve early triage and allocation of intensive care [23-25].

Although established clinical scores like Ranson, BISAP, APACHE II, or CTSI provide comprehensive severity prediction, they require multiple parameters, sometimes delayed imaging, and may lack ease at the point of admission. CAR, derived from routine laboratory values easily available within hours of presentation, offers early insight. It should be viewed not as a replacement but as a supplement to established tools, particularly to prompt early escalation for high-risk patients or to identify low-risk individuals likely to have mild disease.

Recent studies are also exploring additional composite biomarkers. The CRP/calcium ratio (CCR) was studied

in a Chinese cohort (476 patients), showing each unit increase associates with a 7% higher odds of moderate–severe AP and yielding strong discrimination (AUC ~0.87). Other ratios: lactate/albumin (LAR), CRP/lymphocyte (CLR), neutrophil/lymphocyte ratio (NLR), have also shown promise as early risk predictors. These emerging markers suggest that multimodal biomarkers may further refine prognostic stratification when combined with CAR and clinical scores [26-30].

There are several important factors that could have contributed to limitations of this study. Like many cohorts, our study is single-center and relatively modest in sample size, raising concerns about generalizability. The total number of patients (n=40) and, in particular the limited number of severe acute pancreatitis cases (n=13) reduce statistical power and restrict the robustness of multivariable analysis or development of reliable predictive models. These findings should therefore be interpreted as exploratory and hypothesis-generating rather than definitive. We measured CAR only at baseline; serial measurements over the first 48–72 hours might refine prognostication by tracking evolution. Finally, while CAR offers high sensitivity, its specificity, though reasonable, may still lead to false positives. Thus, CAR should guide but not replace comprehensive clinical evaluation.

Conclusion

The CRP/albumin ratio, measured at hospital admission, showed promising discriminative ability for identifying severe acute pancreatitis in this small single-center cohort. In our analysis, it appeared to outperform CRP and albumin individually and demonstrated predictive performance comparable to established tools such as the Ranson score. Its association with complications, including splenic vein thrombosis and paralytic ileus, suggests potential clinical relevance beyond severity classification. However, given the limited sample size and number of severe cases, these findings should be interpreted as preliminary and hypothesis-generating. Larger, multicenter studies are needed to validate the role of the CRP/albumin ratio as an adjunct to clinical and imaging-based severity assessments, particularly in resource-limited settings.

Authors' contribution

CF (Conceptualization; Data curation; Formal analysis; Investigation; Methodology; Project administration; Resources; Visualization; Writing – original draft)
AB (Validation; Visualization; Writing – review & editing, Supervision)
LN (Formal analysis; Investigation; Methodology; Writing – original draft)

Conflict of interest

None to declare

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