



RESEARCH ARTICLE

Role of Serum Procalcitonin as an Early Biomarker of Severity in Acute Pancreatitis: A Prospective Observational Study

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ABSTRACT

Background: Early prediction of severe acute pancreatitis (SAP) remains a clinical challenge despite the availability of several prognostic scoring systems. Serum procalcitonin (PCT), an inflammatory biomarker that rises rapidly during systemic inflammation and infection, has emerged as a promising predictor of disease severity. Early estimation of PCT may facilitate prompt identification of patients requiring intensive management.

Objective: To evaluate the role of serum procalcitonin as an early biomarker of severity in patients with acute pancreatitis and determine its association with Ranson score.

Materials and Methods: This prospective observational study was conducted from May 2022 to May 2024 in the Department of Biochemistry in collaboration with the Department of General Surgery at J.L.N. Medical College and Associated Hospitals, Ajmer. Adult patients diagnosed with acute pancreatitis according to the Revised Atlanta Classification were enrolled after obtaining informed consent. Serum procalcitonin was measured within 24 hours of admission using an immunoassay-based method. Disease severity was assessed using the Ranson scoring system and patients were categorized into mild, moderately severe, and severe acute pancreatitis. Statistical analysis was performed using SPSS version 26.0. Continuous variables were expressed as mean $\pm$ SD, and categorical variables as frequencies and percentages. Pearson correlation, one-way ANOVA, ROC curve analysis, and multivariable logistic regression were used where appropriate. A p-value <0.05 was considered statistically significant.

Results: Serum procalcitonin levels increased progressively with increasing severity of acute pancreatitis and demonstrated a significant positive correlation with Ranson score. ROC analysis showed excellent diagnostic performance for predicting severe acute pancreatitis. Elevated PCT was independently associated with persistent organ failure and severe disease.

Conclusion: Serum procalcitonin is a valuable early biomarker for predicting severe acute pancreatitis. Its routine assessment at admission may improve early risk stratification and clinical decision-making.

Keywords: Acute pancreatitis; Procalcitonin; Severity; Biomarker; Ranson score; Early prediction; Inflammation.

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INTRODUCTION

One of the most frequent gastrointestinal emergencies seen in clinical practice is acute pancreatitis (AP). In severe cases, it causes multiple organ dysfunction, pancreatic autodigestion, inflammatory cytokine release, and systemic inflammatory response syndrome (SIRS) due to acute inflammation of the pancreas caused by early activation of pancreatic digestive enzymes within the gland. About 20% of individuals develop severe acute pancreatitis (SAP), which carries significant morbidity and mortality, despite the fact that roughly 80% of patients recover with supportive care (1). One of the biggest obstacles to treating acute pancreatitis is the early identification of people who are prone to experience severe illness. For early severity prediction, a number of clinical scoring systems have been established, such as the Ranson score, APACHE-II, BISAP score, Glasgow score, and Modified CT Severity

Index. Many of these systems need numerous laboratory tests, serial observations, or imaging studies that might not be readily available, even though their prediction value is respectable. As a result, there is ongoing interest in finding straightforward biochemical indicators that can reliably forecast the severity of a disease in its early stages (2, 3).

Under normal circumstances, thyroid C-cells are the main producers of procalcitonin (PCT), a 116-amino acid precursor peptide of calcitonin. Circulating concentrations are still quite low in healthy people. Procalcitonin is created by several extrathyroid tissues under the influence of inflammatory cytokines like TNF- α and IL-6 during systemic inflammation, especially bacterial infection and severe inflammatory reactions. This leads to a sharp increase in serum levels within three to six hours. PCT has emerged as a significant biomarker in sepsis, systemic inflammatory diseases, and critical illness due to its comparatively short

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half-life and predictable kinetics. Inflammatory cascades that cause cytokine release, endothelial dysfunction, pancreatic necrosis, bacterial translocation, and chronic organ failure are all part of the pathophysiology of severe acute pancreatitis (4,5).

Several researchers have suggested that elevated serum PCT may identify patients at increased risk of developing severe pancreatitis, infected pancreatic necrosis, multiorgan dysfunction, prolonged intensive care unit stay, and mortality because procalcitonin reflects the degree of systemic inflammation. Although prior research has shown promising diagnosis accuracy, more validation is required due to variations in study populations and laboratory techniques, especially with Indian patients. In order to assess serum procalcitonin as an early biomarker of disease severity in acute pancreatitis and ascertain its correlation with the Ranson scoring system, the current prospective study was conducted (6).

MATERIALS AND METHODS

Study Design

Prospective observational study.

Study Duration

May 2022 – May 2024 (24 months).

Study Setting

Department of Biochemistry in collaboration with the Department of General Surgery, J.L.N. Medical College and Associated Hospitals, Ajmer.

Study Population

Adult patients diagnosed with acute pancreatitis.

Sample Size

A total of 112 patients diagnosed with acute pancreatitis were enrolled consecutively during the study period. Based on the Revised Atlanta Classification (2012), patients were categorized into mild acute pancreatitis (n = 38), moderately severe acute pancreatitis (n = 52), and severe acute pancreatitis (n = 22). In addition, 56 age- and sex-matched healthy individuals without evidence of pancreatic disease or systemic inflammatory disorders were included as the control group for comparison of serum procalcitonin levels.

Inclusion Criteria

- Age ≥ 18 years.
- Diagnosis of acute pancreatitis based on Revised Atlanta Classification.
- Presence of at least two of the following:
 - Typical abdominal pain.
 - Serum amylase/lipase ≥ 3 times the upper limit of normal.
 - Radiological evidence of acute pancreatitis.
- Written informed consent.

Exclusion Criteria

- Chronic pancreatitis.
- Pancreatic malignancy.
- Chronic kidney disease.
- Chronic liver disease.
- Pregnancy.
- Patients unwilling to participate.

Data Collection

Detailed demographic information, clinical history, physical examination findings, etiology of pancreatitis, laboratory investigations, and imaging findings were recorded using a structured proforma. Disease severity was assessed using the Ranson scoring system and patients were classified according to the Revised Atlanta Classification into mild, moderately severe, and severe acute pancreatitis.

Laboratory Investigations

Venous blood samples were collected within 24 hours of admission before definitive treatment.

Table 1: Biochemical Variables in Study Population (Severity-wise Comparison)

Biochemical/Hormonal Parameter	Control (n=56) Mean ± SD	Mild AP (n=38) Mean ± SD	Moderately Severe AP (n=52) Mean ± SD	Severe AP (n=22) Mean ± SD
Age (Years)	42.54 ± 14.90	49.29 ± 16.36	49.35 ± 14.52	50.23 ± 16.92
Serum Procalcitonin (PCT) (ng/mL)	0.03 ± 0.01	0.34 ± 0.09	1.01 ± 0.53	3.41 ± 0.79

Table 2: One way analysis of variance for serum procalcitonin (PCT)

Variation	Sum of squares	Degrees of freedom	Variance (mean square)	F	p	Statistical significance
Between Groups	137.43	2	68.7164	268.8244	0.0001	
Within Groups	27.86	109	0.2556			HS
Total	165.29	111				

Investigations included

- Serum procalcitonin
- Serum amylase
- Serum lipase
- Routine biochemical investigations

Estimation of Serum Procalcitonin

Serum procalcitonin concentration was measured using a validated immunoassay according to the manufacturer's protocol. Internal quality control procedures were followed throughout the study.

Statistical Analysis

Data were analyzed using IBM SPSS Statistics version 26.0. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. One-way ANOVA with post hoc analysis was used to compare serum procalcitonin levels among severity groups. Pearson's correlation coefficient assessed the association between PCT and Ranson score. ROC curve analysis determined the optimal cut-off value, area under the curve (AUC), sensitivity, specificity, positive predictive value, and negative predictive value for predicting severe acute pancreatitis. Multivariable logistic regression was performed to identify independent predictors of severe disease. A p-value <0.05 was considered statistically significant.

Ethical Considerations

The study was approved by the Institutional Ethics Committee, and written informed consent was obtained from all participants before enrolment.

RESULTS

Disease Severity Distribution

A total of 112 patients with acute pancreatitis were included in the study. According to the Revised Atlanta Classification, 38 (33.9%) patients had mild acute pancreatitis, 52 (46.4%) had moderately severe acute pancreatitis, and 22 (19.6%) had severe acute pancreatitis. The largest proportion of patients belonged to the moderately severe group, followed by mild and severe disease. For comparison of biochemical parameters, 56 healthy controls were also included.

Comparison of Serum Procalcitonin (PCT) in Various Groups of Subjects

The p values by post-hoc test are in the following table:

Between Groups	p-value	Inference
1 and 2 (Mild vs Moderately Severe)	< 0.0001	HS
2 and 3 (Moderately Severe vs Severe)	< 0.0001	HS
3 and 1 (Severe vs Mild)	< 0.0001	HS

1-Mild AP subjects

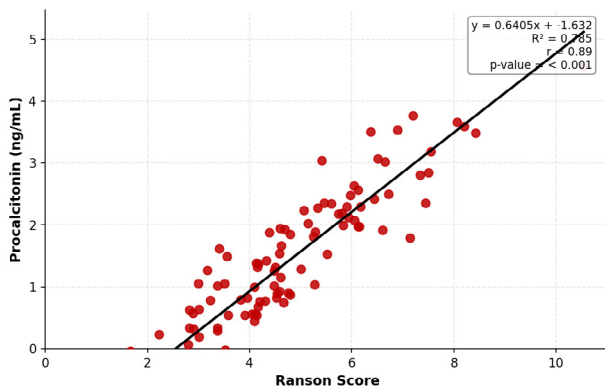
2-Moderately Severe e AP subjects

3-Severe AP subjects

HS – Highly Significant (p < 0.001)

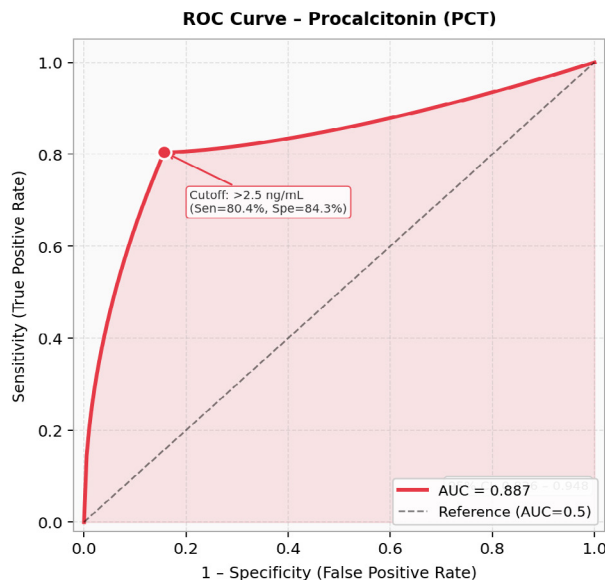
DISCUSSION

The current prospective observational study assessed the potential of serum procalcitonin (PCT) as an early biomarker for acute pancreatitis disease severity prediction.



Positive correlation ($r = 0.886$, $p < 0.001$) — Strong direct relationship

Graph 1: Correlation of Serum Procalcitonin with Ranson Score in AP Patients



Graph 2: PCT: ROC curve of Serum Procalcitonin (PCT) for predicting severe acute pancreatitis

The Revised Atlanta Classification was used to categorise 112 patients with acute pancreatitis into 38 (33.9%) mild, 52 (46.4%) moderately severe, and 22 (19.6%) severe cases. In order to compare the serum procalcitonin concentrations, 56 healthy controls were also included. The results supported its use as an early indicator of severe acute pancreatitis by showing a gradual increase in serum PCT levels with increasing illness severity (7).

In patients with mild acute pancreatitis, the mean serum procalcitonin was 0.34 ± 0.09 ng/mL; in patients with

moderately severe disease, it was 1.01 ± 0.53 ng/mL; in patients with severe acute pancreatitis, it was 3.41 ± 0.79 ng/mL; in contrast, the mean value in healthy controls was only 0.03 ± 0.01 ng/mL. Post-hoc analysis verified statistically significant differences between each pair of severity categories, and one-way ANOVA showed extremely significant differences among the three severity groups ($F = 268.82$, $p < 0.0001$). These results suggest that the inflammatory burden linked to increasing pancreatic damage is closely reflected in serum PCT (8).

Elevated procalcitonin in severe acute pancreatitis has a well-established biological basis. Pro-inflammatory cytokines such as interleukin-6, interleukin-1 β , and tumour necrosis factor- α are released when pancreatic inflammation is severe. These cytokines increase the creation of procalcitonin outside of the thyroid. Circulating PCT levels rise significantly as inflammation develops into persistent organ dysfunction and systemic inflammatory response syndrome. As a result, serum PCT indicates the degree of systemic inflammatory activation in acute pancreatitis in addition to being a sign of bacterial infection (9).

The significant positive correlation between serum procalcitonin and the Ranson score ($r = 0.886$, $p < 0.001$) was a key finding of the current investigation. Serum PCT has a practical benefit because it can be evaluated from a single blood sample taken within the first 24 hours of admission, whereas the Ranson score needs several clinical and laboratory variables gathered over 48 hours. Prompt aggressive fluid resuscitation, closer monitoring, timely ICU referral, and the avoidance of complications are all made possible by early detection of patients who are at risk of developing severe disease (10).

The superior diagnostic performance of serum PCT was further validated by receiver operating characteristic analysis. Excellent discriminatory ability for severe acute pancreatitis was shown by an AUC of 0.887. Serum procalcitonin showed 80.4% sensitivity and 84.3% specificity using a cut-off value of >2.5 ng/mL, showing great diagnostic accuracy for identifying patients at risk of severe illness. These results imply that serum PCT may enhance early risk stratification by supplementing rather than replacing current clinical scoring systems (11).

Overall, routine measurement of serum procalcitonin during the initial assessment of patients with acute pancreatitis is supported by the current data. Serum PCT is a useful supplement for early prognostic evaluation due to its quick availability, objective interpretation, and superior predictive performance, especially in crowded emergency rooms and healthcare settings with limited resources (12).

CONCLUSION

Serum procalcitonin is a useful early indicator for determining the severity of acute pancreatitis, as this study shows. Serum procalcitonin levels rose gradually from mild to severe disease in 112 patients categorised using the Revised Atlanta Classification. It also demonstrated a strong positive correlation with the Ranson score, demonstrating its usefulness in early prognostic assessment. With 80.4% sensitivity and 84.3% specificity at a cut-off value of >2.5 ng/mL for predicting severe acute pancreatitis, ROC curve analysis showed outstanding diagnostic performance (AUC = 0.887). These results suggest that high-risk individuals can be reliably identified by serum procalcitonin shortly after hospital admission. When combined with well-established clinical grading systems, routine serum PCT testing may help with early risk assessment, timely intensive monitoring, suitable treatment treatments, and better clinical results. Serum procalcitonin is a useful biomarker for ordinary clinical practice because of its quick availability, repeatability, and simplicity of measurement, especially in healthcare settings with limited resources.

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