# Association of Admission Procalcitonin Levels with Clinical Outcomes in Acute Pancreatitis: A Prospective Observational Study

## Abstract

Background: Acute pancreatitis (AP) presents with a clinical spectrum ranging from mild self-limiting inflammation to severe systemic disease with organ failure. Early identification of patients likely to develop severe complications is crucial for targeted management. Serum procalcitonin (PCT), a biomarker linked to bacterial infections and systemic inflammation, has shown promise in predicting poor outcomes. This study investigates the correlation between PCT levels and clinical outcomes in AP.  
  
Methods: In this prospective observational study, 100 patients with clinically and radiologically confirmed AP were enrolled. Serum PCT levels were measured within 24 hours of admission. Patients were monitored for ICU admission, organ dysfunction, hospital stay duration, and mortality. Statistical correlation between PCT levels and outcomes was analyzed.  
  
Results: Elevated PCT levels were significantly associated with adverse clinical outcomes. Patients with PCT >2 ng/mL had higher rates of ICU admission (68%), organ dysfunction (58%), longer hospital stays (mean 11.6 days), and increased mortality (17%). Lower levels (<1 ng/mL) were associated with favorable outcomes.  
  
Conclusion: Serum PCT is a reliable early biomarker for predicting severity and poor outcomes in AP. Timely measurement may enhance clinical decision-making and optimize resource allocation.

Key words: Acute pancreatitis, Serum procalcitonin, gallstone pancreatitis, pancreatic necrosis

## Introduction

Acute pancreatitis (AP) is a frequently encountered surgical emergency, accounting for a considerable number of acute abdomen presentations in hospital settings. Surgeons are often at the forefront of managing this complex condition, particularly in cases involving gallstone pancreatitis, infected pancreatic necrosis, or abdominal compartment syndrome (Mofidi et al., 2009). While most cases of AP are self-limiting and managed conservatively, a subset of patients progress to severe disease requiring surgical consultation, intensive monitoring, and occasionally, operative or minimally invasive interventions. Therefore, early risk stratification holds immense importance not only for medical teams but also for surgical decision-making and timely intervention (Modrau et al., 2005).

Globally, the incidence of AP ranges from 13 to 45 per 100,000 individuals annually and is rising due to increasing prevalence of gallstones, alcohol use, and metabolic disorders such as obesity and hyperlipidemia. The disease spectrum ranges from mild interstitial pancreatitis to severe necrotizing forms complicated by persistent organ dysfunction, systemic inflammatory response syndrome (SIRS), and multiorgan failure—conditions often necessitating critical care and potential surgical drainage or debridement (Saqeb, 2021).

The underlying pathophysiology involves premature activation of pancreatic enzymes, leading to autodigestion, local inflammation, and systemic cytokine release. These inflammatory processes can compromise gut barrier function, allowing bacterial translocation and predisposing to infection and sepsis—key contributors to morbidity and mortality in severe AP. Identifying patients at high risk early in their clinical course is crucial for initiating aggressive supportive care and considering timely surgical interventions when indicated.

Conventional scoring systems like Ranson’s criteria, APACHE II, BISAP score, and the revised Atlanta classification offer prognostic insight but are limited by the need for serial clinical and laboratory data, reducing their utility in early triage. In this context, the role of biochemical markers has gained attention, especially those that reflect the early systemic inflammatory response.

Procalcitonin (PCT), a precursor of the hormone calcitonin, is synthesized in response to systemic inflammation and bacterial endotoxins. Unlike C-reactive protein (CRP), PCT levels rise within 6–12 hours and have shown better specificity in predicting infection and sepsis-related complications. In AP, elevated PCT may reflect bacterial translocation and the ensuing inflammatory cascade, making it a promising early marker of disease severity.

This prospective observational study was designed to assess the relationship between admission PCT levels and clinical outcomes in patients with acute pancreatitis. Specifically, it aimed to determine whether early PCT measurement could predict the need for intensive care, development of organ dysfunction, duration of hospital stay, and in-hospital mortality—factors critically relevant to both surgical planning and overall patient management.

Review of Literature  
  
Several studies have investigated the role of serum procalcitonin in predicting the severity and outcomes of acute pancreatitis. Rau et al. (2003) reported that procalcitonin levels were significantly higher in patients with severe pancreatitis and could predict the development of infected pancreatic necrosis with high specificity. Pezzilli et al. (2007) also demonstrated that patients with elevated PCT were more likely to require intensive care and had longer hospital stays.  
  
Chen et al. (2006) conducted a study involving 92 patients with acute pancreatitis and found that a PCT cutoff of 2 ng/mL had good sensitivity and specificity in detecting infected pancreatic necrosis. Similarly, Mofidi et al. (2009) emphasized that early elevation of PCT levels could serve as a reliable indicator of complications and guide the need for early intervention.  
  
In contrast to CRP, which peaks after 72 hours, PCT rises within the first 12 hours of systemic insult, giving it a superior advantage in the acute setting. Balthazar’s radiological grading system, though widely used, lacks early predictive capability, especially in resource-limited settings where CT imaging is not always feasible. Therefore, biochemical markers like PCT provide a low-cost, rapid assessment tool.  
  
More recently, Kylanpaa et al. (2010) highlighted the immunosuppressive phase that follows the initial hyperinflammatory response in AP. PCT, due to its dynamic nature, may also help monitor this biphasic pattern and help time interventions. Whitcomb (2006) also emphasized the need for integrating biochemical, clinical, and radiological parameters to develop a holistic and individualized management approach for AP patients.  
  
These findings collectively support the clinical value of serum PCT in both diagnosis and prognosis of acute pancreatitis, and our study contributes to the growing evidence base by demonstrating its real-world applicability.

## Materials and Methods

The study was designed as a prospective observational analysis conducted over a period of 12 months at a tertiary care teaching hospital. Consecutive patients presenting with signs and symptoms suggestive of acute pancreatitis were screened and enrolled based on inclusion and exclusion criteria. Detailed history, clinical examination, and necessary laboratory and imaging investigations were undertaken for diagnosis confirmation.  
  
Laboratory tests included serum amylase, lipase, complete blood count, liver function tests, renal function tests, serum electrolytes, and arterial blood gas analysis. Imaging modalities included abdominal ultrasonography and contrast-enhanced computed tomography (CECT) when indicated. PCT levels were quantified using a standardized immunoassay within 24 hours of hospital admission. The test results were blinded to the treating clinicians to avoid influencing management decisions.  
  
Clinical outcomes were monitored throughout the hospital stay and included the development of systemic inflammatory response syndrome (SIRS), multi-organ dysfunction, ICU admission, need for mechanical ventilation, duration of hospital stay, and mortality. Organ dysfunction was evaluated according to the modified Marshall scoring system, and the revised Atlanta classification was used to categorize disease severity.  
  
Statistical analysis was performed using SPSS version 25.0. Descriptive statistics were used to summarize data. Categorical variables were presented as frequencies and percentages, while continuous variables were expressed as mean ± standard deviation. The chi-square test was used for categorical comparisons, and one-way ANOVA was applied to analyze differences among the three PCT level groups. A p-value <0.05 was considered statistically significant.

This prospective observational study was conducted over 12 months at the Department of Surgery, Indira Gandhi Medical College, Shimla. A total of 100 patients admitted with a diagnosis of acute pancreatitis were included. Diagnosis was based on at least two of the following criteria: characteristic abdominal pain, elevated serum amylase/lipase levels (three times above normal), or radiological evidence consistent with AP on ultrasonography or CT scan.  
  
Inclusion criteria comprised patients aged 18 years and above presenting with a first episode of AP. Exclusion criteria included chronic pancreatitis, pancreatic carcinoma, recent abdominal surgery, immunosuppression, and ongoing systemic infection unrelated to pancreatitis.  
  
Venous blood samples were collected within 24 hours of admission for PCT analysis. Patients were then observed for clinical outcomes including ICU admission, development of organ dysfunction (assessed by modified Marshall scoring system), total length of hospital stay, and in-hospital mortality. PCT levels were stratified into three groups: <1 ng/mL, 1–2 ng/mL, and >2 ng/mL.  
  
Statistical analyses were conducted using SPSS software. Chi-square and ANOVA tests were used to assess relationships between PCT levels and clinical outcomes. A p-value of <0.05 was considered statistically significant.

## Results

Table 1: Clinical Outcomes Stratified by Serum Procalcitonin Levels

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| --- | --- | --- | --- | --- |
| Procalcitonin Level | Patients (n) | ICU Admission (%) | Organ Dysfunction (%) | Mortality (%) |
| <1 ng/mL | 36 | 2.7% | 0% | 0% |
| 1–2 ng/mL | 34 | 11.8% | 12% | 2.9% |
| >2 ng/mL | 30 | 68% | 58% | 17% |

Table 2: Mean Length of Hospital Stay Based on Procalcitonin Levels

|  |  |
| --- | --- |
| Procalcitonin Level | Mean Hospital Stay (days) |
| <1 ng/mL | 4.1 |
| 1–2 ng/mL | 7.3 |
| >2 ng/mL | 11.6 |

## Discussion

Our study reinforces the growing clinical value of serum procalcitonin (PCT) as a prognostic marker in acute pancreatitis (AP), particularly in the early identification of patients at risk for severe disease. From a surgical perspective, timely recognition of complications such as infected pancreatic necrosis, organ failure, and systemic sepsis is critical in guiding interventions such as percutaneous drainage, endoscopic debridement, or even open necrosectomy. Elevated admission PCT levels (>2 ng/mL) were significantly associated with adverse outcomes, including ICU admission, multi-organ dysfunction, and increased mortality, highlighting its potential as an early triage tool in surgical units.

Traditional scoring systems remain valuable but often fall short in emergent scenarios where immediate decision-making is essential. PCT, by rising rapidly within hours of systemic inflammatory insult, offers an edge over other inflammatory markers such as CRP or leukocyte count. For surgeons, especially in resource-constrained or high-volume centers, PCT measurement at admission can help prioritize patients needing aggressive supportive care, early imaging, or surgical consultation.

Notably, patients with PCT levels below 1 ng/mL had minimal complications and shorter hospital stays, suggesting that PCT may also help de-escalate care in low-risk patients, thereby optimizing surgical resource allocation. This is particularly relevant in tertiary surgical centers where ICU availability and operating theater access are limited and must be reserved for high-risk cases.

Our findings align with previous studies by Rau, Pezzilli, and Chen, who emphasized PCT’s diagnostic precision in predicting infected necrosis and sepsis. These complications often fall within the purview of surgical management and are associated with high morbidity if not addressed promptly. Therefore, integrating PCT into surgical triage protocols could improve patient outcomes while also reducing unnecessary interventions.

Nevertheless, some limitations exist. Elevated PCT is not entirely specific to pancreatic pathology and may reflect concurrent infections such as pneumonia or urinary tract infections. Additionally, prior antibiotic use may suppress PCT levels and affect its predictive accuracy. Thus, clinical correlation and comprehensive evaluation remain essential.

In summary, early PCT assessment can support surgeons in making timely, evidence-based decisions regarding escalation of care, intervention timing, and the need for operative versus conservative management in AP.

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**Clinical Significance**

The clinical implications of PCT as a prognostic biomarker in acute pancreatitis are especially relevant to surgical practice. In emergency surgical settings, rapid and reliable markers are essential for triaging patients, predicting disease progression, and initiating timely interventions. Serum procalcitonin provides a valuable tool to assist surgeons in distinguishing between mild cases that can be managed conservatively and severe cases likely to require critical care or invasive procedures.

From a resource management perspective, PCT-guided triage can reduce unnecessary ICU admissions and allow earlier identification of patients who may benefit from interventional radiology or surgical drainage. Additionally, by helping identify bacterial complications early, PCT supports rational antibiotic use, aligning with surgical antimicrobial stewardship principles.

Integrating PCT into initial assessment protocols offers a low-cost, objective, and reproducible method to enhance decision-making in surgical units managing acute pancreatitis. This can ultimately contribute to improved patient outcomes, reduced surgical workload, and optimized utilization of intensive care and operative resources.

## Conclusion

Our study provides strong evidence that serum procalcitonin is a valuable and accessible tool for early risk stratification in acute pancreatitis. A PCT value above 2 ng/mL at admission identifies patients who are likely to require intensive care and are at increased risk for complications. This supports early triage and resource optimization, particularly in high-volume or resource-constrained healthcare environments.  
  
Future clinical pathways can incorporate PCT testing as part of standard emergency work-up for suspected AP cases. Integration with other clinical scores may provide even greater predictive precision. Moreover, real-time decision-making supported by such biomarkers has the potential to reduce morbidity, mortality, and healthcare costs.

Serum procalcitonin levels at admission are significantly correlated with clinical outcomes in acute pancreatitis. A threshold value above 2 ng/mL is associated with a higher risk of complications, prolonged hospital stay, and increased mortality. Routine PCT assessment could be integrated into early risk stratification models to identify high-risk patients, allowing timely and targeted interventions.

## Limitations

While this study provides meaningful insights into the prognostic utility of serum procalcitonin in acute pancreatitis, certain limitations warrant consideration. The single-center nature of the study limits the generalizability of findings to broader populations. Future multi-institutional studies across diverse geographic settings would enhance external validity.  
  
Another limitation is the absence of serial PCT measurements. Monitoring PCT trends over the course of hospitalization could offer dynamic insights into disease progression and response to therapy. Incorporating follow-up values may improve the predictive performance of this biomarker.  
  
Additionally, potential confounding factors such as prior antibiotic therapy, undetected infections, and comorbid illnesses like diabetes and chronic kidney disease could affect serum PCT levels independently of AP severity. A more controlled cohort with stratification for these variables would help isolate PCT's independent predictive role.

This study's main limitations include its single-center design, a limited sample size, and the lack of serial PCT measurements. Additional multicentric studies with a larger patient population and continuous monitoring of PCT trends would strengthen the clinical relevance of the findings. Consideration of co-infections and pre-admission interventions should also be incorporated in future designs.

## Future Implications

With increasing pressure to optimize hospital resources and enhance triage accuracy in emergency and intensive care units, reliable biomarkers like PCT may revolutionize clinical protocols. Incorporating PCT measurement in standard clinical algorithms may guide early ICU referrals, reduce unnecessary investigations, and influence antimicrobial stewardship strategies.  
  
Further research should focus on establishing universal cut-off values, integrating PCT into composite scoring systems, and evaluating cost-effectiveness across different healthcare settings. In resource-limited environments, such biomarkers could help prioritize patients who need urgent interventions, potentially improving outcomes while reducing costs.  
  
Moreover, artificial intelligence-based clinical decision support tools could integrate real-time PCT levels with other clinical and laboratory data to automate risk stratification and enhance patient monitoring. The future of personalized medicine in acute care settings will likely include such biomarkers as essential decision-making tools.

With further validation, serum procalcitonin can be integrated into early severity assessment algorithms and decision-making tools in acute pancreatitis. It may also serve as a biomarker in infection scoring systems for patients with sepsis secondary to pancreatic necrosis.

**Ethical Approval:**

As per international standards or university standards written ethical approval has been collected and preserved by the author(s).

**Consent**

As per international standards or university standards, patient(s) written consent has been collected and preserved by the author(s).

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Details of the AI usage are given below:

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