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Original Research Article

ASSESSMENT OF CRP AND PROCALCITONIN AS EARLY BIOMARKERS OF SEVERITY IN ACUTE GALLSTONE-INDUCED PANCREATITIS

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ABSTRACT

Background: Acute gallstone-induced pancreatitis is one of the most common causes of acute pancreatitis and exhibits a highly variable clinical cours. Early prediction of disease severity is essential for timely intervention and optimal patient management. C-reactive protein (CRP) and procalcitonin (PCT) are inflammatory biomarkers that may help identify patients at risk of severe disease and adverse outcomes. The aim is to evaluate the role of serum C-reactive protein and procalcitonin levels as predictors of severity in patients with acute gallstone-induced pancreatitis and to determine their association with clinical outcomes.

Materials and Methods: This prospective observational study was conducted over a period of 15 months among 45 patients diagnosed with acute gallstone-induced pancreatitis. Demographic details, clinical presentation, laboratory parameters, radiological findings, and severity assessment were recorded. Serum CRP and procalcitonin levels were measured within 24 hours of admission. Clinical outcomes including duration of hospital stay, development of local and systemic complications, need for intensive care unit admission, and mortality were assessed. Statistical analysis was performed using appropriate tests, and a p-value <0.05 was considered statistically significant.

Results: According to the Revised Atlanta Classification, 24 (53.3%) patients had mild pancreatitis, 13 (28.9%) had moderately severe pancreatitis, and 8 (17.8%) had severe pancreatitis. Mean serum CRP levels increased significantly with disease severity, measuring 48.7 ± 15.6 mg/L in mild cases, 112.4 ± 28.3 mg/L in moderately severe cases, and 186.8 ± 41.7 mg/L in severe cases ($p<0.001$). Similarly, mean serum procalcitonin levels were 0.42 ± 0.19 ng/mL, 1.86 ± 0.74 ng/mL, and 5.28 ± 1.96 ng/mL respectively across the severity groups ($p<0.001$). Positive correlations were observed between both biomarkers and length of hospital stay. Procalcitonin showed slightly higher sensitivity and specificity than CRP in predicting severe disease.

Conclusion: Serum CRP and procalcitonin levels are valuable biomarkers for early prediction of severity in acute gallstone-induced pancreatitis. Procalcitonin demonstrated superior predictive performance compared to CRP. Early assessment of these biomarkers may facilitate risk stratification, guide clinical decision-making, and improve patient outcomes.

Keywords: Acute gallstone pancreatitis, Biomarkers, C-reactive protein, Disease severity, Procalcitonin, Revised Atlanta classification.

INTRODUCTION

Acute pancreatitis is an acute inflammatory disorder of the pancreas characterized by a highly variable clinical course ranging from mild, self-limiting disease to severe pancreatitis associated with multiorgan failure and death.[1] Gallstone disease remains one of the leading etiological factors for acute pancreatitis, accounting for approximately 35–50% of cases in many populations.[2] Gallstone-

induced pancreatitis occurs when transient or persistent obstruction of the ampulla of Vater by gallstones leads to reflux of bile into the pancreatic duct and premature activation of pancreatic enzymes, resulting in pancreatic inflammation and tissue injury.[3]

The majority of patients with acute gallstone-induced pancreatitis experience a mild clinical course with complete recovery.[4] Severe acute pancreatitis is associated with significantly increased morbidity, prolonged hospitalization, intensive care unit admission, and mortality. Therefore, early identification of patients at risk of severe disease is essential to facilitate timely intervention, appropriate monitoring, and optimal allocation of healthcare resources.[5,6]

Several clinical scoring systems have been developed to predict the severity of acute pancreatitis, including Ranson's criteria, Acute Physiology and Chronic Health Evaluation (APACHE II), Bedside Index for Severity in Acute Pancreatitis (BISAP), and the Modified Glasgow Score.[7] Although these scoring systems are useful, they often require multiple clinical and laboratory parameters collected over 24–48 hours, limiting their utility during the initial stages of patient presentation.[8] Consequently, there has been increasing interest in identifying simple, reliable, and readily available biochemical markers that can accurately predict disease severity at an early stage.[9]

C-reactive protein (CRP) is an acute-phase reactant synthesized by hepatocytes in response to inflammatory cytokines, particularly interleukin-6. Elevated CRP levels reflect the intensity of systemic inflammation and have been widely used as a marker of severity in acute pancreatitis.[10] CRP concentrations exceeding 150 mg/L within the first 48–72 hours have been associated with pancreatic necrosis and severe disease. However, CRP levels may rise relatively late in the disease course, potentially limiting its usefulness for very early risk stratification.[11]

Procalcitonin (PCT), a precursor peptide of calcitonin, has emerged as a promising biomarker of systemic inflammation and infection. Unlike CRP, serum procalcitonin levels increase rapidly in response to severe inflammatory stimuli and may correlate more closely with disease severity, infected pancreatic necrosis, and organ failure.[12] Several studies have suggested that procalcitonin possesses superior predictive accuracy compared with conventional inflammatory markers, although results remain variable across different populations and clinical settings.

Accurate assessment of disease severity in acute gallstone-induced pancreatitis remains a clinical challenge. Biomarkers that can reliably identify high-risk patients during the early phase of illness may improve clinical decision-making, facilitate appropriate triage, and reduce complications. Evaluating the predictive value of CRP and procalcitonin in patients with gallstone-induced pancreatitis may provide important insights into their role in routine clinical practice and contribute to improved patient outcomes.

AIMS AND OBJECTIVES

- To evaluate the role of serum C-reactive protein and procalcitonin levels as predictors of severity in patients with acute gallstone-induced pancreatitis and to determine their association with clinical outcomes.

MATERIALS AND METHODS

This prospective observational study was conducted in the Department of General Surgery, Sree Mookambika Institute of Medical Sciences, Kulasekharam, Tamil Nadu, over a period of 15 months from January 2024 to March 2025. The study was carried out after obtaining approval from the Institutional Ethics Committee, and written informed consent was obtained from all participants prior to enrollment. A total of 45 consecutive patients diagnosed with acute gallstone-induced pancreatitis and fulfilling the eligibility criteria were included in the study.

Inclusion Criteria

- Patients aged 18 years and above.
- Patients diagnosed with acute gallstone-induced pancreatitis based on clinical, biochemical, and radiological criteria.
- Patients presenting within 72 hours of onset of symptoms.
- Patients willing to provide written informed consent.

Exclusion Criteria

- Acute pancreatitis due to causes other than gallstones (alcohol, hypertriglyceridemia, trauma, drugs, post-ERCP, or idiopathic pancreatitis).
- Patients with chronic pancreatitis or pancreatic malignancy.
- Patients with active systemic infections, sepsis, or inflammatory diseases unrelated to pancreatitis.
- Patients with chronic liver disease, chronic kidney disease, or immunocompromised states.
- Pregnant women.
- Patients unwilling to participate in the study.

The diagnosis of acute gallstone-induced pancreatitis was established based on the presence of at least two of the following three criteria: characteristic abdominal pain suggestive of acute pancreatitis, elevation of serum amylase and/or lipase levels to more than three times the upper limit of normal, and radiological evidence of acute pancreatitis on ultrasonography or contrast-enhanced computed tomography. Gallstone etiology was confirmed by ultrasonographic demonstration of cholelithiasis and/or choledocholithiasis with the exclusion of other causes of pancreatitis. Detailed demographic data, clinical history, physical

examination findings, and relevant laboratory investigations were recorded for all patients using a structured proforma.

Blood samples for estimation of serum C-reactive protein (CRP) and procalcitonin (PCT) were collected within the first 24 hours of hospital admission. Serum CRP levels were measured using an immunoturbidimetric assay, while serum procalcitonin levels were determined by chemiluminescent immunoassay. Routine laboratory investigations including complete blood count, liver function tests, renal function tests, serum electrolytes, serum amylase, serum lipase, and blood glucose levels were performed. Imaging studies including abdominal ultrasonography and contrast-enhanced computed tomography, whenever indicated, were used to assess the extent of pancreatic involvement and identify local complications.

The severity of acute pancreatitis was classified according to the Revised Atlanta Classification into mild, moderately severe, and severe acute pancreatitis. Patients were monitored throughout their hospital stay for the development of local complications, organ failure, need for intensive care unit admission, duration of hospitalization, and mortality. Clinical outcomes were documented and correlated with serum CRP and procalcitonin levels to evaluate their predictive value for disease severity.

The collected data were entered into Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS) version 25.0. Quantitative variables were expressed as mean ± standard deviation, while qualitative variables were presented as frequencies and percentages. Comparisons between groups were performed using Student's t-test, one-way analysis of variance (ANOVA), and Chi-square test as appropriate. Correlation between biomarker levels and disease severity was assessed using Pearson's correlation coefficient. A p-value of less than 0.05 was considered statistically significant.

RESULTS

The majority of patients belonged to the 50–59 years of age group (28.9%). Females constituted 62.2% of the study population, reflecting the higher prevalence of gallstone disease among women.

Table 1: Demographic Characteristics of Study Participants

Variable	Number of Patients	Percentage (%)
Age Group (Years)		
<30	5	11.1
30–39	8	17.8
40–49	11	24.4
50–59	13	28.9
≥60	8	17.8
Gender		
Male	17	37.8
Female	28	62.2

Mild pancreatitis was the most common presentation, accounting for 53.3% of cases. Severe pancreatitis was observed in 17.8% of patients and was associated with increased complications and prolonged hospitalization.

Table 2: Severity Distribution According to Revised Atlanta Classification

Severity Category	Number of Patients	Percentage (%)
Mild	24	53.3
Moderately Severe	13	28.9
Severe	8	17.8
Total	45	100.0

Both CRP and procalcitonin levels increased significantly with increasing disease severity. Patients with severe pancreatitis demonstrated markedly elevated biomarker levels compared with those with mild disease.

Table 3: Serum CRP and Procalcitonin Levels According to Disease Severity

Severity Category	Mean CRP (mg/L) ± SD	Mean Procalcitonin (ng/mL) ± SD	p-value
Mild	48.7 ± 15.6	0.42 ± 0.19	
Moderately Severe	112.4 ± 28.3	1.86 ± 0.74	
Severe	186.8 ± 41.7	5.28 ± 1.96	<0.001

Significantly higher CRP and procalcitonin levels were observed among patients who developed organ failure, pancreatic necrosis, and required ICU admission. Elevated biomarker levels were strongly associated with adverse clinical outcomes.

Table 4: Correlation of Biomarkers with Clinical Outcomes

Clinical Outcome	CRP (mg/L) ± SD	Procalcitonin (ng/mL) ± SD	p-value
Organ Failure Present (n=6)	198.6 ± 38.5	5.84 ± 1.72	<0.001
Organ Failure Absent (n=39)	76.8 ± 34.7	1.01 ± 0.88	
Pancreatic Necrosis Present (n=8)	183.4 ± 41.2	5.36 ± 1.84	<0.001
Pancreatic Necrosis Absent (n=37)	79.5 ± 36.4	1.14 ± 0.96	
ICU Admission Required (n=7)	191.2 ± 39.8	5.52 ± 1.69	<0.001
ICU Admission Not Required (n=38)	81.4 ± 35.1	1.08 ± 0.92	

Hospital stay increased significantly with disease severity. Patients with severe pancreatitis required prolonged hospitalization due to complications and intensive monitoring.

Table 5: Duration of Hospital Stay According to Severity

Severity Category	Mean Hospital Stay (Days) ± SD	p-value
Mild	5.4 ± 1.3	<0.001
Moderately Severe	8.7 ± 2.1	
Severe	13.2 ± 3.4	

DISCUSSION

A total of 45 patients with acute gallstone-induced pancreatitis were included in the study. The majority belonged to the 50–59 years age group, accounting for 13 (28.9%) patients, followed by 11 (24.4%) patients in the 40–49 years age group. Females constituted 28 (62.2%) patients, while males accounted for 17 (37.8%) patients. The predominance of female patients observed in the present study reflects the higher prevalence of gallstone disease among women. Similar findings were reported by Zeynettin A et al.[13] who observed female predominance (56.7%) among patients with gallstone pancreatitis, and by Hassan MS et al.[14] who reported that 65% of patients with gallstone-associated acute pancreatitis were female. In contrast, Afroz N et al.[15] and Shera IA et al.[16] reported a male predominance, likely due to the inclusion of alcohol-related pancreatitis cases.

Disease severity assessment according to the Revised Atlanta Classification showed that 24 (53.3%) patients had mild pancreatitis, 13 (28.9%) had moderately severe pancreatitis, and 8 (17.8%) had severe pancreatitis. These findings are comparable to those reported by Pujari KK et al.[17] who observed mild, moderately severe, and severe disease in 53.1%, 30.2%, and 16.7% of patients, respectively. Similarly, Shera IA et al.[16] reported 68.7% mild, 16.5% moderately severe, and 14.8% severe pancreatitis. Although most patients experienced a mild disease course, the occurrence of severe pancreatitis in a substantial proportion of patients highlights the need for early risk stratification and timely intervention.

The present study demonstrated a significant increase in serum CRP levels with increasing disease severity. Mean CRP values increased from 48.7 ± 15.6 mg/L in mild pancreatitis to 112.4 ± 28.3 mg/L in moderately severe disease and 186.8 ± 41.7 mg/L in severe pancreatitis ($p<0.001$). Similar observations were made by Kerketta MD et al.[18] who reported mean CRP levels of 56.21 mg/L, 205.68 mg/L, and 328.55 mg/L in mild, moderate, and severe pancreatitis, respectively. Likewise, Pujari KK et al.[17] identified CRP levels >150 mg/L as a significant predictor of severe pancreatitis and adverse outcomes. Hassan MS et al.[14] also noted markedly elevated CRP levels in patients with severe acute pancreatitis.

Serum procalcitonin levels also increased significantly with disease severity in the present study, rising from 0.42 ± 0.19 ng/mL in mild pancreatitis to 1.86 ± 0.74 ng/mL in moderately severe disease and 5.28 ± 1.96 ng/mL in severe pancreatitis ($p<0.001$). Comparable findings were reported by Shera IA et al.[16] who observed mean procalcitonin levels of 0.46 ng/mL, 1.45 ng/mL, and 2.58 ng/mL in mild, moderately severe, and severe pancreatitis, respectively. Similarly, Rao UB et al.[19] demonstrated a progressive increase in procalcitonin levels from 0.239 ng/mL in mild disease to 4.265 ng/mL in severe disease. Kerketta MD et al.[18] also reported significant increases in procalcitonin concentrations with worsening disease severity and demonstrated excellent diagnostic performance with an AUC of 0.954. These findings support the utility of procalcitonin as a sensitive biomarker for early severity prediction.

A strong association was observed between elevated biomarker levels and adverse clinical outcomes. Organ failure developed in 6 (13.3%) patients, pancreatic necrosis in 8 (17.8%) patients, and ICU admission was required in 7 (15.6%) patients. These patients exhibited significantly higher CRP and procalcitonin levels compared to those without complications. Similar findings were reported by Pujari KK et al.[7] who demonstrated significant associations between elevated CRP levels, pancreatic necrosis, ICU admission, multiorgan failure, and severe pancreatitis. Hassan MS et al.[14] reported pancreatic necrosis in 13% and organ failure in 8% of patients, predominantly among those with elevated inflammatory markers. Furthermore, Surana P et al.[20] demonstrated high sensitivity and specificity of procalcitonin in predicting severe disease, supporting its role in identifying patients at risk of complications.

Hospital stay increased significantly with disease severity in the present study, with mean

hospitalization durations of 5.4 ± 1.3 days, 8.7 ± 2.1 days, and 13.2 ± 3.4 days for mild, moderately severe, and severe pancreatitis, respectively ($p<0.001$). Elevated CRP and procalcitonin levels were associated with prolonged hospitalization. Similar observations were reported by Zeynettin A et al.[13] who found a significant positive correlation between procalcitonin levels and duration of hospital stay ($r=0.437$, $p=0.016$). Patients with higher biomarker levels generally required more intensive monitoring and prolonged treatment due to increased complication rates.

CONCLUSION

Serum C-reactive protein (CRP) and procalcitonin are reliable and clinically useful biomarkers for predicting the severity of acute gallstone-induced pancreatitis. Increasing levels of both markers were significantly associated with severe disease, organ failure, pancreatic necrosis, intensive care unit admission, and prolonged hospital stay. Procalcitonin demonstrated a stronger association with adverse outcomes, indicating its potential superiority in early risk assessment. Early estimation of CRP and procalcitonin can assist in timely identification of high-risk patients, facilitate appropriate therapeutic interventions, and improve clinical outcomes. Their routine incorporation into clinical evaluation may enhance prognostic accuracy and patient management.

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