Section: General surgery

Original Research Article

PROCALCITONIN AND C-REACTIVE PROTEIN LEVELS AS PREDICTORS OF SEVERITY IN ACUTE GALLSTONE-INDUCED PANCREATITIS PATIENTS

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Abstract

Background: Acute gallstone-induced pancreatitis is a serious condition characterized by inflammation of the pancreas, often leading to severe complications such as systemic inflammatory response syndrome (SIRS) and multiple organ failure. Accurate early diagnosis and continuous monitoring are essential for effective management and improved patient outcomes. This study evaluates the clinical utility of procalcitonin (PCT) and C-reactive protein (CRP) levels as biomarkers for predicting the severity of acute gallstone-induced pancreatitis. **Materials and Methods:** A total of 114 patients with acute gallstone-induced pancreatitis were included in this cross-sectional study conducted at RIMS Ranchi from November 2022 to April 2024. Demographic data, clinical presentations, laboratory parameters, imaging findings, and biomarker levels were analyzed to establish correlations between PCT, CRP, and the severity of the condition. **Result:** The age distribution showed a predominant group of 31-40 years with male predominance. The most common symptoms included abdominal pain, nausea, vomiting, and jaundice. Laboratory analysis revealed significant variations in serum amylase, lipase, and inflammatory markers across mild, moderate, and severe cases. Mean PCT levels were 0.35, 1.7, and 3.31 in mild, moderate, and severe cases, respectively, while mean CRP levels were 56.21, 205.68, and 328.55 in corresponding categories. Both biomarkers demonstrated strong discriminatory abilities, with high area under the curve (AUC) values in ROC analysis (PCT: 0.954; CRP: 0.98), indicating their effectiveness in predicting severity. Specific cutoff values for PCT (0.54) and CRP (88.02) were identified, highlighting their clinical relevance. **Conclusion:** Procalcitonin and C-reactive protein are valuable biomarkers for assessing the severity of acute gallstone-induced pancreatitis. Their levels correlate significantly with clinical outcomes, making them instrumental in guiding management decisions. Future research should focus on longitudinal studies with larger cohorts to further validate these findings and enhance understanding of disease dynamics and management strategies. Despite the limitations of our study, including a relatively small sample size and geographical biases, the results underscore the potential of PCT and CRP as reliable indicators in clinical practice.

INTRODUCTION

Acute gallstone-induced pancreatitis, a subset of AP, occurs when gallstones obstruct the bile duct, causing a backflow of digestive enzymes and leading to pancreatic inflammation. Gallstones, composed of bile cholesterol and bilirubin, form in the gallbladder and may migrate to obstruct the common bile duct.[1] Globally, the incidence of acute pancreatitis ranges from 4.9 to 35 cases per 100,000 people, with increasing rates due to factors like rising obesity and gallstone formation.[2] Key markers like C-reactive protein (CRP) and Procalcitonin (PCT) are emerging as potential predictors of AP severity. CRP, an acute-phase protein, is widely available and cost-effective, increasing markedly in response to tissue damage and inflammation.[3] Procalcitonin, a precursor of the hormone calcitonin, has gained attention for its

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reliability in detecting systemic inflammation and sepsis, conditions that can develop in severe cases of AP. Both markers are now being evaluated for their utility in early prediction of AP severity, potentially guiding initial treatment and improving patient outcomes.

The Atlanta and Glasgow scoring systems, established frameworks for assessing AP severity, categorize patients based on factors like enzyme levels and organ failure.[4] Yet, these systems require integration with other markers for better prognostic accuracy. This study aims to assess CRP and PCT levels as early predictors of severity in patients with gallstone-induced AP. By comparing these markers with the Atlanta and Glasgow scores, this research seeks to establish whether CRP and PCT measurements, taken within 48 hours of admission, can reliably predict disease severity.[5] The primary objective is to establish a correlation between serum levels of these biomarkers and the severity of the condition. Additionally, the study seeks to recommend specific levels of procalcitonin and C-reactive protein as indicators for assessing severity and to identify and categorize severe cases to prioritize management in intensive care settings. By addressing these objectives, the research aims to enhance the understanding and clinical management of acute gallstone-induced pancreatitis.

MATERIALS AND METHODS

This analytical cross-sectional study assessed the potential of procalcitonin and C-reactive protein levels as markers for the severity of acute gallstone-induced pancreatitis. The study population included all patients admitted with gallstone-induced pancreatitis at the Department of General Surgery, Rajendra Institute of Medical Sciences (RIMS), Ranchi, between November 2022 and April 2024.

The sample size calculation was performed using Stata software, informed by parameters from a similar study evaluating CRP's predictive value in acute pancreatitis. Assuming a sensitivity of 83% and a prevalence of 15% with a width of 30%, the estimated sample size was 40; for a specificity of 69%, a prevalence of 20%, and a width of 10%, the required sample size was 102. With an allowance for a 10% loss to follow-up, the final sample size was 114 patients.[6]

Patients diagnosed with gallstone-induced pancreatitis had their procalcitonin and C-reactive protein levels measured within 48 hours of admission. Follow-up included daily clinical evaluations and comprehensive blood work, including hemoglobin, total leukocyte count, blood glucose, serum electrolytes, liver function tests, kidney function tests, arterial blood gas analysis, and serum amylase and lipase measurements.

Statistical analysis was conducted using IBM SPSS version 28.0.1.0. Receiver operating characteristic (ROC) curves were plotted to determine the optimal cutoff values for procalcitonin and C-reactive protein levels. Descriptive statistics were presented as mean ± SD for normally distributed data, and the area under the curve (AUC) was calculated with a 95% confidence interval. Statistical significance was set at $P < 0.05$. Sensitivity and specificity analyses were rigorously applied to predict and distinguish between mild and severe cases of acute gallstone-induced pancreatitis based on the diagnostic performance of these biomarkers.

RESULTS

The results of the study reveal important demographic, clinical, and laboratory findings regarding patients with acute gallstone-induced pancreatitis. The age distribution indicates that the majority of patients fall within the 31-40 years age group, with 36 patients, followed by the 20-30 years age group with 28 patients. Other age brackets include 21 patients aged 41-50 years and 29 patients aged 51-60 years.

Clinical complaints among patients highlight abdominal pain as the most prevalent symptom, reported by 114 patients. Other symptoms include nausea, noted by 57 patients, and vomiting, reported by 60 patients. Only 2 patients experienced yellow discoloration of the eyes.

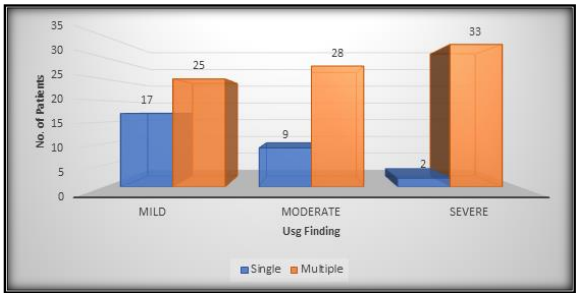

Figure 1: Distribution of patients according to USG findings across different severity level

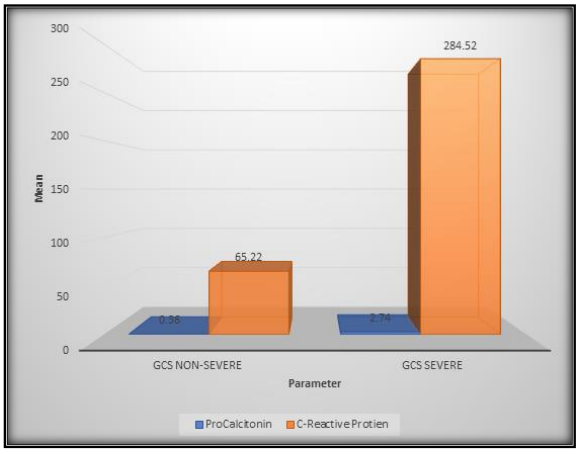

Figure 2: Correlation of GCS Severity with procalcitonin and CRP

Laboratory analyses reveal significant variations in serum amylase and lipase levels according to disease severity. Serum amylase levels increased from 556.09 U/L in mild cases to 2630.71 U/L in severe

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cases, while serum lipase levels rose from 582.28 U/L in mild cases to 3260.28 U/L in severe cases. Procalcitonin levels demonstrated a similar upward trend, starting at 0.35 ng/mL in mild cases and reaching 3.31 ng/mL in severe cases. C-reactive protein levels also increased significantly, from 56.21 mg/L in mild cases to 328.55 mg/L in severe cases.

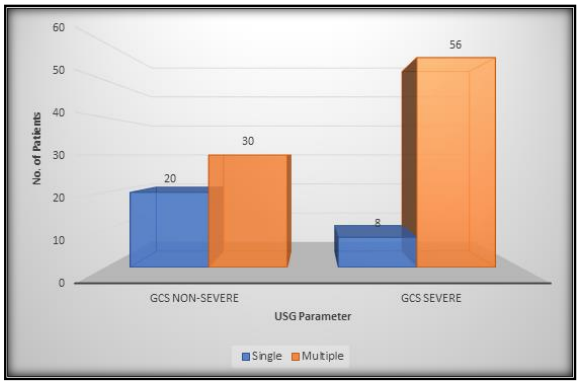

Figure 3: Correlation of GCS Severity with USG Parameter

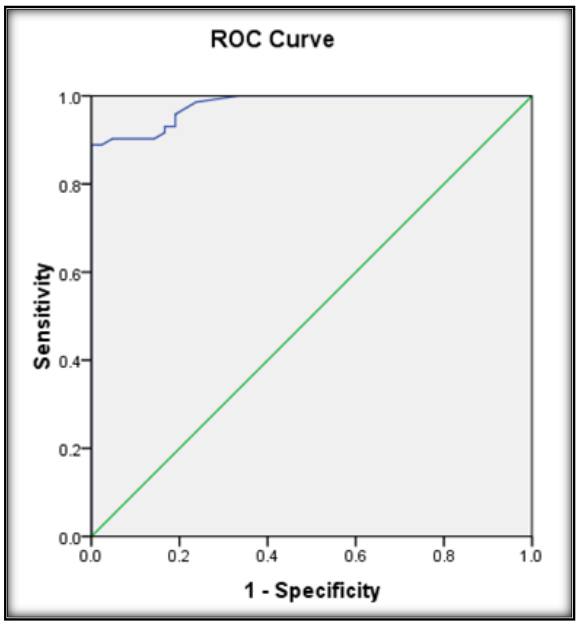

Figure 4: ROC curve of CRP

Ultrasound findings further categorized by severity levels showed that in the mild category, 17 patients had single findings and 25 had multiple findings. In the moderate category, 9 patients had single findings, while 28 had multiple findings. Among severe patients, only 2 had single findings, while 33 presented with multiple findings.

The analysis of Glasgow Coma Scale (GCS) scores indicates a stark contrast between non-severe and severe cases, particularly in the levels of Procalcitonin and CRP. Procalcitonin averaged 0.36 ng/mL in the non-severe category but increased sharply to 2.74 ng/mL in the severe category. Similarly, CRP levels rose from 65.22 mg/L in the non-severe category to 284.52 mg/L in severe cases. When examining the USG findings based on GCS, 20 patients in the non-severe category exhibited single findings, while 30 had multiple findings. In contrast, among severe GCS patients, only 8 had single findings, and 56 presented with multiple findings.

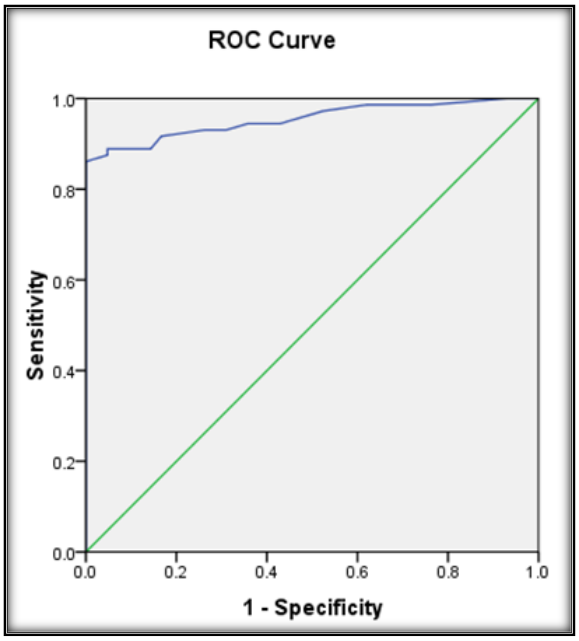

Figure 5: ROC curve of Procalcitonin

Diagnostic accuracy for CRP demonstrated an area under the curve (AUC) of 0.98, indicating excellent discriminative ability, with a cutoff value of 88.02 mg/L. The p-value of 0.0001 confirms statistical significance. CRP's sensitivity was noted at 95.80%, while specificity was 81%. Similarly, Procalcitonin showed strong performance metrics with an AUC of 0.954 and a cutoff value of 0.54 ng/mL, accompanied by a p-value of 0.0001. The sensitivity of Procalcitonin was recorded at 87.50%, and specificity was 95%. These findings collectively underscore the potential of Procalcitonin and C-reactive protein as effective biomarkers for assessing the severity of acute gallstone-induced pancreatitis.

Table 1: Distribution of patients according to Lab Parameters.

Lab Parameter	Range	Mild (N=42)		Moderate (N=37)		Severe (N=35)		P-Value
		Mean	SD	Mean	SD	Mean	SD	
Serum Amylase (U/L)	100-5652	556.09	255.04	1601.02	1013.23	2630.71	1417.07	<0.0001
Serum Lipase (U/L)	70-8479	582.28	222.84	1793.45	1261.82	3260.28	1917.41	<0.0001
Procalcitonin (ng/ml)	0.1-6.1	0.35	0.12	1.7	1.21	3.31	1.4	<0.0001
C-Reactive Protein (mg/L)	7-490	56.21	38.53	205.68	94.46	328.55	92.96	<0.0001
TLC(cells/cumm)	2100-40000	11900.1	3462.12	18501.1	5925.96	20747.5	10745.5	<0.0001
Blood Glucose(mg/dl)	84-320	127.52	18.86	127.59	21.7	153.91	45.74	<0.0002

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LDH(U/L)	11-2820	318.02	115.23	784.32	391.35	1110.34	546.34	<0.0003
AST(U/L)	23-586	63.57	27.32	186.56	106.57	235.11	150.72	<0.0001
Serum Urea(mg/dl)	18-120	35.88	11.34	55.85	25.02	63.31	26.72	<0.0002
Pao2(mm hg)	38-113	75.66	8.42	75.89	8.98	66.02	16.26	<0.0003
Serum Calcium(mg/dl)	0.39-2.1	1.54	0.51	1.01	0.41	0.82	0.38	<0.0001
Serum Albumin(mg/dl)	1.42-4.4	3.56	0.46	3.12	0.51	2.9	0.51	<0.0001

Table 2: Distribution of patients according to USG findings.

USG Finding	Mild		Moderate		Severe		P-Value
	No. of Patients	Percentage	No. of Patients	Percentage	No. of Patients	Percentage	
Single stone	17	14.91	9	7.89	2	1.75	0.001
Multiple Stones	25	21.93	28	24.56	33	28.95	
Total	42	36.84	37	32.46	35	30.70	

Table 3: Correlation of GCS Severity with procalcitonin and CRP.

Parameter	GCS Non-Severe (n=50)		GCS Severe (n=64)		P-Value
	Mean	SD	Mean	SD	
Procalcitonin	0.36	0.12	2.74	1.43	<0.0001
C-Reactive Protein	65.22	42.1	284.52	103.24	<0.0001

Table 4: Correlation of GCS Severity with USG Parameter.

USG Parameter	GCS Non-Severe		GCS Severe		P-Value
	No. of Patients	Percentage	No. of Patients	Percentage	
Single stone	20	17.54	8	7.02	0.0007
Multiple stones	30	26.32	56	49.12	
Total	50	43.86	64	56.14	

Table 5: Distribution of patients according to CRP.

	CRP
Area	0.98
Cutoff	88.02
P-Value	0.0001
95% confidence interval	0.961-0.998
Sensitivity	95.80%
Specificity	81%

DISCUSSION

Acute pancreatitis is a multifactorial condition characterized by inflammation and injury to pancreatic tissue, often leading to complications such as systemic inflammatory response syndrome (SIRS), multiple organ failure, and high mortality rates. The condition frequently necessitates hospitalization, presenting significant challenges for clinicians in predicting its severity and outcomes. Accurate early diagnosis and ongoing monitoring are paramount in preventing complications and guiding treatment strategies. Various clinical and biochemical scoring systems, along with imaging techniques and biomarkers, are employed to evaluate disease severity and prognosis. Ideally, these prognostic methods should be cost-effective, straightforward, and reliable.

In this study, we aimed to evaluate the clinical utility of procalcitonin (PCT) and C-reactive protein (CRP) as biomarkers for assessing the severity of acute gallstone-induced pancreatitis. We included a total of 114 patients, analyzing their clinical presentations, laboratory parameters, and imaging findings to establish the correlation between these biomarkers and the severity of the disease.

Ultrasound findings revealed significant variations based on the severity of pancreatitis.[7] A higher incidence of multiple findings was observed in severe cases, highlighting the utility of imaging in assessing the extent of pancreatic involvement. While trans-abdominal ultrasonography has limitations in detecting pancreatic necrosis, advancements such as contrast-enhanced ultrasonography and endoscopic ultrasonography (EUS) have shown promise in evaluating pancreatic conditions. EUS, in particular, may enhance diagnostic accuracy for biliary acute pancreatitis, although its superiority over computed tomography (CT) remains unconfirmed.[8]

The analysis of CRP levels demonstrated a clear correlation with disease severity. Mean CRP levels increased significantly from 56.21 mg/L in mild cases to 328.55 mg/L in severe cases. The area under the curve (AUC) for CRP was found to be 0.98, indicating excellent diagnostic capability. This aligns with existing literature suggesting that elevated CRP levels are associated with poor outcomes in acute pancreatitis. Notably, CRP levels that exceed specific thresholds, such as 300 mg/L, have been shown to predict severe acute pancreatitis with high sensitivity and specificity.

Similarly, our findings regarding procalcitonin levels highlight its potential as a reliable biomarker. Mean PCT levels rose from 0.35 ng/mL in mild cases to 3.31 ng/mL in severe cases. The AUC for PCT was 0.954, underscoring its strong discriminative ability. PCT has emerged as a crucial marker for systemic inflammation and sepsis, making it particularly

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relevant in the context of acute pancreatitis, where secondary infections may complicate the clinical picture. Previous studies corroborate our findings, establishing a significant association between elevated PCT levels and the presence and severity of infection in pancreatitis patients.

CONCLUSION

Procalcitonin and C-reactive protein serve as valuable biomarkers for assessing the severity of acute gallstone-induced pancreatitis. Their levels correlate significantly with clinical outcomes, making them instrumental in guiding management decisions and improving patient prognoses. Future research should focus on further elucidating the role of these biomarkers in clinical practice, including their potential to inform treatment strategies and improve patient outcomes in acute pancreatitis. In summary, both procalcitonin and C-reactive protein serve as valuable biomarkers for assessing the severity of acute gallstone-induced pancreatitis. Future research should focus on further elucidating the role of these biomarkers in clinical practice, including their potential to inform treatment strategies and improve patient outcomes in acute pancreatitis. Despite its strengths, including detailed patient characterization and robust statistical analysis, our study is limited by its cross-sectional design, relatively small sample size, short duration of monitoring, and potential geographical biases. Thus, future longitudinal studies with larger cohorts and extended follow-up periods are warranted to validate these findings and further refine our understanding of the disease dynamics and management strategies.

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