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Correlation Between Serum Amylase Levels and Pancreatic Necrosis on Contrast CT in Acute Pancreatitis

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ABSTRACT
Acute pancreatitis is a heterogeneous inflammatory condition in which early identification of patients at risk for pancreatic necrosis remains a major clinical challenge. While serum amylase is widely used for diagnosis, its prognostic relevance for disease severity is uncertain. This prospective observational T2 translational study evaluated whether early biochemical parameters, including serum amylase, can be translated into clinically useful predictors of imaging-defined pancreatic necrosis to support risk-adapted clinical decision-making prior to contrast-enhanced computed tomography (CECT). Adult patients diagnosed with acute pancreatitis according to the Revised Atlanta Classification were enrolled prospectively at presentation. Serum amylase was measured at admission using a standardized enzymatic colorimetric assay. Additional routinely available biochemical markers—serum lipase, C-reactive protein (CRP), blood urea nitrogen (BUN), serum calcium, and hematocrit—were assessed to reflect systemic inflammatory burden and disease severity. CECT of the abdomen was performed after 72 hours of symptom onset in accordance with international guidelines. Pancreatic necrosis was evaluated using the modified CT severity index (MCTSI). Correlation and regression analyses were performed to examine associations between early biochemical parameters and imaging-defined pancreatic necrosis. Although serum amylase levels were significantly elevated at presentation, they demonstrated poor correlation with the presence or extent of pancreatic necrosis on CECT. In contrast, inflammatory and metabolic markers—particularly CRP, BUN, and serum calcium—showed stronger associations with radiological severity and necrosis. Multivariable analysis confirmed that serum amylase was not an independent predictor of pancreatic necrosis. Serum amylase remains a diagnostic marker for acute pancreatitis but has limited prognostic utility for predicting pancreatic necrosis. A translational approach integrating early biochemical markers with imaging outcomes may improve early risk stratification, optimize CT timing, and support patient-centered management strategies, particularly in resource-limited clinical settings.
Keywords: *Acute pancreatitis; Serum amylase; Pancreatic necrosis; Contrast-enhanced CT; T2 translational research*

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INTRODUCTION

Acute pancreatitis (AP) is an inflammatory disorder with a highly variable clinical course, ranging from mild, self-limiting disease to severe necrotizing pancreatitis associated with significant morbidity and mortality. [1] Early identification of patients at risk for pancreatic necrosis is crucial, as necrosis is a major determinant of complications, need for intensive care, and mortality.[2-4]

Serum amylase has long been used as a primary biochemical marker for the diagnosis of acute pancreatitis. However, increasing evidence suggests that the magnitude of amylase elevation does not reliably reflect disease severity or predict local complications such as pancreatic necrosis. Despite this, serum amylase continues to be measured routinely at presentation, and its potential role in early prognostication remains a subject of clinical interest[5-7].

Contrast-enhanced computed tomography (CECT) is the reference standard for detecting pancreatic necrosis, but international guidelines recommend delaying imaging until at least 72 hours after symptom onset to allow necrosis to evolve and to avoid unnecessary contrast exposure. This creates a critical early window in which clinicians must rely on clinical assessment and biochemical markers to stratify risk and guide management decisions, including the timing and necessity of CT imaging.[8]
In this context, translational research bridging early biochemical findings and imaging-defined outcomes is essential. This T2 translational study was designed to evaluate whether serum amylase and other routinely available biochemical markers at presentation correlate with pancreatic necrosis on CECT, and whether such markers can inform early risk stratification and clinical decision-making prior to imaging.

MATERIAL AND METHODS

Study Design and Translational Framework

This study was conducted at Department of Medicine, AIMC / Jinnah Hospital from 2023 to 2025 clinical biomarker study. The translational objective was to evaluate whether routinely available biochemical parameters obtained at presentation could be translated into clinically meaningful predictors of imaging-defined pancreatic necrosis in acute pancreatitis. The focus was on informing early risk-adapted clinical decision-making, particularly regarding the timing and utilization of contrast-enhanced computed tomography (CECT).

Study Setting and Duration

The study was carried out at a tertiary care teaching hospital over a defined study period. Ethical approval was obtained from the institutional review board, and written informed consent was obtained from all participants prior to enrollment.

Study Population

Inclusion Criteria

- Adults aged ≥18 years
- Diagnosis of acute pancreatitis based on the Revised Atlanta Classification, requiring at least two of the following:
    - Characteristic abdominal pain
    - Serum amylase and/or lipase ≥3 times the upper limit of normal
    - Imaging findings consistent with acute pancreatitis

Exclusion Criteria

- Chronic pancreatitis
- Known pancreatic malignancy
- Previous pancreatic surgery
- Pregnancy
- End-stage renal disease on dialysis
- Incomplete biochemical or imaging data

Clinical and Biochemical Assessment

Baseline demographic and clinical data were recorded at admission. Venous blood samples were obtained within 24 hours of presentation as part of routine clinical care.

Biochemical Parameters

- Serum amylase (enzymatic colorimetric assay; IU/L)
- Serum lipase
- C-reactive protein (CRP)
- Blood urea nitrogen (BUN)
- Serum calcium
- Hematocrit

All laboratory analyses were performed in the hospital's central laboratory using standardized automated methods.

Translational Risk Stratification (Pre-Imaging)

For translational analysis, patients were analytically risk-stratified at admission into low-, intermediate-, and high-risk categories based on early biochemical markers associated with systemic inflammation and disease severity (e.g., elevated CRP, elevated BUN, low serum calcium, elevated hematocrit). This stratification was used to assess the ability of early biochemical data to predict imaging-defined pancreatic necrosis prior to CECT. Clinical management decisions remained at the discretion of the treating physicians.

Imaging Protocol

CECT of the abdomen was performed after 72 hours of symptom onset in accordance with international guidelines. Imaging was interpreted by experienced radiologists blinded to biochemical results.

Imaging Assessment

- Pancreatic necrosis was assessed using the Modified CT Severity Index (MCTSI)
- Presence and extent of necrosis were documented

Outcome Measures

Primary Outcome

- Presence and extent of pancreatic necrosis on CECT

Secondary Translational Outcomes

- Association between early biochemical parameters and imaging-defined disease severity
- Ability of early biochemical markers to predict pancreatic necrosis prior to imaging
- Potential utility of biochemical risk stratification to inform CT timing and utilization

Statistical Analysis

Statistical analysis was performed using standard statistical software. Continuous variables were expressed as mean ± standard deviation or median with interquartile range, as appropriate. Categorical variables were expressed as frequencies and percentages.

- Correlation analyses (Pearson or Spearman) assessed relationships between biochemical parameters and imaging findings
- Multivariable logistic regression identified independent predictors of pancreatic necrosis
- Receiver operating characteristic (ROC) curve analysis evaluated predictive performance

A p-value <0.05 was considered statistically significant.

RESULTS

Patient Characteristics

A total of 120 patients with acute pancreatitis were included. The mean age was 48.6 ± 13.2 years, with a male predominance. The most common etiologies were gallstone-related and alcohol-induced pancreatitis.

Serum Amylase and Pancreatic Necrosis

Serum amylase levels at admission were markedly elevated across the cohort. However, no significant correlation was observed between serum amylase levels and the presence or extent of pancreatic necrosis on CECT ($r = 0.12$, $p = 0.18$). Patients with necrotizing pancreatitis did not demonstrate significantly higher amylase levels than those with interstitial pancreatitis.

Other Biochemical Markers and Imaging Severity

In contrast, CRP, BUN, low serum calcium, and elevated hematocrit showed significant associations with pancreatic necrosis and higher MCTSI scores. CRP demonstrated the strongest correlation with necrosis extent ($r = 0.54$, $p < 0.001$).

Multivariable Analysis

On multivariable regression analysis, serum amylase was not an independent predictor of pancreatic necrosis. Elevated CRP, elevated BUN, and hypocalcemia remained independently associated with necrotizing disease.

Translational Risk Stratification

Analytical risk stratification based on early biochemical markers identified a high-risk subgroup with a significantly higher incidence of pancreatic necrosis on subsequent CECT. This supports the potential role of early biochemical integration in guiding CT timing and clinical surveillance.

Table 1. Baseline Demographic and Clinical Characteristics of Study Population (n = 120)

Variable	Value
Age (years), mean ± SD	48.6 ± 13.2
Male gender, n (%)	74 (61.7)
Etiology of acute pancreatitis	
— Gallstone-related, n (%)	52 (43.3)
— Alcohol-induced, n (%)	38 (31.7)
— Idiopathic, n (%)	30 (25.0)
Time to presentation (hours), median (IQR)	18 (12–26)
Necrotizing pancreatitis on CECT, n (%)	34 (28.3)
Interstitial pancreatitis, n (%)	86 (71.7)

The study cohort consisted predominantly of middle-aged adults with a male preponderance. Approximately one-third of patients developed necrotizing pancreatitis on contrast-enhanced CT, allowing meaningful comparison between necrotizing and non-necrotizing disease phenotypes.

Table 2. Admission Biochemical Parameters and Their Association with Pancreatic Necrosis

Parameter	Necrosis Present (n=34) Mean ± SD	No Necrosis (n=86) Mean ± SD	p-value
Serum amylase (IU/L)	1186 ± 410	1098 ± 392	0.18
Serum lipase (IU/L)	972 ± 360	801 ± 318	0.04
CRP (mg/L)	186 ± 54	88 ± 42	<0.001
BUN (mg/dL)	32.4 ± 9.8	19.6 ± 6.4	<0.001
Serum calcium (mg/dL)	7.6 ± 0.8	8.5 ± 0.6	<0.001
Hematocrit (%)	46.2 ± 4.8	40.9 ± 3.6	<0.001

Although serum amylase levels were markedly elevated in both groups, no statistically significant difference was observed between patients with and without pancreatic necrosis. In contrast, CRP, BUN, serum calcium, and hematocrit showed strong associations with necrotizing disease, indicating their superior prognostic relevance.

Table 3. Multivariable Logistic Regression Analysis for Predictors of Pancreatic Necrosis

Variable	Odds Ratio (OR)	95% Confidence Interval	p-value
Serum amylase	1.01	0.99–1.02	0.22
CRP (>150 mg/L)	4.86	2.12–11.14	<0.001
BUN (>25 mg/dL)	3.94	1.78–8.72	0.001
Serum calcium (<8.0 mg/dL)	3.21	1.44–7.16	0.004
Hematocrit (>44%)	2.87	1.29–6.41	0.01

On multivariable analysis, serum amylase was not an independent predictor of pancreatic necrosis. Elevated CRP, BUN, hypocalcemia, and hemoconcentration emerged as significant predictors, reinforcing the translational value of integrated biochemical risk assessment prior to imaging.

DISCUSSION

This T2 translational study demonstrates that while serum amylase is a valuable diagnostic marker for acute pancreatitis, it has limited prognostic utility for predicting pancreatic necrosis. The absence of a meaningful correlation between amylase levels and imaging-defined necrosis reinforces the concept that enzyme elevation reflects pancreatic injury but not disease severity.[9-12]

In contrast, markers reflecting systemic inflammation and metabolic derangement—such as CRP, BUN, and serum calcium—were significantly associated with necrosis and radiological severity. These findings support a translational framework in which early biochemical data are integrated with imaging outcomes rather than interpreted in isolation.[13]

Importantly, this study highlights the clinical relevance of early risk stratification prior to CECT. Given the recommended delay in CT imaging, reliance on serum amylase alone may lead to false reassurance. Integrating biochemical markers with clinical assessment may optimize CT utilization, reduce unnecessary imaging, and facilitate early escalation of care in high-risk patients.[14-15]

The findings are particularly relevant in resource-limited settings, where access to advanced imaging may be constrained and early biochemical markers can play a critical role in guiding management.

CONCLUSION

Serum amylase is primarily a diagnostic marker in acute pancreatitis and does not reliably predict pancreatic necrosis. A T2 translational approach integrating early biochemical markers with imaging-defined outcomes provides a more effective strategy for early risk stratification, informed CT timing, and patient-centered clinical decision-making.

ETHICAL APPROVAL

The study was approved by the institutional ethics committee, and all procedures were conducted in accordance with ethical standards.

INFORMED CONSENT

Written informed consent was obtained from all participants.

CONFLICT OF INTEREST

The authors declare no competing interests.

FINANCIAL DISCLOSURE
No external funding was received for this study.

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