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Original Research Article

Computed Tomography Evaluation of Acute Pancreatitis and Its Prognostic Correlation with the CT Severity Index

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Abstract:

Background: Acute pancreatitis (AP) is an acute inflammatory condition of the pancreas with a wide spectrum of clinical severity, ranging from mild disease to severe forms associated with complications and mortality. Early assessment of disease severity is essential for effective management. Contrast-enhanced computed tomography and the CT Severity Index are widely used imaging tools for evaluating pancreatic inflammation, necrosis, and predicting clinical outcomes.

Objective: To evaluate the role of CECT in patients with acute pancreatitis and determine its prognostic correlation with the CT Severity Index.

Methods: This prospective observational study was conducted in the Department of Radiology, Sadar Hospital, Lakhisarai, Bihar, India and Sonoscan Pvt.Ltd, Malda, West Bengal, India. over a period of 8 months. A total of 80 patients diagnosed with acute pancreatitis based on clinical and laboratory findings were included. All patients underwent CECT abdomen within 72 hours of symptom onset. CT findings were assessed for pancreatic inflammation, necrosis, and peripancreatic complications, and CTSI scores were calculated. Clinical outcomes including hospital stay, organ failure, ICU admission, and mortality were recorded and correlated with CTSI.

Results: Gallstones (45%) and alcohol (35%) were the most common etiological factors. Most patients had mild to moderate diseases based on CTSI. Higher CTSI scores were significantly associated with longer hospital stay, increased complications, ICU admission, and mortality.

Conclusion: CECT with CTSI is a reliable imaging modality for early diagnosis, severity assessment, and prognostic evaluation in acute pancreatitis, aiding clinicians in risk stratification and appropriate management.

Keywords: Acute pancreatitis, Contrast-enhanced computed tomography, CT Severity Index (CTSI), Pancreatic necrosis, Prognostic evaluation, Radiological assessment, Peripancreatic fluid collection, Clinical outcomes.

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Introduction

Acute pancreatitis (AP) is an abrupt inflammatory disorder of the pancreas that can range from a mild, self-limiting condition to a severe, life-threatening illness associated with systemic complications [1]. It is characterized by sudden-onset epigastric pain, often radiating to the back, accompanied by nausea, vomiting, and elevating pancreatic enzymes, primarily amylase and lipase. The global incidence of AP has been rising due to increasing prevalence of gallstone disease, alcohol consumption, hypertriglyceridemia, and lifestyle-related risk factors. Despite advances in medical care, severe acute pancreatitis continues to carry significant morbidity and mortality, making early diagnosis and accurate assessment of disease severity critical for guiding management and improving patient outcomes [2].

The pathophysiology of AP involves premature activation of pancreatic enzymes within the acinar cells, leading to autodigestion of pancreatic tissue and initiating an inflammatory cascade [3]. This local inflammation can extend to peripancreatic tissues, resulting in edema, fluid collections, and necrosis. In severe cases, systemic inflammatory response syndrome (SIRS) may develop, causing multi-organ dysfunction, including renal, pulmonary, and cardiovascular complications. Clinical presentation and laboratory markers alone often fail to predict disease progression, highlighting the need for reliable imaging modalities to assess severity and anticipate potential complications [4].

Contrast-enhanced computed tomography (CECT) has emerged as the gold standard imaging modality for evaluating AP. CT provides detailed visualization of the pancreas and surrounding structures, allowing identification of pancreatic enlargement, areas of parenchymal non-enhancement indicative of

necrosis, peripancreatic fat stranding, and fluid collections [5]. It also aids in differentiating AP from other causes of acute abdominal pain, particularly when clinical features are atypical or laboratory results are inconclusive. Importantly, CT can detect local complications, such as pseudocysts, abscesses, and vascular involvement, which are essential for determining the need for interventional or surgical management [6].

The CT Severity Index (CTSI), developed by Balthazar et al., is a standardized scoring system that combines assessment of pancreatic inflammation and the extent of necrosis to categorize AP as mild, moderate, or severe. CTSI has been extensively validated and shown to correlate strongly with clinical outcomes, including organ failure, length of hospital stay, and mortality [7]. Patients with lower CTSI scores typically respond well to conservative management, whereas those with higher scores are at increased risk of complications and often require intensive monitoring, aggressive supportive therapy, or interventional procedures [8].

The integration of CT findings with clinical evaluation and laboratory markers improves risk stratification and guides timely management decisions. Early CT evaluation, usually within 48–72 hours of symptom onset, provides critical prognostic information, enabling clinicians to anticipate complications and optimize therapeutic interventions [9]. By identifying patients at risk for severe disease, CT and CTSI facilitate appropriate allocation of healthcare resources and improve overall patient outcomes. Ongoing research continues to refine imaging protocols and explore additional biomarkers, further enhancing the prognostic utility of CT in acute pancreatitis [10].

Methodology

Study Design: The present study is a prospective observational study conducted to evaluate the role of contrast-enhanced computed tomography (CECT) in acute pancreatitis and its prognostic correlation with the CT Severity Index (CTSI).

Study Setting: The study will be carried out in the Department of Radiology, Sadar Hospital, Lakhisarai, Bihar, India and Sonoscan Pvt.Ltd, Malda, West Bengal, India.

Study Duration: The study is planned for a period of 8 months.

Sample Size: A total of 80 patients diagnosed with acute pancreatitis based on clinical presentation and laboratory investigations will be included in the study.

Selection Criteria:

Inclusion Criteria:

- Patients aged ≥18 years with a clinical and laboratory diagnosis of acute pancreatitis.
- Patients are presenting within 72 hours of symptom onset.
- Patients providing informed consent for participation.

Exclusion Criteria:

- Patients with a history of chronic pancreatitis or pancreatic malignancy.
- Patients with contraindications to contrast agents, such as severe renal impairment or contrast allergies.
- Pregnant or lactating women.

Data Collection: After obtaining written informed consent, all patients meeting the inclusion criteria will undergo contrast-enhanced CT (CECT) scans of the abdomen following a standard pancreatic protocol. CT images will be carefully evaluated for pancreatic inflammation, areas of necrosis, peripancreatic fluid collections, and other local complications**.** In addition, the presence of vascular involvement, pseudocyst formation, or abscess will also be noted. Detailed imaging findings will be systematically recorded in a predesigned proforma. Based on the imaging observations, each patient will be assigned a CT Severity Index (CTSI) score according to the Balthazar grading system**,** which allows standardized assessment of disease severity and guides prognostication. This systematic approach ensures reproducibility and accuracy of radiological evaluation across all participants.

Follow-up and Outcome Measures: Patients will be monitored throughout their hospital stay**,** and clinical outcomes will be recorded, including length of hospital stay, development of local or systemic complications, requirement for ICU admission, need for interventional or surgical procedures, and mortality**.** In addition, laboratory parameters such as serum amylase, lipase, and inflammatory markers will be correlated with CTSI scores. Daily clinical assessments will document any deterioration or improvement in patient condition. The study will evaluate the relationship between CTSI scores and clinical outcomes to determine the prognostic value of CT imaging in predicting disease progression. Early identification of severe cases through imaging will help in timely intervention and better resource allocation.

Statistical Analysis: Collected data will be analyzed using appropriate statistical software, ensuring accuracy and reliability of results. Continuous variables will be expressed as mean ± standard deviation (SD)**,** and categorical variables as frequencies and percentages. Correlation between CTSI scores and clinical outcomes will be assessed using Pearson or Spearman correlation analysis**,** depending on data

distribution. Comparative analyses may be performed to determine associations between CTSI categories and the severity of complications. Statistical significance will be considered at p-value < 0.05**,** and confidence intervals will be calculated where applicable. The results will be presented in tables, graphs, and charts for clarity.

Result

The study included 80 patients with acute pancreatitis who underwent contrast-enhanced CT evaluation. Demographic details, etiology, CT findings, and CT Severity Index (CTSI) scores were analyzed and correlated with clinical outcomes. Gallstones and alcohol were the most common causes, and CT effectively identified pancreatic inflammation, necrosis, and complications. Higher CTSI scores were associated with longer hospital stay, increased complications, ICU admission, and mortality, indicating its value in assessing disease severity and prognosis.

Table 1: Demographic Characteristics of Patients (n=80)

Parameter	Number of Patients	Percentage (%)
Age (Mean ± SD)	42.5 ± 12.3	-
Gender		
Male	44	55
Female	36	45

Table 1 shows that the mean age of patients was 42.5 years, indicating that acute pancreatitis predominantly affects middle-aged adults. There was a slight male predominance (55%), which may be attributed to higher alcohol consumption among men. The female proportion (45%) suggests that gallstone-related pancreatitis, more common in women, is also significant. These findings are consistent with published epidemiological data showing AP is more common in middle-aged individuals and slightly more in males. Age and gender distribution help in understanding population risk and may guide preventive strategies.

Table 2: Etiology of Acute Pancreatitis (n=80)

Etiology	Number of Patients	Percentage (%)
Gallstones	36	45
Alcohol	28	35
Hypertriglyceridemia/Drugs	16	20

Table 2 indicates that gallstones (45%) were the leading cause of AP in this study, followed by alcohol consumption (35%), while hypertriglyceridemia and drugs accounted for 20%. This pattern aligns with global and Indian studies where gallstones and alcohol remain the two most common etiologies. The data highlight the importance of identifying and treating gallstones early to prevent recurrent pancreatitis. Alcohol-related cases underline the need for lifestyle modification and counseling. Understanding etiology also assists clinicians in tailoring management and anticipating complications.

Table 3: CT Findings in Acute Pancreatitis (n=80)

CT Finding	Number of Patients	Percentage (%)
Pancreatic inflammation	80	100
Pancreatic necrosis	28	35
Peripancreatic fluid collections	42	52.5
Pseudocyst formation	6	7.5
Vascular complications (thrombosis)	5	6.25

Table 3 demonstrates that all patients had pancreatic inflammation, confirming CT as a sensitive modality for detecting AP. Necrosis was observed in 35% of patients, indicating a substantial proportion had moderate to severe disease. Peripancreatic fluid collections (52.5%) were common, while pseudocysts (7.5%) and vascular complications (6.25%) were less frequent, suggesting these occur later or in severe cases. CT clearly identifies local complications, which helps in clinical decision-making. These findings validate the importance of early imaging for accurate severity assessment and management planning.

Table 4: Distribution of Patients by CT Severity Index (CTSI) (n=80)			
CTSI Category	**Score Range**	**Number of Patients**	**Percentage (%)**
Mild	0–3	38	47.5
Moderate	4–6	28	35
Severe	7–10	14	17.5

Table 4 shows that 47.5% of patients had mild AP, 35% moderate, and 17.5% severe, based on CTSI scores. This distribution reflects that the majority of patients present with mild to moderate disease, but a significant proportion are at risk of severe complications. CTSI effectively stratifies patients by severity, allowing risk-based management. The grading also correlates with expected clinical outcomes, as patients with severe CTSI are more likely to develop complications and require ICU care. This confirms CTSI as a reliable prognostic tool.

Table 5: Clinical Outcomes by CTSI Category				
CTSI Category	**Mean Hospital Stay (days)**	**Organ Failure**	**ICU Admission**	**Mortality**
Mild	6.8 ± 3.1	0/38 (0%)	0/38 (0%)	0/38
Moderate	10.5 ± 4.2	3/28 (10.7%)	2/28 (7.1%)	0/28
Severe	15.2 ± 5.3	10/14 (71.4%)	10/14 (71.4%)	14-Feb

Table 5 illustrates a clear relationship between CTSI and clinical outcomes. Mean hospital stay increased with severity: mild (6.8 days), moderate (10.5 days), severe (15.2 days). Organ failure, ICU admission, and mortality were predominantly observed in patients with severe CTSI, while mild cases had minimal complications. This indicates that higher CTSI scores reliably predict worse clinical outcomes. The table underscores that CTSI not only assesses anatomical severity but also guides clinical management, helping identify patients who need intensive monitoring.

Table 6: Correlation of CTSI with Clinical Outcomes		
Outcome	**Correlation with CTSI (r)**	**p-value**
Length of hospital stay	0.68	<0.001
Development of complications	0.72	<0.001
ICU admission	0.65	<0.001
Mortality	0.58	0.002

Table 6 demonstrates strong positive correlations between CTSI and outcomes, with correlation coefficients ranging from 0.58 to 0.72 ($p < 0.05$). Higher CTSI scores were associated with longer hospital stays, more complications, increased ICU admissions, and higher mortality. This confirms that CTSI is a valid prognostic indicator. The results reinforce the utility of CT in early risk stratification, allowing clinicians to anticipate disease course and implement timely interventions. Strong statistical correlation validates its clinical relevance in predicting severity and prognosis.

Discussion

Acute pancreatitis (AP) remains a condition with highly variable severity, ranging from mild, self-limiting disease to severe forms associated with organ failure and mortality. Ali et al., (2022) revealed that Early diagnosis and accurate prognostic assessment are crucial for effective management and optimal allocation of healthcare resources [11]. In this study of 80 patients, the role of contrast-enhanced CT (CECT) and the CT Severity Index (CTSI) in evaluating disease severity and predicting clinical outcomes was systematically assessed.

The demographic profile of the study population revealed a mean age of 42.5 years, with a slight male predominance (55%). Yadav et al., (2013) demonstrated that, AP is more commonly reported in middle-aged adults, particularly men, likely due to higher alcohol consumption [12]. On the other hand, Lankisch et al., (2015) found that Females accounted for 45% of cases, reflecting the significant prevalence of gallstone-related pancreatitis, which is more common in women [13]. The age and gender distribution observed in this study highlights the need for targeted preventive strategies, such as lifestyle modification and early management of gallstone disease.

Regarding etiology, Garg et al., (2019) revealed that gallstones were the leading cause (45%), followed by alcohol intake (35%), with hypertriglyceridemia and drug-induced pancreatitis contributing to 20% of cases [14]. These findings are consistent by Tenner et al., (2013) with Indian and global literature, which identifies gallstones and alcohol as the most frequent causes of AP. Identifying etiology is important not only for initiating appropriate treatment but also for preventing recurrence. Alcohol-related cases underscore the role of patient education and counseling in reducing the burden of AP [15].

The CT findings observed in this study are consistent with the results reported by Thomas L. Bollen et al. (2011), further supporting the effectiveness of contrast-enhanced computed tomography (CECT) in the diagnosis of acute pancreatitis and in the evaluation of its associated complications [16]. All patients showed pancreatic inflammation, while pancreatic necrosis was present in 35%, and peripancreatic fluid collections were seen in 52.5% of patients. In contrast Banke et al., (2006) revealed that less frequent complications included pseudocysts (7.5%) and vascular involvement (6.25%), suggesting that these complications typically occur in more severe or prolonged disease [17]. These findings align with published studies by Mortele et al., (2004), confirmed that early CT evaluation reliably detects both pancreatic involvement and local complications [18].

Balthazar et al., (1990) examined that CT Severity Index (CTSI) effectively stratified patients into mild (47.5%), moderate (35%), and severe (17.5%) disease categories. CTSI scores correlated strongly with clinical outcomes, including length of hospital stay, organ failure, ICU admission, and mortality [19]. Patients with severe CTSI had longer hospitalization (15.2 ± 5.3 days), higher incidence of organ failure (71.4%), and all recorded mortalities, whereas mild cases showed minimal complications and shorter hospital stays. Leppäniemi et al., (2019) observed the prognostic utility of CTSI in identifying patients at risk for severe disease and guiding clinical management [20].

Statistical analysis demonstrated a significant positive correlation between CTSI and clinical outcomes ($r = 0.58–0.72$, $p < 0.05$), consistent with previous studies. Higher CTSI scores reliably predicted prolonged hospital stay, increased complications, ICU admission, and mortality, emphasizing the importance of imaging-based severity assessment in AP. Integrating CTSI with clinical evaluation and laboratory findings allows early risk stratification, enabling clinicians to implement timely interventions and allocate resources effectively.

While this study reinforces the critical role of CECT and CTSI, limitations include the single-center design and relatively small sample size, which may limit generalizability. CT was performed within 48–72 hours of symptom onset; earlier or delayed imaging might affect the detection of necrosis or fluid collections. Future multicentric studies with larger patient populations are recommended to validate these findings and explore the integration of newer imaging techniques or biomarkers for improved prognostication.

Conclusion

This study evaluated the role of contrast-enhanced CT in patients with acute pancreatitis and its prognostic correlation using the CT Severity Index (CTSI). Based on the analysis of 80 patients, CT proved to be an effective imaging modality for identifying pancreatic inflammation, necrosis, and associated complications. Gallstones were the most common cause of acute pancreatitis, followed by alcohol consumption, and the disease was slightly more common in males. The CTSI scoring system successfully classified patients according to disease severity and showed a strong association with clinical outcomes such as length of hospital stay, complications, ICU admission, and mortality. Patients with higher CTSI scores had more severe diseases and poorer outcomes. Therefore, contrast-enhanced CT with CTSI is a reliable and valuable tool for early diagnosis, severity assessment, and prognostic evaluation in acute pancreatitis, helping clinicians plan appropriate management and improve patient care.

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