



Diagnostic Performance of Ultrasonography and Contrast-Enhanced Computed Tomography in Early Phase of Acute Pancreatitis - A Comparative Imaging Study.

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Abstract

Background: Early diagnosis and severity assessment of acute pancreatitis are crucial for timely management and prevention of complications. USG (Ultrasonography) is widely available, non-invasive, and cost-effective, whereas CECT (Contrast-Enhanced Computed Tomography) provides detailed assessment of pancreatic morphology and complications. This study compared the diagnostic utility of USG and CECT in the evaluation of the early phase of acute pancreatitis. **Methods:** This institution-based observational study was conducted over one year at North Bengal Medical College and Hospital. Sixty-four patients with clinically and biochemically diagnosed acute pancreatitis within the first week of illness were included. All patients underwent both abdominal ultrasonography and CECT. Imaging findings were compared for detection of pancreatic involvement, etiology, severity, and extrapancreatic complications. Severity was assessed using the MCTSI (Modified CT Severity Index). **Results:** The study included 64 patients, of whom 75% were males. Alcohol was the most common etiology (40%), followed by gallstone disease (34%). USG visualized the pancreas in 87% of cases, whereas CECT visualized it in all patients. Direct evidence of pancreatitis was identified in 56 patients (88%) by USG and in 62 patients (97%) by CECT, demonstrating significantly superior diagnostic performance of CECT. 68% of the patients had edematous pancreatitis, and 28% had pancreatic necrosis. According to MCTSI, 49% of patients had mild, 40% moderate, and 11% severe pancreatitis. Extrapancreatic complications were present in 69% of patients. USG was significantly superior to CECT in detecting gallstones (34% vs. 6%), whereas CECT was more effective in identifying pancreatic necrosis and disease extent. **Conclusion:** CECT is more accurate than USG for diagnosing and staging early phase of acute pancreatitis and for detecting pancreatic necrosis and complications. However, USG remains an excellent initial screening modality and is superior for identifying gallstone etiology. The complementary use of both modalities facilitates comprehensive evaluation and optimal patient management.

Keywords: Early phase of Acute Pancreatitis, Ultrasonography, Contrast-Enhanced Computed Tomography, Modified CT Severity Index, Pancreatic Necrosis, Gallstone Pancreatitis.



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INTRODUCTION

The pancreas is a soft, elongated retroperitoneal organ situated transversely across the posterior abdominal wall at the level of the first and second lumbar vertebrae. It lies posterior to the stomach and anterior to major vascular structures including the aorta, inferior vena cava, splenic vein, and left adrenal gland.[1,2] Located within the anterior pararenal space, the pancreas plays a vital role in both endocrine and exocrine functions.[3]

Acute pancreatitis (AP) is an acute inflammatory condition of the pancreas characterized by variable involvement of adjacent tissues and distant organ systems, accompanied by elevated pancreatic enzyme levels in blood and/or urine.[4] Traditionally, AP was classified into mild interstitial edematous and severe necrotizing forms.[5,6] However, the revised Atlanta Classification recognizes two distinct phases of the disease: an early phase occurring within the first week and a late phase developing thereafter.[7]

The clinical presentation of acute pancreatitis ranges from a mild, self-limiting illness to a severe life-threatening condition associated with multi-organ failure and significant mortality. Approximately 75% of patients experience a benign course, whereas the remainder may develop severe complications requiring intensive management.[8] Early diagnosis and accurate assessment of disease severity are therefore crucial for optimizing treatment and improving outcomes.

The diagnosis of acute pancreatitis is based on a combination of clinical findings, biochemical markers, and imaging studies. Although clinical and laboratory parameters are essential, they may occasionally be inconclusive. Conventional radiography has limited diagnostic utility and is primarily useful for excluding other causes of acute abdomen.[9] Consequently, cross-sectional imaging has become indispensable in the evaluation of acute pancreatitis.[7,10,11]

Ultrasonography (USG) is a widely available, non-invasive, cost-effective imaging modality that can identify pancreatic inflammation and detect biliary causes such as gallstones and bile duct obstruction.[12,13] Advances in technology and operator expertise have enhanced its diagnostic capability. CECT (Contrast-Enhanced Computed Tomography), particularly multidetector CT, provides superior anatomical detail and plays a pivotal role in assessing disease extent, pancreatic necrosis, and local complications.[14,15]

AIMS AND OBJECTIVES

The present study aimed to evaluate and compare the role of USG (Ultrasonography) and contrast-enhanced computed tomography in the assessment of patients presenting with acute pancreatitis during the first week of illness. Specifically, the study sought to determine the effectiveness of ultrasonography as an initial screening modality owing to its bedside availability, non-invasive nature, cost-effectiveness, and safety profile, while assessing the utility of CT in confirming the diagnosis, differentiating interstitial edematous from necrotizing pancreatitis, and evaluating disease severity and complications. Additionally, the study compared the diagnostic performance of both imaging modalities in the early phase of acute pancreatitis and assessed complications using the MCTSI (Modified Computed Tomography Severity Index).

MATERIALS AND METHODS

Study Design

This institution-based observational study was conducted over a period of one year in the Departments of Radio-diagnosis and Surgery at North Bengal Medical College and Hospital, Darjeeling. A total of 64 patients clinically suspected of having acute pancreatitis and presenting within the early phase of the disease were included in the study. All participants underwent ultrasonography and computed tomography evaluation to assess and compare the diagnostic utility of these imaging modalities in the early detection and assessment of acute pancreatitis.

Inclusion and Exclusion Criteria

The study included male and female patients aged up to 80 years who presented with abdominal pain and were clinically suspected of having acute pancreatitis. Only patients with clinically diagnosed and laboratory-supported acute pancreatitis within the first week of illness and referred to the Department of Radiodiagnosis for imaging evaluation were enrolled. Patients who refused consent to participate, pregnant women, individuals with elevated serum creatinine levels (>1.5 mg/dL) precluding contrast-enhanced CT examination, and patients diagnosed solely on clinical suspicion without supportive biochemical evidence were excluded from the study.

Data Collection Tools

Data were collected using a structured clinical evaluation datasheet, routine biochemical investigation reports, standardized case report forms, and informed consent forms obtained from all participants prior to enrollment. Imaging assessment was performed using ultrasonography with 2–5 MHz broadband curvilinear probes on GE LOGIQ F8 and Philips HD-7 ultrasound systems, and contrast-enhanced computed tomography was conducted using a 16-slice GE OPTIMA CT scanner. These tools were utilized to obtain comprehensive clinical, laboratory, and radiological data for the evaluation of patients with acute pancreatitis.

Data Collection Procedure

After obtaining approval from the Institutional Ethics Committee, written informed consent was obtained from all participants. A total of 64 patients presenting with abdominal pain and having clinically and biochemically confirmed acute pancreatitis within the first week of illness were enrolled over a one-year period using purposive sampling. Demographic details, clinical history, comorbidities, laboratory investigations, and radiological findings were recorded using a structured case record form. All patients initially underwent transabdominal ultrasonography using GE LOGIQ F8 and Philips HD-7 ultrasound systems equipped with 2–5 MHz curvilinear transducers, followed by non-contrast and contrast-enhanced CT examination using a 16-slice GE OPTIMA CT scanner. Imaging parameters including pancreatic morphology, parenchymal changes, peripancreatic inflammation, fluid collections, vascular complications, and extrapancreatic manifestations were evaluated. Relevant laboratory investigations such as serum amylase, serum lipase, liver function tests, renal function tests, blood glucose, serum calcium, hematological parameters, and radiographic examinations were also performed. The ultrasonography and CT findings were systematically tabulated and analyzed according to the predefined statistical analysis plan.

Statistical Analysis

Data collected from 64 patients with clinically and biochemically confirmed acute pancreatitis were entered into a Microsoft Excel spreadsheet and analyzed using appropriate statistical methods. Categorical variables were expressed as frequencies and percentages. The diagnostic performances of USG and computed tomography in detecting various pancreatic and peripancreatic findings were compared using the Z-test for proportions. Parameters analyzed included visualization of the pancreas, pancreatic enlargement, heterogeneous parenchyma, peripancreatic inflammation, peripancreatic fluid collection, duct dilatation, and etiological factors. A two-sided p-value of less than 0.05 was considered statistically significant. Results were presented using tables, bar diagrams, pie charts, and percentage distributions. Statistical significance was observed for pancreatic visualization, heterogeneous parenchyma, and peripancreatic inflammation, indicating superior detection by CT compared with USG, while no significant difference was noted for peripancreatic fluid collections and duct dilatation.

RESULTS

Table 1. Demographic Characteristics of Study Population (n=64)

Variable	Frequency	Percentage (%)
Male	48	75.0
Female	16	25.0
≤20 years	2	3.1
21–30 years	26	40.6
31–40 years	16	25.0
41–50 years	10	15.6
51–60 years	8	12.5
>60 years	2	3.1

Table 1 illustrates the demographic profile of the study population. Most patients belonged to the 21–30 years age group (40.6%), followed by the 31–40 years group (25.0%). Males constituted three-fourths (75%) of the study population, indicating a marked male predominance.

Table 2. Clinical Presentation of Acute Pancreatitis

Clinical Feature	Number of Patients	Percentage (%)
Abdominal pain	60	93.8
Nausea/Vomiting	42	65.6
Fever	14	21.9
Respiratory symptoms	12	18.8
Jaundice	6	9.4

Table 2 shows the presenting symptoms among patients. Abdominal pain was the predominant symptom (93.8%), followed by nausea and vomiting (65.6%). Fever, respiratory symptoms, and jaundice were less common presentations.

Table 3. Etiological Distribution and Detection by USG and CT

Etiology	Total Cases	USG Detected	CT Detected
Alcoholism	26	20	24
Gallstones	22	22	4
Hyperlipidemia	2	2	2
Drug-induced	2	2	2
Trauma	4	2	4
Autoimmune	2	2	2
Idiopathic	6	4	6

Table 3 demonstrates the etiological spectrum of acute pancreatitis. Alcoholism (40.6%) and gallstones (34.4%) were the most common causes. Ultrasonography showed superior detection of gallstone disease, whereas CT demonstrated better detection of traumatic and idiopathic causes.

Table 4. Comparison of Pancreatic Findings Detected by USG and CT

Imaging Finding	USG n (%)	CT n (%)
Pancreatic visualization	56 (87.5)	64 (100)
Bulky pancreas	31 (48.4)	42 (65.6)
Heterogeneous parenchyma	36 (56.3)	48 (75.0)
Peripancreatic inflammation	38 (59.4)	49 (76.6)
Peripancreatic fluid collection	13 (20.3)	14 (21.9)
Duct dilatation	6 (9.4)	6 (9.4)

Table 4 compares major pancreatic imaging findings detected by ultrasonography and CT. CT demonstrated superior visualization of the pancreas and better detection of pancreatic enlargement, heterogeneous parenchyma, and peripancreatic inflammation. Detection of duct dilatation was similar for both modalities.

Table 5. Comparison of Extrapancreatic Manifestations Detected by USG and CT

Manifestation	USG	CT
Ascites	20	16
Pleural effusion	8	8
Fatty liver	38	38
Gallstones	22	4
Venous thrombosis	2	6

Table 5 summarizes the extra-pancreatic manifestations. Ultrasonography was superior in detecting gallstones, while CT was more effective in identifying venous thrombosis. Both modalities showed comparable detection rates for pleural effusion and fatty liver.

Table 6. Morphological Classification of Early Acute Pancreatitis on CT

Type	Number of Patients	Percentage (%)
Edematous pancreatitis	44	68.8
Necrotizing pancreatitis (<30% necrosis)	12	18.8
Necrotizing pancreatitis (>30% necrosis)	6	9.4

Table 6 depicts the morphological classification based on CT findings. Edematous pancreatitis constituted the majority of cases (68.8%), whereas necrotizing pancreatitis was observed in approximately one-fourth of patients.

Table 7. Distribution of Modified CT Severity Index (MCTSI) Scores

MCTSI Score	Number of Patients	Percentage (%)
2	30	48.4
4	12	19.4
6	13	21.0
8	5	8.1
10	2	3.2

Table 7 shows the distribution of MCTSI scores among patients. Nearly half of the patients had an MCTSI score of 2, indicating relatively mild disease, whereas only a small proportion had severe scores of 8 or 10.

Table 8. Severity Classification According to Modified CT Severity Index

Severity Category	Number of Patients	Percentage (%)
Mild (Score 2)	30	48.4
Moderate (Score 4–6)	25	40.3
Severe (Score 8–10)	7	11.3

Table 8 categorizes patients according to disease severity based on MCTSI. Mild pancreatitis was the most common presentation (48.4%), followed by moderate disease (40.3%), while severe pancreatitis accounted for only 11.3% of cases.



Figure 1: Ultrasonography shows bulky heterogenous pancreas in a case of early phase of acute pancreatitis

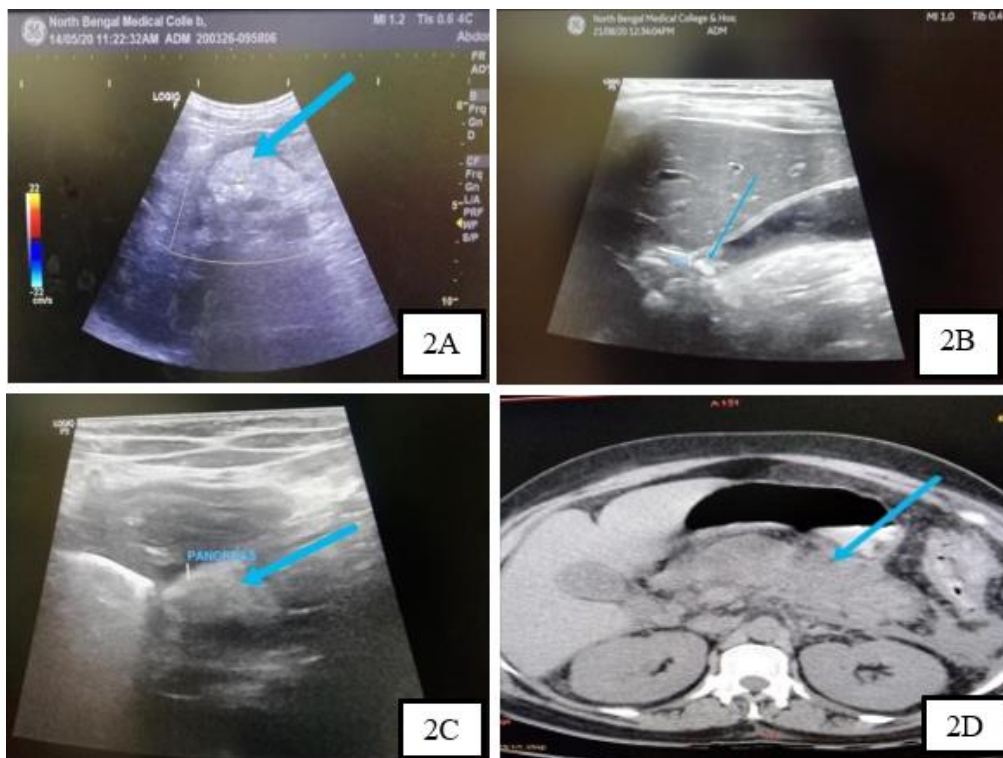


Figure 2: USG And CECT shows a case of gall stone induced early phase of acute pancreatitis

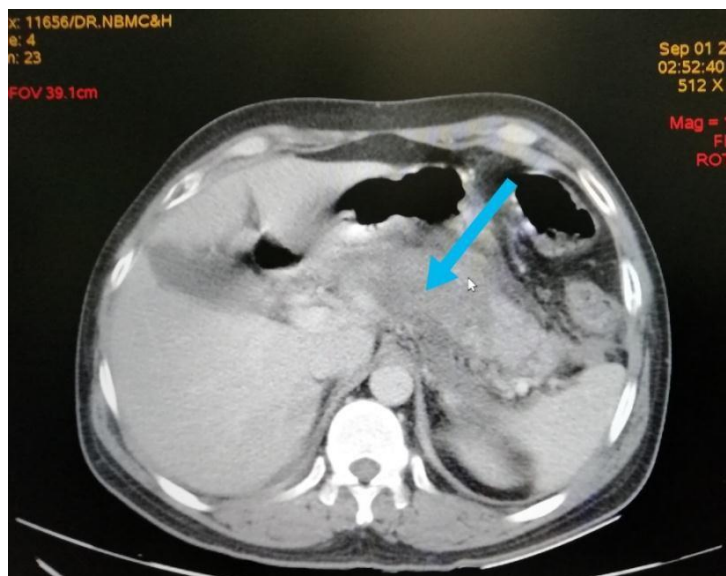


Figure 3: Axial Contrast Enhanced CT Reveals Ill Defined Inflammation Around Pancreas with A Fluid Collection in Peri Pancreatic Region. The Enhancing Pancreas is Partially Visualised in The Head and Body Region with A Focal Non-Enhancing Area Representing Necrosis

DISCUSSION

The present study included 64 patients with early-phase acute pancreatitis, of whom 75% were males and 25% were females. Most patients belonged to the 20–40 years age group, with a peak incidence in the third and fourth decades of life. These findings are comparable to those of Lankisch et al.[16] who reported the highest incidence of acute pancreatitis in patients aged 31–40 years. Similarly, Silverstein et al.[17] observed a male predominance and reported a mean age of 41 years in males and 32 years in females, which closely corresponds to the present study (38 years in males and 32 years in females).

Abdominal pain was the predominant presenting symptom (94%), followed by nausea and vomiting (66%), fever (22%), respiratory symptoms (19%), and jaundice (9%). These findings are consistent with the classical clinical presentation of acute pancreatitis reported in previous studies.

Alcohol was the leading etiological factor in the present study, accounting for 40% of cases, followed by gallstone disease in 34% of patients. Wongnai et al.[18] reported alcohol-related pancreatitis in 60% and biliary calculi in 18% of patients. Although the incidence of alcohol-induced pancreatitis was lower in our study (40% vs. 60%), the prevalence of gallstone-related pancreatitis was higher (34% vs. 18%). This variation may be attributed to regional differences in alcohol consumption patterns and biliary disease prevalence.

Ultrasonography visualized the pancreas in 87% of cases, whereas CT visualized the pancreas in all patients (100%). Calleja and Barkin[19] reported that bowel gas obscured pancreatic visualization in nearly 40% of patients undergoing ultrasonography. The higher visualization rate achieved in the present study may reflect improved equipment and operator expertise. Nevertheless, CT remained superior because of its ability to evaluate the pancreas irrespective of bowel gas interference.

Pancreatic enlargement was detected in 48% of patients by ultrasonography and 66% by CT. Jeffrey et al.[20] reported pancreatic enlargement in approximately one-third of patients with acute edematous pancreatitis. The higher detection rates observed in the present study may be related to earlier imaging and improved resolution of contemporary imaging modalities.

Contrast-enhanced CT identified edematous pancreatitis in 68% of patients and necrotizing pancreatitis in 28%. Among the latter, 19% demonstrated less than 30% necrosis and 9% demonstrated more than 30% necrosis. Bollen et al.[4] and Casas et al. reported pancreatic necrosis in approximately 18% and 15% of patients, respectively. The slightly higher incidence observed in our study may be attributable to referral bias and inclusion of more symptomatic hospitalized patients. Consistent with previous reports, CT proved invaluable in differentiating edematous from necrotizing pancreatitis and in assessing disease severity.

CT demonstrated superior detection of heterogeneous pancreatic parenchyma (75% vs. 56%) and peripancreatic inflammation (76% vs. 59%) compared with ultrasonography. Detection rates for peripancreatic fluid collections were similar between CT and USG (21% vs. 20%), while both modalities showed equal performance in identifying duct dilatation (9%). These findings further support the superior capability of CT in evaluating pancreatic morphology and inflammatory extension.

Direct imaging evidence of pancreatitis was identified in 88% of patients by ultrasonography and 97% by CT. Balthazar et al.[21] reported abnormal ultrasonographic findings in 33–90% of patients with acute pancreatitis. The diagnostic yield observed in the present study falls within this reported range. However, ultrasonography remained particularly useful for detecting cholelithiasis, whereas CT was superior for evaluating pancreatic necrosis and disease extent.

According to the MCTSI, 49% of patients had mild disease, 40% had moderate disease, and 11% had severe disease. Bollen et al.[4] reported corresponding frequencies of 44%, 38%, and 18%, respectively. Although the proportion of mild and moderate disease was similar, severe pancreatitis was less frequent in the present study (11% vs. 18%), possibly reflecting earlier diagnosis and intervention.

Extrapancreatic complications were identified in 69% of patients. Ascites was present in 31% by ultrasonography and 25% by CT, pleural effusion in 12%, fatty liver in 60%, gallstones in 34% by USG, and venous thrombosis in 9% by CT. Chishti et al.[22] reported extrapancreatic complications in 89% of patients, which is considerably higher than the 69% observed in our study. This lower incidence may be attributable to prompt diagnosis and earlier therapeutic management, limiting the progression of local and systemic complications.

The findings of the present study confirm that ultrasonography is an excellent initial screening tool, particularly for detecting gallstones and biliary pathology, whereas contrast-enhanced CT remains the gold standard for comprehensive assessment of pancreatic morphology, severity grading, necrosis detection, and evaluation of extrapancreatic complications in early-phase of acute pancreatitis.

LIMITATIONS

This study has certain limitations. Being a single-center study, the findings may not be fully generalizable to larger populations and may not be directly comparable with results from multicentric or community-based studies. The relatively small sample size further limits the representativeness of the study population. Additionally, although CECT was performed in all eligible patients, CEUS (Contrast-Enhanced Ultrasound) could not be conducted due to the non-availability of ultrasound contrast agents; therefore, a direct comparison between CEUS and CECT could not be undertaken.

CONCLUSION

Acute pancreatitis is most commonly associated with alcohol consumption and gallstone disease, with epigastric pain radiating to the back being the predominant presenting symptom. Ultrasonography serves as a rapid, non-invasive, cost-effective, and readily available initial screening modality; however, its diagnostic utility may be limited by poor pancreatic visualization and inability to adequately assess vascular complications. Contrast-enhanced CT overcomes these limitations, provides definitive diagnosis, differentiates edematous from necrotizing pancreatitis, and plays a pivotal role in disease severity assessment, management, and prognostication.

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