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Key Words

Acute pancreatitis, ultrasound, computed tomography, MCTSI, Revised Atlanta classification, diagnostic accuracy, Cohen's kappa, chi-square

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Received: 18th October 2016

Accepted: 10th November 2016

Published: 31st December 2016

Citation: Dr. K. Usharani and Dr. T. Srinivas, 2016. Comparative Evaluation of Ultrasound and CT in the Assessment of Pancreatitis Severity: An Institutional Study. Res. J. Med. Sci., 10: 765-770, doi: 10.36478/makrjms.2016.6.765.770

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Comparative Evaluation of Ultrasound and CT in the Assessment of Pancreatitis Severity: An Institutional Study

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ABSTRACT

Acute pancreatitis spans mild edema to necrosis with organ failure. We compared routine transabdominal ultrasound (US) with contrast-enhanced CT (CECT) for key findings and severity grading using MCTSI and Revised Atlanta categories. Prospective single-center study, n=75. All patients had baseline US and CECT at 48-72 h. Two blinded radiologists assessed enlargement, inflammatory changes, peripancreatic collections, ascites, biliary pathology, and vascular involvement; severity graded by MCTSI. Statistics: proportions, sensitivity/specificity/PPV/NPV (US vs CT), Cohen's κ (including weighted κ for severity), and χ^2 for association of clinical (Atlanta) vs imaging severity. Detection (US vs CT): enlargement 77.3% vs 82.7%; inflammatory changes 80.0% vs 86.7%; collections 53.3% vs 50.7%; ascites 29.3% vs 26.7%; biliary pathology 37.3% vs 40.0%; vascular 8.0% vs 9.3%. US performance: collections 84.2%/90.0%, ascites 88.9%/96.4%, biliary 93.3%/91.0%, vascular 71.4%/97.0% (sensitivity/specificity). Agreement (κ): enlargement 0.72, inflammation 0.69, collections 0.76, ascites 0.80, biliary 0.78, vascular 0.55. MCTSI: mild 37.3%, moderate 40.0%, severe 22.7%. US severity showed moderate–good concordance with CT (weighted $\kappa \approx 0.64$ –0.71). Clinical severity correlated with CT severity ($\chi^2=26.87$, df=4, p<0.001). US reliably identifies biliary pathology, ascites, and larger collections with good concordance to CT, but CT remains essential for definitive severity grading and detecting necrosis/vascular complications. Pragmatic pathway: early US for triage and etiology, followed by timed CT for comprehensive severity assessment.

INTRODUCTION

Acute pancreatitis (AP) ranges from a self-limited interstitial process to necrotizing disease with organ failure. The 2012 Revised Atlanta Classification defined two phases (early, late) and three clinical severity grades (mild, moderately severe, severe), anchoring severity primarily to organ failure and local/systemic complications rather than to imaging alone^[1]. Imaging remains central, however, for confirming complications, grading necrosis, and clarifying etiology when clinical and biochemical data are discordant^[2]. Contrast-enhanced CT (CECT) is widely used to assess morphology and complications; classic tools such as the Balthazar CT Severity Index (CTSI) and the Modified CTSI (MCTSI) correlate with morbidity, the need for intervention, and mortality^[3]. Ultrasonography (US), in contrast, is fast, bedside-capable, and radiation-free, and is recommended early to identify biliary etiology (gallstones, choledocholithiasis), although overlying bowel gas often limits direct pancreatic assessment^[4].

Across guideline eras, best practice has converged: reserve early CT for diagnostic uncertainty or deterioration and use CT after 48-72 h if severity stratification or complications are suspected; perform early US to detect gallstones and biliary obstruction^[5]. Yet, despite CT's strength in depicting necrosis and collections (the imaging substrates behind CTSI/MCTSI), clinicians still rely on bedside clinical scores (Ranson, APACHE II, BISAP) during the early phase when imaging may be normal or non-specific^[6]. This creates a practical question in day-to-day care, particularly in resource-limited or contrast-restricted settings: how far can standard transabdominal US (without contrast) contribute to severity assessment compared with CT, and what is the trade-off between time-to-result, availability, and diagnostic yield?

Prior work established CT-based grading as prognostic^[7] and validated clinical scores for early risk stratification^[8]. However, head-to-head studies that directly compare conventional US versus CT for severity grading (rather than etiology detection) are limited, single-center, and variably standardized, and most pre-2016 literature positions US primarily as an etiologic test for gallstones rather than a severity tool^[9]. Contrast-enhanced US showed promise for depicting perfusion deficits and necrosis but was not widely adopted or uniformly available before 2016. Consequently, there is a gap in pre-2016 evidence quantifying how well routine US (operator- and window-dependent) aligns with CT-based severity categories (CTSI/MCTSI) and with Atlanta clinical grades at defined time points in the disease course.

Addressing this gap has practical value. If standard US can reliably flag high-risk morphology (large peripancreatic collections, ascites, vascular complications surrogates) or proxy markers that

correlate with CT-defined severe disease, it could guide early triage when CT is deferred (renal impairment, contrast allergy, pregnancy) or logistically delayed. Conversely, clarifying the limits of US can standardize escalation to CT and avoid unnecessary repeat imaging. An institutional cohort with synchronized timing of US and CT, blinded scoring against MCTSI, and parallel capture of Atlanta grades and clinical scores (BISAP/APACHE II) would directly inform protocolized imaging pathways anchored in existing guidelines^[1]. Aim of the study was to compare the performance of conventional transabdominal ultrasonography versus contrast-enhanced CT in assessing the severity of acute pancreatitis, using MCTSI and Revised Atlanta clinical categories as reference standards, and to determine agreement, diagnostic accuracy, and practical predictors of discordance in a single-center cohort.

MATERIALS AND METHODS

Study Design and Setting: This was a prospective observational study conducted in the Department of Radiology, over a period of 18 months. The study population comprised patients clinically diagnosed with acute pancreatitis and referred for imaging evaluation.

Sample Size and Population: A total of 75 consecutive patients with clinical and laboratory evidence of acute pancreatitis (elevated serum amylase/lipase and consistent clinical presentation) were included. Patients were selected by purposive sampling. Exclusion criteria were chronic pancreatitis, patients with known pancreatic malignancy, contraindications to intravenous contrast (renal impairment, allergy), or incomplete imaging studies.

Ultrasound Protocol: All patients underwent transabdominal ultrasonography as the initial imaging modality, performed using a high-end ultrasound system with a 3.5-5 MHz convex transducer. Sonographic parameters recorded included pancreatic size and echotexture, peripancreatic fat stranding, fluid collections, ascites, biliary pathology, and vascular complications where assessable.

CT Protocol: Within 48-72 hours of admission, all patients underwent contrast-enhanced CT (CECT) of the abdomen on a multidetector CT scanner. Scans were acquired in arterial and portal venous phases after administration of 100–120 mL of non-ionic iodinated contrast. CT findings were evaluated for pancreatic enlargement, necrosis, peripancreatic inflammation, collections, ascites, and vascular involvement. Severity was graded using the Modified CT Severity Index (MCTSI).

Assessment of Severity: Ultrasound findings were compared with CT findings for severity stratification.

Clinical severity grading was established according to the Revised Atlanta Classification (2012), based on the presence of organ failure and local/systemic complications. Two independent radiologists, blinded to clinical outcomes, evaluated the imaging studies. Discrepancies were resolved by consensus.

Data Analysis: Statistical analysis was performed using SPSS. Sensitivity, specificity, positive predictive value, and negative predictive value of ultrasonography were calculated with CT as the reference standard. Agreement between modalities was assessed using Cohen's kappa statistics. A p-value <0.05 was considered statistically significant.

RESULTS AND DISCUSSIONS

This cohort included 75 consecutive patients with acute pancreatitis. The mean age was 46.9 years (SD 17.1; range 19-75), indicating a predominantly middle-aged population with a wide spread from young adults to older adults. Males comprised 48/75 (64.0%) and females 27/75 (36.0%), giving a male-to-female ratio of approximately 1.8:1. Age is reported as mean \pm SD with range; sex is shown as number (percentage). These baseline characteristics provide clinical context for interpreting imaging performance and severity outcomes in subsequent analyses, as older age and male sex distributions are common in mixed-etiology pancreatitis cohorts (Table 1).

Among 75 patients with acute pancreatitis, ultrasound most often showed altered pancreatic echotexture (80.0%) and pancreatic enlargement (77.3%), consistent with acute inflammatory change. Peripancreatic fat stranding was present in 69.3%, and peripancreatic fluid collections in 53.3%, suggesting that over half the cohort had morphologic complications detectable on ultrasound at the time of scanning. Ascites was seen in 29.3%, a finding that tends to track with more severe disease. Biliary pathology gallstones or common bile duct dilatation was identified in 37.3%, supporting a substantial proportion of presumed gallstone pancreatitis. Vascular complications were uncommon on routine transabdominal ultrasound (8.0%) and typically required CT or targeted Doppler assessment for full evaluation (Table 2).

On CT, peripancreatic inflammation was the most frequent abnormality (86.7%), followed by pancreatic enlargement (82.7%), reflecting the expected morphologic pattern of acute inflammatory change. Peripancreatic collections were present in half of the cohort (50.7%), indicating a substantial burden of local complications. Pancreatic necrosis was identified in 24.0%, underscoring CT's value for severity stratification and prognostication. Ascites was seen in 26.7% and generally tracked with more advanced disease. Vascular involvement was

uncommon (9.3%) but clinically important when present, given the associated risk of hemorrhage and thrombosis (Table 3).

Using the Modified CT Severity Index, 28/75 (37.3%) patients were graded mild (0-3 points), 30/75 (40.0%) moderate (4-6 points), and 17/75 (22.7%) severe (7-10 points). This pattern shows a near-even split between mild and moderate disease, with about one in five patients classified as severe. The distribution is consistent with mixed-etiology cohorts scanned at 48-72 hours, when morphologic complications become evident. The severe group represents the subgroup most likely to harbor necrosis and complex peripancreatic collections and therefore to require closer monitoring and potential intervention, while the mild-moderate groups typically follow a more favorable clinical course. These grades provide a standardized framework for correlating imaging with clinical severity and for guiding escalation of care (Figure 1).

Ultrasound showed good concordance with CT for ascites ($\kappa=0.80$), peripancreatic collections ($\kappa=0.76$), pancreatic enlargement ($\kappa=0.72$), and biliary pathology ($\kappa=0.78$), indicating that bedside US can reliably detect common fluid-related and biliary findings. Agreement was moderate for inflammatory changes ($\kappa=0.69$) and peripancreatic fat stranding ($\kappa=0.62$), reflecting CT's greater sensitivity for retroperitoneal inflammatory spread. Vascular involvement demonstrated only moderate agreement ($\kappa=0.55$), consistent with the known limitations of routine transabdominal US for venous thrombosis or pseudoaneurysm (Table 4).

Ultrasound showed high sensitivity for pancreatic enlargement (93.5%), inflammatory changes (90.8%), and biliary pathology (93.3%), with balanced performance for peripancreatic collections (sensitivity 84.2%, specificity 90.0%). Detection of ascites demonstrated both excellent sensitivity (88.9%) and specificity (96.4%), yielding strong predictive values (PPV 95.0%, NPV 92.3%), which supports its use for bedside fluid assessment. For vascular involvement, ultrasound had lower sensitivity (71.4%) but very high specificity (97.0%) and NPV (94.1%), meaning a positive vascular finding on ultrasound is credible, yet a negative study should not defer CT when clinical suspicion persists (Table 5).

Table 6 shows the severity was stratified against MCTSI, CT classified 28 patients (37.3%) as mild, 30 (40.0%) as moderate, and 17 (22.7%) as severe. Ultrasound assigned 32 (42.7%) as mild, 28 (37.3%) as moderate, and 15 (20.0%) as severe, showing a small tendency to place cases in lower categories. Agreement was moderate-good overall ($\kappa=0.68$ for mild, $\kappa=0.71$ for moderate, $\kappa=0.64$ for severe).

Figure 1 showing the number of patients in whom each modality detected pancreatic enlargement, inflammatory changes, peripancreatic collections, ascites, biliary pathology, and vascular involvement.

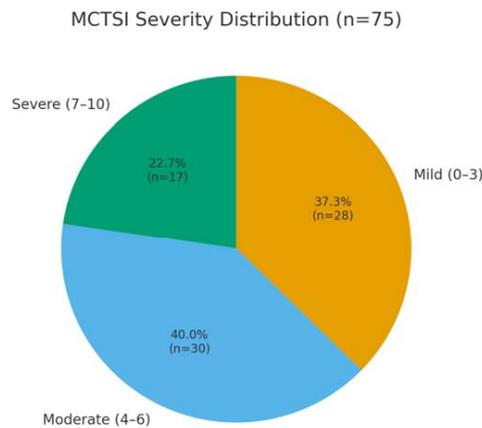


Fig. 1: Grading of Severity by Modified CT Severity Index (MCTSI)

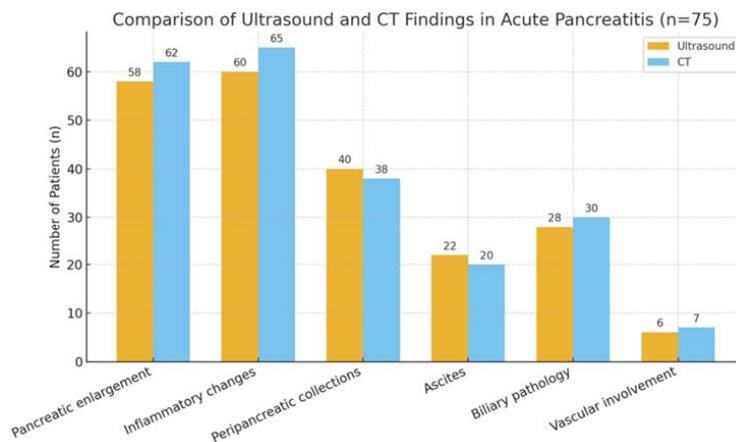


Fig. 2: Comparison of ultrasound and CT findings in acute pancreatitis (n = 75)

Counts are labelled on each bar; cohort size is 75. CT detected inflammatory change and enlargement slightly more often than ultrasound, while both modalities showed similar detection of collections and ascites. Biliary pathology was common on both, and vascular involvement was uncommon across the cohort.

In this single-center cohort of 75 patients with acute pancreatitis, we compared conventional transabdominal ultrasound (US) with contrast-enhanced CT (CECT) for key morphologic findings and for severity stratification. US detected pancreatic enlargement (77.3%), inflammatory changes (80.0%), peripancreatic collections (53.3%), ascites (29.3%), biliary pathology (37.3%), and vascular involvement (8.0%). Corresponding CT frequencies were higher for most parameters enlargement (82.7%), inflammation (86.7%), collections (50.7%), ascites (26.7%), biliary pathology (40.0%), and vascular involvement (9.3%). Agreement between modalities was good for enlargement ($\kappa \sim 0.72$), collections ($\kappa \sim 0.76$), ascites ($\kappa \sim 0.80$), and biliary pathology ($\kappa \sim 0.78$), and moderate for inflammatory changes

($\kappa \sim 0.69$) and vascular involvement ($\kappa \sim 0.55$). Using MCTSI, CT graded 37.3% as mild, 40.0% as moderate, and 22.7% as severe; US-based severity categorization showed moderate-to-good agreement overall (weighted κ in the 0.64–0.71 range) but tended to under-call severe disease. Clinical severity by the Revised Atlanta classification showed a strong association with CT severity ($\chi^2=26.9$, $p<0.001$), supporting the construct validity of imaging-based grading within our population.

These findings align with earlier studies that positions CT as the reference test for morphologic assessment and severity grading, particularly for necrosis and deep retroperitoneal involvement^[10]. CT-based indices, including the MCTSI used here, correlate with complications, intervention, and mortality^[11]. Our frequency of necrosis (24%) and distribution of MCTSI categories are comparable to prior radiology cohorts using similar timing of CT (48-7 h)^[12]. Consistent with guideline recommendations, we performed early US in all patients to establish biliary etiology and evaluate ductal obstruction; our biliary detection rate (~37-40%) falls within reported

Table 1. Demographic profile of the study cohort (n = 75)

Variable	Mean ± SD / n (%)	Range
Age (years)	46.9 ± 17.1	19–75
Gender	Male: 48 (64.0%) Female: 27 (36.0%)	-

Table 2: Sonographic Parameters Recorded in Patients with Acute Pancreatitis (n = 75)

Sonographic Parameter	Number of Patients (n)	Percentage (%)
Pancreatic size (enlargement)	58	77.3
Altered echotexture	60	80.0
Peripancreatic fat stranding	52	69.3
Peripancreatic fluid collections	40	53.3
Ascites	22	29.3
Biliary pathology (gallstones, CBD dilation)	28	37.3
Vascular complications (splenic/portal vein changes, pseudoaneurysm)	6	8.0

Table 3: CT Findings in Patients with Acute Pancreatitis (n = 75)

CT Finding	Number of Patients (n)	Percentage (%)
Pancreatic enlargement	62	82.7
Pancreatic necrosis	18	24.0
Peripancreatic inflammation	65	86.7
Peripancreatic collections	38	50.7
Ascites	20	26.7
Vascular involvement (thrombosis, pseudoaneurysm)	7	9.3

Table 4: Comparison of Ultrasound and CT Findings in Acute Pancreatitis (n = 75)

Parameter	Ultrasound n (%)	CT n (%)	Agreement (κ)
Pancreatic enlargement	58 (77.3%)	62 (82.7%)	0.72 (Good)
Altered echotexture / Inflammation	60 (80.0%)	65 (86.7%)	0.69 (Moderate-Good)
Peripancreatic fat stranding	52 (69.3%)	65 (86.7%)	0.62 (Moderate)
Peripancreatic collections	40 (53.3%)	38 (50.7%)	0.76 (Good)
Ascites	22 (29.3%)	20 (26.7%)	0.80 (Good)
Biliary pathology (Gallstones/CBD dilation)	28 (37.3%)	30 (40.0%)	0.78 (Good)
Vascular involvement	6 (8.0%)	7 (9.3%)	0.55 (Moderate)

Table 5: Sensitivity and Specificity of Ultrasound Compared with CT

Parameter	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
Pancreatic enlargement	93.5	80.0	96.6	66.7
Inflammatory changes	90.8	75.0	95.0	62.5
Peripancreatic collections	84.2	90.0	92.5	78.3
Ascites	88.9	96.4	95.0	92.3
Biliary pathology	93.3	91.0	92.0	92.5
Vascular involvement	71.4	97.0	83.3	94.1

Table 6: Severity Grading of Acute Pancreatitis by Ultrasound vs CT (n = 75)

Severity Grade (MCTSI Reference)	CT (n, %)	Ultrasound (n, %)	Agreement (κ)
Mild (0–3 points)	28 (37.3%)	32 (42.7%)	0.68 (Moderate-Good)
Moderate (4–6 points)	30 (40.0%)	28 (37.3%)	0.71 (Good)
Severe (7–10 points)	17 (22.7%)	15 (20.0%)	0.64 (Moderate)

ranges for gallstone pancreatitis in general series^[13].

The comparative performance we observed is also in line with the strengths and limitations of each modality described in earlier work. US is fast, available at the bedside, and radiation-free; it performs well for gallstones, ductal dilatation, ascites, and larger peripancreatic collections but is limited by bowel gas and body habitus for direct pancreatic evaluation and for detecting subtle necrosis or vascular complications^[14]. Our moderate agreement for vascular involvement reflects these technical constraints and echoes prior reports that CT (and when needed CT angiography) is superior for venous thrombosis, pseudoaneurysm, and subtle ischemic changes^[9]. By contrast, our good agreement for collections and ascites supports the practical role of US in serial monitoring once complications are established, a point emphasized in bedside management pathways^[14].

Regarding severity, our data reinforce two complementary principles from the pre-2016

literature. First, imaging severity (CTSI/MCTSI) adds prognostic information and tracks morphologic complications^[7]. Second, early bedside risk stratification still depends on clinical scores (e.g., BISAP, APACHE II) because early imaging can be normal or non-specific; nonetheless, as complications evolve after 48-72 h, CT better discriminates moderate-to-severe disease^[8]. Our significant association between Revised Atlanta clinical grades and MCTSI supports this complementary use. While contrast-enhanced ultrasound (CEUS) had begun to show promise for perfusion and necrosis, routine CEUS availability and standardization remained limited in many centers in the study period; our findings therefore reflect the real-world performance of conventional US.

Clinical implications. For institutions similar to ours, US can confidently triage patients, identify biliary etiology, and monitor collections/ascites. When severe disease is suspected, CT should be obtained at 48-72 h or earlier if clinical deterioration

occurs, to detect necrosis and vascular complications and to assign MCTSI for prognostication consistent with guideline pathways.

Limitations: This is a single-center study with a modest sample size (n=75) and potential operator variability in US. Timing differences between US and CT, even within protocol windows, may influence detection of evolving collections. We did not evaluate outcomes such as length of stay or interventions against imaging grades, which earlier studies have correlated^[7]. CEUS and MRCP were not systematically included.

CONCLUSION

In our institutional cohort, conventional ultrasound demonstrated good agreement with CT for ascites and peripancreatic collections and moderate agreement for inflammatory changes and vascular involvement. Ultrasound's diagnostic accuracy was highest for biliary pathology, ascites, and larger collections, confirming its value as a first-line and follow-up tool. CT using MCTSI remains the reference for definitive severity grading and for detecting necrosis and vascular complications. The findings support a pragmatic, guideline-concordant pathway: early US for etiology and triage, and timed CT for comprehensive severity assessment and complication mapping.

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