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Original Research Article

Assessment of Acute Pancreatitis using Computed to Mography Severity index and Modified Computed Tomography Severity Index – An Observational Study

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Abstract:

Background: Acute pancreatitis (AP) presents with a wide clinical spectrum, from self-limiting inflammation to severe, life-threatening disease with systemic complications. Computed Tomography Severity Index (CTSI) and Modified CTSI (MCTSI) are validated imaging-based scoring systems for assessing AP severity, but their relative prognostic performance remains debated.

Objectives: To compare CTSI and MCTSI in grading the severity of AP and to correlate these with clinical outcomes, including hospital stay, interventions, infection, and organ failure.

Methods: This prospective, cross-sectional study was conducted at the Department of Radiodiagnosis, SMS Medical College, Jaipur, Rajasthan, on 76 consecutive patients with clinically suspected AP who underwent multi-detector computed tomography (MDCT). Severity was graded using CTSI and MCTSI. Clinical outcomes were recorded, and statistical analysis was performed to assess associations. Receiver Operating Characteristic (ROC) analysis compared predictive accuracy for hospital stay duration.

Results: Alcohol was the most common cause of acute pancreatitis in this study, accounting for 57.89% of cases, followed by cholelithiasis in 36.84%. Among complications, pleural effusion was observed in 53.95% of patients and ascites in 25%, while bowel wall thickening was noted in 60.53%, reflecting significant extrapancreatic involvement. Severity grading by CTSI classified 51.32% of patients as mild, 23.68% as moderate, and 25% as severe, whereas MCTSI categorized 28.95% as mild, 34.21% as moderate, and 36.84% as severe, demonstrating a higher detection rate of severe cases with the modified system. Increasing severity on both scoring systems was significantly associated with prolonged hospital stay, as well as higher rates of intervention, surgical debridement, infection, and organ failure ($p < 0.05$ for all). ROC curve analysis confirmed the superior predictive performance of MCTSI for hospital stay duration, with an AUC of 0.890 compared to 0.756 for CTSI ($p < 0.01$), indicating its greater accuracy in prognostic assessment.

Conclusion: Both CTSI and MCTSI significantly correlate with AP severity and clinical outcomes, but MCTSI provides greater prognostic accuracy due to inclusion of extrapancreatic complications. Routine use of MCTSI can improve risk stratification, guide timely interventions, and enhance patient management.

Keywords: Acute pancreatitis, Computed Tomography Severity Index, Modified CTSI, MDCT, Prognosis, ROC curve, Extrapancreatic complications.

Introduction

Acute pancreatitis (AP) ranges from a mild, self-limiting condition to a life-threatening systemic disease. Although most cases resolve with minimal intervention, approximately 15–20% develop severe complications such as necrosis, organ failure, or infection, leading to significant morbidity and mortality [1].

Contrast-enhanced computed tomography (CECT) plays a pivotal role in the diagnosis and prognostic evaluation of AP. In 1990, Balthazar and colleagues introduced the Computed Tomography Severity Index (CTSI), which combines CT grading of pancreatic inflammation (Balthazar A–E) with the extent of pancreatic necrosis—on a 10-point scale

categorized as mild (0–3), moderate (4–6), and severe (7–10) disease [2]. Multiple studies indicate that CTSI correlates better with clinical outcomes compared to traditional scoring systems like Ranson's criteria, APACHE II, and CRP levels [3]. Despite its utility, CTSI has limitations: it offers poor prediction of extrapancreatic complications and organ failure, shows significant interobserver variability, and grading necrosis beyond 30% may not improve prognostication [4].

To address these limitations, in 2004 Mortele et al. [4] developed the Modified CT Severity Index (MCTSI). This revision maintains the 10-point scoring system but reduces emphasis on extensive necrosis and explicitly adds extrapancreatic complications (e.g., vascular, gastrointestinal, pleural effusions, ascites) for a more comprehensive severity assessment [5].

Research has shown that MCTSI correlates more closely with important clinical outcomes such as length of hospital stay, development of organ failure, ICU admission, need for intervention, and mortality—often outperforming CTSI [6]. For example, studies have observed strong associations between higher MCTSI scores and increased ICU admissions, longer stays, complications, and death [7].

Although both CTSI and MCTSI are validated tools, studies directly comparing their prognostic accuracy against clinical outcome measures. A study by Sahu et al. demonstrated strong concordance between these CT-based scores and RAC severity grading, with MCTSI showing higher sensitivity for distinguishing mild from moderate/severe AP [8]. Additional prospective studies have also aimed to compare CTSI and MCTSI, finding differing categorizations but highlighting the need for outcome-correlated validation [7]. Given these contexts, there remains an unmet need for more robust evidence—particularly from observational studies—to assess how CTSI and MCTSI align with clinical outcomes such as organ failure, interventions, ICU/hospital stay duration, and mortality.

Materials and Methods

This observational, cross-sectional study was conducted in the Department of Radiodiagnosis, SMS Medical College and Attached Group of Hospitals, Jaipur, Rajasthan, after obtaining approval from the Institutional Ethics Committee. All eligible patients presenting with epigastric pain, nausea, vomiting, and suspected acute pancreatitis, who were referred for multi-detector computed tomography (MDCT) evaluation and met the inclusion criteria, were enrolled consecutively. Inclusion criteria comprised patients of any age and sex with clinical evidence of acute pancreatitis and willingness to provide informed written consent, while exclusions included chronic pancreatitis, history of pancreatic surgery, pancreatic malignancy or cysts, pregnancy, and deranged renal function tests precluding contrast use. A total of 76 patients were recruited, the sample size calculated at a 95% confidence level with 15% absolute error, based on literature estimating that 42.8% of cases would have severe acute pancreatitis according to the Modified CT Severity Index (MCTSI). Data collection continued until July 2024, followed by two months for data processing and thesis preparation. Data were recorded in a pre-tested proforma, including demographic details, vital signs, physical findings, and CT features. Imaging was performed on a GE Revolution EVO 128-slice CT scanner with a Mederton CT2 pressure injector using non-contrast and contrast-enhanced protocols (450 mAs, 120 kV, 5 mm axial slices, coronal MPR at 1.5 mm, and 3D volume rendering). Oral contrast (10–20 ml water-soluble contrast in 500–1000 ml water) and intravenous non-ionic iodinated contrast (1.5–2 ml/kg at 3–4 ml/s) were administered, with scanning from the xiphisternum to pubic symphysis and reformatted sagittal and coronal images reviewed in soft tissue window. CT severity was graded using both the original Balthazar Computed Tomography Severity Index (CTSI) and the Modified CTSI, the latter categorizing mild (0–2), moderate (4–6), and severe (8–10) disease. Statistical analysis was performed using SPSS version 29, with data transformed by recoding, counting, and cross-tabulation, and associations tested using Pearson Chi-square or Fisher's Exact Test as appropriate; a p-value <0.05 was considered statistically significant.

Results

A total of 76 patients with acute pancreatitis were evaluated in the study.

Demographic Profile: The largest proportion of patients (35.84%) were aged above 61 years, followed by those aged 41–60 years (27.63%), 21–40 years (21.05%), and 18–20 years (14.47%). The mean age of the subset with complete data (n = 44) was 42.61 ± 12.20 years. Males comprised 56.58% (n = 43) of the study population, while females accounted for 43.42% (n = 33).

Etiology: Alcohol use was the leading cause of acute pancreatitis, identified in 57.89% (n = 44) of patients, followed by cholelithiasis in 36.84% (n = 28). Post-ERCP pancreatitis and trauma were less common, each occurring in 2.63% (n = 2) of cases.

Pleural Effusion and Ascites: Pleural effusion was detected in more than half of the patients, most frequently bilateral (26.32%, n = 20), followed by left-sided (25.00%, n = 19) and right-sided (2.63%, n = 2) involvement. No effusion was seen in 46.05%

(n = 35). Ascites was present in 25.00% (n = 19) of cases, while 75.00% (n = 57) had no ascitic fluid collection.

Extra-Pancreatic and Vascular Complications: Extra-pancreatic complications were uncommon, with subcapsular collection observed in 7.89% (n = 6) and infarction in 2.63% (n = 2). No patient had hemorrhage, and 89.47% (n = 68) had no extra-pancreatic complications. Vascular complications were rare, with venous thrombosis and pseudoaneurysm formation each reported in 1.32% (n = 1). No arterial hemorrhage was detected.

Gastrointestinal Tract Involvement: Inflammatory thickening of the gastrointestinal tract wall was the most frequent associated finding, present in 60.53% (n = 46) of patients. Intramural fluid collection was not observed, and 39.47% (n = 30) showed no gastrointestinal tract involvement.

CTSI Grading and Modified CTSI: The present study, according to the original Balthazar Computed Tomography Severity Index (CTSI), 51.32% (n = 39) of patients had mild acute pancreatitis (score 0–3), 23.68% (n = 18) had moderate disease (score 4–6), and 25.00% (n = 19) had severe disease (score 7–10). In contrast, the Modified CTSI (MCTSI) classified 28.95% (n = 22) as mild, 34.21% (n = 26) as moderate, and 36.84% (n = 28) as severe. The shift toward higher severity grades with MCTSI suggests that inclusion of extrapancreatic complications in the scoring criteria results in a greater proportion of patients being categorized as having moderate or severe acute pancreatitis compared to the original CTSI.

CTSI and Modified CTSI Grading in Relation to Patient Outcomes: Table I presents the outcomes according to Conventional CT Severity Index (CTSI) grading among patients classified as mild (n=39), moderate (n=18), and severe (n=19). The mean duration of hospitalization increased progressively with severity, from 2.92 ± 1.21 days in mild cases to 6.69 ± 1.36 days in moderate cases, and 11.80 ± 5.01 days in severe cases ($p < 0.01$). The need for intervention/drainage was observed in 1 mild case, 4 moderate cases, and 6 severe cases ($p < 0.01$). Surgical debridement was required in none of the mild, 1 moderate, and 3 severe cases ($p = 0.04$). Infection occurred in 1 mild case, 1 moderate case, and 6 severe cases (31.57%) ($p = 0.01$). End organ failure was noted in 1 mild case, 1 moderate case (5.55%), and 5 severe cases (26.31%) ($p = 0.03$).

Table II outlines the outcomes according to the Modified CTSI grading for mild (n=22), moderate (n=26), and severe (n=28) categories. Similar to the conventional CTSI, the duration of hospitalization showed a significant stepwise increase, from 2.85 ± 0.73 days in mild cases to 5.50 ± 4.54 days in moderate cases, and 9.44 ± 4.46 days in severe cases ($p <0.01$). No mild cases required intervention/drainage or surgical debridement, whereas 3 moderate and 8 severe cases underwent intervention/drainage ($p < 0.01$), and 1 moderate and 5 severe cases required surgical debridement ($p < 0.01$). Infection was absent in mild cases, seen in 1 moderate case, and present in 4 severe cases (14.28%) ($p = 0.04$). End organ failure occurred in 1 moderate case (3.84%) and 4 severe cases (14.28%), with no cases in the mild group ($p = 0.04$).

ROC Analysis: The Receiver Operating Characteristic (ROC) curve analysis comparing Modified CT Severity Index (MCTSI) and Conventional CT Severity Index (CTSI) for predicting the duration of hospital stay revealed that both scoring systems possess statistically significant predictive value, albeit with differing levels of accuracy. The MCTSI demonstrated an excellent diagnostic performance, with an area under the curve (AUC) of 0.890, a standard error of 0.022, and a p-value < 0.01, indicating a strong ability to predict prolonged hospitalization. In comparison, the CTSI exhibited a lower AUC of 0.756, with a standard error of 0.057 and a p-value < 0.01, reflecting only moderate predictive capability. These findings highlight that although both indices are significant predictors of hospital stay duration in acute pancreatitis, the MCTSI provides superior accuracy and reliability, making it a more effective tool for guiding clinical decision-making.

Discussion

This cross-sectional observational study was conducted in the Department of Radiodiagnosis at SMS Medical College and Attached Group of Hospitals, Jaipur, Rajasthan, and included all patients undergoing multi-detector computed tomography (MDCT) who met predefined inclusion and exclusion criteria. Patients were enrolled after presenting with clinical features suggestive of acute pancreatitis, such as epigastric pain, nausea, and vomiting. The primary objective was to evaluate acute pancreatitis using the Computed Tomography Severity Index (CTSI) and the Modified Computed Tomography Severity Index (MCTSI), identify relevant CT features, and correlate severity grading with clinical outcomes to determine prognostic value. A sample size of 76 patients was calculated to ensure adequate statistical power.

The study demonstrated the utility of CT imaging for early detection, severity assessment, and prognosis of acute pancreatitis. By correlating CTSI and MCTSI scores with actual clinical outcomes, it was possible to determine which scoring system more accurately reflected disease progression and complications. The findings offer valuable insights for improving risk stratification, guiding management, and optimizing resource utilization.

The demographic analysis revealed a higher incidence of acute pancreatitis among elderly and middle-aged individuals, with the highest proportion (35.84%) in those over 60 years of age. The mean age was 42.61 ± 12.20 years, aligning with earlier reports that the condition is more prevalent in older age groups. A slight male predominance (56.58%) was observed, consistent with prior studies, including Kodekar et al. [9] and Sahu et al. [8] which demonstrated a higher male-to-female ratio, particularly in alcohol-related cases.

Alcohol was identified as the most common cause (57.89%), followed by cholelithiasis (36.84%). This pattern is consistent with global trends, where alcohol and gallstones account for the majority of cases, although their relative contribution varies across populations. Less common causes included post-ERCP and trauma. These findings parallel reports by Banday et al. [10], Khan et al. [11], and Kodekar et al. [9], underscoring the importance of regional epidemiology in determining preventive strategies.

Peripancreatic inflammatory changes were the most common CT finding, consistent with previous studies such as Mendez et al. Pleural effusion, predominantly bilateral, was a frequent extrapancreatic manifestation, observed in over half of the patients. Ascites was seen in 25% of cases, closely matching the incidence in prior studies by Kodekar et al. [9] and Irshad Ahmad Banday et al. [10] Less frequent but clinically significant findings included vascular complications (venous thrombosis, pseudoaneurysm) and gastrointestinal involvement, with bowel wall thickening observed in 60.53% of cases, indicating severe systemic inflammatory response.

When graded using CTSI, 51.32% of patients had mild, 23.68% moderate, and 25% severe disease. In contrast, MCTSI classified a higher proportion (36.84%) as severe, suggesting improved sensitivity in detecting overall disease burden. This trend mirrors findings from Kodekar et al. [9] and Irshad Ahmad Banday et al. [13] where MCTSI consistently shifted more patients into the severe category due to inclusion of extrapancreatic complications in its criteria.

Both CTSI and MCTSI showed a statistically significant correlation between severity grading and hospital stay duration ($P < 0.01$). Patients with mild disease had shorter stays (2.92 ± 1.21 days for CTSI; 2.85 ± 0.73 days for MCTSI), whereas severe cases required prolonged hospitalization (11.80 ± 5.01 days for CTSI; 9.44 ± 4.46 days for MCTSI). Similar correlations with need for interventions, surgical debridement, infection, and organ failure were observed, with MCTSI demonstrating slightly stronger associations. These findings align with Khan et al. [11] Irshad Ahmad Banday et al. [13] and Miko et al. [12] supporting the MCTSI as a more accurate prognostic tool.

ROC analysis confirmed the superior predictive performance of MCTSI over CTSI for hospital stay duration. MCTSI achieved an AUC of 0.890 (excellent range), compared to 0.756 for CTSI (acceptable range), with both differences statistically significant ($P < 0.01$). The enhanced accuracy of MCTSI is attributable to its incorporation of extra pancreatic complications, making it a more comprehensive measure of disease severity.

Strengths and Limitations: The strengths of this study include its prospective design, standardized imaging protocols, and detailed correlation of radiological grading with multiple clinical outcomes. However, limitations include the relatively small sample size, single-center setting, and absence of long-term follow-up, which may limit generalizability.

Conclusion

This study reinforces that while both CTSI and MCTSI are valuable tools in assessing the severity of acute pancreatitis, MCTSI offers superior predictive accuracy due to its inclusion of extra pancreatic findings. Its adoption in routine clinical practice can improve prognostic precision, guide timely interventions, and optimize patient management.

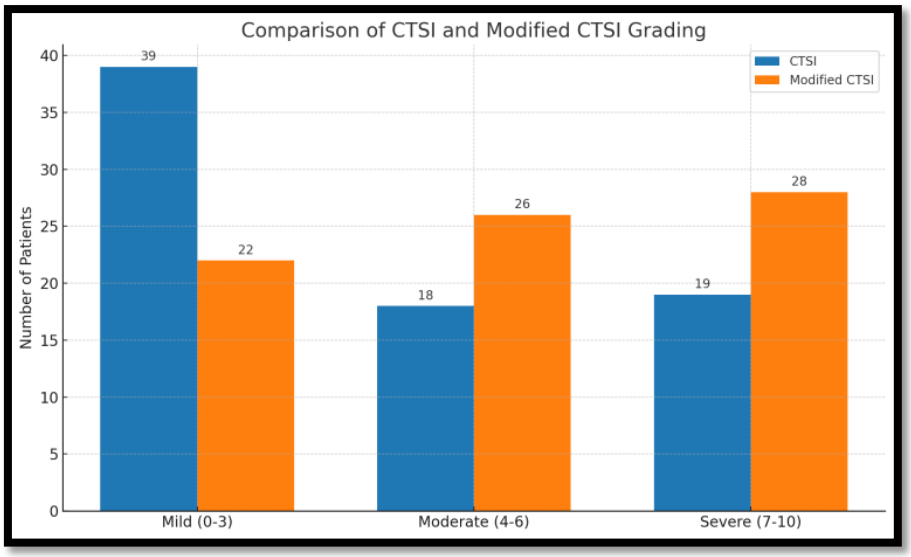

Figure 1: Graphical Distribution of Patients Based on Modified CTSI Grading

Table 1: CTSI Grading and Outcomes Table

Parameter	Mild (n=39)	Moderate (n=18)	Severe (n=19)	P value
Duration of Hospitalization (Days)	2.92 ± 1.21	6.69 ± 1.36	11.80 ± 5.01	<0.01
Intervention/Drainage (n)	1	4	6	<0.01
Surgical Debridement (n)	0	1	3	0.04
Infection (n)	1	1	6 (31.57%)	0.01
End Organ Failure (n)	1	1 (5.55%)	5 (26.31%)	0.03

Table 2: Modified CTSI Grading and Outcomes Table

Parameter / Outcome	Mild (n=22)	Moderate (n=26)	Severe (n=28)	P value
Duration of Hospitalization (Days)	2.85 ± 0.73	5.50 ± 4.54	9.44 ± 4.46	< 0.01
Intervention / Drainage	0	3	8	< 0.01
Surgical Debridement	0	1	5	< 0.01
Infection	0	1	4 (14.28%)	0.04
End Organ Failure	0	1 (3.84%)	4 (14.28%)	0.04

Table 3: The ROC curve for predicting the Duration of hospital stay–A comparison of MCTSI and CTSI

Duration of hospital stay	Area	Std. Error	P value
MCTSI severity grading	0.890	0.022	<0.01
CTSI severity grading	0.756	0.057	<0.01

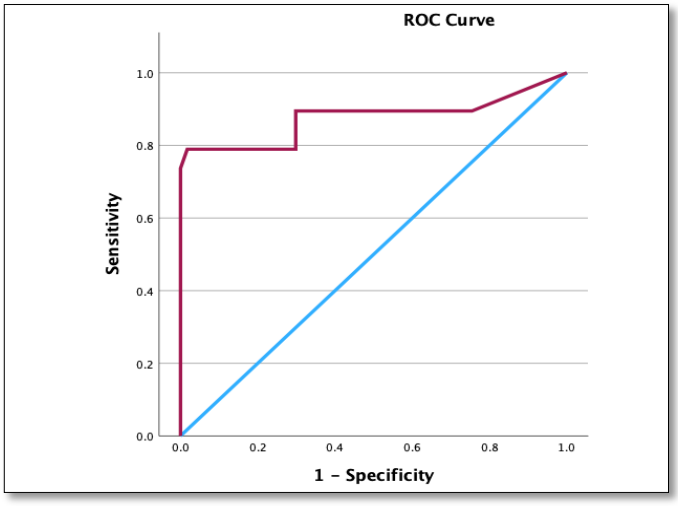

Figure 2: The ROC curve for predicting the Duration of hospital stay MCTSI

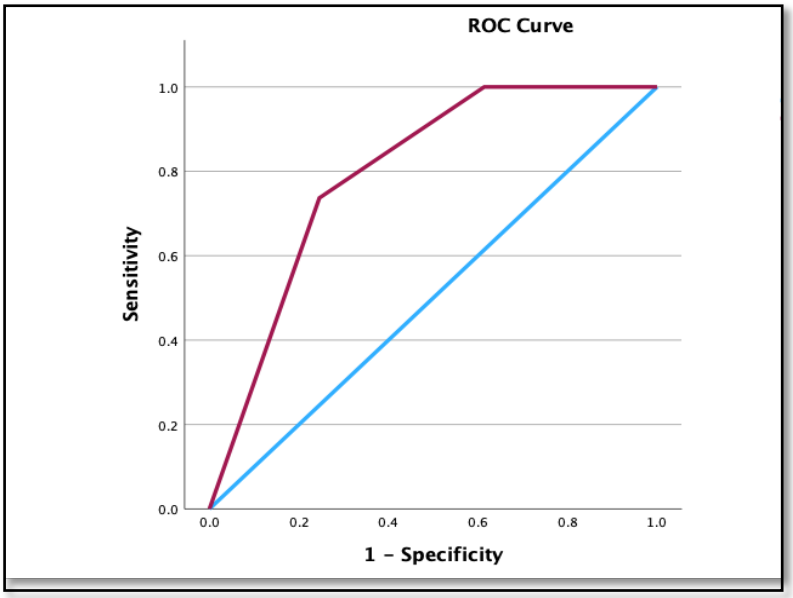

Figure 3: The ROC curve for predicting the Duration of hospital stay CTSI

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