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Original Research Article

Comparison Between Ranson Criteria And Modified Computed Tomography Severity Index In Predicting The Acute Pancreatitis

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Abstract: *Acute pancreatitis (AP) is a potentially life-threatening condition with a highly variable clinical course. Early prediction of disease severity is essential for guiding management and reducing morbidity and mortality. Various scoring systems are used for this purpose, including Ranson criteria and the Modified Computed Tomography Severity Index (MCTSI), though their comparative accuracy remains debated.* ***Objective:*** *To compare the diagnostic accuracy of Ranson criteria and MCTSI in predicting severe acute pancreatitis using the Revised Atlanta Classification as the reference standard.* ***Methods:*** *This cross-sectional validation study was conducted at the Department of Surgery, Bahawalpur Victoria Hospital, Bahawalpur, from 13 June to 13 October 2025. A total of 125 patients aged 18–80 years with a diagnosis of acute pancreatitis were included through non-probability consecutive sampling. Ranson scores were calculated at admission and after 48 hours, while MCTSI was assessed using contrast-enhanced CT within 48–72 hours. Severity was classified according to the Revised Atlanta Classification (2012). Diagnostic performance, including sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall accuracy, was calculated for both scoring systems.* ***Results:*** *The mean age of patients was 44.62 ± 13.28 years, with 62.4% males. Gallstones were the most common etiology (57.6%). According to the Revised Atlanta Classification, 18.4% patients had severe AP. Ranson criteria predicted severe disease in 23.2% patients, while MCTSI predicted 28.0%. Ranson score demonstrated sensitivity of 87.0%, specificity of 91.2%, PPV of 69.0%, NPV of 96.9%, and overall accuracy of 90.4%. MCTSI showed higher sensitivity (91.3%) but lower specificity (86.3%), with a PPV of 60.0%, an NPV of 97.8%, and an accuracy of 87.2%.* ***Conclusion:*** *Both Ranson criteria and MCTSI are reliable tools for predicting severe acute pancreatitis. MCTSI provides higher sensitivity, making it useful for early identification of severe cases, whereas the Ranson criteria demonstrate higher specificity and overall accuracy. Their combined use may improve clinical decision-making in resource-limited settings.*

Keywords: Acute Pancreatitis, Ranson Score, Computed Tomography Severity Index, Disease Severity

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Introduction

Acute pancreatitis (AP) is a common gastrointestinal emergency characterized by acute inflammation of the pancreas, with a clinical spectrum ranging from mild, self-limiting disease to severe necrotizing pancreatitis associated with organ failure and high mortality. Globally, the annual incidence of AP is approximately 34 cases per 100,000 population, with an overall mortality of 1–5% that increases significantly to 15–30% in severe cases (1). Early and accurate prediction of disease severity is essential for appropriate risk stratification, timely intensive care admission, nutritional management, and interventions to mitigate complications such as pancreatic necrosis, infected collections, and persistent organ failure, as defined by the revised Atlanta classification (2012) (2).

Several scoring systems have been developed to predict the severity and outcomes of AP. Ranson's criteria, one of the earliest and most widely used clinical scoring systems, incorporate 11 parameters evaluated at admission and after 48 hours. Its strengths include simplicity and reliance on routinely available laboratory parameters; however, it requires 48-hour data for full assessment, shows limited accuracy for local complications, and has variable performance across populations (3). In contrast, the modified Computed Tomography Severity Index (MCTSI) is an imaging-based tool that combines assessment of pancreatic inflammation, extent of necrosis, and extrapancreatic complications (such as pleural effusion, ascites, and vascular involvement) on contrast-enhanced computed tomography (CECT). MCTSI allows relatively early evaluation and demonstrates better correlation with local complications and overall clinical outcomes compared with the original CT Severity Index (4).

Comparative studies and meta-analyses have reported variable performance between these tools. Ranson's criteria often perform well in predicting systemic severity and mortality when assessed at 48 hours. In contrast, MCTSI shows superior accuracy in identifying pancreatic necrosis and local adverse events, with higher area under the receiver operating characteristic curve (AUC) values for structural complications (5,6). Systematic reviews indicate that no single scoring system is universally superior, underscoring the need for head-to-head comparisons in diverse clinical and socioeconomic settings (7).

In the Pakistani context, AP poses a significant but understudied healthcare burden. Gallstone disease remains the predominant etiology, reflecting the high prevalence of cholelithiasis in South Asia. This is compounded by limited access to timely contrast-enhanced CT imaging in many public and rural healthcare facilities due to cost, radiation exposure concerns, and infrastructural constraints. Delayed or unavailable imaging can lead to suboptimal triage and increased morbidity in resource-limited settings. Local data on severity assessment tools are scarce, underscoring the importance of validating simple, low-cost clinical scores, such as Ranson's criteria, against imaging-based tools like MCTSI. Such validation can support the development of cost-effective, context-specific protocols that optimize resource allocation, reduce unnecessary admissions, and improve patient outcomes in a population experiencing a rising incidence of AP driven by biliary and metabolic risk factors (1).

The present study, therefore, aims to compare the predictive accuracy of Ranson's criteria and the modified CT Severity Index for disease severity, local and systemic complications, and mortality in patients with acute pancreatitis in a tertiary care setting in Pakistan. The findings are expected

to address important regional evidence gaps and contribute to the development of practical, evidence-based guidelines for severity assessment in high-burden, resource-constrained environments.

Methodology

This cross-sectional validation study was conducted in the Department of Surgery, Bahawalpur Victoria Hospital, Bahawalpur, over a period of four months from 13 June 2025 to 13 October 2025, after obtaining approval from the College of Physicians and Surgeons Pakistan (CPSP) and ethical clearance from the Institutional Review Board of Quaid-e-Azam Medical College, Bahawalpur (Ref No. 2476/DME/QAMC Bahawalpur). The study aimed to compare the diagnostic accuracy of the Ranson criteria and the Modified Computed Tomography Severity Index (MCTSI) in predicting the severity of acute pancreatitis using the Revised Atlanta Classification 2012 as the gold standard.

A sample size of 125 patients was calculated using an online diagnostic accuracy sample size calculator, assuming a prevalence of acute pancreatitis of 23.4%, a sensitivity of MCTSI of 93.33%, a specificity of 54.17%, a 95% confidence interval, and a margin of error of 10%. Patients were recruited through a non-probability consecutive sampling technique. All patients aged between 18 and 80 years, of either gender, presenting for the first time with acute pancreatitis in the surgical emergency and fulfilling at least two of the diagnostic criteria—epigastric pain radiating to the back, serum amylase and/or lipase ≥3 times the upper limit of normal, or characteristic findings on abdominal imaging—were included in the study. Patients with pancreatic injury, pregnant females, and post-operative cases were excluded.

After obtaining informed consent, detailed demographic and clinical data were recorded using a structured pro forma, including age, gender, duration of symptoms at presentation, and etiology of acute pancreatitis. All patients received standard management in accordance with institutional protocols. Laboratory investigations, including complete blood count, liver function tests, blood sugar levels, lactate dehydrogenase, serum amylase, and serum lipase, were performed at admission. In contrast, additional investigations, such as serum calcium, arterial blood gases, blood urea nitrogen, and hematocrit, were repeated after 48 hours. Based on these findings, the Ranson score was calculated by the attending physician using established criteria for both gallstone-related and non-gallstone pancreatitis.

All patients underwent contrast-enhanced computed tomography within 48 to 72 hours of admission, and the Modified CT Severity Index was calculated with the assistance of a consultant radiologist, taking into account pancreatic inflammation, extent of necrosis, and presence of extra-pancreatic complications. The severity of acute pancreatitis was categorized as mild, moderate, or severe according to the Revised Atlanta Classification 2012, which served as the reference standard. For diagnostic comparison, severe acute pancreatitis was defined as persistent organ failure lasting more than 48 hours, whereas mild and moderate cases were grouped as non-severe.

Predictions of severe acute pancreatitis were recorded separately for both scoring systems, with a Ranson score ≥3 and an MCTSI score >7 considered positive for severe disease. Data were entered and analyzed using SPSS version 23. Quantitative variables such as age, symptom duration, Ranson score, and MCTSI were reported as means and standard deviations. In contrast, qualitative variables, including gender, etiology, and severity categories, were expressed as frequencies and percentages.

The diagnostic performance of the Ranson criteria and MCTSI was evaluated using 2×2 contingency tables against the Revised Atlanta Classification. Sensitivity, specificity, positive predictive value, negative predictive value, and overall diagnostic accuracy were calculated using standard formulas. Stratification was performed for potential effect modifiers such as age and gender, and post-stratification comparisons were carried out using the chi-square test, with a p-value of ≤0.05 considered statistically significant.

Results

A total of 125 patients diagnosed with acute pancreatitis were included in this study conducted at the Department of Surgery, Bahawalpur Victoria Hospital, Bahawalpur. The mean age of the patients was 44.62 ± 13.28 years. There were 78 (62.4%) males and 47 (37.6%) females, indicating a male predominance. (Table 1). The most common etiology of acute pancreatitis was gallstones, observed in 72 (57.6%) patients, followed by idiopathic causes in 31 (24.8%), alcohol in 14 (11.2%), and other causes in 8 (6.4%). The mean duration of symptoms at presentation was 2.94 ± 1.21 days. (Table 2). According to the Revised Atlanta Classification (gold standard), 64 (51.2%) patients had mild, 38 (30.4%) moderate, and 23 (18.4%) severe acute pancreatitis. (Table 3)

Table 1: Demographic Characteristics of Study Participants (n = 125)

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	Mean ± SD	44.62 ± 13.28	—
Age Groups	18–30	26	20.8%
	31–50	58	46.4%
	>50	41	32.8%
Gender	Male	78	62.4%
	Female	47	37.6%

Table 2: Etiology and Clinical Characteristics of Acute Pancreatitis (n = 125)

Variable	Category	Frequency (n)	Percentage (%)
Etiology	Gallstones	72	57.6%
	Idiopathic	31	24.8%
	Alcohol	14	11.2%
	Others	8	6.4%
Duration of Symptoms (days)	Mean ± SD	2.94 ± 1.21	—

Table 3: Severity of Acute Pancreatitis Based on Revised Atlanta Classification (n = 125)

Severity Category	Frequency (n)	Percentage (%)
Mild	64	51.2%
Moderate	38	30.4%
Severe	23	18.4%

Based on the Ranson score, 29 (23.2%) patients were predicted to be severe (score ≥3), while 96 (76.8%) were predicted to be non-severe. In comparison, MCTSI predicted 35 (28.0%) patients as severe (score >7) and 90 (72.0%) as non-severe. (Table 4)

Table 4: Severity Prediction by Ranson Score and MCTSI (n = 125)

Scoring System	Category	Frequency (n)	Percentage (%)
Ranson Score	Severe (≥3)	29	23.2%
	Non-Severe (<3)	96	76.8%
MCTSI Score	Severe (>7)	35	28.0%
	Non-Severe (<7)	90	72.0%

For diagnostic accuracy analysis, 2×2 tables were constructed comparing both scoring systems with the Revised Atlanta classification. For the Ranson score, there were 20 true positives, 9 false positives, 3 false negatives, and 93 true negatives. For MCTSI, there were 21 true positives, 14 false positives, 2 false negatives, and 88 true negatives. (Table 5 & Table 6)

Table 5: Diagnostic Accuracy of Ranson Score for Predicting Severe Acute Pancreatitis (n = 125)

Ranson Score	Severe AP (Atlanta +)	Non-Severe AP (Atlanta -)	Total
Positive (≥3)	20 (TP)	9 (FP)	29
Negative (<3)	3 (FN)	93 (TN)	96
Total	23	102	125

Table 6: Diagnostic Accuracy of MCTSI for Predicting Severe Acute Pancreatitis (n = 125)

MCTSI Score	Severe AP (Atlanta +)	Non-Severe AP (Atlanta -)	Total
Positive (>7)	21 (TP)	14 (FP)	35
Negative (<7)	2 (FN)	88 (TN)	90
Total	23	102	125

The diagnostic performance of both scoring systems showed that MCTSI had higher sensitivity (91.3%) than the Ranson score (87.0%), whereas the Ranson score had higher specificity (91.2%) than MCTSI (86.3%). The overall diagnostic accuracies were 90.4% for the Ranson score and 87.2% for the MCTSI. (Table 7)

Table 7: Diagnostic Performance of Ranson Score and MCTSI

Parameter	Ranson Score (%)	MCTSI (%)
Sensitivity	87.0%	91.3%
Specificity	91.2%	86.3%
Positive Predictive Value (PPV)	69.0%	60.0%
Negative Predictive Value (NPV)	96.9%	97.8%
Accuracy	90.4%	87.2%

Overall, both scoring systems demonstrated good diagnostic utility for predicting severe acute pancreatitis; however, MCTSI showed higher sensitivity, whereas the Ranson score exhibited better specificity, suggesting complementary roles in clinical assessment.

Discussion

The present study evaluated the diagnostic accuracy of the Ranson score. The Modified CT Severity Index (MCTSI) was used to predict severe acute pancreatitis (SAP) among 125 patients, using the Revised Atlanta Classification as the gold standard. Our findings demonstrated that both scoring systems possess good diagnostic utility, with the Ranson score achieving an overall accuracy of 90.4% (sensitivity 87.0%, specificity 91.2%) and MCTSI achieving 87.2% accuracy (sensitivity 91.3%, specificity 86.3%). These results contribute to the ongoing discourse on the optimal severity prediction tool for acute pancreatitis.

The mean age of our cohort was 44.62 ± 13.28 years with a male predominance (62.4%), which is broadly consistent with epidemiological patterns reported in the literature. Gallstones constituted the most common etiology (57.6%), followed by idiopathic causes (24.8%) and alcohol (11.2%). Hussen et al. reported a similar distribution in their Ethiopian cohort, where gallstones accounted for 28.8% and alcohol for 52.5%, though the relative proportions differed by geographic context (8). Dhar et al. similarly noted that gallstones and alcohol continue to account for the majority of acute pancreatitis cases, with gallstones being the predominant etiology in many populations (9). The severity distribution in our study—mild 51.2%, moderate 30.4%, and severe 18.4%—aligns closely with the findings of Hussen et al., who reported 52.5% mild, 30.5% moderately severe, and 17% severe AP based on the Revised Atlanta Classification (8).

The Ranson score in our study demonstrated a sensitivity of 87.0% and specificity of 91.2% for predicting SAP. He et al. reported that the sensitivity and specificity of the Ranson score for predicting moderately severe and severe AP were 73.53% and 67.65%, respectively, which are notably lower than our findings (10). Mikó et al., in their comprehensive meta-analysis of 5,988 AP cases, reported pooled sensitivity and specificity values of 0.79 and 0.78 for the Ranson score in predicting severity, with an AUC of 0.81 (11). Kumar et al. observed a sensitivity and specificity of 83% and 78%, respectively, for the Ranson score in predicting severity and organ failure (12). Qian et al., in their systematic review, reported a pooled sensitivity of only 0.61 (95% CI: 0.40–0.79) and specificity of 0.79 (95% CI: 0.57–0.92) for the Ranson score (13). The higher sensitivity observed in our study may be attributable to differences in the patient population, sample size, and the severity threshold used for classification. Luo et al. acknowledged that the Ranson score requires 48 hours to complete calculation, potentially limiting its utility for early prediction, although its accuracy remains clinically relevant (14). Silva-Vaz et al. similarly noted that the main disadvantage of the Ranson score is the requirement for 48-hour data collection, which delays clinical decision-making (15).

The MCTSI in our study achieved a sensitivity of 91.3% and specificity of 86.3%. Cucuteanu et al. reported comparable findings for mCTSI, with 98.0% sensitivity and 96.5% specificity for predicting severe AP, though their study utilized extrapancreatic necrosis volume as an additional

comparator (16). Kumar et al. found that MCTSI demonstrated the highest AUC values for predicting SAP (0.919) among several scoring systems, supporting its strong discriminatory ability (12). However, Sharma et al. reported considerably lower MCTSI values, with a sensitivity of only 50% and a specificity of 90.74% for predicting SAP in gallstone-induced pancreatitis (17). He et al. reported MCTSI sensitivity and specificity of 84.00% and 52.94%, respectively, for predicting moderately severe and severe AP (10). Sp and Raju found that MCTSI had the least sensitivity (48%) among the scoring systems evaluated in their study (18). These discrepancies highlight the variability in MCTSI performance across different study populations and underscore the importance of local validation, as emphasized by Hu et al. in their comprehensive review (19).

Our finding that MCTSI offers higher sensitivity while the Ranson score provides better specificity suggests complementary roles for these tools in clinical practice. Mikó et al. concluded that while APACHE II was the most accurate predictor of mortality, CTSI-based scores remained good predictors of both mortality and severity. When CT has been performed, these indices should be utilized more frequently (11). Liu et al. noted that the MCTSI performs well in predicting local complications but may be less reliable for overall severity, suggesting that combining scoring systems could improve predictive accuracy (20). He et al. similarly demonstrated that combining multiple parameters could enhance predictive performance beyond individual scoring systems (21). Zhao et al. emphasized that each scoring system has specific applications but also limitations, reinforcing the concept that no single tool is universally superior (22). Zhang et al. demonstrated that machine learning models incorporating MCTSI with serological indicators achieved superior predictive performance (AUC 0.907) compared to either MCTSI or Ranson score alone, further supporting the value of integrating multiple assessment tools (23).

The high negative predictive values observed for both the Ranson score (96.9%) and MCTSI (97.8%) in our study are clinically significant, as they indicate reliable exclusion of severe disease. Varshney et al. similarly found no significant difference between clinical and imaging-based scoring systems in predicting prognosis, supporting the use of either approach depending on clinical context (24). However, our study is limited by its single-center design and relatively modest sample size. Future multicenter studies with larger cohorts are warranted to validate these findings and explore the potential benefits of combining the two scoring systems to enhance clinical decision-making.

Conclusion

Both Ranson criteria and MCTSI showed good diagnostic performance in predicting severe acute pancreatitis. MCTSI was more sensitive, while the Ranson criteria were more specific and accurate overall. Using both tools together may provide a balanced, practical approach to severity assessment, particularly in settings with variable access to imaging.

Declarations

Data Availability statement
All data generated or analysed during the study are included in the manuscript.

Ethics approval and consent to participate
Approved by the department concerned. (IRBEC-BVH-03-24)

Consent for publication
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Conflict of interest

The authors declared the absence of a conflict of interest.

Author Contribution

AH (Postgraduate Resident)
Manuscript drafting, Study Design,
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Review of Literature, Data entry, Data analysis, and drafting articles.
MAA (Postgraduate Resident)
Conception of Study, Development of Research Methodology Design,

All authors reviewed the results and approved the final version of the manuscript. They are also accountable for the integrity of the study.

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