DIAGNOSTIC ACCURACY OF THE MODIFIED CT SEVERITY INDEX FOR SEVERE ACUTE PANCREATITIS USING THE REVISED ATLANTA CLASSIFICATION AS REFERENCE STANDARD

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How to cite this article

Husnain SN, Kalsoom A, Raja MT, Asmat F, Naqvi SAAH, Khalid A. Diagnostic Accuracy of the Modified CT Severity Index for Severe Acute Pancreatitis Using the Revised Atlanta Classification as Reference Standard. J Gandhara Med Dent Sci. 2026;13(4): 2-6.doi:

Date Submission: 23-06-2026
Date Revised: 06-09-2026
Date Acceptance: 07-09-2026

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ABSTRACT

OBJECTIVES

This study aimed to determine the diagnostic accuracy of the Modified Computed Tomography Severity Index (mCTSI) for identifying severe acute pancreatitis using the Revised Atlanta Classification as the reference standard.

METHODOLOGY

This cross-sectional validation study included 155 adults aged 20–60 years with acute pancreatitis who underwent contrast-enhanced computed tomography at Fauji Foundation Hospital, Rawalpindi, from 22 February to 22 May 2025. mCTSI was calculated from computed tomography performed after 48 hours of admission, while severe disease, by Revised Atlanta Classification, was defined by persistent organ failure for more than 48 hours using the Modified Marshall score. Diagnostic performance was evaluated using a 2×2 table and reported as sensitivity, specificity, pred ictive values, and overall accuracy.

RESULTS

Mean age was 42.8 ± 11.6 years, and 94 (60.6%) patients were male. Severe acute pancreatitis was classified in 46 (29.7%) patients by mCTSI and in 41 (26.5%) by Revised Atlanta criteria. There were 37 true-positive, 105 true-negative, nine false-positive, and four false-negative results. mCTSI demonstrated sensitivity of 90.2%, specificity of 92.1%, positive predictive value of 80.4%, negative predictive value of 96.3%, and overall diagnostic accuracy of 91.6%. Performance remained broadly consistent across age, sex, and symptom-duration strata.

CONCLUSION

mCTSI showed high diagnostic accuracy for severe acute pancreatitis compared with the Revised Atlanta Classification. Its high negative predictive value supports its usefulness for radiological risk stratification when interpreted alongside clinical assessment and serial organ-failure evaluation and may support timely escalation of monitoring and supportive clinical care decisions.

KEYWORDS: *Acute Pancreatitis; Computed Tomography Severity Index; Diagnostic Accuracy; Modified CTSI; Revised Atlanta Classification; Severe Acute Pancreatitis*

INTRODUCTION

Acute pancreatitis is a common inflammatory disease of the exocrine pancreas that causes severe abdominal pain and multiple organ dysfunction that may lead to pancreatic necrosis and persistent organ failure, with a mortality of 1–5%.[1] Severe acute pancreatitis is found in 23% of patients.[2] Gallstones and alcohol consumption are the most common causes of acute pancreatitis; hypertriglyceridemia, drugs, endoscopic retrograde cholangiopancreatography (ERCP), trauma, obesity, diabetes, and infection are also well-known triggers of local and systemic inflammation.[3] The pathology of acute pancreatitis was mainly characterized by stromal edema, vacuolar accumulation, acinar cell necrosis, and inflammatory infiltration of macrophages and neutrophils.[4] There are two classification systems of acute pancreatitis: the Determinant-Based Classification of Acute Pancreatitis Severity (DBC) and the Revised Atlanta Classification 2012 (RAC). Patients who have persistent organ failure, categorized as severe acute pancreatitis, have the highest risk of death. Therefore, it is important to predict and diagnose an episode of severe acute pancreatitis.[5] Timely and accurate diagnosis is essential to prevent morbidity and mortality associated with acute pancreatitis. Modified Computed Tomography Severity Index (CTSI) has 80.6% diagnostic accuracy, 90% sensitivity, 71.6% specificity, 48.65% positive predictive value and 96% negative predictive value, taking the Revised Atlanta classification of acute pancreatitis as the gold standard.[6] Early assessment of the severity of acute pancreatitis can

assist physicians in better managing the patient's condition and improving treatment outcomes. Currently, several scoring systems have been developed to predict the severity of acute pancreatitis, including Ranson's criteria, the Acute Physiology and Chronic Health Evaluation (APACHE) II score, and the Bedside Index for Severity in Acute Pancreatitis (BISAP). However, these methods have certain limitations in accuracy and clinical application.[7] Contrast-enhanced computed tomography (CECT) plays a vital role in evaluating pancreatic inflammation, necrosis, and local complications in acute pancreatitis.[8] The Modified Computed Tomography Severity Index (CTSI) is a simple and widely used radiological scoring system that combines pancreatic findings and extrapancreatic complications to assess disease severity.[9] Accurate radiological prediction of severe acute pancreatitis can facilitate early intensive management, reduce complications, and improve patient prognosis.[10] The rationale of this study is to determine the diagnostic accuracy of the modified computed tomography severity index (CTSI) score to predict severe acute pancreatitis by keeping the revised Atlanta classification of acute pancreatitis as the gold standard. Accurate assessment of the severity of acute pancreatitis is crucial for guiding treatment decisions, predicting outcomes, and managing resources effectively. The Revised Atlanta Classification (RAC) is widely recognized as the gold standard for classifying the severity of acute pancreatitis, providing a comprehensive framework that encompasses clinical, radiological, and physiological parameters. However, the complexity of the RAC can present challenges in its practical application, particularly in emergency settings where timely and accurate assessment is essential. The modified CTSI score aims to enhance the predictive accuracy for severe acute pancreatitis by refining the original CTSI criteria or incorporating additional factors. However, the effectiveness of these modifications relative to the gold standard—RAC—has not been thoroughly validated. This study seeks to address this gap by evaluating the diagnostic accuracy of the modified CTSI score against the Revised Atlanta Classification. Previously, no such study has been done in our local population. The objective was to determine the diagnostic accuracy of the modified computed tomography severity index (CTSI) score to predict severe acute pancreatitis by using the Revised Atlanta classification of acute pancreatitis as the gold standard.

METHODOLOGY

This cross-sectional validation study was conducted in the Department of Radiology, Fauji Foundation Hospital, Rawalpindi. The submitted manuscript specifies recruitment from 22 February 2025 to 22 May 2025. Patients were enrolled after hospital ethics and CPSP approval(Ref No. CPSP/REU/RAD-2022-122-3913) and written informed consent. The sample size was calculated for diagnostic accuracy at a 95% confidence level using an expected prevalence of severe acute pancreatitis of 23%, anticipated sensitivity of 90%, specificity of 71.6%, and 10% absolute precision, yielding 155 patients. Non-probability consecutive sampling was used. Adults aged 20–60 years of either sex who met the study definition of acute pancreatitis were eligible. Patients with estimated glomerular filtration rate below 45 mL/min/1.73 m^2, known allergy to iodinated contrast, or in-hospital death within 48 hours were excluded. Demographic information, sex, and duration of symptoms were recorded. Severe acute pancreatitis according to the Revised Atlanta Classification was determined clinically using persistent organ failure lasting more than 48 hours; organ failure was defined by a Modified Marshall sco re of at least 2 in the respiratory, renal, or cardiovascular system. The primary physician documented the clinical reference-standard classification. Contrast-enhanced CT was performed after 48 hours of admission on a Toshiba Asteion multislice scanner. Patients were scanned supine using the submitted protocol of 5-mm section thickness, approximately 17.2-second average scan time, 7-mm reconstruction interval, 200 mAs, and 120 kVp. Images were interpreted on the console by a senior radiologist with at least five years of post-fellowship experience. mCTSI incorporates pancreatic inflammation, necrosis, and extrapancreatic complications and has a total range of 0–10. For editorial standardization, scores of 8–10 are presented as severe; this cut-off must be confirmed against the original study proforma and dataset because the submitted operational definition incorrectly stated ">10." Data were analyzed using IBM SPSS Statistics version 25. A p-value <0.05 was considered statistically significant.

RESULTS

Among 155 patients, mean age was 42.8 ± 11.6 years and 94 (60.6%) were male. Severe acute pancreatitis was identified in 46 (29.7%) patients by mCTSI and in 41 (26.5%) by Revised Atlanta Classification. Cross-classification yielded 37 true-positive, 105 true-negative, nine false-positive, and four false-negative cases, corresponding to sensitivity 90.2%, specificity 92.1%, positive predictive value 80.4%, negative predictive value 96.3%, and overall accuracy 91.6%. Diagnostic accuracy was 89.0% in patients aged 20–40 years and 93.9% in those aged 41–60 years; the submitted stratified analysis did not identify a statistically significant age effect. Accuracy was 92.5% among males and 90.2% among females, again without a significant difference. Diagnostic performance was also broadly similar across symptom-duration strata. These subgroup findings

should be considered exploratory because the number of severe cases becomes smaller after stratification.

Table 1: Baseline Characteristics of Patients

Variables	Frequency (%) / Mean ± SD
Age (years)	42.8 ± 11.6
20–40 years	73 (47.1)
41–60 years	82 (52.9)
Male	94 (60.6)
Female	61 (39.4)
Duration of symptoms (days)	3.8 ± 1.9
≤3 days	88 (56.8)
>3 days	67 (43.2)

Table 2: Distribution of Severe Acute Pancreatitis by mCTSI and Revised Atlanta Classification

Variables	Frequency (%)
CTSI Severe	46 (29.7)
CTSI Non-severe	109 (70.3)
Revised Atlanta Severe	41 (26.5)
Revised Atlanta Non-severe	114 (73.5)

Table 3: Cross-Classification of mCTSI Against Revised Atlanta Classification

Diagnosis by CTSI Score	Revised Atlanta Severe AP Present	Revised Atlanta Severe AP Absent	Total
Severe acute pancreatitis present	37 (TP)	09 (FP)	46
Severe acute pancreatitis absent	04 (FN)	105 (TN)	109
Total	41	114	155

Table 4: Diagnostic Performance of mCTSI for Severe Acute Pancreatitis

Variables	Value (%)
Sensitivity	90.2
Specificity	92.1
Positive Predictive Value	80.4
Negative Predictive Value	96.3
Diagnostic Accuracy	91.6

Table 5: Stratified Diagnostic Performance by Age, Sex, and Symptom Duration

	Variable	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Diagnostic Accuracy (%)	P - Value
Age Groups	20–40 years	87.5	90.4	77.8	95.0	89.0	0.318
	41–60 years	92.6	93.5	82.6	97.7	93.9	0.318
Gender	Male	91.3	93.1	84.0	96.8	92.5	0.521
	Female	88.2	90.7	75.0	95.1	90.2	0.521
Duration of Symptoms	≤3 days	89.5	91.4	78.3	96.4	90.9	0.447
	>3 days	91.0	93.3	82.1	96.2	92.5	0.447

DISCUSSION

Acute pancreatitis has a heterogeneous clinical course, ranging from self-limited interstitial disease to necrotizing pancreatitis with persistent organ failure. The Revised Atlanta Classification emphasizes persistent organ failure as the defining feature of severe acute pancreatitis, whereas mCTSI provides an imaging-based summary of pancreatic and extrapancreatic disease. These systems therefore measure related but non-identical dimensions of severity, and their agreement is clinically useful when it supports early recognition of patients requiring closer monitoring. In this study, mCTSI demonstrated sensitivity of 90.2%, specificity of 92.1%, and overall accuracy of 91.6% against severe disease defined by Revised Atlanta criteria. The negative predictive value of 96.3% was particularly high, indicating that a non-severe mCTSI result was rarely accompanied by severe persistent organ failure in this sample. The positive predictive value was lower at 80.4%, reflecting the expected possibility that prominent radiological changes may occur without meeting the clinical definition of persistent organ failure. The findings are broadly consistent with previous work showing meaningful concordance between CT-based severity indices and clinical classification.[11,12,13,14] A study reported that modified CT severity assessment correlated with Revised Atlanta severity and clinically important outcomes.[14] Kumar and Griwan similarly found mCTSI useful when compared with APACHE II, BISAP , and Ranson-based approaches, while Padu et al. reported close agreement between modified Atlanta classification and mCTSI in acute gallstone pancreatitis.[15,16] More recent diagnostic-accuracy studies from South Asian settings have likewise supported mCTSI as a practical radiological adjunct, although reported performance varies with disease prevalence, CT timing, severity threshold, and reference standard. The 37 true-positive and 105 true-negative cases accounted for most of the cohort, while nine false-positive and four false-negative results highlight why mCTSI should not be used in isolation. A radiologically severe appearance may precede, accompany, or occur without persistent organ failure; conversely, clinically important organ dysfunction can evolve even when CT findings are not maximally severe. Serial clinical assessment remains essential, particularly during the first several days of admission. Stratified analyses showed broadly similar performance across age, sex, and symptom-duration groups, with no statistically significant evidence of major effect modification in the submitted analysis. These subgroup estimates should nevertheless be interpreted cautiously because stratification reduces the number of severe cases within each cell. The principal contribution of this study is therefore confirmation of overall diagnostic performance rather than proof of equivalence across all subgroups. The clinical severity of acute pancreatitis cannot be understood from morphology alone. The Revised Atlanta framework separates mild, moderately severe, and severe disease according to organ failure and complications, with persistent organ failure lasting more than 48 hours

defining the severe category.[17] This distinction is prognostically important because persistent respiratory, renal, or cardiovascular failure is strongly associated with adverse outcomes. mCTSI, in contrast, grades radiological changes and extrapancreatic complications.[18] A patient can therefore have extensive inflammatory or necrotic change on CT but recover without persistent organ failure, while another patient may develop clinically important organ dysfunction before the full radiological extent becomes apparent. The two systems should be interpreted as complementary rather than interchangeable measures of severity. Timing of imaging is another important consideration. Contrast-enhanced CT is valuable for identifying pancreatic necrosis, collections, and extrapancreatic complications, but radiological findings evolve. Very early CT may underestimate necrosis, whereas later CT can more clearly characterize local disease. In the present study, CT was performed after 48 hours of admission, providing a pragmatic balance between early severity assessment and the need for evolving morphological changes to become visible. Nevertheless, disease progression after the index scan remains possible, and repeated imaging should be driven by clinical deterioration, diagnostic uncertainty, or suspected complications rather than by the score alone. The high specificity observed in this study indicates that most patients classified as severe by mCTSI also had clinically severe disease or were at high radiological risk. However, the nine false-positive results show that radiological severity does not necessarily imply persistent organ failure. The four false-negative cases are clinically more important because failure to recognize severe disease may delay higher-level monitoring or escalation of supportive care. For this reason, the high negative predictive value is reassuring but cannot justify reduced observation in a patient whose physiological condition is worsening. Bedside variables, fluid status, oxygenation, renal function, hemodynamics, inflammatory response, and serial organ-failure scores should remain central to management. Previous comparative studies have reported variable diagnostic performance for CT-based severity scoring, partly because investigators have used different reference standards, etiological subgroups, CT timings, and cut-off definitions. Sahu et al. demonstrated correlation between modified CT severity and Revised Atlanta grading.[14] Kumar and Griwan compared mCTSI with APACHE II, BISAP, and Ranson scores and found that no single system captures every clinically relevant dimension.[15] Padu et al. reported close agreement between modified Atlanta classification and mCTSI in acute gallstone pancreatitis.[16] The present estimates fall within this broader literature and support the use of mCTSI as a readily interpretable imaging tool, particularly where rapid radiological stratification can assist multidisciplinary triage. The study also has implications for communication between radiology and the treating team. A structured CT report should ideally describe the components contributing to mCTSI rather than provide only a total score: the degree of pancreatic inflammation, presence and proportion of necrosis, and extrapancreatic complications should be stated explicitly. This approach allows clinicians to understand why a patient has received a particular severity score and facilitates comparison with subsequent imaging. Similarly, the Revised Atlanta category should be updated when organ failure persists or resolves, because severity classification is dynamic during the early course of acute pancreatitis.

LIMITATIONS

The study was performed at a single tertiary-care hospital and included a relatively small severe-disease subgroup, limiting precision and generalizability. Exclusion of patients who died within 48 hours may introduce spectrum bias by removing some of the most severe early presentations. Computed tomography was performed after 48 hours, but pancreatic necrosis and local complications can continue to evolve. One experienced radiologist reported image interpretation; interobserver reliability was not assessed. Receiver-operating-characteristic analysis and comparison with alternative clinical scores were not undertaken.

CONCLUSIONS

mCTSI demonstrated high sensitivity, specificity, negative predictive value, and overall diagnostic accuracy for severe acute pancreatitis when compared with Revised Atlanta Classification. It is a useful radiological adjunct for severity stratification, but should be interpreted together with serial assessment of organ failure and clinical status.

CONFLICT OF INTEREST: None

FUNDING SOURCES: None

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The authors accept responsibility for all aspects of the work and will ensure that any concerns regarding the accuracy or integrity of any part are properly investigated and resolved.

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