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Diagnostic Accuracy of Modified CT Severity Index in Assessing Severity of Acute Pancreatitis

Maham Zaidi, Jawaid Iqbal, Rizwan Ajmal, Qurat ul ain Haroon, Ramsha Fatima, Sadia Khursheed

ABSTRACT

Objectives: To determine the diagnostic accuracy of the Modified CT Severity Index in assessing the severity of acute pancreatitis, using the APACHE II score as the gold standard.

Study Design and Setting: This was a descriptive cross-sectional study conducted at Liaquat National Hospital, Karachi, over a period of six months from May 1, 2023, to November 30, 2023.

Methodology: A total of 68 patients aged 18–75 years, clinically and ultrasonographically diagnosed with acute pancreatitis, were included through non-probability consecutive sampling. Patients with incomplete APACHE II data or a history of trauma were excluded. MCTSI scores were calculated from contrast-enhanced CT scans and compared with APACHE II scores. Diagnostic accuracy measures, including sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall accuracy, were calculated. Data were stratified by age and gender.

Results: MCTSI demonstrated a sensitivity and specificity of 75% each when compared with APACHE II scores. In patients aged <45 years, sensitivity and specificity were 88.8% and 70.3%, respectively. In those =45 years, sensitivity was 57% and specificity was 84%. Among females, sensitivity reached 100% with a specificity of 79%, while in males, sensitivity and specificity were 69.2% and 75%, respectively. The overall diagnostic accuracy of MCTSI was 76.4%.

Conclusions: MCTSI offers a reliable and practical alternative to APACHE II for early assessment of severity in acute pancreatitis, especially when rapid imaging is available. Its simplicity and reasonable accuracy make it a valuable tool in routine clinical practice.

Keywords: Acute Kidney Injury, Acute Pancreatitis, APACHE II Score, Diagnostic Imaging, Pancreatitis Severity Score

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INTRODUCTION:

Acute pancreatitis (AP) is a common yet potentially life-threatening gastrointestinal emergency characterized by acute inflammation of the pancreas, often triggered by premature activation of pancreatic enzymes within the gland.[1] The disease presents with a sudden onset of severe epigastric pain, frequently radiating to the back, and is usually accompanied by nausea, vomiting, and elevated serum pancreatic enzymes.[2] The clinical course of AP varies widely, ranging from a mild, self-limiting condition that resolves with supportive care in approximately 70–80% of patients, to a severe form that can lead to extensive local and systemic complications.[3] These complications include pancreatic necrosis, pseudocyst formation, systemic inflammatory response syndrome (SIRS), acute respiratory distress syndrome (ARDS), multiorgan dysfunction syndrome (MODS), and even death.[4] The overall mortality rate for severe acute pancreatitis can reach up to 20–30%, particularly in cases complicated by infected necrosis or persistent organ failure.[5]

In developing countries, the most frequent etiological factors associated with AP are gallstone disease and chronic alcohol abuse.[6] The global incidence of AP ranges from 13 to 45

per 100,000 population annually, and although most patients experience a mild course, approximately 20–30% develop moderate to severe disease.[7] Therefore, a timely and accurate assessment of severity is essential to stratify patients for intensive monitoring and targeted interventions.

Numerous clinical, biochemical, and radiological scoring systems have been proposed for predicting the severity of AP.[8] These include single-parameter markers such as elevated blood urea nitrogen, hematocrit, serum creatinine, and C-reactive protein, as well as multi-parameter scoring systems such as Ranson's criteria, the Bedside Index for Severity in Acute Pancreatitis (BISAP), Systemic Inflammatory Response Syndrome (SIRS), and the Acute Physiology and Chronic Health Evaluation II (APACHE II) score.[9] Among these, the APACHE II score is widely regarded as a robust prognostic tool, as it incorporates a combination of 12 physiological parameters, patient age, and chronic health conditions.[10] It is calculated within the first 24 hours of hospital admission and has been shown to provide reliable prognostic information. However, it is time-consuming and may require data not immediately available in all clinical settings.

Despite the availability of these scoring systems, there remains no universally accepted single tool that accurately predicts severity in all clinical scenarios. Many biochemical and physiological markers are influenced by comorbidities, hydration status, and timing of measurement, limiting their reliability. Serum markers such as C-reactive protein and procalcitonin can be delayed in elevation, and scoring systems like Ranson's require data collected over 48 hours, which may delay risk stratification. Similarly, while APACHE II offers broad applicability in critical illness, its reliance on multiple inputs and complex calculations may reduce feasibility in emergency settings.[11] These limitations underscore the need for simpler, objective, and rapid tools that incorporate both clinical and imaging findings for early and accurate assessment of AP severity.

Radiological imaging, particularly contrast-enhanced computed tomography (CECT), plays a pivotal role in diagnosing AP and evaluating associated complications. The original CT Severity Index (CTSI), introduced by Balthazar et al., provided a standardized radiological grading based on pancreatic inflammation and necrosis.[12] While widely adopted, it had certain limitations, such as inter-observer variability and a lack of correlation with extrapancreatic complications.

Despite its potential, the use of MCTSI is still limited in many healthcare systems, particularly in developing countries, due to a lack of local validation studies. In contrast, APACHE II remains the gold standard for prognostic evaluation in AP, though it does not directly assess morphological changes or complications visible on imaging. Given the ease of use and visual guidance offered by CT-based scores, validating MCTSI as a reliable predictor of severity could enhance early clinical decision-making and reduce the burden of complications. Therefore, this study aimed to determine the diagnostic accuracy of the Modified CT Severity Index in assessing severe acute pancreatitis, using the APACHE II score as the reference standard.

METHODOLOGY:

This descriptive cross-sectional study was conducted at Liaquat National Hospital, Karachi, over 6 months from 1st May 2023 to 30th November 2023. The study was approved by the Ethical Review Committee of Liaquat National Hospital (ERC No: ERC/LNH/67/23; Dated: 19th March 2023). It was carried out following the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments. Written informed consent was obtained from all participants before inclusion in the study.

A total of 68 participants were enrolled following the sample size calculated using a diagnostic accuracy calculator, assuming an expected sensitivity of 80%, specificity of 75%, margin of error of 10%, and a confidence level of 95%, based on previous similar studies[12]. The sampling technique used was non-probability consecutive sampling.[13]

All patients of either gender, aged between 18 and 75 years, who were clinically diagnosed with acute pancreatitis and admitted to Liaquat National Hospital were included in the study. In addition to clinical diagnosis, patients with a confirmed diagnosis of acute pancreatitis on ultrasonography were also eligible for inclusion. Patients were excluded from the study if one or more of the twelve clinical parameters required to calculate the APACHE II score were missing from their medical records. Furthermore, individuals with a history of abdominal trauma were also excluded from participation.

The diagnosis of acute pancreatitis was made based on the revised Atlanta criteria, which requires at least two of the following three features: (i) abdominal pain consistent with acute pancreatitis, (ii) serum amylase or lipase levels at least three times the upper limit of normal, and (iii) characteristic findings of AP on imaging such as ultrasonography or CT scan[3]. Patients were excluded if one or more of the twelve parameters required to calculate the APACHE II score were missing from their medical records or if they had a history of recent abdominal trauma. After enrollment, clinical details, laboratory values, and relevant demographic data were collected from medical records on a structured proforma. The APACHE II score was calculated using standard criteria based on the worst values within the first 24 hours of admission. All patients underwent a contrast-enhanced CT scan, and the Modified CT Severity Index (MCTSI) was computed based on imaging findings, which were also recorded on the proforma.

Data were analyzed using SPSS version 19. Descriptive

statistics, including means and standard deviations, were calculated for continuous variables such as age, and frequencies and percentages were reported for categorical variables like gender and CT findings. Diagnostic accuracy measures, including sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of MCTSI, were calculated using 2x2 contingency tables, keeping APACHE II as the gold standard. Stratification was performed by age and gender, and post-stratification diagnostic values were also computed using standard formulas.

RESULTS:

A total of 68 patients were included in the study. The mean age of the participants was 45.34 ± 18.02 years. The majority were male (n = 41, 60%), while females accounted for 40% (n = 27). The most common presenting symptom was abdominal pain accompanied by nausea and vomiting (56%), whereas others presented with abdominal pain along with constipation and generalized weakness. Most patients (82.4%) were managed conservatively. Endoscopic retrograde cholangiopancreatography (ERCP) with stenting was performed in 8.8% of cases, ERCP followed by laparoscopic cholecystectomy in 4.4%, laparoscopic cholecystectomy alone in 3%, and open laparotomy was performed in one case (1.5%).

Complications were absent in 75% of the patients. However, 17.6% developed pancreatic necrosis with associated abdominal collections. Additionally, three patients developed acute respiratory distress syndrome (ARDS), and two patients experienced acute kidney injury (AKI) with septic shock. In terms of clinical outcomes, 79.4% of the patients recovered, while the mortality rate was 10.3%. Another 10.3% of patients left against medical advice.

A total of 68 patients were included in the study. Based on the APACHE II scoring system, 23.5% of the patients were classified as having severe acute pancreatitis (score >11), while 76.5% were considered non-severe (score <12). According to the Modified CT Severity Index (MCTSI), 35.3% of patients had a score greater than 7, indicating severe disease, while 64.7% had a score of 7 or below. Among those identified as severe by MCTSI, 17.6% also had a high APACHE II score (>11), and 17.6% had a low APACHE II score (<12). Conversely, 5.9% of patients with a low MCTSI score (=7) were found to have severe pancreatitis by APACHE II, whereas 58.8% were consistent with the non-severe classification on both scoring systems. (Table 1). Among male patients (n = 41), 39.0% had an MCTSI score >7, of whom 22.0% were also classified as severe by APACHE II, while 17.1% were classified as non-severe. In contrast, 61.0% of males had an MCTSI score =7; 9.8% of these were severe by APACHE II, and 51.2% were non-severe. Overall, 31.7% of male patients had severe disease by APACHE II, and 68.3% were non-severe. Among female patients (n = 27), 29.6% had an MCTSI score >7, of whom 11.1% were severe by APACHE II and 18.5% were non-severe. The remaining 70.4% had an MCTSI score =7, and all of these were classified as non-severe by APACHE II. Overall, only 11.1% of female patients were categorized as severe based on the APACHE II score, while 88.9% were non-severe. (Table 2). In patients aged less than 45 years (n = 36), 44.4% had an MCTSI score >7. Among these, 22.2% were also classified as severe by APACHE II, while another 22.2% were non-severe. The remaining 55.6% had an MCTSI score =7, of which 2.8% were categorized as severe and 52.8% as non-severe by APACHE II. Overall, 25.0% of patients under 45 years of age had severe pancreatitis according to APACHE II, while 75.0% were non-severe. In patients aged 45 years and above (n = 32), 25.0% had an MCTSI score >7, with 12.5% showing severe disease and 12.5% non-severe by APACHE II. Among the 75.0% who had an MCTSI score =7, 9.4% were classified as severe and 65.6% as non-severe. Overall, 21.9% of patients in the =45 age group were found to have severe pancreatitis by APACHE II, while 78.1% were non-severe. (Table 3). A receiver operating characteristic (ROC) curve was generated to assess the diagnostic performance of the Modified CT Severity Index (MCTSI). A score greater than 8 was identified as the optimal cut-off value for severe pancreatitis, demonstrating a sensitivity and specificity of 75%, as illustrated in Figure 1.

DISCUSSION:

The objective of the present study was to evaluate the diagnostic accuracy of the Modified CT Severity Index (MCTSI) for the assessment of the severity of acute pancreatitis (AP), while using the Acute Physiology and Chronic Health Evaluation (APACHE) II as the standard. The study shows that if we considered MCTSI scores = 7, the sensitivity and specificity were 75% each, thus suggesting that MCTSI can be considered a reasonably accurate tool to predict severe acute pancreatitis in a clinical setting.

Our study revealed that MCTSI possesses a sensitivity of 75% and a specificity of 75%. Meaning that this tool potentially does a decent job at predicting severe acute pancreatitis. The findngs are in agreement with the findings of Hu et al. (2023), where sensitivity 80% specifictiy 61%

Table 1: Overall Comparison between APACHE II and MCTSI (n = 68)

MCTSI	APACHE II Positive (>11)	APACHE II Negative (<12)	Total
Positive (>7)	12 (17.6%)	12 (17.6%)	24 (35.3%)
Negative (=7)	4 (5.9%)	40 (58.8%)	44 (64.7%)
Total	16 (23.5%)	52 (76.5%)	68 (100%)

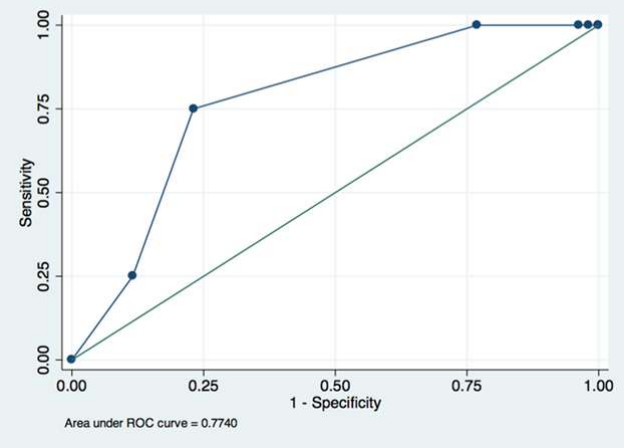
Table 2: Gender-Wise Comparison Between APACHE II and MCTSI

Gender	MCTSI	APACHE II Positive	APACHE II Negative	Total
Male (n=41)	**Positive (>7)**	9 (22.0%)	7 (17.1%)	16 (39.0%)
	Negative (<7)	4 (9.8%)	21 (51.2%)	25 (61.0%)
	Total	13 (31.7%)	28 (68.3%)	41 (100%)
Female (n=27)	**Positive (>7)**	3 (11.1%)	5 (18.5%)	8 (29.6%)
	Negative (<7)	0 (0%)	19 (70.4%)	19 (70.4%)
	Total	3 (11.1%)	24 (88.9%)	27 (100%)

Table 3: Age-Wise Comparison Between APACHE II and MCTSI

Gender	MCTSI	APACHE II Positive	APACHE II Negative	Total
< 45 years (n = 36)	**Positive (>7)**	8 (22.2%)	8 (22.2%)	16 (44.4%)
	Negative (<7)	1 (2.8%)	19 (52.8%)	20 (55.6%)
	Total	9 (25.0%)	27 (75.0%)	36 (100%)
> 45 years (n = 32)	**Positive (>7)**	4 (12.5%)	4 (12.5%)	8 (25.0%)
	Negative (<=7)	3 (9.4%)	21 (65.6%)	24 (75.0%)
	Total	7 (21.9%)	25 (78.1%)	32 (100%)

Figure 1: Receiver operating curve (ROC), showing area under the curve = 0.77



for MCTSI.[8] Yi et al. (2023) also demonstrated lower sensitivity (40%), but high specificity (100%), suggesting that while MCTSI may miss some severe cases, it accurately identifies non-severe cases.[14] However, our study provides value in that it demonstrates there is a is a balanced sensitivity and specificity numbers which suggests MCTSI has a more consistent overall performance when utilized in routine clinical practice.

This study aligns with the findings of Alberti et al. (2021), who showed MCTSI to have greater correlation with clinical outcomes than the original CT severity index.[15] Specifically, Tahir et al.2021 reported that for MCTSI, the sensitivity when comparing MCTSI to clinical severity parameters was 67% while the specificity was 73%.[16] This is consistent with the diagnostic performance we observed. They also reported a sensitivity for MCTSI of 40% and specificity of 100%, and emphasized the strong predictive utility of MCTSI for ruling in severe disease when the number is high, although their sensitivity was low in their setting. In our study, we had similar levels of specificity and sensitivity, suggesting that MCTSI offers an integrated clinical assessment when used in addition to the clinical judgement.

In addition, we share an agreement with the general consensus that MCTSI is easier to apply than APACHE II, which includes 12 physiological parameters and is difficult to apply in all clinical environments. Studies like those by Padmaprakash et al. (2025) and Leghari et al. (2025) have supported APACHE II as a robust predictor of severe pancreatitis.[17,18] While our study did not directly compare MCTSI with other clinical scoring systems such as BISAP or Ranson's criteria, previous research by CF et al. (2021) suggests that imaging-based tools like MCTSI provide valuable supplementary information, especially when laboratory-based scores yield borderline results.[19]

The complication profile in our study, where 17.6% of patients developed pancreatic necrosis and a small subset experienced ARDS or septic shock is consistent with findings from Szatmary et al. (2022) and Heckler et al. (2021), who reported that necrosis and systemic complications are more frequent in severe cases, often confirmed by imaging.[5,20] The overall mortality rate in our study was 10.3%, which also aligns with global data showing mortality in severe acute pancreatitis ranges between 10% and 30%, depending on the presence of organ failure and timely intervention.

Age-wise stratification in our study showed that patients under 45 years of age had a higher sensitivity (88.8%) and diagnostic accuracy (75%) for MCTSI compared to those above 45 years, where sensitivity dropped to 57% and diagnostic accuracy was 78.1%. These findings may be attributed to younger patients presenting with more pronounced imaging findings or possibly fewer comorbidities that may confound the APACHE II score. These age-related discrepancies in diagnostic accuracy are not widely discussed in literature, suggesting a potential area for further research.

Gender-wise analysis revealed notable differences. Among females, MCTSI exhibited impressive sensitivity (100%) and negative predictive value (100%) making it highly successful at identifying people with non-severe cases. Positive predictive value, on the other hand, was low (37.5%), suggesting a potential for over estimating severity in this group. By contrast, males exhibited more balanced sensitivity and specificity (69.2% sensitivity and 75% specificity). These differences may simply represent physiological gender differences in inflammatory response or differences in the distribution of etiological factors; however, literature detailing gender-based accuracy of MCTSI is limited.

The majority of patients in our study had conservative management (82.4%), with only a limited number, undergoing

interventional procedures such as ERCP or laparoscopic cholecystectomy. This is consistent with current global management trends which endorse an approach that supports conservative management of most cases (mild to moderate pancreatitis) unless complications arise.[21,22] In our cohort, the total mortality rate was 10.3%, and the complications included pancreatic necrosis (17.6%), ARDS (4.4%), and AKI with septic shock (2.9%). These comparisons are consistent with worldwide estimates. Severe acute pancreatitis has a mortality rate of between 10% and 30% worldwide, which is especially true with some organ failure.[21]

The use of APACHE II as the standard in our case is supported by the importance of this scale in critical care medicine. Several studies have established APACHE II sensitivity and specificity of 81% and 65% for predicting severe acute pancreatitis, which closely follows our usage of the scale.[8,23] However, APACHE II is time-consuming and influenced by multiple physiological variables, making it less feasible in certain settings. In contrast, MCTSI provides a more direct radiological correlation to disease severity and is easier to apply once imaging is available. Our study supports the idea that MCTSI, due to its ease of calculation and relatively strong diagnostic accuracy, can serve as a reliable adjunct tool for early assessment of severity in acute pancreatitis, particularly in settings where APACHE II scoring is impractical.

CONCLUSION:

The Modified CT Severity Index (MCTSI) has reasonable diagnostic precision for identifying the severity of pancreatitis when assessed against both the APACHE II score. MCTSI provides a useful, practical, and easy to use radiological alternative that demonstrated 75% sensitivity and specificity; useful as clinicians are able to identify non-severe cases, especially within females and younger patients. Since MCTSI may help in early stratification of risk, it may promote timely clinical decision making to promote positive patient outcomes and avoid complications. Further large-scale, multi-center studies are warranted to validate our findings and examine demographics influence on diagnostic performance.

Authors Contribution:
Mahum Zaidi: Substantial contributions to conception and design, acquisition of data, analysis and interpretation of data; Drafting the article & revising it critically for important intellectual content;
Final approval of the version to be published.
Jawaid Iqbal: Acquisition of data, analysis and interpretation of data; Drafting the article, Final approval of the version to be published.
Rizwan Ajmal: Acquisition of data, revising it critically for important intellectual content, Final approval of the version to be published.
Qurat ul Ain Haroon: Drafting the article, Final approval of the version to be published.
Ramsha Fatima: Drafting the article, Final approval of the version to be published.
Sadia Khusrsheed: Analysis and interpretation of data, Final approval of the version to be published

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