Original Article

MEDICINE PALLIATIVE CARE

DOI: 10.47582/jompac.1370969

J Med Palliat Care. 2023;4(6):637-641

Prognostic accuracy of radiological scoring systems in acute pancreatitis: CTSI vs. mCTSI

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Cite this article as: Şahin EA, Kibici Ö, Havan N, Özdamarlar U. Prognostic accuracy of radiological scoring systems in acute pancreatitis: CTSI vs. mCTSI. *J Med Palliat Care*. 2023;4(6):637-641.

Received: 04.10.2023 ◆ **Accepted**: 07.12.2023 ◆ **Published**: 31.12.2023

ABSTRACT

Aims: Acute pancreatitis (AP) is a complex and unpredictable clinical condition with variable outcomes. Early risk assessment is vital for tailored interventions and improved patient outcomes. The computed tomography severity index (CTSI) and modified computed tomography severity index (mCTSI) are radiological scoring systems used to evaluate AP severity.

Methods: We conducted a single-center retrospective study spanning from January 1, 2018, to December 31, 2022, to compare CTSI and mCTSI in predicting mortality in AP. Data were retrieved from our institution's electronic records for 266 eligible adult patients. Statistical analysis assessed the relationship between scoring systems, patient demographics, etiology, and mortality.

Results: Among the 266 patients, 9.4% died. Mortal patients were older (mean age: 72.09±15.12) than survivors (mean age: 59.93±16.93). The most common etiology was biliary pancreatitis (58.64%). mCTSI showed significant differences between the mortality and non-mortality groups (p=0.026), whereas CTSI did not (p=0.112). The ROC analysis for mCTSI yielded an area under the curve of 0.629, with a Youden index of 0.193 (p=0.044). A mCTSI cut-off of 3 had a sensitivity of 59.1% and specificity of 60.2%.

Conclusion: Advanced age and biliary etiology were associated with increased mortality. mCTSI demonstrated superiority in predicting mortality compared to CTSI.

Keywords: Acute pancreatitis, scoring systems, mortality

INTRODUCTION

Acute pancreatitis (AP) is a multifaceted and often unpredictable clinical condition that manifests with varying degrees of severity and clinical courses. Timely risk assessment is paramount for tailoring precise interventions and optimizing patient outcomes. To address this challenge, numerous scoring systems have emerged for the evaluation of AP severity, with the computed tomography severity index (CTSI) and its modified counterpart, the modified computed tomography severity index (mCTSI), gaining significant prominence.

The CTSI, originally introduced by Balthazar et al. in 1990, stands as a comprehensive radiological tool for assessing pancreatic inflammation extent and complications through contrast-enhanced computed tomography (CECT) scans.[1] In subsequent years, the mCTSI was devised as a streamlined alternative with the aim of preserving predictive accuracy while enhancing user-friendliness.[2]

In this study, we embark on an in-depth analysis to compare the effectiveness of CTSI and mCTSI in predicting mortality among patients diagnosed with acute pancreatitis. Our investigation is based on data collected from a single institution, which bolsters the internal validity of our findings while reducing potential variations linked to multi-institutional disparities.[3-6]

The primary outcome of this research is to evaluate and juxtapose the prognostic utility of CTSI and mCTSI in predicting Mortality in patients diagnosed with acute pancreatitis. By leveraging data gathered within our institution over a specified period, we endeavor to provide valuable insights into the clinical applicability of these radiological scoring systems within a specific patient population.

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METHODS

Study Design

The study was carried out with the permission of Kartal Dr. Lütfi Kırdar City Hospital Clinical Researches Ethics Committee (Date: 27.04.2023, Decision No: 2023/514/248/7). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

This study is a single-center retrospective analysis conducted at Kartal Dr. Lütfi Kırdar City Hospital, spanning the period from January 1, 2018, to December 31, 2022. The primary objective of this investigation is to compare the prognostic accuracy of the computed tomography severity index (CTSI) and the modified computed tomography severity index (mCTSI) in predicting mortality among patients diagnosed with acute pancreatitis.

Data Collection

Patient data were retrieved from our institution's electronic medical records (EMR) and radiology databases. A comprehensive search was conducted to identify all patients admitted to our institution with a confirmed diagnosis of acute pancreatitis during the specified study period.

Inclusion Criteria

- Patients diagnosed with acute pancreatitis according to established diagnostic criteria, including clinical, biochemical, and radiological findings.
- Adult patients aged 18 years or older.
- Availability of contrast-enhanced computed tomography (CECT) scans performed within 48 hours of admission for the calculation of both CTSI and mCTSI.
- Complete medical records, including clinical, laboratory, and radiological data.

Exclusion Criteria

- Patients with incomplete medical records or missing relevant data.
- Pediatric patients (aged below 18 years).
- Patients with chronic pancreatitis or other chronic pancreatic diseases.
- Patients with a history of pancreas surgery or trauma.
- Patients with incomplete CECT scans for the calculation of CTSI or mCTSI.

Data Extraction

Data extraction was performed by trained medical personnel using standardized data collection forms. The following information was extracted:

- Demographic information (age, sex).
- Etiology of acute pancreatitis (e.g., gallstone, alcohol-induced, idiopathic).
- Clinical parameters on admission (e.g., vital signs, laboratory values).
- Radiological findings, including CECT scans.
- Computed Tomography Severity Index (CTSI) and Modified Computed Tomography Severity Index (mCTSI) scores calculated based on CECT scans.
- Clinical outcomes, including mortality during hospitalization.

CTSI and mCTSI Scoring Systems

The severity of pancreatitis was assessed using both the CT severity index and the modified CT severity index, and then categorized into mild, moderate, and severe classifications. Computed tomography (CT) with intravenous contrast medium injection is accepted as the imaging procedure of choice: first to document the extent of pancreatic and extrapancreatic acute fluid collections and, second, to detect pancreatic necrosis. These two parameters have been identified as prognostic indicators of the severity of AP. CTSI, based on combined assessment of peripancreatic fluid collections, and the degree of pancreatic necrosis were developed to improve prognostic accuracy. The CT Severity Index includes an assessment of the patient's imagination. A normal pancreas is assigned a score of 0, whereas a focal or diffuse enlargement is assigned a score of 1, peripancreatic inflammation is assigned 2 points, a single fluid collection is assigned 3 points, and several fluid collections and/or gas are assigned 4 points. The scoring system for necrosis assessment is as follows: absence of necrosis is assigned 0 points, 30% necrosis of the pancreas is assigned 2 points, 30%–50% necrosis of the pancreas is assigned 4 points, and 50% necrosis of the pancreas is assigned 6 points. Modified computed tomography severity index (mCTSI) differs from the CTSI by the presence of extra pancreatic complications and grading of the peripancreatic fluid collection by their presence or absence, instead of the number of fluid collections.

Statistical Analysis

Statistical analyses were performed using SPSS 22.0 for Windows. Descriptive criteria were presented as mean and standard deviation values and percentage distribution. The Kolmogorov-Smirnov test was used to examine the conformance of the data to the normal distribution. The ROC analysis was performed to establish the cutoff values of risk scores for predicting mortality. The significance threshold was determined to be $p<0.05$.

RESULTS

A total of 290 acute pancreatitis patients were admitted to the emergency department of Kartal Dr. Lütfi Kırdar City Hospital during the study period. After excluding 21 patients with incomplete data and 3 patients transferred to other hospitals, 266 patients were included in the study. Of these, 158 (59.4%) were male, and 108 (40.3%) were female. Twenty-two (9.4%) patients died during the course of their illness.

One notable finding was the significant difference in mean age between the survivor and non-survivor groups. Patients who succumbed to acute pancreatitis had a notably higher mean age (72.09±15.12) compared to survivors (59.93±16.93). This observation underscores the well-established association between advanced age and increased mortality in AP.[7] Age-related factors such as decreased physiological reserves and comorbidities may contribute to the vulnerability of older patients to severe outcomes in acute pancreatitis.[6,7] Tomographic findings of the survivor and non-survivor groups have been determined in Table 1.

Table 1. Data shows tomographic findings and gender distribution between the non-survivor and survivor group

	Non-survivor grup (n=22)	Survivor grup (n=244)
2 or more regions with fluid collections	6 (27.3%)	26 (10.7%)
Cyst	3 (13.6%)	6 (2.5%)
Abscess	0	1 (0.4%)
More than %50 necrosis	1 (4.5%)	3 (1.2%)
%30-50 necrosis	1 (4.5%)	0
Up to %30 necrosis	2 (9.1%)	3 (1.2%)
Extrapancreatic complications	14 (63.6%)	107 (43.9%)
Ascites	10 (45.5%)	33 (13.5%)
Vascular complications	0	1 (0.4%)
Gastrointestinal complications	15 (68.2%)	82 (33.6%)
Pleural effusion	12 (54.5%)	26 (10.7%)
Parenchymal necrosis	3 (13.6%)	6 (2.5%)
Peripancreatic necrosis	0	0
Peripancreatic and parenchymal necrosis	2 (9.1%)	1 (0.4%)
Male	16 (72.7%)	142 (58.2%)
Female	6 (27.3%)	102 (41.8%)

The etiological heterogeneity of acute pancreatitis is a well-recognized challenge in clinical management. In our study, biliary pancreatitis was the most common etiological factor (58.64%), followed by idiopathic pancreatitis (25.2%). Identifying the underlying cause of acute pancreatitis is imperative, as it can influence both disease severity and patient outcomes.6

Regarding the radiological scoring systems, our analysis revealed that mCTSI showed a significant difference between the survivor group and the non-survivor group, whereas CTSI did not demonstrate such discrimination (Table 2). This finding suggests that mCTSI may have an advantage over the traditional CTSI in predicting Mortality in acute pancreatitis within our specific patient population.

Table 2. Data shows Mann Whitney test results for MCTSI and CTSI

	Non-Survivor group median (range)	Survivor group median (range)	p value
MCTSI	4 (0-10)	2 (0-10)	0,026
CTSI	2 (0-10)	2 (0-10)	0,112

In our receiver operating characteristic (ROC) analysis for mCTSI, the area under the curve (AUC) was 0.629, indicating moderate accuracy in predicting mortality (Figure 1). The Youden index, sensitivity, and specificity values suggest that an mCTSI cut-off level of 3 may have clinical relevance for risk stratification. However, it is important to note that while mCTSI demonstrated statistical significance, the predictive accuracy remains moderate, emphasizing the multifactorial nature of mortality prediction in acute pancreatitis.[8,9]

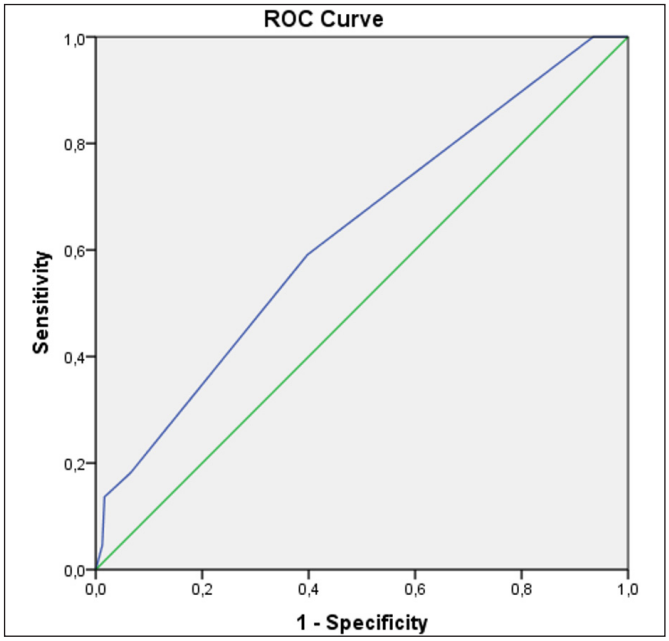

Figure 1. Figure shows the ROC Curve analysis for MCTSI. AUC=0.629 (95% CI:0.506-0.752)

DISCUSSION

Acute pancreatitis (AP) is a multifaceted clinical condition with a broad spectrum of severity and outcomes. The accurate assessment of disease severity plays a pivotal role in guiding clinical decisions and optimizing patient care.[10,11] In this single-center retrospective study spanning from 2018 to 2022, we endeavored to compare the predictive efficacy of the

computed tomography severity index (CTSI) and the modified computed tomography severity index (mCTSI) in forecasting Mortality among patients diagnosed with acute pancreatitis.

Our study population consisted of 266 patients admitted to the emergency department Kartal Dr. Lütfi Kırdar City Hospital, who met the inclusion criteria for the analysis. Notably, our cohort was characterized by a slightly higher proportion of males (59.4%) than females (40.3%), reflecting a trend reported in various epidemiological studies.[12] The overall Mortality rate in our study was 9.4%, consistent with the range of mortality rates reported in the literature.[8]

One of the key findings of our investigation was the significant difference in mean age between the mortality and non-mortality groups. Patients who succumbed to acute pancreatitis had a notably higher mean age (72.09±15.12) compared to survivors (59.93±16.93). This observation underscores the well-established association between advanced age and increased mortality in AP.[7] Age-related factors such as decreased physiological reserves and comorbidities may contribute to the vulnerability of older patients to severe outcomes in acute pancreatitis.[7]

The etiological heterogeneity of acute pancreatitis is a well-recognized challenge in clinical management. In our study, biliary pancreatitis was the most common etiological factor (58.64%), followed by idiopathic pancreatitis (25.2%). The etiological distribution in our cohort aligns with previously reported patterns, where gallstone-related etiology frequently dominates the clinical landscape.[13-16] Identifying the underlying cause of acute pancreatitis is imperative, as it can influence both disease severity and patient outcomes.[6]

Regarding the radiological scoring systems, our analysis revealed that mCTSI showed a significant difference between the mortality group and the non-mortality group, whereas CTSI did not demonstrate such discrimination. This finding suggests that mCTSI may have an advantage over the traditional CTSI in predicting mortality in acute pancreatitis within our specific patient population. This observation is consistent with other studies that have highlighted the utility of mCTSI as a simplified yet effective tool for risk assessment in acute pancreatitis.[11,17]

Numerous scoring systems for acute pancreatitis continue to be utilized in clinical practice.[18] Additional criteria, such as pancreatic volume, have also started to be incorporated into scoring systems.[19] Blood gas characteristics, which encompass many scoring systems, are widely utilized in the diagnosis and management of numerous disorders in medical practice.[20,21] The optimal scoring system should possess characteristics of simplicity, cost-effectiveness, and efficacy, while also avoiding any additional burden on standard clinical examination protocols.

In our receiver operating characteristic (ROC) analysis for mCTSI, the area under the curve (AUC) was 0.629, indicating moderate accuracy in predicting mortality. The Youden index, sensitivity, and specificity values suggest that an mCTSI cut-off level of 3 may have clinical relevance for risk stratification. However, it is important to note that while mCTSI demonstrated statistical significance, the predictive accuracy remains moderate, emphasizing the multifactorial nature of mortality prediction in acute pancreatitis.[9]

CONCLUSION

In conclusion, our study contributes to the growing body of literature on radiological scoring systems in acute pancreatitis. Our findings suggest that mCTSI may have advantages over CTSI in predicting mortality in our specific patient population. However, further prospective studies with larger cohorts are warranted to validate and refine the utility of mCTSI as a prognostic tool in acute pancreatitis. Comprehensive risk assessment in acute pancreatitis should consider multiple factors, including age, etiology, and radiological findings, to facilitate individualized patient management and optimize outcomes.

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was carried out with the permission of Kartal Dr. Lütfi Kırdar City Hospital Clinical Researches Ethics Committee (Date: 27.04.2023, Decision No: 2023/514/248/7).

Informed Consent: Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support.

Author Contributions: All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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