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Correlation between the Predictive Accuracy of Computed Tomography Severity Index and Clinical Metrics in Acute Pancreatitis at a Tertiary Care Hospital Lahore

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ABSTRACT

Acute pancreatitis was a common clinical emergency and presents with a vast spectrum of severity and clinical outcomes. The Computed Tomography Severity Index (CTSI) was widely used to evaluate extent of pancreatic inflammation and necrosis. **Objective:** To compare the CTSI with the clinical severity of acute Pancreatitis in local settings. **Methods:** It was a retrospective cohort study done on 136 cases diagnosed with acute pancreatitis between 2017 to 2023 at Lahore General Hospital, Lahore, Pakistan. Patients received contrast-based Computed Tomography (CT) within 30 days of onset. CTSI scores were independently assessed by two experienced radiologists. Clinical severity was categorized as mild, moderate and severe pancreatitis. Statistical analysis was done with SPSS 26.0 which involved descriptive, correlational statistics, sensitivity and specificity, Positive Predictive Value (PPV), Negative Predictive Value (NPV), predictive Accuracy along with ROC curve analysis and Cohen's kappa statistic. **Results:** The patients were 74.3% males and had a median age of 51 years. CTSI demonstrated 79.37% sensitivity, 83.56% specificity, 80.65% PPV and 82.43% NPV in determining clinical severity as mild, moderate and severe with a predictive accuracy of 81.62%. Cohen's kappa of 0.72 reflected substantial agreements between the CTSI and clinical severity assessment. Under the ROC Curve (AUC) the area was 0.87, showing an excellent diagnostic performance. **Conclusions:** CTSI provides a moderate to fair agreement with clinical severity assessments in acute pancreatitis. It effectively differentiates between mild, moderate and severe cases, supporting its assessment and management.

INTRODUCTION

Acute pancreatitis is an acute development of pancreatic inflammation, with clinical symptoms ranging from mild to severe discomfort, and fatal complications including systemic inflammatory response syndrome and multi-organ failure [1-5]. Timely and correct assessment is crucial for guiding therapeutic decisions. Various clinical scoring systems, including the modified Atlanta classification and the Sequential Organ Failure Assessment (SOFA) score, are utilized in stratifying cases into mild, moderately severe, and acute severe pancreatitis categories based on factors like organ failure and local complications [6]. There are several radiological tests and scoring systems that can be used to access the severity of the disease to guide management and outcome. Among the most commonly used tests are computed tomography, magnetic resonance imaging, and ultrasound, and scoring

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systems include Ranson, Acute Physiology and Chronic Health Evaluation II and Bedside Index for Severity in acute pancreatitis scores. Computed tomography is considered the gold standard due to its high sensitivity and specificity, while magnetic resonance imaging and ultrasound can provide additional information. Scoring systems utilize clinical and laboratory parameters to classify patients into mild, moderate, or severe disease [7]. Computed Tomography (CT) imaging, particularly CTSI is essential for diagnosis and managing acute pancreatitis [8]. It gives insight about possible complications and outcome of acute pancreatitis [9]. Studies show the importance of CTSI corresponding clinical severity scores for better patient management [10]. In a recent study CTSI and Modified CTSI (MCTSI) were compared with clinical severity scores and it was concluded that higher the score the poor the prognosis and vice versa [9]. In another study, concluded that CTSI is a wonderful tool for predicting disease severity and prognosis of acute pancreatitis [11]. Similarly, in another retrospective study, Cucuteanu B et al., found that the CTSI and modified CTSI scores highly correlated positively with the severity of pancreatitis showing a 97.0% sensitivity and 95.0% specificity with Under the Curve (AUC) area of 0.969 [12]. Despite CTSI vast usage, its correlation with 1clinical severity scores like the modified Atlanta classification and SOFA score has not been comprehensively assessed across different clinical settings, particularly in tertiary care centres in various geographic regions [13].

This study aimed to address this issue by comparing CTSI with clinical severity assessments in a tertiary care facility, analysing 136 patients with acute pancreatitis who underwent contrast-enhanced CT within 30 days of clinical onset [14]. CT scan and clinical assessment improve the treatment plan of acute pancreatitis [15]. Our study objective was to compare the CTSI with the clinical severity of acute Pancreatitis in local settings.

METHODS

This retrospective study was carried out at Lahore General Hospital - Lahore from 1st July 2017 to 30th June 2023 to investigate the correlation between CTSI and acute pancreatitis clinical severity [16] under the principles outlined in the Declaration of Helsinki [17] after getting ethical approval vide letter No AMC/PGMI/LGH/article/Research No/047/2024. 136 patients who had acute pancreatitis and had contrast enhanced CT abdomen within one month of symptoms were included in this study from the hospital medical file records by using prevalence of Acute Pancreatitis as 10.90% at 5% margin of error and 95% confidence level using following formula:

$$n = \frac{Z^2 - \frac{a}{2} p\,(1 - p)}{d^2}$$

Hospital departmental permission was taken for all patients' record inclusion before enrolment [18]. Patients with incomplete clinical or CT record were excluded from the study. Patient demographic details, signs and symptoms, etiology and clinical outcome were recorded on a predesigned proforma. Two experienced radiologists then independently analysed the available CT images of the patients and calculated CTSI. The CTSI had 10 point in total score by assigning 0 to 4 points to pancreatic inflammation and 0 to 6 points for necrosis. The severity of pancreatitis was graded as mild (0-3 points), moderate (4-6 points) and severe (7-10 points) [19]. Where there was a discrepancy in the scoring between the two radiologists, a uniform consensus review was conducted to reach single conclusion to ensure accuracy and reliability of the radiological analysis. The clinical severity of pancreatitis for each patient was calculated as mild, moderate and severe disease. Mild was labelled on the basis of pancreatitis in the absence of organ failure and local or systemic complications. Moderate as pancreatitis with the presence of transient organ failure or local or systemic complications and severe on the basis of pancreatitis with persistent organ failure. Then 2x2 contingency table was made and all true positive and negative and false positive and negative cases of acute pancreatitis were entered. Sensitivity, specificity PPV, NPV and predictive accuracy were calculated to see the diagnostic performance of CTSI in identifying mild, moderate, severe cases of acute pancreatitis. The data were analysed by using SPSS 26.0. The demographic and clinical characteristics of the patients were summarized as descriptive statistics. Cohen's kappa statistic was used to quantify level of agreement between clinical severity and CTSI. ROC curve was analysed to determine the predictive value of CTSI in determining clinical severity, and AUC area was calculated to determine the accuracy of CTSI.

RESULTS

Out of 136, 101 (74.3%) were males and 35(25.7%) were females. The median age of the patients was 51.0 years. Biliary cause (69.1%) was the most common etiology identified. It was followed by metabolic cause (14%), pancreatic neoplasm (6.6%), mutation in cationic trypsinogen gene, serine protease 1 (PRSS1) (5.9%), drugs (2.2%), alcohol (1.5%) and pancreatic divisum (0.7%). There were 119 (87.5%) patients with non-necrotic pancreatits, 15 (11%) with necrotic pancreatitis and 2 (1.5%) as nonspecific presentation. There were 44 (32.4%) patients with fluid in peri-pancreatic area.110 were of acute pancreatitis (80.9%) and 2 (1.5%) were acute on chronic cases. CTSI calculated showed 48 (35.2%) were normal, 64 (47.0%) mild, 16 (11.8%) moderate and 8 (5.9%) severe pancreatitis cases as shown in table 1.

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Table 1: Demographics of Categorical Variables

Metrics	Category	Frequency (%)	p-Value
Gender	Male	101 (74.3%)	0.118
	Female	35 (25.7%)	
	Total	136 (100%)	
Etiology	Alcohol	2 (1.5%)	0.135
	Biliary	94 (69.1%)	
	Divisum	1 (0.7%)	
	Drugs	3 (2.2%)	
	Genetic	8 (5.9%)	
	Metabolic	19 (14%)	
	Pancreatic Neoplasm	9 (6.6%)	
	Total	136 (100%)	
Necrotic or Non-Necrotic	Non-Necrotic	119 (87.5%)	0.042
	Necrotic	15 (11%)	
	Unspecified	2 (1.5%)	
	Total	136 (100%)	
Fluid	Absent	92 (67.6%)	0.076
	Present	44 (32.4%)	
	Total	136 (100%)	
Acute or Chronic or Acute on Chronic	Chronic	24 (17.6%)	0.009
	Acute	110 (80.9%)	
	Acute on Chronic	2 (1.5%)	
	Total	136 (100%)	
CTSI	Normal	48 (35.2%)	0.014
	Mild	64 (47%)	
	Moderate	16 (11.8%)	
	Severe	8 (5.9%)	
	Total	136 (100%)	

The ROC curve analysis showed an AUC of 0.87, concluding good predictive value of CTSI for clinical severity. The sensitivity and specificity of the CTSI were 79.37% and 83.56%, respectively; the PPV and NPV were 80.65% and 82.43% respectively with a predictive accuracy of 81.62% suggesting moderate diagnostic performance. Cohen's kappa of 0.72 reflected substantial agreements between the CTSI and clinical severity assessment (Table 2).

Table 2: Predictive Accuracy of Computed Tomography Severity Index in Acute Pancreatitis

Clinical Findings	CTSI Findings N (%)		
	Positive	Negative	Total
Positive	50	12	62
Negative	13	61	74
Total	63	73	136
Sensitivity	79.37%		
Specificity	83.56%		
Positive Predictive Value	80.65%		
Negative Predictive Value	82.43%		
Predictive Accuracy	81.62%		
Under The Curve Area (AUC)	0.87%		
Cohen's Kappa	0.72%		

The ROC curve showed good sensitivity (Y axis) versus specificity (X-axis) for different thresholds with Under the Curve (AUC) area of 0.87, depicting good predictive value of CTSI. The blue line showed CTSI performance, while grey dotted line was reference line with under the curve area (AUC =0.87). The curve indicates that CTSI can reliably tell acute pancreatitis severity level (Figure 1).

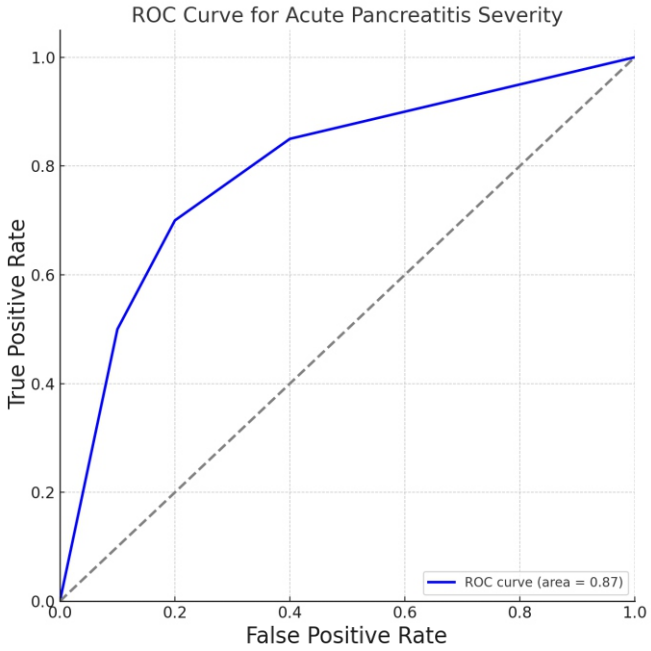

Figure 1: Receiver Operating Characteristic (ROC) Curve with AUC

DISCUSSION

In this study CTSI showed a moderate to fair agreement of clinical severity and prognosis of acute pancreatitis. The calculated sensitivity and specificity further endorsed its good performance. This has been in consistent with the study conducted by Tahir H *et al* [20]. Mathai MJ and colleagues in their study on 150 acute pancreatitis patients concluded high level of accuracy of the CTSI in predicting complications and clinical outcomes [21]. Parmar G *et al.*, in their prospective 80 patients study concluded that CTSI and modified CTSI were better predictors of severity, clinical outcome and mortality compared with Ranson's criteria, with modified CTSI being more accurate and better predictor than CTSI [22]. Olpin JD *et al.*, in their study concluded significant correlation between necrotic and non-necrotic acute pancreatitis for disease severity and prognosis as we saw in our study [23]. Balthazar JA *et al.*, in their study concluded that pancreatic necrosis affects the clinical outcome of acute pancreatitis as we found in our study [24]. Jiang X *et al.*, found similar results as our chi-square test results that further endorsed the importance of CTSI [25]. Cho IR and colleagues in their study on 103 patients of acute pancreatitis found out that CTSI (0.851, $p<0.001$) was useful predictor in 42(40.8%) patients of early mild acute pancreatitis only however our study didn't find variations in CTSI score across various severity groups [26]. This discrepancy is also noted by Kim K and colleagues in their study that CTSI was only capable to

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identify mild acute pancreatitis [27]. Yang Q *et al* in their study Based on the multivariate logistic regression analysis showed that CTSI ≥4 (OR,12.942;95% CI,7.267–23.049, p < 0.001) were identified as independent risk factors for severe acute pancreatitis [28]. Zhang *et al.*, in their study on 683 recurrent acute pancreatitis(RAP) and 1,829 acute pancreatitis(AP) patients found out that the most common etiologies were hypertriglyceridemia and cholelithiasis, respectively. The RAP group had lower extrapancreatic inflammation on CT scores and Acute Physiology and Chronic Health Evaluation II scores than the AP group in the early stage (both P<0.001). The RAP group had higher CTSI scores than the AP group in the late stage (P=0.022). [29]. Yamamoto *et al* in their study on 1097 patients found that the AUC of the CTSI for mortality was 0.65 (95 % confidence interval [CI:] [0.59–0.70]; p < 0.001) making CTSI better predictor [30]. Gupta P and colleagues also found CTSI importance for acute pancreatitis severity and prognosis as ours. They emphasized that it should be used along with clinical severity scores for a better management [31].

CONCLUSIONS

It was concluded that CTSI accurately correlates with clinical severity in acute pancreatitis. It effectively differentiates between mild, moderate and severe cases, supporting its assessment and management. Hence suggested CTSI should be included in the standard assessment protocols for early recognition of high-risk patients. However large sample size studies were required to refine the CTSI in its implementation in various clinical settings.

Authors Contribution

Conceptualization: FS, JM, SS, AZT, AAM, MD, AAM, MD, SR, IUH, GUNT

Methodology: FS, JM, SS, AZT, AAM, MD, AAM, MD, SR, IUH, GUNT

Formal analysis: FS, JM, SS, AZT, AAM, MD, AAM, MD, SR, IUH, GUNT

Writing, review and editing: FS, JM, SS, AZT, AAM, MD, SR, IUH, GUNT

All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

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