# THE DIAGNOSTIC ACCURACY OF NUMERICAL COMPUTED TOMOGRAPHY SEVERITY INDEX AND RANSON SCORE IN PREDICTING SEVERE ACUTE PANCREATITIS

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## ABSTRACT

**Objective:** To determine the diagnostic accuracy of numerical CT severity index (CTSI) and Ranson score in predicting severe Acute Pancreatitis (AP) keeping organ failure as the gold standard.

**Methodology:** This descriptive cross-sectional study was carried out in the Department of Surgery, Medical Teaching Institute, Lady Reading Hospital Peshawar, from November 2020 to May 2021 on 238 patients with acute pancreatitis. All patients were subjected to the prediction of Severe Acute Pancreatitis (SAP)/organ failure on CTSI and Ranson criteria.

**Results:** The mean age of the participants was 30.7+7.6 years. There were 54.2% male and 45.8% female as per gender distribution. The mean duration of AP at presentation was 3.8 +1.8 days. Prediction of SAP in terms of organ failure was predicted in 55.9% of patients on Ranson criteria and 59.2% of patients on CTSI. The sensitivity of Ranson criteria was 37.5% and specificity of 25.4% with a Positive Predictive Value (PPV) of 33.8% and a Negative Predictive Value (NPV) of 28.5%. The sensitivity of CTSI was 88.9% and specificity 71.1% with PPV of 75.9% & NPV of 86.6%.

**Conclusion:** CTSI is a highly sensitive and specific tool for predicting the severity of acute pancreatitis when compared to the Ranson criteria in patients presenting with acute pancreatitis.

**Keywords:** Acute Pancreatitis; Computed Tomography Severity Index; Organ Failure; Ranson Criteria; Severe Acute Pancreatitis

## INTRODUCTION

Acute pancreatitis (AP) is the acute inflammation of pancreatic parenchyma, marked by damage to the cells lining the pancreatic acini on histological examination.[1,2] The commonest etiological factors encountered globally are gallstones and immoderate alcohol consumption.[3,4] The frequency of acute pancreatitis is growing globally by more than 13% in recent years and more steadily in the western world.[5,6]

Clinically, there is wide variation in its presentation. A large majority of cases experience the mild form that is self-limiting however about 20 percent progress into moderate-to-severe acute pancreatitis with a death rate of 13-35 percent.[7] More than 36% of the patients presenting with acute pancreatitis develop severe acute pancreatitis.[8] If first episode of acute pancreatitis is not treated properly it leads to recurrence of the disease in 17% of patients.[9] For achieving better prognosis & survival in patients with acute pancreatitis it is crucial to assess the severity of the disease before time and promptly initiate intensive treatment and intervene early if needed.[10] Such patients need properly administered fluids and antibiotics, pain control, close monitoring for development of organ failure, and certain therapeutic procedures including endoscopy & radiological interventions.[10-12]

For predicting the severity of acute pancreatitis various clinical/biochemical parameters and multi-factorial scoring systems have been proposed aiming for its time management and decreasing the complications.[13-15] One remarkable proceeding in assessing the severity of acute pancreatitis is the development of CTSI which not only detects the presence of fluid around the pancreas but also gives valuable information about the degree of necrotic changes within the pancreatic parenchyma. The sensitivity, specificity, PPV, and NPV of the Ranson score, taking a cut-off value of Ranson score as ≥ 3 in predicting severe AP, are 85.7 (CI, 63.7-97.0), 44.3 (CI, 11.5 – 28.0), 95.3 (CI, 87.1 – 99.0).[16] The sensitivity, specificity, PPV and NPV value of CTSI (CTSI ≥ 3) are 66.7% (CI, 43.0 – 85.4), 67.1%

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(CI, 58.7 – 74.8), 23.3% (CI, 13.4 – 36.0), 93.1% (CI, 86.1 – 97.2) respectively.[16] Patients with CTSI > 5 are more likely to die of this condition (P = 0.0005). They are also more likely to have lengthy hospitalization (P < 0.0001), and have 10 times more chances to undergo a necrosectomy (P = 0.0001).[17] Almost all scoring systems have similar accuracy in predicting the severity and prognosis of acute pancreatitis and none of them is gold-standard.[1]

This study was planned to ascertain the diagnostic accuracy of numerical CT severity index and Ranson score in predicting severe acute pancreatitis keeping organ failure as the gold standard, to utilize the outcome of the study in our day-to-day clinical practice.

## METHODOLOGY

This descriptive cross-sectional study was conducted at the Department of General surgery, MTI, Lady Reading Hospital (LRH) Peshawar from November, 2020 to May, 2021. Permission from the ethical committee (IREB) of MTI, LRH Hospital to conduct the study was taken (Ref: No.105/LRH/MTI, dated 15/04/2021). Taking the prevalence of severe acute pancreatitis in-patient with acute pancreatitis as 36%[8] and the sensitivity of CTSI as 66.7% and specificity of 67.1%[16] with 10% margin of error, and 95% confidence interval using the WHO formula, the sample size was calculated as 238 patients of acute pancreatitis. Non-probability consecutive sampling technique was used and informed written consent was taken from every patient after explaining the purpose and benefits of the study. All patients of both genders aging 15-40 years who presented to the department with acute pancreatitis were included in the study. Those patients with known chronic pancreatitis, inflammatory bowel disease, gastrointestinal malignancies, intestinal TB, immunocompromised status or any chronic infectious disease were excluded from the study. Patient demographic data like age, sex, address was noted. Detail history was taken. The investigations like serum amylase and lipase level, full blood count, blood glucose level, serum AST and LDH level, serum Calcium, hematocrit, blood urea, serum electrolytes, ABGs were done on arrival and after 48 hours of admission and Ranson Score was calculated. All patients were treated as per hospital protocol. They were kept nil by mouth for first 48 hours, receiving appropriate antibiotics, fluids, painkillers, with strict monitoring of vitals, intake & output record, and assessed for the development of any organ failure as per standard definition.[18] The patients were sent for CTSI score as soon as possible just after diagnosis and admission. The CTSI score was calculated under the supervision of an experienced radiologist. All the data collected was recorded on a Performa was subsequently analyzed using a statistical program (IBM-SPSS. Version.23). Numerical data such as age, Ranson score, CTSI and duration of illness was reported as Mean ± SD. Frequencies and percentages were computed for qualitative variables like gender, finding on CTSI, Ranson score, and organ failure. Stratification of Ranson score and CTSI was done against severe acute pancreatitis. Post-stratification chi-square test was applied, comparing the CTSI positive prediction (≥ 3) with the gold standard of organ failure prediction. Then diagnostic accuracy, sensitivity, specificity, positive predictive & negative predictive values were calculated.

## RESULTS

This study was carried out on 238 patients with acute pancreatitis (AP). The mean ±SD sample's age was 30.7 ± 7.6 years with the age range of 18-40 years. There were 129 (54.2%) male and 109 (45.8%) female patients.

The mean duration of AP at presentation was 3.8 ±1.8 days. Prediction of severe acute pancreatitis (SAP) in terms of organ failure was predicted in 55.9% (133) patients on Ranson criteria and 59.2% (141) patients on CTSI. On the follow up, the SAP (in terms of organ failure) was recorded in 50.4% (120) patients.

On applying the formulae for calculation,

Table 1: Ranson criteria and SAP organ failure (n = 238)

| Variable | | SAP (organ failure) | |
|---|---|---|---|
| | | Positive | Negative |
| SAP on Ranson Criteria | Positive | 45 | 88 |
| | Negative | 75 | 30 |

SAP Severe Acute Pancreatitis
Sensitivity of Ranson Criteria TP/TP + FN = 37.5%
Specificity of Ranson Criteria TN/TN + FP = 25.4%
Positive Predictive Value Ranson Criteria TP/TP + FP = 33.8%
Negative Predictive Value Ranson Criteria TN/TN + FN = 28.5%
Accuracy of Ranson Criteria TP + TN/n = 31.5%

Table 2: CTSI and SAP organ failure (n = 238)

| | | SAP (organ failure) | |
|---|---|---|---|
| | | Positive | Negative |
| SAP on CTSI | Positive | 107 | 34 |
| | Negative | 13 | 84 |

SAP Severe Acute Pancreatitis, CTSI Computed Tomography Severity Index.
Sensitivity of CTSI TP/TP + FN = 88.9%
Specificity of CTSI TN/TN + FP = 71.1%
Positive Predictive Value CTSI TP/TP + FP = 75.9%
Negative Predictive Value CTSI TN/TN + FN = 86.6%
Accuracy of CTSI TP + TN/n = 80.2%

the sensitivity of Ranson criteria was 37.5% and specificity 25.4%. The positive predictive value of the Ranson criteria is 33.8% and the negative predictive value is 28.5%. (Table 1). The sensitivity of CTSI was 88.9% and specificity 71.1%. The positive predictive value of the CTSI is 75.9% and the negative predictive value is 86.6%. (Table 2).

## DISCUSSION

Acute pancreatitis (AP) is the acute inflammation of pancreatic parenchyma resulting from abnormal activation of its enzymes, marked by damage to the cells lining the pancreatic acini on histological examination. This activity may take an indolent course recovering without any untoward effect or may lead to serious locoregional & systemic complications and high mortality.[1,2,7]

Gloor et al demonstrated that the mortality rate of necrotizing pancreatitis was nine percent, ranging from 3-24% based on the infectious level of the patients and the quality of therapy given.[19] With a considerable load on health system, increasing frequency, and 5 to 10 percent mortality in general, developing a definitive tool to stratify the risks of acute pancreatitis is of foremost significance. Also, it is the leading digestive system disease among hospitalized patients that needs new guidelines for its management based on recent evidences.[19,20]

Ranson's score is a good tool to accurately classify severe acute pancreatitis however it takes 48 hours to calculate it and thus can lead to a delay in initiating therapy.[6] The APACHE-II criteria though better than Ranson scoring in predicting severity, involves collecting myriads of parameters, and several of them are prognostically irrelevant.[21,22]

Research shows that many studies have used Ranson scoring to predict the severity of acute pancreatitis. In the present study, severe acute pancreatitis in terms of organ failure was predicted in 55.9% of patients on Ranson criteria with a sensitivity, specificity, PPV, NPV, and accuracy value of 37.5%, 25.4%, 33.8%, 28.5%, and 31.5% respectively. According to Yadav et al,[23] Ranson score was 97.6 percent sensitive and 93.5 percent specific in predicting severe acute pancreatitis. Similarly, other authors showed superior results for Ranson scoring when compared to our results in predicting the severity of acute pancreatitis.[24]

One remarkable proceeding in assessing the severity of acute pancreatitis is the development of CTSI which not only detects the presence of fluid around the pancreas but also gives valuable information about the degree of necrotic changes within the pancreatic parenchyma. It also gives other details like splanchnic vascular and extra-pancreatic complications. Therefore, many recent studies suggest carrying out this investigation as soon as possible but not sooner than 3 days after the diagnosis of acute pancreatitis. Still, it has certain limitations including inter-observer variation in reporting the score, absence of significant correlation between the CT scoring & other locoregional complications, and lastly, though overall prognosis is bad in patients with higher index there is no remarkable dissimilarity in clinical outcomes of patients having pancreatic necrosis of >50 percent and those having 30 to 50 percent.[25] In the present study, severe acute pancreatitis in terms of organ failure was predicted in 59.2% on CTSI, with 88.9% sensitivity, 71.1% specificity, 75.9% PPV, 86.6% NPV, and 80.2% accuracy. Similar results were shown by Khanna et al. with an 87.5 percent sensitivity, 91.3 percent NPV in predicting necrosis and in predicting organ failure, it was 65.2 percent sensitive.[26] To overcome the aforementioned issues and to improve the diagnostic accuracy, a modified computed tomography severity index (MCTSI) was introduced which has a sensitivity & specificity for assessing severity.[27] It has sensitivity & specificity of 71 & 93 percent with PPV and NPV of 69 & 94 percent respectively.[28] Sharma et al. reported that the MCTSI was 98.6 percent sensitive, 26.5 percent specific with PPV & NPV of 73.7 percent & 90 percent respectively. These studies are confirming that the MCTSI correlates better with APACHI-II and it is a robust way of assessing the severity of acute pancreatitis.[29]

The limitation of this study was the use of CSTI, which has now been improved by the modified version of CSTI.

## CONCLUSION

CTSI is a highly sensitive and specific tool for predicting the severity of acute pancreatitis as compared to the Ranson criteria in patients presenting with acute pancreatitis..

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## Author's Contribution

RUS conceived the idea, designed the study, and checked the overall manuscript for revisions. SS helped in the design of the study, drafted the manuscript, conducted the literature search, and assisted in the data analysis. SA contributed in data collection and interpretation of data. Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

## Conflict of Interest

Authors declared no conflict of interest

## Grant Support and Financial Disclosure

None

## Data Sharing Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.