RESEARCH ARTICLE

Comparative analysis of computed tomography severity indices in predicting the severity and clinical outcome in patients with acute pancreatitis [version 2; peer review: 1 approved, 2 approved with reservations]

Geetanjali Parmar, Griselda Philomena Noronha, Vinaya Poornima

Department of Radiodiagnosis, Kasturba Medical College, Mangalore, Manipal Academy of Higher Education, Manipal, India., Mangalore, Karnataka, 575001, India

Abstract

Background: Acute pancreatitis (AP) has unpredictable severity. Its management is based on initial assessment of disease severity. It ranges from mild interstitial to severe necrotic form; the latter is associated with poor prognosis. Contrast-enhanced computed tomography (CT) of the abdomen is the gold standard in early detection of pancreatic necrosis and in assessing the severity of AP. Two CT grading systems exist to assess the severity of AP: CT severity Index (CSI) and modified CSI (MCSI). This study compares the usefulness of these two systems in predicting the severity and clinical outcome in AP in comparison with Ranson's criteria and clinical outcome parameters.

Methods: This is a prospective hospital-based screening study of 80 patients aged >12 years with clinical diagnosis of AP who underwent contrast-enhanced CT study of the abdomen. Comparative analysis between MCSI and CSI with Ranson's criteria and clinical outcome parameters was assessed by Chi-Squared test.

Results: The accuracy of CSI and MCSI in predicting the requirement of critical care, superadded infection, multiple organ dysfunction syndrome (MODS) and requirement of intervention were 73.0%, 64.5%, 69.8% 60.9% and 77.2%, 76.0%, 74.4% & 56.6% respectively. Area under the curve for MCSI score was significantly higher (AUC: 0.861; 95% CI: 0.736-0.986) than CSI score (AUC:0.815;95% CI:0.749-0.941). MCSI and CSI showed significant correlation with Ranson's
criteria; however, MCSI correlation was better (r:0.53; p<0.01) than CSI (r:0.35; p:0.04).

**Conclusion:** CSI and MCSI are better predictors of severity, clinical outcome and mortality compared with Ranson’s criteria, with MCSI being more accurate and better predictor than CSI. The accuracy of MCSI is better than CSI for prediction of requirement of critical care, development of superadded infection and development of MODS in AP. However, CSI and MCSI have low accuracy in predicting intervention in AP.

**Keywords**
Acute Pancreatitis, CT severity index, Modified CT severity index, clinical outcome parameters, Ranson’s criteria, hospital stay, multisystem organ dysfunction syndrome, sepsis.

This article is included in the Manipal Academy of Higher Education gateway.
Introduction

Acute pancreatitis (AP) is one of the most common causes of acute abdomen. Based on the severity, 80% of cases are mild, and 20% of cases are severe, which morphologically correlate with oedematous and necrotizing forms of AP, respectively. The mild form is self-limiting without causing major physiological insult. The severe form is life-threatening and can lead to early or late multiple organ dysfunction syndrome (MODS) and superadded infection.1,2,3

Contrast-enhanced computed tomography (CT) of the abdomen is the gold standard4 in identifying necrosis and fluid collections in AP. This can aid in predicting disease severity and the patient’s prognosis, thus guiding the management.

The original Ranson criteria were developed in the 1970s, and while they have been validated over time, there are calls for updates to reflect modern clinical practices. The Ranson score is often considered better for early assessment of acute pancreatitis severity upon admission and within the first 48 hours. This is because it incorporates both clinical and laboratory parameters that can be evaluated upon hospital admission, providing an early prognostic indicator. The Ranson score’s criteria can be calculated without the need for advanced imaging, making it accessible in settings where CT scans may not be immediately available. This simplicity and the ability to rapidly assess the severity can be crucial in acute settings. Studies have shown that the Ranson score has a good predictive value for mortality and morbidity in AP, especially when assessed within the first 24 hours. It allows for the stratification of patients into risk categories, which can guide initial treatment decisions.5 There are a few limitations to Ranson’s score. Few meta-analyses have shown that other scoring systems have better sensitivity & specificity than Ranson’s score. The exact score and severity cannot be determined until 48 hours have passed, which becomes a problem in emergency situations before 48 hours to assess severity. Ranson’s score has 11 parameters that make it relatively complex to assess. It cannot be used in pediatric patients & patients at high altitudes.6

The Atlanta classification is based on a morphological assessment of AP severity on CT, which usually takes place after at least 48-72 hours based on which CSI & MCSI scores are calculated.7 Various studies suggest evidence that severity can be better assessed by CT than the clinical grading systems due to direct visualization of necrosis and complications of AP on CT.8,9 Although the CT severity index (CSI) shows a good correlation with the severity of AP, few studies suggested few limitations. One of the main challenges is the subjectivity in interpreting CT findings, as different radiologists may have varying interpretations. This can lead to inter-observer variability and affect the accuracy of the CSI score. Also, CSI is less immediately accessible due to the need for contrast-enhanced CT scans, which are usually performed after at least 48-72 hours.7 Moreover, the CSI does not consider certain important factors, such as the patient’s clinical condition, laboratory parameters, vascular and extrapancreatic complications. Few studies suggest that CSI doesn’t show a good correlation with clinical outcome, mortality & need for surgical or percutaneous interventional procedures, MODS, and superadded infection.7 These shortcomings led to the modification and simplification of CSI by Mortele et al.1 leading to the formation of a modified CT severity index (MCSI) which took into account of vascular & extrapancreatic complications which theoretically should better correlate with clinical outcome.1 The Atlanta classification’s strength lies in its comprehensive approach to defining the disease and its complications such as necrosis, abscess, and pseudocyst formation, but it is less directly predictive of mortality.5 By identifying specific complications, the Atlanta classification helps plan the timing of potential surgical interventions. The present study is performed to assess the predictability of the two CT severity indices, namely CSI & MCSI in comparison with Ranson’s score in AP with respect to severity, mortality & clinical outcome parameters.
Methods
This is a prospective hospital-based screening study performed in the department of Radiodiagnosis affiliated to Kasturba Medical College (KMC), Mangalore (MLR), Manipal Academy of Higher Education (MAHE), Manipal, India on 80 patients with the clinical diagnosis of AP who underwent contrast-enhanced CT abdomen over a period of 2 years from September 2019 to September 2021. The study was performed after the approval from the Institutional Ethics Committee (IEC), KMC, MLR, MAHE with approval number of IEC KMC MLR 09-19/411. The diagnosis of acute pancreatitis was made based on a combination of one or more clinical features like relevant history of alcohol consumption, presence of gall stones, abdominal pain, vomiting, features of ileus, fever, tachycardia, hypotension, and other organ dysfunctions. The clinician then correlates with elevated lipase and amylase laboratory parameters, about threefold above the laboratory upper limit. Finally, the clinician confirms the diagnosis based on imaging findings, such as CECT abdomen or ultrasound of the pancreas. The diagnostic decision rests with the treating clinician.

Acute Pancreatitis cases at our institute are managed by the Department of Surgery. Patients with clinical features of acute pancreatitis or those being evaluated for abdominal pain in the emergency department are thoroughly evaluated and admitted based on the discretion of the attending surgeon. The patients are managed conservatively with bowel rest, fluid resuscitation, intravenous (i.v) antibiotics and analgesics, and other supportive measures as and when indicated, including supplemental oxygen, inotropic or ventilatory support, and transfusions if indicated for Disseminated intravascular coagulation (DIC). Patients with mild cases and stable vital parameters were admitted to the wards, and those with one or more organ dysfunction or unstable vitals were admitted to the intensive care unit (ICU). The investigations for Ranson’s score were not performed for all cases but based on the clinical condition at the discretion of the attending surgeon. Complete blood counts, glucose, calcium, liver and renal function tests, and blood gas were performed at baseline for all cases, whereas the post-48-hour investigations were done selectively based on the clinical condition of the patient.

Patients were followed up with contrast-enhanced CT (CECT) abdomen based on Ranson’s criteria and suspected complications and treated accordingly. Mild cases and those showing an improving trend were not subjected to further imaging.

Usually, CT is deferred for at least 48–72 hours post-onset of illness to allow the acute process to subside. Patients in the ICU are imaged only after the stabilization of their vital status. There is a Surgical intensive care unit in the hospital with ventilators and routine intensive care support systems. Unfortunately, no step-up or high-dependency unit (HDU) facility is available in that hospital. Any patient who is found to have any organ dysfunction or features of shock is admitted to the ICU for monitoring and treatment and started on appropriate treatment. They are provided with supplemental oxygen, Non-invasive ventilation (NIV) or endotracheal intubation with ventilation as and when required, hemodynamic support with transfusions or inotropic and pressor supports, and routine conservative management. Paediatric patients <12 years of age were excluded from the study, as Ranson’s criteria scoring is not done in this group of patients in our hospital. Patients with poor imaging results due to poor compliance or motion artifacts were excluded. Patients without intravenous (i.v.) contrast administration were also excluded. Patients with a diagnosis of acute-on-chronic, recurrent, and calcific pancreatitis and those who got discharged against medical advice or were lost to follow-up were also excluded from the study. Patients with cardiac, renal & respiratory comorbidities were excluded from the study. Since informed consent is routinely taken prior to every CT study and research data are obtained from the CT machine computer and patient case files with no direct interaction with the study participants, IEC, KMC, MLR waived off additional informed consent from the study participants for this research.

16-slice and 32-slice CT scanner machines were used to acquire 5-mm plain CT axial sections followed by the administration of 1.5–2.0 mL/kg body weight (80–100 mL) of non-ionic i.v. contrast through the automated injector. This was followed by around 1 mL/kg body weight (40–50 mL) of normal saline. The rate of injection for both contrast and saline administration was ~4 mL/s which was altered in accordance with haemodynamic status, body weight and size of the i.v. cannula. The images were acquired in the arterial and porta-venous phases at 6–8 and 35–45 seconds respectively in all cases by bolus tracking method which is described as follows. A locator was placed on the aorta at D12–L1 level and the contrast injection got automatically triggered via the automated injector once the aorta at this level showed optimum contrast opacification. Axial sections of 5 mm slice thickness were then reformatted to thin 0.6 mm axial, sagittal and coronal sections. The clinical and laboratory details of the patient were obtained from the CT requisition form and patient case file. This was followed by assessment of severity of acute pancreatitis using both CSI (Tables 1a, 1b and 1c) and MCSI (Tables 2a, 2b and 2c). Accordingly, severity of AP was graded as mild, moderate and severe based on the scores.
CT severity index (CSI)\textsuperscript{10}

Table 1a. Grading of acute pancreatitis by CSI with allocation of points to each grade.

| GRADE  | CT findings                                                                 | Points |
|--------|-----------------------------------------------------------------------------|--------|
| A      | Normal pancreas                                                             | 0      |
| B      | Focal or diffuse enlargement of the pancreas including irregularity of gland contour, inhomogenous attenuation, dilatation of pancreatic duct and foci of small fluid collections within the gland, where there was no evidence of peri-pancreatic changes. | 1      |
| C      | Abnormalities of pancreas which were intrinsic associated with hazy streaky densities representing inflammation in the surrounding peri-pancreatic fat. | 2      |
| D      | A single ill-defined fluid collection (phlegmon).                          | 3      |
| E      | Two or multiple, ill-defined collections of fluid or evidence of gas within or surrounding to the pancreas. | 4      |

Table 1b. Assessment of presence & extent of pancreatic necrosis in AP by CSI with allotment of points.

| Percentage of necrosis (%) | Points |
|----------------------------|--------|
| Absent                     | 0      |
| <30                        | 2      |
| 30–50                      | 4      |
| >50                        | 6      |

Table 1c. Total points from CT grading of AP (Table 1a) & assessment of pancreatic necrosis (Table 1b) were combined to get CSI score with categorization of severity.

| Severity of AP | CSI score |
|----------------|-----------|
| Mild           | 0 to 3    |
| Moderate       | 4 to 6    |
| Severe         | 7 to 10   |

Modified CT Severity Index (MCSI)\textsuperscript{10}

Table 2a. Grading of acute pancreatitis by MCSI with allocation of points to each grade.

| CT findings                                                                 | Points |
|----------------------------------------------------------------------------|--------|
| Normal pancreas                                                            | 0      |
| Intrinsic pancreatic abnormalities with or without inflammatory changes in peri-pancreatic fat | 2      |
| Pancreatic or peri-pancreatic fluid collection or peri-pancreatic fat necrosis | 4      |

Table 2b. Assessment of presence & extent of pancreatic necrosis in AP by MCSI with addition of extra-pancreatic complications & allotment of points.

| Percentage of necrosis (%)                                                                 | Points |
|-------------------------------------------------------------------------------------------|--------|
| Absent                                                                                    | 0      |
| <30                                                                                       | 2      |
| >30                                                                                       | 4      |
| Extra-pancreatic complications (one or more of pleural effusion, ascites, vascular complications or gastrointestinal tract involvement) | 2      |
Wherever available Ranson’s criteria score was noted down from patient case file and the correspondence of both the CT indices were studied with respect to the Ranson’s criteria. Ranson’s criteria score consists of 11 prognostic parameters, out of which five parameters are assessed at the admission and six parameters are assessed during initial 48 hours of hospital stay (Tables 3a and 3b).

### Table 2c. Total points from CT grading of AP (Table 2a) & assessment of pancreatic necrosis with extra-pancreatic complications (Table 2b) were combined to get MCSI score with categorization of severity.

| Severity of AP | MCSI score |
|----------------|------------|
| Mild           | 0 to 2     |
| Moderate       | 4 to 6     |
| Severe         | 8 to 10    |

**Ranson’s criteria**

Ranson’s criteria score was noted down from patient case file and the correspondence of both the CT indices were studied with respect to the Ranson’s criteria. Ranson’s criteria score consists of 11 prognostic parameters, out of which five parameters are assessed at the admission and six parameters are assessed during initial 48 hours of hospital stay (Tables 3a and 3b).

### Table 3a. Assessment of five prognostic parameters of Ranson’s criteria at admission.

| Prognostic factors assessed at the time of admission |
|-----------------------------------------------------|
| Age more than 55 years                              |
| WBC Count more than 16,000 cells/mm³                |
| Blood Glucose more than 200 mg/dL                   |
| Serum glutamic oxaloacetic transaminase (AST) more than 250 U/L |
| Serum Lactate dehydrogenase (LDH) more than 350 U/L |

### Table 3b. Assessment of remaining six parameters of Ranson’s criteria during the first 48 hours of hospital stay.

| Prognostic factors assessed during initial 48 hours of hospital stay |
|---------------------------------------------------------------------|
| Serum calcium <8.0 mg/dL (<2.0 mmol/L)                               |
| Haematocrit fall > 10%                                              |
| Arterial oxygen tension (PO₂) < 60 mmHg                             |
| Blood urea nitrogen increase by 5 mg/dL or more despite intravenous fluid hydration |
| Base deficit > 4 mEq/L                                               |
| Sequestration of fluids >6 L                                        |

**Ranson’s score interpretation**

Ranson’s score of 0 or 1 suggests complications will not develop in AP and mortality is negligible. On the other hand, Ranson’s score of 3 or more predicts severe AP with possible mortality. The mortality in AP is directly proportional to Ranson’s criteria score (Table 3c).

### Table 3c. Shows percentage of mortality with respect to the Ranson’s criteria score.

| Ranson’s criteria score | Mortality (%) |
|-------------------------|---------------|
| 0–2                     | 0–3           |
| 3–4                     | 15            |
| 5–6                     | 40            |
| 7–11                    | 100           |
The clinical outcome parameters\textsuperscript{9,10} were noted down from all the patient case files and its association with CT severity indices were studied and are as follows:

1. The extent of hospital or intensive care unit (ICU) stay (greater than or equal to 15 days);
2. Requirement of critical care, (Arterial oxygen tension ($PO_2$) $<$60 mmHg or requirement of ventilation, systolic blood pressure (BP) $<$90 mmHg);
3. Requirement for (surgical/percutaneous) intervention (like drainage and aspiration);
4. Evidence of infection, (combination of a fever more than 100°F and elevated WBC count greater than 15,000 cells/mm);
5. Existence of organ failure (Arterial $PO_2$ $<$60 mmHg or requirement of ventilation, serum creatinine of $>$3 mg/dL or urine output of $<$500 mL per 24 h and systolic BP of $<$90 mmHg); and
6. Death.

Outcome Variables that were studied are as follows:

- Sensitivity, specificity, positive predictive value, negative predictive value and accuracy of CSI and MCSI with respect to clinical outcome parameters like mean hospital stay, requirement of critical care, superadded infection, MODS, requirement of intervention & mortality.
- Concordance of CSI and MCSI with the score of Ranson’s criteria.

Statistical analysis
The data was collected on a pre-designed study proforma. Qualitative data was expressed as percentage and frequency. Chi-Squared test was used to assess the association among the qualitative variables. The level of significance was represented by p-value of less than 0.05. Screening efficacy was computed using standard formulae. Wherever necessary, the results were graphically represented. Pearson correlation was used to assess the magnitude and direction of association between CSI and MCSI with Ranson’s score. Receiver operating characteristics (ROC) curves were used to compare the role of CSI and MCSI in predicting the mortality in AP with r value from +1 to −1. The r value of +0.1 to +1.0 and −0.1 to −1 was suggestive of positive, zero and negative correlation respectively. Area under the curve (AUC) between CSI and MCSI as predictor of mortality was analyzed. Statistical package for social sciences (SPSS) version 21.0 (RRID:SCR_002865) and Microsoft Excel 2010 (RRID:SCR_016137) were used for most of the analysis and graphical representation respectively.

Results
Demographics
The patients with AP in this study were more or less equally distributed across all the decades from the 2nd to 6th decade with a mean age of 44.41 years. There was clear male predominance of 77.5% with 22.5% female patients with a male-to-female ratio of 3.5:1. The most common cause for acute pancreatitis was alcoholism (56.3%) followed by gallstones (28.8%).

Severity grading on CT by MCSI and CSI
As per MCSI, more than half of patients (56%) with AP had mild disease, about one-third of them (36.3%) had moderate disease, and a small percentage (7.5%) had severe disease (Figure 1). As per CSI, about half of patients (52.5%) with AP had moderate disease, about one-fourth of them (26.3%) had severe mild disease, and 21.3% had mild severe disease (Figure 1).

Association of MCSI and CSI score with the clinical outcome parameters
1) Requirement of the critical care

Based on the MCSI score, all the patients with severe AP (100.0%) required critical care, 82.8% of moderate disease needed critical care, and only third one-third of patients with mild disease (31.1%) needed intensive care with (p<0.01) (Figure 2). The overall sensitivity and specificity for the prediction of critical care requirement was 85.7% and 68.9%.
respectively with an accuracy of 77.2%. As per the CSI score, most (95.2%) of severe disease, about half (52.4%) of moderate disease, and a small percentage (11.8%) of mild disease required critical care (p<0.01) (Figure 2). The overall sensitivity and specificity for the prediction of critical care requirement were 66.7% and 88.2% respectively with an accuracy of 73%.

2) Development of superadded infection

As per MCSI, the superadded infection was seen in 83%, 41% and 4% of severe, moderate and mild disease of AP respectively (p value<0.01) (Figure 3). The overall sensitivity and specificity were 49% & 96% respectively with an accuracy of 76% in predicting superadded infection in AP patients. Based on the CSI score, there was no (0.0%) superadded infection in mild disease, while it was present in slightly less than half (47.6%) of severe disease and about
1.4% in moderate disease ($p<0.01$) (Figure 3). Hence the overall specificity & sensitivity for prediction of the presence of superadded infections were 100.0% and 30.2% respectively with an accuracy of 64.5%.

3) Development of multiple organ dysfunction syndrome (MODS)

As per MCSI, MODS developed in 15.6% of mild, 58.6% of moderate and 83.3% of severe AP ($p<0.01$) (Figure 4). Overall sensitivity & specificity for prediction of development of MODS were 62.9% and 84.4% respectively with an accuracy of 74.4% respectively. As per the CSI score, there was no (0.0%) development of MODS in mild disease. On the contrary, most (95.2%) of severe disease and 21.4% percentage of moderate disease developed MODS (Figure 4). The overall specificity & sensitivity for the prediction of the development of MODS was 100.0% and 40.0%, respectively, with an accuracy of ~69.8%.

![Figure 3. Bar diagram showing the MCSI and CSI score association with the superadded infection development.](image1)

![Figure 4. Bar diagram showing the MCSI and CSI score association with the development of MODS.](image2)
4) Requirement of intervention

As per MCSI, intervention was performed in 55.6% of mild, 65.5% of moderate & 83.3% of severe cases of AP (p<0.01) (Figure 5). The overall sensitivity & specificity for prediction of the requirement of intervention was 68.6% and 44.4% respectively with an accuracy of 56.6%. As per CSI score, approximately three-quarters (76.2%) of patients with severe AP required intervention, 61.9% of patients with moderate disease and 41.2% of patients with mild disease required intervention (p<0.01) (Figure 5). The overall sensitivity and specificity for prediction of the requirement of intervention by CSI was ~66.7% and ~58.8%, respectively, with an accuracy of ~60.9%.

Comparison of screening efficacy of MCSI and CSI with clinical outcome parameters

The MCSI score showed good sensitivity and specificity for the development of MODS, good sensitivity for predicting the requirement for critical care and intervention, and good specificity for the development of superadded infection (Figure 6a).

**Figure 5.** Bar diagram showing association of MCSI & CSI score with the requirement of intervention.

**Figure 6a.** Shows screening efficacy of MCSI score with clinical outcome parameters.
CSI score showed high specificity for the development of MODS and superadded infection. The overall accuracy is better with the MCSI score than the CSI score for the prediction of the requirement of critical care, development of superadded infection & development of MODS. Both MCSI and CSI scores had low accuracy in predicting the requirement of intervention (Figure 6b).

**Association of MCSI and CSI score with mortality**

As per the MCSI score, the mortality rate was 67% in severe AP, 24.1% in moderate disease and 2.2% in mild disease (Figure 7). The overall specificity and sensitivity for the mortality prediction were 91% and 33%, respectively, with an accuracy of 87.5%. As per the CSI score, the mortality rate was highest for severe AP (43%) followed by moderate AP (7%) and nil (0%) in mild AP (Figure 7). The overall sensitivity & specificity for prediction of mortality was 75% and 82.4%, respectively, with an accuracy of 73.8%.

**Figure 6b.** Shows screening efficacy of CSI score with clinical outcome parameters.

**Figure 7.** Bar diagram showing the association of MCSI & CSI score with mortality.
Association of MCSI score with mean hospital stay
The mean hospital stay by MCSI was highest in the moderate grade of AP with ~22 days as compared to approximately 12 & 13 days in mild & severe disease respectively (p<0.01) (Table 4a).

The mean hospital stay as per CSI score was significantly higher in moderate and severe grade of acute pancreatitis, corresponding to approximately 18 and 19 days, respectively, as opposed to approximately 8 days in mild disease (p<0.01) (Table 4b).

Correlation analysis for MCSI & CSI scores with Ranson's criteria
Ranson’s criteria score was available with 31 out of 80 patients (38.8%). There was significant correlation between Ranson’s criteria and both CT severity indices (CSI and MCSI) but the correlation was highly statistically significant and better with the MCSI score (r=0.53; p<0.01) as compared to the CSI score (r=0.35; p=0.04) (Table 5, Figures 8a & 8b).

Table 4a. Shows the association of MCSI with mean hospital stay.

| MCSI Score | N   | Mean hospital stay (days) |
|------------|-----|--------------------------|
| Mild       | 45  | 12.27                    |
| Moderate   | 29  | 22.14                    |
| Severe     | 6   | 13.33                    |
| Total      | 80  | 15.93                    |

Table 4b. Shows the association of CSI with mean hospital stay.

| CSI Score | N   | Mean hospital stay (days) |
|-----------|-----|--------------------------|
| Mild      | 17  | 7.53                     |
| Moderate  | 42  | 17.95                    |
| Severe    | 21  | 18.67                    |
| Total     | 80  | 15.93                    |

Association of MCSI score with mean hospital stay
The mean hospital stay by MCSI was highest in the moderate grade of AP with ~22 days as compared to approximately 12 & 13 days in mild & severe disease respectively (p<0.01) (Table 4a).

The mean hospital stay as per CSI score was significantly higher in moderate and severe grade of acute pancreatitis, corresponding to approximately 18 and 19 days, respectively, as opposed to approximately 8 days in mild disease (p<0.01) (Table 4b).

Correlation analysis for MCSI & CSI scores with Ranson's criteria
Ranson’s criteria score was available with 31 out of 80 patients (38.8%). There was significant correlation between Ranson’s criteria and both CT severity indices (CSI and MCSI) but the correlation was highly statistically significant and better with the MCSI score (r=0.53; p<0.01) as compared to the CSI score (r=0.35; p=0.04) (Table 5, Figures 8a & 8b).

Table 5. Shows Pearson correlation of MCSI & CSI scores with Ranson's criteria score.

| Pearson co-relation | r-value | p-value |
|---------------------|---------|---------|
| Ranson's criteria   |         |         |
| CSI Score           | 0.35    | 0.040   |
| MCSI Score          | 0.53    | <0.01   |

Figure 8a. Scatter plot between CSI score (x-axis) with Ranson's criteria score (y-axis) which shows a positive correlation with Pearson correlation coefficient (r-value) of 0.35.
Figure 8b. Scatter plot between MCSI score (x-axis) with Ranson's criteria score (y-axis) which shows a positive correlation with Pearson correlation coefficient (r-value) of 0.53.

Table 6. Shows area under the curve (AUC) analysis of CSI, MCSI & Ranson's score in predicting mortality in AP.

| Test result variable(s) | Area | SE  | p-value | Asymptotic 95% confidence interval |
|-------------------------|------|-----|---------|-----------------------------------|
|                         |      |     |         | Lower bound | Upper bound |
| MCSI Score              | 0.788| 0.082| <0.001  | .627       | .949       |
| CSI Score               | 0.886| 0.065| <0.001  | .759       | 1.014      |
| Ranson score            | 0.990| 0.014| <0.001  | .962       | 1.017      |

Figure 9. ROC curve analysis of CSI, MCSI & Ranson criteria scores shows CSI (red coloured graph), MCSI (blue colored graph) & Ranson score (green colored graph) as significant predictors of mortality in AP with Ranson score being near perfect & best predictor of mortality in AP, better than both CSI & MCSI with CSI being better mortality predictor than MCSI (orange coloured graph is reference line).
ROC Curve analysis of MCSI, CSI & Ranson’s score for prediction of mortality

According to ROC Curve analysis, CSI, MCSI & Ranson’s scores were significant predictors of the development of mortality in AP. However, the area under curve (AUC) was near perfect and the best predictor of the mortality (AUC 0.990; 95% CI: 0.962-1.017) of AP followed by CSI score (AUC: 0.886; 95% CI: 0.759-1.014) which is better predictor of mortality than the MCSI score (AUC: 0.788; 95% CI: 0.627-0.949) (Table 6 & Figure 9).

Discussion

Contrast-enhanced computed tomography of the abdomen is the imaging modality of choice and is the gold standard in diagnosing AP. The necrotizing form of AP, though less common, if present, is associated with a myriad of life-threatening complications. Among all the diagnostic tests available, CT has the highest diagnostic accuracy in detecting pancreatic necrosis. Steinberg et al. in their study suggested the evidence that 80 to 90% of AP was due to cholelithiasis & chronic alcoholism. Our study suggests evidence of alcoholism as the most common etiological factor for AP (56.3%) followed by gallstones (28.8%). Similar evidence was suggested by Wongnai et al. in their study on 90 patients of AP, where alcoholism and pancreaticobiliary ductal calculi were reported as an aetiological factor in 60% and 18% of patients respectively. In India, alcohol consumption is predominantly seen in males (male-to-female ratio of 24.3:1). The suggestive evidence of alcohol abuse as the commonest aetiological factor of AP combined with the male predominance of alcohol consumption in India explains the male to female preponderance (3.5:1) in this study. Similar evidence was suggested by Dugernier T L et al. and Balthazar EJ et al.

On the contrary, Raghuwanshi S et al. suggested the evidence of most common aetiology for AP as cholecystolithiasis (42%) followed by alcoholism (38%) with remaining 20% aetiology for AP belonged to rest category which included idiopathic, trauma and drug induced cases (24%, 2% and 2% respectively). Casas et al. in their study on 148 patients suggested cholelithiasis (57%) as the most common aetiological factor for AP followed by alcoholism (21%) with both together contributing to another 5% of AP patients. Bollen TL et al. and Jauregui et al. also suggested the evidence of cholelithiasis as the predominant aetiological factor for AP.

Severity of AP

This study is comparative analysis between MCSI and CSI grading systems in assessing severity and clinical outcome. Majority of the patients with AP belonged to mild category as per MCSI and moderate category as per CSI. This resulted in a small group of patients who had different categories of severity by CSI and MCSI. The present study suggests MCSI to be more accurate predictor of severity than CSI as it predicted clinical outcome more accurately in those patients who were differently categorized in severity by CSI. This better prediction of severity and clinical outcome by MCSI in AP may be attributable to inclusion of extra-pancreatic complications of AP like ascites, pleural effusion, vascular complications and gastrointestinal complications in the assessment of MCSI which are not included in CSI. Kondekar S et al. and Banday et al. suggested partially opposing evidence from our study where the majority of the patients by MCSI belonged to the mild category as per our study and the majority of the patients belonged to the severe category as per CSI unlike our study.

Clinical outcome parameters

Banday et al. in their study suggested evidence of increasing mean duration of hospital stay with increasing severity by MCSI score and concluded that the duration of mean hospital stay is directly proportional to severity grading by MCSI system in acute pancreatitis.

Our study suggests mean hospital stay in AP by CSI score is significantly longer in moderate and severe disease as compared to mild disease (p<0.01) whereas the mean hospital stay by MCSI is significantly longer in moderate disease as compared to mild and severe disease (p<0.01). This can be attributed to the fact that mild cases were discharged relatively early from the hospital in contrast to moderate category cases, and very severe cases had higher mortality with fewer hospital stays.

Overall in the present study, MCSI score showed good sensitivity for prediction of requirement of critical care, development of MODS and requirement of intervention. MCSI showed good specificity for MODS and development of superadded infection. CSI showed high specificity for MODS and development of superadded infection. Overall accuracy of MCSI was better than CSI for prediction of requirement of critical care, development of superadded infection and development of MODS. Both scores showed lower accuracy with regard to requirement of intervention.
The sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) of MCSI in predicting severity according to the study by Bollen TL et al. were 71%, 93%, 69% and 94%, respectively. This study suggested evidence of an accurate correlation of clinical scoring systems with systemic complications & mortality in AP. The study also suggested evidence that the radiological scoring system was more accurate in predicting the severity of acute pancreatitis, superadded infection and need for intervention than the clinical scoring system. Among the two radiological scoring systems, the study suggested no evidence of significant differences between CSI and MCSI in predicting the severity of acute pancreatitis.

Bollen et al. suggested CSI showed better sensitivity, specificity, PPV and NPV than MCSI. Whereas Jauregui-Arrieta LK et al. suggested different evidence where MCSI showed better sensitivity, specificity and PPV than CSI in severe AP and concluded that MCSI is a better screening test than CSI in severe AP. Sharma et al. suggested sensitivity and NPV is better with MCSI (98.6% and 90%, respectively) than CSI (87.3% and 57.1%, respectively) with similar PPV for both (~74%) and low specificity of 26.5% and 35.3% for MCSI and CSI, respectively.

**Ranson’s criteria**

The present study shows a significant correlation between Ranson’s criteria and both severity indices on CT (CSI and MCSI), but the correlation of MCSI with Ranson’s criteria is highly statistically significant, which suggests that MCSI is a better predictor of severity and clinical outcome than CSI.

On receiver operating characteristic (ROC) curve analysis, the present study suggests evidence that both CSI and MCSI are significant predictors of development of mortality in AP. However, the area under curve was significantly higher for CSI score (AUC: 0.886; 95% CI: 0.759-1.014) as compared to MCSI (AUC: 0.788; 95% CI: 0.627-0.949) which suggests CSI as a better predictor of mortality in AP than MCSI. The AUC for Ranson’s score was significantly highest with near complete to 1 (AUC: 0.990; 95% CI: 0.962-1.017) indicating that it is the best predictor of mortality in AP than both the CT severity indices.

Mangalanandan S et al. suggested evidence of strong correlation between Ranson’s criteria and MCSI with mild and severe forms of AP showing 100% agreement with each other. But moderate category in MCSI score had disagreeing results because Ranson’s criteria has only mild and severe categories due to which moderate category patients could not be studied. Their study suggested that MCSI (sensitivity of 93.33% and specificity of 54.17%) is more sensitive but less specific than Ranson’s criteria (sensitivity of 80% and specificity of 83.3%) in predicting actual outcome of AP. Although Chand P et al. suggested evidence of lack of statistical significant difference between Ranson’s criteria and MCSI in evaluation of the outcome of AP with respect to the systemic complications, there was statistically significant difference between MCSI and Ranson’s criteria with respect to local complications with increased incidence of local complications with higher Ranson’s criteria. The uniqueness of this study is that there was no other study in the literature comparing both radiological severity indicators CSI & MCSI with Ranson’s score alone in this combination at the time of conceptualization of this study. There were studies comparing CSI alone or MCSI alone with Ranson score or correlating radiological scores (CSI/MCSI) with multiple clinical scoring systems in various combinations. One of the drawbacks of the study was pediatric patients below the age of 12 years were not included as Ranson’s criteria is not done for them in our hospital. Also, a smaller sample size which may increase the margin of error when compared to a study with a relatively larger sample size. Third drawback is the lack of availability of Ranson’s criteria score in 61.2% of the patients in the study due to the usage of various other alternative clinical grading systems like Revised Atlanta Classification, Acute Physiology and chronic health evaluation (APACHE) II & Bedside index of severity in acute pancreatitis (BISAP) by the treating clinician. These alternative clinical grading systems are affordable, quick & require less effort in assessing the severity of AP than Ranson’s criteria. Since no single scoring system can universally predict the patient outcome perfectly, it is a limitation of the study. There is a delay of at least 48 hours to obtain the complete Ranson’s score, and CSI & MCSI can only be obtained after at least 48-72 hours of admission. This delay of 48-72 hours in obtaining scores leads to lesser sensitivity in the very early stage of the disease.

**Conclusion**

Both CSI and MCSI are better predictors of severity, clinical outcome, and mortality, with Ranson’s criteria being the best predictor of mortality & CSI being a better predictor of mortality than MCSI in patients with AP. The accuracy of MCSI is better than CSI for the prediction of the requirement of critical care, development of superadded infection, and development of MODS. Both CSI and MCSI scores have low accuracy in predicting the intervention requirement in AP patients.
Data availability

Underlying data

Mendeley: Underlying data for ‘Comparative analysis of computed tomography severity indices in predicting the severity and clinical outcome in patients with acute pancreatitis’, https://doi.org/10.17632/htkzkr9zbr.2.25

Data are available under the terms of the Creative Commons Attribution 4.0 International license (CC-BY 4.0).

Acknowledgment

We would like to acknowledge Dr. Ashvini Kumar, Former Head of Department and former Professor of Radiodiagnosis at Kasturba Medical College, Mangalore, Manipal Academy of Higher Education, Manipal, India, who provided insight and expertise that greatly assisted this research. We acknowledge Dr. Sushrit A Neelopant, Assistant Professor, Department of Community Medicine, Raichur Institute of Medical Sciences, Raichur for statistical analysis of this study. We also acknowledge Dr. Rajat Choudhary, a former postgraduate resident in the Department of General Surgery at Kasturba Medical College, Mangalore, Manipal Academy of Higher Education, Manipal, India for providing surgical insight to this study.

References

1. Frossard JL, Steer ML, Pastor CM: Acute pancreatitis. Lancet. 2008; 371: 143–152. PubMed Full Text
2. Balthazar EJ: Acute Pancreatitis: Assessment of Severity with Clinical and CT Evaluation. Radiology. June 2002; 223(3): 603–613. PubMed Full Text
3. Mortele KJ, Wiesner W, Intriere L, et al: A Modified CT Severity Index for Evaluating Acute Pancreatitis: Improved Correlation with Patient Outcome. AJR. 2004; 183: 1261–1265. PubMed Abstract | Publisher Full Text
4. Zhao K, Adam SZ, Keswani RN, et al: Controversies in clinical pancreatology: management of acute idiopathic recurrent pancreatitis. Pancreas. 2003 Aug; 27(2): 103–117. PubMed Full Text
5. Ranson, Glasgow, MOF, APACHE-II, and CTSI scores in predicting the severity of acute pancreatitis. Am. J. Gastroenterol. 2010; 105(2): 435–441. PubMed Abstract | Publisher Full Text
6. Basit H, Ruan GJ, Mukherjee S: ‘Ranson Criteria’ in StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2022 Jan. Reference Source
7. Alberti P, Parado E, Mata R, et al: Evaluation of the modified computed tomography severity index (MCSTIS) and computed tomography severity index (CTSI) in predicting severity and clinical outcomes in acute pancreatitis. J. Dig. Dis. 2021; 22: 41–48. PubMed Abstract | Publisher Full Text
8. Leung TK, Lee CM, Lin SY, et al: Balthazar computed tomography severity index is superior to Ranson criteria and APACHE II scoring system in predicting acute pancreatitis outcome. World J. Gastroenterol. 2005; 11(38): 6049–6052. PubMed Abstract | Publisher Full Text | Free Full Text
9. Kumar AH, Griwan MS: A comparison of APACHE II, BISAP, Ranson’s score and modified CTSI in predicting the severity of acute pancreatitis based on the 2012 revised Atlanta Classification. Gastroenterol. Rep (Dove). 2018 May; 6(2): 127–131. PubMed Abstract | Publisher Full Text
10. Kondeskar S, Minne I: Assessment of acute pancreatitis using CT severity index and modified CT severity index: A tertiary care hospital based observational study. Int. J. Radiol. Diagn. Imaging. 2020; 3(7): 118–122. Publisher Full Text
11. Abu-Eshy SA, Abolfotouh MA, Nawar E, et al: Ranson’s criteria for acute pancreatitis in high altitude: do they need to be modified? Saudi J. Gastroenterol. 2008 Jan; 14(1): 20–23. PubMed Abstract | Publisher Full Text
12. Bhat MS: SBRs manual of surgery. 6th ed. India: Jaypee Brothers Medical Publishers (P) Ltd.; 2019.
13. Uroz T, Shoukat S, Bohkar I, et al: Diagnostic accuracy of contrast enhanced computed tomography (CECT) in detection of necrosis in acute pancreatitis by taking surgical findings as gold standard. J. Pak. Med. Assoc. November 2020; 70(11): 1930–1933.
14. Steinberg WM, Charlton MJ, Forssmark CE, et al: Controversies in clinical pancreatology: management of acute idiopathic recurrent pancreatitis. Pancreas. 2003 Aug; 27(2): 103–117. PubMed Full Text
15. Wongnai A, Mai WN: CT FINDINGS OF ACUTE PANCREATITIS IN MAHARAJA NAKORN CHIANG MAI HOSPITAL. Chiang Mai Med. J. 2007; 46(1): 45–53.
16. Balasubramani K, Paulson W, Chellappan S, et al: Sociodemographic Risk Factors of Alcohol Consumption in Indian Men and Women: Analysis of National Family Health Survey-4 (2015–16), a Nationally Representative Cross-Sectional Survey Front. Public Health. August 2021; 9: 1–10. PubMed Full Text
17. Dugernier TL, Laterre PF, Wittebol X, et al: Compartmentalization of the inflammatory response during acute pancreatitis: correlation with local and systemic complications. Am. J. Respir. Crit. Care Med. 2003 Jul; 168(2): 148–157. PubMed Abstract | Publisher Full Text
18. Balthazar EJ, Freyney PC, VanSonnenberg E: Imaging and intervention in acute pancreatitis. Radiology. 1994 Nov; 193(2): 297–306. PubMed Full Text
19. Raghuvanshi S, Gupta R, Vyas MM, et al: CT Evaluation of Acute Pancreatitis and Its Prognostic Correlation with CT Severity Index. J. Clin. Diagn. Res. 2016 Jun; 10(6): TC06–TC11. PubMed Abstract | Publisher Full Text
20. Casas JD, Diaz R, Valderas G, et al: Prognostic value of CT in the early assessment of patients with acute pancreatitis. Am. J. Roentgenol. 2004 Mar; 182(3): 569–574. PubMed Abstract | Publisher Full Text
21. Bollen TL, Singh VK, Maurer R, et al: Comparative evaluation of the modified CT severity index and CT severity index in assessing severity of acute pancreatitis. Am. J. Roentgenol. 2011 Aug; 197(2): 386–392. PubMed Abstract | Publisher Full Text
22. Jakregui-Ariteta LK, Alvarez-Lopez F, Cobian-Machuca H, et al: Effectiveness of the modify tomographic severity index in patients with severe acute pancreatitis. Rev. Gastroenterol. Mex. 2008; 73(3): 144-148. PubMed Abstract
23. Banday IA, Gattoo I, Khan AM, et al: Modified Computed Tomography Severity Index for Evaluation of Acute Pancreatitis and its Correlation with Clinical Outcome: A Tertiary Care Hospital Based Observational Study. J. Clin. Diagn. Res. 2015 Aug; 9(8): TC01–TC05. PubMed Abstract | Publisher Full Text
24. Bollen TL, Singh VK, Maurer R, et al: A comparative evaluation of radiologic and clinical scoring systems in the early prediction of severity in acute pancreatitis. Am. J. Gastroenterol. April 2012;
25. Sharma V, Rana SS, Sharma RK, et al.: A study of radiological scoring system evaluating extrapancreatic inflammation with conventional radiological and clinical scores in predicting outcomes in acute pancreatitis. Ann. Gastroenterol. 2015; 28(3): 399–404. PubMed Abstract

26. Mangalanandan S, Thomas DA, Benjamin G: Correlation of Modified Computed Tomography Severity Index with Ranson’s Criteria in Assessing Severity of Acute Pancreatitis. Int. J. Anat.

27. Chand P, Singh R, Singh DP, et al.: Evaluation of the Outcome of Acute Pancreatitis by Ranson’s Criteria and Modified CT Severity Index. Int. J. Contemp. Med. Surg. Radiol. 2017; 2(2): 58–61.

28. Noronha G, Parmar G, Poornima V: “COMPARITIVE ANALYSIS OF CT SEVERITY INDICES IN PREDICTING THE SEVERITY & CLINICAL OUTCOME IN PATIENTS WITH ACUTE PANCREATITIS”, Mendeley [DATASET], 2022; V2. Publisher Full Text
Open Peer Review

Current Peer Review Status: ?  ✓  ?

Version 2

Reviewer Report 20 August 2024

https://doi.org/10.5256/f1000research.168815.r304605

© 2024 Dawra S. This is an open access peer review report distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Saurabh Dawra
Postgraduate Institute of Medical Education and Research (PGIMER), Chandigarh, Punjab and Haryana, India

While the majority of queries have been addressed, I disagree that Atlanta criteria is based on CT findings. In fact, it is a clinical criteria.

To my mind the major shortcomings of the study are: Single center study with limited sample size. Use of Ranson's criteria which is cumbersome, multiple investigations have to be done repeatedly and is no longer the standard of care at other center’s. Plz mention how useful is your study in present day scenario: Does it guide us to early/late interventions, does it have prognostic utility to predict infections (ranson's criteria) uses a lot of parameters). Does it guide towards early organ support?

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Pancreas, Liver

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Reviewer Report 15 August 2024

https://doi.org/10.5256/f1000research.168815.r304604

© 2024 Xiao J. This is an open access peer review report distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Juan Xiao
Guilin Medical University, Guangxi, China

The authors have incorporated RANSON score in figure 9 (Table 6) which could be found that RANSON SCORE is better than MCSI Score or CSI Score in predicting mortality. RANSON score cutoff value got here could be used for analysis included RANSON score in figure 6.

**Competing Interests:** No competing interests were disclosed.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

---

**Version 1**

Reviewer Report 29 September 2023

https://doi.org/10.5256/f1000research.138249.r206452

© 2023 Xiao J. This is an open access peer review report distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Juan Xiao
Guilin Medical University, Guangxi, China

This study described the usefulness of modified CT severity index in the prediction of acute pancreatitis severity and outcome which is of clinical significance. However, there are still some issues which need to be addressed.

1. The authors should put the MSCI and SCI results compared to the same parameter together in one figure but not separately in Figure 1-5, 7.

2. The Ranson score result should be added in figure 6 and 9 in order to support your conclusion that MSCI is better than Ranson score in outcome prediction.

3. Did the MSCI score correlate to the etiologies of acute pancreatitis?

**Is the work clearly and accurately presented and does it cite the current literature?**

Yes

**Is the study design appropriate and is the work technically sound?**

Partly

**Are sufficient details of methods and analysis provided to allow replication by others?**

Yes
If applicable, is the statistical analysis and its interpretation appropriate?
I cannot comment. A qualified statistician is required.

Are all the source data underlying the results available to ensure full reproducibility?
Yes

Are the conclusions drawn adequately supported by the results?
Partly

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Biochemistry, baic medicine, acute pancreatitis

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Author Response 15 Mar 2024
Griselda Noronha

Dear Reviewer,
Thank you for your detailed review of our article titled "Comparative Analysis of Computed Tomography Severity Indices in Predicting the Severity and Clinical Outcome in Patients with Acute Pancreatitis" submitted to the F1000 Journal. We appreciate your time and effort in providing constructive feedback to enhance the quality of our research.

We acknowledge your suggestions.
1) Based on your feedback, we will revise the figures accordingly to incorporate the MSCI and CSI results compared to the same parameter together in one figure but not separately in Figure 1-5, 7. We are committed to addressing all your concerns and making the necessary revisions to strengthen the validity and impact of our findings. Your valuable input will undoubtedly improve the clarity and reliability of our study, and we are grateful for your insightful suggestions.

2) Regarding the addition of the Ranson score in Figures 6 and 9 of our manuscript to better support the conclusion that the MCSI is superior to the Ranson score in predicting clinical outcomes in patients with acute pancreatitis, we apologize for any confusion or oversight on our part in not including the Ranson score in the mentioned figures. It would be great if you could suggest how to incorporate the Ranson score in figure 6 and 9 as we are unable to figure it out. I discussed with my statistician and he was unable to figure it out. Hence your input would be greatly appreciated on this.

3) In our study we found that the most common etiology for acute pancreatitis was alcoholism followed by gall stones and third was idiopathic. we have not correlated MCSI with acute pancreatitis etiologies in our study.
We will promptly update the manuscript as per your recommendations and hope that these revisions will further enhance the significance and relevance of our research in the field of acute pancreatitis management.

Thank you once again for your thorough review and for guiding us to refine our work for publication in F1000 Journal.

Sincerely,
Griselda Philomena Noronha
Corresponding Author

*Competing Interests:* No competing interests were disclosed.

---

**Reviewer Report 29 September 2023**

https://doi.org/10.5256/f1000research.138249.r206377

© 2023 Trna J. This is an open access peer review report distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Jan Trna
Masaryk University, Brno, Czech Republic

Interesting topic with interesting results showing that CT results can predict severity well. This is probably not a completely new finding, however comparison with Ranson scoring system and showing that CTSI is better is interesting since CT is reproducible and not subjective. There are many new scoring systems and showing that good old CTSI is good is in my opinion a very good piece of evidence.

Is the work clearly and accurately presented and does it cite the current literature?
Yes

Is the study design appropriate and is the work technically sound?
Yes

Are sufficient details of methods and analysis provided to allow replication by others?
Yes

If applicable, is the statistical analysis and its interpretation appropriate?
Yes

Are all the source data underlying the results available to ensure full reproducibility?
Yes
Are the conclusions drawn adequately supported by the results?
Yes

**Competing Interests:** No competing interests were disclosed.

**Reviewer Expertise:** gastroenterology, endoscopy

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

---

**Author Response 15 Mar 2024**

Griselda Noronha

Thank you so much for your valuable comments and review report. Highly appreciate your feedback.

**Competing Interests:** No competing interests were disclosed.

---

**Reviewer Report 19 July 2023**

https://doi.org/10.5256/f1000research.138249.r182028

© 2023 Dawra S. This is an open access peer review report distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

---

**Saurabh Dawra**
Postgraduate Institute of Medical Education and Research (PGIMER), Chandigarh, Punjab and Haryana, India

**Introduction:**
1. I would recommend to change the first line that the disease has unpredicted severity. With the present level of research, we do have fair enough idea of predicted severity. The authors may rephrase the sentence.

2. While it is agreed that CTSI has its fair share of limitations, the same hasn’t been brought about clearly in the “Introduction” section.

3. Please bring out clearly why have you chosen Hanson’s criteria as comparison to CTSI. What about Atlanta classification?

**Methods:**
1. How was pancreatitis diagnosed?

2. What is your institutional protocol of managing pancreatitis?
3. At what stage of disease/day of illness was the CT done?

4. Do you perform all investigations as required to calculate Ranson’s criteria on all patients with AP?

5. What do you mean by critical care? What is your institute’s protocol in admitting the patients for critical care?

Discussion:

1. What is unique in your study? How is it different from other comparisons including meta analysis on the same topic?

2. What are your limitations?

Is the work clearly and accurately presented and does it cite the current literature?
Partly

Is the study design appropriate and is the work technically sound?
No

Are sufficient details of methods and analysis provided to allow replication by others?
No

If applicable, is the statistical analysis and its interpretation appropriate?
Partly

Are all the source data underlying the results available to ensure full reproducibility?
No

Are the conclusions drawn adequately supported by the results?
Partly

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Pancreas, Liver

I confirm that I have read this submission and believe that I have an appropriate level of expertise to state that I do not consider it to be of an acceptable scientific standard, for reasons outlined above.

Author Response 15 Mar 2024
Griselda Noronha

Thank you for your insightful questions regarding our manuscript. We appreciate the opportunity to clarify these points and ensure a comprehensive understanding of our study.
protocols and findings. Below, please find detailed responses to each of your queries:

**introduction:**

1. "I would recommend to change the first line that the disease has unpredicted severity. With the present level of research, we do have fair enough idea of predicted severity. The authors may rephrase the sentence" - Thank you so much for bringing this to us. We will surely rephrase this sentence.

2. "While it is agreed that CTSI has its fair share of limitations, the same hasn’t been brought about clearly in the “Introduction” section" - Again thank you for your valuable feedback. We shall do this change.

3. "Please bring out clearly why have you chosen Hanson’s criteria as comparison to CTSI. What about Atlanta classification?"
   a) The Ranson criteria was the first scoring system specifically designed to assess the severity and prognosis of acute pancreatitis & hence it is extensively studied and validated globally. Since its used since ages, it is a reliable tool.
   b) Ranson’s score is directly correlated with patient outcomes which means it is a clear prognostic indicator. High score at admission and at 48 hours later is associated with increased rate of mortality and morbidity which helps in stratifying patients according to the need for ICU admission and aggressive therapy.
   c) Ranson criteria is simpler and more straightforward, making it easier to apply in clinical settings, especially where immediate decisions are required while other scores like APACHE II requires more amount of data & is relatively complex to calculate.
   d) APACHE II and BISAP are non-specific to pancreatitis and are used in various critical care settings whereas Ranson’s criteria is specifically designed for acute pancreatitis.
   e) Though BISAP score is simple & easy to use, it predicts based on the assessment within first 24 hours of admission. It is relatively inferior in predicting the complications or mortality which can happen later in the course of illness. Ranson’s score is relatively superior to BISAP in this context as it considers assessment both at admission & 48 hours after admission.
   f) APACHE II is more complex, need more data to calculate and it is not specific to acute pancreatitis as compared to Ransons score.

4. **why not Atlanta Classification?** Atlanta classification is based on morphological assessment of acute pancreatitis severity on CT which usually takes place after at least 48-72 hours. Based on that we give CSI & MCSI scores. Till then Ranson’s score will provide early prognostic information before detailed imaging findings are available.

**Method:**

1. **How was pancreatitis diagnosed?**
The diagnosis of pancreatitis in our study followed a rigorous, multi-dimensional approach in line with established clinical guidelines. Initially, we considered the patient’s clinical presentation, including relevant history (e.g., alcohol consumption, gallstones), as well as symptoms like abdominal pain and vomiting. Objective findings such as ileus, fever,
tachycardia, and hypotension were also critical. Crucially, we substantiated our clinical suspicion through laboratory evidence, particularly elevated lipase and amylase levels, which were at least threefold above the upper limit of normal. Finally, imaging played a pivotal role in our diagnostic algorithm. Contrast-EnhancedComputed Tomography (CECT) of the abdomen or Ultrasound was utilized to confirm the diagnosis, adhering to the principle that the clinician's discretion, based on a synthesis of these data points, ultimately guided the diagnostic process.

2. Institutional protocol for managing pancreatitis
At our institution, the Department of Surgery manages pancreatitis cases. The management protocol begins at the point of presentation, where patients with symptoms indicative of pancreatitis or those evaluated for abdominal pain are assessed by the attending surgeon. Our approach prioritizes conservative management, including bowel rest, fluid resuscitation, and the administration of IV antibiotics and analgesics. Supportive measures such as supplemental oxygen, inotropic or ventilatory support, and transfusions for DIC are employed based on individual patient needs. Admission decisions—whether to the ward for mild cases or the ICU for those with significant organ dysfunction or unstable vitals—are made in accordance with the severity of the clinical presentation. Follow-up and further management, including imaging with CECT abdomen, are guided by established criteria, such as Ranson's criteria, and the clinical judgment concerning suspected complications.
Reference: (Banks PA, Freeman ML. Practice guidelines in acute pancreatitis. Am J Gastroenterol. 2006;101:2379–2400.)

3. At what stage of disease was CT done?
The timing for deploying CECT in our cases was carefully considered, primarily focusing on patients exhibiting signs of complicated pancreatitis, as defined by the Atlanta criteria, or when clinical suspicion of complications arose. Adhering to best practice, we generally deferred CT imaging for at least 48-72 hours following the onset of symptoms. This delay allows the acute inflammatory processes to stabilize, thereby enhancing diagnostic accuracy and informing subsequent management decisions, particularly in our ICU patients who are closely monitored for any signs of worsening or complications.
Reference: Busireddy KK, AlObaidy M, Ramalho M, Kalubowila J, Baodong L, Santagostino I, Semelka RC. Pancreatitis-imaging approach. World J Gastrointest Pathophysiol. 2014 Aug 15;5(3):252-70. doi: 10.4291/wjgp.v5.i3.252. PMID: 25133027; PMCID: PMC4133524.)

4) Do you perform all investigations as required to calculate Ranson's criteria on all patients with AP?
The investigations for Ranson's criteria were not performed for all cases but based on the clinical condition as per the discretion of the attending surgeon. Complete blood counts, glucose, calcium, liver and renal function tests and blood gas was performed at baseline for all cases whereas the post 48 hour investigations were done selectively based on the clinical condition of the patient. Based on the predicted severity, a decision to perform a CECT scan abdomen was taken.

5. What do you mean by critical care? What is your institute's protocol in admitting the
patients for critical care?

We had a Surgical intensive care unit at our hospital with ventilators and routine intensive care support systems. Unfortunately, there was no step-up or high dependency unit (HDU) facility available. Any patient who was found to have any organ dysfunction or features of shock was admitted to the ICU for monitoring and treatment and started on appropriate treatment. They were provided with supplemental oxygen, Non invasive ventilation (NIV) or endotracheal intubation with ventilation as and when required and hemodynamic support with transfusions or inotropic and pressor supports along with routine conservative management.

Discussion:

6) unique in our study:
There was no other study in the literature comparing both radiological severity indicators CSI & MCSI with Ranson's score alone in this combination at the time of conceptualization of this study. There were studies comparing CSI alone or MCSI alone with Ranson score or correlating radiological scores (CSI/MCSI) with multiple clinical scoring systems.

7) Limitations of study:
a) the patients who underwent CECT for acute pancreatitis but who were discharged against medial advice or lost for follow up could not be assessed and excluded from the study.
b) the study did not include patients below 12 years of age as Ranson's criteria is not done for paediatric patients in our hospital.
c) smaller sample size which may increase the margin of error when compared to a study with a relatively larger sample size.
d) Since no single scoring system can universally predict the patient outcome perfectly, it is a limitation of the study.
e) Ranson's score needs 48 hours to complete the score. CSI & MCSI is obtained after at least 48-72 hours of admission. So there is delay of obtaining scores and hence it has lesser sensitivity in very early stages of disease.

We trust these responses address your queries comprehensively. Our team is committed to delivering research that meets the highest standards of clinical rigor and transparency. Should you require further details or clarification, we are at your disposal.

Competing Interests: No competing interests were disclosed.
The benefits of publishing with F1000Research:

- Your article is published within days, with no editorial bias
- You can publish traditional articles, null/negative results, case reports, data notes and more
- The peer review process is transparent and collaborative
- Your article is indexed in PubMed after passing peer review
- Dedicated customer support at every stage

For pre-submission enquiries, contact research@f1000.com