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Original Research Article

A COMPARATIVE STUDY OF APACHE II AND CTSI SCORING SYSTEMS IN ACUTE ALCOHOLIC PANCREATITIS: PREDICTING MORTALITY, ORGAN FAILURE, AND SURGICAL INTERVENTIONS

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ABSTRACT

Background: APACHE II is the most widely used ICU scoring system helpful in predicting outcomes. CT severity index (CTSI) is a radiological scoring system which stratifies the severity of pancreatitis. It is useful in identifying the persons who need immediate surgical intervention. Comparison of both indices in patients with acute alcoholic pancreatitis in prediction of outcomes is the primary aim of this study.

Materials and Methods: Data of 75 patients was collected retrospectively from the health records. APACHE II scores were calculated based on the physiological parameters and biochemical markers measured within 24 hours of admission in the hospital. CECT scans of all patients were analyzed and CTSI was calculated. Appropriate statistical methods were employed to compare the predicting efficacy of both scoring systems.

Results: Although both APACHE II and CTSI were correlating significantly with the clinical outcomes, higher APACHE II scores were associated with higher rates of mortality and CTSI scores above 0.83 was indicative of need of surgical intervention.

Conclusion: Both APACHE II and CTSI scoring systems are excellent indicators of outcomes in patients with acute alcoholic pancreatitis. APACHE II scores utilize the physiological derangements while CTSI analyzes the anatomical abnormalities. Application of both scores will enable the treating physician to triage the patients and allocate resources who need the most, especially in a resource limited center.

Keywords: pancreatitis, alcohol, APACHE II, ICU, CTSI, contrast enhanced CT, surgery, mortality.

INTRODUCTION

AAP represents a critical medical emergency marked by inflammation of the pancreas secondary to excessive alcohol intake. It presents with severe pain abdomen along with elevated levels of pancreatic enzymes. It can lead to sepsis, multi-organ involvement and ultimately death, thus making the evaluation process of its severity essential. Amongst the various scoring systems available, APACHE II (Acute Physiology and Chronic Health Evaluation II) and CTSI (Computed tomography severity index) are the most commonly used, both having their own limitations and advantages.

APACHE II scoring system represents one of several measures used in ICU settings to assess patients because it rests upon multiple physiological criteria such as body temperature, pulse, oxygenation status, and biochemical parameters such as serum electrolytes and serum creatinine level. This scoring tool is the most frequently used tool for mortality prediction in intensive care, especially when applied within the first 24-48 hours of hospital admission.[1,2]

CTSI functions as an assessment system that uses contrast-enhanced computed tomography scans (CECT) for assessing pancreatitis severity. CTSI analyzes the anatomical changes of pancreas and extra-pancreatic tissues along with evidence of fluid collection. CTSI since the time of development by Balthazar has undergone multiple alterations throughout for further precise assessment of pancreatic and extra-pancreatic anatomy

With improved inter-observer reliability and prognostic accuracy compared to its previous versions, CTSI is an invaluable tool in predicting severity of pancreatitis.[3,4]

Although previous studies have analyzed the effectiveness of APACHE II and CTSI in predicting outcomes in AAP, studies comparing both scoring systems are scarce. Although, APACHE II scoring system provides a better prediction of progressing into multi-organ involvement in acute pancreatitis, CTSI scoring system give a better picture on the extent of inflammatory damage.[5,6]

This study aims to analyze and compare these two scoring systems in predicting the outcomes and need for surgery in patients with acute pancreatitis.

MATERIALS AND METHODS

This retrospective study was conducted in the Department of Radiology of a tertiary care center, over a period of one year (From November 2023 to October 2024). Patients who were diagnosed with acute pancreatitis secondary to alcoholic etiology were included in this study. Patients with other causes of acute pancreatitis, chronic pancreatitis incomplete medical data or insufficient imaging records were excluded. A total of 75 individuals were selected.

Demographic details of patients such as age, gender and residence were taken. Clinical history such as presenting complaints, history of alcohol abuse was recorded. Data on blood pressure, body temperature, heart rate, oxygenation status and Glasgow coma scale at the time of presentation was taken. Data on biochemical markers (serum electrolytes, serum creatinine, serum amylase and lipase) and imaging findings were collected. APACHE II scores were calculated based on the physiological and biochemical parameters within first 24 hours of admission.

All patients were subjected to CECT within 72 hours of admission and CTSI scores were calculated based on the extent of pancreatic inflammation, necrosis and peripancreatic fluid collections. SPSS software version 26.0 was used to perform all statistics. Pearson correlation coefficient was calculated and Receiver Operating Characteristic (ROC) curve analyses were used to validate APACHE II and CTSI scoring systems. P value of less than 0.05 was considered statistically significant.

RESULTS

Table 1: Demographic profile of study population

Characteristic		Results
Age (in years)	21–30	12 (16.0%)
	31–40	18 (24.0%)
	41–50	22 (29.3%)
	>50	23 (30.7%)
Gender distribution	Males	65 (86.7%)
	Females	10 (13.3%)
Alcohol Consumption history	Present	75 (100%)
Duration of alcohol consumption	<5 years	25 (33.3%)
	5-10	35 (46.67%)
	>10 years	10 (13.3%)

Most of the patients belong in the >50 years age group (30.7%), followed by 41-50 years age group (29.3%). The mean age of the study population was 44.1 ± 11.2 years with an age range of 29-67 years. The study has a male predominance (86.7%), consistent with higher rates of pancreatitis in males.

Alcohol consumption was present in all patients, with the majority (46.7%) consuming alcohol for 5–10 years. The mean duration of alcohol use is 6.3 ± 4.1 years with 2 -20 years range. The mean BMI was 29.45 ± 4.3 kg/m², indicating a significant prevalence of obesity.

Table 2: Clinical and Biochemical Characteristics at Admission (n=75)

Clinical/Biochemical Parameter	Mean ± SD (Range)
Serum Amylase (U/L)	1405 ± 360 U/L (800–2400)
Serum Lipase (U/L)	1020 ± 230 U/L (500–2150)
Serum Total Bilirubin	1.8 ± 1.0 mg/dL (0.4–3.5)
White Blood Cell Count (×10⁹/L)	12.8 ± 3.2 ×10⁹/L (8.5–20.1)
Serum Creatinine	1.8 ± 1.0 mg/dL (0.9–5.2)
Aspartate Aminotransferase (U/L)	270 ± 115 U/L (140–610)
Alanine Aminotransferase (U/L)	255 ± 95 U/L (120–550)
C-Reactive Protein (mg/L)	68.2 ± 15.4 mg/L(25–115)

Table 3: APACHE II Score Distribution and Clinical Outcomes (n=75)

APACHE II Score Range	Number of Patients (%)	Mortality (%)	Organ Failure (%)	Length of Hospital Stay (days)
0–9 (Mild)	28 (37.3%)	0 (0%)	1 (3.6%)	7.2 ± 3.8
10–15 (Moderate)	30 (40.0%)	4 (13.3%)	7 (23.3%)	12.4 ± 4.2
16–24 (Severe)	17 (22.7%)	6 (35.3%)	10 (58.8%)	17.5 ± 5.0

Mortality rates were significantly higher in the severe APACHE II score group (35.3%) ($P < 0.01$), compared to the mild and moderate groups. This shows the effectiveness of APACHE II in predicting mortality risk based on physiological parameters.

With increase in the APACHE II score, the incidence of organ failure increased significantly ($p < 0.01$). Organ failure was seen in 58.8% of the patients, thus indicating the importance of early risk stratification. Length of stay also increased with severity, indicating that more severe cases generally require prolonged hospitalization for intensive care.

Table 4: CTSI Score Distribution and Complications (n=75)

CTSI Score Range	Number of Patients (%)	Necrosis (%)	Fluid Collections (%)	Infections (%)
0–3 (Mild)	30 (40.0%)	0 (0%)	3 (10.0%)	2 (6.7%)
4–6 (Moderate)	32 (42.7%)	8 (25.0%)	14 (43.8%)	5 (15.6%)
7–10 (Severe)	13 (17.3%)	11 (84.6%)	18 (69.2%)	9 (69.2%)

Higher CTSI scores correlated strongly with a greater incidence of necrosis, fluid collections, infections, and the need for surgical interventions. The severe group (7-10) showed very high rates of these complications, indicating that the CTSI score is a strong predictor of the severity of pancreatitis and its complications. CTS scores demonstrate a reliable association with severe complications (p value <0.001) value.

Table 5: Predictive Accuracy of APACHE II and CTSI in Predicting Clinical Outcomes (ROC AUC Values)

Outcome Measure	APACHE II AUC (95% CI)	CTSI AUC (95% CI)
Mortality	0.88 (0.77–0.94)	0.79 (0.67–0.88)
Organ Failure	0.85 (0.75–0.91)	0.78 (0.67–0.87)
Surgical Intervention	0.71 (0.60–0.81)	0.83 (0.73–0.91)

The APACHE II score demonstrated excellent predictive ability for mortality (AUC = 0.88) and organ failure (AUC = 0.85), making it a robust tool for assessing the prognosis in critically ill patients.

With AUC = 0.83, CTSI was more efficient in predicting the need for surgical intervention than for predicting mortality and outcomes.

Table 6: Correlation between the clinical outcomes and scoring systems

Outcome Measure	APACHE II Score (r)	CTSI Score (r)
Mortality	0.60 ($p < 0.001$)	0.57 ($p < 0.001$)
Organ Failure	0.56 ($p < 0.001$)	0.52 ($p = 0.002$)
Need for Surgical Intervention	0.42 ($p = 0.02$)	0.75 ($p < 0.001$)
Length of Hospital Stay (days)	0.45 ($p = 0.01$)	0.50 ($p = 0.003$)

Both APACHE II and CTSI scores showed moderate to strong positive correlations with mortality and organ failure, suggesting that higher scores are associated with worse outcomes. The correlation between need for surgical intervention and CTSI scoring was strong ($r = 0.75$, $p < 0.001$), while positive correlation was seen for mortality and organ failure with APACHE II scores.

Table 7: Length of Hospital Stay Based on APACHE II and CTSI Scores

Severity Group		Mean Length of Stay (Days)
APACHE II Score	Mild APACHE II (0–9)	7.2 ± 3.8
	Moderate APACHE II (10–15)	12.4 ± 4.2
	Severe APACHE II (16–24)	17.5 ± 5.0
CTSI Score	Mild CTSI (0–3)	6.9 ± 3.3
	Moderate CTSI (4–6)	12.3 ± 4.0
	Severe CTSI (7–10)	18.0 ± 5.2

Both scoring systems showed a direct relationship with the length of stay. Patients with severe scores (APACHE II: 16–24, CTSI: 7–10) had the longest hospital stays, reinforcing that more severe cases of pancreatitis typically require prolonged hospitalization for management.

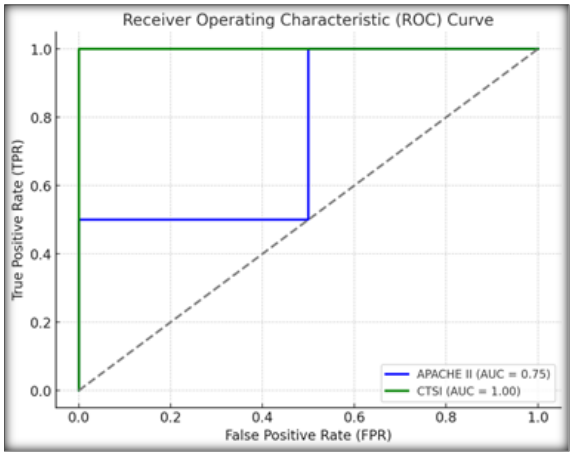

Figure 1: The ROC curve compares the predictive accuracy of APACHE II and CTSI scores for clinical outcomes

DISCUSSION

Acute pancreatitis is the one of most common cause of acute pain abdomen, especially in the backdrop of excessive alcohol intake. This study was conducted to evaluate the predictive accuracy of two of the most widely used severity scoring systems – APACHE II and CTSI in patients with acute alcoholic pancreatitis.

Most of the study participants in were males (46.7%) which is in concordance with several studies globally, in which males are most commonly affected.[1] Most of the patients included in this study were above 41 years (41-50 years – 29.73% and >50 years -30.7%) with a mean age of 44.1 ± 11.2 years. Papchristou et al,[6] also had observed a similar age pattern in their study.

In present study, 46.7% of the patients had a history of alcohol intake of 5-10 years duration which is similar to the findings of Balthazar et al,[7] who observed that longer duration of alcohol intake was associated with higher levels of pancreas related morbidity and mortality.

The mean BMI observed in this study was 29.45 ± 4.3 kg/m², which is suggestive that majority of the patients belong to obese category. This is similar to findings of GBD 2015 Pancreatitis Collaborators who linked obesity to a higher risk of developing pancreatitis.[8]

In present study, the mean serum amylase (1405 ± 360 U/L) and serum lipase (1020 ± 230 U/L) were significantly elevated. These are similar to the study findings of Singh et al,[9] who observed a similar mean value of serum amylase levels. Elevated serum bilirubin levels (1.8 ± 1.0 mg/dL) is suggestive of associated liver damage or biliary involvement which is similar to findings of GBD 2015 Pancreatitis Collaborators where patients with elevated serum bilirubin levels were found to have severe form of pancreatitis.[8]

Furthermore, the elevated white blood cell count (12.8 ± 3.2 ×10⁹/L) reflects the inflammatory response often seen in acute pancreatitis, as similarly noted in studies by Papachristou et al.[6] Serum creatinine levels of 1.8 ± 1.0 mg/dL suggest renal dysfunction, a common complication in severe pancreatitis, and elevated liver enzymes (AST: 270 ± 115 U/L, ALT: 255 ± 95 U/L) further support the presence of hepatic injury, as reported by Kuo et al.[10]

APACHE II Score Distribution and Clinical Outcomes

The distribution of APACHE II scores in the present study revealed a clear correlation between severity and clinical outcomes. Higher rates of mortality (35%) were seen in patients with severe APACHE II scores (16-24) than those with mild and moderate APACHE II scores. This is supported by the study findings by Knaus et al.[11] Additionally Papachristou et al,[6] reported that 59% of patients with severe category of APACHE II scores had increased prevalence of organ failure. The parallel rise in the duration of hospital stay with higher APACHE II scores was a finding observed in study by Wu et al.[4]

CTSI Score Distribution and Complications

In this study, patients with higher CTSI scores (7–10, severe) exhibited a significantly greater incidence of complications, including pancreatic necrosis (84.6%), fluid collections (69.2%), and infections (69.2%). These findings align closely with the research by Balthazar et al,[7] who established the CTSI as a reliable tool for identifying severe complications in acute pancreatitis, including necrosis and the need for surgical intervention. Similarly, Singh et al,[9] highlighted that elevated CTSI scores are strongly correlated with the development of local complications such as fluid collections and infected pancreatic necrosis. The present study's significant p-value (<0.001) further supports the robust predictive capacity of CTSI for complications, as documented in the literature.

Predictive Accuracy of APACHE II and CTSI in **Predicting Clinical Outcomes**

The predictive accuracy of both APACHE II and CTSI scoring systems was evaluated using ROC curves. For mortality, APACHE II demonstrated excellent predictive ability (AUC = 0.88), which is consistent with previous studies, including Papachristou et al,[6] who found similar AUC values for APACHE II in predicting mortality. For organ failure, APACHE II also outperformed CTSI (AUC = 0.85 vs. 0.78), reinforcing the finding that APACHE II is a strong predictor of adverse physiological outcomes, as reported by Kumar et al.[13] However, CTSI demonstrated superior predictive accuracy for surgical intervention (AUC = 0.83), highlighting its usefulness in assessing local complications, as noted by McKay et al. (2019), who similarly found CTSI to be highly predictive of the need for surgery in severe pancreatitis.[9]

Correlation Between APACHE II and CTSI Scores with Clinical Outcomes

Both APACHE II and CTSI scores were significantly correlated with clinical outcomes in this study. Mortality and organ failure were positively correlated with both scoring systems, as observed by Singh et al. (2009), who demonstrated similar correlations between APACHE II and CTSI with mortality and organ failure.[5] Additionally, CTSI had a notably stronger correlation with the need for surgical intervention (r = 0.75), indicating that CTSI is an effective tool for identifying patients who may require surgical intervention due to complications such as infected pancreatic necrosis. This finding is in line with McKay et al,[13] who also observed a strong correlation between CTSI and the need for surgical treatment.

Length of Hospital Stay Based on APACHE II and CTSI Scores

As expected, the length of hospital stay increased with the severity of both APACHE II and CTSI scores. Patients with severe APACHE II scores (16–24) had the longest stay (17.5 ± 5.0 days), a finding that supports the work of Petrov et al,[14] who reported similar correlations between disease severity and length of stay in acute pancreatitis.

CONCLUSION

Acute pancreatitis can progress to mulit-organ failure rapidly. Assessment of its severity and predictingits outcome is essential in this condition. The study highlights the observation that APACHE II score in comparison to CTSI score has the advantage of being easy to calculate in resource limited settings. However, CTSI with its excellent ability to predict surgical intervention in a patient scores over APACHE II scoring system thus avoiding the patient to deteriorate further. Combined use of both scoring systems is thus recommended. Further studies on larger cohort is required to strengthen the correlation.

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Conflicts of Interest: None declared.

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