# A COMPARATIVE EVALUATION OF BISAP, APACHE II AND CTSI SCORING SYSTEMS IN THE EARLY PREDICTION OF SEVERITY IN ACUTE PANCREATITIS

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**ABSTRACT**

**BACKGROUND**

Acute Pancreatitis (AP) is a common disorder with substantial burden on the healthcare system. The clinical course of AP is usually mild and often resolves without sequelae. Early, quick and accurate risk stratification of AP patients would permit evidence-based early initiation of intensive care therapy for patients with Severe AP (SAP) to prevent adverse outcomes and allow treatment of mild AP. Therefore, a reliable risk stratification tool to predict the severity and prognoses of AP is of great clinical importance for the management of this disease.

The aim of the present study is designed to compare the accuracy of BISAP to the traditional multifactorial scoring systems-APACHE II and CTSI in predicting disease severity, PNec and mortality.

**MATERIALS AND METHODS**

The present prospective observational study is carried out for a period of 2 years. 100 consecutive patients with acute pancreatitis according to inclusion and exclusion criteria were taken and were fully explained regarding the study and written informed consent was taken. Detailed case history and clinical examination was done. Vitals and GCS score were recorded. Necessary laboratory investigations were done. CECT of abdomen was done.

**RESULTS**

In the present study, among 100 patients, 60% are males and 40% are female patients. Mean age group of patients in present study is 37.82±10.73 years. The commonest aetiology alcohol accounted for 61% cases followed by idiopathic in 20% and gallstones in 16% cases. Severe acute pancreatitis developed in 20% of patients. Pancreatic necrosis developed in 14% of patients. In the present study, mortality is 6%. All the scoring systems are found to be comparable and good in the prediction of severe acute pancreatitis (AUC for BISAP - 0.80, APACHE II - 0.81, CTSI - 0.79). CTSI is more accurate (AUC - 0.96) in predicting PNec when compared to BISAP (AUC - 0.91) and APACHE II (AUC - 0.84). APACHE II is excellent (AUC - 1.00) in predicting mortality.

**CONCLUSION**

The present study concluded that all the scoring systems were found to be comparable and good in the prediction of SAP, whereas CTSI is more accurate in predicting PNec and APACHE II was excellent in predicting mortality.

**KEYWORDS**

Acute Pancreatitis, Pancreatic Necrosis, Mortality, BISAP, APACHE II and CTSI.

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## BACKGROUND

Acute Pancreatitis (AP) is a common disorder with substantial burden on the healthcare system. The clinical course of AP is usually mild and often resolves without sequelae. Nonetheless, between 10 and 20% of patients experience a Severe AP (SAP) attack resulting in an intense inflammatory response, a variety of local and systemic complications, a prolonged hospital course, significant morbidity and mortality.[1-4] However, the individual patient's response to pancreatic injury is highly variable and often unpredictable.

Early, quick and accurate risk stratification of AP patients would permit evidence-based early initiation of intensive care therapy for patients with Severe AP (SAP) to prevent adverse outcomes and allow treatment of Mild AP (MAP) on the common ward. Therefore, a reliable risk stratification tool to predict the severity and prognoses of AP is of great clinical importance for the management of this disease. An ideal scoring system should promise an early, quick, simple, accurate and reproducible description of disease severity.

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Currently, a variety of scoring systems are available to evaluate the severity of AP. However, all scoring systems have their own distinct pros and cons.

1. Bedside Index for Severity in Acute Pancreatitis (BISAP) has been proposed as an accurate method for early identification of patients at risk for in-hospital mortality by Wu et al in 2008.[5]
2. Acute Physiology and Chronic Health Evaluation (APACHE) II- It was originally designed to predict intensive care unit survival. APACHE II requires the collection of a large number of parameters some of which may not be relevant to AP prognosis, whereas other important measures such as pancreatic injury and significant regional complications are missed.[6,7]
3. Computed Tomography Severity Index (CTSI), Balthazar et al[8] developed this grading system based on Contrast-Enhanced CT scan (CECT) findings of AP and Pancreatic Necrosis (PNec). The CTSI, however, is based on local complications and has the drawback of not reflecting the systemic inflammatory response.
4. Ranson's score is moderately accurate in classifying patients in terms of severity, but has the disadvantage of requiring a full 48 hrs. to be completed missing a potentially valuable early therapeutic window.[9] In addition, it contains data not routinely ordered or collected during hospitalisation at the current time (e.g., lactate dehydrogenase, fluid sequestration and base deficit).

Thus, the current study focuses on comparing accuracy of BISAP to the traditional multifactorial scoring systems- APACHE II and CTSI in predicting disease severity, PNec and mortality based on the 2012 Revised Atlanta Classification.

## MATERIALS AND METHODS

The present prospective observational study is carried out in tertiary hospital at Gandhi Hospital, Secunderabad, from November 2013 to December 2015. Consecutive patients with acute pancreatitis were enrolled after inclusion and exclusion criteria are applied. Patients and relatives were fully explained regarding the study and written informed consent was taken. The study protocol was approved by Ethical Committee of the college and Dr. NTR University of Health Sciences, Vijayawada, AP.

### Inclusion Criteria

The patients with Acute Pancreatitis (AP) diagnosed according to Revised Atlanta Classification 2012, i.e. based on the presence of two of the following three features- 1. Abdominal pain characteristic of AP; 2. Serum amylase and/or lipase ≥3 ULN; and 3. Characteristics findings of AP on abdominal CT scan were enrolled in the study.

### Exclusion Criteria

Patients with age below 19 years, patients with chronic pancreatitis, pancreatic malignancy, history of pancreatic surgery, pregnant females, patients who did not underwent CECT abdomen and patients not giving informed consent were excluded from the study.

Demographic details of the patients noted. Detailed history of present and past clinical condition was taken.

The patients and their relatives were questioned on the probable cause of pancreatitis. History was also taken regarding pancreatotoxic drug intake, abdominal trauma and ERCP.

Pancreatitis was thought to be idiopathic if there was no history of alcohol or pancreatotoxic drug intake or abdominal trauma preceding the attack of acute pancreatitis and if investigations did not show gallstone, hypertriglyceridemia or hypercalcaemia.

Glasgow Coma Scale (GCS) score is calculated for each patient based on the best eye opening, motor and verbal response [E+M+V = 3 to 15]. GCS score is used to define the impaired mental status (GCS<15) in BISAP scoring and is one of the 12 physiologic variables used in the calculation of APACHE II score.

Vital data (temperature, pulse rate, respiratory rate and blood pressure) noted and complete clinical examination was done. Hemogram, blood urea nitrogen, serum creatinine, serum amylase/lipase, arterial blood gas analysis, random blood sugar, serum electrolytes and serum ionized calcium, liver function test, fasting serum triglycerides, ultrasound abdomen and chest x-ray were done within 24 hrs. of admission.

Contrast-Enhanced Computerised Tomography (CECT) abdomen was performed within 7 days.

Severity of AP was determined according to the 2012 Revised Atlanta Classification. Patients were classified as Severe Acute Pancreatitis (SAP) based on the presence of organ failure for more than 48 hrs. PNec was assessed by CECT abdomen. Evidence of PNec on CT was defined as lack of enhancement of pancreatic parenchyma with contrast.

### Score Calculation

BISAP and APACHE II scores were calculated using data from the first 24 hrs. after admission. CTSI was calculated from CECT abdomen done within 7 days.

BISAP score provides 1 point for 5 parameters (total 5 points)- 1) BUN greater than 25 mg/dL, 2) Impaired mental status (GCS <15), 3) SIRS, 4) Age older than 60 years and 5) Pleural effusion.

APACHE II score is calculated by assigning points for 12 physiologic variables for age and for chronic health status in generating a total point score. The physiologic variables included are temperature, heart rate, respiratory rate, mean arterial pressure, PaO2, arterial pH, serum sodium, serum potassium, serum creatinine, haematocrit, total leucocyte count and Glasgow Coma Scale (GCS).

The CTSI takes into account two parameters- changes in pancreatic morphology and peripancreatic changes (0-4) and the extent of pancreatic necrosis (0-6) and score ranges from 0-10.

Patients were monitored until end point of study, which includes either death or discharge from hospital. Patients

were given standard medical care throughout the study periods.

Patients were stratified according to following cutoff values of the scoring systems – BISAP ≥3, APACHE II ≥8 and CTSI ≥3. The ability of the BISAP, APACHE II and CTSI scores to predict the severity (SAP) as well as Pancreatic Necrosis (PNec) and mortality in acute pancreatitis patients were compared.

All the statistical analyses were performed using 'Statistical Package for Social Sciences' (SPSS) software 20th Version. Continuous data is presented as mean±standard deviation (SD). Categorical values were evaluated using Pearson's chi-square or Fisher's exact test. The P value of <0.05 was taken as significant sensitivity, specificity, Positive Predictive Value (PPV) and Negative Predictive Value (NPV) were calculated for individual scoring systems. Receiver-operating characteristic curves for SAP, PNec and mortality were created for scoring systems using cutoff values (BISAP ≥3, APACHE II ≥8 and CTSI ≥3) and the predictive accuracy of each scoring system was measured by the area under the receiver operating curve (AUC).

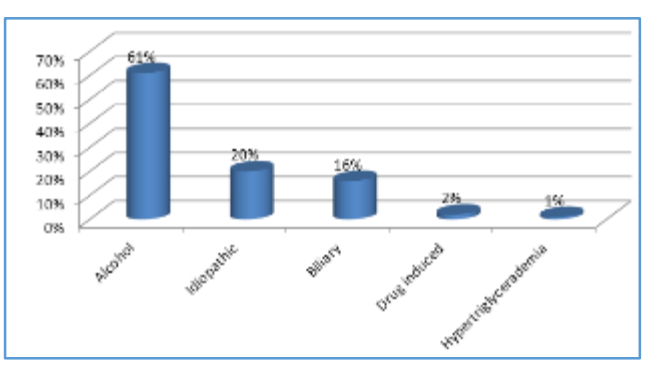
## RESULTS

A total number of 100 patients with acute pancreatitis were entered in the study.

| Variable | No. of Patients | Percentage (%) |
|---|---|---|
| **Age Distribution in Years** | | |
| 19 to 29 | 26 | 26% |
| 30 to 39 | 26 | 26% |
| 40 to 49 | 30 | 30% |
| 50 to 59 | 14 | 14% |
| 60 to 69 | 4 | 4% |
| **Sex Distribution** | | |
| Males | 60 | 60% |
| Females | 40 | 40% |
| **Total** | **100** | **100** |

***Table 1. Demographic Data of Patients***

In present study, out of 100 patients with acute pancreatitis, 60 are males and 40 are females with mean age are 37.82±10.73 years (Table 1).




***Graph 1. Aetiology of Acute Pancreatitis***

In the present study, aetiology of acute pancreatitis could be ascertained in 80% of patients with 61% patients having alcohol-related acute pancreatitis, 2% with drug-induced pancreatitis (1 is on sodium valproate and other on azathioprine), 1% patients with hypertriglyceridemia and 20% patients were labeled as idiopathic (Graph 1).

| Variable | No. of Patients | Percentage |
|---|---|---|
| **Grading of AP** | | |
| Mild acute pancreatitis | 62 | 62% |
| Moderately severe acute pancreatitis | 18 | 18% |
| Severe Acute Pancreatitis (SAP) | 20 | 20% |
| **Pancreatic Necrosis (PNec)** | 14 | 14% |
| **Organ Failure** | 20 | |
| Respiratory failure | 10 | 50% |
| Renal failure | 6(20) | 30% |
| Shock | 4(20) | 20% |
| **Outcome** | | |
| Death | 6 | 6% |
| Discharge | 94 | 94% |

***Table 2. Data of Grading of AP, PNec Outcome of the Patients***

In the present study, mild AP observed in 62 (6%) patients, moderately severe AP observed in 18 (18%) patients and twenty patients (20%) developed persistent organ failure for ≥48 hrs. and were classified as SAP. Fourteen patients (14%) had evidence of PNec on CECT. Six patients died during hospitalisation (mortality 6%). Of the 20 patients with organ failure, the most frequent organ dysfunction observed was respiratory failure 10 (50%), 6 (30%) had renal failure, 4 patients developed shock (20%) (Table 2).

| Scoring System | No. of Patients | SAP | PNec | Mortality |
|---|---|---|---|---|
| **BISAP** | | | | |
| ≤2 | 84 | 10 (11.9%) | 4 (4.8%) | 2 (2.4%) |
| ≥3 | 16 | 10 (62.5%) | 10 (62.5%) | 4 (25%) |
| **APACHE II** | | | | |
| ≤7 | 62 | 6 (9.7%) | 4 (6.5%) | 0 (0%) |
| ≥8 | 38 | 14 (36.8%) | 10 (26.3%) | 6 (15.8%) |
| **CTSI** | | | | |
| ≤2 | 58 | 4 (6.9%) | 0 (0%) | 0 (0%) |
| ≥3 | 42 | 16 (38.1%) | 14 (33.3%) | 6 (14.3%) |

***Table 3. Incidence of SAP, PNec and Mortality Stratified by BISAP Score, APACHE II and CTSI***

The number of patients with a BISAP score of ≤2 was 84 and ≥3 was 16. On chi-square test, patients with a BISAP score ≥3 had a 5-fold higher likelihood of developing SAP (OR 5.3), thirteen times for PNec (OR 13.1) and 11-fold higher likelihood of death (OR 10.5). There were statistically significant trends for increasing severity (P <0.001), PNec (P <0.001) and mortality (P <0.001) with increasing BISAP. In regards to mortality, two patients who died had a BISAP score of 2, two patients had a score of 3, two patients had a BISAP score of 4.

| Variable | Sensitivity (95% CI) | Specificity (95% CI) | PPV (95% CI) | NPV (95% CI) |
|---|---|---|---|---|
| **SAP** | | | | |
| BISAP | 50 (23.7-76.3) | 92.5 (80.1-90.7) | 62.5 (30.6-86.3) | 88.1 (75-94.8) |
| APACHE II | 70 (39.7-89.2) | 70 (54.6-81.9) | 36.8 (19.2-58.9) | 90.3 (75.1-96.7) |
| CTSI | 80 (49.0-94.3) | 67.5 (52.0-79.9) | 38.1 (20.8-59.1) | 93.1 (78.0-98.1) |
| **PNec** | | | | |
| BISAP | 71.4 (35.9-1.8) | 93 (81.4-97.6) | 62.5 (30.6-86.3) | 95.2 (84.2-98.7) |
| APACHE II | 71.4 (35.9-1.8) | 67.4 (52.5-79.5) | 26.3 (11.8-48.8) | 93.6 (79.3-98.2) |
| CTSI | 100 (64.6-100) | 67.4 (52.5-79.5) | 33.3 (17.2-54.6) | 100 (88.3-100) |
| **Mortality** | | | | |
| BISAP | 66.7 (20.8-93.9) | 87.2 (74.8-94.0) | 25 (7.2-59.1) | 97.6 (87.7-99.6) |
| APACHE II | 100 (43.9-100) | 66 (51.7-77.8) | 15.8 (5.5-37.6) | 100 (89.0-100) |
| CTSI | 100 (43.9-100) | 61.7 (47.4-74.2) | 14.3 (5.0-34.6) | 100 (88.3-100) |

***Table 4. Sensitivity, Specificity, Positive and Negative Predictive Value of Different Scoring Systems in Predicting SAP, PNec and Mortality (%)***

The sensitivity of BISAP in predicting SAP in our study is 50%, specificity is 92.5%, sensitivity and specificity of APACHE is 70% and CTSI sensitivity is 80% and specificity is 67.5%.

The sensitivity of BISAP in predicting PNec in our study is 71.4%, specificity is 93%, sensitivity of APACHE is 71.4% and specificity is 67.4% and CTSI sensitivity is 100% and specificity is 67.4%.

The sensitivity of BISAP in predicting mortality in our study is 66.7%, specificity is 87.5%, sensitivity of APACHE is 100% and specificity is 66% and CTSI sensitivity is 100% and specificity is 61.7% (Table 4).

In the present study, ROC curves are created for scoring systems using cutoff values- BISAP ≥3, APACHE II ≥8 and CTSI ≥3 to evaluate the predictive accuracy for SAP, PNec and mortality.

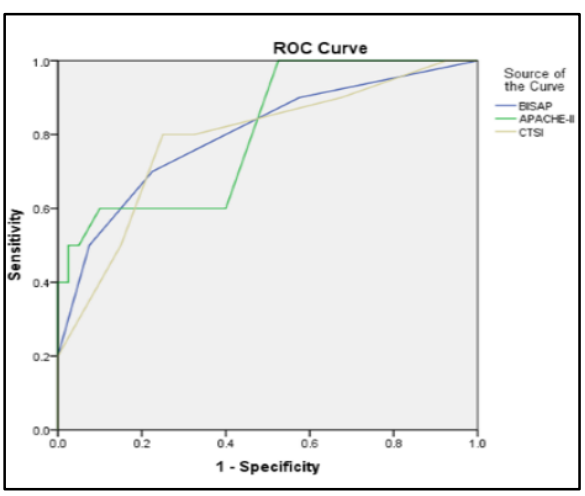



***Figure 1. ROC Curve Comparison of BISAP, APACHE II and CTSI in Predicting SAP***

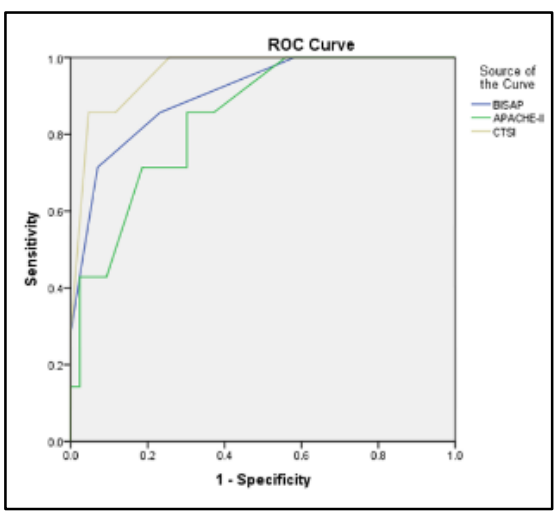



***Figure 2. ROC Curve Comparison of BISAP, APACHE II and CTSI in Predicting PNec***

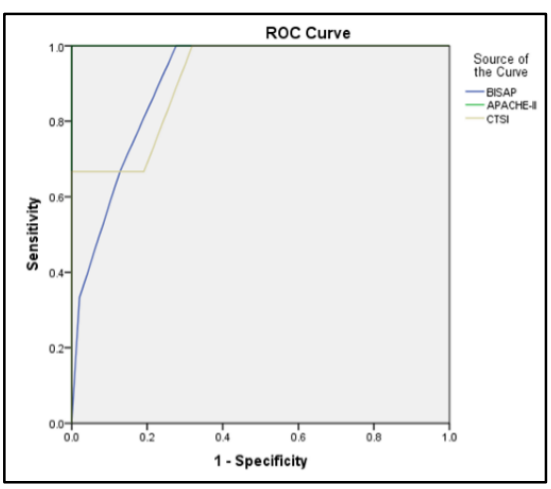



***Figure 3. ROC Curve Comparison of BISAP, APACHE II and CTSI in Predicting Mortality***

| AUC* (95% CI) | SEVERITY | PNEC | MORTALITY |
|---|---|---|---|
| BISAP | 0.80 (0.63-0.97) | 0.91 (0.79-1.00) | 0.90 (0.79-1.00) |
| APACHE II | 0.81 (0.65-0.96) | 0.84 (0.71-0.98) | 1.00 (1.00-1.00) |
| CTSI | 0.79 (0.62-0.95) | 0.96 (0.90-1.07) | 0.92 (0.77-1.00) |

***Table 5. AUC (area under curve) of Scoring Systems in Predicting SAP, PNec and Mortality***

All the scoring systems are found to be comparable and good in the prediction of severe acute pancreatitis (AUC for BISAP - 0.80, APACHE II - 0.81, CTSI - 0.79). CTSI is more accurate (AUC - 0.96) in predicting PNec when compared to BISAP (AUC - 0.91) and APACHE II (AUC - 0.84). APACHE II is excellent (AUC - 1.00) in predicting mortality (Table 5).

## DISCUSSION

Acute pancreatitis remains a common disorder with devastating consequences. Early evaluation of severity of acute pancreatitis is essential to allow clinician to predict the patient's clinical course, estimate prognosis and determine the need for admission to the intensive care unit. Although, most episodes are mild and self-limiting up to a fifth of patients develop a severe attack that can be fatal. So, a reliable risk stratification tool to predict the severity and prognoses of AP is of great clinical importance for the management of this disease.

Mean age of the patients in our study was 37.8±10.73 years, which is almost equal compared to other studies by Jitin Yadav et al[10] (38.9±14.59), V. Sharma et al[11] (40.6±12.99), Zhang J et al[12] (51.8±13.5), Park JY et al[13] (52±17), Chen L et al[14] (53.6±16.6). Out of the 100 cases studied, 60% were males and 40% were females. Other studies Cho JH et al,[15] Jitin Yadav et al,[10] V. Sharma et al,[11] Zhang J et al,[12] Park JY et al,[13] Chen L et al[14] and Papachristou et al[16] also showed male preponderance.

In the present study, most common aetiology of acute pancreatitis is alcohol similar to other studies. However, biliary aetiology of acute pancreatitis is less in the present study when compared to other studies. Other causes include traumatic hypercalcaemia, hypertriglyceridemia, drug-induced and post ERCP pancreatitis. In our study, there are no cases of hypercalcaemia, traumatic and post ERCP pancreatitis (Table 6).

| | Percentage of Patients | | | | |
|---|---|---|---|---|---|
| **Aetiology** | **Our Study** | **Jitin Yadav et al[10]** | **V. Sharma et al[11]** | **Zhang J et al[12]** | **Park JY et al[13]** |
| **Alcohol** | 61 | 40.3 | 50.5 | 56.7 | 50 |
| **Biliary** | 16 | 31.1 | 34.3 | 26.4 | 29 |
| **Idiopathic** | 20 | _ | 11.4 | 9.3 | 16 |
| **Others** | 3 | _ | 3.8 | 7.6 | 5 |

***Table 6. Comparison of Aetiology of Acute Pancreatitis***

In the present study, 20% patients developed persistent organ failure for ≥48 hrs. and were classified as SAP. Other studies by Papachristou et al[16] (22%), Cho JH et al[15] (13%), Zhang J et al[12] (13.5%), Park JY et al[13] (10.2%), Chen L et al[14] (20.3%) also showed similar results.

The sensitivity of BISAP in predicting severity in our study is 50%, which is higher than Papachristou et al[16] (37.5%) study, but lower than Cho JH et al[15] (62%) and Park JY et al[13] (71%) studies. The specificity of BISAP in predicting severity in our study is 92.5%, which is comparable to Papachristou et al[16] study (92%) and higher than that of Cho JH et al[15] (72%) and Park JY et al[13] (85%) studies.

The sensitivity of APACHE II in predicting severity in our study is 70%, which is comparable to Papachristou et al[16] (70%) and Park JY et al[13] (71%) studies and lower than that of Cho JH et al[15] (81%) and Zhang J et al[12] (85%) studies. The specificity of APACHE II in predicting severity in our study is 70%, which is comparable to Papachristou et al[16] (70.3%) study and higher than that of Cho JH et al[15] (66%) and Zhang J et al[12] (63%) studies and lower than that of Park JY et al[13] (85%) study.

The sensitivity of CTSI in predicting severity in our study is 80%, which is lower than Papachristou et al[16] (85.7%) study, but higher than Cho JH et al[15] (67%) and Park JY et al[13] (52%) studies. The specificity of CTSI in predicting severity in our study is 67.5%, which is comparable to Cho JH et al[15] (67%) study and lower than that of Papachristou et al[16] (71%) and Park JY et al[13] (77%) studies.

In the present study, 14% of patients developed pancreatic necrosis. In different studies, pancreatic necrosis ranged from 13 to 23.6%, Papachristou et al[16] (19%), Zhang J et al[12] (15.4%), Park JY et al[13] (13.2%) and Ajay K Khanna et al[17] (23.6%). The sensitivity of BISAP in predicting PNec in our study is 71%, which is comparable to Zhang J et al[12] (69%) study and higher than that of Papachristou et al[16] (33%) and Ajay K Khanna et al[17] (59%) studies. The specificity of BISAP in predicting PNec in our study is 93%, which is comparable to Papachristou et al[16] (91%) study and higher than that of Zhang J et al[12] (89%) and Ajay K Khanna et al[17] (53%) studies.

The sensitivity of APACHE II in predicting PNec in our study is 71.4%, which is lower than Zhang J et al[12] (82%) study and higher than that of Papachristou et al[16] (63%) and Ajay K Khanna et al[17] (65%) studies. The specificity of APACHE II in predicting PNec in our study is 67.4%, which is comparable to Papachristou et al[16] (68%) study and higher than that of Zhang J et al[12] (62%) and Ajay K Khanna et al[17] (62%) studies. The sensitivity of CTSI in predicting PNec in our study is 100%, which is higher than other three Papachristou et al[16] (97%), Park JY et al[13] (98%) and Ajay K Khanna et al[17] (88%) studies. The specificity of CTSI in predicting PNec in our study is 67.4%, which is lower than Papachristou et al[16] (97%) and Park JY et al[13] (98%) studies and higher than that of Ajay K Khanna et al[17] (55%) study.

Out of 100 patients with acute pancreatitis, six patients died (6%), who died had severe acute pancreatitis. Mortality rate in other studies are as follows; Papachristou et al[16]

(3.8%), Jitin Yadav et al[10] (10.1%), V. Sharma et al[15] (7.6%), Zhang J et al[12] (3.2%), Park JY et al[13] (2%), Chen L et al[14] (2.6%) and Ajay K Khanna et al[17] (12.5%). The sensitivity of BISAP in predicting mortality in our study is 66.7%, which is comparable to Zhang J et al[12] (67%) and Park JY et al[13] (67%) studies and higher than that of Papachristou et al[16] (57%) and lower than that of Chen L et al[14] (83%) study. The specificity of BISAP in predicting mortality in our study is 87.2%, which is comparable to Papachristou et al[16] (87%) study and higher than that of Zhang J et al[12] (82%), Park JY et al[13] (80%) and Chen L et al[14] (67%) studies.

The sensitivity of APACHE II in predicting mortality in our study is 100%, which is similar to Papachristou et al[16] (100%) and Ajay K Khanna et al[17] (100%) studies and higher than that of Zhang J et al[12] (84%) and Park JY et al[13] (83%) studies. The specificity of APACHE II in predicting mortality in our study is 66%, which is comparable to Papachristou et al[16] (65.7%) and Ajay K Khanna et al[17] (64%) studies and lower than that of Zhang J et al[12] (73%) and Park JY et al[13] (83%) studies. The sensitivity of CTSI in predicting mortality in our study is 100%, which is similar to Papachristou et al[16] (100%) and Jitin Yadav et al[10] (100%) studies and higher than that of Ajay K Khanna et al[17] (71%) study. The specificity of CTSI in predicting mortality in our study is 61.7%, which is comparable to Jitin Yadav et al[10] (61%) study and higher than that of Papachristou et al[16] (59%) and Ajay K Khanna et al[17] (45%) studies.

| | Area Under Curve (AUC) - SAP | | |
|---|---|---|---|
| **Studies** | **BISAP** | **APACHE II** | **CTSI** |
| Our study | 0.80 | 0.81 | 0.79 |
| Zhang J et al[12] | 0.79 | 0.83 | _ |
| Park JY et al[13] | 0.80 | 0.80 | 0.67 |
| Chen L et al[14] | 0.76 | 0.76 | _ |
| Cho JH et al[15] | 0.74 | 0.78 | 0.69 |
| Papachristou et al[16] | 0.81 | 0.78 | 0.84 |
| Ajay K Khanna et al[17] | 0.80 | 0.88 | 0.66 |

***Table 7. Comparison of AUC of Different Scoring Systems in Predicting SAP***

| | Area Under Curve (AUC) - PNec | | |
|---|---|---|---|
| **Studies** | **BISAP** | **APACHE II** | **CTSI** |
| Our study | 0.91 | 0.84 | 0.96 |
| Jitin Yadav et al[10] | 0.93 | _ | 0.96 |
| Zhang J et al[12] | 0.83 | 0.80 | _ |
| Chen L et al[14] | 0.71 | 0.70 | _ |
| Papachristou et al[16] | 0.78 | 0.72 | 0.98 |

***Table 8. Comparison of AUC of Different Scoring Systems in Predicting PNec***

| | Area Under Curve (AUC) - Mortality | | |
|---|---|---|---|
| **Studies** | **BISAP** | **APACHE II** | **CTSI** |
| Our study | 0.90 | 1.00 | 0.92 |
| Jitin Yadav et al[10] | 0.85 | _ | 0.80 |
| Zhang J et al[12] | 0.79 | 0.81 | _ |
| Park JY et al[13] | 0.86 | 0.87 | _ |
| Chen L et al[14] | 0.80 | 0.80 | 0.87 |
| Papachristou et al[16] | 0.82 | 0.94 | 0.83 |

***Table 9. Comparison of AUC of Different Scoring Systems in Predicting Mortality***

## CONCLUSION

The present study concluded that all the scoring systems were found to be comparable and good in the prediction of SAP, whereas CTSI is more accurate in predicting PNec and APACHE II was excellent in predicting mortality.

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