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Corresponding Author
S.S. Sonika,
MS General surgery, Karnataka Institute of Medical Sciences, Hubli, India

Author Designation
[1]Senior Resident
[2]Professor and HOD
[3]Junior Resident

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Comparative Study of BISAP Score and CTSI Score in Predicting the Severity of Acute Pancreatitis

[1]S.S. Sonika, [2]Ishwar R. Hosamani and [3]Fahad Mulla
[1]MS General surgery, Karnataka Institute of Medical Sciences, Hubli, India
[2]General surgery department, Karnataka Institute of Medical Sciences, Hubli, India
[3]Department of General surgery, Kingsway hospital, Nagpur, India

ABSTRACT
One important gastrointestinal condition that may vary in severity is acute pancreatitis (AP). The purpose of this research is to evaluate the predictive accuracy of the Computed Tomography Severity Index (CTSI) score in predicting the severity of acute pancreatitis when compared to the Bedside Index for Severity in Acute Pancreatitis (BISAP) score. Patients were given an acute pancreatitis diagnosis, their BISAP score was determined and they underwent CTSI scoring 48 hours after their symptoms first appeared. The data was analyzed by using SPSS software. The research comprised 50 participants with acute pancreatitis. The average age was between the range of 31-40 years. AUC (area under the curve) was 0.80, PPV (positive predictive value) was 50%, NPV (negative predictive value) was 95.7% and sensitivity was 50% for the BISAP score. Specificity was 95.7%. The CTSI score had the following values: 100% for sensitivity, 56.5% for specificity, 16.7% for positive predictive value (PPV), 100% for negative predictive value (NPV) and 0.81 for area under the curve (AUC). Both the BISAP and CTSI scores are equally useful in predicting the severity of acute pancreatitis, with similar performance characteristics. However, the BISAP score may offer advantages in terms of simplicity and accessibility for initial risk stratification in clinical practice. The choice between these scoring systems should consider clinical context and resource availability.

INTRODUCTION

Acute pancreatitis, a common gastrointestinal condition, is a significant surgical challenge[1], affecting approximately 2.29% of people[2].Eighty percent of acute pancreatitis is caused by consumption of alcohol and gallstones together. AP has a variety of clinical manifestations. Most patients have a moderate and self-limiting course, while 10-20% experience a quickly escalating inflammatory response linked to a considerable risk of morbidity and death. Acute edematous, acute persistent, or acute hemorrhagic necrotizing AP may be classified according to severity[3]. Organ failure, pancreatic necrosis, infections and even death are possible outcomes of severe acute pancreatitis (SAP)[4]. The primary diagnostic criteria are determining the severity and assessing the risk factors upon admission[5]. The prognosis is excellent for just 10-20% of individuals with mild inflammation. In extreme situations, however, patients may present with distant organ failure or pancreatic necrosis, necessitating intensive medical care or surgery with a 40% mortality risk. There is a 5-10% chance of overall death[6,7]. Acute pancreatitis has been categorized into three severity levels based on the updated Atlanta classification[8]. Eighty percent of cases of acute pancreatitis are minor, self-limiting and do not need medical attention. However, 10-20% of patients often have severe sickness when necrosis develops in parts of the pancreas and the surrounding tissues. A first inflammatory reaction occurs in these people and it progresses to a systemic inflammatory response syndrome that culminates in multi organ failure and death[8,9]. Because pancreatic damage varies from person to person, it may be difficult to anticipate how someone will respond to it. While acute pancreatitis generally has a fatality rate of 2-5%, severe cases may have a mortality rate as high as 20-30%[10,11]. Because of SAP's high mortality rate, it is crucial to establish early and dependable techniques for assessing the severity of the illness to initiate more aggressive treatments that may reduce its adverse effects and high death rate. Forecasting the SAP requires thorough and ongoing clinical exams, a multi-factor grading system and imaging studies[10,11]. The CT Severity Index (CTSI) and the BISAP grading system are important tools for evaluating illness severity and forecasting consequences. Several multi factorial scoring systems, which include clinical and biochemical criteria, have been used for many years to determine the severity of acute pancreatitis[12]. The Glasgow score, MOSS score, BISAP score, APACHE II score and the criteria set by Ranson *et al*., are some of the scoring systems used. Depending on the cut-off value and scoring duration, these scoring techniques' sensitivity and specificity for diagnosing severe acute pancreatitis range from 55-90%[13]. Previous research has shown the dependability of various scoring systems, but few studies have compared their performance or assessed their prognostic value alongside imaging modalities like CT scans[14]. Additional study is required to examine the efficacy of various scoring systems in accurately predicting sickness severity, taking into account the potential cost-saving and diagnostic simplification benefits[15]. Advancements in CT imaging methods, such as contrast-enhanced CT (CECT), have enabled the identification of pancreatic necrosis and other problems linked to acute pancreatitis[16]. The research aimed to evaluate the clinical outcomes of individuals with acute pancreatitis and categorize them based on BISAP and CTSI scores.

MATERIALS AND METHODS

Study Design: The study was a single-centered, prospective, observational, hospital-based research done in the general surgery department of Karnataka Institute of Medical Sciences (KIMS), Hubli, from September 2019 to August 2021, spanning 18 months. Information on the patient's initial demographics, clinical data and radiological tests was gathered. Study approval was obtained before commencing data collection.

Study Participants: The research offered a suitable sample size of 50 inpatients who had been diagnosed with acute pancreatitis clinically. Individuals who had a clinical diagnosis of acute pancreatitis were deemed eligible for inclusion, however, those who had a diagnosis of acute-on-chronic pancreatitis and were admitted after 24 hours after symptom start were not.

Assessment Instrument: X-ray, Blood Urea Nitrogen, CT scan, SIRS Scale and Glasgow Coma Scale.

Procedure: Patients reporting epigastric discomfort were evaluated for their mental state using the Glasgow Coma Scale (GCS). After being clinically diagnosed with acute pancreatitis, the patients provided written permission. An examination was conducted to identify signs of systemic inflammatory response syndrome and blood samples were collected within 24 hours of symptom onset to test Blood Urea Nitrogen (BUN) levels. X-ray imaging was used to identify pleural effusion and then BISAP Scoring (Table 1) was conducted using the gathered parameters. A CT scan was performed 48 hours later to evaluate the severity of pancreatitis using the CTSI grading system (Table 2).0-2 Points: Lower mortality (<2 Percent)
3-5 Points: Higher mortality (>15 Percent)

Statistical Analysis: SPSS (Version 25) was used for statistical analysis. For continuous data, descriptive statistics like mean and standard deviation were used, whereas percentages and numerical values were

utilized for categorical variables. To compute frequencies and proportions, descriptive statistics were used. Men and women were the dichotomous factors whose means were compared using the two-sided independent samples t-test, while multilevel variables were compared using the one-way ANOVA test.

RESULTS AND DISCUSSIONS

Distribution of Age and Gender Among Respondents: The (table 3) outlines the age and gender distribution among 50 study participants. Most participants (72%) fall between 21-40 years, with the 31-40 age group being the largest (40%). Notably, there are no females in the 21-30 and 31-40 age groups. Older age brackets have fewer participants, with a slight increase in females. Overall, the data indicates a predominance of males across age groups, suggesting potential gender disparities in the sample.

Frequency of Etiologies in Patients with Gallstone Disease: Forty one patients in the research represented in (table 4) had a history of alcohol drinking, which was identified as a potential causal factor. Five individuals were diagnosed with gallstone disease, with three having cholelithiasis and two having choledocholithiasis. The aetiology of the condition in the remaining 4 cases was unknown.

Distribution of Patients According to the BISAP Point Score: Among the 11 patients in the trial, none exhibited severe pancreatitis, pancreatic necrosis, or death since they all had a BISAP score of 0. Out of 19 patients with a BISAP score of 1, 1 had severe pancreatitis, 2 had pancreatitis necrosis and 2 died. Out of 16 patients with a BISAP score of 2, 1 had severe pancreatitis, 4 had pancreatic necrosis and 2 died. Two of the four persons with a BISAP score of three developed acute pancreatitis, all four had pancreatic necrosis and two of them died (Table 5).

CT Severity Index Scores and Associated Complications in Pancreatitis Patients: Twelve participants in this research had a CTSI score of 1, with one patient dying and none suffering from acute pancreatitis or pancreatic necrosis. Two CTSI scores were obtained from 14 individuals, none of whom had pancreatic necrosis, severe pancreatitis, or death. Twelve individuals with a CTSI score of three included two with severe pancreatitis, zero with pancreatic necrosis and three with fatalities. Three individuals with pancreatic necrosis and no deaths or severe pancreatitis were among the six with a CTSI score of 4. None of the patients had severe pancreatitis or died; just one patient (CTSI score of 5) suffered pancreatic necrosis as demonstrated in (Table 6). Two patients had severe pancreatitis, four had pancreatic necrosis, and two of the patients died as a consequence of their CTSI score of six. Only one patient-who had pancreatic

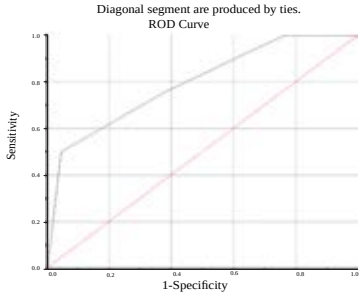

Fig. 1: ROC Of BISAP score predicting SAP

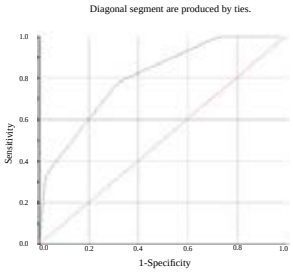

Fig. 2: ROC of BISAP Score predicting PNec

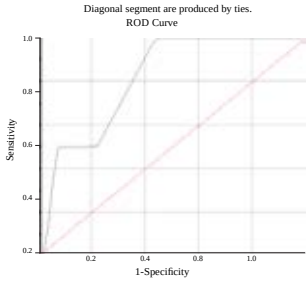

Fig. 3: ROC of CTSI Score predicting SAP

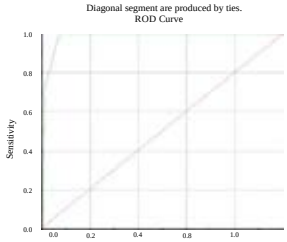

Fig. 4: ROC of CTSI score predicting PNec

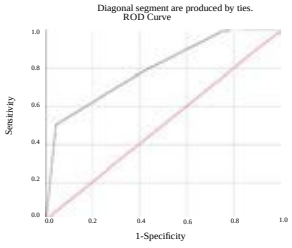

Fig. 5: ROC of BISAP score predicting mortality

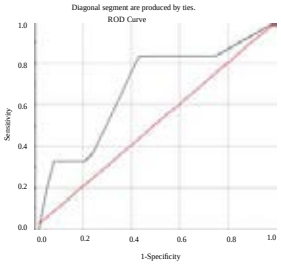

Fig. 6: ROC of CTSI score predicting mortality

Table 1. BISAP score component

Component	Point
Impaired mental status (Glasgow coma scale <15)	1 Point
Blood urea nitrogen (BUN)>25 mg/dl	1 Point
SIRS, defined as ≥2 of the following	
Respiratory rate >20 beats per minute or PaCO2<32 mmHg.,	
Temperature <36°C or >38°C	
WBC count <4×109 or >12×109/1 or >10% immature bands	
Pulse >90 beats/min	1 Point
Age >60years	1 Point
Pleural Effusion	1 Point

Table 2. CT severity index (CTSI)

Parameters	Points
Grading of Pancreatitis	
Normal Pancreas	0
Pancreatic Enlargement	1
Peripancreatic inflammation	2
Fluid collection from a single acute pancreas	3
≥2 acute peripancreatic fluid collection	4
Pancreatic necrosis	
None	0
≤30%	2
30-50%	4
≥50%	6

Table 3. Distribution of age and gender among study participants

Age Groups (in years)	Male = n (%)	Female = n (%)	Total = n (%)
20	3 (6.3)	1 (50)	4 (8)
21-30	16 (33.3)	0 (0)	16 (32)
31-40	20 (41.7)	0 (0)	20 (40)
41-50	4 (8.3)	0 (0)	4 (8)
51-60	2 (4.2)	1 (50)	3 (6)
61 and above	3 (6.3)	0 (0)	3 (6)
Total	48 (100)	2 (100)	50 (100)

Table 4. Distribution of the study subjects according to the etiology

Etiology	Frequency = n (%)
Alcohol	41 (82)
Choledocholithiasis	2 (4)
Cholelithiasis	3 (6)
Idiopathic	4 (8)
Total	50 (100)

Table 5. Distribution of patients and proportion with severity ofPNec, AP and mortality stratified by BISAP point score

BISAP Score	No. of Patients	Severity	PNec	Mortality
0	11 (22%)	0 (0%)	0 (0%)	0 (0%)
1	19 (38%)	1 (25%)	2 (22.2%)	2 (33.3%)
2	16 (32%)	1 (25%)	4 (44.4%)	2 (33.3%)
3	4 (4%)	2 (50%)	3 (33.3%)	2 (33.3%)
Total	50 (100%)	4 (100%)	9 (100%)	6 (33.3%)
	p-value	0.013	0.006	0.071

Table 6. Distribution of Patients and Proportion with SAP, Pnec and Mortality Stratified by the CTSI Point Score

CTSI Score	No. of Patients	Severity	PNec	Mortality
1	12 (24%)	0 (0%)	0 (0%)	1 (16.7%)
2	14 (28%)	0 (0%)	0 (0%)	0 (0%)
3	12 (24%)	2 (50%)	0 (0%)	3 (50%)
4	6 (12%)	0 (0%)	3 (33.3%)	0 (0%)
5	1 (2%)	0 (0%)	1 (11.1%)	0 (0%)
6	4 (8%)	2 (50%)	4 (44.4%)	2 (33.3%)
7	1 (2%)	0 (0%)	1 (11.1%)	0 (0%)
Total	50 (100%)	4 (100%)	9 (100%)	6 (100%)
	P value	0.032	0.00001	0.104

Table 7. AUC of various scoring systems in predicting PNec, mortality and SAP

AUC	Severity	PNec	Mortality
BISAP	0.80 (0.55-1.00)	0.80 (0.65-0.95)	0.74 (0.53-0.94)
CTSI	0.81 (0.64-0.98)	0.98 (0.96-1.00)	0.67 (0.43-0.915)

Table 8. Distribution of incidence of SAP, PNec and mortality stratified by BISAP score

BISAP	No. of Patients	Severity	PNec	Mortality
2	46	2 (4.3%)	6 (13%)	4 (8.7%)
≥3	4	2 (50%)	3 (75%)	2 (50%)
Total	50	4 (8%)	9 (18%)	6 (12%)

Table 9. Distribution of incidence of SAP, PNec and mortality stratified by CTSI score

CTSI	No. of Patients	Severity	PNec	Mortality
2	26	0 (0%)	0 (0%)	1 (3.8%)
≥3	24	4 (16.7%)	9 (37.5%)	5 (20.8%)
Total	50	4 (8%)	9 (18%)	6 (12%)

Table 10. Odds ratio (OR) of BISAP and CTSI score

Score	Severity OR (CI)	PNec OR (CI)	Mortality
BISAP (≥3)	22 (1.95-247)	20 (1.78-225.01)	10.5 (1.15-95.92)
CTSI (≥3)	11.63(0.59-228.6)	32.48(1.76-597.56)	6.58(0.71-61.78)

Table 11. Scoring Systems Performance for Severity, Pnec and mortality

Variables	Scoring Systems	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
Severity	BISAP	50	95.7	50	95.7
	CTSI	100	56.5	16.7	100
PNec	BISAP	33.3	97.6	75	87
	CTSI	100	63.4	37.5	100
Mortality	BISAP	33.3	95.5	50	91.3
	CTSI	83.3	56.8	20.8	96.2

necrosis-had a CTSI score of 7 and no other patients had severe pancreatitis or died.

Area Under Curve of BISAP and CTSI Scoring Systems: The CTSI score had a slightly larger area under the curve than the BISAP score, which was less reliable in predicting the severity of acute pancreatitis (Table 7). The BISAP score has a lower area under the curve than the CTSI score, making it less reliable in predicting pancreatic necrosis. Compared to the CTSI score, the area under the BISAP score curve for pancreatitis mortality prediction is greater. The BISAP and CTSI scores were cut off at ≥3 using the maximum sensitivity as well as specificity values identified in the Receiver operating characteristic ROC curves (Fig. 1-6).

Distribution of Incidence of SAP, PNec and Mortality by BISAP Score and CTSI Score: In this study, 46 patients had a BISAP score of 2 or less, 2 of them had severe acute pancreatitis, 6 of them had pancreatic necrosis, 4 of them resulted in mortality (Table 8). In this study, 4 patients had a BISAP score of 3 or more, 2 of them had severe acute pancreatitis, 3 of them had pancreatic necrosis, 2 of them resulted in mortality. In addition to this, 26 patients had a CTSI score of 2 or less, out of 26 none had severe acute pancreatitis and pancreatic necrosis, 1 out of them resulted in mortality (Table 9). Also, 24 patients had a CTSI score of 3 or more, 4 of them had severe acute pancreatitis, 9 of them had pancreatic necrosis, 5 of them resulted in mortality.

Odds Ration (OR) of BISAP and CTSI: In this study, when BISAP score is 3 or more the odds of developing severe acute pancreatitis are 22 and the odds of having pancreatic necrosis is 20 and the odds of landing mortality is 10.5. In addition to this, when CTSI score is 3 or more the odds of developing severe acute pancreatitis are 11.6 and the odds of having pancreatic necrosis is 32.4 and the odds of landing mortality is 6.5 as represented in (Table 10).

Scoring Systems Performance for Severity, PNec and Mortality: The sensitivity and specificity of BISAP for predicting severe acute pancreatitis is 50% and 95.7% respectively which is shown in (Table 11). The PPV is 50% and NPV is 95.7%. The sensitivity and specificity of CTSI for predicting severe acute pancreatitis is 100% and 56.5% respectively. The PPV is 16.7% and NPV is 100%. The sensitivity and specificity of BISAP for predicting pancreatic necrosis is 33.3% and 97.6% respectively. The PPV is 75% and NPV is 87%. The sensitivity and specificity of CTSI for predicting pancreatic necrosis is 100% and 63.4% respectively. The PPV is 37.5% and NPV is 100%. The sensitivity and specificity of BISAP for predicting mortality is 33.3% and 95.5% respectively. The PPV is 50% and NPV is 91.3%. The sensitivity and specificity of CTSI for predicting mortality is 83.3% and 56.8% respectively. The PPV is 20.8% and NPV is 96.2%.

AP is a common illness with a range of clinical manifestations. Severe acute pancreatitis carries a significant risk of illness and death. Early hospitalization and treatment based on illness severity may help identify those in need of intensive measures to avert a serious attack. The BISAP grading system and the CTSI radiological examination are compared in the study to assess the severity of acute pancreatitis. The average age, according to the poll, was 35.16 years, and there were more men than women. The median age is 34 years with a range of 26.75 to 40.0. The average age of those who did not survive in this research was 37.1 years. Alcohol was the primary cause in 82% of cases, followed by cholelithiasis in 6%, choledocholithiasis in 4% and idiopathic reasons in 8%. The findings aligned with Barreto *et al.*, research, indicating that around 80% of the cases were linked to alcohol misuse and gallstone disease[2].BISAP showed stronger link with disease severity and death, whereas CTSI exhibited a stronger correlation with the amount of pancreatic necrosis when their ROC curves were compared. Based on the highest values of sensitivity and specificity derived from the ROC curves, a cut-off of >=3 was applied to the BISAP and CTSI scores. This finding aligns with research by Papachristou *et al.* with 185 patients, which also yielded a comparable cut-off point[12]. 12% of patients in the current trial had a fast-escalating inflammatory response linked to substantial morbidity and death, aligning with the results of a study by Courtney *et al*.[3].The current research shows that CTSI has greater sensitivity and negative predictive value, but BISAP has better specificity and positive predictive value. Hagjer *et al.* conducted a study comparing the AUC, sensitivity, specificity, PPV and NPV of BISAP and CTSI for

predicting the severity of acute pancreatitis. The AUC values were 0.87 for BISAP and 0.65 for CTSI. The sensitivity values were 7.14% for BISAP and 37.9% for CTSI. The specificity values were 95.7% for BISAP and 90.3% for CTSI. The PPV values were 83.3% for BISAP and 78.6% for CTSI. The NPV values were 91.7% for BISAP and 60.9% for CTSI. In predicting mortality in acute pancreatitis, the AUC for BISAP was 0.892 (95% CI 0.81-0.97) and for CTSI was 0.509 (95% CI 0.40-0.78). The sensitivity of BISAP was 85.7 and CTSI was 17.2, while the specificity of BISAP was 88.7 and CTSI was 93.5. The BISAP and CTSI showed a positive predictive value (PPV) of 50.0 and 71.4, respectively, whereas the BISAP and CTSI showed a negative predictive value (NPV) of 97.9 and 54.7, respectively[17]. The present study confirmed that the BISAP score offers a precise way to classify patients with acute pancreatitis according to their risk. The elements are easily obtainable and have therapeutic significance. This result is consistent with studies conducted by Wu BU, Johannes *et al.* Papachristou *et al*.[13,18].

CONCLUSION

This single-centered prospective observational study, involving 50 inpatients diagnosed with acute pancreatitis, investigated the efficacy of the BISAP as a predictive tool for in-hospital mortality risk among elderly patients. Through comprehensive assessment utilizing X-ray, blood urea nitrogen levels, CT scans, SIRS scale, GCS and scoring scales like CTSI and BISAP, the study demonstrated the utility of BISAP in promptly categorizing high-risk individuals. The findings underscore the significance of integrating BISAP assessment into routine clinical practice to facilitate early identification and proactive management of at-risk patients. By implementing timely interventions and tailored care strategies based on BISAP scores, healthcare providers can potentially mitigate complications and reduce mortality rates associated with acute pancreatitis.

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