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Original article

Critical Evaluation of BISAP Score in Assessing the Severity of Acute Pancreatitis: A Prospective Observational Study

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Abstract

Background: Early identification of patients at risk of mortality during acute pancreatitis is crucial for improving outcomes. Surgeons have long sought a clinical scoring system that is straightforward, easy to calculate using clinical parameters, and practical to apply. ***Aim:*** To evaluate the role of the BISAP scoring system in assessing the severity of acute pancreatitis. ***Settings and Design:*** Prospective observational study conducted in a tertiary care centre in central India from Jan 2023 to April 2024. ***Methods and Material:*** The study encompassed all patients diagnosed with acute pancreatitis. Within 24 hours of admission, the BISAP score was computed. Additionally, organ failure was assessed using the Marshall Scoring System. ***Results:*** Among 190 patients included in the study, there were 174 males and 16 females. The most common aetiology among men was alcoholism, while among women, it was gallstone disease. Of the total 190, 51 patients developed develop organ failure & 18 patients died, with 16 of them having a BISAP score ≥3. The BISAP score demonstrated a sensitivity of 90.64% and a specificity of 84.3% for predicting organ failure. Additionally, it showed a positive predictive value of 94.02% and a negative predictive value of 76.7% in this regard. ***Conclusion:*** The BISAP score serves as a valuable tool for risk stratification and prognostic prediction in clinical practice. It is recognized for its simplicity and accuracy in identifying patients early who are at higher risk for mortality and morbidity during hospitalization.

Keywords: ***BISAP score, Acute Pancreatitis, Predicting Severity, CTSI, Pancreatic Necrosis.***

Introduction

Acute pancreatitis, is one of the most common abdominal emergencies in the world. It is an inflammation of the pancreas, affecting all age groups and is a leading cause of acute abdominal pain globally, with an incidence of 10 to 50 cases per 100,000 people annually [1]. In the U.S., it results in about 210,000 hospital admissions yearly, straining healthcare resources [2]. Gallstones and alcohol consumption are the primary causes, varying by socioeconomic, ethnic, and cultural factors.

The condition involves pancreatic enzyme activation leading to localized inflammation, which typically resolves without complications. However, 10-20% of patients experience severe acute pancreatitis (SAP), resulting in significant morbidity, prolonged hospitalization, and mortality [3]. SAP can lead to systemic inflammatory response syndrome (SIRS), multiorgan failure, and pancreatic necrosis, with patient responses varying unpredictably, highlighting the need for personalized treatment.

Identifying biomarkers to predict severe complications is crucial but challenging. There are various scoring systems available, such as the Ranson criteria, Acute Physiology and Chronic Health Evaluation (APACHE) II, and the Modified Glasgow score for predicting severity. These systems are complex and are primarily used for outcome comparisons in clinical research studies rather than as reliable predictive tools in routine patient care. This gap led to the development of a simple yet effective scoring system called the BISAP score, proposed by Wu *et al* [4] in 2008, which is easier to calculate and can be assessed at the patient's bedside at the time of admission.

The Bedside Index for Severity in Acute Pancreatitis (BISAP) is a new prognostic tool showing promise in predicting in-hospital mortality. Validated through extensive datasets and prospective studies, BISAP effectively categorizes patients for management and research purposes.

BISAP uses 5 points

B: Blood urea nitrogen (BUN) >25mg/dl
I: Impaired mental status by evidence of disorientation or disturbance in mental status
S: SIRS

A: Age >60 years
P: Pleural effusion.

SIRS is defined by the presence of any 2 of the following 5 criteria

- Pulse >90 beats / min
- Respiration >20 per min
- PaCO 2 < 32 mm Hg
- Temperature >100.4 ° F or < 96.8 ° F
- White blood cell count >12,000 or < 4,000 cells per mm3 or >10 % immature neutrophils (bands)

Despite BISAP's proven effectiveness abroad, there is a lack of research in the Indian subcontinent, especially in central India, due to differing etiological factors like alcohol consumption. This study aims to evaluate BISAP's efficacy locally and compare it with the CT Severity Index (CTSI) for predicting acute pancreatitis severity, enhancing patient management and treatment strategies.

Subject & Methodology

The aim of this study is to evaluate the role of the BISAP score in assessing the severity of acute pancreatitis. The primary objective is to examine the prognostic utility of the BISAP scoring system in determining the severity of this condition. Additionally, the secondary objective is to establish the agreement between the BISAP scoring system and the Computed Tomography Severity Index (CTSI) in predicting the severity of acute pancreatitis.

This prospective observational study was conducted in the General Surgery department at the All India Institute of Medical Sciences (AIIMS) in Nagpur, following approval from the Institutional Ethics Committee (IEC). The study population consisted of patients diagnosed with acute pancreatitis who were admitted to the General Surgery department at AIIMS Nagpur from Jan 2023 to April 2024.

Patients diagnosed with acute pancreatitis were informed about the study details. Written informed consent was obtained before enrolment, and a patient information sheet was provided. Demographic information, blood investigations, and imaging findings were documented in the case sheet for all patients. Clinical symptoms, signs, and causative factors were also recorded.

The study included all patients diagnosed with acute pancreatitis who were over 18 years of age and admitted to AIIMS Nagpur. Exclusion criteria were patients under 18 years of age, critical patients with comorbidities, those unwilling to participate, and patients with psychiatric illness.

Definitions

The diagnosis of acute pancreatitis is based on the presence of any two of the following three features:

1. Abdominal pain characteristic of acute pancreatitis.
2. Serum amylase and / or Lipase ≥ 3 times the upper limit of Normal
3. Characteristic findings of Acute pancreatitis on abdominal CT or other imaging studies.

The BISAP score was determined at time of admission, with each variable in the system assigned 1 point. A total score of 2 or less indicated mild acute pancreatitis, while a score of 3 or more indicated severe pancreatitis. The CT severity index (CTSI) was calculated from CT scans performed within 48 hours of admission. Severity classification relied on the presence of organ failure lasting over 48 hours, assessed using the modified Marshall scoring system 48 hours post-admission as shown in Table 1. A score of >2 indicates presence of organ failure.

True positives were patients with a BISAP score of 3 or higher and experienced organ failure, while true negatives had a BISAP score of 2 or lower without organ failure. False positives occurred when the BISAP score was 2 or lower, but organ failure was present, whereas false negatives had a BISAP score of 3 or higher, but no organ failure. BISAP score was compared to the gold standard grading for severity of acute pancreatitis using the modified Marshall scoring for organ failure.

Table 1: Modified Marshal Scoring system for Organ failure

Organ system	**Score 0**	**Score 1**	**Score 2**	**Score 3**	**Score 4**
Respiratory system (PaO_2/ FiO_2 ratio)	>400	301-400	201-300	101-200	<101
Cardio Vascular system Systolic BP (mmHg)	>90	<90, fluid responsive	<90, not fluid responsive	<90 pH<7.3	<90 pH<7.2
Renal system Sr. Creatinine (mg/dL)	<1.4	1.5 - 1.8	1.9 - 3.5	3.6-4.9	>5

Statistical Analysis

Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were calculated from the data. CTSI scores were used to predict severity, as well as to detect necrosis and fluid collections. Kappa statistics was calculated. Characteristic receiver operating curves (ROC) were determined for both scoring systems to evaluate their effectiveness in predicting severity and organ failure. The area under the curve (AUC) for each scoring system was compared to assess their relative performance. A P value < 0.01 was chosen to be significant for all tests given the multiple testing conducted among the study cohort. All statistical calculations were carried out using SPSS 28.0

Results

A total of 190 patients diagnosed with acute pancreatitis were studied. The study sample consisted predominantly of males, with a male-to-female ratio of 11:1 (174 males and 16 females). The mean age of the participants was 38.88 years with a standard deviation of 11.94 years. The proportion of organ failure is not significantly different across age category as P - value for incidence of organ failure with respect to age was found to be 0.388. The aetiology of the conditions was varied, with the majority of cases attributed to alcohol (155 cases, 82%). The mean Body Mass Index (BMI) of the participants was 23.3 with a standard deviation of 3.82. The proportion of organ failure is statistically significant across BMI categories as P-value was found to be <0.001. 131 participants (69%) had a BISAP score of ≤2 (Mild acute pancreatitis). In terms of organ failure, 51 participants (27%) experienced organ failure. The mortality rate within the study was 9%, with 18 participants not surviving. The demographics, clinical characteristics imaging results and outcomes are detailed in Table 2.

The BISAP Scoring System and CTSI Severity Index were applied to all patients to predict the severity of their condition. Outcomes were measured in terms of organ failure, as indicated by the Modified Marshall Score, and mortality.

Most of the patients enrolled in the study had mild acute pancreatitis, with 131 patients (69%) having a BISAP score of 0 to 2. There were 59 patients (31%) with a BISAP score of 3 and above, categorized as having severe acute pancreatitis. Majority of organ failure 46 (78%) is noted in patients with BISAP score ≥ 3. Morality was also higher 16 (89%) in patients with BISAP score ≥ 3. The trend for increasing incidence of organ failure and mortality with increasing BISAP score was statistically significant. (P- value <0.001) A contrast-enhanced CT scan could not be performed in 14 patients due to elevated renal parameters. About 137 (72%) patients in our study had a CT Severity Index (CTSI) score over 4. Organ failure occurred in nearly 52% of patients with a CT Severity Index (CTSI) score greater than 7. Figures 1 and 2 show the distribution of organ failure and mortality according to BISAP and CTSI scores, respectively. The data was extrapolated into a 2x2 table, and the analysis was conducted as shown in Table 3.

Upon analysis, the results indicated a sensitivity of 90.64%, specificity of 84.3%, positive predictive value (PPV) of 94.02%, negative predictive value (NPV) of 76.7%, and overall diagnostic accuracy of 88.94%. These findings suggest that the BISAP score demonstrates good performance in predicting the severity of acute pancreatitis.

From the study, the kappa statistic for BISAP scoring system in predicting Organ failure was calculated to be 0.7702, with a standard error of 0.0722 and a z value of 10.67. There was an agreement of 90.53%, while the expected agreement was only 58.78%.

After compiling the data, a Receiver-Operator Curve (ROC) was plotted to compare the BISAP scoring system and the CT Severity Index. (**Figure 1**)

The scoring system's effectiveness in predicting outcomes is evaluated using the area under the curve (AUC) and the standard error. The BISAP scoring system has an AUC of 0.9187 with a standard error of 0.0245, indicating high accuracy. On the other hand, the CTSI scoring system has an AUC of 0.7826 with a standard error of 0.0413, suggesting moderate accuracy.

Table 2: Demographics, Clinical characteristics, Imaging results, Outcomes of cases in this prospective observational cohort (n=190)

Variable	**Data**
Male: Female	11:1 (87/8)
Mean Age	38.88 ± 11.94
Aetiology	
1. Alcohol	155 (82%)
2. Gall stones	13 (7%)
3.Idiopathic	12 (6%)
4. calcific	9 (4.5%)
5.Traumatic	1 (0.5%)
BMI	23.3±3.82
Scoring Systems	
BISAP score	
1. Score ≤ 2	131 (69%)
2. Score ≥ 3	59 (31%)
CTSI score	
1. 0-3 (Mild)	39 (23%)
2. 4-6 (Moderate)	95 (52%)
3. 7-10 (Severe)	42 (25%)
4. CT scan Not done	14
Outcome	
Organ Failure	
1.Present	51 (27%)
2.Absent	139 (73%)
Deaths	18 (9%)
BMI - Body Mass Index; CT - Computed Tomography; *Values are presents as Number (%) or Mean ± S.D.*	

Table 3: Table showing the correlation between the BISAP score and Organ Failure at 48 hours of hospital admission:

		Organ failure		**Total No. of cases**
		No	**Yes**	
BISAP score	**≤ 2 (Mild)**	126	5	131
	≥ 3 (Severe)	13	46	59
Total		139	51	**190**

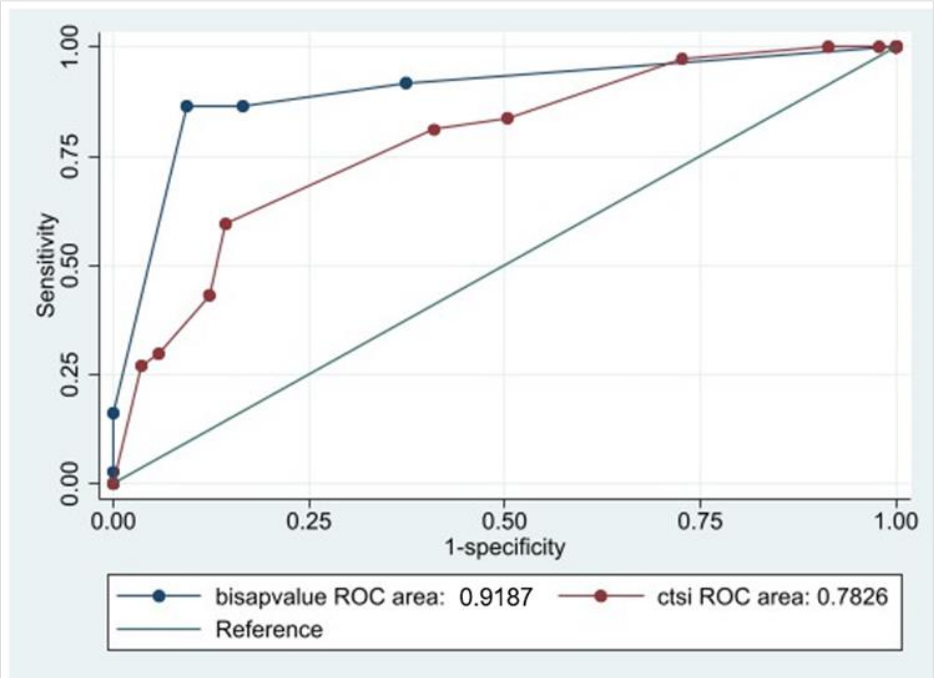

Figure 1: ROC Curve - Receiver Operating Characteristic curve comparing BISAP score and CTSI. Larger Area under curve of BISAP score indicating its superiority.

Discussion

Acute pancreatitis, a common abdominal emergency, has a global incidence of approximately 33.74 cases per 100,000 person-years, with an estimated mortality rate of around 1.16 per 100,000 person-years [5]. While most cases resolve within a week, about 20% progress to moderate to severe forms, with mortality rates of 20-40%. Early prediction of progression is crucial, but existing scoring tools like APACHE II and Ranson's score have limited accuracy. The BISAP score, a simple yet effective tool, is increasingly used for this purpose. This prospective observational study at AIIMS Nagpur evaluated the BISAP score's efficacy in predicting acute pancreatitis severity and mortality. It was also found that BISAP was better than CTSI score in predicting severity & Organ failure.

The BISAP score is a practical tool for acute pancreatitis risk assessment due to its simplicity, early assessment capability, and universal applicability for all patients with acute pancreatitis. It allows for bedside evaluation upon hospital admission, facilitating timely identification and intervention for high-risk patients. Its use aids in formulating effective treatment plans and optimizing patient care.

In our study, the gender distribution was predominantly male, comprising 98% of participants, with females making up only 2%. This differs from Sumitra *et al* 's 2018 study, where males accounted for 68% and females for 32% of the sample [6]. Georgios *et al* (2010) observed a nearly equal distribution, with 51% male and 49% female participants [7].

It has been observed that a BMI greater than 25 increases the risk of severe acute pancreatitis. The mortality risk increases when the BMI is greater than 30 or less than 18.5 [8]. There was almost 100% mortality (2 out of 2) who were underweight (BMI <18.5). In our study, the mean Body Mass Index (BMI) was recorded at 23.3 with a standard deviation of 3.82. This value is in accordance to Sumitra *et al* (2018), which reported a mean BMI of 25.483 with a standard deviation of 4.168 [6].

Several studies have investigated the etiological factors of acute pancreatitis, including alcohol-related, gallstones, and idiopathic cases. Alcohol-related pancreatitis is more prevalent in India due to cultural acceptance and tradition of alcohol consumption [9]. Changing lifestyles, including urbanization and stress, contribute to increased alcohol use. Limited awareness, healthcare resources, and genetic factors also play roles in its higher incidence compared to other regions. The most common aetiology identified in our study was alcohol-related, accounting for 82%. Senapati *et al* (2014) and Zhang *et al* (2014) found rates of 53% and 56.7%, respectively for alcohol related pancreatitis [10,11]. Gallstones were observed in 7% of our cases, compared to 40% in Sumitra *et al* (2018), 29% in Senapati *et al* (2014), and 26.4% in Zhang *et al* (2014) [6,10,11].

In our study, 69% of participants had a BISAP score of 2 or less, while 31% had a BISAP score of 3 or more. Sumitra *et al* (2018), in her observational study showed 80% of participants had a BISAP score of 2 or less, and 20% had a score of 3 or more [6]. Wu *et al* (2008) reported the highest percentage of participants with a BISAP score of 2 or less at 91%, with only 9% having a score of 3 or more [4].

The revised Atlanta classification defines severe disease based on the presence of local pancreatic complications and extra pancreatic organ failure. Recent studies highlight organ failure as a more robust predictor of severe disease and hospitalization duration [12-14]. The BISAP scoring system enhances prediction of organ failure early in the disease course, further emphasizing its advantages. Our prospective cohort, organ failure was absent in 73% of cases and present in 27%. Sumitra *et al* (2018) reported a similar finding, with 81.6% absence and 18.3% presence of organ failure while Wu *et al* (2008) noted 90% absence and 10% presence of organ failure in their study [6,4].

Receiver Operating Characteristic (ROC) curves illustrate the performance of a binary classifier across different thresholds. The Area Under the Curve (AUC) summarizes this performance, with higher values indicating better discriminatory ability. AUC values close to 1 indicate strong classifier performance, while values near 0.5 suggest poor discrimination between classes. In our study, the Area Under the Curve (AUC) with a 95% Confidence Interval (CI) in the Receiver Operating Characteristic (ROC) of the BISAP score was 0.9187 (0.87 - 0.96). Sumitra *et al* (2018) reported an AUC of 0.915 (0.86 - 0.95) for the BISAP score, while Georgios *et al* (2010) reported an AUC of 0.81 (0.74 - 0.87) [6,7]. For the CTSI

score, our study found an AUC of 0.7826 (0.70 - 0.86). Sumitra *et al* (2018) reported an AUC of 0.627 (0.53 - 0.73), and Georgios *et al* (2010) reported an AUC of 0.84 (0.76 - 0.89) [6,7]. This once again highlights the superiority of the BISAP score in predicting severity.

The BISAP scoring system was found to be superior to other scoring systems in predicting severity due to its simplicity and higher sensitivity and PPV. The CT Severity Index (CTSI) is another scoring system used for predicting severity in acute pancreatitis. While it is highly sensitive, it lacks specificity and tends to overestimate severity. Additionally, it comes with the disadvantages of high cost and the risk of contrast-associated complications. Moreover, it cannot be utilized in patients with acute kidney injury, which is common in acute severe pancreatitis. Furthermore, not all centres have access to CT scanning facilities.

The BISAP scoring system is widely used in clinical practice nowadays, with management plans being deployed based on the severity predicted by this scoring system. In this study, 126 cases were identified as true positives, and 46 were true negatives. The sensitivity of the scoring system is 91%, and the specificity is 84%. The positive predictive value (PPV) is 94%, and the negative predictive value (NPV) is 77%. The sensitivity, specificity, positive predictive value, and negative predictive value of BISAP scoring system in predicting the severity in our study is comparable to findings by different studies as shown in Table 4.

Table 4: Comparison of sensitivity, specificity, positive predictive value, and negative predictive value of BISAP scoring system across different studies:

Studies	**Our study**	**Sumitra *et al* [6] (2018)**	**Senapati *et al* [10] (2014)**	**Zhang *et al* [11] (2014)**	**Georgios *et al* [7] (2010)**	**Singh *et al* [12] (2009)**
Sensitivity	90.64%	90.9%	92%	88.9%	37.5%	71%
Specificity	84.3%	95.9%	76%	50.0%	92.4%	83%
Positive predictive value (PPV)	94.02%	83.3%	17%	17.78%	57.7%	17.5%
Negative predictive value (NPV)	76.7%	97.9%	99%	22.2%	84.3%	99%

The limitation of the study was Contrast-enhanced CT scans were not feasible for all patients. Those with elevated creatinine levels due to acute kidney injury (AKI) or chronic kidney disease (CKD) did not undergo CT scans. Additionally, in patients with a high risk of contrast-induced nephropathy, performing a contrast CT scan could potentially worsen renal failure, which is a component of organ failure in acute pancreatitis.

To summarise, the BISAP score effectively predicted mortality, organ failure in patients with acute pancreatitis. Its potential application in smaller healthcare centres and countries with less developed healthcare systems is promising. The BISAP score facilitates early risk stratification and decision-making within 24 hours of admission for acute pancreatitis cases, enhancing clinical evaluation and management. Ultimately, this contributes to improving outcomes for these patients. This study, being a prospective observational study with a large sample size, can be extrapolated to the community for further study purposes.

Conclusion

Acute pancreatitis, a common abdominal emergency, requires effective triaging and treatment planning to reduce mortality and morbidity rates. The BISAP scoring system proves superior in early severity prediction at admission, offering simplicity with bedside-accessible variables. In contrast, complex systems like APACHE II and Ranson's are less prompt and straightforward. The CT severity index (CTSI), while commonly used, can overestimate severity, and presents logistical challenges in availability and usage. Thus, BISAP stands out as a practical tool for daily clinical use, enhancing patient care outcomes.

Abbreviations

BISAP - Bedside Index for Severity of Acute Pancreatitis
CTSI - Computed Tomography Severity Index
SAP - Severe Acute Pancreatitis
SIRS - Systemic Inflammatory Response Syndrome
APACHE - Acute Physiology and Chronic Health Evaluation
BUN - Blood Urea Nitrogen
PPV - Positive Predictive Value
NPV - Negative Predictive Value
ROC - Receiver Operating Characteristic curves
AUC - Area Under Curve
BMI - Body Mass Index

Ethical approval

Yes. It was approved by Institute ethical committee (IEC) of All India Institute of Medical Sciences. Serial number: IEC/Pharmac/2023/513 dated 03/01/2023.

Data availability

The authors confirm that the data supporting the findings of this article are available within the article and its supplementary materials. Detail data regarding the participant is available with the authors.

Author contributions

Dr. Dhamodhara Kannan Shivarajan: Writing - original draft /Conceptualization/ Data curation / Review of Literature / Resources
Dr. Bhupendra Mehra: Supervision/ Validation /Writing - review & editing/ Project administration
Dr. Siddharth P. Dubhashi: Supervision/ Validation /Writing - review & editing/ Project administration
Dr. Nitin Sherkar: Supervision/ Validation /Writing - review & editing/ Project administration

Conflicts of Interests

None declared.

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