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Original Article

Investigating the prognostic power of Bedside Index for Severity in Acute Pancreatitis (BISAP) score

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Abstract

Background: Patient management and necessary supportive treatments, an accurate prognosis of the illness is essential for patients with acute pancreatitis. Thus far, no diagnostic technique has demonstrated superiority over the other in terms of clinical judgment. The aim of this study was to examine the predictive accuracy of the Bedside Index for Severity in Acute Pancreatitis (BISAP) score in contrast to Ranson's criteria.

Methods: Our research is a retrospective cross-sectional analysis. Inclusion criteria encompassed patients admitted to the emergency department with acute pancreatitis. Exclusion criteria comprised individuals with liver, heart, or renal failure upon admission or during hospitalization. Each patient's demographic data, including age, gender, education level, and consciousness level, were considered. Statistical analysis was conducted using SPSS 16 software with a significance level set at $p < 0.05$.

Results: Out of 286 patients, 221 were diagnosed with moderate acute pancreatitis, while 65 were diagnosed with severe acute pancreatitis. Among these patients, 5 (7.1%) succumbed to complications related to pancreatitis, including 3 males and 2 females. Both the BISAP and Ranson criteria demonstrated significant capability in assessing the severity of both moderate and severe acute pancreatitis with a 95% confidence level. The analysis revealed a statistically significant area under the curve for both criteria (P= 0.002).

Conclusion: Although BISAP and Ranson have both good accuracy and efficacy to determine the severity of pancreatitis, BISAP scoring criteria have higher prognostic accuracy.

Keywords: BISAP, Acute pancreatitis, Prognosis.

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An inflamed pancreas is the common and complicated clinical condition known as acute pancreatitis. Its severity ranges from mild to severe and is typically brought on by the pancreatic self-digestion enzyme system (1). There are various etiologies for the disease, and the mortality rate ranges from 5% to 10%. Most cases (80–90%) have a mild, self-limiting illness, but 10–20% have acute pancreatitis, which ultimately results in multi-organ diseases, pancreatic necrosis, and tissue destruction around the affected area (2-4). For patient management and necessary supportive treatments, an accurate prognosis of the illness is essential. Thus far, no diagnostic technique has demonstrated superiority over the other in terms of clinical judgment. A desirable prognostic scoring system ought to possess the qualities of simplicity, non-invasiveness, accuracy, and quantifiability. Furthermore, the methods used for evaluation should be easily adaptable during the period of diagnosis (5). Since the 1980s, scoring systems such as Ranson's score, the modified Glasgow score, and APACHE II have become widely utilized for assessing the severity of acute pancreatitis in clinical settings (6). However, these methods possess significant constraints.

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The Ranson's score and modified Glasgow score encompass information that is not ordinarily obtained during the moment of admission to the hospital and necessitate a completion period of 48 hours (7). The BISAP scoring system offers a prompt and straightforward evaluation of the condition upon entry, and as the BISAP score escalates, there is a notable inclination towards mortality and the utmost frequency, thereby supplying valuable insights in this domain and aiding in the enhancement of patient care (8).

It is a straightforward task to compute using the data points accessible within the initial 24-hour period of arrival to the emergency department. Other clinical prediction scores found in literature require extensive computation, relying on clinical and laboratory data spanning a 48-hour hospitalization period. However, they do not exceed the predictive accuracy of BISAP in forecasting severe pancreatitis (9, 10).

This is particularly significant given that the initial 24–48-hour timeframe is the utmost critical period for the administration of pancreatitis. At the conclusion of this 48-hour duration, the majority of patients have exhibited the gravity of their ailment through either clinical enhancement or the onset of organ dysfunction (11). Henceforth, various markers are employed for diagnosing acute pancreatitis. The aim of this investigation was to assess the predictive efficacy of the Bedside Index for Severity in Acute Pancreatitis (BISAP) score in contrast to Ranson's criteria, a commonly employed clinical measure in acute pancreatitis patients. This comparative analysis aimed to mitigate complications and reduce additional costs for patients. The study presented a novel approach to prognostic evaluation in acute pancreatitis, focusing on the BISAP score and comparing it with the widely utilized Ranson's criteria. The key innovation lies in prioritizing the BISAP score's early assessment capability, enabling swift and uncomplicated evaluation within the crucial initial 24 hours of a patient's emergency department admission.

Methods

Study design: This retrospective cross-sectional study was conducted at Imam Khomeini Hospital in Sari over a 2-year period, focusing on the data collected from eligible patients. The sample size comprised 286 individuals meeting inclusion criteria, defined as patients with acute pancreatitis admitted to the emergency room. Exclusion criteria encompassed instances of liver failure, heart failure, and kidney failure prior to admission.

Data collection: For each eligible patient, comprehensive demographic information, including age, sex, education level, and level of consciousness, was systematically recorded. Within the initial 24 hours of admission, data on amylase, lipase, creatinine, BUN, and vital signs—such as heart rate, temperature, and breathing rate—were meticulously documented. Simultaneously, the BISAP questionnaire and Ranson's criteria were administered. Ranson's criteria involved age and measurements of WBC, Glu, AST, LDH at admission, as well as measurements of Ca, Haematocrit, PO_2, base deficit, and fluid sequestration within 48 hours after hospitalization.

The Bedside Index for Severity in Acute Pancreatitis (BISAP) score was similarly calculated based on predefined criteria, with one score assigned for each case (table 1). The scoring system for Ranson's criteria was applied based on predefined thresholds. Points were allocated for each met criterion, with associated mortality rates delineated for different score ranges (table 2). Follow-up of patients extended for one month, during which their treatment regimens were meticulously recorded. Ranson's criteria, differentiating between admission and the initial 48 hours, established clear criteria-mortality associations.

Table 1. Individual components and interpretation of the BISAP scoring system

Components
BUN >25 mg/dl
Impaired mental status (Glasgow Coma Scale Score <15)
SIRS* SIRS is defined as two or more of the following: (1) Temperature of <36 or >38°C (2) Respiratory rate >20 breaths/min or $PaCO_2$ <32 mmHg (3) Pulse >90 beats/min (4) WBC <4,000 or >12,000 cells/mm 3 or >10% immature bands
Age >60 years
Pleural effusion detected on imaging

Interpretation	
BISAP Score	Mortality
0	0.1%
1	0.4%
2	1.6%
3	3.6%
4	7.4%
5	9.5%

BUN: Blood Urea Nitrogen,
SIRS: Severe Inflammatory Response Syndrome
WBC: White Blood Cell
BISAP: Bedside Index for Severity in Acute Pancreatitis

Statistical analysis: Descriptive and analytical analyses were carried out in accordance with both the general and specific objectives of the project. Research findings were presented using mean dispersion indices and standard deviation (SD±M). One-way analysis of variance tests, along with Tukey's post hoc test, were employed to compare between groups and ensure sample normal distribution. Diagnostic measures including sensitivity, specificity, false positive predictor, and false negative predictor were utilized. All statistical analyses were conducted using SPSS 16 software, with significance level set at $p < 0.05$.

Results

This research was conducted on 286 hospitalized patients diagnosed with acute pancreatitis at Imam Khomeini Hospital in Sari. Among them, 183 were males and 103 were females. The demographic and clinical characteristics of these patients are summarized in table 3. Based on the findings presented in, the age group between 30-39 years exhibited the highest frequency (21.3%), while the age group of 20-29 years demonstrated the lowest frequency (6.6%). Additionally, a higher proportion of male patients (64.0%) were diagnosed with pancreatitis.

Table 2. Individual components and interpretation of the Ranson's criteria

At admission or diagnosis	
Age over 55 years	
White blood count over 16,000/cu mm	
Serum lactic dehydrogenase (LDH) over 350 U/I	
Serum glutamic oxaloacetic transaminase (AST) over 250 U/I	
During initial 48h	
Haematocrit fall greater than 10% points	
Blood urea nitrogen rise more than 5 mg/dl	
Arterial PO_2 below 60 mm Hg	
Base deficit > 4 meq/l	
Estimated fluid sequestration more than 6000 ml	
Interpretation	
Criteria Met	**Mortality**
0-2	2%
3-4	15%
5-6	40%
7-8	100%

Table 3. Demographic and clinical characteristics of patients

Variable	Grouping	Frequency
Age	20-29	(6.6%) 19
	30-39	(21.3%) 61
	40-49	(18.9%) 54
	50-59	(16.8%) 48
	60-69	(15.7%) 45
	70≤	(20.7%) 59
Gender	Male	(64.0%) 183
	Female	(36.0%) 103
Variable	**Mean±Standard deviation**	
Age	0.06±53.81	
Amylase	542.99±1233.53	
Lipase	752.64±1428.52	

All patients underwent scoring based on clinical characteristics using two rating indices for pancreatitis patients, namely BISAP and RANSON, to determine the severity of their condition. The frequency distribution of different severity levels according to BISAP and RANSON scores is detailed in table 4. Clinical data from 286 patients diagnosed with acute pancreatitis were analyzed to compare the diagnostic efficacy of BISAP and Ranson scores in determining the severity and accuracy of acute pancreatitis using receiver-operating characteristic (ROC) curves. Among the patients, 221 had moderate acute pancreatitis, while 65 had severe acute pancreatitis.

Table 4. Frequency and percentage of different scores according to BISAP and Ranson indices

Ranking	BISAP	Ranson
0	(51.7%) 148	(42.3%) 121
1	(23.8%) 68	(23.8%) 68
2	(14.3%) 41	(21.7%) 62
3	(5.9%) 17	(4.5%) 13
4	(4.2%) 12	(4.9%) 14
5	-	(2.4%) 7
6	-	(0.3%) 1

Additionally, 5 (1.7%) patients died due to pancreatitis complications, with 3 being male and 2 females. The ages of the male patients were 91, 58, and 65 years, with BISAP scores of 4, 4, and 3, and Ranson scores of 6, 5, and 5, respectively. The female patients were 80 and 51 years old, with BISAP scores of 4 and 4, and Ranson scores of 5 and 4, respectively. The objective of this study was to aid surgeons and emergency medicine specialists in expediting prognosis for patients requiring surgery and those who do not, based on BISAP and Ranson scores. Tables 5 and 6 display the area under the curve (AUC), 95% confidence intervals for the AUC, and p-values for the significance of the AUC for both indicators.

These tables also present the diagnostic value indicators (sensitivity, specificity, positive and negative predictive values, and positive and negative likelihood ratios) and their confidence intervals for each indicator. To assess the prognostic capability of the BISAP index, the results

obtained using the ROC curve are detailed in table 5. According to the obtained results, the hypothesis of equality of the area under the performance characteristic curve is rejected with a value of 0.5 and it can be said that the BISAP index has the ability to determine the prognosis of severe and moderate acute pancreatitis patients with 95% confidence ($p<0.0001$). The ROC curve for this index can be seen below. To check the predictive power of the Ranson index, the following results were obtained using the ROC curve (table 6, figure 2).

Table 5. Test results for BISAP index

Variable	BISAP (CI)**
The area under the curve	(0.97, 0.91) 0.94
P-Value	*0001/0 >
sensitivity	(93.5, 75.3) 86.15
specificity	(96.5, 89.6) 93.67
Positive likelihood ratios	(22.8, 8.1) 13.6
Negative likelihood ratios	(0.08, 0.30) 0.15
Cut-point	1 <

* It is significant at the 0.05 level
**95% confidence interval

Table 6. Test results for Ranson indexes

Variable	Ranson (CI)**
The area under the curve	(0.84, 0.92) 0.89
P. Value	*0001/0 >
sensitivity	(90.1, 70.0) 81.54
specificity	(85.1, 74.2)80.09
Positive likelihood ratios	(5.5, 3.1) 4.1
Negative likelihood ratios	(0.4, 0.1) 0.23
Cut-point	1 <

* It is significant at the 0.05 level
**95% confidence interval

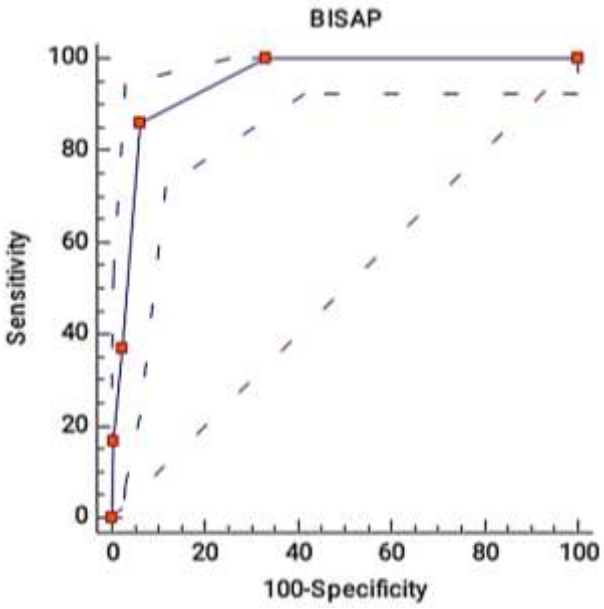

Figure 1 .The ROC curve for BISAP index

According to the obtained results, the hypothesis of the equality of the area under the performance characteristic curve is rejected with a value of 0.5 and it can be said that the Ranson index has the ability to determine the prognosis of severe and moderate acute pancreatitis patients with 95% confidence (p<0.0001). To assess whether there is a significant distinction between the BISAP and Ranson indices and to determine which index better predicts the prognosis of patients with severe acute pancreatitis compared to moderate acute pancreatitis, the area under the curve for both indices was compared. The results are documented in table 7 and figure 3. Analysis of the results revealed a statistically significant difference in the area under the curve between the two indices (P = 0.002). Consequently, it can be inferred that the BISAP index demonstrates superior prognostic accuracy compared to the Ranson index.

Table 7 .The results of the test to examine the difference in the area under the ROC curve between BISAP and Ranson indices

	Difference between the 2 areas	Test statistics	P-value	Confidence interval	
				Lower limit	Upper limit
Area	0.057	0.057	*0.002	0.021	0.094

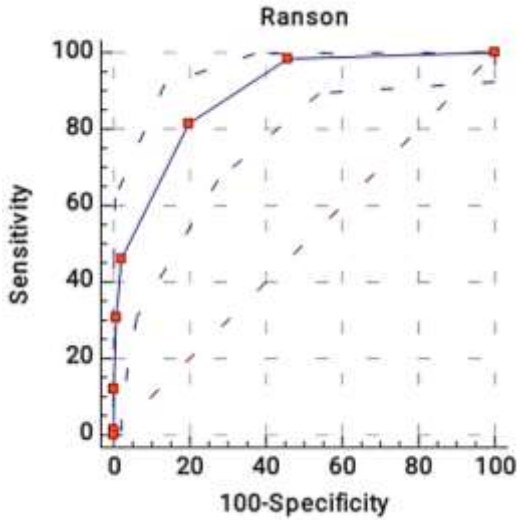

Figure 2. The ROC curve for Ranson index

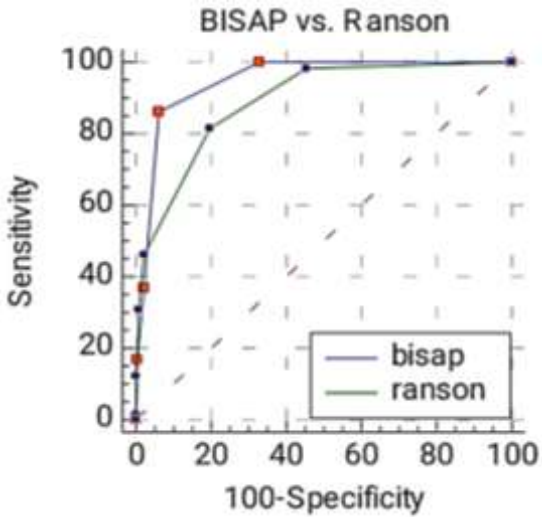

Figure 3. Comparison of the ROC curve in terms of two indexes

Discussion

The study findings indicate that both Ranson's criteria and the BISAP index exhibit high sensitivity and specificity in predicting the prognosis of patients with moderate and severe acute pancreatitis. However, the BISAP index demonstrated superior prognostic accuracy compared to the Ranson index.

An acute inflammation of the pancreas, known as acute pancreatitis or acute necrosis of the pancreas, frequently manifests as epigastric pain, nausea, vomiting, diarrhoea, anorexia, fever, chills, hemodynamic issues, and shock (12). When the disease is mild, it can usually be treated with supportive measures like fluid therapy and no oral nutrition. However, in more severe cases, the patient may require surgery and intensive care unit care even with supportive measures. The patient faces a high mortality rate in such circumstances (13). In each of them, different types of clinical and laboratory criteria and imaging are used. But each of these criteria has shortcomings, which has caused the investigations to continue to find the best criteria for diagnosing the severity of the disease. For example, in Ranson's grading criteria, the results of the investigations can be used after 48 hours. Due to the problems mentioned in the calculation and efficiency of these tests, in recent years, the use of blood biomarkers to measure and evaluate the severity of pancreatitis has been considered. Diagnosis of acute pancreatitis is possible after rejecting other differential diagnoses and based on a combination of clinical findings, serum markers and CT scan or by observing the pancreas during surgery (14).

The aim of this study was to examine the predictive capability of the Bedside Index for Severity in Acute Pancreatitis (BISAP) score in comparison to Ranson's criteria, a widely used clinical measure in patients with acute pancreatitis. The goal is to enable timely diagnosis, thereby reducing complications and additional costs for patients. According to the study findings, the age group between 30-39 years had the highest frequency (21.3%), whereas the age group of 20-29 years had the lowest frequency (6.6%). Additionally, the study revealed that the majority of patients diagnosed with acute pancreatitis were male (64%), consistent with previous research, such as the study conducted by Vidarsdottir et al. in 2011 involving 134 patients, where 58% were males (15). Most studies have reported a higher prevalence of acute pancreatitis among females, contrary to the findings of this study (16, 17). No specific age group was found to be immune to acute pancreatitis; however, the middle-aged population is observed to be more frequently affected, consistent with findings from the study conducted by Kaya et al. in Turkey, which aligns with the current study. Researchers conducted a comparative analysis between the precision of Ranson's scoring system and the novel BISAP system in individuals diagnosed with acute pancreatitis. The recently proposed BISAP index has shown to be a reliable method for categorizing patients within 24 hours of admission. Their findings indicate that the BISAP score yielded similar results to Ranson's scoring system, suggesting agreement between the BISAP score and Ranson's score in evaluating the severity and subsequent mortality frequency in patients with acute pancreatitis (8).

However, in the current study, we demonstrated that the BISAP index exhibits higher prognostic accuracy compared to the Ranson index. In a study by Wu et al., involving 17,990 patients with acute pancreatitis across 212 hospitals in 2005, various prognostic tools used in the initial evaluation of patients with the condition were compared. Their findings concluded that the BISAP criterion is a reliable and effective method for early detection of high-risk individuals with acute pancreatitis (18). In a study conducted by Chen et al. in 2013, involving 497 patients, the value of BISAP criteria in assessing the severity and prognosis of acute pancreatitis patients was evaluated. Their findings indicated that, when compared to APACHE II and Ranson criteria, BISAP proved to be a more accurate measure for determining the severity and prognosis of acute pancreatitis (19).

Numerous factors may contribute to these disparities. Firstly, variations can be observed in the characteristics of individuals participating in the study, including factors such as race, lifestyle, and genetic background. Additionally, differences in etiological distribution may also account for the observed variations. The BISAP score offers several advantages compared to other scoring systems. It involves straightforward data acquisition during admission, including physical examination, vital signs, limited laboratory data, and imaging to detect pleural effusion. This streamlined process facilitates convenient calculation and predicts in-hospital death in the early stages of the disease (2, 10, 18, 20). One of the limitations of this study is the failure to include other valid prognostic criteria, including APACHEII, in addition to Ranson. Our study is also limited to one treatment centre (Imam Khomeini Hospital, Sari) and expanding the geographical scope of the study may lead to a more detailed investigation.

The aim of this study was to assist surgeons and emergency medicine specialists in expediting the assessment of disease severity and prognosis for patients requiring surgery and those who do not, based on the BIASP and Ranson indices. Our findings indicate that both the

BISAP and Ranson prognostic criteria demonstrate adequate accuracy in evaluating the severity and prognosis of patients with acute pancreatitis. However, the BISAP criterion exhibits higher prognostic accuracy compared to Ranson's criterion.

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Authors' contribution: F.B: Conceptualization, Resources, Supervision; S.A.H: Methodology, Writing - Review & Editing; F.J: Formal analysis, Visualization; Z.B: Methodology, Conceptualization, K.B: Data curation, Writing

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