

## Original Research Article

# Prospective evaluation of the BISAP score and its correlation with Marshall score in predicting severity of organ failure in acute pancreatitis

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**Received:** 05 February 2017

**Accepted:** 03 March 2017

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## ABSTRACT

**Background:** The bedside index for severity in acute pancreatitis (BISAP), a newer prognostic scoring system, has been proposed as a simple and clinically oriented severity scoring system for early identification of patients with acute pancreatitis. This study evaluates the efficacy of BISAP score to predict the severity of organ failure in patients of acute pancreatitis and its correlation with Marshall score.

**Methods:** The clinical, laboratory and radiological data for all patients admitted with a diagnosis of acute pancreatitis conducted at tertiary hospital of Armed Forces over a two-year period, was prospectively collected for this study. BISAP score was calculated within 24hrs of presentation. Markers of severity were the development of organ failure and presence of pancreatic necrosis. Outcome at 28 days (viz. recovery, organ failure and mortality) was studied for each patient. BISAP score computed at 24h was correlated with the above and its efficacy to predict the severity of organ failure in Acute Pancreatitis, was assessed.

**Results:** Out of 50 patients in the study group, 41 were male and 9 were female with the mean ( $\pm$ SD) age  $43.74 \pm 16.85$  years. Majority of the study population had alcohol (56%) as the etiology followed by gall stones (28%). Outcome assessed at 28 days revealed recovery of 54%, complication of 36% and mortality of 10% of study population. BISAP score computed within 24 hours of admission of 2 or more significantly predicted the severity and complication with P value  $<0.001$ . Statistically significant trends of increasing severity and organ failure ( $P < 0.001$ ) with increasing BISAP was observed.

**Conclusions:** BISAP score is a reliable means of predicting the severity and organ failure and stratifying patients with Acute Pancreatitis within 24 hours of admission. The statistically significant incidence of increasing severity and mortality with increasing BISAP score will help us to risk stratify the patients within 24 hours of admission and help improve clinical care and facilitate necessary interventions as early as possible.

**Keywords:** BISAP, Marshall score, Pancreatitis, Organ failure

## INTRODUCTION

Acute pancreatitis is a protean disease with a variable clinical course leading to substantial burden on health care system. Predicting severity of pancreatitis early in

the course of disease is critical to maximize therapy and to prevent and minimize organ dysfunction and complications. Unfortunately the management of patients with acute pancreatitis is complicated by the inability to distinguish mild from severe disease during the early

stages of presentation. There are no simple clinical scoring systems in acute pancreatitis that can predict severity based on routine laboratory and diagnostic testing within 24h of presentation. Current method of risk stratification in acute pancreatitis have important limitations. The Ranson and modified Glasgow score contain data not routinely collected at the time of hospitalization.<sup>1,2</sup> Both require 48h to complete, missing a potentially valuable early therapeutic window.<sup>1-3</sup> The APACHE II was originally developed as an intensive care instrument and requires the collection of a large number of parameters, some of which may not be relevant to prognosis in acute pancreatitis.<sup>4,5</sup>

There is a need for a simple and clinically oriented severity scoring system that can predict severity of acute pancreatitis within 24h of presentation. Early recognition of severe disease would enable the clinician to consider more aggressive interventions within a time frame that could potentially prevent adverse outcomes.

A newer prognostic scoring system, the 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. The BISAP combines findings of physical examination, vital signs, routine laboratory data, and imaging studies to derive a five-point score. The BISAP score comprises of five variables: Blood Urea Nitrogen >25mg/dl, Impaired Mental Status, Systemic Inflammatory Response Syndrome, Age >60years, and Pleural Effusion detected on imaging. One point is assigned for each variable within 24h of presentation and added for composite score of 0-5.

The primary advantage of BISAP score is simplicity. There is no need for additional computation. In addition each of the parameter can be easily obtained early in the course of admission. The BISAP score stratifies patients within the first 24h of admission according to the severity and is able to identify patients at increased risk of mortality prior to the onset of organ failure. The ability to risk stratify patients early in their course is a major step in improving future management strategies in acute pancreatitis.

## METHODS

This was a prospective study conducted at tertiary hospital of Armed Forces. All patients meeting the inclusion criteria and hospitalized over a two year period were included in this study. The clinical, laboratory and radiological data for all patients admitted in this institution with a diagnosis of acute pancreatitis was prospectively collected for this study.

### Inclusion criteria

All patients admitted to this hospital with a diagnosis of acute pancreatitis irrespective of etiology.

### Exclusion criteria

- Recurrent pancreatitis
- Patients with acute on chronic pancreatitis
- Patients with deranged renal and liver functions prior to the onset of disease

All the patients admitted as a case of acute pancreatitis were assessed within 24h of presentation and following work up were performed

- Systematic medical history
- Complete physical examination
- Laboratory evaluation including chest radiograph

Acute pancreatitis was defined as presence of two or more of the following: characteristic abdominal pain; serum amylase and /or lipase levels 3 times the upper limit of normal; and/or a contrast enhanced computed tomography (CT) of the abdomen within the first 96h of hospitalization demonstrating changes consistent with acute pancreatitis. BISAP Score was calculated within 24hours of presentation.

### Components of the BISAP scoring system

- BUN >25 mg/dl
- Impaired mental status (Glasgow Coma Scale <15)
- SIRS  
SIRS is defined as two or more of the following:
  - a. Temperature of <36 or >38 C
  - b. Respiratory rate >24 breaths/min or PaCO<sub>2</sub> <32mmHg
  - c. Pulse >90beats/min
  - d. WBC <4,000 or >12,000 cells/mm<sup>3</sup> or >10% immature bands
- Age >60 years
- Pleural effusion detected on chest radiograph

One point was assigned for each positive variable within 24h of presentation and added for a composite score of 0-5. Markers of severity were the development of organ failure and presence of pancreatic necrosis. Organ failure was defined as a score of  $\geq 2$  in one or more of the three (respiratory, renal and cardiovascular) organ systems as described in Marshall score (Table 1).<sup>6</sup>

Assessment for Organ failure at 72h were done on all patients using Marshall scoring system. A CECT of the abdomen was done at 72h to 96h to look for pancreatic necrosis and its extent. Outcome at 28 days (viz. recovery, complication and/or surgical intervention and mortality) was studied for each patient. BISAP score computed at 24hour was correlated with the above and its

efficacy to predict the severity of organ failure and outcome in acute pancreatitis was assessed.

**Statistical analysis**

The data were presented as Mean±SD. Proportion of the study parameters were estimated using percentages. The limit of significance was calculated using p-value. The P

value of <0.05 was taken as statistically significant.

**Statistical software**

Microsoft word and Microsoft Excel were used to generate graphs, tables etc. The statistical software namely SPSS version 16.0 was used for the analysis of the data.

**Table 1: Criteria for organ failure based on Marshall scoring system.**

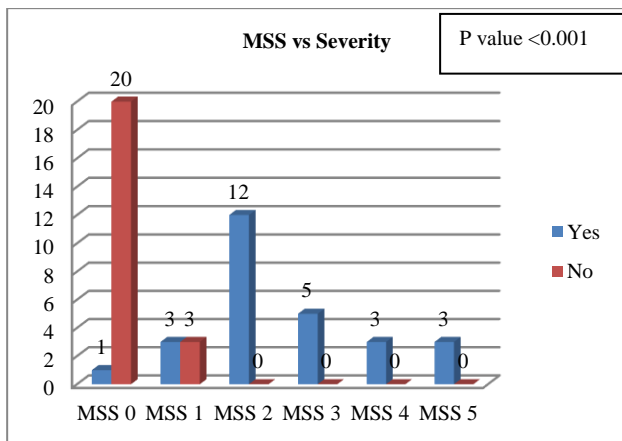
Organ system	Score				
	0	1	2	3	4
Respiratory (PaO <sub>2</sub> / FiO <sub>2</sub> )	>400	301-400	201-300	101-200	<101
Renal (serum creatinine, mg/dl)	≤1.5	>1.5 to ≤1.9	>1.9 to ≤3.5	>3.5 to ≤5.0	>5.0
Cardiovascular (systolic blood pressure, mm Hg)	>90	<90, Fluid responsive	<90, Fluid unresponsive	<90, pH<7.3	<90, pH<7.2

**RESULTS**

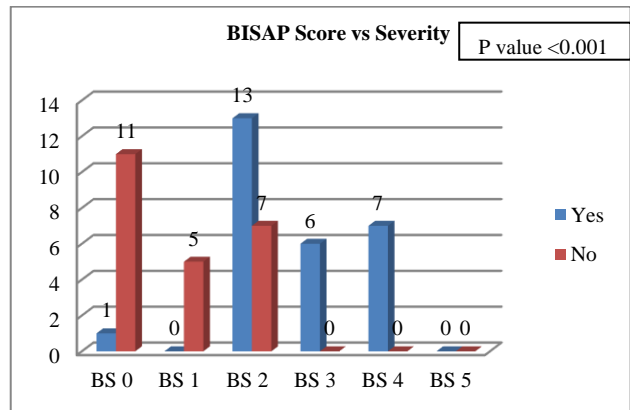
The study group consisted of 50 patients admitted in Army Hospital Research & Referral Delhi Cantt with the diagnosis of Acute Pancreatitis, 41 were male and 9 were women. The mean (±SD) age was 43.74±16.85 years, with a range of 21 to 84 years. Maximum study population were in between 20–40 years of age, all of whom were men accounting for about 58% of study group. Etiology of Acute Pancreatitis among the study population was Alcohol (56%), Gall stones (28%), Idiopathic (14%) and post ERCP (2%). BISAP score was computed within 24 hrs of presentation of the study group as a case of Acute Pancreatitis based on clinical, laboratory and radiological supported diagnosis. One point is assigned for each positive variable within 24h of presentation and added for a composite score of 0-5. Based on the development of organ failure and pancreatic necrosis, the study population were assessed for severity and outcome was studied at 28 days from onset. In this study population 54% (n=27) people had severe pancreatitis out of total 50.

Markers of severity was the development of organ failure as defined by score of ≥2 in MSS and evidence of pancreatic necrosis in CTSI >4. The trend for increasing severity with MSS of 2 and above was statistically significant (Figure 1) (P<0.001).

Outcome assessed at 28 days revealed recovery of 54% people, complication of 36% and mortality of 10% of study subjects. BISAP score computed at 24h was correlated with the severity and outcome observed at 28 days. BISAP score of 2 or more significantly predicted the severity with P value <0.001 (Figure 2).



**Figure 1: Correlation of MSS with severity.**



**Figure 2: Correlation of BISAP score with severity.**

BISAP score of 0 and 1 significantly predicted the recovery with P value <0.001. BISAP score of 2 and above significantly predicted the complication with P value <0.001. BISAP score of 3 and above significantly predicted the mortality with P value <0.001 (Table 2).

The trend for increasing severity and mortality with increasing BISAP was statistically significant with (P <0.001) and (P<0.001) respectively. Spearman's rank correlation coefficient or Spearman's rho measured

statistically significant ( $P < 0.001$ ) the relationship between BISAP score, Marshal scoring system (MSS) in

assessing the outcome of acute pancreatitis (Table 3).

**Table 2: Correlation of outcome with BISAP score.**

		Outcome (28 days)			Total
		Recovery	Complication	Mortality	
BISAP score	0	12	0	0	12
	1	5	0	0	5
	2	10	10	0	20
	3	0	5	1	6
	4	0	3	4	7
	5	0	0	0	0
<b>Total</b>		27	18	5	50
<b>Chi-Square Tests</b>		<b>Value</b>	<b>df</b>	<b>P value</b>	
Pearson Chi-Square		44.299 <sup>a</sup>	8	<0.001	

**Table 3: Statistical correlation of BISAP with MSS predicting outcome.**

			Outcome (28 days)	BISAP Score	MSS
<b>Spearman's rho</b>	Outcome (28 days)	Correlation coefficient	1	0.790**	0.858**
		P value	-	<0.001	<0.001
		N	50	50	50
	BISAP score	Correlation coefficient	0.790**	1	0.813**
		P value	<0.001	-	<0.001
		N	50	50	50
	MSS	Correlation coefficient	0.858**	0.813**	1
		P value	<0.001	<0.001	-
		N	50	50	50
		P value	<0.001	<0.001	<0.001
		N	50	50	50

\*\*Correlation is significant at the 0.01 level (2-tailed).

## DISCUSSION

Acute pancreatitis (AP) is a disease with numerous manifestation characterized by a variable clinical course. It can vary from a mild self-limiting disease with only minimal or transitional systemic manifestations in approximately 80% to 90% of patients, to a clinically severe form in 10% to 20% of patients, with local and systemic complications. The overall mortality rate of AP is 2% to 5%, but the mortality rate of patients with severe disease may reach 20% to 30%. Therefore, the early recognition of severe disease would allow the clinician to consider more aggressive interventions within a time frame that could potentially prevent adverse outcomes.

Acute pancreatitis is best defined clinically by a patient presenting with two of the following criteria: a) Symptoms, such as epigastric pain, consistent with the disease; b) A serum amylase or lipase, greater than three times the upper limit of normal; or c) Radiologic imaging consistent with the diagnosis, usually using computed tomography (CT) or magnetic resonance imaging (MRI). Pancreatitis is classified as acute unless there are CT,

MRI, or endoscopic retrograde cholangiopancreatography (ERCP) findings of chronic pancreatitis.

We prospectively studied 50 patients with a diagnosis of Acute Pancreatitis based on clinical, laboratory and radiological investigations in tertiary hospital of Armed Forces. The study group consisted of patients of which 41 were male and remaining 9 were female patients. The mean ( $\pm$ SD) age was  $43.74 \pm 16.85$  years, with a range of 21 to 84 years. The maximum study population were in between 20–40 years of age ( $n=29$ ), all were men accounting about 58% of study group. The gender bias is likely due to the fact that this is a tertiary care center catering for the armed forces with a predominant male population.

The etiology of acute pancreatitis in our study population was maximum of alcohol (56%), followed by gall stones (28%), idiopathic (7%) and post ERCP (2%). This was similar compared to study by Cho Y, Kim H et al which had a male sex (69%) and alcohol as a etiology (42%) in their study population except that the study group had 299 population.<sup>7</sup> The most common cause of AP in most areas of the world is gallstones, accounting for at least

35% to 40% of cases.<sup>8,9</sup> In recent cohort studies of BISAP, gallstones were the leading cause (27%-36%) of AP, and alcohol was the second or third leading cause (14% -21.4%).<sup>1,10</sup> However, in our study, alcohol (56%) was the leading etiologic factor in AP. This difference in etiology might be related to geographic characteristics, including sociocultural differences and working conditions of Armed Force personnel.

The ability to risk stratify patients early in their disease course has several important implications. First, early identification of high risk patients may alert doctors to institute aggressive resuscitation efforts and to consider speciality care referral. Second, it's a major step in improving future management strategies in acute pancreatitis. Perez et al reported an overall mortality rate of 14% among 99 patients with pancreatic necrosis but found that the concomitant presence of organ failure at admission or during hospitalization was associated with a nearly 50% mortality rate.<sup>11</sup> Rau et al noted a 19 fold increased risk of mortality among 230 patients with sterile necrosis, treated either operatively or conservatively, with multisystem >2 organ failure.<sup>12</sup> In addition to the presence of organ failure, the persistence of organ failure has been shown to a major determinant of mortality in acute pancreatitis.<sup>13,14</sup>

In our study, admitted patients in the study group were assessed within 24hrs of presentation and BISAP score was calculated. One point was assigned for each variable. Severity was assessed based on the development of organ failure and pancreatic necrosis. Assessment for Organ failure at 72hrs was performed in all patients using Marshall scoring system. A CECT of the abdomen was done at 72h to 96h to look for pancreatic necrosis and its extent. Outcome at 28 days (viz. recovery, complication and/or surgical intervention and mortality) was studied for each patient.

It was observed that 54% of our study group had acute severe pancreatitis compared to remaining 46%. There were 24, 10, 40, 12, 14, and 0% of cases with BISAP scores of 0 – 5, respectively, with corresponding severity rates of 2, 0, 26, 12, 14, and 0%. The trend for increasing severity with increasing BISAP score of 2 and above was statistically significant ( $P < 0.0001$ ). The observations were similar to study done by Singh et al among 397 cases, where the BISAP scores of  $\geq 3$  predicted the severity with the development of organ failure, persistent organ failure, and necrosis in the prospective cohort of 397 cases.<sup>1</sup>

In our study population, outcome assessed at 28 days revealed recovery in 54%, complication in 36% and mortality in 10% of total population. There were 24, 10, 40, 12, 14, and 0% of cases with BISAP scores of 0 – 5, respectively, with corresponding complication rate of 0,0,20,10,6 and 0% and corresponding mortality rate of 0,0,0,2,8 and 0%. This trend of increasing complication with BISAP score of  $\geq 2$  and increasing mortality with

BISAP score of  $\geq 3$  was statistically significant ( $P < 0.001$ ). Our study result was consistent with previous studies in which there were 24.2, 42.3, 19.1, 11.1, 2.5, and 0.8 % of cases with BISAP scores of 0–5, respectively, with corresponding mortality rates of 0, 2, 0, 9.50, and 33% which also had revealed statistically significant trend of increasing mortality with increasing BISAP score.<sup>1</sup>

Respiratory failure (22/27, 81.4%) was the most common organ dysfunction in severe pancreatitis in our study, and this finding concurs with those of previous studies [77, 81]. It was followed by renal failure (5/27, 18.5%).

Ransons score, which requires 11 signs for computation, recorded at admission and 48hrs is primarily aimed to evaluate the function of early operative intervention in patients of Acute Pancreatitis.<sup>15</sup> It is cumbersome and accurate Ranson's score takes 48h to complete and not all laboratories measure all the parameters in routine blood tests (e. g. serum lactate dehydrogenase). More recently, the APACHE II system, developed for general use in intensive care units, has supplanted Ranson score because it can be applied at any point in time, unlike Ranson score, which is calculated only 48 hours after admission.<sup>16</sup> Ranson criteria and the APACHE II system are very cumbersome to use, and both are limited by their complexity.

Bedside Index for Severity in Acute Pancreatitis is a newly developed prognostic scoring system. It also has the advantage of being applicable at any time during the course of acute pancreatitis, unlike Ranson score. In this regard, it is much like the APACHE II system, but is much simpler to use. Therefore, it has been proposed that the primary advantage of BISAP over the traditional scoring systems, such as Ranson score and APACHE II, is its simplicity.<sup>1</sup>

BISAP score carries several important advantages over other prognostic scoring systems in acute pancreatitis. The score is simple to calculate, requiring only those vital signs, laboratories, and imaging that are commonly obtained at the time of presentation or within 24hrs of presentation. BISAP score was initially derived and tested using 36,248 cases of acute pancreatitis across 389 hospitals, reflecting the full spectrum of health-care delivery.<sup>17,18</sup> BISAP score predicts organ failure and in-hospital mortality. There have also been prior studies that have proposed scoring systems for the prediction of mortality based on the collection of routine vital signs and laboratory data within 24 hours of admission.<sup>19</sup> The correlation of increasing trend in BISAP score and severity in cases of AP in form of organ failure and outcome is statistically significant as seen with Marshall scoring system.

The limitations of our study were the size of study population which limits a more extensive evaluation of the ability of the BISAP score to predict organ failure and

pancreatic necrosis. The Glasgow coma scale assessment used for the evaluation of impaired mental status in SIRS is subject to inter observer variation. Also being an Armed Forces Hospital majority of our study population were men.

## CONCLUSION

We conclude that the newly proposed BISAP score is a reliable means of predicting the organ failure and outcomes and stratifying patients with Acute Pancreatitis within 24 hours of admission. The statistically significant incidence of increasing severity and mortality with increasing BISAP score will help us to risk stratify the patients within 24 hours of admission and help improve clinical care and facilitate necessary interventions as early as possible. It will also help us to facilitate enrollment of appropriate patients with Acute Pancreatitis in future prospective trials.

*Funding: No funding sources*

*Conflict of interest: None declared*

*Ethical approval: The study was approved by the institutional ethics committee*

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**Cite this article as:** Kaushik MR, Dubey AP, Jain R, Rathore A, Pathak A. Prospective evaluation of the BISAP score and its correlation with Marshall score in predicting severity of organ failure in acute pancreatitis. *Int J Adv Med* 2017;4:534-9.