

## BISAP Score as a Superior Predictor for Severe Acute Pancreatitis Compared to Ranson's Criteria: A cross sectional study

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### **ABSTRACT:**

**Background:** Acute pancreatitis (AP) is an inflammatory condition of the pancreas characterized by activation of pancreatic enzymes to cause self-digestion of the pancreas, which presents as a mild upper abdominal discomfort with local inflammation to severe disease with multi-organ failure. It has a mortality of approximately 1% among all AP but it might be as high as 20% to 30% among those with severe acute pancreatitis (SAP). In clinical practice, accurate classification of the severity of acute pancreatitis is valuable in reducing mortality by clinical decision-making and action. The aim of this study is to compare the accuracy of BISAP scoring system and Ranson scoring system in predicting severity of acute pancreatitis. **Methods:** This is an observational, cross-sectional study conducted using a non-probability purposive sampling method. **Result:** A total of 25 patients with first episode of Acute Pancreatitis admitted were evaluated. **Result:** BISAP score of less than or equal to 3 predicted 93.75% of severe attacks and 83.3% of mild attacks with a PPV of 93.75% and NPV of 83.3% and accuracy of 90.09%. Ranson's score of greater than or equal to 4 predicted 42.8 % of severe attacks and 75 % of mild attacks with a positive predictive value of 33.33% and negative predictive value of 75% and accuracy of 60%. BISAP score has a better sensitivity, specificity, PPV, NPV and Accuracy than Ranson score in predicting the severity of AP putting the cutoff score >3 for both the scoring systems. **Conclusion:** BISAP scoring system is very simple, cheap, easy to remember and calculate. It is instantaneous and there is no time delay in contrast to Ranson's score. It is also found to be superior to RANSON's score in predicting severity.

**Keywords:** Acute Pancreatitis, Accuracy, BISAP score, Ranson Score, Severity

### **INTRODUCTION:**

Acute pancreatitis (AP) is an inflammatory condition of the pancreas characterized by activation of pancreatic enzymes to cause self-digestion of the pancreas,<sup>1</sup> which presents as a mild upper abdominal discomfort with local inflammation to severe disease with multi-organ failure. It has a mortality of approximately 1% among all AP but it might be as high as 20% to 30% among those with severe acute pancreatitis (SAP). According to the Atlanta Classification, SAP is defined as an AP associated with local and/or systemic complications.<sup>2</sup> In clinical practice, accurate classification of the severity of acute pancreatitis is valuable in reducing mortality by clinical decision-making and action. The two score

commonly used for the purpose are BISAP scoring system and Ranson's scoring system.

BISAP score was proposed by Wu et al. in 2008. The 5-point BISAP score system incorporates the variables: blood urea nitrogen level >25 mg/dl, impaired mental status, systemic inflammatory response syndrome (SIRS), and age >60 years, and presence of pleural effusion. One point is assigned for each variable within 24 h of presentation and added for a composite score of 0 – 5. The association between higher BISAP score (>3) can lead to increased risk of development of SAP and increased rate of mortality has been studied.<sup>3</sup>

The RANSON's score, modified Glasgow score (MGS) and APACHE II are amongst many scoring systems employed for assessment of the severity of acute

pancreatitis and have been most widely used in clinical practice since 1980s.<sup>4</sup> The two most common causes of AP are cholelithiasis/choledocholithiasis (biliary) and alcohol (definitions vary as does duration with consumption between 50 and 80 grams or 4–7 drinks/day) with frequency estimates of 40% and 30%, respectively.<sup>5,6,7</sup> For the two important causes, The RANSON's criteria has been developed for Acute non

gallstone pancreatitis and acute gallstone pancreatitis.<sup>5</sup> Severity assessment by Ranson's score is made by giving one point for each of the 11 variables.<sup>8</sup> In patients with fewer than three of these 11 prognostic factors the mortality rate is low (0.9%), with three or four factors, 18%; with five or six factors, 50%; and with more than six factors, 90%.<sup>9</sup>

**Table 1: Ranson's criteria (For Acute Non-Gallstone Pancreatitis)**

Upon admission	Within 48 hours
Age >55 years	Drop in HCT >10%
White blood cell count >16 × 10 <sup>9</sup> /L	Serum Ca <8 mg/dL
Blood glucose >200 mg/dL	Base deficit >4 mEq/L
LDH >350 IU/L	Increase BUN >5 mg/dL
AST >250 IU/L	Fluid deficit >6 L
	Arterial PO2 <60 mmHg

**Table 2: RANSON's criteria (For Acute Gallstone Pancreatitis)<sup>5</sup>**

Upon admission	Within 48 hours
Age > 70 years	Drop in HCT >10%
White blood cell count >18 × 10 <sup>9</sup> /L	Serum Ca <8 mg/dL
Blood glucose >220 mg/Dl	Base deficit >5 mEq/L
LDH >400 IU/L	Increase BUN >2 mg/dL
AST >440 IU/L	Fluid deficit >6 L
	Arterial PO2 <60 mmHg

The aim of this study is to compare the accuracy of BISAP scoring system and RANSON scoring system in predicting severity of acute pancreatitis.

## **MATERIALS AND METHODS:**

### **Study Design:**

This was an observational, cross-sectional study conducted at Bir Hospital, National Academy of Medical Sciences (NAMS), Kathmandu. The study included patients presenting to the Emergency Department with a clinical impression of acute pancreatitis (AP) between July 2020 and March 2021.

### **Sampling Technique and sample size determination:**

A non-probability purposive sampling method was used to select the participants for this study. Patients meeting

the inclusion criteria were consecutively recruited from the Emergency Department.

The sample size was determined using the following formula:

Sample size is calculated by using the formula.<sup>10</sup>  

$$n = [(Z_{\alpha/2} + Z_{\beta})^2 * \{p_1(100-p_1) + p_2(100-p_2)\}] / (p_1 - p_2)$$

Where,

n= sample size

P<sub>1</sub>= Proportion of first group

P<sub>2</sub>= Proportion of second group

Z<sub>α/2</sub> = z deviates corresponding to the α error rate

Z<sub>β</sub> = z deviates corresponding to the β error rate

Calculating the sample size,

- $P1 = 0.692$  (sensitivity of BISAP score 69.2%).<sup>11</sup>
- $P2 = 0.974$  (sensitivity of RANSON score 97.4%).<sup>11</sup>
- $Z_{\alpha/2} = 1.96$  at 95% confidence level
- $Z_{\beta} = 0.84$  at 80% power

After calculation,  $n = 25$

Hence, the required sample size for the study is 25 cases.

**Inclusion Criteria:**

1. All patients admitted to the Emergency Department with a diagnosis of acute pancreatitis (AP).

**Exclusion Criteria:**

1. Patients with associated chronic kidney disease, chronic obstructive pulmonary disease (COPD), or malignancy.
2. Patients with known hematologic disorders.
3. Patients under 16 years of age.
4. Patients who did not provide consent.

**Data Collection and Procedure:**

Of all 72 Patients admitted with diagnosis of AP in NAMS, Bir Hospital during the study period from 1<sup>st</sup> July 2020 to 31<sup>st</sup> Dec 2020, 25 patients meeting the inclusion criteria and from whom informed consent was obtained were enrolled in the study. Data, including age, sex, and etiological factors were recorded for each patient in preformed proforma. All the investigations required are routine investigations done in all the cases of Acute Pancreatitis, so the study did not add any financial burden to patients undergoing study.

Patient with AP were diagnosed with >2 of the following (as per the revised Atlanta Classification, 2012). Characteristic abdominal pain, increased levels of serum amylase and/or lipase 3 times the normal value and Ultrasonography (USG) of the abdomen within first 7 days of hospitalization demonstrating changes consistent with AP.

All laboratory investigations required for the diagnosis and scoring will be performed in Bir Hospital, NAMS.

**To convert BUN (mg/dL) to urea (mmol/L):** multiplied by 10 to convert from /dL to /L and divided by 28 to convert from mg BUN to mmol urea, i.e.  $10/28 = 0.357$

So, the conversion factor is 0.357

BUN mg/dL multiplied by 0.357 = urea (mmol/L)

Urea (mmol/L) divided by 0.357 = BUN (mg/dL)

BISAP score immediately following availability of the reports & Ranson’s score within 48 hours of hospitalization were calculated. Studied patients were followed till their hospital stay and observed for development of any complications.

The etiology of acute pancreatitis was considered to be biliary if stones detected in the gallbladder and/or common bile duct and of alcoholic etiology if the patient or his/her relatives reports consumption of more than 60 g pure alcohol/ day. Other identified causes were endoscopic procedures (endoscopic retrograde cholangiopancreatography with or without sphincterotomy), hyperlipidemia, trauma and drugs and labeled as others. In the remaining cases the etiology was classified as unknown or idiopathic.

A CT or MRI or USG of the abdomen, obtained at any time in the first 7 days of hospitalization, was required to differentiate necrotizing from interstitial pancreatitis. Organ failure was defined as a score of  $\geq 2$  in one or more of the three (respiratory, renal and cardiovascular) out of the five organ systems initially described in the Marshall score. Organ failure scores were calculated for all patients during the first 72 hours of hospitalization based on the most extreme laboratory value or clinical measurement during each 24h period. Duration of organ failure is defined as transient ( $\leq 48$  h) or persistent ( $\geq 48$ h) from the time of presentation.

**Statistical Analysis:**

Independent t test was used to examine differences in age; Fischer’s exact test for sex; and chi square test for etiology were used. Sensitivity, specificity, positive predictive value, negative predictive value and accuracy were calculated. A “p” value of less than 0.05 was considered to be statistically significant.

The outcome of the disease and the prediction of severity of the disease by BISAP score were compared with those of Ranson to assess the sensitivity, specificity and predictive value. The values were calculated as follows:

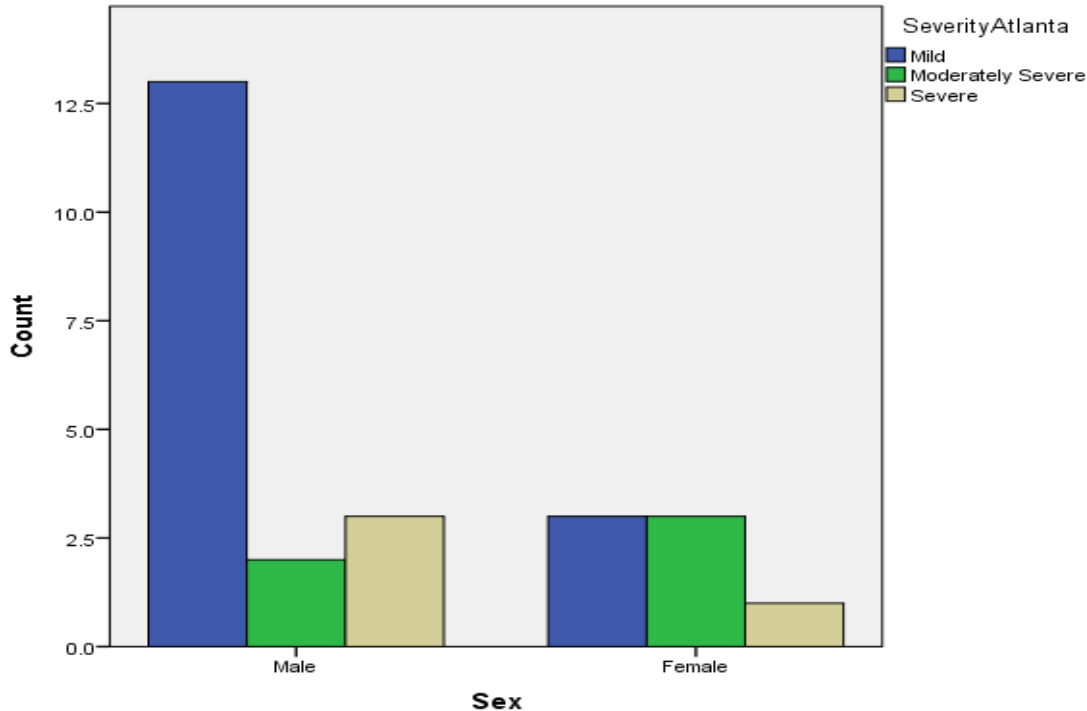
TP	FN	Sensitivity=TP/TP+FN
FP	TN	Specificity=TN/TN+FP
PPV= TP/TP+FP	NPV=TN/TN+FN	Accuracy=TP+TN/TP+TN+FP+FN

The data was analyzed using the SPSS for Windows.

**RESULTS:**

A total of 25 patients with first episode of Acute Pancreatitis admitted were evaluated. According to Atlanta Revised criteria, 16 patients had mild pancreatitis, 5 patients had moderately severe pancreatitis, 4 patients had severe pancreatitis. As shown in the figure 1,

Out of 25 patients, 18 (72%) were male and 7 (28%) were female. 12 (48%) were alcoholic, 11 biliary (44%), 1 idiopathic (4%), 1 other (post ERCP) (4%). Among male patients 66.6 % (12) were alcoholic pancreatitis and only 22.2% (4) were biliary whereas in female 100% (7) were biliary. The median age of the patients was 49 years.



**Figure 1: Multiple Bar Diagram showing distribution of severity of AP based on sex**

**Table 3: Outcome of patients based on different cut off Ranson’s score**

	Uncomplicated	Local Complications			Systemic Complications
Ranson’s Score	Outcome	Pseudocyst	Pancreatic Necrosis	Hemorrhagic Pancreatitis	MODS/Renal/Respiratory Failure
<= 3	15	2	2	0	0
>3	3	1	0	0	0
>5	0	0	1	0	1
Total	18	3	3	0	1

Of the 25 patients, 18 patients had ranson’s score less than or equal to 3, 7 patients had a score of more than 3. Of the 25 patients, 18 (72%) patients had no complications, 6 (24%) patients developed local complications: 3(12%) Pancreatic necrosis and 3(12%) Pseudocyst, one (4%)

**Table 4: Outcome of patients based on different cut off BISAP score**

BISAP Score	Uncomplicated Outcome	Local Complications			Systemic Complications
		Pseudocyst	Pancreatic Necrosis	Hemorrhagic Pancreatitis	MODS/Renal/Respiratory Failure
<= 3	17	1	1	0	0
>3	1	2	2	0	1
Total	18	3	3	0	1

Of the 25 patients, 19 patients had a BISAP score less than or equal to 3, 6 patients had a score more than 3.

**Table 4: Prediction of severity by Ranson's score**

Ranson's Score	Sensitivity	Specificity	PPV	NPV	Accuracy
>=3	50%	70%	44.4%	75%	64%
>=4	42.8%	75% %	33.3%	75%	60%
>=5	100%	94%	95%	100%	95%

Ranson's score of greater than or equal to 4 predicted 42.8 % of severe attacks and 75 % of mild attacks with a positive predictive value of 33.33% and negative predictive value of 75% and accuracy of 60%. Ranson's score of greater than or equal to 3 predicted a smaller number of severe attacks 50% but a greater number of mild attacks 70% with a PPV of 44.4% and NPV of 75% and accuracy of 64%. Ranson's score of greater than or equal to 4 predicted a greater number of severe attacks with a specificity of 75% and but had an accuracy of only 60%. Ranson's score of greater than or equal to 5 had the best sensitivity, specificity and accuracy.

**Table 5: Prediction of severity by BISAP score**

BISAP Score	Sensitivity	Specificity	PPV	NPV	Accuracy
<=3	93.75%	83.3%	93.75%	83.3%	90.09%
>3	83.3%	78.9%	55.5%	93.75%	80%

BISAP score of less than or equal to 3 predicted 93.75% of severe attacks and 83.3% of mild attacks with a PPV of 93.75% and NPV of 83.3% and accuracy of 90.09%. BISAP score of more than or equal to 3 predicted 83.3% of severe attacks and 78.9% of mild attacks with a PPV of 55.5% and NPV of 93.75% and accuracy of 80%.

**Table 6: Prediction of severity by Ranson and BISAP scoring systems**

	Sensitivity	Specificity	PPV	NPV	Accuracy
Ranson Score	42.8%	75%	33.3%	75%	60%
BISAP Score	83.3%	78.9%	55.5%	93.75%	80%

BISAP score has a better sensitivity, specificity, PPV, NPV and Accuracy than Ranson score in predicting the severity of AP putting the cutoff score >3 for both the scoring systems.

## **DISCUSSION:**

Acute pancreatitis is an acute inflammatory process of pancreas with variable involvement of other regional tissues or remote organ system. An important prerequisite for effective prevention of adverse outcomes is to identify the patients at risk early on in the disease

course. The struggle to identify an ideal early clinical predictor of severity is still on. An ideal predictor is expected to be simple, inexpensive, reproducible, should contain few parameters, and should be feasible at all levels of healthcare.

Wu et al. derived and validated in 2009, a new prognostic BISAP scoring system based on the results of multi-centre retrospective cohort study in the US. For the derivation of the score, they collected data from 17,992 cases of AP from 212 hospitals in 2000–2001 as derivation cohort and for the validation of the score they collected data from 18, 256 cases of AP from 177 hospitals in 2004–2005. Using Classification and Regression Tree (CART) analysis, a clinical scoring system was developed for prediction of in-hospital mortality in AP. The performance of the new scoring system was further validated by comparing its predictive accuracy with that of Acute Physiology and Chronic Health Examination (APACHE) II.<sup>12</sup>

Similarly, in a prospective study done in between June 2003 and September 2007, by Papachristou et al, it was found that BISAP score had a sensitivity of 37.5%, a specificity of 92.4%, a PPV of 57.7%, and an NPV of 84.3% in predicting SAP in comparison to a sensitivity, specificity, PPV, NPV of 83.3%, 78.9%, 55.5%, 93.75%, 80% respectively in our study. They compared the sensitivity and specificity values generated from the ROC curves and found Ranson score had a sensitivity of 84 %, specificity 90 %, PPV 70 % , and NPV 95 % and concluded BISAP index was not found to be either simpler or more accurate than the existing multifactorial scoring systems. However, in our study the ROC curve shows a better AUC for BISAP in the prediction of severity of AP. There was one mortality in our study with BISAP score 5 whereas in their study one patient who died had a BISAP score of 1, two patients had a score of 2, four patients had a BISAP score of 3, and no such patients had a score of 4 or 5.<sup>13</sup>

In July 2010 to July 2012, Khanna et al included 72 patients in a prospective study who were clinically suspected to have acute pancreatitis in a single surgical unit in Department of General Surgery, IMS, BHU, in collaboration with the Department of Gastroenterology, Department of Pathology, Department of Radiology, and Causality services. In his study the ROC curves for different scores were compared for different outcomes. He found that in determining severity of AP, BISAP was found to be 74.2 % sensitive, 68.3% specific, with a PPV of 63.4%, NPV of 77.8% and with an accuracy of 70.8%. On the other hand, for Ranson’s, sensitivity,

specificity, PPV, NPV, and accuracy were 83.9%, 78.0%, 74.3%, 86.5%, 80.6% respectively. They have compared all the scoring systems, biochemical and radiological markers for prediction of morbidity and mortality in acute pancreatitis and concluded that there is no ideal single method in assessing severity and further search for a simpler score.<sup>14</sup>

In a prospective study done in 164 patients by Venkatesh N, Vijayakumar C, Balasubramaniyan G, et al. (February 10, 2020), they found that among the scoring system compared, MGS had the highest sensitivity for predicting the severity of AP. However, Ranson score on admission had better diagnostic accuracy for predicting severity, organ failure, and mortality based on ROC curves. Procalcitonin had the best sensitivity, specificity, PPV, NPV, and diagnostic accuracy for association with severity in AP. BISAP score could predict SAP in 27 patients (26%), Ranson score at admission could predict SAP in 34 patients (33%), and Ranson score at 48 hours after admission could predict SAP in 61 (59%) patients. He demonstrated that Ranson score on admission had a good AUC (0.8483), and Ranson score 48 hours after admission (AUC 0.8167) had a fair accuracy. BISAP (AUC 0.6399) had poor accuracy for the prediction of severity in AP on the basis of ROC curves. Mean age was 45.09 years and mortality rate was 12.5 % in their study.<sup>15</sup>

In a similar prospective and a retro prospective study done by Parimala et al to compare BISAP score and Ranson’s score, 60 in-patients presenting with features of AP in Government Stanley Medical College General Hospital from November 2016 to September 2017, with the data obtained within 48 hours of hospitalization. They compared the sensitivity, specificity, PPv, NPV and accuracy of Ranson score with those of BISAP score in terms of determining the severity and organ failure. They found that both Ranson’s score and BISAP were very sensitive for prediction of systemic complications (100%) but less sensitive for prediction of local complications (93.33). In comparison to our study, it showed that BISAP score has better results than RANSON score in predicting severity and complications.<sup>16</sup>

**Table 14: Comparative Sensitivity, Specificity, PPV, NPV and Accuracy of various studies**

S.N.	Study	Sensitivity		Specificity		PPV		NPV		Accuracy	
		RANSON	BISAP	RANSON	BISAP	RANSON	BISAP	RANSON	BISAP	RANSON	BISAP
1	Papachristou et al <sup>18</sup>	84.2	37.5	89.8	92.4	9.6	57.7	95.3	84.3		

2	JY Park et al <sup>19</sup>	74.2	71	71.3	84.9	22.8	34.9	96	96.3		
3	Khanna et al <sup>14</sup>	83.9	74.2	78	68.3	74.3	63.4	86.5	77.8	80.6	70.8
4	Chen et al <sup>1</sup>	64.4	61.4	86.4	83.1	54.6	48.1	90.5	89.4		
5	Arif et al <sup>11</sup>	97.4	69.2	78.4	77.8	51.3	42.2	99.2	91.5	82	76.2
6	Hagjer et al <sup>16</sup>	57.1	71.4	93.5	95.7	72.7	83.3	87.8	91.7		
7	Parimala et al <sup>17</sup>	93..33	93.33	96	96	93.33	93.33	96	96	95	95
8	Our study	42.8	83.3	75	78.9	33.3	55.5	75	93.75	60	80

In developing countries like Nepal where hospitals with high dependency care not accessible easily, BISAP score can be used to identify patients whose disease course will be mild with minimal and substantial hospital costs in initial evaluation of patient which will prevent unnecessary referrals to tertiary centres. Our study was done in a single tertiary centre where most of the cases are referred from other centres where most of the AP patients had already had been resuscitated and referred. Although, the BISAP appears to be a promising new stratification scheme for severity in acute pancreatitis. We recommend the need for validation of this severity assessment system at the community level in a multicenter setting involving a large sample size and including the clinical interventions done in hospital and their effect in patient cohort. Until then, patients with predicted as non-severe based on the BISAP criteria should not be discharged home from the emergency room.

### **CONCLUSION:**

Acute Pancreatitis is one of the common diagnoses among the cases which present with acute abdomen in emergency. Grading and treating the cases of Acute Pancreatitis has been challenging and plays a vital role in preventing the life of the patient. BISAP is promising algorithm consisting FIVE parameters, which include checking levels of BUN, GCS, signs of SIRS, Age and Pleural effusion which can predict severe course of AP at the time of admission and has high specificity and positive predictive value, so it can be used for early assessment and triaging of disease and to stratify the case which can be managed in center which lack high dependency units and can minimize the referrals to higher centers when not indicated. From this study, we

can conclude that BISAP scoring system is not inferior to Ranson's scoring system in predicting the severity of acute pancreatitis. BISAP scoring system is very simple, cheap, easy to remember and calculate. Its instantaneous and there is no time delay in contrast to Ranson's score takes a minimum of 48 hours and also all the tests' reports in Ranson's criteria cannot be available at many places due to lack of facility and extra economic burden to the patient.

**CONFLICT OF INTEREST:** None

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