

## “Comparative Efficacy of Bisap and Ranson’s Scoring Systems in Predicting Severity of Acute Pancreatitis”

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### Abstract

**Introduction** Acute pancreatitis (AP) is defined as an inflammatory process of the pancreas with possible peri-pancreatic tissue and multi organ involvement inducing multi organ dysfunction syndrome (MODS) with an increased mortality rate. The worldwide incidence of acute pancreatitis ranges between 5-80 cases per 100,000 populations per year. Most patients develop a mild and self-limited course, however 10-20% of patients develop a rapidly progressive inflammatory response associated with prolonged length of hospital stay and significant morbidity and mortality. Early assessment of severity and identification of patients at risk is important for early intensive therapy and timely intervention. The study is conducted for assessment of the two scoring systems, viz. Ranson’s and BISAP in predicting the severity of acute pancreatitis.

**Materials and Methods:** The prospective study was carried out among the patients admitted in the Department of Surgery in Gauhati Medical College and Hospital, Guwahati, Assam for a period of one year from 1<sup>st</sup> June 2020 to 31<sup>st</sup> May 2021. Routine general and systemic examination of the patients and routine investigations and imaging studies was performed at admission. Ranson’s score and BISAP score were calculated. Sensitivity, specificity, AUC curve was determined.

**Results and Observations:** The average Ranson’s score of the severe acute pancreatitis patients in our study is 3.94. The sensitivity of Ranson’s scoring system in predicting severe acute pancreatitis is 75% while specificity is 84.21%. There is significant correlation between disease severity and Ranson’s score  $\geq 3$  with p value 0.0003. The average BISAP score of the severe acute pancreatitis patients in our study is 2.36. The sensitivity of BISAP scoring system in predicting severe acute pancreatitis is 75% while specificity is 86.84%. There is significant correlation between disease severity and BISAP score  $\geq 2$  with p value 0.0001. AUC of Ranson’s score (0.897) in the ROC plot is higher than that of BISAP score (0.866), hence Ranson’s score is more accurate in predicting the severity of the disease.

**Conclusion:** Both Ranson’s and BISAP scoring systems were equally sensitive while BISAP score was found to have a slightly higher specificity, PPV and NPV as compared to Ranson’s score. On comparing accuracy on the ROC curve, Ranson’s score was found to be more accurate in predicting the severity of the disease as compared to BISAP score as the area under curve (AUC) on the ROC was higher in case of Ranson’s score with the curve being nearer to y-axis.

**Key words:** BISAP, Ranson, pancreatitis.

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### I. Introduction

Acute pancreatitis (AP) is defined as an inflammatory process of the pancreas with possible peri-pancreatic tissue and multi organ involvement inducing multi organ dysfunction syndrome (MODS) with an increased mortality rate<sup>(1)</sup>.

The worldwide incidence of acute pancreatitis ranges between 5-80 cases per 100,000 populations per year. Acute pancreatitis has a highly variable clinical course. Most patients develop a mild and self-limited course, however 10-20% of patients develop a rapidly progressive inflammatory response associated with prolonged length of hospital stay and significant morbidity and mortality. Patients with mild pancreatitis have a mortality rate of less than 1% but in severe acute pancreatitis this mortality rate increases to 10-30%<sup>(2)</sup>.

Mortality in severe pancreatitis can be as low as 10% to as high as 99% noted by studies of Tenner S et al.1997<sup>(3)</sup> and Mayerle J et al.2005<sup>(4)</sup>. But usually mortality ranges from 10% to 85% between various countries and centres<sup>(5)</sup>.

Early assessment of severity and identification of patients at risk is important for early intensive therapy and timely intervention, has shown to improve prognosis and survival. The study is conducted for assessment of the two scoring systems, viz. Ranson’s and BISAP in predicting the severity of acute pancreatitis.

## **II. Aims And Objectives**

1. To estimate the sensitivity and specificity of Ranson’s and BISAP scoring systems in predicting the severity of acute pancreatitis.
2. To compare the efficacy and accuracy of the two scoring systems in predicting the severity of acute pancreatitis.

## **III. Materials And Methods**

The prospective study was carried out among the patients admitted in the Department of Surgery in Gauhati Medical College and Hospital, Guwahati, Assam for a period of one year from 1<sup>st</sup> June 2020 to 31<sup>st</sup> May 2021.

### **INCLUSION CRITERIA:**

1. Cases with clinical history of upper abdominal pain with increased level of pancreatic enzymes (more than three times the upper limit)and CT abdomen findings suggestive of Acute Pancreatitis.
2. Onset of pain abdomen <48 hours.
3. Age >18 years.

### **EXCLUSION CRITERIA:**

1. Patients with other co-morbid conditions like cardiac disease, chronic liver disease, renal disease or any lung pathology.
2. Acute on chronic pancreatitis.
3. Recurrent attack of acute pancreatitis with previous history of complications like pseudocyst, walled off necrosis, etc.

**COLLECTION OF DATA:** Data was collected by predesigned and pretested proforma along with clinical examination and laboratory investigations including particulars of the patient, chief complaints, history of present illness, history of past illness etc were recorded. Routine general and systemic examination of the patients was performed at admission. Routine investigations and imaging studies such as ultrasonography, chest x-ray and contrast enhanced CT scan was done. Ranson’s score and BISAP score were calculated. The basic regimen for treating acute pancreatitis was followed.

**STATISTICAL ANALYSIS:** Continuous data were expressed as average. Categorical values were evaluated using Chi square or Fischer exact test. Sensitivity, specificity, positive predictive value and negative predictive value of each of the two scoring systems were calculated. A p-value of <0.005 was considered to be significant. Odds Ratio for each of the two scoring systems were calculated based on the Fischer exact test.

Comparison of scoring systems for prediction of severe acute pancreatitis were calculated on the basis of the area under curve (AUC) generated from the receiver operating characteristic curve (ROC), using the SPSS version 16.0, which determined the accuracy for each of the two scoring systems. Pair wise comparison of the AUC, between the two systems was done using the MedCalc version 15.8 software.

The following cut-off values were selected for prediction of severe acute pancreatitis: Ranson’s  $\geq 3$  and BISAP  $\geq 2$  on the basis of AUC generated from the ROC curve.

## **IV. Results And Observations**

The present study comprises of 50 patients suffering from acute pancreatitis admitted in Department of Surgery, Gauhati Medical College and Hospital for a period of one year from 1<sup>st</sup> June 2020 to 31<sup>st</sup> May 2021. After proper diagnosis of acute pancreatitis, the severity assessment was done by Ranson’s and BISAP scoring systems. Revised Atlanta classification 2012 for determination of severity was taken as gold standard. The study evaluated the prognostic usefulness of these scoring systems in predicting the severity of acute pancreatitis in particular severe acute pancreatitis.

In the present study, age of patients ranges from 21 to 65 years. The mean age of incidence is 43.7 years. Out of 50 cases, 34 patients were female and 16 patients were male.

**Aetiology: Biliary pancreatitis:** 37 patients had gall stone disease. Of these 37 patients, 32 patients were female and 5 patients were male. 1 female patient and 2 male patients had only CBD stone and no gall stones. **Alcohol**

**intake:** 10 patients used to take alcohol on regular basis and all of them were male and 1 had associated gall stone disease. **Others:** In 3 patients, no cause of acute pancreatitis could be determined and were labelled as idiopathic acute pancreatitis.

**Severity as per revised Atlanta Classification:** 37 patients (74%) had mild to moderate AP while 13 patients (26%) had severe AP. Out of the 16 male cases, 12 cases had mild to moderate AP while 4 patients had severe AP. Among the 34 females, 25 patients had mild to moderate AP while 9 patients had severe AP.

### RAISON’S CRITERIA

The patients were divided into two categories namely mild to moderate and severe acute pancreatitis. Patients with Ranson’s score more than or equal to 3 were considered severe.

35 patients were considered mild to moderate AP, out of which 23 patients were female and 12 were male. 15 patients were considered severe AP out of which 11 (73.34%) were female patients and 4 (26.6%) were male.

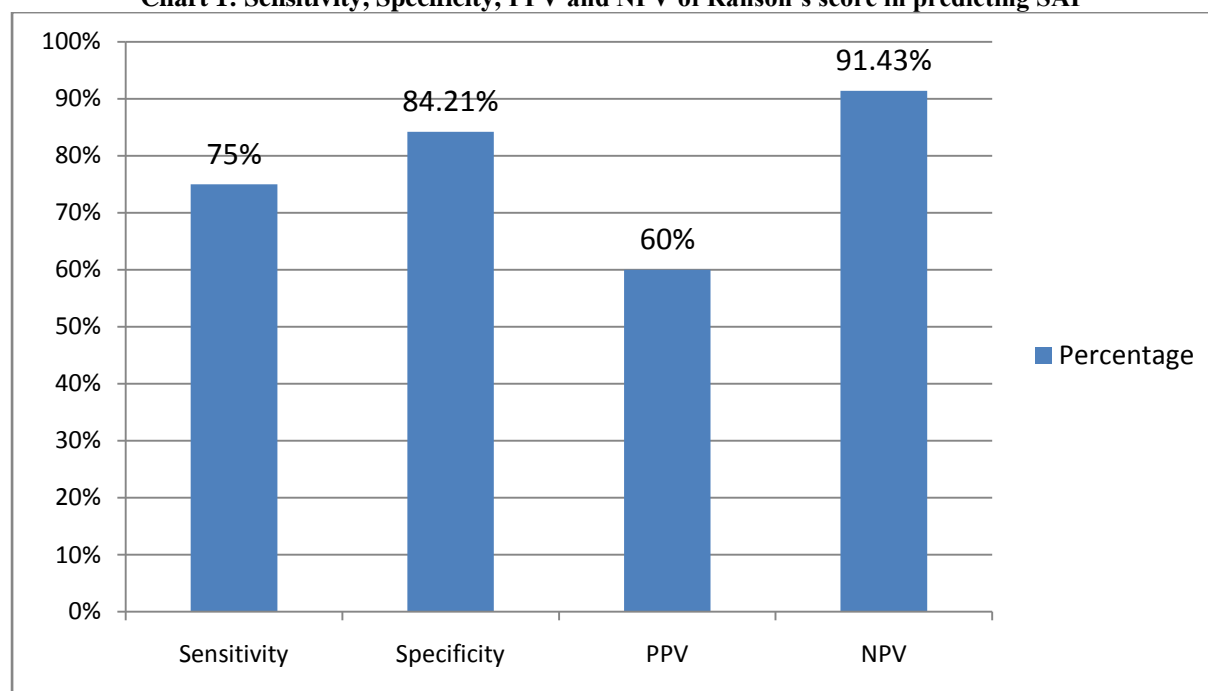
**Aetiology: Biliary pancreatitis:** out of the 37 patients, 26 patients had mild to moderate AP whereas 11 had severe AP. **Alcohol intake:** out of the 10 patients 6 patients had mild to moderate AP and 4 patients had severe AP. **Others:** 3 patients were idiopathic acute pancreatitis and had mild to moderate AP.

The average Ranson’s score of the severe acute pancreatitis patients in our study is 3.94.1 patient expired. Mortality rate of severe acute pancreatitis (according to Ranson’s score) in our study is 6.67%.

In our study, the sensitivity of Ranson’s scoring system in predicting severe acute pancreatitis is 75% while specificity is 84.21%. The positive predictive value of Ranson’s score in our study is 60% while negative predictive value is 91.43%.

There is significant correlation between disease severity and Ranson’s score  $\geq 3$  with p value 0.0003.

**Chart 1: Sensitivity, Specificity, PPV and NPV of Ranson’s score in predicting SAP**



### BISAP SCORING

Patients with BISAP score more than or equal to 2 were considered severe AP.

36 patients were considered mild to moderate AP out of which 22 patients (61.12%) were female and 14 (38.88%) were male.

14 patients were considered severe AP out of which 12 (85.72%) were female patients and 2 (14.28%) were male.

**Aetiology: Biliary pancreatitis:** out of the 37 patients, 25 patients had mild to moderate AP whereas 12 had severe AP. **Alcohol intake:** out of the 10 patients 9 patients had mild to moderate AP and 1 patient had severe AP. **Others:** 3 patients, had idiopathic acute pancreatitis out of which 2 patients had mild to moderate AP and 1 had severe AP.

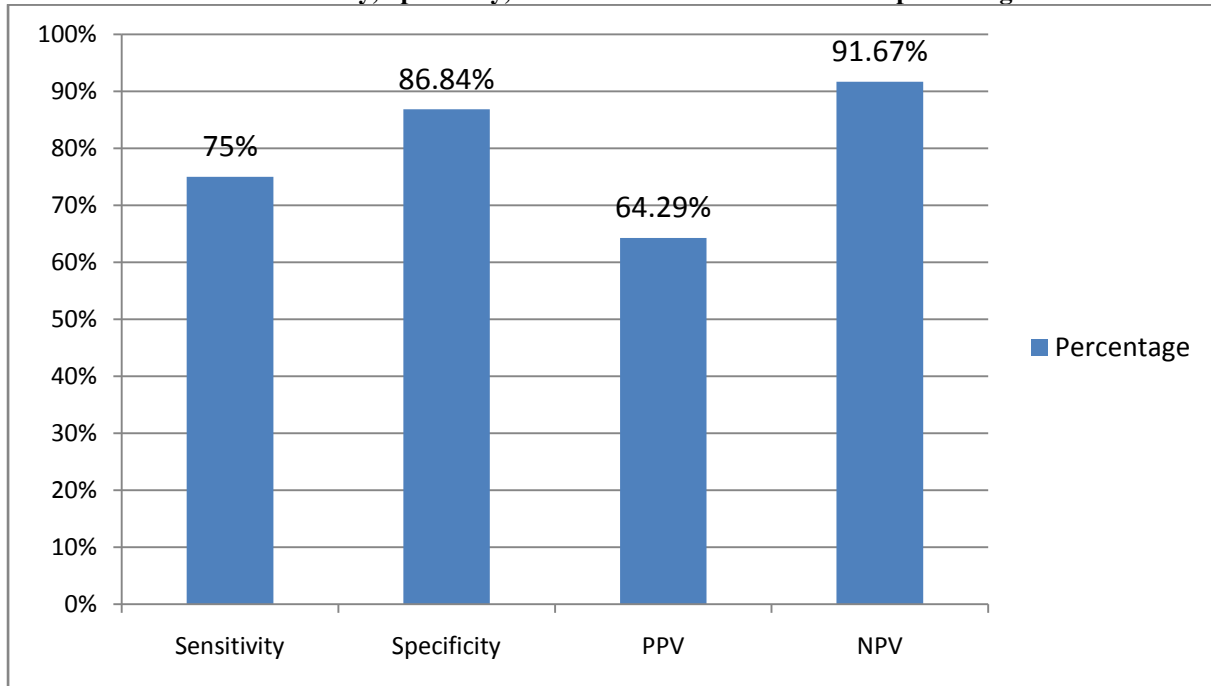
The average BISAP score of the severe acute pancreatitis patients in our study is 2.36.1 patient expired.

Mortality rate of severe acute pancreatitis (according to BISAP score) in our study is 7.14%.

In our study, the sensitivity of BISAP scoring system in predicting severe acute pancreatitis is 75% while specificity is 86.84%. The positive predictive value of BISAP score in our study is 64.29% while negative predictive value is 91.67%.

There is significant correlation between disease severity and BISAP score  $\geq 2$  with p value 0.0001.

**Chart 2: Sensitivity, Specificity, PPV and NPV of BISAP score in predicting SAP**



**COMPLICATIONS IN ACUTE PANCREATITIS**

In this study, complications of acute pancreatitis included shock in 3 patients (7.89%), ARDS in 7 patients (18.42%), Acute renal failure in 9 patients (23.68%), sepsis in 8 patients (21.05%), pleural effusion in 7 patients (18.42%), pseudocyst in 1 patient (2.63%), Necrosis in 2 patients (5.26%) and ascites in 1 patient (2.63%).

**MORTALITY**

1 patient died of severe acute pancreatitis (Mortality = 2%).

The mortality rate among the severe acute pancreatitis patients is 8.33%.

Ranson’s score: <3 – no mortality  
 $\geq 3$  – 6.67% mortality

BISAP score: <2 – no mortality  
 $\geq 2$  – 7.14% mortality

**COMPARISON BETWEEN RANSON’S AND BISAP SCORE IN PREDICTING SEVERITY**

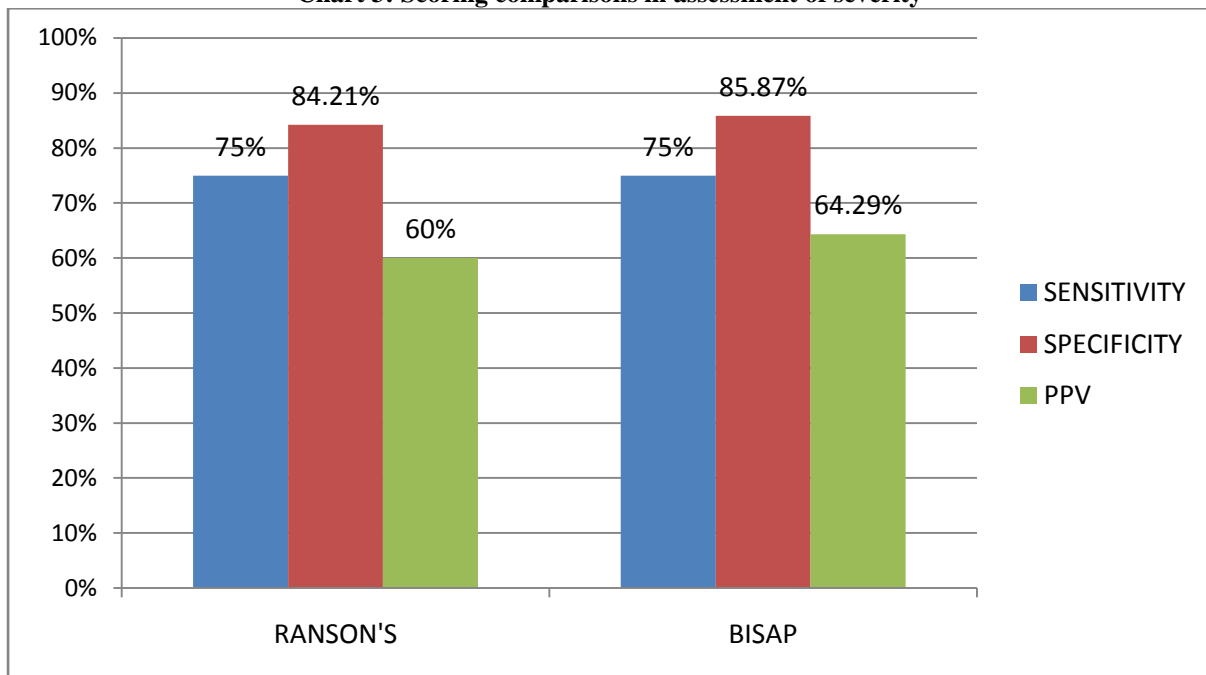
Taking the revised Atlanta classification (2012) of severity of pancreatitis, the sensitivity and specificity of the two scoring systems were calculated.

Severe acute pancreatitis is characterised by persistent organ failure, i.e. organ failure for more than 48 hours.

**Table 1: Scoring comparisons in assessment of severity**

SCORES	SENSITIVITY	SPECIFICITY	PPV	NPV
Ranson’s	75%	84.21%	60%	91.43%
BISAP	75%	85.87%	64.29%	91.67%

**Chart 3: Scoring comparisons in assessment of severity**



In our study, both Ranson’s and BISAP scoring systems are having the same sensitivity, i.e. 75%, whereas BISAP score has a slightly higher specificity (85.87%) as compared to Ranson’s score (84.21%) in predicting severe acute pancreatitis.

There is significant correlation between disease severity and Ranson’s score  $\geq 3$ , with odds ratio 16.00 and 95% confidence interval 3.325 to 77.003, and p value of 0.0003.

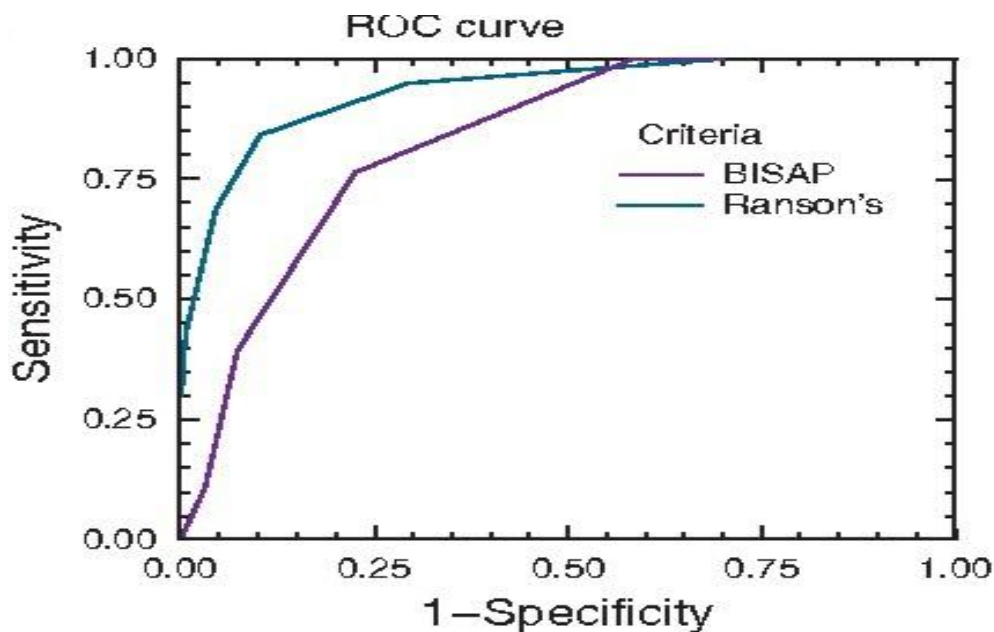
There is significant correlation between disease severity and BISAP score  $\geq 2$ , with odds ratio 19.800 and 95% confidence interval 3.956 to 99.093, and p value of 0.0001.

**COMPARISON OF ACCURACY OF RANSON’S AND BISAP SCORE IN PREDICTION OF SEVERITY BY ROC CURVE**

Receiver operating characteristic (ROC) curves for severe acute pancreatitis were calculated for Ranson’s and BISAP scores, and the predictive accuracy of each of the scoring systems was measured by the area under the ROC curve (AUC) with standard error and 95% confidence interval (CI). A p value of  $< 0.05$  was considered statistically significant.

**Table 2: Receiver operating curve findings of scoring systems**

Scores	AUC	95% CI	p value
Ranson’s score	0.897	0.781-1.103	$< 0.005$
BISAP score	0.866	0.747-0.985	$< 0.005$



AUC of Ranson’s score (0.897) in the ROC plot is higher than that of BISAP score (0.866), hence Ranson’s score is more accurate in predicting the severity of the disease.

### V. Discussion

Two severity scoring systems namely Ranson’s and BISAP scoring system have been used to grade the patients and an attempt has been made to correlate them to the outcome in terms of mortality and development of complications.

#### Age

The age of the patients in the present study ranged from 21-65 years with mean age of 43.7 years. Incidence of disease was highest in the age group of 41-50 years (24%).

**Table 3: Comparison of age with different studies in acute pancreatitis**

Study	No(s) of patients	Range	Mean (in years)
Garg et al.2001 <sup>(6)</sup>	169	15-80	41.3
Yeung YP et al.2006 <sup>(7)</sup>	101	20-96	64
Papachirstou et al.2009 <sup>(8)</sup>	185	15-90	52
Ajay K et al.2013 <sup>(9)</sup>	72	18-76	40.5
Present study,2021	50	21-65	43.7

The mortality rate of present study is comparable with published data.

#### Sex

Acute pancreatitis associated with biliary tract calculi showed female preponderance in the present study. Out of the 50 cases, 34 patients were female and 16 were male.

**Table 4: Comparison of sex distribution with different studies in acute pancreatitis**

Study	Total cases	Male	Female
Garg et al.2001 <sup>(6)</sup>	169	116 (68.63%)	53 (31.37%)
Yeung YP et al.2006 <sup>(7)</sup>	101	43 (42.6%)	58 (57.4%)
Papachirstou et al.2009 <sup>(8)</sup>	185	94 (51%)	91 (49%)
Simoes et al.2011 <sup>(10)</sup>	193	113 (59.4%)	80 (40.6%)
Ajay K et al.2013 <sup>(9)</sup>	72	37 (51.4%)	35 (48.6%)
Present study,2021	50	16 (32%)	34 (68%)

**Aetiology**

**Table 5: Aetiology comparison with different studies in acute pancreatitis**

Study	Alcohol	Gallstones	Idiopathic
Vege S et al.2004 <sup>(11)</sup>	40%	35%	20%
Papachirstou et al.2009 <sup>(8)</sup>	14%	36%	27%
Simoes et al.2011 <sup>(10)</sup>	39.3%	29.1%	31.9%
Yadav J et al.2015 <sup>(12)</sup>	40.3%	31.1%	15.7%
Present study,2021	18%	76%	6%

**Co-morbidities**

In the study by Yeung YP et al, 2006 out of 101 patients, 43 (42.6%) had at least one co-morbid disease<sup>7</sup>. Common co-morbidity was hypertension (25.7%) and diabetes mellitus (23.8%). Present study had 18% patients with co-morbidities. The common co-morbid disease was diabetes mellitus and hypertension.

**Mortality**

The overall mortality in our study is found to be 2%. The following table shows the different rates of mortality in different studies.

**Table 6: Mortality comparison with different studies in acute pancreatitis**

Study	Mortality
Papachirstou et al.2009 <sup>(8)</sup>	3.8%
Bollen et al.2010 <sup>(13)</sup>	6%
Simoes et al.2011 <sup>(10)</sup>	11%
Rithin S et al.2011 <sup>(14)</sup>	7.8%
Ajay K et al.2013 <sup>(9)</sup>	12.5%
Present study,2021	2%

The mortality rate of present study is comparable with published data.

The mortality rate among severe acute pancreatitis patients in our study is 8.33%.

**Table 7: Mortality comparison in severe acute pancreatitis patients with different studies**

Study	Mortality
VegeS et al.2004 <sup>(11)</sup>	10-25%
Papachirstou et al.2009 <sup>(8)</sup>	17.5%
Simoes et al.2011 <sup>(10)</sup>	30%
Rithin S et al.2011 <sup>(14)</sup>	21%
Ajay K et al.2013 <sup>(9)</sup>	36%
Park JY et al.2013 <sup>(15)</sup>	19.35%
Present study,2021	8.33%

The present study showed mortality rate in severe acute pancreatitis patients on the lower side as compared to published data.

**Complications**

In our study, acute renal failure (ARF) was the most common complication (23.68%), followed by sepsis (21.05%).

**Table 8: Comparison of complications in acute pancreatitis with different studies**

Study	ARF	Pseudocyst	ARDS	Necrosis	Shock	Sepsis
Papachirstou et al.2009 <sup>(8)</sup>				19%		
Bollen et al.2010 <sup>(13)</sup>				69%		19%
Simoes et al.2011 <sup>(10)</sup>		56.5%		30.4%		
Rithin S et al.2011 <sup>(14)</sup>	10%	16%	6%	4%		
Ajay K et al.2013 <sup>(9)</sup>				23.6%		
Jitin Y et al.2015 <sup>(12)</sup>				39.5%		

Present study,2021	23.68%	2.63%	18.42%	5.26%	7.89%	21.05%
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The complication rates of acute pancreatitis in the present study are comparable with published data.

**Prediction of severity by Ranson’s score**

The sensitivity of Ranson’s scoring system was 75% while it had 84.21% specificity in predicting severe acute pancreatitis. The positive predictive value of Ranson’s score was 60% in the study while negative predictive value was 91.43%.

**Table 9: Comparison of Ranson’s score in predicting severe acute pancreatitis with different studies**

Study	Sensitivity	Specificity	PPV	NPV
Larvin et al.1989 <sup>(16)</sup>	75%	77%	57.4%	95.7%
Papachirstou et al.2009 <sup>(8)</sup>	84.2%	89.8%	69.6%	95.3%
Simoes et al.2011 <sup>(10)</sup>	91.2%	74.4%		
Joon HC et al.2015 <sup>(17)</sup>	85.7%	44.4%	18.8%	95.3%
Present study,2021	75%	84.21%	60%	91.43%

The results of the present study are comparable with the published data. There is significant correlation between disease severity and Ranson’s score  $\geq 3$ , with odds ratio 16.00 and 95% confidence interval 3.325 to 77.003, and p value of 0.0003.

**Prediction of severity by BISAP score**

The sensitivity of BISAP scoring system was 75% while it had 86.84% specificity in predicting severe acute pancreatitis. The positive predictive value of BISAP score was 64.29% in the study while negative predictive value was 91.67%.

**Table 10: Comparison of BISAP score in predicting severe acute pancreatitis with different studies**

Study	Sensitivity	Specificity	PPV	NPV
Gompertz M et al.2012 <sup>(18)</sup>	71.4%	99.1%	83.3%	98.3%
Bezmarevic M et al.2012 <sup>(19)</sup>	74%	59%		
Yadav J et al.2015 <sup>(20)</sup>	100%	69.2%		
Raja J et al.2019	85.2%	91.3%	78%	89.8%
Present study,2021	75%	86.84%	64.29%	91.67%

The sensitivity, specificity and NPV of the present study are comparable with the published data. However the present study shows low PPV of 64.29%. There is significant correlation between disease severity and BISAP score  $\geq 2$ , with odds ratio 19.800 and 95% confidence interval 3.956 to 99.093, and p value of 0.0001.

The sensitivity of both Ranson’s and BISAP score in predicting severe acute pancreatitis in this study is found to be equal (75%). The specificity, PPV and NPV are found to be slightly higher for BISAP score as compared to Ranson’s.

In terms of accuracy on applying the ROC curve for both the scoring systems, the area under curve (AUC) is found to be higher for Ranson’s score [AUC=0.897, 95% CI: 0.781-1.013] than BISAP score [AUC=0.866, 95% CI: 0.747-0.985]. Hence, Ranson’s score is found to be more accurate among the two in this study.

**VI. Summary**

In this study, 50 patients with acute pancreatitis were selected after thorough clinical assessment and subsequent biochemical and radiological confirmation. The age group of the patients ranges from 21-65 years with mean age of incidence of 43.7 years, with highest number in the age group of 41-50 years (24%).The M:F ratio of acute pancreatitis in this study was 1:2.1. There was male predominance in acute alcoholic pancreatitis (100%) and female predominance was seen in acute biliary pancreatitis (86.8%).

Out of these 50 cases, 37patients were of acute biliary pancreatitis, 10were acute alcoholic pancreatitis and 3 were idiopathic pancreatitis. According to the revised Atlanta classification, 38 (76%) patients were classified as having mild to moderate acute pancreatitis and 12 (24%) as severe acute pancreatitis.

35 patients were considered having mild to moderate pancreatitis and 15 having severe disease by Ranson’s criteria. The average Ranson’s score of severe patients was 3.94. There was no mortality in the mild to moderate group however 1 patient expired in the severe group (6.67%). The sensitivity of Ranson's scoring system was 75% while it had 84.21% specificity in predicting severe acute pancreatitis. The positive predictive value of Ranson's score was 60% in the study while negative predictive value was 91.43%. There is significant correlation between disease severity and Ranson’s score  $\geq 3$ , with odds ratio 16.00 and 95% confidence interval



3.325 to 77.003, and p value of 0.0003. The AUC for Ranson’s score in ROC curve was 0.897 with 95% CI of 0.781-1.013.

36 patients were considered having mild to moderate pancreatitis and 14 having severe disease by BISAP score. The average BISAP score of the severe patients was 2.36. There was no mortality in the mild to moderate group however 1 patient expired in the severe group (7.14%). The sensitivity of the BISAP scoring system was 75%, while it had 86.84% specificity in predicting severe acute pancreatitis. The positive predictive value of BISAP score was 64.29% in the study while negative predictive value was 91.67%. There is significant correlation between disease severity and BISAP score  $\geq 2$ , with odds ratio 19.800 and 95% confidence interval 3.956 to 99.093, and p value of 0.0001. The AUC for BISAP score in ROC curve was 0.866 with 95% CI of 0.747-0.985.

38 patients developed complications, of which acute renal failure (ARF) was the most common complication occurring in 9 (23.68%) patients, followed by sepsis in 8 (21.05%) patients.

The sensitivity of both Ranson’s and BISAP score in predicting severe acute pancreatitis in this study is found to be equal (75%). The specificity, PPV and NPV are found to be slightly higher for BISAP score as compared to Ranson’s.

In terms of accuracy on applying the ROC curve for both the scoring systems, the area under curve (AUC) is found to be higher for Ranson’s score [AUC=0.897, 95% CI: 0.781-1.013] than BISAP score [AUC=0.866, 95% CI: 0.747-0.985]. Hence, Ranson’s score is found to be more accurate among the two in this study.

## VII. Conclusion

In this study it was found that both Ranson’s and BISAP scoring systems were equally sensitive in identifying the severe acute pancreatitis patients as defined by the revised Atlanta Classification 2012. However, BISAP score was found to have a slightly higher specificity, PPV and NPV as compared to Ranson’s score.

On comparing accuracy on the ROC curve, Ranson’s score was found to be more accurate in predicting the severity of the disease as compared to BISAP score as the area under curve (AUC) on the ROC was higher in case of Ranson’s score with the curve being nearer to y-axis.

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