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A comparative study of BISAP, Ranson's score, APACHE II score and modified CT severity index in predicting morbidity and mortality of acute pancreatitis

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Abstract
A total of 130 patients with acute pancreatitis in JSS hospital from the time of November 2018 to April 2020 have been considered in the present study. A cross sectional prospective study in which the patient was observed from the day of admission and followed up till discharge. Out of 130 patients in this study, 102 were male. Majority of the study population had alcohol consumption (52.3%) as etiology. Severe acute pancreatitis was found in 15 patients. Outcomes revealed recovery in 70% of patients and complications in 36%. Mortality was 3% of the study population. Statistically significant trends of increasing severity and organ failure (P<0.0001) was observed with increasing BISAP. BISAP scoring system is an easy, feasible clinical bedside scoring system in prediction of acute pancreatitis severity. It plays a crucial role to determine the cases who might require intensive care in the course of the illness.

Keywords: BISAP, acute pancreatitis, MCTSI, ranson, apache II

Introduction
With a reported annual incidence ranging from 4.9 to 35 per 100,000 population, acute pancreatitis is the single most frequent gastrointestinal cause of hospital admissions around the world [1]. ACUTE PANCREATITIS is a reversible pancreatic parenchymal injury with inflammation which presents with varied clinical presentation, it mostly presents as mild self-limiting disease but in about 10 – 20% of cases it presents with systemic complications which require intensive care unit treatment or surgical interventions and mortality in these cases can be as high as 30-40%. Predicting the severity and outcome in AP can guide appropriate triage of the patients and direct specialist care for the patients likely to have severe AP [2]. A number of parameters have been assessed for the prediction of severity in AP. These include single parameters like presence of pleural effusion, obesity, age, serum blood urea nitrogen, creatinine, haematocrit, levels of C-reactive protein, procalcitonin, and multi-parameter scores like Ranson's score, systemic inflammatory response syndrome (SIRS), Bedside Index of severity in AP (BISAP), and acute physiology and chronic health evaluation (APACHE)-II score [2, 4]. BISAP is a 5-parameter score which includes blood urea nitrogen, impaired mental status, presence of SIRS, age, and pleural effusion [4].

According to the revised Atlanta classification, acute pancreatitis is clinically defined by at least two of three features, (a) abdominal pain suggestive of pancreatitis; (b) serum amylase and lipase levels three or more times normal; and (c) characteristic findings on imaging studies[5]. Acute pancreatitis is classified on the basis of its severity as.

Mild acute pancreatitis, which is characterized by absence of organ failure and local or systemic complications.

Moderately severe acute pancreatitis, which is characterized by no organ failure or transient organ failure less than 48 hours with or without local complications and,

Severe acute pancreatitis characterized by persistent organ failure more than 48 hours that may involve one or multiple organs [6].

The present study was aimed to assess the clinical pattern of acute pancreatitis and to do a comparative study of various predicting systems like Ranson, APACHE II and BISAP in predicting severity, local complications and mortality in acute pancreatitis.

Materials and Methods

This is a prospective study, in which 130 patients with acute pancreatitis admitted to our hospital during the period of November 2018 to March 2020 were included in the study. The consecutive patients who were diagnosed and treated for acute pancreatitis during this period formed the pool for the present study. Patients who were diagnosed as acute pancreatitis were only included in the present study.

The diagnostic criteria of acute pancreatitis referred to the Atlanta Classification of Acute Pancreatitis which includes the presence of at least two of the three features:

- Abdominal pain suggestive of pancreatitis;
- Serum amylase and lipase levels three or more times normal; and
- Characteristic findings on imaging studies.

Patients with chronic pancreatitis with acute exacerbations and patients of pancreatic malignancies were excluded from this study. Patients were classified as mild acute pancreatitis (MAP), moderately severe acute pancreatitis (MSAP) and severe acute pancreatitis (SAP), based on the presence of organ failure and local complications. Patient's demographic data, history and clinical features and complications were recorded along with serum amylase and lipase levels. BISAP and APACHE II score were calculated in 24 hours after admission. Ranson score was calculated in 48 hours. Patients were divided into two groups each, BISAP and

We included patients with AP diagnosed on the basis of presence of 2 of the following 3 criteria: abdominal pain consistent with the diagnosis; elevated pancreatic enzymes (serum lipase and/or amylase) to a level of more than thrice the upper normal value; and radiological evidence of AP and having a CT done at the institution with 3-10 days of onset of symptoms [1]. We excluded patients with early (<3 days) or late CT (>10 days), and those who did not undergo CT (renal failure, pregnancy, mild disease) and those having features of chronic pancreatitis on imaging. Persistent organ failure was defined as organ failure (respiratory, cardiovascular or renal) persisting beyond 48 h. We use revised Atlanta definitions and the modified Marshall score for definition of organ failure, local complications and persistent organ failure (POF) [1]. Interventions included radiology-guided pigtails, surgery and endoscopic necrosectomy/drainage procedures. Briefly, we preferred radiology-guided pigtails to treat infected collections during the early course and upsized and multiple pigtails were inserted in non-responsive cases. If patients did not respond to antibiotics and pigtail drainage, they might have needed to undergo pancreatic necrosectomy but this was usually delayed beyond 3-4 weeks. Occasional patients who developed late infection in organized collections that were close to gastric or duodenal lumen underwent endoscopic (if bulge is present) or endosonographic (distant, non-bulging) guided drainage at our institution.

Summary statistics was done by means of proportions for categorical/binary variables and mean, median, Standard deviation, InterQuartile Range (IQR) for continuous variables. Inferential statistics was done by using Chi square test/fisher exact, Independent t test, one-way ANOVA, Mann Whitney test, Kruskal Wallis test, Pearson correlation and ROC curve with AUC (area under curve). All the statistical methods were done using the SPSS 21.0 version for windows. $P<0.05$ was considered statistically significant. Chi square test/fisher exact test are used comparing two or more independent proportions. Fisher exact is used when the number of expected numbers in >20% cells is <5. Independent t test was used to compare means between independent groups/mutually exclusive groups. Receiver operating characteristic (ROC) curve is used for measuring discriminating ability of a continuous variable for a binary outcome. Any ROC curve with significant (statistically) AUC area under curve, is considered useful. AUC is interpreted as 0.9-1 = excellent (A),.80-.90 = good (B),.70-.80 = fair (C),.60-.70 = poor (D) and.50-.60 = fail (F) Pearson correlation is used to correlate the two continuous variables which are normally distributed. Correlation coefficient (r), is classified as excellent if >0.8, good if 0.6-0.8, fair if 0.4-0.6 and poor if <0.4. The significant correlation indicates that there is a linear relationship between variables. R2 is square if r, coefficient of determination, indicates the% variability in the variable due to another variable. The sign of r value indicates the direction of correlation, when positive, as one variable increases, other variable also increases linearly and when it is negative, as one variable increases, other decreases and vice versa. Mann Whitney test was used to compare the continuous variable which is not normally distributed/ ordinal variables between two independent groups. Kruskall Wallis test was used to compare the continuous variable which is not normally distributed/ ordinal variables between more than two independent groups.

Results

Out of the total of 130 patients studied, 102 were men, i.e., 78.5% while 28 were women, i.e., 21.5%, The age at diagnosis ranged between 18 -70 years with mean age of 40.8 years and median age of 38.5 with a standard deviation of 13.67. Most of the patients, i.e. 37(28.5%), were in the 4th decade of their life, followed by the 3rd decade (n=35, 26.9%) and the 5th decade (n=31, 23.8%). Only 9 patients (6.9%) were > 61years of age (Table 1).

Table 1: Age Distribution of Patients of Acute Pancreatitis

Age (Yrs)	Count	Column N%
<30	35	26.9%
31-40	37	28.5%
41-50	31	23.8%
51-60	18	13.8%
>61	9	6.9%
TOTAL	130	100%

Table 2: Sex distribution of patients of acute pancreatitis

Sex	Count	Column N%
Female	28	21.5%
Male	102	78.5%
Total	130	100%

Most of the cases in this study, (n = 68, 52.3%) were of alcohol induced acute pancreatitis, while 33 (25.4%) patients were gallstone induced, ERCP in 2 (1.5%). In 25 (19.2%) patients etiology couldn't be identified and were termed as idiopathic. Most of the patients of alcohol induced acute pancreatitis were male, while most of patients of gallstone induced pancreatitis were female. (Table 3).

Table 3: Etiological Distribution of Patients of Acute Pancreatitis.

Etiology	Count	Column N%
Ethanol	68	52.3%
Gall stone	33	25.4%
Idiopathic	25	19.2%
Post ercp	2	1.5%
Dyslipidemia	1	0.8%
Drug induced	1	0.8%
Total	130	100%

Out of 130 patients, mean duration of stay was 8.84 days with standard deviation of 3.62. Out of a total of 130 patients participating in this study 62 (47.7%) patients were of mild acute pancreatitis (MAP) while 53 (40.8%) patients were of moderately severe (MSAP) and 15 (11.5%) were of severe acute pancreatitis (SAP). A total of 39 (30%) patients developed complications during the course of illness and 4 patients died during treatment with a mortality rate of 3.1%. It was observed that the incidence of MSAP and SAP, local complications, and mortality were significantly higher in the group with higher scores of BISAP, Ranson, APACHE II and MCTSI than in the group with lower scores (ROC CURVES 1 AND 2). Pancreatic necrosis was present in 25 patients, while 13 developed persistent organ failure and 40 needed intensive care unit (ICU) admission. BISAP was the second most accurate in predicting severe acute pancreatitis (AUC 0.873) and organ failure (0.759) after MCTSI.

All the four scoring systems were found to be similar in predicting severity, local complication and mortality. All the four scorings had a sensitivity of 51.28% to 92.31% and specificity of 50 to 79.12% in predicting complications (P value <0.0001).

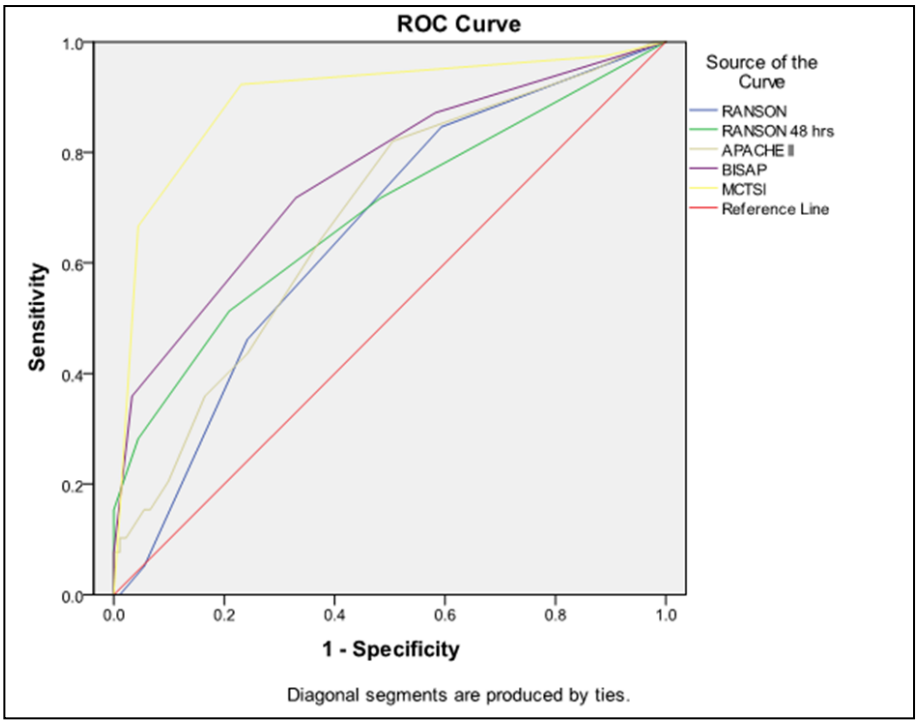

Fig 1: ROC curve for complications

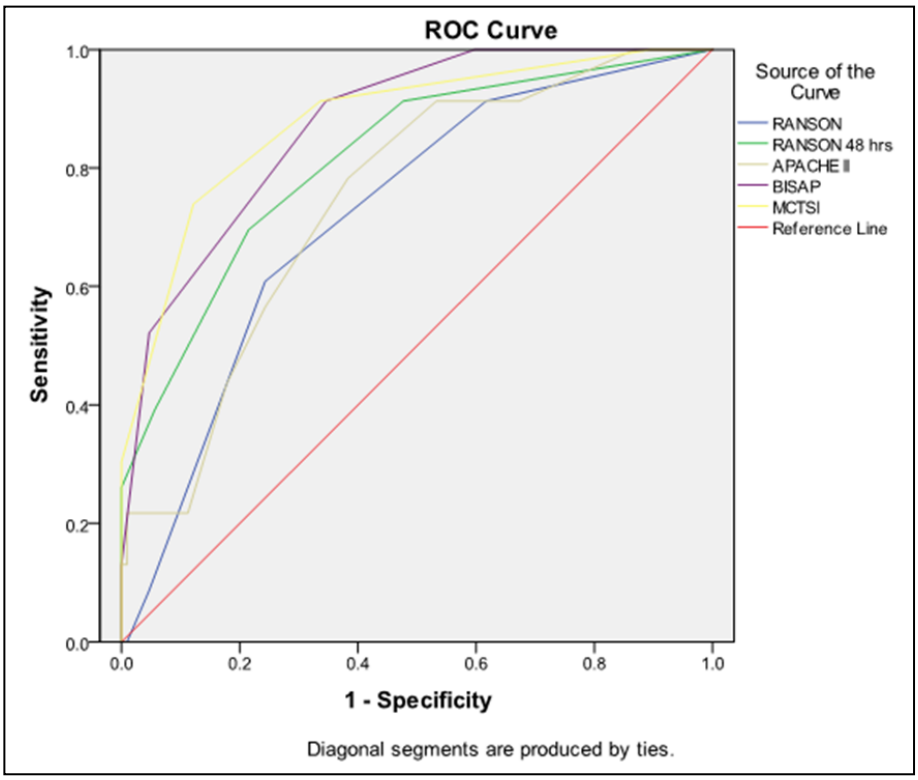

Fig 2: ROC curve for poor prognosis

Scoring system	Atlanta Classiciation						P Value
	Mild		Moderate		Severe		
	Mean	SD	Mean	SD	Mean	SD	
Ranson	.50	.74	1.15	1.03	2.67	1.35	<0.0001
Apache ii	3.15	1.91	5.60	3.12	8.33	5.47	<0.0001
Bisap	.55	.72	1.64	.83	3.00	.93	<0.0001
Mctsi	3.81	1.07	6.19	1.77	8.13	1.41	<0.0001

Table 4 shows comparative analysis of BISAP, Ranson, APACHE II, MCTSI scores in predicting severity based on Atlanta classification. It shows that the patients with mild acute pancreatitis had significantly lower scores while with severe disease had significantly higher scores. (MAP= mild acute pancreatitis. MSAP=moderately severe acute pancreatitis, SAP=severe acute pancreatitis)

Table 5 shows comparative analysis of BISAP, Ranson and APACHE II scores in predicting complications. It shows that the patients who did not survive had significantly higher scores compared to those who survived.

Table 6 shows statistical analysis of BISAP, Ranson, APACHE II and MCTSI scores. It is observed that all the four systems were very specific in predicting severity, local complications and mortality but lacked sensitivity in predicting severity and local complications. (PPV=positive predictive value, NPV=negative predictive value, PLR=positive likelihood ratio, NLR= negative likelihood ratio)

Table 5: Comparative analysis of ranson, apache II, mctsi and bisap scores in predicting complications

Scoring system		Complications				P value
		Major Complication		No Major Complication		
		Count	Row N%	Count	Row N%	
Ranson's	>=2	20	51.3%	19	48.7%	<0.0001
	<2	19	20.9%	72	79.1%	
Apache II	>4	29	39.2%	45	60.8%	0.001
	<4	7	13.5%	45	86.5%	
BISAP	>=2	28	48.3%	30	51.7%	<0.0001
	<2	11	15.3%	61	84.7%	
MCTSI	>=5	36	63.2%	21	36.8%	<0.0001
	<5	3	4.1%	70	95.9%	

Table 6: Statistical Analysis of Ranson, Apache II, Mctsi, Bisap Scores

	Ranson	APACHE II	MCTSI	BISAP
Sensitivity	51.28%	80.56%	92.31%	71.79%
Specificity	79.12%	50%	76.92%	67.3%
PPV	51.28%	39.19%	63.16%	48.28%
NPV	79.12%	86.54%	95.89%	84.72%
Diagnostic accuracy	70.77%	58.73%	81.54%	68.46%

Discussion

In the present study it was observed that acute pancreatitis was more common in men (78.5%) than in women (21.5%). Baig SJ *et al*. in their study acute pancreatitis done in 2008 in eastern India, also observed a male predominance with 73% of their patients being male [7]. Vengadakrishnan K *et al*. in their study in Chennai, India in 2015 observed that acute pancreatitis was found five times more common in males than in females [8]. Nesvaderani M *et al*. in 2015 published their retrospective cohort study of 932 patients and observed that 50.4% patient patients were females [9]. Present study is in concurrence with other Indian studies. This may be because most of our patients had alcohol induced acute pancreatitis and alcoholism is far more common in male population in India. In the present study we observed that a total of 37(28.5%), were in the 4th decade of their life, followed by the 3rd decade (n=35, 26.9%) and the 5th decade (n=31, 23.8%) with mean age of 40.81 years and median age of 38.5. G. Efron in his study to determine the natural history of pancreatitis, published in British Journal of Surgery in the year 1966, observed that incidence of pancreatitis increased with age, was most in 3rd, 4th & 5th decades of life, and again dipped during later part of life [10, 13]. Vengadakrishnan *et al*. in their study observed that most patients were in the age group of 21 to 40 years [8]. Nesvaderani M *et al*. observed a median age of 50 which was higher then what was observed in our study [9].

Baig SJ *et al*. in their study observed a mean age of 30 years which was similar to that of our study [7]. Chang MC *et al*. in their study done in Taiwan and published in 2003 observed that patients with alcohol-related acute pancreatitis were the youngest (mean age: 41.5 years), while those with gallstone pancreatitis were the eldest (mean age: 64.1 years) [11]. This observation made by Chang *et al*. may be the cause of younger mean age in the current study. All the patients in our study presented with pain abdomen suggestive of acute pancreatitis. Pain abdomen is one of the diagnostic criteria as described in revised Atlanta classification for acute pancreatitis [2]. It was an important diagnostic criterion in our study and thus patients who had pain abdomen suggestive of pancreatitis were only included in this study. Organ failure and shock are the characteristic features, apart from other complications, which differentiates MAP with MSAP/SAP.

Contrary to the classical test book teaching of biliary disease being the most common cause of acute pancreatitis, it was observed in our study that alcohol (52.3%) was the most common cause of acute pancreatitis followed by gallstones (25.4%). Chang MC *et al*. in their study observed that alcohol was the etiology in 33.6%, followed by gallstones in 34.1%. They also observed that the predominant cause of acute pancreatitis in women was gallstones, while alcohol was the leading cause of acute pancreatitis in men.[11] Guo-Jun Wang *et al*. in their review of etiology and pathogenesis of acute pancreatitis published in 2009 opined that in developed countries, obstruction of the common bile duct by stones (38%) and alcohol abuse (36%) are the most frequent causes of acute pancreatitis.[12] Baig SJ *et al*. observed alcoholism in 41.1%, gallstones in 23.5%, trauma in 17.6%, idiopathic in 11.7% and post-ERCP in 5.8%.8 Simoes *et al*. in their study observed that the most common etiology was alcohol consumption (39.3%), followed by gallstones (24.1%).14 High incidence of alcoholism as an etiological factor in our study may be due to high prevalence of alcoholism among males in this part of the globe. Other authors have also made similar observation [7, 13]. It may be possible that recently alcoholism is replacing gall stone as the most common cause of acute pancreatitis. Only two patients in our study were post ERCP pancreatitis.

We observed sensitivity of 99.2% for serum lipase and 100% for serum amylase. Gomez *et al*. in their study in 2012 observed sensitivity of serum lipase to be 95-100% depending on cause.[14] Some studies observed sensitivity for serum amylase to be 63.6% and that for serum lipase to be 99.5%, whereas, specificity for serum amylase to be 99.4% and that for lipase to be 99.2%.[15] present study is not in agreement with most authors that Serum lipase is superior to serum amylase in the diagnosis of acute pancreatitis. Cho JH in their comparison of scoring systems in predicting the severity of acute pancreatitis in 2015 concluded that the APACHE-II scoring system seems to have the highest accuracy in assessment of the severity and outcome of acute pancreatitis, although the predictive accuracy of APACHE-II was not significantly different compared to that of

the other scoring systems [16]. Khanna *et al*. in their study observed a sensitivity and specificity of 83 and 78 for Ranson score in predicting severity and organ failure, sensitivity and specificity of BISAP was 74 and 68 and that for APACHE II it was 80 and 82. They concluded that there is no single ideal method in assessing the severity of the disease. Individual preference and available institutional facilities influence the method chosen for prognostic assessment of acute pancreatitis.[17]In the present study all the four scoring systems were found to be similar in predicting severity, complications and mortality. All the four scorings had a sensitivity of 51.28% to 92.31% and specificity of 50 to 79.12% in predicting complications (P value <0.0001). All the four systems had high negative predictive value and low positive predictive value (Table 6) as observed by other authors.[9] Therefore, all four scoring systems can be used to predict the severity, local complications, and mortality of acute pancreatitis but none was found to be superior to others.

Conclusion

Incidence of alcohol induced acute pancreatitis is on the increase. Mean age is also on the lower side nowadays. All the scoring systems in this study were very similar in predicting severity, complications and mortality. Although all four scoring systems can be used to predict severity, complications, and mortality of acute pancreatitis, they were much better in predicting mortality. There is no ideal predicting system for acute pancreatitis, but these scoring systems can be used to triage patients for better healthcare delivery. We recommend that although MCTSI score is a better predictor of organ failure, BISAP should be used for the identification of high-risk patients due to its simplicity. MCTSI helps to identify local and systemic complications with pancreatic necrosis.

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