Original Article

Comparison of BISAP (Bedside Index for Severity in Acute Pancreatitis) score, RANSON criteria and MCTSI (Modified Balthazar Computed Tomography Severity Index) in predicting the SAP (Severity of Acute Pancreatitis)

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Abstract

Background: To evaluate and compare the efficacy of the BISAP score, Ranson' criteria and MCTSI in estimating the acute pancreatitis severity. **Materials and Methods:** This observational, prospective, comparative, hospital-based research was carried out in 77 patients who presented with acute abdomen, having classic clinical manifestations of AP. All patients were assessed for BISAP (at admission) score, Ranson' criteria (at admission and 48 hours after admission) and MCTSI (at 72 hours). Each clinical score was calculated based on the worst (most extreme) laboratory and vital sign measurement obtained at admission and at 48 hours. Sensitivity, specificity, Positive Predictive Value (PPV), and Negative Predictive Value (NPV) were calculated for individual scoring systems. Receiver-Operating Characteristic (ROC) curves for severe AP were calculated for all score to analyze and compare the performance of predictions. **Results:** Total 77 participants were included for final analysis and mean age of patients was 42.68±15.15 years. The sensitivity of Ranson's scoring system at 48 hours was 35.9%, specificity in predicting SAP 92.3%, PPV 95.8% while NPV was 22.6%. The sensitivity of BISAP scoring system in predicting SAP was 50.0%, specificity 84.6%, PPV 94.1% and NPV 25.6%. The sensitivity of MCTSI scoring system in predicting SAP was 53.1%, specificity 100%, PPV 100% and NPV 30.2%. The area under curve (AUC) using ROC curves of MCTSI (0.77) was higher than that of BISAP (0.66), Ranson's at 48 hours (0.64) and Ranson's at admission (0.55). **Conclusion:** This study concluded that the simplest scoring system; BISAP shows fairly acceptable predictive accuracy for severity of AP. Clinical scoring systems and the modified CT-based scoring system have comparable prediction accuracy for AP severity.

Keywords: BISAP (Bedside Index for Severity in Acute Pancreatitis) score, RANSON criteria, MCTSI (Modified Balthazar Computed Tomography Severity Index), acute pancreatitis.

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Introduction

Acute Pancreatitis (AP) is typically a sudden, reversible inflammatory process of the pancreas. Acute pancreatitis can range in severity from mild to severe and the later may be life threatening. Mild AP has a very low mortality rate (<1%) while the severe one has mortality rate up to 30%.[1-3] Severity of the disease is classified as mild, moderate, and severe by the absence or presence of organ failure and local or systemic complications. Severe AP (SAP) is defined by the presence of persistent organ failure for ≥ 2 days. Case-mortality rate of SAP may be as high as 30%.[3] In order to reduce this, it is important to precisely evaluate severity and identify patients susceptible for developing persistent organ failure and initiate appropriate treatment early in the course of the disease.[4]

Varieties of scoring systems are available such as Ranson criteria, Acute Physiology and Chronic Health Evaluation (APACHE II) and Computed Tomography Severity Index (CTSI).[5-7] But these systems are either complicated or require data not collected routinely in early stages of disease, making early risk stratification difficult.[8]

A new prognostic scoring system for early estimation of the severity of AP, named the Bedside Index of Severity in Acute Pancreatitis (BISAP) was proposed by Wu et al. in 2008.[9] The 5-point BISAP system incorporates the variables like blood urea nitrogen level > 25 mg/dl, impaired mental status, Systemic Inflammatory Response Syndrome (SIRS), age > 60 years and presence of pleural effusion.[10]

The Ranson's render a major advantage in the evaluation of the disease severity in AP but require 48 hours of data collection before the severity can be assessed.[11] MCTSI is based on the radiologic CT findings of inflammation, presence of collections

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(pancreatic and extra-pancreatic) and degree of necrosis. Presence of pancreatic necrosis predicts a more severe outcome (major complication, longer hospitalization, and/ or death). A MCTSI < 2 is associated with low morbidity and mortality. On the other hand, a score of ≥ 6 is associated with greater likelihood for prolonged hospitalization, surgical debridement of the necrosis and death. This study was planned to evaluate and compare the efficacy of the BISAP score, Ranson criteria and MCTSI in predicting the severity of acute pancreatitis.

Materials and Methods

This study was carried out over fourteen months on a total of 77 patients who presented with acute abdomen, having classic clinical manifestations of AP. The diagnosis of severity was based on the 2012 Revised Atlanta Classification (RAC).[12] The study was approved by the Institute Ethics Committee. Informed written consent in vernacular/ spoken language was obtained from all participants enrolling for study.

Study Design: prospective, observational, comparative, hospital- based study.

Place of study: Department of General Surgery, Government Medical College Rajindra Hospital, Patiala, Punjab.

Duration of study: July 2023 to September 2024.

Sample size calculation: $n = Z^2P(1-P)/d^2$ formula was used for calculating adequate sample size. Where, n is the sample size, Z is the statistic corresponding to level of confidence, P is the prevalence (obtained from similar studies conducted by the researchers), and d is the precision (corresponding to effect size). For this study, Z = 1.65 (corresponding to 95% confidence level), P = 4.15%, and d = 5%. Using above formula, the minimum sample size came out to be 54. Total 77 participants were included for final analysis. Three patients denied consent/ admission and were excluded out from analysis.

Inclusion criteria

- Age between 18–80 years
- Acute abdominal pain suggestive of AP
- Serum amylase and/or lipase levels at least three times the upper limit of normal
- Characteristic findings of AP on imaging.

Exclusion criteria

- History of chronic pancreatitis
- Acute-on-chronic pancreatitis, recurrent pancreatitis based on history of previous similar attacks or previous hospital records of AP
- Chronic pancreatitis features on imaging with a history of complications like dilated pancreatic duct, pancreatic calcification, areas of atrophy, pseudocysts and abscesses in pancreas
- Additional comorbidities such as cardiac, renal, pulmonary (respiratory), hepatic failure
- Pregnancy
- Refusal to give consent/ incomplete information
- Treated elsewhere before presenting to emergency
- Hospitalization discharge within 48 hours

Evaluation of patients included demography, detailed history, a thorough clinical examination and investigations. Data were collected regarding demographics like age, gender, admission date, length of hospitalization, relevant laboratory parameter evaluation including amylase and lipase levels; complete blood count (CBC) with differential; metabolic panel (Blood urea Nitrogen (BUN, creatinine, glucose, LDH, LFT, and calcium levels); triglyceride level; urinalysis; and arterial blood gases. Relevant clinical and biochemical parameters were studied and clinical scores calculated - on admission (BISAP, Ranson) and at 48 hours following admittance (Ranson, MCTSI, SIRS, Modified Marshal Organ Failure).

Organ failure was assessed using the modified Marshall score which was determined using the most extreme clinical measurement or laboratory value during each 24-hour period for every patient throughout the first 72 hours of hospitalization.[12] Imaging modalities include plain film chest radiography, transabdominal USG, CT abdomen scans (plain and contrast - enhanced). A USG whole abdomen was done for all the patients to confirm the involvement of pancreas and excluding other causes of acute abdominal pain like acute cholecystitis, subacute intestinal obstruction and acute renal colic. Each patient underwent a contrast-enhanced CT within 48 hours of admission. All CT scan images were reviewed and analyzed in consensus by two professional radiologists, each blinded to patient outcome. The MCTSI was evaluated after the CT scan within 48 to 72 hours. Patients were managed as per the standard institute guidelines.

All patients were assessed for BISAP score (at admission), Ranson' criteria (at admission and 48 hours after admission) and MCTSI (at 72 hours). Patients were followed up until discharge or until 2 weeks. Each clinical score was calculated based on the worst (most extreme) laboratory and vital sign measurement obtained at admission and at 48 hours. Data from initial admissions at outside hospitals were collected on all transferred patients and used to calculate each patient's clinical scores. For the admission Ranson' criteria calculation, the 5 variables measured at admission were used.

Statistical analysis: The database was processed, analyzed and imported into Statistical Package for Social Science (SPSS) software version 25.0 for Windows (SPSS, Chicago, IL, United States). Descriptive variables were expressed as mean ± standard deviation (SD) and categorical variables were expressed as absolute numbers or a percentage. All quantitative normally distributed data were analyzed using the student's t-test or ANOVA test. Sensitivity, specificity, Positive Predictive Value (PPV), and Negative Predictive Value (NPV) were calculated for individual scoring systems. Receiver-Operating Characteristic (ROC) curves for severe AP were calculated for Ranson, BISAP, MCTSI, using cutoff values. The area under curve (AUC) was used to analyze and compare the performance of predictions. A p value <0.05 was considered statistically significant.

Results

Mean age of patients was 42.68±15.15 years. The majority of cases were seen in the age group of 31-40 years (21 cases;

27.27%). Majority of patients were males (74.02%). 75.32% patients had non-biliary pancreatitis. About half of all patients (51.95%) had 3 to 5 days' stay at hospital, followed by 5 to 7 days' stay (25.97%). 23 (29.87%) patients had organ failure, 12 (15.58%) had ICU stay and 5 patients (6.49%) died. [Table 1]

Table 1: Demographic and other characteristics details of the patients (n=77)

Characteristics	Category	No. of patients	%
Gender	Male	57	74.02
	Female	20	25.97
Age group (years)	<20	01	01.29
	21-30	20	25.97
	31-40	21	27.27
	41-50	14	18.18
	51-60	07	09.09
	61-70	11	14.28
	71-80	03	03.89
Etiology	Alcohol	51	66.23
	Gall stones	19	24.67
	Idiopathic	07	00.09
Types	Biliary	19	24.67
	Non-Biliary	58	75.32
Presentation	Radiating pain in abdomen	60	77.92
	Non-radiating pain in abdomen	09	11.68
	Localized Peritonitis	60	77.92
	Diffuse Peritonitis	08	10.38
	Vomiting	57	74.02
	Distension of abdomen	51	66.23
	Obstipation	35	45.45
Ranson' score	≥ 3	24	31.16
	< 3	53	68.83
BISAP score	≥ 3	11	14.28
	<3	66	85.71
MCTSI	0-2	04	00.05
	4-6	39	50.64
	8-10	34	44.15
2012, RAC	Mild	13	16.80
	Moderately severe	30	38.96
	Severe	34	44.15
Hospital stay (days)	<3	15	19.48
	3 – 5	40	51.94
	5 – 7	20	25.97
	7 – 14	02	02.59
Outcome	Discharged	72	93.50
	Death	05	06.49
	ICU admission	12	15.58
CT findings	Pancreatic necrosis	37	48.05
	Pancreatic fluid collection	71	92.20
	Pleural effusion	45	58.44
	Ascites	51	66.23

Majority of patients in non-biliary group at admission (96.55%) and at 48 hours (68.96%) had Ranson score of 0 to 2. Ranson score both upon admission and 48 hours later was 1.21±0.89 and 1.76±1.55 respectively and this difference was found to be statistically significant (p=0.02). 15 patients (78.95%) and 13 patients (68.42%) respectively in biliary pancreatitis group had Ranson score of 0 to 2. Ranson score was 1.53±1.17 at admission and 1.95 ±2.01 at 48 hours, with no significant difference. [Table 2]

Table 2: Ranson score both upon admission and 48 hours later in non-biliary group and biliary group

Ranson score	Non-biliary group (n=58)		Biliary group (n=19)	
	At admission	At 48 hours	At admission	At 48 hours
0-2 points	56 (96.55%)	40 (68.96%)	15 (78.95%)	13 (68.42%)
3-4 points	02 (03.45%)	14 (24.14%)	04 (21.05%)	04 (21.05%)
5-6 points	00 (00.00%)	04 (06.89%)	00 (00.00%)	01 (05.26%)
7-11 points	00 (00.00%)	00 (00.00%)	00 (00.00%)	01 (05.26%)
Range	0-3	0 -6	0-4	0-7
Mean±SD	1.21±0.89	1.76±1.55	1.53±1.17	1.95±2.01
p-value	0.0204*		0.4359	

*significant

17(77.92%) patients were younger than 60 years. 39(50.64%) patients had elevated BUN levels. Impaired GCS was present in 3(3.89%), SIRS in 28(36.36%) and pleural effusion in 45(58.44%) patients. BISAP score ≥ 3 was seen in 16(20.77%) patients. [Table 3]

Table 3: BISAP score and associated factors (n=77)

Parameter	Variables	Number	Percentage
BUN (mg/ml)	Normal (5 to 25)	38	49.35
	Elevated (>25)	39	50.64
Mental status	GCS =15	74	96.10
	GCS < 15	03	03.89
SIRS	Absent	49	63.64
	Present	28	36.36
Age (Years)	≤60	60	77.92
	>60	17	22.08
Pleural effusion	Absent	32	41.56
	Present	45	58.44
BISAP score	0	10	12.99
	1	24	31.17
	2	27	35.06
	3	13	16.88
	4	01	01.29
	5	02	02.59

All 77 patients underwent CT scan and all had pancreatic inflammation, of whom 71 (92.21%) had pancreatic/ peripancreatic fluid collection or fat necrosis. 37 (48.05%) had pancreatic necrosis and 64 (83.12%) had extra pancreatic complications. [Table 4]

Table 4: Modified Balthazar CT severity index and associated factors (n=77)

Parameters	Variables	Number	Percentage
Pancreatic inflammation (PI)	No inflammation	0	0
	PI – intrinsic abnormalities with peripancreatic inflammatory changes	06	07.79
	PI – pancreatic/ peripancreatic fluid collection or fat necrosis	71	92.21
Pancreatic necrosis (PNec)	None	40	51.95
	< 30 %	19	24.67
	>30 %	18	23.37
Extra- pancreatic complications (EPC)	Present	64	83.12
	Absent	13	16.88

Comparison of Ranson score (at admission) with RAC for acute pancreatitis that is moderately severe (n = 30) and severe (n = 34). Out of total cases, 6 were graded as severe while 13 were graded as not severe by both criteria but at 48 hours, 23 cases were graded as severe while 12 as not severe by both criteria. According to BISAP score, 32 cases were graded as severe while 11 as not severe by both criteria. According to MCTSI score, 34 cases were graded as severe while 13 as not severe by both criteria. [Table 5]

Table 5: Comparison of Ranson criteria (at admission and 48 hours) with RAC, BISHOP and MCTSI for MSAP and SAP

		Severe Acute Pancreatitis (n=77)	
Scores	Acute Pancreatitis	Severe n (%)	Not Severe n (%)
Ranson (on admission)	Severe	06 (09.4)	00 (0.0)
	Not Severe	58 (90.6)	13 (100)
Ranson (on 48 hours)	Severe	23 (35.9)	01 (07.7)
	Not Severe	41 (64.1)	12 (92.3)
BISHOP	Severe	32 (50.0)	02 (15.4)
	Not Severe	32 (50.0)	11 (84.6)
MCTSI	Severe	34 (53.1)	00 (0.0)
	Not Severe	30 (46.9)	13 (100)

The sensitivity of Ranson's scoring system at 48 hours was 35.9%, specificity in predicting SAP 92.3%, PPV 95.8% while NPV was 22.6%. The sensitivity of BISAP scoring system in predicting SAP was 50.0%, specificity 84.6%, PPV 94.1% and NPV 25.6%. The sensitivity of MCTSI scoring system in predicting SAP was 53.1%, specificity 100%, PPV 100% and NPV 30.2%. [Table 6]

Table 6: Predictive value of several grading methods for SAP

Scores	Sensitivity %	Specificity %	PPV %	NPV %	Accuracy %
Ranson (at admission)	09.4	100	100	18.3	24.7

Ranson (48 hours)	35.9	92.3	95.8	22.6	45.5
BISAP	50.0	84.6	94.1	25.6	55.8
MCTSI	53.1	100	100	30.2	61.1

The predictive accuracy of each scoring system for predicting SAP was measured by the area under the ROC curve (AUC) with standard error and 95% confidence interval (CI). The AUC of MCTSI (0.77) was higher than that of BISAP (0.66), Ranson's at 48 hours (0.64) and Ranson's at admission (0.55). [Table 7 & Figure 1]

Table 7: Receiver operating characteristic (ROC) results of scoring systems' curves for forecasting SAP

Scores	AUC	95% CI	P value
Ranson (on admission)	0.55	0.38-0.72	0.61
Ranson (at 48hours)	0.64	0.49-0.79	0.13
BISAP	0.66	0.51-0.82	0.06
MCTSI	0.77	0.66-0.88	0.004

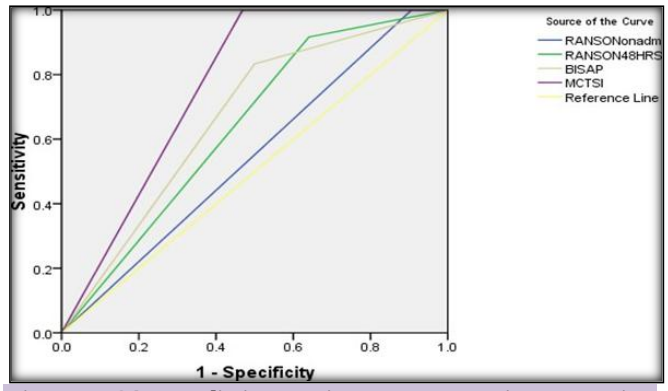

Figure 1: SAP prediction scoring systems' receiver operating characteristic (ROC) curve

Discussion

Acute pancreatitis is a sinister sickness that leads to footfalls in emergency departments of people across all ages and gender. Rapid assessment of its severity is critical to judgment on patients in acute need of intensive therapeutic care. In this study, patients have been graded using severity grading systems, specifically Ranson's, BISAP, and MCTSI of acute pancreatitis within given constraints and hence correlate the result in terms of the development of complications and mortality.

In present study mean age of the patients was found 42.68 years and the age group of 31–40 years old had the highest illness incidence (27.27%). Similar incidence of disease was also reported by other studies. [13-16] Incidence of acute pancreatitis cases were mostly in male (74%) as compared to female (26%). Other studies have also reported male preponderance, [13,15,17] but Sharma et al. study and Yeung et al. study reported more in female. [16,17] Alcohol (66.23%) was the most common etiological factor, followed by gall stone disease (24.67%). Simoes et al, Yadav et al. and Vege et al. have also reported alcohol as most common etiological factor. [17-19] High per capita tippling in the state where the hospital is located and consequent male preponderance in this study may be key to stark differences from similar studies.

Mean value of hospital stay in present study was 5.75 days. 52% patients stayed for 3–5 days. All patients were discharged within 2 weeks. All the cases of mortality were graded as having SAP based on 2012, RAC. The overall mortality in our study was 6.49%. Among SAP, it was slightly higher at 7.8%. Other studies have also reported higher mortality rates in SAP, [15-17,19,20] but the present study showed mortality rate in SAP patients on the lower side as compared to published data. Cause of death was multiple organ failure.

In this study, 38.96% patients were graded as moderately severe and 44.15% were graded as having SAP. Pancreatic necrosis was present in 48.05% patients. The most frequent consequence was ARDS (36.36%), which was followed by sepsis (29.87%). The current study's complications were like those reported in the literature. [15–19] 15.58% required ICU admission, and 29.87% experienced chronic organ failure.

The sensitivity of Ranson's scoring system was 35.9%, specificity in predicting SAP 92.3%, PPV 95.8% while NPV was 22.6%. There was no significant correlation between disease severity and Ranson's score ≥ 3 at 48 hours with 95% confidence interval 0.49 –0.79, and p value of 0.13. The current study's findings were consistent with the data that had been published. [Table 8]

Table 8: Comparison of Ranson's SAP prediction score across various studies

Studies	Sensitivity %	Specificity %	PPV %	NPV%
Larvin et al[21]	75.0	77.0	57.4	95.7
Papachristou et al[15]	84.2	89.8	69.6	95.3
Simoes et al[17]	91.2	74.4	-	-
Cho et al[22]	85.7	44.4	18.8	95.3
Sarma et al[16]	75.0	84.2	60.0	91.4
Present study, at 48 hours	35.9	92.3	95.8	22.6

The sensitivity of BISAP scoring system in predicting SAP was 50.0%, specificity 84.6%, PPV 94.1% and NPV 25.6%. There was significant correlation between disease severity and BISAP score ≥3, with 95% confidence interval 0.51–0.82, and p value of 0.06. The sensitivity, specificity and NPV of the present investigation compare negatively with the published statistics. [Table 9]

Table 9: BISAP score comparison with several studies for SAP prediction

Studies	Sensitivity %	Specificity %	PPV %	NPV %
Gompertz et al[23]	71.4	99.1	83.3	98.3
Bezmarevic et al[24]	74.0	59.0	-	-
Yadav et al[18]	100	69.2	-	-
Sarma et al[16]	75.0	86.8	64.3	91.6
Present study	50.0	84.6	94.1	25.6

The present study showed low sensitivity of Ranson at 48 hours (35.9%) compared to BISAP (50.0%) score in predicting SAP. But specificity, PPV was found higher for Ranson at 48 hours (92.3%, 95.8%) as compared to BISAP (84.6%, 94.1%).

Regarding precision when using the ROC curve, the AUC was found higher for BISAP (AUC = 0.66, 95% CI: 0.51-0.82 and Ranson at 48 hours, 95 CI: 0.49–0.79, AUC = 0.64. Hence, in this study, BISAP was proven to be more accurate than the other one. In the present study, the AUC of MCTSI was higher for SAP (0.77) than Ranson's score. In one of the few similar studies using MCTSI (rather than the more often studied CTSI score), Mortele et al. and Banday et al, noted that this scoring system correlates closely with patient outcome measures.[25-26] Kumar et al. found only APACHE II comparable to MCTSI in their AUC comparison based study (p = 0.13).[27] MCTSI appears a good option nevertheless given poor availability and restricted access to radiographic scanning facilities in India, it may not be the first line choice of the doctor facing an AP patient in deciding whether or not early referral to a tertiary care center is in order.

There is significant advantage of the modified CT score method for AP clinical severity prediction and pancreatic necrosis. Nevertheless, the Ranson score determined at 48 hours bags the honors when organ failure, ICU admission and mortality are deciding factors. So early management of AP need not wait for the scan to be underway. Rather, from a resource utilization perspective and as a way of reducing radiation exposure in AP, when the diagnosis has been made on clinical grounds (abdominal pain and elevated serum amylase and/or lipase), Clinical scoring systems can first be used to determine the severity and prognosis, with imaging saved for situations where the diagnosis is unclear, when a patient has been clinically predicted to have SAP, when conservative therapy has failed to improve the patient's condition, or when a potentially fatal complication is suspected. Getting a CT scan to determine severity on the day of admission is not advised because there doesn't seem to be any benefit to doing one for prognosis purposes when compared to the more straightforward clinical rating methods.

Limitations: Sample size was too small to uncover definitive directions for best prognosis in AP and MCTSI scanning protocol used in lieu of plain CTSI. Further studies with long term follow up are needed.

Conclusion

In conclusion, the simplest scoring system, BISAP shows fairly acceptable predictive accuracy for severity of AP. Clinical scoring systems and the modified CT-based scoring system have comparable prediction accuracy for AP severity. No simple scoring system capable of reaching maximal utility is available, and unique models are needed in order to achieve further improvement of predictive accuracy. However, availability and affordability of imaging modalities are not easy, Consequently, it is not required to get a CT scan for a severity assessment on the day of admission.

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Conflicts of interest

There are no conflicts of interest.

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