International Surgery Journal
Aggarwal A et al. Int Surg J. 2020 May;7(5):1473-1480
http://www.ijsurgery.com
pISSN 2349-3305 | eISSN 2349-2902

DOI: http://dx.doi.org/10.18203/2349-2902.isj20201854

Original Research Article

Comparison of BISAP and Ranson's score for predicting severe acute pancreatitis and establish the validity of BISAP score

Amulya Aggarwal[1], Alok V. Mathur[1]*, Ram K. Verma[1], Megha Gupta[2], Dheeraj Raj[1]

[1]Department of General Surgery, Shri Guru Ram Rai Institute of Medical and Health Sciences, Dehradun, Uttarakhand, India
[2]Department of Anaesthesia and Critical Care, All India Institute of Medical and Health Sciences, Rishikesh, Uttarakhand, India

Received: 06 March 2020
Revised: 09 April 2020
Accepted: 13 April 2020

***Correspondence:**
Dr. Alok V. Mathur,
E-mail: dralokvardhanmathur@yahoo.com

ABSTRACT

Background: Pancreatitis can lead to serious complications with severe morbidity and mortality. So an early, quick and accurate scoring system is necessary to stratify the patients according to their severity so as to enable early initiation of required management and care. Scoring system commonly used have some drawbacks. This study aimed to compare bedside index for severity in acute pancreatitis (BISAP) and Ranson's score to predict severe acute pancreatitis and establish the validity of a simple and accurate clinical scoring system for stratifying patients.
Methods: This is a prospective comparative study on 100 patients diagnosed with acute pancreatitis admitted in department of general surgery. Parameters included in the BISAP and Ranson's criteria were studied at the time of admission and after 48 hours. Result of these two were compared with that of revised Atlanta classification.
Results: As per the BISAP score, the sensitivity and specificity were 95.8 % (95% CI, 76.8-99.8), 94.7 % (95% CI, 86.3-98.3) whereas positive likelihood ratio, negative likelihood ratio 18.21 (95% CI, 6.9-47.44), 0.04 (95% CI, 0.01-0.30) and accuracy was 95 % (95% CI, 88.72%-98.36%). On using Ranson's score, the sensitivity and specificity were 91.6 (95% CI, 71.5-98.5) and 89.4 (95% CI, 79.8-95) with a positive predictive value 8.71 (95% CI, 4.47-18.96) and negative predictive value of 0.09 (95% CI, 0.02-0.35) and accuracy of 90% (95% CI, 82.38%-95.10%)..
Conclusions: BISAP score outperformed Ranson's score in terms of Sensitivity and specificity of prediction of severe pancreatitis. The authors recommend inclusion of BISAP Scoring system in standard treatment protocol of management of acute pancreatitis.

Keywords: BISAP score, Ranson's score, Revised Atlanta classification, Severe acute pancreatitis

INTRODUCTION

Pancreatitis is an inflammation of glandular parenchyma characterized by activation of pancreatic enzymes leading to injury or self-digestion of acinar components. The pathologic process could result in a self-limiting disease with no sequelae or in catastrophic auto digestion activity with cytotoxic effects and life- threatening complications with variable involvement of other regional tissues or remote organ systems in the acute form. In the case of chronic inflammation, fibrosis and calcification are the main features of the disease.[1]

The clinical evidence of pancreas-related abdominal pain associated with significant elevation of serum amylase and lipase led to the term pancreatitis. The clinical observations along with further imaging studies, including ultrasound, Computed tomography (CT) and

especially magnetic resonance imaging (MRI) of the bilio-pancreatic system, should address the required treatment patient by patient. It is quite difficult to diagnose pancreatitis in early stage, but its importance lies in directing the treatment of the patient, whether medical or surgical. Early, quick, and accurate risk stratification of acute pancreatitis cases would help in evidence-based early initiation of intensive care therapy for patients with severe acute pancreatitis to prevent outcomes and allow treatment of mild severe cases on the common ward. Only the dynamic observation of patients with controlled follow-up enables us to classify pancreatitis and to define the disease better, assigning the definitive labels supported by the biochemical and radiologic sources well characterized by the different classification systems available. The clinician should be able to recognize pancreatitis at an early stage, but avoid assigning a definitive classification immediately, instead investigating all the factors available to determine whether a first acute attack could lead to chronic changes with fibrosis, permanent disruptions and exocrine-endocrine insufficiency.

The clinical course of acute pancreatitis may vary from a mild transitory form to a severe necrotizing disease leading to deadly complications. Most cases of acute pancreatitis (80%) are mild (interstitial edematous pancreatitis) and self-limiting, subsiding spontaneously within 3 to 5 days.[1,2] Patients with mild pancreatitis usually respond well to medical treatment and generally do not need intensive care unit (ICU) treatment or surgical intervention.[3] Morbidity and mortality rates are less than 1%.[1,3] In contrast, severe pancreatitis (necrotizing pancreatitis) is associated with organ failure or local complications, such as necrosis, abscess formation, or pseudocyst, or both. Severe pancreatitis may be observed in 15% to 20% of all diagnosed cases of pancreatitis.[4]

In, another study, the overall mortality rate was 4 percent (10 of 263 patients). The mortality rate was 9 percent (10 of 106) in patients with necrotizing disease.[3,4]

Acute pancreatitis is a disease with substantial burden on the healthcare system. Recent data indicate a rise in absolute number as well as rate of emergency room visits, hospital admissions and direct health care costs for Acute Pancreatitis. With an overall mortality rate of 5-10%, a reliable method of risk stratification for Acute Pancreatitis is of significant clinical importance.[4-6]

Acute pancreatitis, which is the subject of this study, is the most frequent pancreatic disease and is also the one that often presents diagnostic dilemma and especially therapeutic ones.[5] Current methods of risk stratification in Acute Pancreatitis have limitations.[6,7] Ranson's score is relatively accurate in classifying the severity of acute pancreatitis, but it is difficult to calculate the score as it requires a 48-hour period, missing missing a potentially valuable early therapeutic window.[8,9] The most commonly utilized prediction scoring system for clinical research studies in acute pancreatitis is the acute physiology and chronic health examination (APACHE)-II which is more accurate than Ranson's score.[10-12] However, 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.[11]

The revised Atlanta classification of acute pancreatitis defines mild pancreatitis as associated with minimal organ dysfunction and an uneventful recovery. Severe pancreatitis was defined as associated with organ failure and/or local complications such as "acute" pseudocyst, pancreatic necrosis, or pancreatic abscess.[13-19]

The purpose of this study was to compare bedside index for severity in acute pancreatitis (BISAP) and Ranson's score to predict severe acute pancreatitis and establish the validity of a simple and accurate clinical scoring system for stratifying patients according to their risk of in hospital mortality. To establish the validity of a clinical tool, the BISAP score useful early in course of the disease, we have analysed the data collected at the time of admission and the first 48 hours of hospitalization.

Aims and objective of this study was to compare BISAP and Ranson's score for predicting severe acute pancreatitis and to establish the validity of BISAP scoring system.

METHODS

This is a hospital-based prospective type of observational study which was conducted from November 2017 to April 2019 in Shri Guru Ram Rai Institute of Medical and Health Sciences, Dehradun, India. The study was conducted after approval from the Institutional Ethics committee.

A purposive sampling was done and every eligible case of acute pancreatitis confirmed by clinical, biochemical, and radiological parameters admitted in Department of General Surgery during the mentioned 18 months duration was considered in the study. A total of 100 patients were enrolled in the study after obtaining written and informed consent. The data collected were evaluated to see the outcome.

All patients with a diagnosis of acute pancreatitis were included in this study with following selection criteria. Presence of at least two of the following. Acute abdominal pain and tenderness suggestive of pancreatitis, serum amylase/lipase ≥3 times the normal and imaging findings (USG and/or CT) suggestive of acute pancreatitis.

Patients with chronic pancreatitis and pancreatic malignancy were excluded. Patients with moderate and

severe pancreatitis were managed in ICU and those with mild pancreatitis were managed in ward.

Patients were studied and data was collected at the time of admission and after 48 hours & comparison of the two scoring systems, the Ranson's score and the BISAP score was done with the Revised Atlanta Classification of Acute Pancreatitis (2012), taking it as a gold standard.[8,9,13-20]

Findings were entered in Microsoft excel and analysed using SPSS by applying chi-square test and t-test.

BISAP criteria

BU Wu et al in 2008 conducted a study on more than 17000 patients suffering from acute pancreatitis and using CART analysis, developed a scoring system known as BISAP scoring system of severe acute pancreatitis.[20]

Criteria included in the BISAP scoring system were blood urea nitrogen (>25 mg/dl), Altered mental status (defined as any record of disorientation, lethargy somnolence, coma or stupor in the medical record), pleural effusion (on chest radiography or CT), age (>60 years) and the systemic inflammatory response syndrome (SIRS) defined by the presence of >2 of the following.

- Pulse >90 beats/min
- Respirations >20/min or $PaCO_2$ <32 mmHg
- temperature >38°C or <36°C
- WBC count >12000 or <4000 cells/mm^3 or >10% immature neutrophils (bands)
- Each criterion is given 1 point and the total BISAP Score was calculated.

For the prediction of SAP as per the BISAP score, the cutoff taken was 3.

Cases with score ≤2 are classified as mild acute pancreatitis whereas cases of ≥3 were placed under the category of severe acute pancreatitis (SAP).

Ranson's score

Ranson et al studied patients having severe acute pancreatitis and developed a scoring system to classify acute pancreatitis patients. They published their work in 1974 and in 1977.[8,9]

Criteria to be considered at the time of admission: Age >55 years, White Blood Cell count > 16,000/mm3, Blood Glucose > 200 mg/dl, AST > 250 IU/l, LDH >350 IU/l.

Criteria studied after 48 hours, blood urea nitrogen rise >5 mg%, arterial oxygen saturation (PaO2) <60 mmHg, serum calcium <8 mg/dl, Base deficit >4 mEq/l, fluid needs >6L, hematocrit fall >10%

Each criterion was given 1 point and total Ranson's Score was calculated.

For the prediction of SAP as per the Ranson's score, the cutoff taken was 3.

According to Ranson's score, patients were stratified into mild acute pancreatitis ≤2 and severe acute pancreatitis ≥3.

Revised Atlanta classification of acute pancreatitis (2012)

An international working group has modified the Atlanta classification for acute pancreatitis to update the terminology and provide simple functional clinical and morphologic classifications.[13-19] This classification system was taken as the gold standard classification of acute pancreatitis and BISAP and Ranson's scoring systems were compared with it.

Organ failure

Mainly three organ systems are considered for organ failure, namely: The respiratory system (by estimating PaO_2/FiO_2), The renal system (by serum creatinine levels) and the cardiovacsular system (by systolic blood pressure).

For non-ventilated patients, the FiO_2 is taken as 21% at room air and further at supplemental oxygen (in l/min) of 2,4,6-8 and 9-10, FiO_2 was taken as 25%, 30%, 40% and 50% respectively.

Marshall scoring system for acute pancreatitis

Organ failure is defined a score ≥2 for at least one of the three organ systems. Duration of organ failure is defined as transient (≤48 hours from time of presentation), or persistent (>48 hours from time of presentation). Persistent multi organ failure is defined as two or more organs failing during same 3-day period.

Local complications: Pancreatic pseudocyst / pancreatic necrosis / pancreatic abscess / peri-pancreatic fluid collection.

Systemic complications: Related to exacerbations of underlying co-morbidities related to the acute pancreatitis.

Outcome: Improved or mortality.

Grades of severity according to revised Atlanta classification

Mild acute pancreatitis: No organ failure, no local or systemic complications.

Moderately severe acute pancreatitis: Organ failure that resolves within 48 h (transient organ failure) and/or local or systemic complications without persistent organ failure.

Severe acute pancreatitis: Persistent organ failure (>48 h) may be single organ failure or multiple organ failure.

Table 1: Marshall scoring system to calculate organ failure (for revised Atlanta classification). each criterion is given a score from 0 to 4 as shown in above table according to the value calculated.

Organ system	Score=0	Score= 1	Score=2	Score=3	Score=4
Respiratory (PaO_2/FiO_2)	>400	301-400	201-300	101-200	<101
RenaL (serum creatinine in 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)	>90	<90, fluid responsive	<90, not fluid responsive	<90, pH<7.3	<90, pH<7.2

Statistical data analysis

Data were coded and examined using SPSS program IBM version 22. Details of variables were presented in terms of frequency and percentages. The sensitivity, specificity, positive likelihood ratio, negative likelihood ratio and diagnostic accuracy with 95% confidence interval of BISAP score, Ranson's score and Revised Atlanta classification of acute pancreatitis were calculated using 'R' software. Cross tabulation was done using Chi-square test. Graphical presentation of sensitivity and specificity was done using ROC curve. Statistical significance level was taken at 5%.

RESULTS

Table 2 categorization of all the patients into mild acute pancreatitis and severe acute pancreatitis according to Ranson's score.

All patients included in our study were classified according to Ranson's Criteria into mild (<3) and severe (≥3) acute pancreatitis. Table 2 indicates that 7 out of 70 patients who were classified as mild acute pancreatitis, were having a score of 0-1 while 63 patients were having a score of 2. 30 patients were classified as severe acute pancreatitis, among which 3 cases were having a score of 3-4 and 27 cases were having a score of more than 4.

Table 2: Assessment of severity according to Ranson's score (n=100).

Severity	Ranson's score	No. of patients (%)
Mild acute pancreatitis	0-1	7 (7)
	2	63 (63)
Severe acute pancreatitis	3-4	03 (3)
	>4	27 (27)

Table 3 categorization of all the patients into mild acute pancreatitis and severe acute pancreatitis according to BISAP score.

Table 3: Assessment of severity according to BISAP score (n=100).

Severity	BISAP score	No. of patients (%)
Mild acute pancreatitis	≤2	73 (73)
Severe acute pancreatitis	≥3	27 (27)

Table 3 shows when patients were classified as per the BISAP scoring system, 73 out of 100 patients came out to be that of mild acute pancreatitis (≤2) and 27 cases that of severe acute pancreatitis (≥3).

On comparing BISAP score with Atlanta classification

Table 4 comparison of total cases according to severe acute pancreatitis present or not as suggested by BISAP score and Atlanta classification.

Table 4 shows that when comparison was done between patients classified according to BISAP scoring system and revised Atlanta classification, out of total 100 cases, there were 23 cases predicted positive for the disease entity (SAP) by both the scoring systems whereas 72 cases were classified of not having severe acute pancreatitis (SAP) by both the scoring systems. 4 cases were suggested positive for SAP by BISAP scoring system but negative by revised Atlanta classification. Only a single case was classified having SAP by revised Atlanta classification but predicted negative by BISAP scoring system.

Table 4: Diagnostic value of different scoring systems in predicting disease severity (n=100).

BISAP score versus Atlanta classification			
		Atlanta classification	
		Positive (SAP present) (%)	Negative (SAP absent) (%)
BISAP score	Positive (SAP present)	23 (23)	4 (4)
	Negative (SAP absent)	1 (1)	72 (72)

SAP= Severe acute pancreatitis.

On comparing Ranson's score with Atlanta classification

Table 5: Diagnostic value of different scoring systems in predicting disease severity (n=100).

Ranson's score versus Atlanta classification			
		Atlanta classification	
		Positive (SAP present) (%)	Negative (SAP absent) (%)
Ranson's score	Positive (SAP present)	22 (22)	8 (8)
	Negative (SAP absent)	2 (2)	68 (68)

SAP= Severe acute pancreatitis.

Table 5 comparison of total cases according to severe acute pancreatitis present or not as suggested by Ranson's score and Atlanta classification. Table 5 shows that total cases were classified according to Ranson's scoring system and revised Atlanta classification and were compared with each other. There were 22 cases which were suggested of having severe acute pancreatitis by both the scoring systems. On the other hand, 68 cases were predicted to be negative for the disease by both the systems. 8 cases were positive for SAP by Ranson's scoring system but negative for SAP by the gold standard system, the revised Atlanta classification. Only 2 cases which were suggested positive for SAP by revised Atlanta classification were predicted negative by Ranson's scoring system.

Table 6 Diagnostic value of BISAP and Ranson's score in predicting disease severity using different statistical parameters (sensitivity, specificity, positive predictive value, negative predictive value and accuracy).

Various statistical parameters were calculated using the data collected and with the help of data from Table 4 and Table 5 by applying appropriate statistical tests. As shown in table 6, for predicting severe acute pancreatitis, BISAP score ≥3 had a sensitivity and specificity of 95.8 %, 94.7 % with a positive likelihood ratio 18.21, negative likelihood ratio 0.04 and accuracy of 95 %. The Ranson's score had a sensitivity of 91.6 %, specificity of 89.4 %, positive likelihood ratio 8.71, negative likelihood ratio 0.09 and accuracy of 90 %.

Hence, comparison of parameters as shown in table 6 indicates that BISAP score proves to be more sensitive and specific as compared to Ranson's score in prediction of severe acute pancreatitis.

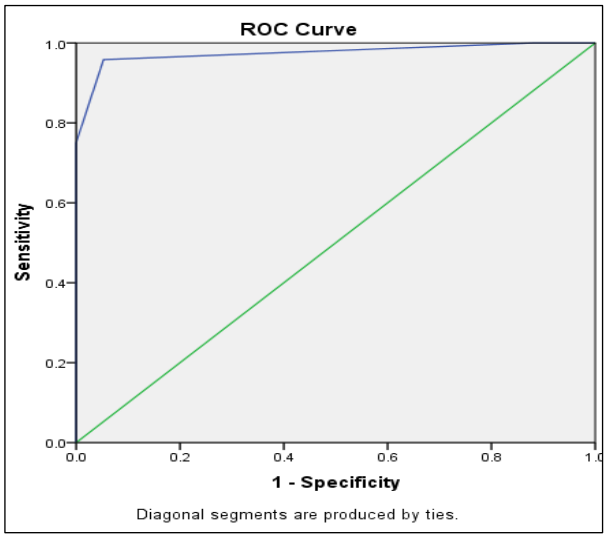

Figure 1: ROC curve for predicting SAP according to BISAP score.

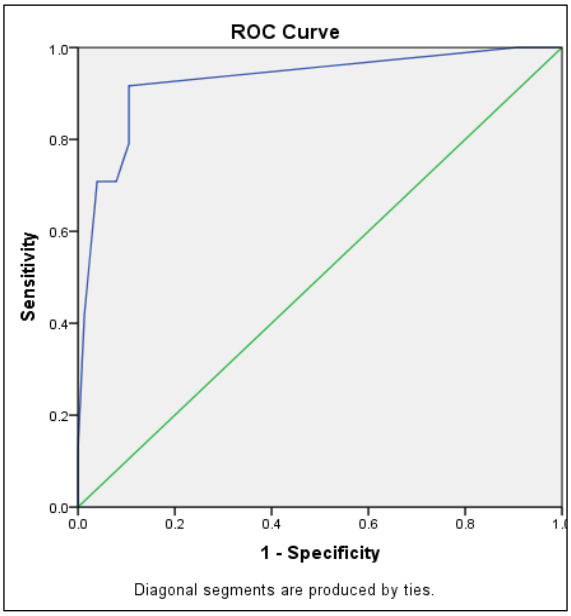

Figure 2: ROC curve for predicting SAP according to Ranson's score.

Table 6: Diagnostic value of BISAP and Ranson's score in predicting disease severity using different statistical parameters.

SAP	Sensitivity (%, 95% CI)	Specificity (%, 95% CI)	Positive likelihood ratio	Negative likelihood ratio	Accuracy (%, 95% CI)
BISAP score	95.8 (76.8-99.8)	94.7 (86.3-98.3)	18.21 (6.9-47.44)	0.04 (0.01-0.30)	95 (88.72-98.36)
Ranson's Score	91.6 (71.5-98.5)	89.4 (79.8-95)	8.71 (4.47-18.96)	0.09 (0.02-0.35)	90 (82.38-95.10)

SAP= Severe acute pancreatitis.

Figure 1 graph showing area under receiver-operator curve (ROC) for predicting severe acute pancreatitis according to BISAP score. Area under receiver-operator curve (ROC) for BISAP score in predicting severe acute pancreatitis, as shown in Figure 1, was calculated to be 0.975 with a standard error 0.022 (p=0.0001) and 95% CI 0.932 - 1.000.

Figure 2 graph showing Area under receiver-operator curve (ROC) for predicting severe acute pancreatitis according to Ranson's score. For SAP according to Ranson's score, area under Curve (AUC) as shown in figure 2, was calculated to be 0.927 with a standard error 0.034 (p=0.0001) and 95% CI 0.861-0.994.

DISCUSSION

Prediction of SAP

In our study, the severity of the disease was predicted using BISAP and Ranson's score by means of various statistical parameters. There were studies for predicting severe acute pancreatitis and a few were compared with results of our study. Lifen Chen et al in their study for predicting SAP as per the BISAP scoring demonstrated a sensitivity of 61.4% and a specificity of 83.1% whereas 64.4% and 86.4% sensitivity and specificity respectively as per the Ranson's scoring system.[21]

Table 7: For predicting SAP sensitivity, specificity, positive predictive value, negative predictive value and accuracy as calculated on the basis of BISAP and Ranson's score as suggested by our study and its comparison with the various other studies.

Severe acute pancreatitis (sap) prediction		Sensitivity (%, 95% CI)	Specificity (%, 95% CI)	Positive likelihood ratio	Negative likelihood ratio	Accuracy
Our Study	BISAP score	95.8 (76.8-99.8)	94.7 (86.3-98.3)	18.21 (6.9-47.44)	0.04 (0.01-0.30)	95% (88.72%-98.36%)
	Ranson's Score	91.6 (71.5-98.5)	89.4 (79.8-95)	8.71 (4.47-18.96)	0.09 (0.02-0.35)	90% (82.38%-95.10%)
Lifen Chen et al[21]	BISAP Score	61.4%	83.1%	-	-	-
	Ranson's Score	64.4%	86.4%	-	-	-
Wei Gao et al[22]	BISAP score	51% (43-60)	91% (89-92)	7.23 (4.21-12.42)	0.56 (0.44-0.71)	-
	Ranson's score	66% (59-60)	78% (76-81)	4.05 (2.26-7.27)	0.36 (0.22-0.60)	-
Jitin Yadav et al[23]	BISAP score	97.6% (87.4-99.6)	94.8% (87.2-98.5)	-	-	-
	Ranson's score	97.6% (87.4-99.6)	93.5% (85.4-97.8)	-	-	-

A meta- analysis done by Wei Gao and his colleagues regarding the outcome of severe acute pancreatitis, the overall sensitivity of BISAP score ≥3 was 51% (95% CI, 43-60) and specificity was 91% (95% CI, 89-92). The positive and negative likelihood ratios were 7.23 (95% CI, 4.21-12.42) and 0.56 (95% CI, 0.44-0.71) respectively.[22]

Yadav et al calculated a sensitivity of 97.6% (87.4-99.6) and specificity of 94.8% (87.2-98.5) by the BISAP score. The Ranson's score depicted a sensitivity and specificity of 97.6% (87.4-99.6) and 93.5% (85.4-97.8) respectively.[23]

Results from this study suggested higher sensitivity values of BISAP and Ranson's score in predicting SAP as compared to the other studies, as shown in table 7. The

specificity values of BISAP and Ranson's score were similar to other studies mentioned above.

There were other studies which were conducted to predict severe acute pancreatitis in different parts of the globe and the results were similar.[24-26]

Comparison of area under curve for prediction of disease severity

Our study also predicted the severity of disease by calculating the AUC (area under curve of receiver operator curve) by using BISAP (Figure 1) and Ranson's score (Figure 2) and then compared it with the established studies as shown in Table 8. Authors found that our study was able to predict SAP with high accuracy.

Table 8: Prediction of disease severity (SAP) as suggested by BISAP Score and Ranson's score on the basis of AUC and comparison with various other studies.

Disease severity prediction (SAP)		AUC (95% CI)
Our study	BISAP score	0.975 (0.932-1.000)
	Ranson's Score	0.927 (0.861-0.994)
Chen et al[21]	BISAP Score	0.762
	Ranson's Score	0.801
Gao et al[22]	BISAP Score	0.87 (0.81-0.93)
	Ranson's Score	0.83 (0.75-0.91)
Yadav et al[23]	BISAP Score	0.962 (0.923-1.002)
	Ranson's Score	0.956 (0.914-0.998)

CONCLUSION

BISAP score, outperformed Ranson's score in terms of Sensitivity and specificity of prediction of severe pancreatitis.

Parameters included in BISAP score are easy to obtain, and are usually routinely measured at the time of admission, or within first 24 hours.

The authors recommend incorporating the BISAP score into day-to-day clinical practice. This would enable early detection of cases likely to progress to severe pancreatitis. Such patients would then merit early initiation of effective treatment including adequate fluid resuscitation, timely intensive care, early organ support, appropriate antibiotic administration and need for surgical intervention. This may help reduce the incidence of complications and will improve outcome.

Limitations of the study were smaller sample size and limited information regarding initial versus recurrent episode of acute pancreatitis.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. British Society of Gastroenterology. United Kingdom guidelines for the management of acute pancreatitis. Gut. 1998;42(2):1-13.
2. Dervenis C, Johnson CD, Bassi CA, Bradley E, Imrie CW, McMahon MJ, et al. Diagnosis, objective assessment of severity,and management of acute pancreatitis. Santorini consensus conference. Int J Pancreatol. 1999;25:195-210.
3. Wig JD, Bharathy KG, Kochhar R, Yadav TD, Kudari AK, Doley RP, et al. Correlates of organ failure in severe acute pancreatitis. JOP. 2009;10:271-5.
4. Gloor B, Müller CA, Worni M, Martignoni ME, Uhl W, Büchler MW. Late mortality in patients with severe acute pancreatitis. Br J Surg Society. 2001;88(7):975-9.
5. Working Group IAP/APA Acute Pancreatitis Guidelines. IAP/APA evidence-based guidelines for the management of acute pancreatitis. Pancreatology. 2013;13(4):1-15.
6. Fagenholz PJ, Fernández-Del Castillo C, Harris NS, Pelletier AJ, Camargo Jr CA. Increasing United States hospital admissions for acute pancreatitis,1988-2003. Ann Epidermiol. 2007;17:491-7.
7. Banks PA, Freeman ML, Practice guidelines in acute pancreatitis. Am J Gastroenterol. 2006;101:2379-400.
8. Ranson JHC, Rifkind KM, Roses DF, SD F. Prognostic signs and the role of Operative management in acute pancreatitis. Surg Gynecol Obstet. 1974;139:69-81.
9. Ranson JHC. Etiological and prognostic factors in human acute pancreatitis: A review. Am J Gastroenterol.1982:77:633.
10. Yeung YP, Lam BY, Yip AW. APACHE system is better than Ranson system in the prediction of severity of acute pancreatitis. Hepatobiliarypancreat Dis Int. 2006;5:294-9.
11. Knaus WA, Draper EA, Wagner DP, Zimmerman JE. APACHE II: a severity of disease classification system, Critical Care Med. 1985;13(10):818-29.
12. Taylor SL, Morgan DL, Denson KD, Lane MM, L. Pennington R. A comparison of the Ranson, Glasgow, and APACHE II scoring systems to a multiple organ system score in predicting patient outcome in pancreatitis, Am J Surg. 2005;189(2):219-22.
13. Thoeni RF. The revised Atlanta classification of acute pancreatitis: its importance for the radiologist and its effect on treatment. Radiology. 2012;262(3):751-64.

14. Banks PA, Bollen TL, Dervenis C, Gooszen HG, Johnson CD, Sarr MG, et al. Classification of acute pancreatitis 2012: revision of the Atlanta classification and definitions by international consensus. Gut. 2013;62(1):102-11.
15. Choi JH, Kim MH, Oh D, Paik WH, Park DH, Lee SS, et al. Clinical relevance of the revised Atlanta classification focusing on severity stratification system. Pancreatology. 2014;14:324-9.
16. Bollen T L. Imaging of acute pancreatitis: update of the revised Atlanta classification. Radiol Clin North Am. 2012;50(3):429-45.
17. Sheu Y, Furlan A, Almusa O, Papachristou G, Bae KT. The revised Atlanta classification for acute pancreatitis: a CT imaging guide for radiologists. Emerg Radiol 2012;19(3):237-43.
18. Zaheer A, Singh VK, Qureshi RO, Fishman EK. The revised Atlanta Classification for acute pancreatitis: Updates in imaging terminology and guidelines. Abdom Imaging. 2013;38:125-36.
19. Manrai M, Kochhar R, Thandassery RB, Alfadda AA, Sinha SK. The Revised Atlanta Classification of Acute Pancreatitis: A Work Still in Progress? JOP. 2015;16:356-64.
20. Wu BU, Johannes RS, Sun X, Tabak Y, Conwell DL, Banks PA. The early prediction of mortality in acute pancreatitis: a large population-based study. Gut. 2008;57(12):1698-703.
21. Chen L, Lu G, Zhou Q, Zhan Q. Evaluation of the BISAP score in predicting severity and prognoses of acute pancreatitis in Chinese patients. Inte Surg. 2013;98(1):6-12.
22. Gao W, Yang HX, Ma CE. The value of BISAP score for predicting mortality and severity in acute pancreatitis: a systematic review and meta-analysis. PloS one. 2015;10(6).
23. Yadav J, Yadav SK, Kumar S, Baxla RG, Sinha DK, Bodra P, et al. Predicting morbidity and mortality in acute pancreatitis in an Indian population: a comparative study of the BISAP score, Ranson's score and CT severity index. Gastroenterol Report. 2016;4(3):216-20.
24. Kaya E, Dervişoğlu A, Polat C. Evaluation of diagnostic findings and scoring systems in outcome prediction in acute pancreatitis. World J Gastroenterol. WJG. 2007;13(22):3090.
25. Papachristou GI, Muddana V, Yadav D, O'Connell M, Sanders MK, Slivka A, et al, Comparison of BISAP, Ranson's, APACHE-II and CTSI scores in predicting organ failure, complications and mortality in acute pancreatitis, Am J Gastroenterol. 2010;105(2):435-41.
26. Bhopal FG, Azhar F, Mahmood S, Mehmood N, Iqbal M. Validity of Ranson's Criteria in Acute Pancreatitis. J Rawalpindi Med Col. 2011;15(2):84-7.

Cite this article as: Aggarwal A, Mathur AV, Verma RK, Gupta M, Raj D. Comparison of BISAP and Ranson's score for predicting severe acute pancreatitis and establish the validity of BISAP score. Int Surg J 2020;7:1473-80.