A Comparative Study between Bedside Index for Severity in Acute Pancreatitis (BISAP) and Acute Physiology and Chronic Health Evaluation (APACHE-II) Scoring System in Assessing the Severity of Acute Pancreatitis at Bangalore Medical College and Research Institute, Bangalore, India

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ABSTRACT

BACKGROUND

Acute pancreatitis (AP) is an inflammatory disease of the pancreas, that results from intrapancreatic activation, release, and digestion of the organ by its own enzymes. The diagnosis of acute pancreatitis can be made when a patient presents with threefold elevated serum levels of amylase or lipase, abdominal pain and vomiting. In this study, we wanted to assess the severity of acute pancreatitis by using BISAP (Bedside index for severity in acute pancreatitis) and APACHE-II (Acute physiology and chronic health evaluation) scoring systems and compare the accuracy of BISAP scores with APACHE-II scores.

METHODS

A prospective study including 201 patients was conducted from April 2018 to March 2020 in Victoria Hospital, affiliated to BMCRI.

RESULTS

Among 201 AP patients, 129 were found to have mild acute pancreatitis (MAP), 72 were of severe acute pancreatitis (SAP), 192 survival cases, and 9 death cases. The larger the rating score, the higher the proportion of severe pancreatitis and mortality risk. Two kinds of scoring criteria; BISAP score points and Apache II score points compared in patients with MAP and SAP, In Apache II score to predict severity of organ failure, the sensitivity, specificity, positive predictive value, negative predictive value was 84.72 %, 93.02 %, 87.14 %, 91.60 % and area under the curve was 0.958 ($P < 0.0001$). In BISAP, the sensitivity, specificity, positive predictive value, negative predictive value was 90.28 %, 80.62 %, 72.22 %, 93.69 % and area under the curve was 0.917 ($P < 0.0001$).

CONCLUSIONS

Ability of APACHE II score prediction of AP in severity of organ failure and mortality are stronger than BISAP score, But APACHE II scoring system indicators were cumbersome, complicated assessment. BISAP scoring system is simple, economical, rapid and reliable, and it can effectively predict the severity and mortality of acute pancreatitis, and can be used as a preliminary screening method in accurate risk stratification and initiation of management accordingly at community health care, secondary health care and tertiary health care Hospitals.

KEYWORDS

Pancreatitis, Severity, Prediction, APACHE II and BISAP

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BACKGROUND

Acute pancreatitis is an inflammatory disease of the pancreas that results from intrapancreatic activation, release and digestion of the organ by its own enzymes.[1] The diagnosis of acute pancreatitis can be made when a patient presents with threefold elevated serum levels of amylase or lipase, abdominal pain, and vomiting. Although in 75 % to 80 % of cases, acute pancreatitis is a mild disease, 20 % to 25 % of patients are likely to develop a severe form of the disease and may benefit from early intensive care monitoring and treatment.[2] The causes of acute pancreatitis include gall stones, alcohol ingestion, post-ERCP (endoscopic retrograde cholangiopancreatography) status, hypertriglyceridemia, hypercalcemia, drugs, sphincter of Oddi dysfunction, abdominal trauma, pancreatic neoplasms, pancreatic divisum and others. In approximately 20 % of the patients however, the cause is unknown. Management of this disease is mainly conservative and usually includes resuscitation with intravenous fluids, adequate analgesia, nasogastric tube drainage in selected cases, enteral feeding or parenteral hyper alimentation depending on severity of the disease, antibiotics in severe disease and ERCP in selected cases.

Surgery has a role only in the management of complications of the disease such as infected necrosis.[3] A prediction of the course and outcome of the disease is needed most when a patient comes in to the emergency room, but it is often rather difficult to make such a prediction. For example, although enzymatic activity of serum amylase and lipase are used to diagnose pancreatitis, they are not helpful in determining disease severity.[4]

Various scoring systems include Ranson score, acute physiology, and chronic health evaluation (APACHE), and computed tomography severity index (CTSI). The main limitation of the Ranson score is that it cannot be completed until 48 hours following admission. APACHE allows determination of disease severity on the day of admission, but complexity is its major drawback. CTSI is calculated based on CT findings and cannot reflect the systemic inflammatory response.[5]

The prognosis of acute pancreatitis (AP) depends on its severity, which was classified as mild, moderate, or severe by the latest revised Atlanta classification.[6] Most patients present with mild or moderate acute pancreatitis, and only 15 – 20 % of patients have severe AP (SAP). Notably, the mortality of mild or moderate AP is far less than that of SAP. The mortality is approximately 1 % among all AP patients, but reaching as high as 20 % to 30 % among those with severe course. It is of clinical significance to identify the patients most likely to develop SAP after admission, which will assist triage and the initiation of aggressive early treatment.[7] A series of severity scoring systems have been developed for the early detection of SAP. Currently, the Ranson criteria and the APACHE II system are most widely used in clinical practice.[8] However, they are very cumbersome and complex for quick evaluation. In 2008, the BISAP score was proposed for the early recognition of patients at risk of mortality. This 5-point scoring system is comprised of five variables: blood urea nitrogen level > 25 mg/dl, impaired mental status, development of systemic inflammatory response syndrome (SIRS), age > 60 years, and presence of pleural effusion.[9] Compared with traditional scoring systems, BISAP is more convenient to use with fewer items. Several studies have been conducted to validate the BISAP score. However, they differed in many aspects, such as population, cut-offs, and clinical endpoints, which result in a broad range of predictive accuracy. Thus, we conducted this study to compare the accuracy of BISAP and APACHE-II scoring systems in assessing severity of acute pancreatitis.[10]

The severity of acute pancreatitis varies from mild uncomplicated disease to critical disease associated with both local and systemic complications. It is important to determine the severity of acute pancreatitis in the individual patient for triage, treatment and prognosis. Since 1992, when the International symposium on acute pancreatitis in Atlanta published its consensus, it has become customary to define the severity of acute pancreatitis as either mild or severe.[11] Acute pancreatitis is severe when it is associated with local or systemic complications. A large body of evidence now demonstrates that the two key determinants of severity in acute pancreatitis are organ failure absent, transient, or persistent—and pancreatic complications absent, non-infectious, or infectious. Determinants-based classification of the severity of acute pancreatitis appears to be more useful for the clinical assessment of severity in individual patients and for comparing groups of patients.[12]

Objectives

1. To assess the severity of acute pancreatitis by using BISAP and APACHE-II scoring systems.
2. To compare the accuracy of BISAP scores with APACHE-II scores.

METHODS

A prospective study was conducted in Victoria Hospital and Bowring and Lady Curzon Hospital, affiliated to Bangalore Medical College and Research Institute, Bangalore, from April 2019 to May 2020. The study was approved by the Institutional Ethical Review Board. Written informed consent was obtained from each study subject at the time of enrolment.

Sample Size Estimation

Sample size of estimation: Based on previous study by Ajay K. Khanna et al.[1] about 44.4 % of the patient had score size

The sample size calculation is
N = 4PQ/d2 where P = proportion = 44.4 % Q = 100 – P = 55.6 d = precision = 7
$n = 4 \times 44.4 \times 55.6 / (7)^2$
Sample size (n) = 201

The APACHE II Score

Physiologic Variable	High Abnormal Range					Low Abnormal Range			
	+4	+3	+2	+1	0	+1	+2	+3	+4
Rectal Temp (°C)	≥41	39-40.9		38.5-38.9	36-38.4	34-35.9	32-33.9	30-31.9	≤29.9
Mean Arterial Pressure (mmHg)	≥160	130-159	110-129		70-109		50-69		≤49
Heart Rate	≥100	140-179	110-139		70-109		50-69	40-54	≤39
Respiratory Rate	≥50	35-49		25-34	12-24	10-11	6-9		≤5
Oxygenatation a)FIO_2≥0.5 record A-aDO_2 b)FIO_2<0.5 record PaO_2	≥500	350-499	200-349		<200 PO_2>70	PO_2 61-70		PO_2 55-60	PO_2<55
Arterial pH	≥7.7	7.6-7.69		7.5-7.59	7.33-7.49		7.25-7.32	7.15-7.24	<7.15
HCO_3 (mEq/l)	≥52	41-51.9		32-40.9	22-31.9		18-21.9	15-17.9	<15
K (mEq/l)	≥7	6-6.9		5.5-5.9	3.5-5.4	3-3.4	2.5-2.9		<2.5
Na (mEq/l)	≥100	160-179	155-159	150-154	130-149		120-129	111-119	≤110
S. Creat (mqm/dl)	≥3.5	2-3.4	1.5-1.9		0.6-1.4		<0.6		
Hematocrit (%)	≥60		50-59.9	46-49.9	30.45.9		20-29.9		<20
TLC (10^3/cc)	≥40		20-39.9	15-19.9	3-14.9		1-2.9		<1
GCS									

Age -score
<44 → 0
45-54 → 2
55-64 → 3
65-74 → 5
≥75 → 6

GCS:		
15 → 0	14 → 1	13 → 2
12 → 3	11 → 4	10 → 5
9 → 6	8 → 7	7 → 8
6 → 9	5 → 10	4 → 11
3 → 12		

JAMA 1993;270(24):2957-2963

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The Apache II Score

BISAP score

BUN	• BUN >25 mg/dL (8.9 mmol/L) (1 point)
Impaired mental status	• Abnormal mental status with a Glasgow coma score <15 (1 point)
SIRS	• Evidence of SIRS (systemic inflammatory response syndrome) (1 point)
Age	• age >60 years old (1 point)
Pleural effusion	• Imaging study reveals pleural effusion (1 point)

0-2 Points: Lower mortality (<2 percent)

3-5 Points: Higher mortality (>15 percent

BISAP Score

Inclusion Criteria

The study is conducted in all patient's above 18 years presenting with abdominal pain consistent with acute pancreatitis - acute onset of a persistent, severe, epigastric pain often radiating to the back; elevated serum amylase and/or lipase levels at least three times greater than the upper limit of normal; and characteristic finding of acute pancreatitis on radiological investigations**.** Severe AP was defined as the persistence of single or multiple organ failure for more than 48 hours as per Atlanta, 2012 classification.

Exclusion criteria

Patients below the age of 18 years and in patients diagnosed to have pancreatic carcinoma.

Methods of Data Collection

After admission, data was collected by history taking, meticulous physical examination, and appropriate blood/laboratory and radiological investigations.

Investigations that were used for the study to access the severity of attack:

1. Complete hemogram
2. Serum electrolytes
3. Renal function test
4. Liver function test
5. PT-INR
6. HBsAg
7. HCV test
8. HIV antibodies
9. Blood culture
10. Serum Amylase
11. Serum Lipase
12. Serum Calcium
13. Ultrasound of the abdomen
14. Arterial Blood Gas analysis
15. CECT abdomen
16. ECG
17. Chest X-ray PA view

Gold standard investigation was CECT abdomen and pelvis.

Statistical Analysis

Data that showed normal distribution was analyzed using independent student t-test for comparison of methods. Results on continuous measurements are presented on Mean ± SD (Min-Max) and results on categorical measurements are presented in number (%). The statistical software namely Statistical Package for Social Sciences (SPSS 20.0) was used for the analysis of the data. Chi-square/Fisher's exact test has been used to find the significance of study parameters on categorical scale between two or more groups. The area under the receiver-operating curve (AUC) was calculated using XLSTAT, 2016 (Addinsoft SARL). Sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) were calculated based on Youden index.

RESULTS

Age in Years	18 - 30	31 - 40	41 - 50	51 - 60	61 - 70	71 - 80	Total
Frequency	0	8	18	13	6	5	50
Percentage	0	16	36	26	12	10	100

Table 1. Age Distribution

Mean age was 39.04 years. Most of them belonged to the age group of 31 - 40 years followed by 41 - 50 years. In our study, 183 (91 %) were male and 18 (9 %) were female.

Symptoms	Frequency	Percentage
Pain abdomen	201	100 %
Vomiting	155	77.1 %

Table 2. Symptomology

In our study, all patients of acute pancreatitis had pain abdomen (100 %), while (77.11) patients had vomiting.

Habits	Frequency	Percentage
Alcohol	98	48.75
Smoking	86	42.78

Table 3. Habitual Distribution in Patients

In our study, 48.75 % patients were consuming alcohol and 42.78 % patients were smokers. In our study, 19.40 % patients were diabetic, 11.44 % patients were hypertensive, 8.45 % patients were obese, and 3.98 % had ischemic heart disease.

Severity Analysis

Atlanta Criteria AP	Frequency	Percentage
Severe	72	34.82 %
Mild	129	64.17 %
APACHE II score	**Frequency**	**Percentage**
Severe	61	30.34
Mild	140	69.65
BISAP score	**Frequency**	**Percentage**
Severe	65	32.33
Mild	136	67.66

Table 4. Severe Acute Pancreatitis (SAP) Defined as Per Scores

35.82 % patients were SAP as per Atlanta's criteria, 30.34 % patients were SAP as per APACHE II score, and 32.33 % were SAP as per BISAP score in the study.

Mortality Analysis

Mortality	Frequency	Percentage
Improved	192	95.52 %
Death	9	4.47 %
Total	**201**	**100**

Table 5. Mortality Analysis in Acute Pancreatitis Patients

In our study, 192 (95.52 %) patients with AP improved, and 9 (4.47 %) patients died. In Apache II score =/> 8 was used to predict severity, the sensitivity, specificity, positive predictive value, negative predictive value was 84.72 %, 93.02 %, 87.14 %, 91.60 % and area under the curve was 0.958 (P < 0.0001). In BISAP score =/> 2 was used to predict severity, the sensitivity, specificity, positive

predictive value, negative predictive value was 90.28 %, 80.62 %, 72.22 %, 93.69 % and area under the curve was 0.917 (P < 0.0001).

Grading	AUC Area	95% CI	Youden Index	Cut Off Point	Sensitivity	Specificity	PPV	NPV
Apache II	0.958	0.935-0.982	0.948	8	84.72%	93.02%	87.14%	91.60%
BISAP	0.917	0.880-0.954	0.870	2	90.28%	80.62%	72.22%	93.69%

Table 6. BISAP and APACHE II Score of AP to Compare the Predictive Power of Organ Failure

Grading	AUC AREA	95% CI	Youden Index	Cut off Point	Sensitivity	Specificity	PPV	NPV
Apache II	0.980	0.962-0.999	0.948	8	100.0%	94.79%	47.37%	100.0%
BISAP	0.985	0.965-1.000	0.870	3	100.0%	81.38%	26.47%	100.0%

Table 7. Mortality Prediction of BISAP and APACHE II Grading in AP

When a score of =/> 8 was used to predict mortality in APACHE II 9 (4.47 %) died. The sensitivity, specificity, positive predictive value, negative predictive value was 100 %, 94.79 %, 47.37 %, 100 % and area under the curve was 0.980 (P < 0.0001).

When a score of =/> 3 was used to predict mortality in BISAP 9 (4.47 %) died. The sensitivity, specificity, positive predictive value, negative predictive value was 100 %, 81.38 %, 26.47 %, 100 % and area under the curve was 0.985 (P < 0.0001).

DISCUSSION

In this prospective study, 201 patients with acute pancreatitis were enrolled, after admission; data was collected by history taking, meticulous physical examination, and appropriate blood/laboratory and radiological investigations. Comparison of severity of AP respectively BISAP score and APACHE II score, two scoring systems are compared by operating characteristic curve (ROC Curve), calculated by the area under the curve (AUC) in AP, and the ability to predict the severity and prognosis. Among 201 AP patients, 129 were found to have mild acute pancreatitis, 72 were of severe acute pancreatitis, 192 survival cases, and 9 deaths. The larger the rating score, the higher the proportion of severe pancreatitis and mortality risk. Two kinds of scoring criteria; BISAP score points and APASCHE II score points compared in patients with MAP and SAP, In APACHE II score to predict severity of organ failure, the sensitivity, specificity, positive predictive value, negative predictive value was 84.72 %, 93.02 %, 87.14 %, 91.60 % and area under the curve was 0.958 (P < 0.0001). In BISAP, the sensitivity, specificity, positive predictive value, negative predictive value was 90.28 %, 80.62 %, 72.22 %, 93.69 % and area under the curve was 0.917 (P < 0.0001). When a score used to predict mortality in APACHE II, the sensitivity, specificity, positive predictive value, negative predictive value was 100 %, 94.79 %, 47.37 %, 100 % and area under the curve was 0.980 (P < 0.0001). In BISAP, the sensitivity, specificity, positive predictive value, negative predictive value was 100 %, 81.38 %, 26.47 %, 100 % and area under the curve was 0.985 (P < 0.0001).

In many ways, traditional Ranson Score, acute physiology and chronic health evaluation II (APACHE II), Balthazar CT severity index (CTSI) and so on, in 2008 just raised the severity of acute pancreatitis, Bedside index for severity in acute pancreatitis (BISAP). APACHE II grading 1981 in a medical centre of Washington University research group Knaus et al.[7] came up with APACHE original score type, including a hospital within 32 hours 34 term acute physiological, mainly used intensive care unit (ICU) patients severity and prognosis assessment.[13]

Because the parameters are too cumbersome, difficult clinical operations, in 1985 its revised, reduced to monitoring indicators 15 items (including acute physiological indicators 12 item, the age factor, Glasgow coma scale and chronic health evaluation, all quantify, become APACHE II grading7. APACHE II scoring criteria, be able to fully evaluate the general condition of the patient. The system is used to assess the severity of the disease, strengthen the monitoring of critically ill patients, because of APACHE II score AP changes in prognosis has a special advantage, increasingly widely used in AP patient, if scores are higher, the more severe the disease, the worse the prognosis, the higher the incidence of organ failure and death. In 1992 Atlanta conference with APACHE II as a diagnostic points for SAP forecast the sensitivity, specificity, positive predictive value and negative predictive value measures to 65 %,76 %,43 % with 89 %.[14,15] APACHE II score prediction AP sensitivity to mortality in patients with an average of 65 % - 81 %, The specificity was 77 % - 91 %, positive predictive value 23 % - 69 % and negative predictive value 86 % - 99 %, can better forecasting mortality of the patient in AP.[16,17]

According to a study by Papachritou et al. the number of patients with a BISAP score of > or = 3 was 26; Ranson's> or = 3 was 47, APACHE-II > or = 8 was 66, and CTSI > or = 3 was 59. Of the seven patients that died, AUCs for BISAP, Ranson's, APACHE-II, and CTSI in predicting SAP are 0.81 (confidence interval (CI) 0.74 - 0.87), 0.94 (CI 0.89 - 0.97), 0.78 (CI 0.71 - 0.84), and 0.84 (CI 0.76 - 0.89), respectively. APACHE II grading within 24-hour admission results can be obtained rapidly, continuous observation of the dynamic changes in their scores, contribute to a more accurate assessment of prognosis. Studies have shown that there is evidence-based, APACHE II score in predicting organ dysfunction, better sensitivity and specificity highest.[18,19]

Lo Yi-wave et al. 10 research indicates that dynamic APACHE II rating assessment of the severity is reliable, guide clinical treatment, is the most effective and most widely used rating for AP the degree of clinical score directly relates to the patient's condition severity, but APACHE II scoring system range indicators cumbersome, complicated assessment.[20,21] Difficult to complete the indicators, need some equipment conditions, poor clinical feasibility, limited its application in clinical practice, more used in scientific

research and clinical trials; long-term health and medical history evaluation section requires patient treatment process known in detail, the subject of evolution, pancreas damage, significant local complications related parameters have not been involved, cannot fully reflect the pancreas Local lesions.[22,23] In recent years, obesity is considered the factors leading to AP increase the severity of risk factors.

BISAP grading system

BISAP Harvard University scholar ratings Bu Wu et al.[14] against AP the prognosis and treatment outcome in year 2000 - 2001, 212 Hospitals 17992 AP patients were studied. By 2004, In year 2005, 177 hospitals of 18256 AP clinical data to validate the severity and accuracy of the prediction of proposed mortality. A traditional scoring method timeliness poor, the new scoring system is less complicated in predicting severe acute pancreatitis.[24,25]

In a study by Zhang J et al. there were statistically significant trends for increasing severity ($P < 0.001$), PNec ($P < 0.001$) and mortality ($P < 0.001$) with increasing BISAP. The AUC for severity predicted by BISAP was 0.793 (95 % confidence interval [CI] 0.700 - 0.886), APACHE II 0.836 (95 % CI 0.744 - 0.928) and by Ranson score was 0.903 (95 % CI 0.814 - 0.992). The AUC for PNec predicted by BISAP was 0.834 (9 5% CI 0.739 - 0.929), APACHE II 0.801 (95 % CI 0.691 - 0.910) and by Ranson score was 0.840 (95 % CI 0.741 - 0.939). The AUC for mortality predicted by BISAP was 0.791 (95 % CI 0.593 - 0.989), APACHE II 0.812 (95 % CI 0.717 - 0.906) and by Ranson score was 0.904 (95 % CI 0.829 - 0.979).[26]

Singh v. k et al. found in study, BISAP scoring system in predicting SAP mortality sensitivity, specificity, positive predictive value, negative predictive value was 73 %, 92 %, 57 % with 84 %.[27] Prediction of mortality in AP sensitivity, specificity, positive predictive value and negative predictive value were 71 %, 83 %, 17.5 % with 99 %.[28]

Papachristou et al. study confirms BISAP score mortality forecast in AP accuracy with the traditional APACHE II and Ranson scoring system was not statistically significant difference, the operation is simple, readily available indicators, the calculation is simple, high accuracy, easy to remember, comprehensive evaluation index of vital signs, laboratory tests, imaging findings, and less subjective indicators, predictable within 24 hours of AP. The severity and risk of death, can dynamically observe the patient's condition changes.[29,30]

CONCLUSIONS

Acute pancreatitis is one of the commonest condition encountered in day to day practice. In early prediction of severity and prognosis of acute pancreatitis, comparison between BISAP score and APACHE II score was used. There are significant differences in scoring pattern; higher the score, more severe the disease, the higher the organ failure and mortality. Ability of APACHE II score prediction of AP in severity of organ failure and mortality are stronger than BISAP score, But APACHE II scoring system indicators were cumbersome complicated assessment. BISAP scoring system is simple, economical, rapid and reliable, and it can effectively predict the severity and mortality of acute pancreatitis, and can be used as a preliminary screening method in accurate risk stratification and initiation of management accordingly at community health care, secondary health care and tertiary health care hospitals. A brief introduction and historical review of acute pancreatitis has been presented with a detailed review on surgical anatomy, physiology, pathology, clinical evaluation and investigations including fine needle aspiration cytology (FNAC) and management.

Data sharing statement provided by the authors is available with the full text of this article at jebmh.com.
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