A Comparative Study of Different Predictive Severity Scoring Systems for Acute Pancreatitis in Relation To Outcome – A Prospective Study

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Abstract: *Acute Pancreatitis is the most terrible of all the calamities that occur in connection with the abdominal viscera. The suddenness of its onset, the illimitable agony which accompanies it, and the mortality attendant upon it, all render it most formidable of catastrophes." -**Berkeley Moynihan**(1865-1936) Atlanta classification stratified acute pancreatitis into three groups (i) Mild acute pancreatitis which comprised of no organ failure and no local or systemic complication, (ii) Moderately severe acute pancreatitis with organ failure that resolves within 48 hrs (transient organ failure) and local or systemic complication without persistent organ failure, and (iii) Severe acute pancreatitis with persistent organ failure ,single organ failure or multiple organ failure . A comparative prospective study was done at R.I.M.S., Ranchi from the period Jan 2018 to Jun 2018 comprising 30 patients who were admitted and diagnosed as a case of acute pancreatitis. All adult patients whose details were available according to the study protocol and acute pancreatitis was proven by Contrast Enhanced Computed Tomography (CECT) of abdomen, were included in the study. Ranson's criteria , Acute Physiology and Chronic Health Evaluation[APACHE]II, Balthazar Computed Tomography Severity Index (CTSI) and Goris Multi Organ Failure score were compared in terms of their ability to accurately predict the severity of Acute Pancreatitis and it was found out which severity scoring system is the best in predicting the severity in a case of acute pancreatitis in our set up. At the selected cut-off score, each predictive system was evaluated for significant relationship to the severity of acute pancreatitisS. Sensitivity, specificity, positive and negative predictive values, positive and negative likely hood ratios (LR+ and LR) and AUC under the ROC for all the scoring systems were determined using Epi -6 statistical software and statistical package SPSS Inc., PASW statistic 18. It was concluded that all the scores under study had good predictive value in terms of different predictive accuracy parameters APACHE II and Goris MOF(at cut off>0) are useful for prediction of severe cases, whereas CTSI and Ranson's score can be most useful to identify those who are not likely to be severe later on .*

I.   Introduction

Acute Pancreatitis is the most terrible of all the calamities that occur in connection with the abdominal viscera. The suddenness of its onset, the illimitable agony which accompanies it, and the mortality attendant upon it, all render it most formidable of catastrophes". [1]

Acute Pancreatitis is currently defined as pancreatic inflammation that may be followed by clinical and biological restitution of the gland, if the primary cause is eliminated. It includes a wide spectrum of clinical illness that ranges from mild self-limited symptoms to rapid deterioration and death.[2]

As per proceedings of an international symposium held in Atlanta, Georgia, in September 1992 severe acute pancreatitis was defined as the presence of organ failure (particularly shock, pulmonary insufficiency, and renal failure) and/or local complications (especially pancreatic necrosis, abscess or pseudo cyst) complemented by the presence of unfavorable prognostic signs (Ranson's criteria $\geq$3 or Acute Physiology and Chronic Health Evaluation [APACHE] II score $\geq$ 8). [3]

correct

The incidence of acute pancreatitis varies in different centres and depends upon etiologic factors. Approximately 80% of patients either have gallstones or history of sustained alcohol abuse.[4] Malnutrition, independent of alcohol abuse, is a factor for pancreatitis and males are affected more than females in third world countries.[5]

NEED FOR STUDY

Prior assessment of severity is one of the most important issues in the management of acute pancreatitis. It allows the managing physician to identify those patients who are most likely to have a severe episode, to transfer them to an intensive care unit for closer supervision and early administration of therapies to reduce severity. A variety of predictive systems have been developed with the goal of assisting clinicians in predicting prognosis. However, there is no highly sensitive and specific test or severity scoring system exists that can accurately measure prognosis at admission and a lack of consensus still prevails as to which severity scoring system is the best predictor of prognosis and final outcome in a case of acute pancreatitis.The purpose of present study is therefore, to compare the predictive efficacy of severity and outcome amongst 04 different severity scoring systems for acute pancreatitis, namely Ranson's criteria, Acute Physiology and Chronic Health Evaluation [APACHE] II, Balthazar CT Severity Index and Organ Failure scale in our set up.

II. Aim And Objective

1.To compare Ranson's criteria , Acute Physiology and Chronic Health Evaluation[APACHE]II, Balthazar Computed Tomography Severity Index (CTSI) and Goris Multi Organ Failure score in terms of their ability to accurately predict the severity of Acute Pancreatitis.

2. To find out which severity scoring system is the best in predicting the severity in a case of acute pancreatitis in our set up.

RANSON'S SCORE:- Morbidity and mortality rates correlate with the obtained score as follows:

0- 2 = 2% mortality

3- 4 = 15% mortality

5- 6 = 40% mortality

7- 8 = 100% mortality

ADMISSION	INITIAL 48 HOURS
Gallstone Pancreatitis	
Age > 70 yr	Hct fall >10
WBC >18,000/mm^3	BUN elevation >2 mg/100 mL
Glucose > 220 mg/100 mL	Ca^{2+} <8 mg/100 mL
LDH >400 IU/L	Base deficit >5 mEq/L
AST >250U/100 mL	Fluid sequestration >4 L
Nongallstone Pancreatitis	
Age >55 yr	Hct fall >10
WBC >16,000/mm^3	BUN elevation >5 mg/100 mL
Glucose >200 mg/100 mL	Ca^{2+} <8 mg/100 mL
LDH >350 IU/L	Pao$_2$ <55 mm Hg
AST >250U/100 mL	Base deficit >4 mEq/L
	Fluid sequestration >6 L

APACHE2

Acute Physiology and Chronic Health Evaluation [APACHE]II scores is used to classify patients in the intensive care unit at admission, at 24 hours, and at 48 hours. Patients are evaluated by physiologic scores and evaluation of chronic health status. Each variable is assigned a value of 0 to 4, with more severe deviations given higher values. Physiologic scores correlate with severity of illness.

APACHE II Score = (acute physiology score) + (age points) + (chronic health points)

Acute physiological score

Points \ Criterias	+4	+3	+2	+1	0	+1	+2	+3	+4
Rectal temp(^{0}C)	>41	39 - 40.9		38 - 38.9	36 - 38.4	34 - 35.9	32- 33.9	30- 31.9	<29.9
MAP (mmHg)	>160	130 - 159	110 -129		70 - 109		50 - 69		<49
Heart rate(bpm)	>180	140 - 179	110 -139		70 - 109		55 - 69	40 - 54	<39
Resp rate(bpm)	>50	35 - 49		25 - 34	12 - 24	10 - 11	6-9		<5
O$_2$ delivery (ml/min)	>500	350 - 499	200 -349		<200				
P$_a$O2 (mmHg)					>70	61- 70		55 - 60	<55
Arterial pH	>7.7	7.6 - 7.69		7.5- 7.59	7.3- 7.49		7.25 -7.3	7.15 -7.2	<7.15
Serum Na$^+$ (mmol/L)	>180	160- 179	155- 159	150- 154	130- 149		120- 129	111- 119	<110
Serum K$^+$ (mmol/L)	>7	6-6.9		5.5- 5.9	3.5- 5.4	3- 3.4	2.5- 2.9		<2.5
S.Creatinine (mg/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
WBC count (10^3/ml)	>40		20 - 39.9	15 - 19.9	3 - 14.9		1- 2.9		<1

Age Points

Age	<44	45-54	55-64	65-74	>75
Points	0	2	3	5	6

Chronic Health Point

History of Severe Organ Insufficiency	Points
Nonoperative patients	5
Emergency postoperative patients	5
Elective postoperative patients	2
No h/o organ insufficiency	0

APACHE II Score = (acute physiology score) + (age points) + (chronic health points)

Balthazar CT Score

Grade	CT findings
A	Normal
B	Focal or diffuse enlargement of the pancreas, including irregularities of contour and inhomogeneous attenuation
C	Pancreatic gland abnormalities in grade B plus peripancreatic inflammation
D	Grade C plus a single fluid collection
E	Grade C plus 2 or more fluid collections and/or the presence of gas in or adjacent to the pancreas

CT grade	Assigned score	Percent necrosis	Assigned score
A	0	None	0
B	1	<30	2
C	2	30–50	4
D	3	>50	6
E	4		

Organ failure scale

a. Dopamine hydrochloride ≤10 µg/kg/min, or nitroglycerin of ≤20 µg/kg/min, or volume loading

b. Dopamine hydrochloride >10 µg/kg/min, and/or nitroglycerin of >20 µg/kg/min

	Normal organ function 0 point	Organ dysfunction 1 point	Organ failure 2 points
Lung	No mechanical ventilation	Mechanical ventilation with PEEP≤10 and FiO_2≤0.4	Mechanical ventilation with PEEP >10 or FiO_2 >0.4
Heart	Normal Systolic BP	Systolic BP≥100 mmHg with low dose of vasoactive drugs [a]	Periods with Systolic BP <100 mmHg and/or high dose of vasoactive drugs[b]
Kidney	Serum creatinine <2 mg/dl (<150 µmol/l)	Serum creatinine ≥ 2 mg/dl (≥150 µmol/l)	Hemodialysis or peritoneal dialysis
Liver	SGOT<25 Units/l and bilirubin <2 mg/dl	SGOT≥25units/l or bilirubin ≥2 mg/dl (≥□34 µmol/l)	SGOT≥50 units/l or bilirubin ≥6 mg/dl (≥100 µmol/l)
Haemato-poetic	Normal counts	Leukocytes≥30,000; platelets≤50,000	Leukocytes≥60000 or ≤2,500
GI tract	Normal	Stress ulcer, Acalculous cholecystitis	Bleeding ulcer; Necrotizing enterocolitis or pancreatitis; perforation of gallbladder
CNS	Normal	Diminished responsiveness	Severely disturbed responsiveness ; neuropathy

III. Material And Method

Type of study - Comparitive Prospective Study

Duration - Jun 2017 to Jun 2018

Sample size - 30

Inclusion criteria - All adult patients whose details were available according to the study protocol and acute pancreatitis was proven by Contrast Enhanced Computed Tomography (CECT) of abdomen, were included in the study.

METHODOLOGY

Data collected and severity determined.

Prediction of a severe pancreatitis has been made in this study if either of the following is present

1. Ranson's Score ≥3 after 48 hrs
2. APACHE II Score of ≥8 on admission.
3. CT severity index(CTSI) score of ≥6 in the first CECT abdomen
4. Goris Multi organ failure(MOF) score >0 i.e any organ dysfunction/failure .
5. Persistent or progressive organ failure during the first week of admission. (calculated by daily calculation of Goris score)

Prediction of a mild pancreatitis has been made if

1. Ranson's Score <3 after 48 hrs
2. APACHE II Score of <8 on admission
3. CT severity index(CTSI) score of <6 in the first CECT abdomen
4. Goris Multi organ failure(MOF) score =0 i.e no organ dysfunction/failure at admission
5. Any transient organ failure which is resolved within 48 hrs of its development (calculated by daily calculation of Goris score during the first week of admission)

In this study, final outcome parameters which were considered to demarcate the pancreatitis a severe one , were as follows:-

1. Duration of hospital stay >3 weeks
2. Treatment in ICU for >48 hrs
3. Requirement of Inotropic support
4. Requirement of ventilator support
5. Requirement of dialysis(peritoneal/hemodialysis)
6. Local complication in the form of development of pancreatic necrosis (more than 30% of the Parenchyma or more than 3 cm), pseudocyst or pancreatic abscess
7. Systemic complication in the form of SIRS, sepsis, MODS
8. Multi organ failure
9. Requirement of percutaneous aspiration
10. Requirement of necrosectomy
11. Death

If any one among the above list had been present, the pancreatitis was demarcated as severe.

At the selected cut-off score, each predictive system was evaluated for significant relationship to the severity of acute pancreatitiS.

Sensitivity, specificity, positive and negative predictive values, positive and negative likely hood ratios (LR+ and LR) and AUC under the ROC for all the scoring systems were determined using Epi -6 statistical software and statistical package SPSS Inc., PASW statistic 18.

IV.   Results

Distribution of patients in relation to actual severity according to
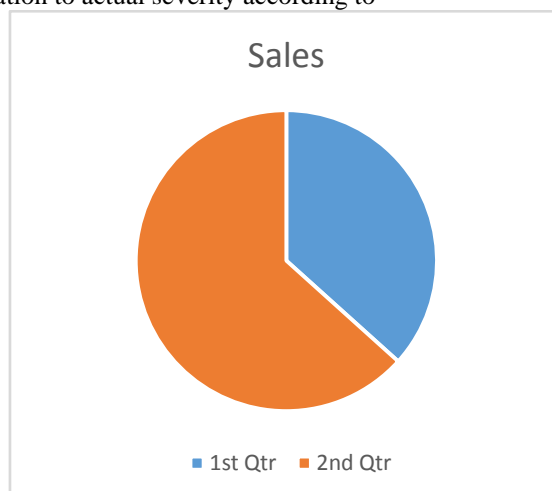
Distribution of patients in relation to different outcome parameters

Sl No.	Outcome parameters	n (%) Out of 11 severe pancreatitis cases
1	Length of hospital stay>3 wks	9(81.81%)
2	ICU Stay >48 Hrs	7(63.63%)
3	Pancreatic necrosis >30%	8(72.72%)
4	Pancreatic pseudocysts	4(36.36%)
5	Pancreatic abscess	1(9%)
6	Pancreatic fistula	1(9%)
7	Multi organ failure	3(27.27%)
8	Requirement of Inotropic support	3(27.27%)
9	Requirement of ventilator support	3(27.27%)
10	ARDS	1(9%)
11	Sepsis	3(27.27%)
12	Requirement of percutaneous needle aspiration	2(18.18%)
13	Necrosectomy	1(9%)
14	Death	1(9%)

Comparison of Ranson's score with the final outcome

Ranson's Score	Final outcome		Total
	severe pancreatitis	Mild pancreatitis	
Severe(Ranson's ≥3)	8	7	15
Mild(Ranson's <3)	3	12	15
Total	11	19	30

Sensitivity = 73%   Specificity = 63%
Positive predictive value = 53%   Negative predictive value = 80%
Positive Likelihood Ratio (LR+) = 1.97
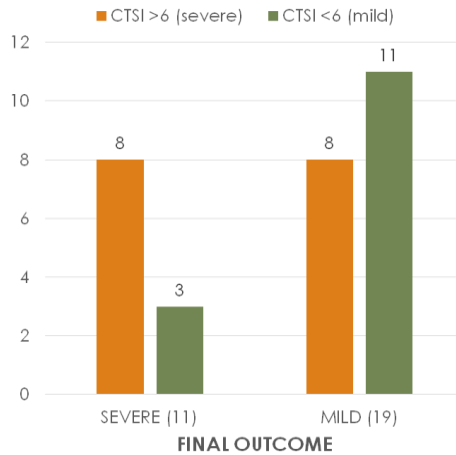Negative Likelihood Ratio (LR-) = 0.43

Comparison of APACHE II score with the final outcome
According to our study parameters 11 patients were diagnosed with severe pancreatitis. And among these 11, 2 patients were correctly predicted as severe by APACHE II.
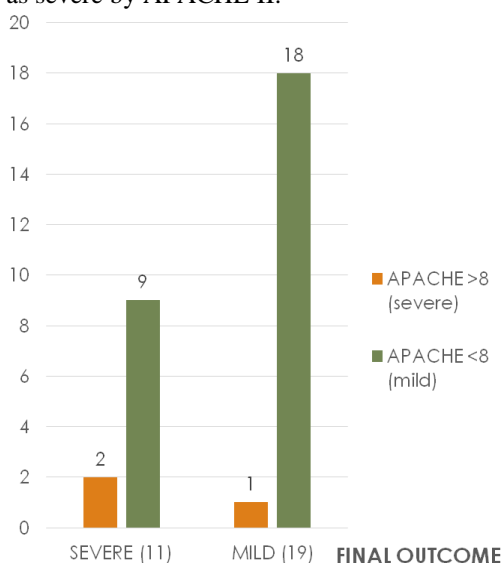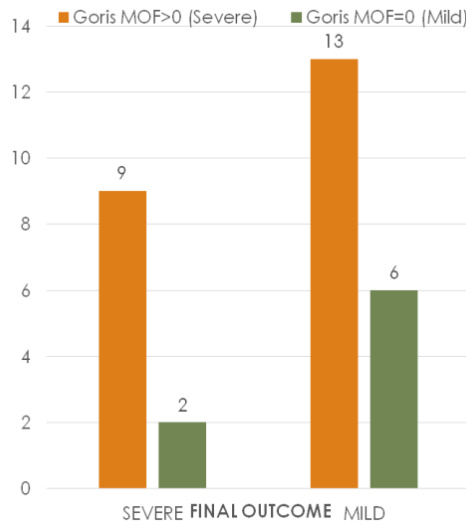
Sensitivity = 18%
Specificity = 95%
Positive predictive value =67%
Negative predictive value = 67%
Positive Likelihood Ratio(LR+) = 3.45
Negative Likelihood Ratio (LR-) = 0.87

**Prediction of severe pancreatitis by CTSI score**

Sensitivity = 73%
Specificity = 58%
Positive predictive value =50%
Negative predictive value = 79%
Positive Likelihood Ratio (LR+) = 1.73
Negative Likelihood Ratio(LR-) = 0.47

Modified Goris MOF score (at a cut off value of 0)   in relation to final outcome

Sensitivity = 82%
Specificity =32%
Positive predictive value =41%
Negative predictive value =75%
Positive Likelihood Ratio (LR+) =1.20
Negative Likelihood Ratio (LR-) = 0.58

Persistent/progressive organ failure during first week in relation to final outcome
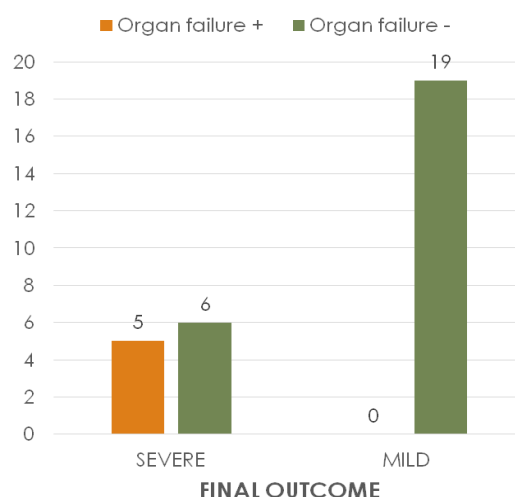
Sensitivity =45%
Specificity =100%
Positive predictive value =100%
Negative predictive value =76%

The predictive performance of different severity scoring systems for severe acute pancreatitis
 <u>Sensitivity</u> :

SCORE	SENSITIVITY	SPECIFICITY	PPV	NPV	+ LR	- LR
Ranson's	73%	63%	53%	**80%**	1.97	0.43
APACHE II	18%	**95%**	67%	67%	**3.45**	0.87
CTSI	73%	58%	50%	**79%**	1.73	0.47
Modified Goris MOF >0	**82%**	32%	41%	75%	1.20	0.58
Persistent/ progressive organ failure during first week	45%	**100%**	100%	76%	-	-

In our study, Modified Goris MOF score > 0 has highest sensitivity (82%) followed by Ranson score (73%) and CTSI (73%).
That means Modified Goris MOF Score at a cut off value of 0   predicted   82 % cases of total actual severe pancreatitis   as severe on admission.
Specificity:
Presence of organ failure during first week has been found to be 100% specific. (Since, assessment for organ failure was done at the end of the first week, it had the advantage of assessing the patient for more duration which may impact in 100% specificity.)
APACHE score also had shown a comparable very high specificity (95%). Thus APACHE score had been more useful for prediction of severity, as it predicted mild pancreatitis correctly in 95% cases as early as on admission.
Positive Predictive Value(PPV):
PPV of presence of organ failure during first week is 100%.
APACHE score have a PPV of 67 % i.e   67% of those cases who were predicted to have sever pancreatitis ,finally turned out to be severe. Though, Modified Goris score >0 had high sensitivity(82%), it had very low PPV(41%)
Negetive Predictive Value (NPV):
In the present study, Ranson score had   highest NPV of 80% followed by CTSI(79%) i.e these scores turned out to be good for predicting mild form.

Positive likely hood ratio (LR+) :
APACHE score in this current study had highest and significant LR+ of 3.45. This is so because the test had a very low false positive error rate.

Negetive likely hood ratio (LR-)   :
LR- is lowest for Ranson's score (0.43). This can be explained with a low false negative error rate and good specificity**.**

V.   Discussion

DISCUSSION		OUR STUDY	OTHER STUDIES
Ranson's Criteria (6)	Sensitivity Specificity PPV NPV	73% 63% 53% 80%	75% 77% 49% 91%
APACHE II (7)	Sensitivity Specificity PPV NPV	18% 95% 67% 67%	56% 98% 95% 82%
CTSI (8)		73% 58%	83% 65%

VI.   Conclusion

* In conclusion, all the scores under study had good predictive value in terms of different predictive accuracy parameters.
* APACHE II and Goris MOF(at cut off>0) are   useful for prediction of severe cases, whereas
* CTSI and Ranson's score can be most useful to identify those who are   not likely to be severe later on .
* In this study the sample size was too small to apply these observations in a greater perspective. For further validating the observations, better prediction models with larger sample size and randomized control trials will be required in future.

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