Evaluation of the severity of acute pancreatitis using BISAP, Ranson and APACHE II scores and comparing them with Modified Computed Tomography Severity Index score

Dr. Velmurugan S[1], Dr. (Prof.) T.R. Khurana[2], Dr. (Prof.) Shibani Mehra[3]

[1]Senior Resident, Department of Medicine, ABVIMS & Dr.RML hospital New Delhi
[2]Professor, Department of Medicine, ABVIMS & Dr.RML hospital New Delhi
[3]Professor, Department of Radiology, ABVIMS & Dr.RML hospital New Delhi
*Corresponding Author

Received:- 12 October 2021/ Revised:- 18 October 2021/ Accepted: 24 October 2021/ Published: 31-10-2021

Abstract—

Aims and Objectives: *Most of the studies published so far compare one or two out of the three clinical scores for assessing the severity of acute pancreatitis namely BISAP, Ranson and APACHE II scores with the Radiological Score of Modified Computed Tomography Severity Index. There is a paucity of studies that compare all three Clinical Scores with the Radiological Score of Modified Computed Tomography Severity Index. The aim of this study is to compare all three clinical scores with the radiological score mentioned above.*

Materials and Methods: *This is a cross sectional study which was conducted in the Department of Medicine and Department of Radiology, ABVIMS and Dr. Ram Manohar Lohia Hospital, New Delhi. A total of 40 patients were studied from November 2018 to March 2020. Admitted patients who fit into the New Diagnostic Criteria of the Revised Atlanta Classification for acute pancreatitis were taken into the study after getting the informed consent signed. CECT abdomen was done during the hospital stay and modified CTSI score was calculated. Patients with BISAP score ≥ 3, Ranson score ≥ 3, APACHE II score ≥ 8 and modified CTSI ≥ 4 (4-6: moderately severe, 8-10: severe; Note that in modified CTSI score, the final scores are always in even number) were classified as severe acute pancreatitis.*

Results: *The results of our study showed that the Modified CTSI score has the highest accuracy among the four scores in predicting severity of acute pancreatitis (AUC 0.969, P value <0.0001) which is statistically significant. Among the bedside scores namely APACHE II, Ranson and BISAP scores, the AUC was high in APACHE II score (AUC 0.750, P value 0.001) in comparison with Ranson score (AUC 0.688, P value <0.0001) and BISAP score (AUC 0.656, P value 0.0002).*

Keywords: BISAP, Ranson, APACHE-II, Modified CTSI scores.

I. INTRODUCTION

The global incidence of acute pancreatitis is 33.74 per 100,000 population per year and the crude mortality rate is 1.16 per 100,000 population per year[1] with the mortality rate of about 3% overall[2], 10-30% in severe pancreatitis[3].

There are several scoring systems to categorise the severity of acute pancreatitis. The patients with mild acute pancreatitis can be managed conservatively. Whereas patients with severe acute pancreatitis need intensive medical care and may require respiratory assistance, hemodialysis and inotropic support for hemodynamic stability. There are four widely used scoring systems based on lab investigations, clinical and radiological findings. They are BISAP score (Bedside Index of Severity in Acute Pancreatitis), APACHE II score (Acute Physiology And Chronic Health Evaluation), Ranson score and Modified CTSI Score (Computed Tomography Severity Index) which includes Balthazar CTSI score and Necrosis score based on CECT abdomen.

Image based scoring system like Modified CTSI not only depicts the degree of inflammation and hence the severity of pancreatitis to the greater extent of accuracy but also it helps in finding the cause of pancreatitis in some cases like Gallstone,

Pancreatic mass etc., Chatzicostas et al[4] in their study showed that the image based scoring system CTSI is superior to the bedside scoring systems Ranson score, APACHE II score and APACHE III score in predicting severity of acute pancreatitis.

It is not feasible to do the imaging studies like CECT abdomen in every hospital set up. However it is feasible to do bedside clinical assessments and investigations like CBC, KFT, LFT, serum electrolytes, ABG, serum LDH, Chest X Ray, USG abdomen and assess the severity of acute pancreatitis using bedside scores such as BISAP score, Ranson score and APACHE II score. And so we can make further decisions based on the severity of the disease.

This study will use BISAP, Ranson and APACHE II scores to classify the severity of acute pancreatitis in a patient whose diagnosis is made by the New Diagnostic Criteria of 'The Revised Atlanta Classification'. And the Organ Failure which is characteristic of Severe Pancreatitis is determined by 'The Modified Marshall Scoring System'[5]. The scores will be then compared with Modified CTSI (Computed Tomography Severity Index) score.

In 1992, The Atlanta Symposium was held, in which the acute pancreatitis is defined to be severe when there is organ failure, local complications such as pancreatic necrosis, abscess formation, and pseudocyst, and Ranson score ≥ 3, APACHE II score ≥ 8[6].

Severity of acute pancreatitis nowadays is assessed by Revised Atlanta Classification of acute pancreatitis. According to this classification, patient is said to have mild acute pancreatitis when there is no organ failure and local complications. In moderately severe acute pancreatitis patient has transient organ failure (lasting for less than 48 hours) and/or local complications (such as pancreatic necrosis, abscess and pseudocyst) and/or systemic complications. In severe acute pancreatitis, the patient has persistent organ failure (lasting more than 48 hours).

For proper definition of organ failure, modified Marshall scoring system is used. In this scoring system respiratory, cardiovascular and renal assessments are done. A score of ≥ 2 indicates organ failure[5].

Organ System	Score0	Score 1	Score 2	Score 3	Score 4
Respiratory(PO2/FiO2)	>400	300-400	200-300	100-200	≤100
Renal(serum creatinine in mg/dl)	≤1.4	1.5-1.8	1.9-3.5	3.6-4.9	≥5
Cardiovascular(Systolic BP along with pH)	>90	<90, responds to fluid therapy	<90, not responds to fluid therapy	<90, pH<7.3	<90, pH<7.2

Some bedside clinical scoring systems to assess the severity of acute pancreatitis are BISAP score, Ranson score, APACHE II score. And radiological scoring system to assess the severity of acute pancreatitis are Balthazar CTSI score and modified CTSI score.

BISAP score is the simplest of the three above mentioned bedside clinical scoring systems. The required parameters to calculate BISAP score are Blood Urea Nitrogen (BUN), GCS assessment, assessment of markers of Systemic Inflammatory Response Syndrome (SIRS), age, pleural effusion. A score of ≥ 3 is said to be severe acute pancreatitis. SIRS is said to be present when ≥ 2 of the following features are present. Heart rate >90/minute, temperature >38°C or <36°C, respiratory rate >20/minute, WBC >12000 or <4000 cells/mm^3.

Ranson score requires assessment at two different time, one at the time of admission and another one at 48 hours after admission. In Ranson score, 11 parameters are assessed. Each parameter is given 1 point. A score of ≥ 3 is said to be severe acute pancreatitis. Thus it is a disadvantage that one has to wait for 48 hours to assess the severity of acute pancreatitis using Ranson score. The parameters assessed at the time of admission are age, WBC, serum LDH, AST, RBS. The parameters assessed at the 48 hours after the admission are drop in hematocrit >10%, increase in BUN > 5mg/dl, Calcium <8mg/dl, PO2 <60mmhg, Base Deficit >4mEq/L, Fluid loss >6L

APACHE II score (Acute Physiology And Chronic Health Evaluation) score is used to assess the severity of disease in a patient who is admitted in ICU. It is calculated only once and is not recalculated during the hospital stay. The maximum score is 71. A score of ≥ 8 is said to be severe disease. It uses 12 acute physiological parameters, age and chronic health status of the patient[7].

Based on Balthazar CTSI score & Modified CTSI score, the severity of acute pancreatitis was classified into mild, moderate and severe categories[8].

Acute pancreatitis severity category using Balthazar CTSI severity score:

Mild Pancreatitis CTSI Score	:	0-3
Moderately severe Pancreatitis CTSI Score	:	4-6
Severe Pancreatitis CTSI Score	:	7-10

Acute pancreatitis severity category using the modified CTSI score:

Mild Pancreatitis Modified CTSI score	:	0-2
Moderately severe Pancreatitis Modified CTSI score	:	4-6
Severe Pancreatitis Modified CTSI score	:	8-10

In modified CTSI score, the final scores are always in even number.

II. MATERIALS AND METHODS

It is a Cross Sectional Study conducted in the Department of Medicine, ABVIMS, DR.RML Hospital, New Delhi from 1st November 2018 to 31st March 2020**.** A total of 40 admitted patients who fit into the New Diagnostic Criteria[5] (according to the Revised Atlanta Classification for acute pancreatitis) i.e., the patient with any of the two: 1.Abdominal pain 2.Raised serum lipase or serum amylase level more than three times the normal values 3.Radiological evidence (USG or CT scan) were taken into the study after getting the informed consent. On the day of admission, the following details such as age, temperature, heart rate, respiratory rate, blood pressure, chronic health status evaluation of the patients were collected. And blood samples for CBC, KFT, LFT, serum electrolytes, serum LDH, and ABG were taken and Chest X Ray and USG abdomen were done. BISAP and APACHE II scores were calculated for all the patients. Patients were kept on NPO and managed with intravenous fluids and input/output monitoring was done for all the patients. After 48 hours of admission, the blood samples for CBC, KFT, serum electrolytes and ABG were taken. Ranson score was calculated after 48 hours of admission. CECT abdomen was done during the hospital stay and modified CTSI score was calculated. Patients with BISAP score ≥ 3, Ranson score ≥ 3, APACHE II score ≥ 8 and modified CTSI ≥ 4 (4-6: moderately severe, 8-10: severe; In modified CTSI score, the final scores are always in even number) were classified as severe acute pancreatitis.

III. ETHICAL CONSIDERATION

This study was carried out after the approval from the Institutional Ethics Committee.

IV. RESULTS

TABLE 1
DISTRIBUTION OF BISAP SCORE AND RANSON SCORE OF STUDY SUBJECTS.

BISAP Score	Frequency	Percentage	Ranson Score	Frequency	Percentage
<3	30	75.00%	<3	28	70.00%
≥3	10	25.00%	≥3	12	30.00%
Mean ± SD	1.55 ± 1.47		Mean ± SD	1.9 ± 1.66	
Median(IQR)	1(0-2.25)		Median(IQR)	1.5(1-3)	
Range	0-5		Range	0-7	

In our study, based on BISAP score, 75% (30 out of 40 patients) of the study population was categorised as mild acute pancreatitis and the remaining 25% (10 out of 40 patients) was categorised as severe acute pancreatitis. Based on Ranson Scoring, 70% (28 out of 40 patients) of the study population was categorised as mild acute pancreatitis and 30% (12 out of 40 patients) of the study population was categorised as severe acute pancreatitis.

TABLE 2
DISTRIBUTION OF APACHE-II SCORE OF STUDY SUBJECTS.

APACHE-II score	Frequency	Percentage
<8	19	47.50%
≥8	21	52.50%
Mean ± SD	8.93 ± 7.29	
Median(IQR)	8(2.75-15)	
Range	0-29	

According to APACHE II scoring system, 47.5% (19 out of 40 patients) of the study population were suffering from mild acute pancreatitis and 52.5% (21 out of 40 patients) of the study population were suffering from severe acute pancreatitis.

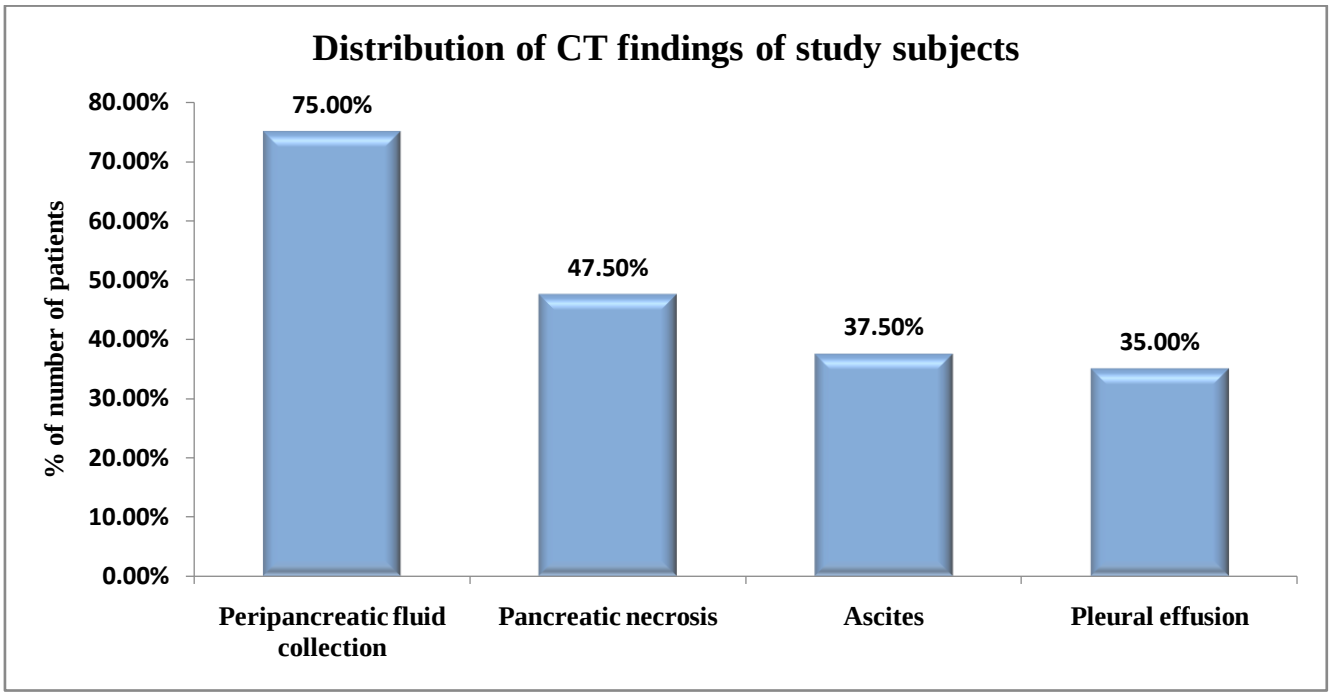

FIGURE 1: Distribution of CT findings of study subjects.

The percentage of Local and extra-pancreatic complications such as pancreatic necrosis, peripancreatic fluid collection, ascites and pleural effusion among the study population are 47.50% (19 out of 40 patients), 75% (30 out of 40 patients), 37.50% (15 out of 40 patients) and 35%(14 out of 40 patients) respectively.

TABLE 3
DISTRIBUTION OF MODIFIED CTSI SCORE OF STUDY SUBJECTS

Modified CTSI score	Category	Frequency	Percentage
0-2	Mild	10	25.00%
4-6	Moderately severe	17	42.50%
8-10	Severe	13	32.50%
Mean ± SD		5.4 ± 2.69	
Median(IQR)		6(3.5-8)	
Range		2-10	

Based on modified CTSI score, 25% (10 out of 40 patients) were classified as mild acute pancreatitis, 42.50% (17 out of 40 patients) were classified as moderately severe acute pancreatitis and 32.50% (13 out of 40 patients) were classified as severe acute pancreatitis.

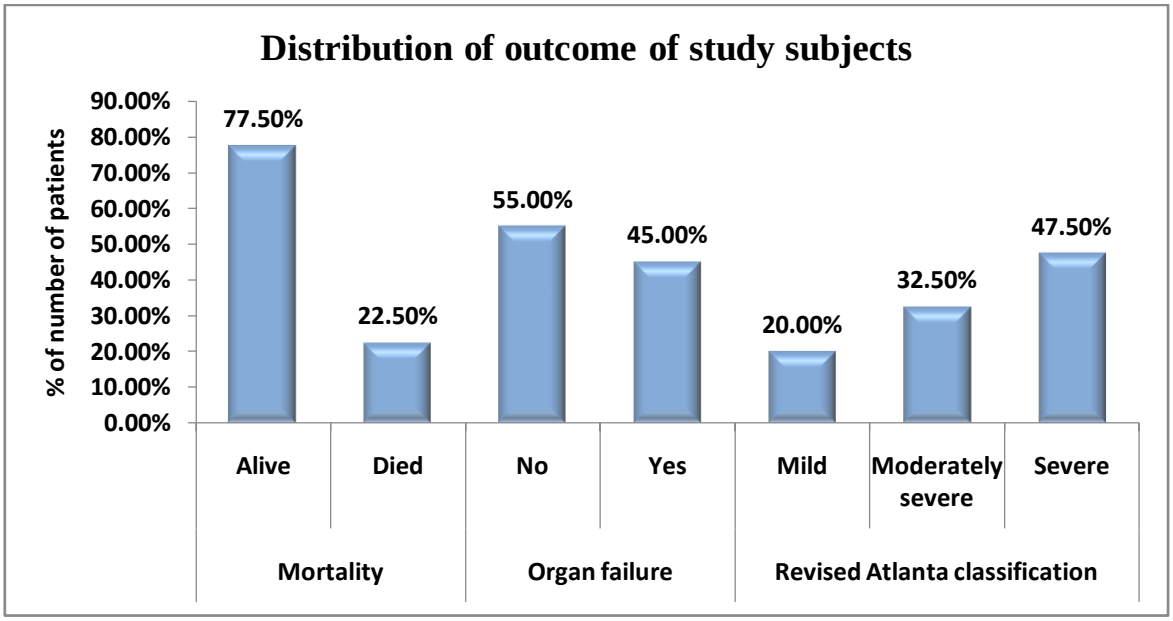

FIGURE 2: Distribution of outcome of study subjects.

Among the study population, 22.50% (9 out of 40 patients) did not survive, 45% (18 out of 40 patients) had organ failure. Based on Revised Atlanta Classification, 20% (8 out of 40 patients) were classified as mild acute pancreatitis, 32.50% (13 out of 40 patients) were classified as moderately severe acute pancreatitis and 47.50% (19 out of 40 patients) were classified as severe acute pancreatitis.

TABLE 4
SENSITIVITY, SPECIFICITY, POSITIVE PREDICTIVE VALUE, NEGATIVE PREDICTIVE VALUE OF BISAP SCORE, RANSON SCORE, APACHE-II SCORE AND MODIFIED CTSI SCORE FOR PREDICTING SEVERE ACUTE PANCREATITIS

Severe acute pancreatitis	BISAP score(≥3)	Ranson score(≥3)	APACHE-II score(≥8)	Modified CTSI score(≥4)
Area under the ROC curve (AUC)	0.656	0.688	0.75	0.969
Standard Error	0.0416	0.0435	0.0761	0.0217
95% Confidence Interval	0.490 - 0.799	0.522 - 0.824	0.588 - 0.873	0.859 - 0.999
P value	0.0002	<0.0001	0.001	<0.0001
Sensitivity(95% CI)	31.25%(16.1-50.0%)	37.5%(21.1-56.3%)	62.5%(43.7-78.9%)	93.75%(79.2 - 99.2%)
Specificity(95% CI)	100%(63.1 - 100.0%)	100%(63.1 - 100.0%)	87.5%(47.3 - 99.7%)	100%(63.1 - 100.0%)
PPV(95% CI)	100%(69.2 - 100.0%)	100%(73.5 - 100.0%)	95.2%(76.2 - 99.9%)	100%(88.4 - 100.0%)
NPV(95% CI)	26.7%(12.3 - 45.9%)	28.6%(13.2 - 48.7%)	36.8%(16.3 - 61.6%)	80%(44.4 -97.5%)
Diagnostic accuracy	45.00%	50.00%	67.50%	95%

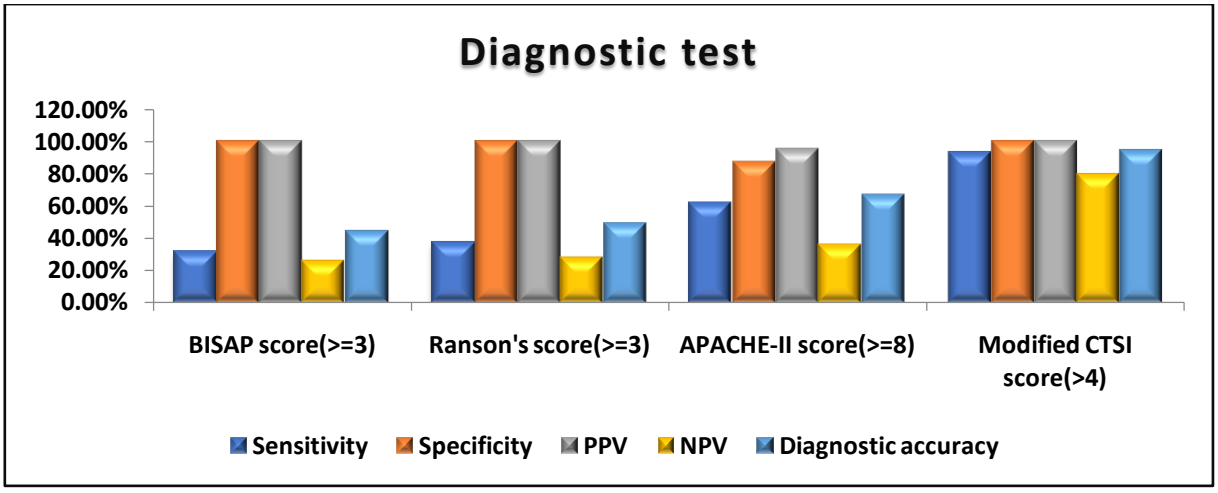

FIGURE 3: Sensitivity, specificity, positive predictive value, negative predictive value of BISAP score, Ranson score, APACHE-II score and modified CTSI score for predicting severe acute pancreatitis.

For predicting severity of acute pancreatitis, AUC was noted highest in modified CTSI score (0.969, P value <0.0001) followed by APACHE II score (0.750, P value 0.001), Ranson score (0.688, P value <0.0001) and BISAP score (0.656, P value 0.0002). The highest sensitivity for predicting severity of acute pancreatitis among the four scores was seen in modified CTSI (93.75%). Regarding the specificity for predicting severity of acute pancreatitis, modified CTSI, Ranson and BISAP has 100% specificity each. When the sensitivity for predicting severity of acute pancreatitis is compared among the scores namely APACHE II, BISAP, Ranson scores that can be obtained bedside, APACHE II score is highly sensitive (62.5%), followed by Ranson score (37.5%) and BISAP score (31.25%).

V. DISCUSSION

The distribution of local and extra-pancreatic complication noted in our study was 70% (30 out of 40 patients) peripancreatic fluid collection, 47.50% (19 out of 40 patients) pancreatic necrosis, 37.50% (15 out of 40 patients) ascites and 35% (14 out of 40 patients) pleural effusion.

The percentage of study population categorized into mild acute pancreatitis and severe acute pancreatitis are score 75% and 25% based on BISAP, 70% and 30% based on Ranson score, 47.50% and 52.50% based on APACHE II score respectively. Based on modified CTSI score 25% of the patients had mild acute pancreatitis and 42.50% of the patients had moderately severe acute pancreatitis, 32.50% of the patients had severe acute pancreatitis.

The mortality rate observed in our study was 22.50% (9 out of 40 patients). Of the 40 patients in our study population, 32.50% (13 out of 40 patients) belonged to moderately severe category and 47.50% (19 out of 40 patients) belonged to severe category, according to Revised Atlanta classification of acute pancreatitis. Among the study population, 45% (18 out of 40 patients) had organ failure.

For predicting severity of acute pancreatitis, AUC was noted highest in modified CTSI score (0.969, P value <0.0001) followed by APACHE II score (0.750, P value 0.001), Ranson score (0.688, P value <0.0001) and BISAP score (0.656, P value 0.0002). The highest sensitivity for predicting severity of acute pancreatitis among the four scores was seen in modified CTSI (93.75%). When the sensitivity for predicting severity of acute pancreatitis is compared among the scores namely APACHE II, BISAP, Ranson scores that can be obtained bedside, APACHE II score is highly sensitive (62.5%), followed by Ranson score (37.5%) and BISAP score (31.25%). Among the bedside scores namely Ranson, APACHE II and BISAP scores, the AUC was high in APACHE II score i.e., AUC of 0.750 (Table 4).

VI. CONCLUSION

1. The mortality rate in our study was 22.50%. According to Revised Atlanta classification of acute pancreatitis, 32.50% of the study population belonged to moderately severe category and 47.50% of the study population belonged to severe category in our study.

2. Modified CTSI score has the highest accuracy among the four scores in predicting severity of acute pancreatitis (AUC 0.969, P value <0.0001) which is statistically significant. Among the bedside scores namely APACHE II, Ranson and BISAP scores, the AUC was high in APACHE II score (AUC 0.750, P value 0.001).

ETHICAL APPROVAL

The Institutional Ethical Committee approval was taken before starting the study

Reference Number : F.No.TP(MD/MS)(118/2018)/IEC/PGIMER/RMLH

Date : 24th October 2018

REFERENCES

[1] Xiao A, Tan M, Wu L, Asrani V, Windsor J, Yadav D, Petrov M. Global incidence and mortality of pancreatic diseases: a systematic review, meta-analysis, and meta-regression of population-based cohort studies. Lancet Gastroenterol Hepatol. 2016;1:45-55.

[2] Longo D, Fauci A, KasperD, Hauser S, Jameson L, Loscalzo J. Harrison's Principle of Internal Medicine. 20th ed. 2018;Vol2:p2437-2449.

[3] Pattanaik S K, Kumar A, John A. Comparison of beside index of severity in acute pancreatitis (BISAP) and acute physiology and chronic health evaluation (APACHE II) score in assessing severity of acute pancreatitis. International Surgery Journal. 2017 Dec; 4(12):4054-4057.

[4] Chatzicostas C, Roussomoustakaki M, Vardas E, Romanos J, Kouroumalis EA. Balthazar computed tomography severity index is superior to Ranson criteria and APACHE II and III scoring systems in predicting acute pancreatitis outcome. J Clin Gastroenterol 2003; 36(3): 253-260.

[5] Foster B, Jensen K, Bakis G, Shaaban A, Coakley F. Revised Atlanta Classification for Acute Pancreatitis: A Pictorial Essay. RSNA. 2016 May;36(3):675-687.

[6] Sands B E. Mount Sinai expert guides. Gastroenterology.1st ed. 2015. p292-303

[7] Vincent J L, Moreno R. Clinical Review: Scoring Systems in the Critically ill. Crit Care.2010; 14 (2): 207.

[8] Banday I A, Gattoo I, Khan A M, Javeed J, Gupta G, Latief M. Modified Computed Tomography Severity Index for Evaluation of Acute Pancreatitis and its Correlation with Clinical Outcome: A Tertiary Care Hospital Based Observational Study. Journal of Clinical and Diagnostic Research. 2015 Aug; 9(8): 1-5.