Original Article

DOI: 10.7860/IJARS/2021/44831:2595

Correlation of Modified Computed Tomography Severity Index with Ranson's Criteria in Assessing Severity of Acute Pancreatitis

Radiology Section

S MANGALANANDAN[1], DIVYA ANN THOMAS[2], GEENA BENJAMIN[3]

ABSTRACT

Introduction: Acute Pancreatitis (AP) is an illness which results in increase in morbidity and mortality when there is a delay in diagnosis and there are false results. Various scales help in making early and accurate diagnosis of AP and predict prognosis. Validity of these scales needs to be studied and compared. Balthazar score and Ranson's criteria have been commonly used. Modified CT score's usefulness need to be studied as it involves only CT and their early detection will help in reducing the morbidity (reducing the residual damage) and mortality.

Aim: To determine validity of modified Computed Tomography Severity Index (CTSI) and Ranson's score in assessing severity of AP and study their correlation.

Materials and Methods: This is an observational study among 39 patients with AP. Ranson's score and Modified CT index was calculated and actual outcome of the disease was observed.

Results: Ranson's Score and Modified CTSI were strongly correlated with rho value of 0.912 and p-value of <0.001. Sensitivity and specificity of Ranson's criteria in predicting the actual outcome of the disease is 80% and 83.3%, respectively. Sensitivity and specificity of Modified CT criteria in predicting the actual outcome of the disease is 93.33% and 54.17%, respectively.

Conclusion: From the results of this study, it is evident that Modified CT index is more sensitive than Ranson's score, but less specific.

Keywords: Computed tomography, Diagnosis, Pancreatitis

INTRODUCTION

Clinically the presentation of AP varies from oedematous mild AP to severe AP, and is commonly seen with necrosis of the pancreas, a protracted clinical course, failure of organ, a high incidence of local complications, and a high mortality rate [1]. Severe AP occurs in nearly one-fourth of patients with AP. The 1992 Atlanta classification defined severe AP "as the presence of organ failure or local complications such as pancreatic necrosis". Revision on Atlanta classification described interstitial and necrotising pancreatitis based on CT scan and included peripancreatic necrosis [2].

Various clinical scales including the Ranson and Acute Physiology and Chronic Health Evaluation (APACHE II) systems have been used for assessing the severity of AP since the 1970s [3,4]. Balthazar CTSI was used from 1990 [5]. Computed tomography with intravenous contrast medium injection is widely accepted as the imaging procedure of choice: primarily to document the extent of pancreatic and extrapancreatic acute fluid collections and, secondarily to detect pancreatic necrosis. These two parameters have been widely used as prognostic indicators in assessing the severity of AP. Modified CTSI uses combined assessment of degree and extent of pancreatic involvement, pancreatic necrosis and fluid collections to improve prognostic accuracy [6]. The present study was conducted to evaluate the outcome of AP by Ranson's criteria and modified CTSI.

Severity Classification

Organ failure, local complications (fluid collections and necrosis) and systemic complications [7] are used to stratify disease severity. Mild disease lacks organ failure and local or systemic complications and is associated with rare mortality (1-2%) [8]. Moderately severe disease have transient organ failure (resolves within 48 hours) or local or systemic complications and is associated with a low mortality rate of approximately 2% [9]. Severe disease has persistent organ failure (persists beyond 48 hours), a mortality rate of approximately 20-30% [10,11] and typically also presents with local complications.

Severity Assessment

A prognostic method to identify patients likely to develop severe AP would allow clinicians to triage into an intensive care setting and initiate outcome improving measures, such as aggressive fluid resuscitation [12]. Radiologic grading systems developed to help predict disease severity [13] are CTSI and modified CTSI. Both the CTSI and modified CTSI assign points on the basis of the presence and extent of pancreatic inflammation, parenchymal necrosis, and extrapancreatic complications (modified CTSI only) observed on CT, up to a maximum of 10 points. The score correlates with mortality and indexes of patient morbidity, including occurrence of pancreatic infection, length of hospital stay, and need for invasive intervention [13]. For severity assessment MRI can be comparably used [14]. A major drawback of imaging for severity assessment is its reliance on necrosis characterisation, which as discussed previously is difficult within 72 hours of disease onset. Therefore, imaging solely for severity assessment at admission is not recommended. There are several clinically-based scoring systems for predicting the severity of AP. The Ranson score, APACHE II and Bedside Index for Severity in AP are three of the most prevalent. However, these clinical scoring systems provide limited additional information, because they typically require 24-48 hours of clinical data to become accurate, and severe disease is often apparent regardless of score. Clinically-based systems for severity assessment are of limited efficacy, similar to imaging-based systems [15].

Ranson's criteria: At admission/diagnosis:

i. Age >55 years
ii. WBC >16,000/mm^3
iii. Blood Glucose >200 mg/dlL
iv. Serum LDH >350 U/L
v. AST >250 U/L

During initial 48 hours:

vi. Hematocrit decrease >10%

vii. Blood Urea Nitrogen increase >5 mg/dL

viii. Serum Calcium <8 mg/dL

ix. Base deficit >4 mmol/L

x. Fluid Sequestration >6000 mL

xi. PaO_2 <60 mm Hg

Scoring: 1 point for each criterion met. Criteria (Mortality rate): 0-2 (~2%), 3-4 (~15%), 5-6 (40%), 7-8 (100%)

Modified CT Severity Index (CTSI)

a. Pancreatic inflammation score: Normal pancreas (0 points)/ Intrinsic pancreatic abnormalities with or without inflammatory changes in peripancreatic fat (2 points)/Pancreatic or peripancreatic fluid collection or peripancreatic fat necrosis (4 points)

b. Pancreatic necrosis score: None (0 points)/<30% (2 points)/>30% (4 points)

c. Extrapancreatic complications: 1/> pleural effusion, ascites, vascular complication, parenchymal or GIT involvement)=2 points

CT Grade: Mild-0-2, Moderate-4-6, Severe-8-10

MATERIALS AND METHODS

This is an observational study (hospital-based) done in our institute involving the Department of Radiodiagnonis and the Department of General Surgery February 2016-August 2017. The sample size worked out to be 39 i.e., 39 people satisfied inclusion, exclusion criteria and undergoing a contrast-enhanced CT after clearance obtained from Institutional Ethical Committee [16].

Inclusion Criteria

i. All patients referred for CT with positive laboratory findings (serum amylase and serum lipase) for AP.

ii. All patients referred for CT who are diagnosed with AP on ultrasonography.

Exclusion Criteria

i. Chronic Pancreatitis.

ii. Pancreatitis associated with pancreatic carcinoma and metastasis

ii. Pancreatitis secondary to trauma.

iv. Acute on chronic pancreatitis

Study Procedure

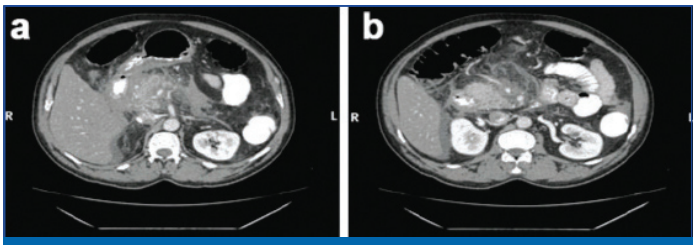
Imaging: A MDCT (GE OPTIMA 128 SLICE) using 120 KVp and 160 MAS was used. The patients were scanned in supine position with suspended respiration. Noncontrast-enhanced scans were obtained from the diaphragm to the level of the pubic symphysis. Then oral mannitol (100 mL) and rectal gastrografin (40 mL), both diluted with water upto one litre was given. It was followed by intravenous contrasts study using 80 mL of Iopamidol (370 mg/mL) because the pancreas has essentially the same attenuation coefficient as unopacified bowel and blood vessels. Following i.v., contrast by pressure injector scan acquisition was done in three phases.

First phase (pancreatic parenchymal phase) images were acquired after a delay of 40-45 seconds. Contrast enhancement is best during this arterial phase and therefore it is the best phase to study pancreas. Thinner slices were obtained to avoid partial volume averaging when trying to obtain a more accurate density reading of a small lesion and at any time greater spatial resolution was required and for virtualisation of pancreatic duct. The Second phase (portal venous phase) images of the entire abdomen and pelvis after a delay of about 70 seconds were acquired. The Third phase (delayed phase) images of the entire abdomen and pelvis were taken after a delay of about 15 minutes after administration of i.v., contrast. All images were viewed in a range of standard window settings [Table/Fig-1-5].

CASE 1

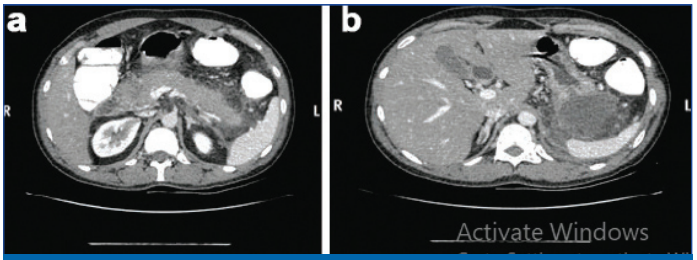
[Table/Fig-1]: A 26-year-old female presented with epigastric pain and serum amylase of 1400 IU/L. CECT showing bulky pancreatic tail. No evidence of peripancreatic stranding or fluid collection or necrosis. MCTSI-2.

CASE 2



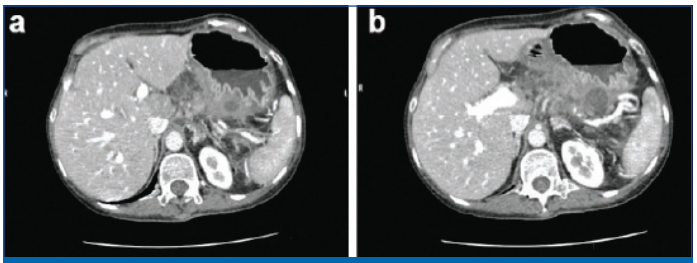
[Table/Fig-2a,b]: A 55-year-old alcoholic presented with upper abdominal pain serum amylase 2000 IU/L. CECT images showing bulky head and neck of pancreas with extensive peri pancreatic fat stranding and left anterior fascial thickening, mild duodenal wall thickening- acute interstitial oedematous pancreas. MCTSI- 4.

CASE 3



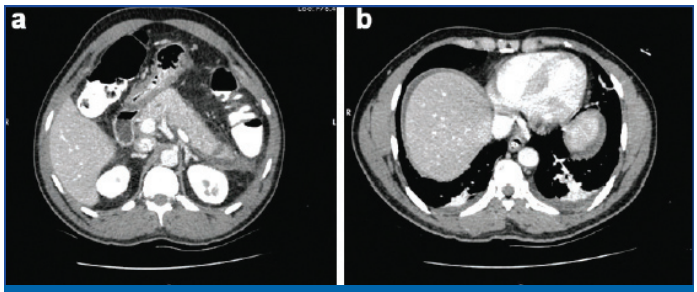
[Table/Fig-3a,b]: A 29-year-old male presented with abdominal pain-one week. Serum amylase 1500 IU/l. CECT shows bulky oedematous pancreas with adjacent peripancreatic fat stranding and collection at the tail region abuting greater curvature of stomach and reaches upto spleen with bilateral pleural effusion- acute interstitial oedematous pancreatitis with acute peripancreatic fluid collection. MCTSI- 6.

CASE 4



[Table/Fig-4a,b]: A 44-year-old female presented with recurrent epigastric pain since six weeks with serum amylase 2200 IU/L.CECT shows bulky pancrearic body and tail with two cystic lesions in tail region, mild peripancreatic fat stranding and fluid present- Pseudocyst.

CASE 5



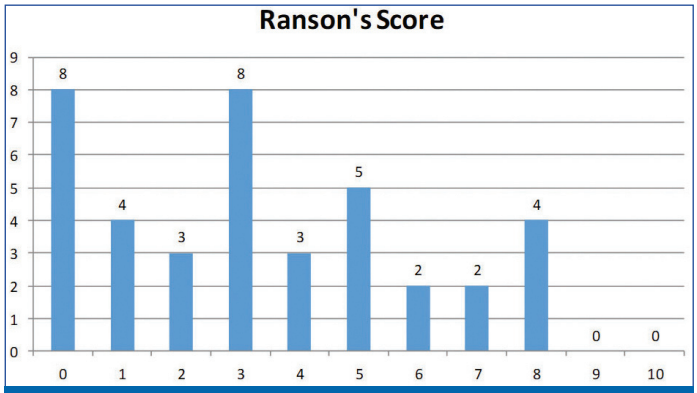
[Table/Fig-5a,b]: A 58-year-old male, alcoholic presented with recurrent abdominal pain since three weeks. CECT shows hypodense nonenhancing area within tail of pancreas with peripancreatic fat stranding and fluid, thickening of left anterior renal and lateral conal fascia, mild ascites, bilateral mild pleural effusion- acute necrotic collection. MCTSI- 8.

RESULTS AND STATISTICAL ANALYSIS

Variables Related to Severity of AP

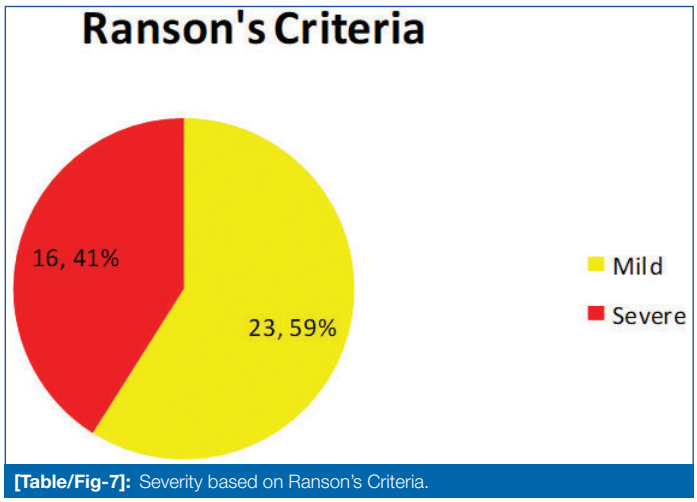
Out of the study population, about 22 (56.4%) had decreased PCV, 5 (12.8%) were having increased blood urea nitrogen, 7 (18%) were having base deficit, 22 (56.4%) were having fluid sequestration and 8 (20.5%) were having PaO_2 level less than 60.

In the study population, Ranson's Severity score is graphically represented as the following [Table/Fig-6]



[Table/Fig-6]: Graphical representation of Ranson's Severity Score.

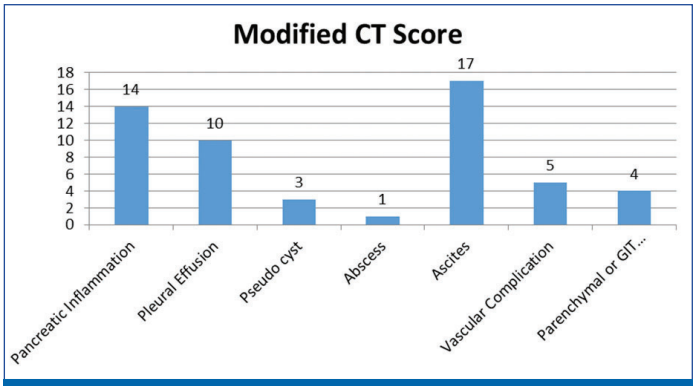
Ranson's Score is further categorised into Mild (≤3) and Severe (>3) based on the scores for Ranson's Criteria. Out of the study population, 23 (59%) were falling into mild category and rest 16 (41%) were falling into severe category according to Ranson's Criteria. This is shown in [Table/Fig-7].



[Table/Fig-7]: Severity based on Ranson's Criteria.

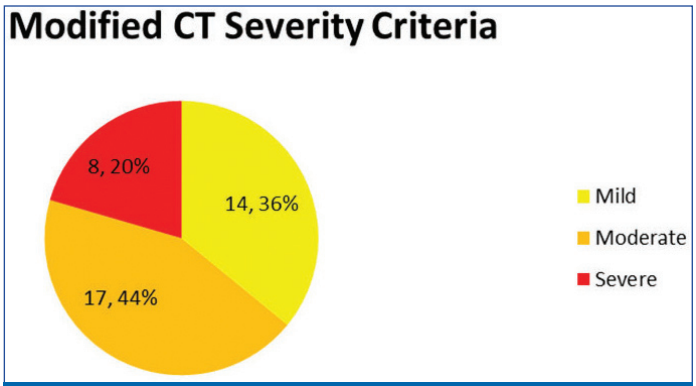
Modified CT score: In the study population, Modified CT score is graphically represented in the following [Table/Fig-8].

The score is maximum contributed by the ascites and pancreatic inflammation.



[Table/Fig-8]: Graphical representation of Modified CT Score.

Modified CT Score is further categorised into Mild (0-2); [Table/Fig-1], Moderate (4-6); [Table/Fig-2,3] and Severe (8-10); [Table/Fig-5] based on the scores for Modified CT scoring criteria. Out of the study population, 14 (36%) were falling into mild category, 17 (43.6%) were falling into moderate category and rest 8 (20.5%) were falling into severe category according to Modified CT severity criteria. This is shown in [Table/Fig-9].



[Table/Fig-9]: Severity based on modified CT severity criteria.

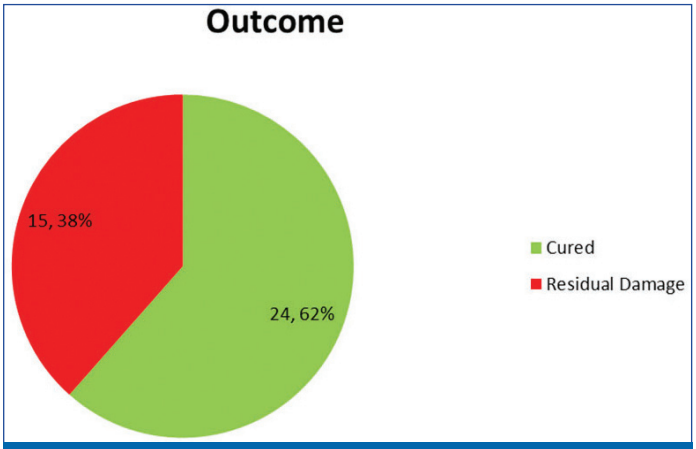
Outcome of Acute Pancreatitis

In the present study, among 17 patients in moderate category of modified CTSI, nine patients had ascites of which four underwent ascitic tapping and five were managed conservatively.

Among eight patients in severe category of modified CTSI, all had ascites of which five underwent ascitic tapping and three were managed conservatively. Five patients had pleural effusion in moderate and five in severe category of modified CTSI, of which three underwent pleural tapping in each of these categories. Two patients with pleural effusion were managed conservatively in both categories. One patient in moderate category had pancreatic abscess, for him needle aspiration was done. Five patients in severe category had vascular complications of which, three had thrombosis and two had pseudoaneurysm. All were under follow-up. All patients among severe category had necrosis. Among 17 patients in moderate category, five had necrosis. They were all managed conservatively with follow-up. Among 39 patients in our study, three patients had pseudocyst [Table/Fig-4], one each in mild, moderate and severe category. They were managed conservatively due to their small size (<4 cm). Out of the 39 patients studied, majority 24 (61.5%) were completely cured from the disease. And rest 15 (38.5%) had residual damage with the disease. None of the patient died in the present study. This is represented in [Table/Fig-10].

Cross Tabulation of Categories of Ranson's Score and Modified CT Score

The following [Table/Fig-11] represents the cross tabulation between categories of Ranson's score and Modified CT Score. Mild and severe are agreed 100% same as the other criteria. The 17 participants present in moderate in modified CT score were distributed equally in mild and severe category of Ranson's Criteria as 9 and 8, respectively. (Chi-square value 21.5, p-value=<0.001).



[Table/Fig-10]: Outcome of the patients.

		Severity by Modified CT score			Total
		Mild	Moderate	Severe	
Severity by Ranson's score	Mild	14	9	0	23
	Severe	0	8	8	16
Total		14	17	8	39

[Table/Fig-11]: Cross tabulation of categories of Ranson's score and modified CT score: (n=39).
Chi-square value 21.5, p-value=<0.001

Correlation between Ranson's score and Modified CT severity score: Correlation test (Spearman's rho) was done between the two ordinal variables (Ranson's Score and Modified CT Severity Score) and the two variables were strongly correlated with rho value of 0.912 and p-value of <0.001. This is represented in the following [Table/Fig-12].

Spearman's rho	Modified CT severity score	Correlation coefficient	1.000	0.912**
		Sig. (2-tailed)	0.00	0.00
		n	39	39
	Ranson's score	Correlation coefficient	0.912**	1.000
		Sig. (2-tailed)	0.00	0.00
		n	39	39

[Table/Fig-12]: Correlation between Ranson's score and modified CT severity score.
**Correlation is significant at the 0.01 level (2-tailed)

Cross Tabulation between Ranson's Score Severity and Outcome

The following [Table/Fig-13] represents the cross tabulation between categories of Ranson's score and outcome of the disease. There is a significant association between the prediction of severity by Ranson's criteria with the actual outcome of the disease with sensitivity and specificity being 80% and 83.3%, respectively.

		Outcome		Total
		Cured	Residual damage	
Severity by Ranson's criteria	Mild	20	3	23
	Severe	4	12	16
Total		24	15	39

[Table/Fig-13]: Cross tabulation of categories of Ranson's score and disease outcome: (n=39).
Chi-square value=15.30, degree of freedom=1, p-value <0.001

Calculations for accuracy of Ranson's score with the outcome of disease are represented in the following [Table/Fig-14].

Cross Tabulation between Modified CT Score and Outcome

The following [Table/Fig-15] represents the cross tabulation between categories of Modified CT Score and outcome of the disease. There is a significant association between the prediction of severity by Modified CT Score with the actual outcome of the disease with p-value <0.001.

Statistic	Formula	Value	95% CI
Sensitivity	$\frac{a}{a+b}$	80.00%	51.91% to 0.00%
Specificity	$\frac{d}{c+d}$	83.33 %	0.00% to 0.00%
Positive likelihood ratio	$\frac{Sensitivity}{1-Specificity}$	4.80	1.89 to 12.16
Negative likelihood ratio	$\frac{1-Sensitivity}{Specificity}$	0.24	0.09 to 0.67
Disease prevalence	$\frac{a+b}{a+b+c+d}$	38.46%	0.00% to 0.00%
Positive predictive value	$\frac{a}{a+c}$	75.00%	54.21% to 88.37%
Negative predictive value	$\frac{d}{b+d}$	86.96 %	70.46% to 94.91%
Accuracy	$\frac{a+d}{a+b+c+d}$	82.05%	0.00% to 0.00%

[Table/Fig-14]: Accuracy of Ranson's score with the outcome of disease.

		Outcome		Total
		Cured	Residual damage	
Severity by CT	Mild	13	1	14
	Moderate	11	6	17
	Severe	0	8	8
Total		24	15	39

[Table/Fig-15]: Cross tabulation of categories of modified CT Score and disease outcome: (n=39).
Chi-square value=18.67, degree of freedom=2, p-value, <0.001

For the purpose of calculation of accuracy indicators the moderate and severe categories of modified CT index have been clubbed together and represented in the following [Table/Fig-16].

		Outcome		Total
		Cured	Residual damage	
Severity by CT	Mild	13	1	14
	Moderate and severe	11	14	25
Total	24		15	39

[Table/Fig-16]: Cross tabulation of categories of modified CT Score and disease outcome: (n=39).

Calculations for accuracy of Modified CT score with the outcome of disease are represented in the following [Table/Fig-17]. There is a significant association between the prediction of severity by Modified CT criteria with the actual outcome of the disease with sensitivity and specificity being 93.33% and 54.17%, respectively.

DISCUSSION

The study population comprised of 33 males (85%) and 6 females (15%). The prevalence of the biochemical markers needed for the calculation of Ranson's Score was as follows: About 22 (56.4%) had decreased PCV, 5 (12.8%) were having increased blood urea nitrogen, 7 (18%) were having base deficit, 22 (56.4%) were having fluid sequestration and 8 (20.5%) were having PaO_2 level <60. Out

Statistic	Formula	Value	95% CI
Sensitivity	$\frac{a}{a+b}$	93.33%	68.05% to 0.00%
Specificity	$\frac{d}{c+d}$	54.17 %	0.00% to 0.00%
Positive likelihood ratio	$\frac{Sensitivity}{1-Specificity}$	2.04	1.29 to 3.21
Negative likelihood ratio	$\frac{1-Sensitivity}{Specificity}$	0.12	0.02 to 0.85
Disease prevalence	$\frac{a+b}{a+b+c+d}$	38.46%	0.00% to 0.00%
Positive predictive value	$\frac{a}{a+c}$	56.00%	44.66% to 66.74%
Negative predictive value	$\frac{d}{b+d}$	92.86 %	65.38% to 98.89%
Accuracy	$\frac{a+d}{a+b+c+d}$	69.23%	0.00% to 0.00%

[Table/Fig-17]: Accuracy of modified CT score with the outcome of disease.

of the study population, 23 (59%) were falling into mild category and rest 16 (41%) were falling into severe category according to Ranson's Criteria. Out of the study population, 14 (36%) were falling into mild category, 17 (43.6%) were falling into moderate category and rest 8 (20.5%) were falling into severe category according to Modified CTSI.

In the present study, out of the 39 patients, majority 14 (35.9%) were having AP due to cholelithiasis, followed by aetiologies including alcohol (12, 30.8%), idiopathic (11, 28.2%) and post ERCP (2, 5.1%). Out of the 39 patients studied majority 24 (61.5%) were completely cured from the disease. And rest 15 (38.5%) had residual damage with the disease. Ranson's score is calculated by biochemical parameters and needs time, whereas modified CT criteria need CT equipment and manpower in the form of radiologist to interpret the imaging findings. When comparing the categories of Ranson's score and Modified CT Score, mild and severe forms showed 100% agreement with each other. But moderate category in Modified CT Score has disagreeing results. Since Ranson's criteria has only mild and severe category, moderate category among participants cannot be studied for agreement.

Correlation test (Spearman's rho) between the two ordinal variables (Ranson's Score and Modified CT Severity Score) showed strong correlation between the two variables with rho value of 0.912 and p-value of <0.001. Chand P et al., showed lack of statistical significant difference between Ranson's criteria and Modified CTSI in evaluation of the outcome of AP amongst the systemic complications [16]. Even though the local complications were seen in patients with higher Ranson's score, the statistical difference was not significant. Kumar et al., demonstrated lack of significant difference between Ranson's score and Modified CTSI in predicting pancreatic necrosis, organ failure and ICU admission in patients with AP with a p-value of 0.10, 0.22, and 0.10, respectively [17]. The present findings are of strong correlation between Ranson's score and Modified CTSI and in line with previous studies.

When comparing categories of Ranson's score and outcome of the disease, there was a significant association between the prediction of severity by Ranson's criteria with the actual outcome of the disease with sensitivity and specificity being 80% and 83.3%, respectively. There is a significant association between the prediction of severity by Modified CT criteria with the actual outcome of the disease with sensitivity and specificity being 93.33% and 54.17%, respectively. Hence, it is evident that Modified CT index is more sensitive than Ranson's score, but less specific.

In the present study, results of higher sensitivity and lower specificity of Modified CTSI in comparison to Ranson's score is comparable to previous published studies. Though Modified CTSI has higher sensitivity, the lower specificity could be due to one-time evaluation of imaging findings performed about 72 hours after symptom onset in comparison to Ranson's score which includes follow-up of the biochemical parameters at admission and after 48 hours postadmission enabling assessment of disease progression.

Limitation(s)

Studies with large sample size are recommended to explore more about the usefulness of Modified CT Index.

CONCLUSION(S)

Sensitivity and specificity of Ranson's criteria in predicting the actual outcome of the disease is 80% and 83.3%, respectively. Sensitivity and specificity of Modified CT criteria in predicting the actual outcome of the disease is 93.33% and 54.17%, respectively. Hence it is evident that Modified CTSI is more sensitive than Ranson's score, but less specific. In this study, results showed that moderate and severe categories of Modified CT index have almost five times more chance of getting a residual damage. (Likelihood Ratio positive=4.80). As there is no mortality among the 39 study participants, mortality rates and its predictability cannot be calculated. So, as Ranson's Score is time consuming and Modified CT is more sensitive, Modified CT score for predicting the outcome of the AP can be used.

REFERENCES

[1] Yousaf M, McCallion K, Diamond T. Management of severe acute pancreatitis. Br J Surg. 2003;90:407-20.
[2] Bradley EL. A Clinical based classification system for acute pancreatitis. Arch Surg. 1993;128:586-90.
[3] Ranson JH, Rifkind KM, Roses DF, Fink SD, Eng K, Spencer FC. Prognostic signs and the role of operative management in acute pancreatitis. Surg Gynecol Obstet. 1974;139:69-81.
[4] Larvin M, McMahon MJ. APACHE II score for assessment and monitoring of acute pancreatitis. Lancet. 1989;2:201-05.
[5] Balthazar EJ, Robinson DL, Megibow. Acute pancreatitis: Value of CT in establishing prognosis. Radiology. 1990;174:331-36.
[6] Joon HC, Tae NK, Hyun HC, Kook HK. Comparison of scoring systems in predicting the severity of acute pancreatitis. World J Gastroenterol. 2015;21(8):2387-23.
[7] Balthazar EJ. Acute pancreatitis: Assessment of severity with clinical and CT evaluation. Radiology. 2002;223:603-13.
[8] Wu BU, Banks PA. Clinical management of patients with acute pancreatitis. Gastroenterology. 2013;144:1272-81.
[9] Türkvatan A, Erden A, Türkoğlu MA, Seçil M, Yüce G. Imaging of acute pancreatitis and its complications. Part 2. Complications of acute pancreatitis. Diagn Interv Imaging. 2015;96:161-69.
[10] Tenner S, Baillie J, DeWitt J, Vege SS. American College of Gastroenterology guideline: Management of acute pancreatitis. Am J Gastroenterol. 2013;108:1400-15.
[11] Horton KM. Multidetector CT and three-dimensional imaging of the pancreas: State of the art. Journal of Gastrointestinal Surgery. 2002;6(2):126-28.
[12] Alfidi RJ, Haaga JR. Computed tomography scanning of the pancreas. Radiol Clin North Am. 1977;15(3):367-76.
[13] Eichelberger MR, Chatten J, Bruce DA, Garcia VF, Goldman M, Koop CE. Acute pancreatitis and increased intracranial pressure. Journal of Pediatric Surgery.1981;16(4):562-70.
[14] Jeffrey R. Sonography in acute pancreatitis. Radiol Clin North Am. 1989;27(1):05-17.
[15] 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.

[16] Chand P, Singh R, Singh DP, Rani N. Evaluation of the outcome of acute pancreatitis by Ranson's criteria and modified CT severity index. International Journal of Contemporary Medicine Surgery and Radiology. 2017;2(2):58-61.

[17] Harshit Kumar A, Singh Griwan M. A comparison of APACHE II, BISAP, Ranson's score and modified CTSI in predicting the severity of acute pancreatitis based on the 2012 revised Atlanta Classification. Gastroenterol Rep (Oxf). 2018;6(2):127-131. doi:10.1093/gastro/gox029

PARTICULARS OF CONTRIBUTORS:
1. Associate Professor, Department of Radiology, Pushpagiri Institute of Medical Science, Thiruvalla, Pathanamthitta, Kerala, India.
2. Resident, Department of Radiology, Pushpagiri Institute of Medical Science, Thiruvalla, Pathanamthitta, Kerala, India.
3. Professor, Department of Radiology, Pushpagiri Institute of Medical Science, Thiruvalla, Pathanamthitta, Kerala, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dr. S Mangalanandan,
Pushpagiri Institute of Medical Science Thiruvalla,
Pathanamthitta-689101, Kerala, India.
E-mail: anand.mangal443@gmail.com

PLAGIARISM CHECKING METHODS: [Jain H et al.]
- Plagiarism X-checker: Apr 27, 2020
- Manual Googling: May 22, 2020
- iThenticate Software: Oct 27, 2020 (6%)

ETYMOLOGY: Author Origin

AUTHOR DECLARATION:
- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. Yes

Date of Submission: **Apr 26, 2020**
Date of Peer Review: **Jun 10, 2020**
Date of Acceptance: **Jul 01, 2020**
Date of Publishing: **Jan 01, 2021**