

Modified CT severity index for evaluation of acute pancreatitis and correlation with patient outcome

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Abstract

Background: The assessment of the severity of acute pancreatitis has a significant role in management. Mild pancreatitis responds well to the supportive therapy, whereas severe pancreatitis requires intensive monitoring and specific treatment. **Aims:** To study the prognostic value of MDCT in acute pancreatitis and to correlate modified CT severity index with clinical outcome. **Materials and methods:** This is a correlative study done for a period of 24 months in Study group consists of 47 patients selected using purposive sampling method from patients admitted to Government General Hospital with clinical impression of acute pancreatitis during study period. **Results:** In present study out of 47 patients, pancreas was normal in 2% cases in CT scan. Pancreatic inflammation was seen in 98% of patients. 83% patients had no evidence of pancreatic necrosis on CT scan. 15% of patients had less than 30% necrosis and only 2% had more than 30% necrosis. 56% patients had one or more extra pancreatic complications. 45% patients are considered to have end organ failure. Hepatic failure is the most common system failure seen in 38% patients. 36% patients had evidence of systemic infection. 8% patients required surgical interventions. According to Modified CT Severity Index, 40% patients had mild, 43% patients had moderate and 17% had severe pancreatitis. and according to RAC grading of pancreatitis 51% had mild, 34% had moderate, and 15% were severe. **Conclusion:** MCTSI is more useful scoring system than CTSI when used within three days of symptom onset.

Key words: Modified Computed Tomography Severity Index, Computed Tomography Severity Index, Revised Atlanta classification.

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Received Date: 20/11/2019 Revised Date: 19/12/2019 Accepted Date: 11/01/2020

DOI: <https://doi.org/10.26611/101313314>

Access this article online

Quick Response Code:



Website:

www.medpulse.in

Accessed Date:
09 March 2020

INTRODUCTION

Acute pancreatitis is a process of acute inflammation of pancreas usually caused by biliary stone, alcohol ingestion, metabolic factors and drugs. Abdominal pain

is the major symptom of acute pancreatitis. It is generally classified into mild and severe forms. Mild pancreatitis, also called as interstitial or edematous pancreatitis is associated with minimal organ failure and an uneventful recovery. Severe pancreatitis also called as necrotizing pancreatitis occurs approximately in 20% of the patients and is associated with organ failure or local complications, including necrosis, infection or pseudocyst formation. The diagnosis is usually established by leukocytosis, elevated serum amylase, serum lipase. A computed tomography (CT) scan confirms the clinical impression of acute pancreatitis. The assessment of the severity of acute pancreatitis has a significant role in management. Mild pancreatitis responds well to the supportive therapy, whereas severe pancreatitis requires intensive monitoring and specific

How to cite this article: Polysetty Obuleswar Prasad, N S Vidya, G V. Prasad, D R Anand. Modified CT severity index for evaluation of acute pancreatitis and correlation with patient outcome. *MedPulse International Journal of Radiology*. March 2020; 13(3): 154-161. <http://www.medpulse.in/Radio%20Diagnosis/>

treatment. The aim of this study is to determine whether early CT is effective in assessing the severity of acute pancreatitis and in predicting the prognosis and clinical outcome in these patients.

MATERIALS AND METHODS

SOURCE OF DATA

This is a correlative study done in the department of Radiodiagnosis in Sri Venkateswara Medical College, Tirupathi for a period of 24 months from October 2017 to October 2019. Study group consists of 47 patients selected using purposive sampling method from patients admitted to Government General Hospital with clinical impression of acute pancreatitis during study period.

METHOD OF COLLECTION OF DATA

Patients admitted to Government General Hospital with clinical impression of acute pancreatitis who underwent contrast enhanced MDCT during study period within three days of admission were included in the study. All scans were done using GE Bright speed 16 - slice MDCT with 120. KVP and 300 mAs with 5 mm slice thickness. Bolus tracking method is used for post contrast scan with the tracker placed in the descending aorta at the level of dome of diaphragm. 70-80 ml of 350mg/ml non ionic iodinated contrast (IOHEXOL) was injected using pressure injector at the rate of 3- 4ml/sec. Threshold set at 150 Hounsefield units(HU) and delay of 3 seconds was

given after the attainment of threshold for arterial phase. Venous phase acquired after a delay 60 seconds from the time of contrast injection. Scanning was done in cranio-caudal direction in arterial and venous phases; from the level of diaphragm to aortic bifurcation in the arterial phase and from the level of diaphragm to the level of pubic symphysis in the venous phase. Images were retro reconstructed with 1.25 mm slice thickness and reformatted in sagittal and coronal planes for analysis.

The severity of pancreatitis was scored using modified CT severity index and classified into three categories (mild, moderate and severe). The modified index is a 10 point scoring system derived by assessing the degree of pancreatic inflammation (0 to 4 points) pancreatic necrosis (0 to 4 points) and extrapancreatic complications (0 or 2 points). Clinical outcome parameters included the length of hospital stay, the need for surgical intervention and the occurrence of infection, organ failure and death. Collected data were analyzed by frequency, percentage and Chi square test to assess the statistical significance.

Inclusion Criteria: Patients admitted with clinical suspicion of acute pancreatitis who underwent contrast enhanced MDCT within three days of admission.

Exclusion Criteria: Patients admitted with clinical suspicion of acute pancreatitis who did not undergo contrast enhanced MDCT, Pancreatitis due to trauma.

RESULTS

The present study was conducted in the Department of Radio diagnosis, S.V.R.R. Government General Hospital, Tirupathi from October 2017 to October 2019. The study comprised of a total of 47 patients. In the present study, out of 47 cases, 35 (74.5%) were male and 12 (25.5%) were females with a male to female ratio of 2.9: 1.

Table 1: Age distribution of the study group

Age group (in years)	Number of patients	Percentage
15-25	5	11
26-35	18	38
36-45	9	19
46-55	7	15
Above 55	8	17
Total	47	100

Study included patients between the age group ranging from 15 years to 79 years with a mean age of 40 yrs. Maximum number of patients was seen in the age group of 26- 35 years of age group which consisted of 18 (38.3%) patients.

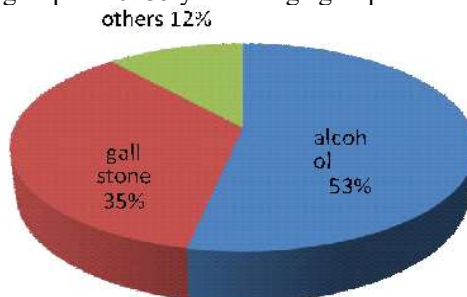


Figure1: Etiology of Pancreatitis

In the present study, 27 of 47 patients were alcoholic comprising of 53%, 16 (35%) patients had gall stones and remaining patients were grouped as others which consisted of 4 patients, diagnosed as pancreatic carcinoma (n=1) and idiopathic (n=3).

Table 2: Mode of clinical presentation of acute pancreatitis

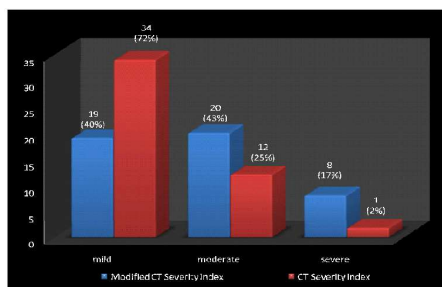
Mode of clinical presentation	Number of patients	Percentage
Pain abdomen	47	100
vomiting	40	85
Fever	17	36
Jaundice	3	6
Laboratory diagnosis		
Amylase normal	7	15
Amylase high	40	85
Lipase normal	4	8
Lipase high	43	92
Ultrasonography		
Normal	6	14
Abnormal	41	86

All 47 patients (100 %) presented with pain abdomen. 40 patients (85%) had vomiting, 17(36%) patients had fever and 3(6%) of patients had jaundice at the time of admission. Amylase was elevated in 40 (85%) patients at presentation. Lipase was elevated in 43(92%) patients at presentation. In 6 (14%) patients’ ultrasound was normal. 41 (86%) patients had abnormal ultrasound findings such as bulky pancreas with altered echogenicity, peripancreatic fat stranding, fluid collection, ascites or pleural effusion. After diagnosing Acute Pancreatitis based on the clinical presentation, biochemical parameters and ultrasonography, patients were subjected to CT scan of the abdomen according to the standard protocol. The severity of the pancreatitis was assessed by assigning point system by using Modified CT Severity Index and CT Severity Index. The modified index is a 10-point scoring system derived by assigning points to the degree of pancreatic inflammation (0 to 4 points) pancreatic necrosis (0 to 4 points) and extra pancreatic complications (0 or 2 points). All patients were graded into mild (score 0-2), moderate (score 4-6) or severe (score 8-10).

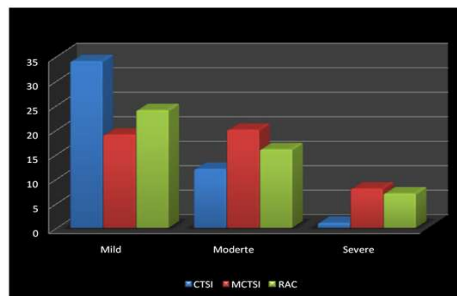
Table 3: Modified CT severity index scoring

Pancreatic Inflammation.	Number of patients	Percentage
0 score	2	4
2 score	24	51
4 score	21	44
pancreatic necrosis		
0 score	39	83
2 score	7	15
4 score	1	2
Extra pancreatic complications		
0	21	44
2	26	56

In the present study, pancreas was normal in 2 (4.3%) patients. 24 (51.1%) patients had intrinsic pancreatic abnormalities with or without inflammatory changes in peripancreatic fat, to whom 2 points were assigned. Remaining 21 (44.7%) patients had pancreatic or peripancreatic fluid collection or peripancreatic fat necrosis, to whom 4 points were assigned. A total of 39 (83%) patients had no evidence of pancreatic necrosis on CT scan. 7(15%) patients had less than 30% necrosis to which 2 points were assigned. only 1 patient had more than 30% necrosis, to which 4 points were assigned. Out of 47 patients, 21 (45%) patients had no evidence of extra pancreatic complications. 26 (56%) patients had one or more extra pancreatic complications such as pleural effusion, ascites, vascular complications, parenchymal complications, or gastrointestinal tract involvement. In the present study, 22 patients (85%) had both ascites and pleural effusion. 4 patients (20%) had only isolated ascites. None of the patients had isolated pleural effusion. One patient is found to have splenic vein aneurysm and another found to have portal vein thrombosis. patients severe pancreatitis. The discrepancy is attributed to the inclusion of extrapancreatic complications in MCTSI scoring system. Hence, two extra points were added to the severity index in addition to the pancreatic. inflammation and necrosis findings.



Graph 2



Graph 3

Graph 2: Comparison of total number of patients belonged to each severity indexes based on MCTSI and CTSI; **Graph-3.** Comparison of total number of patients belonged to each severity indexes based on MCTSI, CTSI and RAC grading

Modified CT Severity index was calculated by adding points assigned to each parameter. The severity of pancreatitis is classified into three categories: mild (0-2 points), moderate (4-6 points) and severe (8-10 points). According to the Modified CT Severity Index, the patients were graded into mild (n=19), moderate (n=20) and severe (n=8) i.e. 40% patients had mild, 43% patients had moderate and 17% had severe pancreatitis. In CTSI scoring system, 34 patients (72%) belonged to mild category, 12 (25%) patients had moderate and only patient belonged to severe pancreatitis. But in MCTSI scoring system 19 (40%) patients found to have mild pancreatitis and 20 (43%) patients found to have moderate and 8 (17%).

Graph 3, Out of 47 patients, as per the RAC grading 24 patients were classified under mild category, 16 were moderate and 7 were severe. 51% are mild, 34% are moderate, and 15% were severe.

Table 4: Patient outcomes and duration of hospitalization in severity based on Modified CT Severity Index and CTSI

	MCTSI	MILD	MODERATE	SEVERE
Total number of patients		19	20	8
Mean duration of hospitalization (in)		6	9	14
Surg int		0 (0%)	2 (10%)	2 (25%)
Infection		2 (10%)	8 (40%)	7 (88%)
End organ failure		6 (32%)	7 (35%)	8 (100%)
CTSI				
Total number of patients		34	12	1
Mean duration of hospitalization		7	14	3
Surgical intervention		1 (3%)	2 (17%)	1 (100%)
Infection		10 (29%)	6 (50%)	1 (100v)
End organ failure		11 (32%)	9 (75%)	1 (100%)

21 of 47 patients (45%) are found to have end organ failure. Hepatic failure was seen in 18 (38%) patients is the most common system failure in patients with acute pancreatitis in our study. Cardiac failure seen in 6 (13%), Renal failure in 5 (10%) patients. Respiratory failure and CNS failure each seen in 1 (2%) patient. One patient developed raise in hematocrit value. Of these 21 patients who developed end organ failure, 6 patients had mild, 7 patients had moderate and 8 patients had severe pancreatitis according to the MCTSI. 32% of patients who had mild pancreatitis had end organ failure, whereas end organ failure is seen in 35% and 100% of patients who had moderate and severe pancreatitis respectively (p=0.002). According to CTSI, of these 21 patients, 11 patients had mild, 9 patients had moderate and 1 patient had severe pancreatitis. 32% of patients who had mild pancreatitis had end organ failure, whereas end organ failure is seen in 75% and 100% of patients who had moderate and severe pancreatitis respectively (p=0.012). The above statistics shows that, highly

significant correlation exists between the prediction of end organ failure with the classification according to the MCTSI (p=0.002) than CTSI (p=0.012). A total of 17 (36%) patients who had fever and leukocytosis were considered to have systemic infection. Of these 17 patients, 2 patients had mild, 8 patients had moderate and 7 patients had severe pancreatitis according to the MCTSI. 10% of patients who had mild pancreatitis had systemic infection, whereas systemic infection is seen in 40% and 88% of patients who had moderate and severe pancreatitis respectively (p=0.001). According to CTSI, of these 17 patients, 10 patients had mild, 6 patients had moderate and 1 patient had severe pancreatitis. 29% of patients who had mild pancreatitis had systemic infection, whereas systemic infection was seen in 50% and 100% of patients who had moderate and severe pancreatitis respectively (p=0.172). With above statistical values, it can be concluded that, there is a highly significant correlation between the prediction of systemic infection with the classification according to the

MCTSI (P=0.001), compared to the classification according to CTSI which is not statistically significant (p=0.172). Surgical intervention was required in 4 (8%) patients. Three patients who underwent laprotomy or USG guided aspiration had infected pseudocyst. One patient underwent surgical necrosectomy and subsequently that patient expired. In our study, none of the patients who had mild pancreatitis according to MCTSI scoring underwent surgical intervention. Two patients (4%) had infected pseudocyst belonged to group of moderate pancreatitis, underwent surgical intervention. Two patients who had severe pancreatitis underwent surgical intervention, of them one had infected pseudocyst and another had necrosectomy. The statistical p value 0.117 is not significant. One patient, who had mild pancreatitis according to CTSI scoring, had infected pseudocyst and underwent surgical intervention. Two patients (4%) had infected pseudocyst belonged to group of moderate pancreatitis, underwent surgical intervention. One patient who had severe pancreatitis underwent surgical intervention, necrosectomy. The statistical p value 0.017 is significant. Above statistical analysis shows significant correlation between CTSI scoring system (p=0.017) and surgical intervention as compared to the MCTSI scoring system (0.117). Duration of hospital stay in our study was ranging from 2 to 23 days with mean duration of 9 days. The mean duration of hospitalization in mild, moderate and severe classes of Acute Pancreatitis according to Modified CT Severity Index was 6, 9 and 14 days respectively. Whereas it was 7, 14 and 3 days respectively as per the CT Severity Index. The above values shows that mean duration of hospitalization correlates well with the severity classification based on the MCTSI than CTSI. One patient who had severe pancreatitis (score 10) based on both classification died due to multiple organ failure. The same patient underwent surgical necrosectomy and

died on 3rd day of hospitalisation. Mortality rate in our study was 2%.

DISCUSSION

Pancreatitis is classified as acute unless there is CT, MRI, or endoscopic retrograde cholangiopancreatography (ERCP) findings of chronic pancreatitis when pancreatitis is classified as chronic pancreatitis, and any episode of acute pancreatitis is considered an exacerbation of inflammation superimposed on chronic pancreatitis.

Initial clinical assessment of the progression of acute pancreatitis alone has been inadequate in identifying patients who develop a severe disease. Identifying severe cases are important and can play a significant role in management decision and in reducing the morbidity and mortality associated with severe acute pancreatitis. Ranson score, Glasgow score, APACHE II, Marshall and SOFA (Sepsis-related organ failure assessment) scoring system are different severity scoring system studied in the past and proven to be indicators of the clinical severity. But, none of the above scoring system are proven to be the precise indicators of the adverse clinical outcome.

Age incidence

Mean age of presentation is 40 years in our study population. It is concurrent with study done by Thomas *et al.*⁸, Jauregui *et al.*⁹, and others. The prevalence of chronic alcohol abuse and biliary stones are common in fourth and fifth decades explain the high incidence of the acute pancreatitis in this age group.

Sex distribution:

M: F ratio in our study is about 3:1. Similar results are seen by Freeny *et al.*⁴ As alcohol was the most common etiological factor in our study which is common in males, a high M: F ratio was observed.

Table 5: Age and sex distribution comparison in different studies

Study series	Total no of Patients	Male	Female	M:F	Age in years
Present study	47	35	12	2.9:1	15-79 (mean-40)
Mortele <i>et al.</i> ⁵	66	37	29	1.2:7	19-87 (mean-53)
Bollen <i>et al.</i> ⁶	179	107	89	1.2:1	21-91 (mean- 45)
Freeny <i>et al.</i> ⁴	34	26	8	3.2:1	31-71 (mean- 56)
Bollen <i>et al.</i> ⁷	150	84	66	1.2:1	21-91(mean-54)
Jauregui <i>et al.</i> ⁸	30	19	11	1.7:1	18-82 (mean-45)

Table 6: Etiological factors comparison in different studies

Study series	Biliary Stones	Alcohol abuse	Miscellaneous	Idiopathic
Present study	35%	53%	10%	2%
Bollen <i>et al.</i> ⁶	34%	22%	16%	13%
Dugernier T L ⁹	22%	60%	-	-
Freeny <i>et al.</i> ⁴	20%	35%	-	-
Jauregui <i>et al.</i> ⁸	53%	27%	-	-

Etiology

Chronic alcohol abuse is the most common etiological factor in our study constituting 53% of cases. Similar results were observed by Dugernier T L⁹ and Freeny *et al.*⁴ In contrary, studies done by Bollen T L *et al.*⁷ and Jauregui *et al.*⁹ showed biliary stones as the predominant etiological agent.

Correlation of CT Scoring Indexes With patient outcome parameters

Present study showed a significant correlation of grades of severity of pancreatitis based on both MCTSI and CTSI with patient outcome parameters. However MCTSI was more closely associated with patient outcome than CTSI in our study. Several studies reported a strong correlation between the CT evaluation and the clinical severity of acute pancreatitis and some studies have not corroborated these findings.

This difference in statistical significance between CTSI and MCTSI in our study may be attributed to the inclusion of extrapancreatic complications in the MCTSI system. We assume that the presence of ascites and pleural fluid may be responsible for the improved correlation with MCTSI, because they may be early indicators of organ dysfunction. Another important difference between the MCTSI and CTSI is that, MCTSI differentiates only between presence and absence of acute fluid collections and, therefore does not require a count of the collections as in case of CTSI. Similar study was done by Morteale K J *et al.*⁵ In his study, when applying the modified index, the severity of pancreatitis and the following parameters correlated more closely than when the previously established CTSI was applied: the length of the hospital stay, the need for surgical or percutaneous procedures, and the occurrence of infection. Significant correlation between the severity of

pancreatitis and the development of organ failure was seen only using the MCTSI ($p = 0.0024$), not the CTSI ($p = 0.0513$). Our study resulted in almost similar findings except that CTSI score showed statistically significant correlation with prediction of surgical intervention than MCTSI score. This difference is due to the presence of infected pseudocyst in two patients who presented with relapse of pancreatitis but had different scores in both indexes. In contrary to present study results, Bollen T L *et al.*¹² showed no statistically significant differences between the two CT scoring systems with regard to all the studied severity parameters. The differences observed may be due to differences in criteria for organ failure and clinically severe AP (the present study used criteria in accordance with the Marshall criteria of end organ failure). In present study, for the MCTSI and CTSI to detect severe pancreatitis, sensitivity was 40% vs. 34%, negative predictive value was 67% vs. 56% respectively, specificity and positive predictive value of 100% for both indexes. Hence MCTSI is more useful for the screening in patients with severe acute pancreatitis than CTSI. Jauregui *et al.*⁹ found similar results, stating that for the MCTSI and CTSI, to detect severe pancreatitis, sensitivity was 61% vs. 38%, specificity 66% vs. 100% and positive predictive value of 81% vs. 100%, respectively. Correlation of CT scoring indexes with RAC grading of acute pancreatitis Present study showed significant correlation between MCTSI and RAC grading of acute pancreatitis. MCTSI grading was concordant with RAC grading in 42 cases CTSI was concordant with RAC grading in 37 cases and both MCTSI, CTSI were concordant with RAC grading in 32 cases. Thus MCTSI showed significant correlation with RAC grading of severity.

Table 7: Comparison table between present study and others studies

Study series	Our study	Morteale <i>et al.</i> ⁵	Bollen <i>et al.</i> ⁶
Total no of patients	47	66	196
MCTSI			
Mild	14 (40%)	34 (52%)	86 (44%)
Moderate	20 (43%)	22 (33%)	75 (38%)
Severe	8 (17%)	10 (15%)	35 (18%)
CTSI			
Mild	34 (72%)	42 (63%)	136 (69%)
Moderate	12 (26%)	19 (28%)	41 (21%)
Severe	1 (2%)	5 (9%)	19 (10%)
Duration of hospital stay in days	2-23 (mean-9)	0-34(mean-7)	0-113 (mean-6)
Surgical intervention	4 (8%)	10 (15%)	19 (10%)
Infection	17 (36%)	21 (32%)	7 (4%)
End organ failure	21(45%)	9 (14%)	38 (19%)
Death	1 (2%)	2 (30%)	11 (6%)

Table 8: Comparison table showing statistical significance (p value) of the two CT indexes in prediction of patient outcome between present study and other studies

Correlation factors		Our study	Mortele <i>et al.</i> ⁵	Bollen <i>et al.</i> ⁶
Duration of	MCTSI	p = 0.02	p = 0.035	p < 0.0001
	CTSI	p = 0.05	p = 0.15	p < 0.0001
hospital stay	MCTSI	p = 0.117	p = 0.012	p < 0.0001
	CTSI	p = 0.017	p = 0.0324	p < 0.0001
Surgical	MCTSI	p = 0.002	p = 0.0024	p < 0.0001
	CTSI	p = 0.012	p = 0.0513	p < 0.0001
intervention	MCTSI	p = 0.001	p < 10 -10	p = 0.06
	CTSI	p = 0.172	p < 0.0001	p = 0.04
End organ	MCTSI	p = 0.001	p < 10 -10	p = 0.06
	CTSI	p = 0.172	p < 0.0001	p = 0.04
failure	MCTSI	p = 0.001	p < 10 -10	p = 0.06
	CTSI	p = 0.172	p < 0.0001	p = 0.04
Infection	MCTSI	p = 0.001	p < 10 -10	p = 0.06
	CTSI	p = 0.172	p < 0.0001	p = 0.04

Role of Extrapancreatic Complications In Assessment Of Severity

In a study done by Mole D J *et al.*¹⁰ showed that extrapancreatic complications are associated more closely with the multi organ failure than presence of infection. In our study extrapancreatic complications were significantly associated with adverse outcome. Patients who had extrapancreatic complications had more severity score according to the MCTSI than CTSI, thereby increase in the number of patients having moderate and severe pancreatitis according to the MCTSI when compared to the CTSI. This resulted in the more closely association with the patient outcome in MCTSI. Study done by De Waele *et al.*¹¹ showed similar results and concluded that, extrapancreatic inflammation assessed by abdominal CT scan allows accurate estimation of disease severity and mortality within 24 h of admission.

Prediction of pancreatic infection and correlation with patient outcome In present study, 36% of patients were found to have evidence of systemic infection. However, the presence of infection was not confirmed in our study. Beger H G *et al.*¹² did clinical study on 114 patients with acute necrotizing pancreatitis, found 23.8% to have infection by bacterial contamination of the pancreatic necrosis confirmed by laparotomy. Hence it can be stated that, presence of fever and leukocytosis is the sensitive indicator of presence of the infection. Furthermore, evidence of infection is seen in 40% and 88% of patients with moderate and severe pancreatitis respectively as compared to only 10% of patients with mild pancreatitis. Hence classifying the patients according to the MCTSI may yield a better prediction of pancreatic infection. Also, the mean duration of hospital stay was more than those without evidence of infection.

Role of Pancreatic Necrosis in Prediction of Outcome

In present study 8 patients had severe pancreatitis and all patients had evidence of necrosis on CECT. All these patients had adverse clinical outcome when compared to

the patients who had mild or moderate pancreatitis. Similar results seen in study done by Dugernier T L *et al.*⁹ where all patients with acute severe pancreatitis had necrosis on CT scan. There is no significant correlation between presence of necrosis and need of surgical intervention in our study. Similar results were seen in study done by Freeny *et al.*⁴. This can be explained as patients presented with relapse and having pseudocyst and mild severity of pancreatitis but required surgical intervention. It was observed in our study that no significant association exists in different subgroups of necrosis when using the CT severity index (between patients who have 30– 50% necrosis and patients who have more than 50% necrosis) and clinical outcome. Similar results were seen by Balthazar *et al.*¹³ This is an important limitation of the CTSI as it is cumbersome and technically difficult to quantify the necrosis as 30-50% or above 50%. This limitation is not observed in MCTSI as patients having more than 30% necrosis are grouped together and assigned 4 points. In present study 2% of mortality rate was observed, Lescence *et al.* observed 6% mortality in their study.¹⁴ The mean annual mortality rate for acute pancreatitis in the population was 1.3 per 100,000. Study done by Chamisa, T *et al.*¹⁵ showed difference in mortality rate in gallstone pancreatitis and alcohol induced pancreatitis which was 6.5% and 3.1% respectively.

CONCLUSION

Present study showed highly significant correlation between the MCTSI score and the prediction of end organ failure, systemic infection and duration of hospital stay .and RAC grading of pancreatitis However no significant correlation found with the need for surgical intervention. There was significant correlation of grades of severity of acute pancreatitis based on MCTSI with patient outcome parameters than grades of severity of acute pancreatitis based on CTSI. Extra pancreatic complications, when included in the CT scoring system (MCTSI) were significantly correlated with end organ

failure and adverse clinical outcome. Hence MCTSI may be more useful scoring system than CTSI when used within three days of symptom onset.

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Source of Support: None Declared
Conflict of Interest: None Declared