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Role of modified CT severity index as a prognostic marker of acute pancreatitis

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Abstract

Severe acute pancreatitis can develop in approximately 15 to 25 percent of patients having acute pancreatitis. Early identification of patients at increased risk for morbidity and mortality can be predicted by the severity of disease, and hence the prediction helps in assisting early triage to intensive care units (ICU) and selection of patients for specific interventions. The present prospective study was done among 55 patients in the Department of Radiodiagnosis, Kamineni Hospitals, L.B. Nagar, Hyderabad. Liver failure followed by respiratory and renal failure were the most commonly associated organ failure with acute pancreatitis. MCTSI and CTSI have comparable accuracy in predicting various organ failure in patients with acute pancreatitis. Both the scoring indices correlated significantly with other outcome indicators of acute pancreatitis also. In most of the cases presence of the necrosis was associated with the end organ failure but it cannot be termed as a causative factor for organ failure.

Keywords: acute pancreatitis, CT severity index, organ failure.

1. Introduction

Acute pancreatitis is a complex disease with variable clinical pattern. Most of the patients with mild disease show complete recovery, whereas around 15–20% of patients develop clinically severe acute pancreatitis with local and systemic complications; and has a mortality rate of 20–30%^[1, 2] The most common causes of pancreatitis are alcohol intake and choledocholithiasis. Other causes include metabolic disorders (hyperlipidemia, hypercalcemia), ERCP induced pancreatitis, medications (azathioprine, sulphonamides), trauma, tumours, and congenital anomalies such as pancreas divisum.³

2. Aim and Objectives

2.1 Aim

- To grade the CT findings of patients with acute pancreatitis according to the modified CT severity index.

2.2 Objectives

- To correlate the grading system with patient outcome in terms of
- Organ failure
- Mortality
- Duration of hospital stay

3. Material and Methods

The present study was undertaken in the Department of Radiodiagnosis, Kamineni Hospitals, L.B. Nagar, Hyderabad. This is a prospective cross sectional study done among 55 patients of either gender presenting to the department of Radio-diagnosis in our hospital with acute pancreatitis. Institutional Ethical Committee approval taken.

3.1 Inclusion Criteria

Patients admitted in hospital with clinical suspicion of acute pancreatitis who underwent contrast enhanced MDCT.

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3.2 Exclusion Criteria

- Patients with chronic pancreatitis suggested by intra-ductal calculi, ductal stricture and parenchymal calcification.
- Patients who are discharged from hospital before they recover from organ failure as per the above mentioned criteria.
- Patients not willing to undergo Contrast study.
- Patients with known history of allergy to iodinated contrast agents.
- Patients with deranged renal function test (serum creatinine > 1.5 mg/dl after rehydration).
- Pregnant Patients.

4. Results

Table 1: Distribution of study participants based on age (n=55)

Age (in years)	Frequency	Percent
10-20	3	5.5
21-30	10	18.2
31-40	13	23.6
41-50	17	30.9
51-60	8	14.5
61-70	2	3.6
71-80	1	1.8
81-90	1	1.8
Total	55	100.0

Maximum of the study participants were in the age group of 41-50 years who represented 30.9% of the study participants. The mean age of the study participants was 41.2±14.2 years and the minimum age among the participants was 13 years. Majority of the study participants were males who represented 81.8% of all study participants and while females were 18.2%. Nearly half of all the study participants were found to be consuming alcohol.

Table 2: Distribution of study participants based on presence of clinical features (n=55)

Clinical Feature	Frequency	Percentage
Vomiting	44	80.0
Fever	16	29.1
Jaundice	8	14.5
Gall Stones	8	14.5
Abnormal TLC	48	87.3
Abnormal Amylase	46	83.6
Abnormal Lipase	48	87.3
Abnormal USG	47	85.5

Vomiting was the most common symptom and abnormal TLC, amylase and lipase were the most common features among the study participants

Table 3: Distribution of study participants based on Modified CT Severity Index (n=55)

Modified CT Severity Index	Frequency	Percent
Mild	2	3.6
Moderate	35	63.6
Severe	18	32.7
Total	55	100.0

Majority of the study participants were in moderate severity range who represented 63.6% of the study participants according to modified CT severity index.

Table 4: Distribution of study participants based on CT Severity Index (n=55)

CT Severity Index	Frequency	Percent
Mild	14	25.5
Moderate	32	58.2
Severe	9	16.4
Total	55	100.0

Majority of the study participants were in moderate severity range who represented 58.2% of the study participants. Nearly 15% of all study participants were found to have respiratory failure on evaluation during the course of the illness. Nearly 12.7% of all study participants were found to have CVS failure on evaluation during the course of the illness. Nearly 15% of all study participants were found to have renal failure on evaluation during the course of the illness. Nearly 25% of all study participants were found to have liver failure on evaluation during the course of the illness.

Three of all study participants were found to have haematological failure on evaluation during the course of the illness. Nearly 36.4% of all study participants were found to have EOF on evaluation during the course of the illness. Nearly 25.5% of all study participants were found to have pseudocyst on evaluation during the course of the illness. Five of all study participants were found to have thrombosis on evaluation during the course of the illness. Almost 70% of all study participants were found positive of infection on evaluation during the course of the illness. Five of all study participants required surgical interventions during the management of illness.

Table 5: Association between age and modified CT severity index (n = 55)

Age	Modified CT severity index			Total n (%)	P value
	Mild	Moderate	Severe		
≤30	0(0.0)	6(46.2)	7(53.8)	13(100.0)	0.293
31-45	2(10.0)	12(60.0)	6(30.0)	20(100.0)	
46-60	0(0.0)	14(77.8)	4(22.2)	18(100.0)	
>60	0(0.0)	3(75.0)	1(25.0)	4(100.0)	
Total	2(3.6)	35(63.6)	18(32.7)	55(100.0)	

* Chi Square test was applied to test statistical difference in proportions

No significant association was observed between age of the study participant and MCTSI (p value – 0.293).

Table 6: Association between CT severity index and CVS failure (n = 55)

CT severity index	CVS Failure		Total n (%)	P value
	Present	Absent		
Mild	1(7.1)	13(92.9)	14(100.0)	<0.001
Moderate	1(3.1)	31(96.9)	32(100.0)	
Severe	5(55.6)	4(44.4)	9(100.0)	
Total	7(12.7)	48(87.3)	55(100.0)	

* Chi Square test was applied to test statistical difference in proportions

Higher proportion of study participants with CTSI with severe grades had respiratory failure as compared to mild and moderate grades. Also, this association was found to be statistically significant (p value < 0.001).

Table 7: Association between CT severity index and renal failure (n = 55)

CT severity index	Renal Failure		Total n (%)	P value
	Present	Absent		
Mild	0(0.0)	14(100.0)	14(100.0)	0.083
Moderate	5(15.6)	27(84.4)	32(100.0)	
Severe	3(33.3)	6(66.7)	9(100.0)	
Total	8(14.5)	47(85.5)	55(100.0)	

* Chi Square test was applied to test statistical difference in proportions

Higher proportion of study participants with CTSI with severe grades had renal failure as compared to mild and moderate grades. However, this association was not found to be statistically significant (p value – 0.083).

Table 8: Association between modified CT severity index and liver failure (n = 55)

Modified CT severity index	Liver Failure		Total n (%)	P value
	Present	Absent		
Mild	0(0.00)	2(100.0)	2(100.0)	0.229
Moderate	7(20.0)	28(80.0)	35(100.0)	
Severe	7(38.9)	11(61.1)	18(100.0)	
Total	14(25.5)	41(74.5)	55(100.0)	

* Chi Square test was applied to test statistical difference in proportions

Higher proportion of study participants with MCTSI with severe grades had liver failure as compared to mild and moderate grades. However, this association was not found to be statistically significant (p value – 0.229).

Table 9: Association between CT severity index and liver failure (n = 55)

CT severity index	Liver Failure		Total n (%)	P value
	Present	Absent		
Mild	2(14.3)	12(85.7)	14(100.0)	0.513
Moderate	9(28.9)	23(71.9)	32(100.0)	
Severe	3(33.3)	6(66.7)	9(100.0)	
Total	14(25.5)	41(74.5)	55(100.0)	

* Chi Square test was applied to test statistical difference in proportions

Higher proportion of study participants with CTSI with severe grades had liver failure as compared to mild and moderate grades. However, this association was not found to be statistically significant (p value – 0.513).

Table 10: Association between modified CT severity index and haematological failure (n = 55)

Modified CT severity index	Haematological Failure		Total n (%)	P value
	Present	Absent		
Mild	0(0.00)	2(100.0)	2(100.0)	0.430
Moderate	1(2.9)	34(97.1)	35(100.0)	
Severe	2(11.1)	16(88.9)	18(100.0)	
Total	3(5.5)	52(94.5)	55(100.0)	

* Chi Square test was applied to test statistical difference in proportions

proportions

Higher proportion of study participants with MCTSI with severe grades had haematological failure as compared to mild and moderate grades. However, this association was not found to be statistically significant (p value – 0.430).

Table 11: Association between CT severity index and haematological failure (n = 55)

CT severity index	Haematological Failure		Total n (%)	P value
	Present	Absent		
Mild	1(7.1)	13(92.9)	14(100.0)	0.033
Moderate	0(0.0)	32(100.0)	32(100.0)	
Severe	2(22.2)	7(77.8)	9(100.0)	
Total	3(5.5)	52(94.5)	55(100.0)	

* Chi Square test was applied to test statistical difference in proportions

Higher proportion of study participants with CTSI with severe grades had haematological failure as compared to mild and moderate grades. Also, this association was found to be statistically significant (p value – 0.033).

Table 12: Association between modified CT severity index and duration of hospital stay (n = 55)

Modified CT severity index	Duration of hospital stay				Total n (%)	P value
	Upto 1 week	1-2 weeks	2-3 weeks	>3 Weeks		
Mild	2(100.0)	0(0.0)	0(0.0)	0(0.0)	2(100.0)	0.024
Moderate	23(65.7)	10(28.6)	2(5.7)	0(0.0)	35(100.0)	
Severe	4(22.2)	10(55.6)	1(5.6)	3(16.7)	18(100.0)	
Total	29(52.7)	20(36.4)	3(5.5)	3(5.5)	55(100.0)	

* Chi Square test was applied to test statistical difference in proportions

Higher proportion of study participants with MCTSI with severe grades had higher duration of hospital stay as compared to mild and moderate grades. Also, this association was found to be statistically significant (p value – 0.024).

Table 13: Association between CT severity index and duration of hospital stay (n = 55)

CT severity index	Duration of hospital stay				Total n (%)	P value
	Upto 1 week	1-2 weeks	2-3 weeks	>3 Weeks		
Mild	10(71.4)	3(21.4)	1(7.1)	0(0.0)	14(100.0)	0.001
Moderate	18(56.3)	12(37.5)	2(6.3)	0(0.0)	32(100.0)	
Severe	1(11.1)	5(55.6)	0(0.0)	3(33.3)	9(100.0)	
Total	29(52.7)	20(36.4)	3(5.5)	3(5.5)	55(100.0)	

* Chi Square test was applied to test statistical difference in proportions

Higher proportion of study participants with CTSI with severe grades had higher duration of hospital stay as compared to mild and moderate grades. Also, this association was found to be statistically significant (p value – 0.001).

Table 14: ROC analysis and Area under the Curve for Modified CT severity index and CT severity index in predicting various organ failures (n = 55)

Organ failure	Respiratory failure	
	MCTSI	CTSI
AUC	0.860	0.864
95 % CI of AUC	0.731-0.990	0.735-0.993
p value	0.001	0.001
CVS Failure		
AUC	0.811	0.807
95 % CI of AUC	0.59-1.0	0.577-1.0
p value	0.008	0.009
Renal Failure		
AUC	0.719	0.738
95 % CI of AUC	0.543-0.896	0.572-0.904
p value	0.049	0.033
Liver Failure		
AUC	0.602	0.619
95 % CI of AUC	0.429-0.775	0.448-0.791
p value	0.258	0.186
Haematological failure		
AUC	0.651	0.663
95 % CI of AUC	0.208-1.0	0.197-1.0
p value	0.384	0.345

5. Discussion

The present study was undertaken with a primary aim to grade the CT findings of patients with acute pancreatitis according to the modified CT severity index. The present study was carried out as a prospective cross sectional study among 55 patients of either gender presenting to the department of Radio-diagnosis in our hospital with acute pancreatitis. Cases of acute pancreatitis were graded according to the modified CT severity index. According to the modified CT severity index pancreas was assessed as normal parenchyma, presence of inflammation, or peri-pancreatic fat stranding and presence of the peri-pancreatic/pancreatic fluid collection. Pancreas is assessed in terms of the attenuation for the pancreatic necrosis.

The mean age of the study participants was 41.2±14.2 years and Majority of the study participants were males (81.8%). Majority of the study participants were in moderate severity range who represented 63.6% of the study participants and 32.7% were in severe category according to modified CT severity index. Nearly 15% of the participants had respiratory failure, 12.7% had CVS failure, 15% had renal failure, and 25% had liver failure. The mean duration of hospital stay of the study participants was 8.4±5.5 days. Higher proportion of study participants with MCTSI with severe grades had various organ failures. Higher proportion of study participants with MCTSI with severe grades had higher duration of hospital stay as compared to mild and moderate grades. The ROC curve analysis showed comparable AUC values for both MCTSI and CTSI for predicting various organ failures.

Banday IA *et al.* [4] studied the role of modified computed tomography severity index in evaluation of acute pancreatitis and its correlation with clinical outcome among 50 patients. The results of the studied noted that maximum patients were in the age group 40-50 years (42.0%). The mean age was 42.32 years and 66% were males. The age distribution of the patients were similar to that of the present study where the mean age of the study participants was 41.2±14.2 years. Sahu B *et al.* [5] in their study assessed the severity of acute pancreatitis using CTSI and MCTSI, to correlate with clinical outcome measures, and to assess

concordance with severity grading. The study was undertaken among 60 patients inclusive of 36 males with a mean age of 37 years. A relatively higher mean age group of the patients were noted in the present study as compared to the above discussed study. The proportion of male patient were higher in the present study (81.8) as compared to that of the above discussed studies. Banday IA *et al.* [4] in their study observed that Pleural effusion was the most common extra-pancreatic complication, 28 patients (56%), followed by ascites. Sharma V *et al.* [6] in the study among 105 patient with acute pancreatitis and noted that Fluid collections occurred in 91 (86.7%), organ failure in 83 (79.0%) and persistent organ failure occurred in 71 (67.6%) patients. In the present study 15% of the participants had respiratory failure, 12.7% had CVS failure, 15% had renal failure, and 25% had liver failure, these were significantly lower rates as in comparison to observations of Banday IA *et al.* [4] *et al* study.

Pleural effusion was seen among 33.3% in Nath *et al.* [7] study and 20% among the patients in Maringhini *et al.* [8] study. Ascites was observed among 18% of the patients with acute pancreatitis in Maringhini *et al.* [8] study. In case of Sharma V *et al.* [6] *et al* study interventions (radiological and surgical) were needed in 16 (15.2%) patients while 8 (7.6%) patients succumbed to their illness.

Nath L *et al.* [7] in their study among 60 patients with acute pancreatitis, 90% were males, Pleural effusion was seen in 33.3% of cases, ascites in 18.3% of cases, vascular complication in 10% of cases, extrapancreatic parenchymal abnormalities in 8.3% of cases and GIT involvement in 5% of cases. These findings and observations were comparable to that of the present study results. In Nath L *et al* [7] study out of 60 cases of acute pancreatitis 76.7% of cases showed Moderate (4-6) type, 13.3% of cases showed Mild (0 – 2) type and 10% of cases showed severe (8 – 10) type of acute pancreatitis according to MCTSI. Melkundi S *et al.* [9] evaluated 100 cases of acute pancreatitis it was noted that in case of MCTSI scoring system 26(26%) patients were found to have mild pancreatitis, 63 (63%) patients were found to have moderate and 11(11%) patients had severe pancreatitis. These findings of the above discussed studies were identical

to that of the present study observations, where a similar proportions of patients were in moderate severity range according to MCTSI.

Sahu B *et al.* [5] study reports revealed that According to CTSI and MCTSI, mild, moderate, and severe cases were 45%, 31.7%, 23.3% and 40%, 16.7%, 43.3%, respectively. In the present study majority of the patients were in moderate severity according to both CTSI and MCTSI, in contrast to the mild severity predominance in the above discussed study.

Banday IA *et al.* [4] in their study observed that the outcome parameters in terms of length of hospital stay, need of intervention, development of infection, and development of organ failure were more in patients with higher modified CT severity index. Both CTSI and MCTSI were significantly associated with outcome parameters ($P < 0.001$), except duration of ICU stay, in Sahu B *et al.* [5] study. Identical results were obtained in the present study also, where the higher proportion of participants in higher range of severity had organ failure and increased duration of hospital stay.

Raghuwanshi S *et al.* [10] assess prognostic correlation and clinical outcome of acute pancreatitis on the basis of CT severity index among 50 patients. It was noted in the study that Organ system failure, death were more seen in severe grade in modified CTSI. The study also concluded that Modified CT severity index makes the score easier to calculate and reduces the inter-observer variation. Scores obtained with the modified Mortelet index, show a stronger statistical correlation for all clinical outcome parameters in all the patients better than the Balthazar index. Banday IA *et al.* [4] concluded that the MCTSI is a simpler scoring tool and more accurate than the Balthazar CTSI. In this study, it had a stronger statistical correlation with the clinical outcome, be it the length of hospital stay, development of infection, occurrence of organ failure and overall mortality. It could also predict the need for interventional procedures.

Bollen TL *et al.* [1] in their research work compared the MCTSI with the CTSI regarding assessment of severity parameters in 397 patients with acute pancreatitis. The results of the study revealed that for both CT indexes a significant relationship was observed between the score and each severity parameter ($p < 0.0001$), no significant differences were seen between the CT indexes. Contrastingly Mortelet KJ *et al.* [11] assess the correlation with patient outcome of a modified CT severity index in the evaluation of patients with acute pancreatitis compared with the CT severity index among 266 patients. It was observed in the study that significant correlation between the severity of pancreatitis and the development of organ failure was seen only using the modified index. In agreement to the above discussed studies the present study observed a similar AUC values for both CTSI and MCTSI in predicting organ failure, though in case of certain selected organ/system MCTSI performed better than CTSI in prediction of organ failure.

A significant association was observed between severe grades of MCTSI and occurrence of organ failure among patients with acute pancreatitis in Raghuwanshi S *et al.* [10] study. AUC for predicting persistent organ failure for CTSI and MCTSI was 0.916 and 0.931 respectively in Sahu B *et al.* [9] study. Parhi AP *et al.* [12] in their research work observed that 22 out of 50 patients developed organ failure. Of these 22 patients who developed end organ failure, 6 patients had mild, 7 patients had moderate and 9 patients

had severe pancreatitis according to the MCTSI. 30% of patients who had mild pancreatitis had end organ failure, whereas end organ failure is seen in 33% and 100% of patients who had moderate and severe pancreatitis respectively ($p < 0.002$). These findings with respect of prediction of organ failure were comparable to that of the observations noted in the present study.

6. Conclusion

The present study was undertaken with a primary aim to grade the CT findings of patients with acute pancreatitis according to the modified CT severity index. This prospective cross sectional study done among 55 patients of either gender presenting to the department of Radiodiagnosis in our hospital with acute pancreatitis.

Cases of acute pancreatitis were graded according to the modified CT severity index. According to the modified CT severity index pancreas was assessed as normal parenchyma, presence of inflammation, or peri-pancreatic fat stranding and presence of the peri-pancreatic/pancreatic fluid collection. Pancreas is assessed in terms of the attenuation for the pancreatic necrosis. The mean age of the study participants was 41.2 ± 14.2 years and Majority of the study participants were males (81.8%). Majority of the study participants were in moderate severity range who represented 63.6% of the study participants and 32.7% were in severe category according to modified CT severity index. Nearly 15% of the participants had respiratory failure, 12.7% had CVS failure, 15% had renal failure, and 25% had liver failure. The mean duration of hospital stay of the study participants was 8.4 ± 5.5 days. Higher proportion of study participants with MCTSI with severe grades had various organ failures. Higher proportion of study participants with MCTSI with severe grades had higher duration of hospital stay as compared to mild and moderate grades. The ROC curve analysis showed comparable AUC values for both MCTSI and CTSI for predicting various organ failures.

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