Accuracy of Modified Computed Tomography Index in Evaluation of Acute Pancreatitis and Its Correlation with Outcome - A Prospective Observational Study

S Ratna Vasanthan[1], Govardhanan R[2], Jawahar R[3]

[1]Associate Professor, Department of Radiology, [2]Associate Professor, Department of Radiology, [3]Senior Resident, Department of Radiology, Sri Venkateshwara Medical College and Research Center, India

Corresponding author: Govardhanan R, Associate Professor, Department of Radiology, Sri Venkateshwara Medical College and Research Center, India

ABSTRACT

Introduction: Acute Pancreatitis is one of the most complex and clinically challenging of all abdominal disorders. Early assessment of the cause and severity of acute pancreatitis is of utmost importance. Aims: To assess the severity of acute pancreatitis (AP) using a modified CT severity index (MCTSI), to correlate its diagnostic accuracy with clinical outcome.

Material and Methods: In this observational study, 39 cases with acute pancreatitis undergoing Contrast-enhanced computerized tomography (CECT) of the abdomen and pelvis from November 2017 to July 2019 were selected. Two radiologists, blinded to clinical parameters, independently assessed MCTSI. The cases were followed for 30 days. Clinical outcome parameters included duration of stay in the hospital and intensive care unit (ICU), necrosis, abscess, pseudocyst and need for intervention. coGuide was used for statistical analysis

Results: We included 39 cases,35(89.74%) males, age range 26–60 (mean 37 years). 19(48.71%) participants had moderate pancreatitis according to CT grading. Out of 39 participants, 7(17.94%) had necrosis. 9(23.07%) had pseudocyst, 9(23.1%) had local complications, and 2(5.2%) had systemic complications. The mean difference of ICU stays, and overall hospital stay was statistically significant with CT index findings (P value <0.05). The CT gradings of ICU stay had a sensitivity of 76.9% in predicting outcome. specificity 52%, positive predictive value 52.6%, negative predictive value 76.9% and the total prevalence was 51%.

Conclusion: MCTSI showed significant correlation with clinical outcome parameters and higher sensitivity and specificity in differentiating mild from moderate/severe AP.

Keywords: Acute Pancreatitis; CT Severity Index; Modified CT Severity Index; Necrotizing Pancreatitis; Organ Failure

INTRODUCTION

Acute pancreatitis (AP) is an inflammatory process of the pancreas with possible peripancreatic tissue and multiple organ involvement inducing multiple organ dysfunction syndromes (MODS) with an increased mortality rate. The incidence of acute pancreatitis per 100,000 population ranges from 5 to 80 cases per year, with the highest incidence rates seen in Finland and the USA.[1]

Abdominal pain is the major symptom of acute pancreatitis. It is generally classified into mild and severe forms. Mild pancreatitis, also called interstitial or edematous pancreatitis, is associated with minimal organ failure and 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.[2] The majority of patients with the mild disease recover completely, whereas approximately 15–20% of patients develop clinically

severe AP with local and systemic complications; and mortality in this group may reach 20–30%. Identification of patients with clinically severe AP is important as these patients may benefit from transfer to a specialized or intensive care unit (ICU), where they can receive aggressive fluid resuscitation and be closely monitored to develop organ failure (OF).[3]

Diseases of the pancreas have a very variable presentation, and imaging plays an important role in the diagnosis and management of pancreatic diseases. Modalities for imaging pancreas range from plain x-ray to Ultrasonography (USG), endoscopic ultrasound, Endoscopic Retrograde Cholangiopancreatography (ERCP), Computed Tomography (CT), Magnetic Resonance Imaging (MRI), Magnetic Resonance Cholangiopancreatography (MRCP). Computed Tomography (CT) is highly accurate, and sensitive than USG in both diagnosing as well as demonstrating the extent[4] With the advent of CECT contrast-enhanced scans,

there has been a significant improvement in the grading system. Contrast-enhanced CT has shown an overall accuracy of 87% with a sensitivity of 100% for the detection of extended pancreatic necrosis. The sensitivity and specificity for diagnosing pancreatic necrosis increase with greater degrees of pancreatic non-enhancement and complications have also been shown to correlate with the degree of non-enhancement. However, early CT scans often fail to identify developing necrosis until such areas are better demarcated, which may become evident only 2–3 days after the initial clinical onset of symptoms.[5]

As early treatment of patients with severe acute pancreatitis can reduce morbidity and mortality. Balthazar in 1990, created the CT Severity Index (CTSI) by combining the original grading system with the presence and extent of pancreatic necrosis. The combined score of CTSI proved to have better prognostic accuracy than the Balthazar score but it, too, had some drawbacks. The score obtained with the index did not significantly correlate with the subsequent development of organ failure, extrapancreatic parenchymal complications or peripancreatic vascular complications.[6] In view of these limitations, a modified and Simplified simplified CT scoring system was hypothesized in 2004 by Mortele and colleagues so as to determine if the scores obtained with this could be used to predict the clinical outcome more accurately.[7]

A study was done by Shetty et al.[2] where he compared the MCTSI and CTSI to detect severe pancreatitis. Sensitivity was 40% vs 34%, and the negative predictive value was 67% vs 56% respectively, specificity and positive predictive value of 100% for both indexes A study of comparison be-tween CTSI and modified CTSI and comparison of both with APACHE II concluded that modified CTSI was better than CTSI for assessing the severity of acute pancreatitis and the CTSI is better than APACHE II in assessing severe acute pancreatitis.[8] Most other studies with similar study designs include CTSI rather than modified CTSI. It is important to note that CTSI does not weight extrapancreatic complications such as pleural effusions and vascular complications while giving additional weight to pancreatic necrosis involving >50% of the pancreas. Banday et al.[9] and Mortele et al.[7] observed that modified CTSI is a simpler and more accurate scoring tool as compared to CTSI and has a stronger statistical correlation with length of stay, development of infection, organ failure and mortality In one of the few similar studies using modified CTSI, Yang et al.[10] observed modified CTSI to have outstanding performance (AUC 0.791) in predicting local complications as compared to APACHE II and BISAP

There have been few studies on assessing the diagnostic accuracy of MCTSI in India. Hence, the present study aimed to determine the accuracy of the modified computed tomography index in evaluating acute pancreatitis and its correlation with the outcome at a tertiary care hospital.

Aims and objectives
1. To grade the severity of acute pancreatitis according to the MCTSI and determine its diagnostic accuracy in predicting outcome. (Modified Computed Tomography Severity Index).
2. To correlate the grading system with patient outcome in terms of ICU stay, ward stay and the total duration of hospital stay

MATERIAL AND METHODS

A Hospital-based observational study was conducted in OPD of a tertiary care hospital at Puducherry from November 2017 to July 2019. Acute pancreatitis patients attending a tertiary care hospital at Puducherry were included in study. 39 cases were selected as sample using convenience sampling for the feasibility of the study.

Inclusion criteria: Cases diagnosed as acute pancreatitis and who are willing to undergo CECT of abdomen and pelvis were included in this study.

Exclusion criteria
-Patients with chronic pancreatitis.
-Congenital pancreatic lesion.
- Pancreatic carcinoma and metastasis.
-Pancreatic trauma
-Patients who did not give consent

Ethical consent was obtained from the concerned ethical committee of the hospital and written informed consent was obtained from the participants before the start of the study. Confidentiality of the participants was maintained throughout the study.

Data collection: Ultrasonography suggestive of acute pancreatitis and a are taken up for computed tomography study and evaluated. Cases of acute pancreatitis were graded according to the modified CT severity index, as shown in the Table-1 and were assessed on 5th day of initial CT and the day of discharge. Two radiologists, blinded to clinical parameters, independently assessed MCTSI. The study was done with SIEMENS - Somatom 6 slice. Pre contrast and post-contrast study were performed from the chest base to the pubic symphysis with 5mm slice thickness reconstructed to 1.25 mm slice thickness with contrast study being performed in early arterial and in pancreatic parenchymal phase. The findings were recorded and graded as per the modified CT severity index. Percentage of necrosis was calculated as follows. The volume of necrosis in each slice is calculated as area X slice thickness. Then the volumes got in each slice were added together for the total necrotic volume. Similarly the volume of pancreatic tissue present in each section was calculated, and the volume in each section was added to get the total pancreatic volume. The percentage necrosis was then calculated as the ratio of necrotic tissue volume by total pancreatic volume X 100.

Clinical Outcome Parameters noted were as below:
-    need for intervention (surgical/aspiration and drainage),
-    the length of hospital stay (in days) (ICU, ward, the total duration of hospital stay)
-    evidence of infection in any organ system(necrosis)
-    Local complications (pseudocyst, abscess)
-    Systemic complications (shock, haemorrhage)

The modified CTSI was calculated by summing these values, and acute pancreatitis was then categorized as:

Mild Pancreatitis   Modified CTSI score 0-2

Moderate Pancreatitis   Modified CTSI score 4-6
Severe Pancreatitis   Modified CTSI score 8-10

STATISTICAL ANALYSIS

Hospital stays. (ICU stay, ward stay) considered as Primary outcome variable Baseline parameters like age group, gender and CT grading were considered as explanatory variables Necrosis, pseudocyst, abscess, local and systemic complications were considered as secondary outcome variables. Descriptive analysis was carried out by mean and standard deviation for quantitative variables, frequency and proportion for categorical variables. The association between categorical explanatory variables and the quantitative outcome was assessed by comparing the mean values. The mean differences, along with their 95% CI, were presented. ANOVA test was used to assess statistical significance. The association between explanatory variables and categorical outcomes was assessed by cross tabulation and comparison of percentages. Chi square test was used to test statistical significance.

RESULT

A total of 39 subjects were included in the final analysis.

Table 2: The mean age was 36.10 years in the study population. 17(43.58%) participants were 25 to 30 years, 14(35.89%) between 31 to 50 years. The majority, 35(89.74%) participants were male, and 4(10.25%), were female. 16(41.02%) participants were admitted 1 to 7 days in the hospital,4(10.25%) were >7 days. 21(53.84%) participants admitted for 1 to 7 days inward, 13(33.33%) for 8 to 14 days and 5(12.82%) stayed >14 days in ward.13(33.33%) had mild, 19(48.71%) had moderate, and 7(17.94%) had severe pancreatitis.

Table 3: Out of 39 participants, 7(17.94%) participants had necrosis. 9(23.07%) participants had pseudocyst, 9(23.1%) participants had local complications, and 2(5.2%) participants had systemic complications. Among the study population, 1(2.6%) participant had embolization GD &Spl A and debridement, and 1(2.6%) required USG –PC aspiration.

Table 4: The difference in age group across the CT index findings is insignificant with a P-value of 0.586, with the majority, 8 (42.11%) aged between 31 to 50 years having moderate CT index findings. Among the mild, 11 (84.62%) participants were male and remaining 2 (15.38%) participants were female. Among the participants in moderate, 17 (89.47%) participants were male and remaining 2 (10.53%) participants were female. Among the participants in severe, all 7 (100%) participants were male. The mean difference of ICU stays, ward stay and overall hospital stay was statistically significant with CT index findings (P value <0.05).

Table 5: The CT gradings of systemic complication had a sensitivity of 100% in predicting outcome. specificity was 91.8%, positive predictive value was 40%, negative predictive value was 100%, and the prevalence was 5%. The CT gradings of local complication had a sensitivity of 100% in predicting outcome. specificity was 43%, positive predictive value was 34.6%, negative predictive value was 100%, and the prevalence was 23%. The CT gradings of ICU stay had

Prognostic indicator	Points
Normal pancreas	0
Normal pancreas Pancreatic inflammation	2
Intrinsic pancreatic abnormalities with /without inflammatory changes	2
Pancreatic fluid accumulation/peripancreatic fat necrosis	4
Pancreatic necrosis	
None	0
>30	2
<30	4
Extra pancreatic complications (pleural effusion, vascular complications, parenchymal complications or gastrointestinal tract involvement)	2

Table-1: Modified CT severity index (MCTSI)

Parameter	Summary
Age(mean±SD)	36.10 ± 16.127
Age group	
1 to 30 years	17(43.58%)
31 to 50	14(35.89%)
51 years and above	8(20.51%)
Gender (Male: female ratio)	
Male	35(89.74%)
Female	4(10.25%)
Hospital stay (Days)	
ICU stay	
1 to 7	16(41.02%)
>7	4(10.25%)
Nil	19(48.71%)
Ward stay	
1 to 7	21(53.84%)
8 to 14	13(33.33%)
>14	5(12.82%)
Total hospital stays	
1 to 7	15(38.46%)
8 to 14	16(41.02%)
>14	8(20.51%)
Ultrasound findings	
Direct evidence of pancreatitis	17(43.58%)
Abnormalities consistent with pancreatitis	13(33.33%)
No abnormality detected	9(23.07%)
Endoscopy findings	
Normal	32(82.05%)
Abnormal	7(17.94%)
Duodenitis	2(5.1%)
Gastritis	3(7.7%)
Oesophagitis	1(2.6%)
Erosive gastritis	1(2.6%)
CT grade	
mild	13(33.33%)
Moderate	19(48.71%)
Severe	7(17.94%)

Table-2: Summary of baseline parameters (N=39)

Consequence	No. of cases
Necrosis	
Present	7(17.94%)
Absent	32(82.05%)
Abscess	
Present	1(2.56%)
Absent	38 (97.43%)
Pseudocyst	
Present	9(23.07%)
Absent	30(76.92%)
Local complication	
Present	9(23.1%)
Absent	30(76.9%)
Systemic complication	
Present (abdominal bleed and shock)	2(5.2%)
Absent	37(94.1%)
Intervention needed	
Embolization GD &Spl A and debridement	1(2.6%)
USG –PC aspiration	1(2.6%)

Table-3: Distribution according to consequences of acute pancreatitis (N=39)

Parameter	CT findings			P value
	Mild(N=13)	Moderate(N=19)	Severe(N=7)	
Age group				
1 to 30 years	5 (38.46%)	7 (36.84%)	5 (71.43%)	0.586
31 to 50 years	5 (38.46%)	8 (42.11%)	1 (14.29%)	
51 years and above	3 (23.08%)	4 (21.05%)	1 (14.29%)	
Gender				
Male	11 (84.62%)	17 (89.47%)	7 (100%)	*
Female	2 (15.38%)	2 (10.53%)	0 (0%)	
Total hospital stays				
ICU	0.46 ± 0.97	2.58 ± 3.7	12.86 ± 18.48	0.006
ward	6.77 ± 2.52	9.21 ± 4.37	16 ± 12.44	0.010
Hospital stay	7.23 ± 2.77	11.79 ± 6.29	28.86 ± 29.6	0.004
* No statistical test was applied-due to 0 subjects in the cell				

Table-4: Comparison of baseline parameter with CT scan findings (N=39)

CT grade	Sensitivity	Specificity	Positive predictive value	Negative predictive value	Diagnostic Accuracy
Systemic complication	100%	91.8%	40%	100%	5%
Local complication	100%	43%	34.6%	100%	23%
ICU stay	76.9%	52%	52.6%	76.9%	51%

Table-5: Predictive validity of CT gradings in predicting outcomes (N=39)

a sensitivity of 76.9% in predicting outcome. specificity was 52%, positive predictive value was 52.6%, negative predictive value was 76.9%, and the total prevalence was 51%.

DISCUSSION

This was a prospective study conducted from November 2017 to July 2019. We included 39 cases,35(89.74%) males, age range 26–60 (mean 37 years). 19(48.71%) participants had moderate pancreatitis according to CT grading. Out of 39 participants, 7(17.94%) had necrosis. 9(23.07%) had pseudocyst, 9(23.1%) had local complications, and 2(5.2%) had systemic complications. The mean difference of ICU stays, ward stay and overall hospital stay was statistically significant with CT index findings (P value <0.05). The CT gradings of ICU stay had a sensitivity of 76.9% in predicting outcome. specificity was 52%, positive predictive value was 52.6%, negative predictive value was 76.9%, and the total prevalence was 51%.

The mean age of patients in the study was 36±5 years with maximum patients in the age group 21 to 30 years (31%). The age group affected reflects the etiologies of alcohol and gall stones common in the age group 20 to 40 yrs. Most of the patients were male (90 %) as compared to female (10%). No association of age and gender was noted with the severity of pancreatitis in our study. These observations were similar to that of a study conducted by Parhi AP et al.[11] where the

mean age was 40 years and in contrast to a study done by Kumar AHet al[5] where the mean age of the study population was 48.42 years, and the male-to-female ratio was 0.51 (34% males). The higher incidence of gall stone disease and female preponderance in this study was compared to similar studies in other parts of India could be attributed to the higher prevalence of gall stone disease in northern India.[12]

Previous studies by Sharma et al.[13] showed that both CTSI and MCTSI were significantly associated with all clinical outcome parameters, including the length of hospital stay, admission to and length of ICU stay, persistent OF, pancreatic infection, need for intervention, mortality, and clinical severity of AP. The present study also produced similar results but was in contrast to a study by Sahu et al.[3] where they did not find a significant association of these scores with the length of ICU stay.

The CT grades were classified into 2, 4, 6, 8 and 10 according to the MCTSI. We further classified the grades into mild (grade 2 & 4), moderate (grade 6) and severe (grade 8 & 10). MCTSI showed good concordance with a severity grading which is similar to a study by Apoorva[14] where 13 patients out of 50 patients having MCTSI >8. The findings were in contrast to a study by Gonapati et al.[15] where, Balthazar scoring system was applied, and the study population was categorized into mild (21/48); moderate (10/48) and severe (17/48) pancreatitis.

Most of the patients were of moderate CT severity (48%), and minimum patients had a severe grade (18%). Mild pancreatitis was present in 33 percent of patients. These findings were in contrast to Banday et al[9], where a much larger number, viz. 22/50 (44%) patients were placed in the severe pancreatitis group and 9/50 (18%),19/50 (38%) patients as mild and moderate pancreatitis. Fewer patients in the mild grade in our study may be explained by decreased use of CECT in mild cases of AP as CECT in not indicated in mild forms unless the diagnosis of AP is by itself doubtful or development of complications is suspected. 51% of patients with pancreatitis needed ICU admission. There was a significant correlation between the necessity of ICU admission and grade of pancreatitis. In the present study, 7(17.94%) developed necrosis which is in contrast to a study by Kiranmai et al.[16] where, out of 50 cases, 15 (30%) patients had necrosis. This present study showed an association between MCTSI and duration of hospital stay, ICU stay. This is in contrast to a study by Melkundi S et al.[17] where P value relating to hospital stay are not comparable thus showing that there was no association between duration of hospital stay and modified CT severity index.

The total percentage of patients developing local complications in the study was 23%. Presence of local complications was positively associated with CT grading. Systemic complication developed in 2 patients (5%). This finding is in contrast to Shetty et al.[2] where 36% of patients were found to have evidence of systemic infection. No mortality due to pancreatitis was observed in our study may be due to small size. The finding was in contrast to Parida et al.[18] where, the mortality rate was 2% the risk of death increases with age, co-morbidities, and severe disease. The accuracy of MCTSI in predicting the necessity of

ICU were Sensitivity = 76.9%, Specificity = 52%, Positive predictive value = 52.6 %, Negative predictive value = 76.9 %. All patients with grade 8 and grade 10 needed ICU admission. These findings were similar to a study done by Shetty et al.[2] where he compared the MCTSI and CTSI to detect severe pancreatitis, and 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. In everyday clinical practice, Revised Atlanta classification system, BISAP score, HAP score, CT severity index can be used to assess the severity of AP because these scoring systems can be measured at the bedside and need limited components. The severity assessment is the initial main part of AP management because treatment of AP depends on the grade of severity and aetiology[19]

Limitation: The main limitation is the small sample size and Nonrandomized study. Patients with mild acute pancreatitis could not be included in the present study as a CT scan is not indicated in all cases of pancreatitis. Pancreatitis patients with renal failure were excluded in the study as contras administration is contraindicated in them. As patients with a moderate and severe grade of Acute Pancreatitis have a higher possibility of local complications, a follow-up study with ultrasound / CT may be considered in these patients.

CONCLUSION

Based on findings, it can be concluded that The Modified CT Severity Index is a simpler scoring tool and more accurate. In this study, it had a stronger statistical correlation with the clinical outcome with the necessity of ICU admission, duration of ICU stay and the total duration of hospital stay. CT grading correlates directly with the development of local and systemic complications and can predict the need for interventions. MCTSI had higher sensitivity and specificity in differentiating between mild, moderate and severe acute pancreatitis.

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