

## Research Article

# Assessment of Acute Pancreatitis Using CT Severity Index and Modified CT Severity Index

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**Abstract:** To assess the severity of acute pancreatitis (AP) using computed tomography (CT) severity index (CTSI) and modified CT severity index (MCTSI), to correlate with clinical outcome measures, and to assess concordance with severity grading, as per the revised Atlanta classification (RAC). **Material and Methods:** This is a prospective and descriptive study conducted in the Department of Radiology at a Maheshwara Medical College. A total of 50 patients enrolled with the chief complaint of epigastric pain, nausea and vomiting and CECT abdomen were suggestive of acute pancreatitis were included in this study. Assessment of severity of acute pancreatitis was done in all cases by Balthazar CTSI scoring and Mortelet Modified CTSI scoring. **Results:** In our study total 50 cases of acute pancreatitis cases were included in the study. Out of 50 cases, 36 (72 %) were male and 13 (26%) were females. We found that acute pancreatitis was found three times more common in males than in females. Cholelithiasis was found to be most common aetiological factor for acute pancreatitis in 48% cases followed by alcoholic pancreatitis was seen in 26% of cases. Least Aetiological factor such as Trauma and drug induced. Pleural effusion was the most common extra-pancreatic complication, 27 patients (54%). Left pleural effusion was more common than the right, and in none of the cases, isolated right sided pleural effusion was found. Ascites was the second most common complication seen in 9 patients (18%). **Conclusion:** In conclusion CECT was found to be an excellent imaging modality for diagnosis, establishing the extent of disease process and in grading its severity. The Modified CT Severity Index is a simpler scoring tool and more accurate than the Balthazar CT Severity Index. In this study, it had a stronger statistical correlation with the clinical outcome, be it the length of hospital stay, development of infection and occurrence of organ failure. It could also predict the need for interventional procedures.

**Keywords:** Acute pancreatitis, Balthazar CTSI and Mortelet Modified CTSI scoring.

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## INTRODUCTION

Acute pancreatitis is a common disease with excessive frequency of morbidity and mortality. It is defined as an acute inflammatory disease of pancreas, characteristically exhibiting with abdominal pain and concomitant with increased levels of pancreatic enzymes in the blood or urine [1]. It has a broad spectrum of findings that varies in severity from mild interstitial or oedematous pancreas to severe forms with significant local and systemic complications [2]. According to the severity, acute pancreatitis is divided into mild acute pancreatitis (absence of organ failure and local or systemic complications, moderately severe

acute pancreatitis (no organ failure or transient organ failure less than 48 hours with or without local complications) and severe acute pancreatitis (persistent organ failure more than 48 hours that may involve one or multiple organs) [3].

Computed tomography is the gold standard technique not only for its global picture of the pathology and complications but also for the non-invasive method of evaluating the morphology of pancreas and peripancreatic regions in an acute situation. It is unaffected by bowel gas distension and obesity, which is a definite disadvantage on ultrasonographic evaluation [4]. Contrast material enhanced

computed tomography helps in early diagnosis and staging of severity of acute pancreatitis and its complications which helps in prediction of prognosis of the disease.

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 a 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, extra pancreatic parenchymal complications or peripancreatic vascular complications [5]. In view of these limitations, a modified and Simplified CT scoring system was hypothesized in 2004 by Mortelet and colleagues so as to determine if the scores obtained with this could be used to predict the clinical outcome more accurately. The modified Mortelet CTSI was easier to calculate and was found to correlate more closely with patient outcome measures like the length of the hospital stay, the need for surgery/intervention, and the occurrences of infection, organ failure and death than the currently accepted Balthazar CT severity index, with similar interobserver variability [6].

Thus, this study was performed to determine the value of computed tomography evaluation in early diagnosis of acute pancreatitis, differentiate between acute oedematous and acute necrotising pancreatitis, grade the percentage of necrosis and to grade the

disease based on modified computed tomography severity index.

The purpose of our study was to diagnose early in cases of acute pancreatitis which helps to treat the patients based on severity of disease, as this study was conducted in the rural setup hospital. The MCTSI predicts the patient outcome, with regard to length of hospital stay and development of organ failure, which is the primary determinant of outcome in the early phase of acute pancreatitis.

The treatment is primary based initially on the MCTSI, which predicts the disease outcome. There are number of laboratory investigations, which do not assess the extent of pancreatic inflammation. Few clinical grading systems like RANSON and APACHE II are most commonly used indicators to assess disease severity. While RANSON score cannot be used for the first 48 hours, APACHE score is cumbersome to use [7].

**MATERIALS AND METHODS**

This is a prospective and descriptive study conducted in the Department of Radiology at Maheshwara Medical College. A total of 50 patients enrolled with the chief complaint of epigastric pain, nausea and vomiting and CECT abdomen were suggestive of acute pancreatitis were included in this study.

**Assessment of Severity**

Assessment of severity of acute pancreatitis was done in all cases by Balthazar CTSI scoring [3] and Mortelet Modified [7] CTSI scoring.

**Table-1: Each case was assigned a CT grade from A to E and awarded points from 0-4.**

Grades	Characteristics	Points
Grade A	Normal pancreas	0 Point
Grade B	Focal or diffuse enlargement of the pancreas (including contour irregularities, non-homogenous attenuation of the gland, dilation of the pancreatic duct and foci of small fluid collections within the gland, as long as there was no evidence of peri-pancreatic disease.	1 Point
Grade C	Intrinsic pancreatic abnormalities associated with hazy streaky densities representing inflammatory changes in the peri-pancreatic fat.	2 Point
Grade D	Single ill-defined fluid collection (phlegmon).	3 Point
Grade E	Two or multiple, poorly defined fluid collections or presence of gas in or adjacent to the pancreas.	4 Point

**Table-2: The presence and extent of necrosis in each case was classified into four categories and awarded points from 0-6 as follows:**

Necrosis	Points
Necrosis absent	0 Points
< 30% necrosis	2 Points
30-50%	4 Points
> 50% necrosis	6 Points

**Table-3: The Balthazar CTSI was calculated by adding the above points in each case and the total score was then categorized as**

Severity	CTSI score
Mild pancreatitis	CTSI score 0-3
Moderate pancreatitis	CTSI score 4-6
Severe pancreatitis	CTSI score 7-10

**Table-4: Mortelet Modified CTSI Scoring**

Prognostic indicator	Points
Normal pancreas	0 point
Intrinsic pancreatic abnormalities with or without inflammatory changes in peripancreatic fat	2 points
Pancreatic or peripancreatic fluid collection or peripancreatic fat necrosis	4 points

**Table-5: The Modified CTSI was calculated by summing these values and total score was categorized as:**

Severity	Modified CTSI score
Mild pancreatitis	Modified CTSI score 0-2
Moderate pancreatitis	Modified CTSI score 4-6
Severe pancreatitis	Modified CTSI score 8-10

**Table-6: The severity is classified into three categories based on clinical and morphologic findings according to revised Atlanta classification [8]**

Severity	Characteristics
Mild	No organ failure and no local or systemic complications.
Moderate	Presence of transient organ failure less than 48h and/or presence of local complications.
Severe	Persistent organ failure > 48 hour

**Outcome Parameters**

Clinical follow-up of the patients was done in terms of the following parameters:

- Need for surgery or percutaneous intervention.
- Length of hospital stay.
- Existence of organ failure-respiratory, cardiovascular, kidney, liver, haematological system.
- Evidence of infection in any organ system.
- Discharged/death.

The clinical outcome was compared with the currently accepted Balthazar’s CTSI and Modified Mortelet’s CTSI in all the cases.

Method of data collection clinical diagnosis was based on the symptoms like upper abdominal pain, nausea, vomiting, fever and/or elevation of serum amylase three times the upper limit of normal (normal serum amylase 20-110 U/L).

**Inclusion Criteria**

Clinically suspected case of acute pancreatitis of all ages

**Exclusion Criteria**

1. Patients with chronic pancreatitis suggested by intra-ductal calculi, ductal stricture and parenchymal calcification.
2. Any previous pancreatic surgery.
3. Other pancreatic pathology like pancreatic malignancy, cyst.
4. Contraindicated cases for contrast study.
5. Pregnant females.
6. Postoperative cases.

**STATISTICAL ANALYSIS**

Data analysis was done using SPSS version 25<sup>th</sup> Data transformation by recoding, counting and cross tabulation was performed and obtained information was processed using Pearson chi-square and Fisher’s-exact test.

**RESULTS**

Total 63 cases of acute pancreatitis cases were included in the study. These patients underwent CT abdomen and pelvis, later images were reviewed by radiologist.

**Table-7: Age distribution of patients with acute pancreatitis**

Age in years	No. of patients	Percent
< 20	3	6
21-40	27	54
41-60	13	26
> 60	7	14

In table 7: The maximum patients were in the age group of 21 to 40 years [n=27 (54%)], followed by 41 to 60 years group [n= 13 (26%)]. The minimum age of patients was 18 years and maximum age was 62 years

**Table-8: Gender wise distribution of patients with acute pancreatitis**

Gender	No. of patients	Percent
Male	36	72
Female	13	26
Total	50	100

In table 50 cases, 36 (72 %) were male and 13 (26%) were females. We found that acute pancreatitis was found three times more common in males than in females.

**Table-9: Aetiological Distribution of Acute Pancreatitis**

Cause	No. of patients	Percent
Alcohol	13	26
Cholelithiasis	24	48
Trauma	1	2
Drug Induced	1	2
Post ERCP	2	4
Idiopathic	9	18

Cholelithiasis was found to be most common aetiological factor for acute pancreatitis in 48% cases followed by alcoholic pancreatitis was seen in 26% of cases. Together cholelithiasis and alcoholism accounted for 74% of cases. Least Aetiological factor such as Trauma and drug induced.

**Table-10: Extra-pancreatic Complications**

Findings	No. of patients	Percent
<b>Pleural fluid</b>		
• Bilateral pleural effusion	16	32
• Left pleural effusion	11	22
<b>Extra pancreatic complications</b>		
• Infarction		
• Sub capsular collection	0	0
• Haemorrhage	3	6
	0	0
<b>Ascites</b>	9	18
<b>Vascular complications</b>		
• Venous thrombosis	3	6
• Arterial haemorrhage	0	0
• Pseudo aneurysm formation	1	2
<b>Inflammation of GIT</b>		
• Thickening of wall	7	14
• Intramural fluid collection	0	0

**Extra-Pancreatic Complications**

In table 10, in our study, pleural effusion was the most common extra-pancreatic complication, 27 patients (54%). Left pleural effusion was more common than the right, and in none of the cases, isolated right sided pleural effusion was found. Ascites was the second most common complication seen in 9 patients

(18%). Among vascular complications, venous thrombosis was the most common (2 in portal vein and 1 in splenic vein). One case of pseudoaneurysm were found, both in splenic artery.

**Table-11: Grading severity of acute pancreatitis using Balthazar CTSI score.**

Severity	Score	No. of patients	%
Mild	0-3	21	42
Moderate	4-6	12	24
Severe	7-10	17	34
Total		50	100

In table 11, Majority of the cases were categorized as mild pancreatitis according Balthazar CTSI score.

**Table-12: Grading severity of acute pancreatitis using modified mortele CTSL.**

Severity	Score	No. of patients	%
Mild	0-3	11	22
Moderate	4-6	19	36
Severe	7-10	20	40
Total		50	100

In table 12, Majority of the cases were categorized as severe pancreatitis using the Modified Mortelet CTS score.

**Table-13: Patient outcome using currently accepted Balthazar CTSL.**

Outcome Parameter	Mild (n=21)		Moderate (n=12)		Severe (n=17)	
	No.	%	No.	%	No.	%
Mean duration of hospitalization (in days)	13		21		26	
Intervention/drainage	1	7.6	3	35.2	3	20
Surgical debridement	0	0	0	0	1	5
Infection	1	3.8	0	0	5	30
End organ failure	1	3.8	1	5.8	4	25

In table 13, intervention and length of stay was significantly more (p-value = 0.02 and 0.01 respectively) associated with moderate grade. Infection, organ system failure and death were significantly associated with severe grade.

**Table-14: Patient outcome using modified Mortelet CTSL.**

Outcome Parameter	Mild (n=11)		Moderate (n=19)		Severe (n=20)	
	No.	%	No.	%	No.	%
Mean duration of hospitalization (in days)	6		18		26	
Intervention/drainage	0	0	4	21.7	6	25.9
Surgical debridement	0	0	0	0	3	14.8
Infection	0	0	1	4.3	5	22.2
End organ failure	0	0	1	4.3	3	18.5

In table 14, average duration of hospital stay was significant more (p-value = 0.02) with severe

grade. Infection, organ system failure and death were also significantly associated with severe grade.

**Table-15: Comparison of outcome according to the currently accepted balthazar ctsi and mortelete modified ctsi and revised atlanta classification (N=50).**

Grading System	Severity	Organ Failure
Balthazar CTSI	Mild	1
	Moderate	1
	Severe	4
Modified Mortelete CTSI	Mild	0
	Moderate	1
	Severe	3

In table 15, organ failure, moderate and severe category in modified Mortelete CTSI, mild, moderate, severe category in Balthazar CTSI.

## DISCUSSION

The present study was undertaken to assess acute pancreatitis on CT and patient was prognostically compared on the source of CTSI (including Balthazar's Computed Tomography Severity Index and the Modified Computed Tomography Severity Index). In study group involved of 36 (72%) males and 13 (26%) females were found, three times more common in males than in females. In another prospective study conducted by Block *et al.*, comprised of 61 (65.6%) males and 32 (34.4%) females.<sup>[9]</sup>

In our study, most common aetiological factors were cholelithiasis (48%) and alcoholism (26%) followed by idiopathic (18%), post ERCP (4%), trauma (4%) and drug induced (2%). Casas *et al.*, in their study of 148 patients, found the cause of acute pancreatitis as gall stones in 57%, alcohol over indulgence in 21% and to both in 5% which is in concordance with the present study.<sup>[10]</sup> According to Steinberg *et al.*, biliary calculi and alcohol together constituted about 80-90% of causes of acute pancreatitis, the frequency varied in different populations.<sup>[11]</sup> Peripancreatic inflammatory changes were the most common CT findings seen in 88% of the cases of acute pancreatitis. Mendez *et al.*, found that out of 32 patients, 28 (87.5%) exhibited extrapancreatic spread of the inflammatory process.<sup>[12]</sup>

In the present study, 13 (20.63%) patients found left pleural effusion to be the most common abnormality which is similar to the other study.<sup>[13]</sup> Ascites was found to be present in 16 patients (25.3%) in our study. Venous thrombosis was seen in 3 patients (4.7%). Irshad Ahmad Banday *et al.*, in their study

found ascites to be the second most common complication and was seen in 18 patients (36%).<sup>[14]</sup> Among vascular complications, venous thrombosis was the most common (2 in portal vein and 1 in splenic vein). A fairly common finding in the present study was inflammation of gastrointestinal tract seen in 11 (17.4%). A recent study by Irshad Ahmad Banday *et al.*, stated that GI involvement was found in 13 patients that is (26%).<sup>[14]</sup> Balthazar *et al.*, have also reported similar incidence.<sup>[15]</sup>

In our study, the possible explanation for this is the large number of patients having mild pancreatitis in their study group. Using the currently accepted Balthazar CTSI, the severity of acute pancreatitis was graded as mild (score of 0-3) in 21 (42%) cases, moderate (score of 4-6) in 12 (24%) and severe (score of 7-10) in 17 (34%) patients. Using the modified CTSI scoring, maximum number 27 (42.8%) of the patients had severe (score of 7-10) pancreatitis. Mild (score of 0-3) and moderate (score of 4-6) pancreatitis were categorized in 11 (22%) and 19 (36%) patients respectively. This was fairly similar to the study conducted by Irshad Ahmad Banday *et al.*, where in when Balthazar CT Severity Index was employed, acute pancreatitis was graded as mild in 22/50 (44%), moderate in 11/50 (22%) and severe in 17/50 (34%) patients.<sup>[14]</sup> In contrast, in their study, while using the Modified CT Severity Index, 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.<sup>[15]</sup>

According to Balthazar CT severity index, amongst the patients with mild pancreatitis (n=21, average duration of hospital stay was 13 days). In the moderate group pancreatitis group (n=12), average duration of hospital stay was 21 days. In the severe group (n=17), average duration of hospital stay was 24 days. Modified CT scoring system correctly predicted the outcome in all the patients who had a shift in their severity grades than Balthazar CTSI. The change in severity scoring was seen mainly due to the presence of extrapancreatic complication.

The strong relationship between the Modified CT severity index and the patient outcome in this study correlates with the findings of Mortelete *et al.*,<sup>[7]</sup> Similar trends in duration of hospital stay, intervention or surgery, evidence of infection and organ failure in patients with variable grades of severity of pancreatitis were observed in our study as that seen by Mortelete in

their study. This also correlated with the study by Irshad Ahmad Banday *et al.*, which concluded that Modified CT Severity Index is a simpler scoring tool and more accurate than the Balthazar CT Severity Index. <sup>[15]</sup>

Results of our study were also found similar to a study conducted by Shivanand Melkundi *et al.*, which showed a 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. <sup>[16]</sup>

Patient outcome using currently accepted Baltazar CTSI (N=50) showed intervention and length of stay was maximum with mild grade. Infection, organ system failure was significantly associated with severe grade. Whereas with Modified Mortelet CTSI (N=50) the average duration of hospital stay was significant more with severe grade and organ system failure was significantly associated with severe grade. Similarly, a study shows, patient outcome in terms of organ failure is more accurately assessed by revised Atlanta classification in comparison with Balthazar and modified CT severity index. The revised classification seems to be a good predictor for clinical outcome of AP Shyu JY *et al.*, <sup>[17]</sup>

### Limitations

Sample size was small which may have affected the result. In patients of derange renal function and pregnant patients contrast CT is contraindicated. Repeated follow-up study was not possible due to cost and radiation exposure. Different treatments were given to patients who changed the patient outcome. However, in first week only clinical parameters are useful.

### CONCLUSION

Contrast enhanced Computed Tomography is excellent diagnostic modality to stage the severity of inflammatory process, detect the pancreatic necrosis and depict local complications and grading of severity of acute pancreatitis. The scores obtained with the modified Mortelet index, showed a stronger correlation for all outcome parameters in all the patients better than the Balthazar index. Revised Atlanta classification is more accurate than modified Mortelet index and Balthazar severity index for assessing patient mortality and organ failure.

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