

## Assessment of acute pancreatitis using the CT severity index and modified CT severity index

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**Background:** 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 study, conducted from August 2019 to July 2020, in the Department of Radiology, Al Ameen Medical College. A total of 70 patients referred from the Department of Medicine and Department of Surgery, presented 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 the present study total 70 cases of acute pancreatitis cases were included in the study. These patients underwent CT abdomen and pelvis, later images were reviewed by the radiologist. The maximum patients were in the age group of 21 to 40 years [n=33 (47.1%)]. Majority of the cases were categorized as mild pancreatitis according to Balthazar CTSI score. Majority of the cases were categorized as severe pancreatitis using the Modified Mortelet CTSI score. Whereas, organ failure, moderate and severe category in modified Mortelet CTSI, mild, moderate, severe category in Balthazar CTSI. **Conclusion:** In conclusion CECT was found to be an excellent imaging modality for diagnosis, establishing the extent of the disease process and in grading its severity.

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

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## Introduction

Acute pancreatitis (AP) is one of the most common gastrointestinal causes for hospitalization in India. Despite recent advances in medicine, pancreatitis continues to be associated with substantial morbidity and mortality [1]. The most common cause of acute pancreatitis is gallstones/biliary related, followed closely by alcohol use [2].

The diagnosis of pancreatitis is established with any two of three following criteria: (1) Abdominal pain consistent with that of Acute pancreatitis; (2) Serum amylase and/or lipase greater than three times the upper limit of normal; and (3) Characteristics findings seen in cross-sectional abdominal imaging [3].

Multiple criteria and scoring systems have been established for assessing the severity of acute pancreatitis. The cornerstones of management include aggressive intravenous hydration, appropriate nutrition and pain management. Endoscopic retrograde cholangiopancreatography (ERCP) and surgery are important aspects in the management of acute gallstone pancreatitis [4].

The annual incidence of Acute pancreatitis ranges from 15.9 to 36.4 per 100000 persons. The burden of the disease on healthcare resource utilization is expected to increase shortly [5]. Despite the improvement it was seen in access to healthcare, imaging modalities and interventions, Acute pancreatitis continues to have significant morbidity and mortality that has largely remained unchanged over time [6]. The overall mortality rate is 5% to 17% in severe Acute pancreatitis, and 1.5% in mild Acute pancreatitis [7].

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 ultra-sonographic evaluation [8].

Contrast material enhanced computed tomography helps in early diagnosis and staging of severity of acute pancreatitis and its complications which helps in the 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 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 [9]. Because of these limitations, a modified and Simplified CT scoring system was hypothesized in 2004 by Mortelet and colleagues 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 [10].

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 the present study was to diagnose early in cases of acute pancreatitis which helps to treat the patients based on the severity of the disease, as this study was conducted in the rural setup hospital. The MCTSI predicts the patient outcome, concerning the 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 primarily based initially on the MCTSI, which predicts the disease outcome. There are several laboratory investigations, which do not assess the extent of pancreatic inflammation. Few clinical grading systems like RANSON and APACHE II are the 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 [11].

## Materials and Methods

This is a prospective study, conducted from August 2019 to July 2020, in the Department of Radiology, Al Ameen Medical College, Vijayapur, Bijapur, Karnataka, India.

A total of 70 patients referred from the Department of Medicine and Department of Surgery, presented

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.**

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 the total score was categorized.**

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
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**Table-6: The severity is classified into three categories based on clinical and morphologic findings according to revised Atlanta classification [12].**

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**

A clinically suspected case of acute pancreatitis of all ages.

**Exclusion criteria**

01. Patients with chronic pancreatitis suggested by intra-ductal calculi, ductal stricture and parenchymal calcification.
02. Any previous pancreatic surgery.
03. Other pancreatic pathology like pancreatic malignancy, a cyst.
04. Contraindicated cases for contrast study.
05. Pregnant females.
06. Postoperative cases.

Equipment used in the study – Siemens Somatom Sensation MDCT 40 slice and Mederton Inkjeterton CT2 (pressure injector).

**Statistical analysis**

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

**Results**

Total of 70 cases of acute pancreatitis cases was included in the study. These patients underwent CT abdomen and pelvis, later images were reviewed by a radiologist.

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

Age in years	No. of patients	Percent
< 20	7	10
21-40	33	47.1
41-60	19	27.1
> 60	11	15.7
Total	70	100

In table 7: The maximum patients were in the age group of 21 to 40 years [n=33 (47.1%)], followed by 41 to 60 years group [n= 19 (27.1%)]. The minimum age of patients was 18 years and the maximum age was 63 years with a minimum number of patients seen below the age of 20 years.

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

Gender	No. of patients	Percent
Male	51	72.8
Female	19	27.1
Total	70	100

In table 8, out of 70 cases, 51 (72.8%) were male and 19 (27.1%) were females. It was 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	21	30.0
Cholelithiasis	33	47.1
Trauma	1	1.42
Drug-Induced	1	1.42
Post ERCP	2	2.85
Idiopathic	12	17.1
Total	70	100

Cholelithiasis was found to be the most common aetiological factor for acute pancreatitis in 47.1% of cases followed by alcoholic pancreatitis was seen in 30% of cases.

Together cholelithiasis and alcoholism accounted for 77.1% of cases. Least Aetiological factor such as Trauma and drug-induced.

**Table-10: Extra-pancreatic complications.**

Findings	No. of patients	Percent
Pleural fluid		
• Bilateral pleural effusion	19	27.1
• Left pleural effusion	14	20.0
Extra pancreatic complications		
• Infarction	0	0
• Subcapsular collection	4	5.7
• Haemorrhage	0	0
Ascites	17	24.2
Vascular complications		
• Venous thrombosis	3	4.2
• Arterial haemorrhage	0	0
• Pseudoaneurysm formation	1	1.42
Inflammation of GIT		
• Thickening of the wall	12	0
• Intramural fluid collection	17.1	0

**Extra-Pancreatic Complications**

In table 10, in the present study, pleural effusion was the most common complication 19 patients (27.1%).

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 17 patients (24.2%). Among vascular complications, venous thrombosis was the most common (2 in the portal vein and 1 in splenic vein). One case of pseudoaneurysm was found, both in the splenic artery. More than one complication was present in a few cases.

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

Severity	Score	No. of patients	%
Mild	0-3	29	41.4
Moderate	4-6	19	27.1
Severe	7-10	22	31.4
Total		70	100

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

**Table-12: Grading the severity of acute pancreatitis using modified mortelete CTSI.**

Severity	Score	No. of patients	%
Mild	0-3	16	22.8
Moderate	4-6	26	37.1
Severe	7-10	28	40.0
Total		70	100

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

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

Outcome Parameter	Mild (n=29)		Moderate (n=19)		Severe (n=22)	
	No.	%	No.	%	No.	%
Mean duration of hospitalization (in days)	14		22		24	
Intervention/drainage	3	10.3	7	36.8	5	22.7
Surgical debridement	0	0	0	0	1	4.5
Infection	2	6.8	0	0	7	31.8
End organ failure	1	3.4	1	5.2	6	27.2

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

**Table-14: Patient outcome using modified Mortelete CTSI.**

Outcome Parameter	Mild (n=16)		Moderate (n=26)		Severe (n=28)	
	No.	%	No.	%	No.	%
Mean duration of hospitalization (in days)	7		17		27	
Intervention/drainage	0	0	5	19.2	7	25.0
Surgical debridement	0	0	0	0	4	14.8
Infection	0	0	1	3.8	6	21.4
End organ failure	0	0	1	3.8	5	17.8

In table 14, the average duration of hospital stay was significantly 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=70).**

Grading System	Severity	Organ Failure
Balthazar CTSI	Mild	1
	Moderate	1
	Severe	6
Modified Mortelete CTSI	Mild	0
	Moderate	1
	Severe	5

In table 15, organ failure, the 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 the present study group involved of 51 (72.8%) males and 19 (27.1%) 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 [13].

In the present study, most common aetiological factors were cholelithiasis (47.1%) and alcoholism (30.0%) followed by idiopathic (17.1%), post ERCP (2.85%), trauma (1.42%) and drug-induced (1.42%).

Casas et al., in their study of 148 patients, found the cause of acute pancreatitis as gall stones in 57%, alcohol overindulgence in 21% and to both in 5% which is in concordance with the present study [14].

According to Steinberg et al., biliary calculi and alcohol together constituted about 80-90% of cases of acute pancreatitis, the frequency varied in different populations [15]. 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 [16].

In the present study, 14 (20%) patients found left pleural effusion to be the most common abnormality which is similar to the other study [17]. Ascites was found to be present in 17 patients (24.2%) in the present study. Venous thrombosis was seen in 3 patients (4.2%). Irshad Ahmad Banday et al., in their study, found ascites to be the second most common complication and was seen in 18 patients (36%) [18].

Among vascular complications, venous thrombosis was the most common (2 in the 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%) [18]. Balthazar et al., have also reported similar incidence [19].

In the present 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 29 (41.4%) cases, moderate (score of 4-6) in 19 (27.1%) and severe (score of 7-10) in 22 (31.4%) patients. Using the modified CTSI scoring, maximum number 28 (40.0%) 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 16 (22.8%) and 26 (37.1%) patients respectively. This was fairly similar to the study conducted by Irshad Ahmad Banday et al., wherein 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 [18,19].

According to Balthazar CT severity index, amongst the patients with mild pancreatitis (n=29), the average duration of hospital stay was 14 days). In the moderate group pancreatitis group (n=19), the average duration of hospital stay was 22 days. In the severe group (n=22), the 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 Mortelet et al., [10] 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 the present study as that seen by Mortelet in their study. This also correlated with the study by Irshad Ahmad Banday et al., which concluded that the Modified CT Severity Index is a simpler scoring tool and more accurate than the Balthazar CT Severity Index [15].

Results of the present 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 [20].

Patient outcome using currently accepted Baltazar CTSI (N=70) 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=70) the average duration of hospital stay was significantly more with severe grade and organ system failure was significantly associated with severe grade.

Similarly, a study shows, the 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 [21].

## Limitations

The sample size was small which may have affected the result. In patients of deranging renal function and pregnant patients contrast CT is contraindicated.

The repeated follow-up study was not possible due to cost and radiation exposure. Different treatments were given to patients which changed the patient outcome. However, in the first week, only clinical parameters are useful.

## Conclusion

Contrast-enhanced Computed Tomography is an excellent diagnostic modality to stage the severity of the inflammatory process, detect the pancreatic necrosis and depict local complications and grading of severity of acute pancreatitis.

## What does the study add to the existing knowledge?

The scores obtained with the modified Mortele 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 the modified Mortele index and Balthazar severity index for assessing patient mortality and organ failure.

## Author's contribution

**Dr. MD Atik Ahmed:** Concept, study design

**Dr. MD Toufik Ahemad:** Manuscript preparation

**Dr. MD Mustak Ahmed:** Manuscript preparation

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