

## Original Article

# Role of Computed Tomography In The Evaluation of Severity of Acute Pancreatitis

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### Abstract

**Title:** Role of computed tomography in the evaluation of severity of acute pancreatitis. **Introduction:** Early diagnosis and determination of severity of acute pancreatitis is important for management and it depends largely on severity of disease. Medical treatment of mild acute pancreatitis includes conservative management while severe acute pancreatitis requires intensive care to surgical intervention (open or minimally invasive) in selected cases. **Methodology:** This prospective study was carried out to find out the correlation between modified CT severity index and patient's clinical outcome in acute pancreatitis enrolling 96 subjects in the department of Radiology and Imaging, BIRDEM during two years time period. Severity of acute pancreatitis was assessed by both clinical and imaging staging (Modified CT severity index) in mild, moderate and severe groups. **Result:** Mean age ( $\pm$  SD) of the study subjects was  $35.48 \pm 14.59$  years and number of male was 60 (62.50%) and female was 36 (37.50%). Acute pancreatitis was associated with hypertriglyceridemia (19.79%), gall stone (12.5%), post ERCP (6.25%) and alcoholism (2.08%). Aetiology was unidentified in 59.73% subjects. Majority of the subjects with acute pancreatitis presented with abdominal pain, fever (20.08%), vomiting (54.41%) and oedema (25%). On imaging, diffuse pancreatic enlargement was noted in 29.16% subjects. Pancreatic inflammation with and without peripancreatic fat involvement were observed in 27.08% and 72.91% subjects respectively. Pseudocyst formation (13.54%), ascites (30.20%), renal fascia involvement (46.87%) and pleural effusion (37.5%) were seen in CT scan. Severity of acute pancreatitis was evaluated by clinical findings and CT severity index and the measure of agreement between clinical and imaging staging was almost perfect. CT severity index in acute pancreatitis had statically significant relation with clinical outcome (0.573), organ failure (0.674), need for surgical intervention (0.463) and hospital stay (0.235). **Conclusion:** Modified CT severity index in acute pancreatitis correlates with patient outcome. During reporting if this simple scoring system is applied then we can easily measure the severity and determine whether patient need medical or surgical intervention.

**Key words:** Modified CT severity index, Clinical outcome of acute pancreatitis.

### Introduction

Acute pancreatitis is now a common disease with significant mortality and morbidity<sup>1</sup>. Almost in every case other than biochemical tests and USG, CT scan is being done to assess the degree of extent of pancreatic

necrosis and extrapancreatic involvement<sup>2</sup>. It is important to select an appropriate severity categorization for a disease to take early necessary measures. Several scoring system like Ranson's criteria, the Imrie scoring system, the Acute Physiology & -

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Chronic Health Evaluation System (Both APACHE II & APACHE III), Balthazar CT severity index, Modified CT severity index were described to predict severity of acute pancreatitis<sup>3-8</sup>. Ranson's criteria described clinical categorization of acute pancreatitis on basis of age in years, white blood cell count, blood glucose, serum AST, serum LDH and estimation of fluid sequestration<sup>3</sup>. APACHE II and APACHE III systems observed only vital functions like CNS, CVS and renal functions. All these systems were based on clinical observations<sup>6</sup>. Categorization of acute pancreatitis by imaging system was introduced by Balthazar et al. Balthazar CT severity index comprised of direct observation of patient outcome and correlated it with contrast enhanced CT scan (CECT scan) describing only pancreatic inflammation and necrosis<sup>7</sup>. It did not include peripancreatic fat abnormalities, fluid collection or extrapancreatic complications (Pleural effusion, ascites and GIT complication). The modified CT severity index described both intra and extra pancreatic findings in acute pancreatitis and correlated with patient outcome parameters but validity of this scoring system was conducted on retrospective method<sup>8</sup>. Most of the scoring and grading systems had some limitations. This prospective study was carried out to find out the correlation between modified CT severity index and patient's clinical outcome in acute pancreatitis.

**Methodology**

This prospective study was carried out in the Department of Radiology and Imaging, BIRDEM for a period of two year from July, 2011 to June, 2013. Clinically suspected and biochemically diagnosed acute pancreatitis patients referred to the Radiology and Imaging Department of BIRDEM for imaging were enrolled in this study. Subjects were referred from Department of Gastroenterology and Medicine. Patients underwent contrast enhanced CT scan within 7 days after onset of symptoms were included. Patients with non-contrast CT scan were excluded from the study. A total number of 96 subjects were enrolled in this study. CT scan was performed by dual slice helical scanner (Siemens, Somatom Emotion Duo). Demographic informations were prospectively recorded and substantiated by means of inspection of medical records. All the study subjects were followed up to discharge. CT measurement of severity index of acute pancreatitis was done by researcher at first and findings were confirmed by consultant radiologist of the Department of Radiology and Imaging, BIRDEM who did not know about the serum enzyme level to eliminate observation

bias. Subjects were categorized as mild, moderate and severe by CT severity index. Subject's clinical condition was assessed by Glasgow Prognostic score and categorized as mild, moderate and severe classes also. For Glasgow Prognostic score serum albumin, arterial pO<sub>2</sub>, serum calcium, RBS, LDH, blood urea, total WBC count and serum transaminases were measured. Then agreement between these scoring systems were calculated by Kappa test to observe whether CT severity index correlate with clinical condition (By Glasgow Prognostic score) of the subjects. Simple linear regression test was done between CT severity index and subject's clinical outcome to find out relation between them.

**CT severity index:**

Prognostic Indicator		Points
Pancreatic inflammation	Normal pancreas	0
	Intrinsic pancreatic abnormalities with or without inflammatory changes in peripancreatic fat	2
	Pancreatic or peripancreatic fluid collection or peripancreatic fat necrosis	4
Pancreatic necrosis	None	0
	30%	2
	>30%	4
Extrapancreatic complications(One or more of pleural effusion, ascites, vascular complications, parenchymal complications of pancreas or gastrointestinal tract involvement)		2
Image analysis for each case was assessed by using the modified CT severity index and categorized as mild (0-2 points), moderate (4-6 points), or severe (8-10 points). <sup>8</sup>		

Glasgow Prognostic scoring systems (For clinical staging)

To predict severe pancreatitis, the Glasgow system is a simple prognostic system that uses 8 factors [white cell count, glucose, urea, PO<sub>2</sub>, calcium, LDH, transaminases (SGOT, SGPT), albumin] during the first 48 hours following admission for pancreatitis, A point is assigned if a certain breakpoint is met at any time during that 48-hour period. The parameters and breakpoints are:

- Serum albumin <32 g/L (3.2 g/dL) = 1 point
- Arterial PO<sub>2</sub> on room air <8 kPa (60 mmHg) = 1 point
- Serum calcium <2 mmols/L (8 mg/dL) = 1 point
- Blood glucose >10.0 mmols/L (180 mg/dL) = 1 point
- Serum LDH >600 units/L = 1 point
- Serum urea nitrogen >16.1 mmols/L (45 mg/dL) = 1 point
- WBC count >15 x 10<sup>9</sup>/L (15 x 10<sup>3</sup>/microlitre) = 1 point
- Transaminases (SGOT and SGPT) >200 IU/L = 1 point

The addition of the parameter points yielded the Glasgow prognostic criteria. The score ranged from 0 to 8. If the score was 0-2, the likelihood of mild pancreatitis was high. If the score was 3-4, moderate pancreatitis was likely and if score was 5 and more severe pancreatitis was more likely<sup>8</sup>.

**Result**

**Demographic characteristics of the study subject:** A total of 96 patients were included in the study and they were divided into four age groups. Mean age of the study subjects was 35.48 ± 14.59 years. Maximum number was found between 21 to 40 years of age and the age ranged from 20-63 years. The number of male was 60 (62.50%) and female was 36 (37.50%).

**Risk factors of acute pancreatitis among the study subjects:** It was observed that acute pancreatitis was associated with hypertriglyceridemia (19.79%), gall stone (12.5%), post ERCP (6.25%) and alcoholism (2.08%). Aetiology was unidentified in 59.73% subjects. (Table II)

**Clinical presentation of the study subjects:** Majority of the subjects with acute pancreatitis presented with abdominal pain (mild in 36.45%, moderate in 31.25% and severe in 20.08%) in this present study. Subjects had raised temperature (20.08%), vomiting (54.41%) and oedema (25%). Some (27.8%) had compliant of palpable abdominal mass. Few subjects with severe acute pancreatitis had periumbilical discoloration (12.5%) and flank discoloration

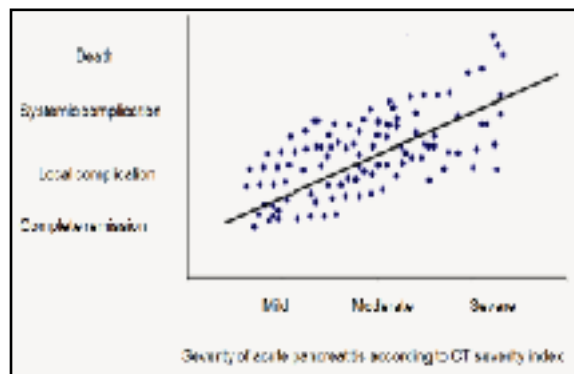
**CT scan findings of the study subjects:** It was seen that diffuse pancreatic enlargement was noted in 29.16% subjects. Pancreatic inflammation with and without peripancreatic fat involvement were observed in 27.08% and 72.91% subjects respectively. Pseudocyst formation (13.54%), ascites (30.20%), renal fascia involvement (46.87%) and pleural effusion (37.5%) were seen in CT scan. Pancreatic necrosis (More than 30% in 29.16% and less than 30% in 38.54%) was revealed. (Table I)

**Clinical outcome of the study subjects:** About 42.7% subjects were completely cured. Several complications (Local, 30.28% and systemic, 22.91%) were observed. Surgical intervention was required in 16.67% subject. Shock was observed in 34.37% subjects. Respiratory failure (7.29%), hepatic failure (3.12%), renal failure (2.08%) and CNS failure (1.04%) were seen. It was observed that death occurred in 3.12% subjects. Mean (± SD) hospital stay was 10.45 (± 4.55) days (Table I).

**Table I:** Clinical outcome of the study subjects (n=96)

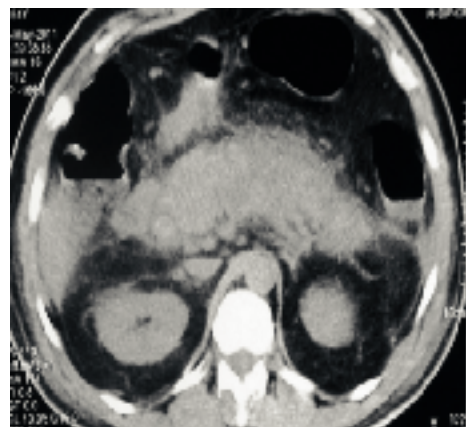
Outcome	Number of subjects	Percentage
Complete remission	41	42.70
Local complications	29	30.28
Systemic complications	22	22.91
Death	03	03.12
Need for surgical intervention	16	16.67
CVS failure (Shock)	33	34.37
Respiratory failure	07	07.29
Hepatic failure	03	03.12
Renal failure	02	02.08
CNS failure	01	01.04
Hospital stay in days (mean ±SD)	10.45±4.55	

\*Multiple responses were elicited.



**Figure 01:** Scatter diagram showing relationship between severity of acute pancreatitis determined by CT severity index and clinical outcome.

**Illustration 01:** Contrast enhanced CT scan (Delayed) showing mild intrinsic pancreatic inflammation with peripancreatic fat inflammation and thickened left sided renal fascia (Mild pancreatitis= 2 points). This CT image was taken from 54 years old male subject of with clinically suspected case of acute pancreatitis. Subjects had complete remission within 3 days without any complication.



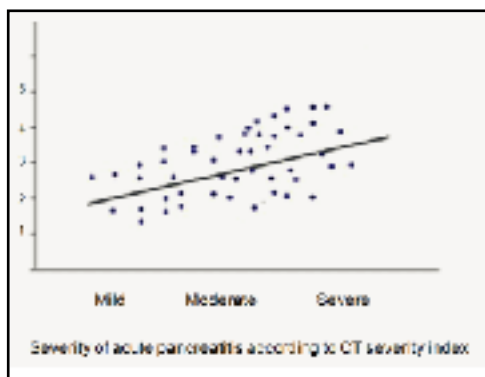
Association of severity between clinical scoring with CT severity index in acute pancreatitis: Severity of acute pancreatitis was evaluated by clinical findings on the basis of Glasgow prognostic score and Modified CT severity index. Image analysis for each case was assessed by using the modified CT severity index and categorized as mild (0-2 points), moderate (4-6 points), or severe (8-10 points). Glasgow prognostic score ranged from 0 to 8. If the score was 0-2, the likelihood of mild pancreatitis was high. If the score was 3-4, moderate pancreatitis was likely and if score was 5 and more severe pancreatitis was more likely. The results of the interpreter analysis was Kappa = 0.863 with  $p < 0.001$  when association of severity by clinical scoring and CT severity scoring was compared. This measure of agreement, while statistically significant, was almost perfect agreement (Table II).

**Table II:** Association of severity between clinical scoring with CT severity index in acute pancreatitis

Glasgow prognostic score	CT severity index						Total
	Mild		Moderate		Severe		
	n	%	n	%	n	%	
Mild	37	97.36	02	05.94	00	00	39 (40.62)
Moderate	01	02.64	32	91.42	03	13.05	36 (37.50)
Severe	00	00	01	02.64	20	86.95	21 (17.88)
Total	38	39.58	35	34.45	23	25.67	96 (100)

(Kappa=0.852, p value =0.001)

Measurement of agreement (Kappa)	Asymp. Std. Error	Approx. T	p value
0.852	0.088	8.879	0.001



**Figure 02:** Scatter diagram showing relationship between severity of acute pancreatitis determined by CT severity index and number of organ failure.

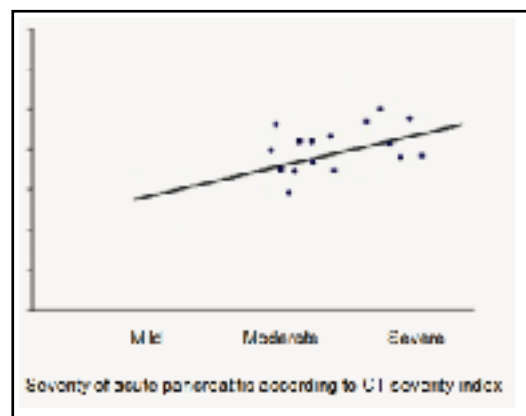
**Illustration 02:** Contrast enhanced CT scan (Oral and IV) showing pancreatic inflammation with fluid collection (Moderate pancreatitis= 4 points, pancreatic necrosis<30% = 2 points, Total=6 points). This CT image was taken from 45 years old male patient of with clinically suspected and biochemically diagnosed case of acute pancreatitis. Subject was haemodynamically unstable on admission and stayed in the hospital for about 6 days.



**Relation of CT severity index with patient's outcome in acute pancreatitis:** CT severity index in acute pancreatitis had statically significant (p is less than 0.05) relation with clinical outcome (0.573), organ failure (0.674), need for surgical intervention (0.463) and hospital stay (0.235) which was found on simple linear regression test (Table III and Figures 01-04).

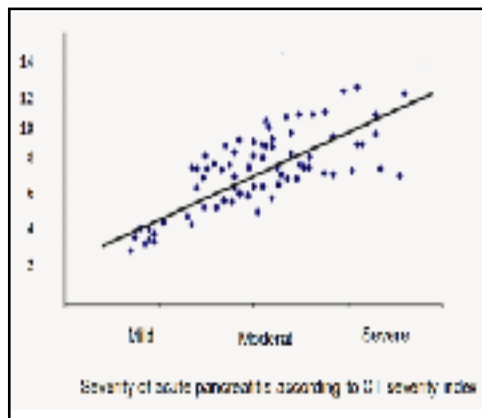
**Table III:** Relation of CT severity index with patient's outcome in acute pancreatitis

Parameter	Regression coefficient value ( )	p value
Clinical outcome	0.573	0.035
Organ failure	0.674	0.001
Need for surgical intervention	0.463	0.011
Hospital stay	0.235	0.047

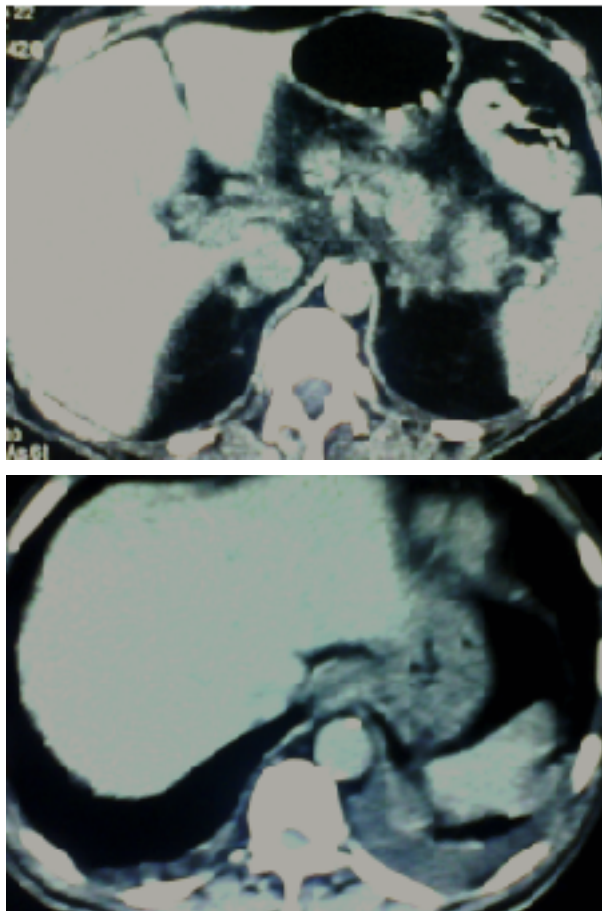


**Figure 03:** Scatter diagram showing relationship between severity of acute pancreatitis determined by CT severity index and number of surgical intervention.

**Figure 04:** Scatter diagram showing relationship between severity of acute pancreatitis determined by CT severity index and length of hospital stay.



**Illustration 03:** Contrast enhanced CT scan showing peripancreatic inflammation (= 2 points), pancreatic necrosis >30% (= 4 points) and moderate left sided pleural effusion (=2 points) and diagnosed as severe pancreatitis. This CT image was taken from 66 years old female subject of with circulatory-respiratory failure. This patient stayed in the hospital for 12 days.



## Discussion

Demographically acute pancreatitis generally affected all gender groups with a male preponderance<sup>2</sup>. Previous study reported that acute pancreatitis occurred between 25-75 years<sup>9</sup>. Comparable result was observed regarding the age-gender characteristics of the current study subjects where mean age of the study subjects was 35.48 ( $\pm$  14.59) and their age ranged from 20 to 63 years. Researchers found that 30-75% of all cases of acute pancreatitis were due to gallstone, more than 30% of pancreatitis cases were due to complications of heavy alcohol abuse, 25% of pancreatitis was due to hypertriglyceridaemia, 15% due to post ERCP procedure and 10-30% was idiopathic<sup>10</sup>. In present study it was seen that acute pancreatitis was associated with hypertriglyceridemia (19.79%), gall stone (12.5%), post ERCP (6.25%) and alcoholism (2.08%). Though the percentage of the risk factors of acute pancreatitis of the present study did not match with the previous study result, it was common that same comparable risk factors (like previous study) were responsible for acute pancreatitis. Majority of the subjects with acute pancreatitis presented with abdominal pain, raised temperature, vomiting and oedema. Few had complaints of palpable abdominal mass. Other subjects with severe acute pancreatitis had periumbilical discoloration and flank discoloration. Previous comparable study reported that hallmark symptom of acute pancreatitis was upper abdominal pain, usually with nausea and vomiting. Occasionally, body wall ecchymosis (Cullen's sign at the umbilicus, Grey-Turner's sign in the flanks) indicated a severe necrotizing pancreatitis<sup>11</sup>. These findings were comparable with this present study finding.

It was found that about 20% of the acute pancreatitis was severe with a mortality of about 20%<sup>12</sup>. Necrosis would be followed by a systemic inflammatory response syndrome and organ failure. The further clinical course was then determined by bacterial infection. In present study it was observed that death occurred in 3.12% subjects. Several complications (Local, 30.28% and systemic, 22.91%) were also seen. Surgical intervention was required in 16.67% subjects. Organ failure was noted also. Otsukiet et. al.<sup>12</sup> also found that mild pancreatitis, the CT features were ranged from a normal-appearing pancreas with no peripancreatic abnormalities to diffuse enlargement and heterogeneous attenuation of the gland with ill-definition of the border. In severe pancreatitis, there is, in addition to the features stated above, a lack of normal enhancement of part-

of the pancreas or the entire pancreas, in keeping with necrosis. Area as of non-enhancement was considered a reliable CT sign for necrosis. Other characteristics of severe pancreatitis included more extensive peripancreatic inflammatory change than was seen in mild acute pancreatitis. Usually, this was associated with focal fluid collections. Other findings in CT scan were presence of pseudocyst, ascites, pleural effusion etc. This present study revealed the similar result where it was seen that diffuse pancreatic enlargement was noted in 29.16% subjects. In present study pancreatic inflammation with peripancreatic fat involvement was observed in 27.08% subjects. Pseudocyst formation (13.54%), ascites (30.20%), renal fascia involvement (46.87%) and pleural effusion (37.5%) were also seen in CT scan.

Severity of acute pancreatitis was evaluated by clinical findings and CT severity index and the measure of agreement between clinical and imaging staging was almost perfect. This result reflected that CT severity index had relation with clinical findings. Similar result was observed in the a comparable study where it was reported that there were no statistically significant differences between the predictive accuracies of CT and clinical scoring systems and was concluded that the predictive accuracy of CT scoring systems for severity of AP was similar to clinical scoring systems<sup>13</sup>. Simple linear regression revealed that CT severity had statistical significant relation with clinical outcome, organ failure, hospital stay and need for surgical intervention. Mortelet et al observed the similar comparable result like this present study<sup>8</sup>. They found that the severity of pancreatitis and length of the hospital stay, need for surgical or percutaneous procedures and occurrence of infection and correlated more closely. Significant correlation between the severity of pancreatitis and the development of organ failure (9/66 patients) was seen using the modified index.

## Conclusion

It was observed that modified Computerized Tomography (CT) severity index in acute pancreatitis correlates with patients' clinical outcome. It could be concluded that during reporting if this simple scoring system is applied then we can easily measure the severity and determine whether patient need medical or surgical intervention.

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