Role of Computed Tomography in Predicting Severity of Acute Pancreatitis

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ABSTRACT
The current study was based on Computed Tomography (CT) findings and results. We found 63% of patients with acute interstitial edematous pancreatitis, and we found 37% of patients with acute necrotic pancreatitis in 46 cases. Based on our findings, we observed bulky pancreas among 26 cases (56.52%), 17 cases (36.95%) of pancreatic necrosis, 9 cases of pancreatic atrophy, 11 cases of pseudocyst, and 9 cases of peri-pancreatic fluid. When we evaluated the Modified CT Severity index among the study cases, we observed that 19.56% cases have mild index, the majority (56.52% cases) have moderate index while 23.91% have severe index. We also found that majority of the cases were clinically cured and discharged, i.e., 47.82%. 19.56% of the total study subjects reported recurrence of episodes of pancreatitis, while 30.43% of the total patients turned into chronic pancreatitis. This study presents a cross-sectional hospital-based analytical study carried out among 46 cases of AP referred to under the radiology department for further diagnostic evaluation, in a tertiary healthcare facility in Maharashtra. The present study Data Source included all the AP patients referred to the radiological department in a tertiary health research center. They met the standards for inclusiveness, which assented to the analysis. Type of study is Hospital analytical based study. The study duration is 18 months. Data collection was done through semi-structured, pre-designed, and pre-validated proformas in patients meeting inclusion requirements that included disease history, clinical outcomes, investigative records, and descriptions of surgical interventions.

INTRODUCTION
Acute pancreatitis is a complicated, clinically contingent condition. The bulk of moderate illness cases are treated fully, with only 15-20% causing local and neurological problems clinically serious AP and even a 20-30 percent of mortality rates (Isaji et al., 2006). Throughout the clinical presence with extent, the phase of acute pancreatitis (AP) is extremely unpredictable. In most cases, the condition is moderate and accidental and can also be reversed, but with organs degeneration and death by up to 10-50%, that will lead to a serious narcotization in around 20% of the cases. Because of this potential for deterioration and fatal outcome, the stratification of the severity of AP is essential (Balthazar et al., 1994). The detection of critically critical PA patients is important because they can undergo intense fluid overload and be tracked extensively for organ impairment progression through referral to an intensive care unit (ICU). Extreme differentiation is necessary throughout the initial analysis of patients, yet many predictor classification methods.
are already in use, both clinical or otherwise lab, including CT approaches. The usage of intravenous (IV) contrast factors is often a required indicator for the occurrence and magnitude of pancreatic necrosis in two widely utilized CT scoring schemes—CT severity index (CTSI), developed by Balthazar et al (Busireddy et al., 2014) as well as improved CT severity indices, as suggested by Mortele, which help classify local and/or extra-pancreas disorders including inflammation shifts (Xu et al., 2013).

The Atlanta classification was introduced in 1992, wherein it distinguished AP into moderate and extreme categories. As previous research studies have identified certain incoherence and anomalies in the meaning of definitions (Davila-Cervantes et al., 2004), this categorization was evaluated in 2012 to standardize and simplify different definitions relating to AP. The RAC or the revised Atlanta classification definition characterized AP’s ‘severity’ as a medium, mildly extreme, or severe, describing the different categories of libraries specifically. The classification and assessment of patients with AP by use of CT and Ultrasound play a critical role. Advanced CT is important to ascertain the extent of the condition as well as the risks of extreme acute pancreatitis (Makary et al., 2005; Khan et al., 2016; Ahn et al., 2010). Widespread adoption and superior CT contrast-enhanced spatial resolutions (CECT) render it the most widely employed imaging tool in APs for treatment, intensity estimation, and RAC morphology.

3. To assess the morbidity and mortality associated with acute pancreatitis

**Figure 1: Age Distribution**

**Research Objectives**

This study aims to evaluate the role of computed tomography in predicting the severity of acute pancreatitis and its correlation with its clinical outcomes. This further includes analytical objectives to,

1. Differentiate between acute edematous and acute necrotizing pancreatitis
2. To evaluate the complications using the CT severity index

**Figure 2: Gender-Based Distribution**

**Literature Review**

The average age of male subjects was 47.71 years and that of female subjects was 51.48 years as identified in MIR et al (Mir et al., 2013).

In the research conducted by Raghuwanshi et al (Banday et al., 2015), there were 35 male patients and 15 female patients with a male: female ratio of 2:1 in the population. According to Raghuwanshi et al. (Banday et al., 2015), the most common aetiologic factors were cholelithiasis (42%) and alcoholism (38%), followed by idiopathic (24%), trauma (2%) and drug-induced (2%). Caca et al., gall stones in 57%, alcohol overindulgence in 21% and to both in 5%.

According to Banday et al. (Raghuwanshi et al., 2016), alcoholic pancreatitis was seen in 36% of cases. Together cholelithiasis and alcoholism accounted for 76% of cases. In males, alcohol was found to be the most common aetiological agent accounting for 54.54% of cases. In females, cholelithiasis was found to be the most common aetiological agent accounting for 70.58% of cases. In their research, Banday et al. (Raghuwanshi et al., 2016) found that within the age range, the average number of patients were 40-50 years or 42.0%. The mean age was 42.32 years. 66% were male and 34% were females with a male to female ratio of 2:1.

According to Steinberg et al. (Steinberg et al., 2017), biliary calculi and alcohol together constituted about 80-90% of causes of acute pancreatitis.

In its longitudinal case analysis, Chen et al. (Chen et al., 2017) observed a median age of 47.5 ± 14.3 years for all registered patients. Chen et al. (Chen et al., 2017), in their study, observed 208 patients of biliary tract stones (n=97), alcohol abuse (n=30),
Table 1: Age Distribution

| Age group (in years) | Number of participants | Percentage |
|---------------------|------------------------|------------|
| 20–30               | 12                     | 26.08%     |
| 30–40               | 23                     | 50%        |
| 40–50               | 7                      | 15.21%     |
| 50–60               | 4                      | 8.69%      |
| Total               | 46                     | 100%       |

Table 2: Gender-Based Distribution

| Gender | Number of participants | Percentage |
|--------|------------------------|------------|
| Males  | 39                     | 84.78%     |
| Females| 7                      | 15.22%     |
| Total  | 46                     | 100%       |

Table 3: Distribution of participants according to the presence of gall stones

| Presence of gall stones | Number of participants | Percentage |
|-------------------------|------------------------|------------|
| Present                 | 10                     | 21.73%     |
| Absent                  | 36                     | 78.26%     |

Figure 3: Distribution of participants according to the presence of gall stones

and idiopathic acute pancreatitis.

In a study conducted by Sahu et al., (Abbey et al., 2017), they observed 25% cases presented with >30% necrosis, 23.33% cases presented with >30% pancreatic necrosis and 51.66% cases did not have necrosis.

MATERIALS AND METHODS

Data

This study presents a cross-sectional hospital-based analytical study carried out among 46 cases of AP referred to under the radiology department for further diagnostic evaluation, in a tertiary healthcare facility in Maharashtra.

Data Source

The present study included all the AP patients referred to the radiological department in a tertiary health research center and met the standards for inclusiveness, which assented to the analysis.

Type of study

Hospital analytical based study

Study duration

18 months

Data collection

The data were obtained through semi-structured, pre-designed, pre-validated proformas in patients meeting inclusion requirements that included disease history, clinical outcomes, investigative records and descriptions of surgical interventions. The patients, for further medical incidents were additionally, followed up.

CT severity index

The CT severity index (CTSI) combines the Balt-hazar grade (0-4 points) with the extent of pancreatic necrosis (0-6 points) on a 10-point severity scale. On the day of admission, scoring systems based on imaging do not outperform scoring systems based on clinical and biochemical parameters with regard to predicting clinical outcomes. Therefore, performing CT on the day of admission solely for prediction purposes is not recommended.

Inclusion Criteria
1. Patients clinically detected with increased serum amylase, including lipase rates with AP.
2. Cases between 20-60 years of age

**Exclusion criteria**
1. Cases with chronic calcifying pancreatitis
2. <20 years or >60 years of age
3. Cases in whom contrast study is not possible due to renal causes

**CT Protocol**
Pre and post contrast study was done. Post contrast study was done after giving 80-90 ml of Omnipaque contrast (1.2 ml/kg of body wt.) at the rate of 3ml/sec. Axial 5mm slices were taken. Sections were taken from the dome of diaphragm up to pubic symphysis. Reconstruction was done in 1.5 mm sections in sagittal, coronal, and axial planes.

**Methods**
A comprehensive history, clinical signs and symptoms, period and study, have been assessed for acute pancreatitis. Ultrasound (USG) abdominal and/or computerised tomography (CT), blood and urine tests have been carried out where appropriate. Where required. Abdominal ultrasound and CT scan was used to determine the alteration in physiology, size, volume, wall thickness, location of peri-pancreatic collection, the extent of pancreatic parenchymal disease, the nature of main pancreatic duct and its relation to the cyst. The outcome and complications following other methods was evaluated.

**Statistical analysis**
All the collected data was entered with the help of MS Excel software. Statistical analysis is done using SPSS 17.0 software. The results and observations were tabulated and represented graphically using Microsoft Excel software 10.0. Spearman’s correlation methods was used to correlate Modified CT severity index with outcomes in this study. The patient’s outcome of interest was calculated with 95% confidence limits. P-value of <0.05 is considered as significant.

**RESULTS AND DISCUSSION**
This research was performed in KIMS, Karad, among 46 patients of acute pancreatitis referred to the general medicine ward. Following their informed approval, respondents who fulfilled the eligibility requirements were included in the analysis.

**Demographic characteristics**

**Age distribution**
In this study it was found that most of the participants belonged to 30– 40 years of age group (23 cases), followed by 12 cases in the age group of 20-30 years, 7 cases in 40 – 50 years and 4 cases in 50-60 years of age group (Table 1, Figure 2).

**Gender-wise distribution of cases**
In the present study, Out of 46 study participants, the majority were males (39, 84.78%) and 7 were females (15.22%) (Table 2) (Figure 2). Here we observed that male participants outnumbered the female participants.

**Presence of Gall Stones**
In the present study, 10 cases (21.73%) were identified with gall stones, while the rest of the cases had no gall stones (Table 3 and Figure 3).

**Clinical Presentation**
Table 4: Clinical presentation of patients

| Clinical features          | Patient count | Percentage  |
|----------------------------|---------------|-------------|
| Pain in abdomen            | 44            | 95.65%      |
| Guarding                   | 32            | 69.56%      |
| Tenderness                 | 39            | 84.78%      |

Table 5: Diagnosis of acute pancreatitis based on CT findings

| Diagnosis on CT | Number of participants | Percentage |
|-----------------|------------------------|------------|
| AIEP            | 29                     | 63.04%     |
| ANP             | 17                     | 36.95%     |
| Total           | 46                     | 100%       |

Table 6: CT characteristics of AIEP

| CT Finding (AIEP)          | Number of participants | Percentage |
|----------------------------|------------------------|------------|
| Bulky pancreas             | 20                     | 68.96%     |
| Pseudocyst                 | 11                     | 37.93%     |
| Peri-pancreatic fluid      | 9                      | 13.04%     |
| Pleural effusion           |                        |            |
| Right                      | 0                      | 0          |
| Left                       | 4                      | 13.79%     |
| Bilateral                  | 3                      | 10.34%     |
| Vascular complications     | 0                      | 0          |

Table 7: CT characteristics of Acute necrotic pancreatitis

| ANP CT findings            | Number of participants | Percentage |
|----------------------------|------------------------|------------|
| Bulky pancreas             | 6                      | 35.28%     |
| Necrosis                   | 11                     | 64.7%      |
| Atrophy                    | 0                      | 0          |
| Wall-off Necrosis          | 4                      | 25.52%     |
| Necrotic fluid collections | 12                     | 70.58%     |
| Pleural effusion           |                        |            |
| Right                      | 0                      | 0          |
| Left                       | 1                      | 5.88%      |
| Bilateral                  | 3                      | 17.64%     |
| Ascites                    | 4                      | 23.53%     |
| Vascular complications     | 1                      | 5.88%      |

In the present study, 44 cases with acute pancreatitis presented with abdominal pain, whereas 32 cases presented with guarding and 39 with tenderness (Table 4 and Figure 4).

Diagnosis Based On Computed Tomography Findings

As we assessed the diagnosis of the study subjects, of acute pancreatitis based on Computed Tomography (CT) findings, we found 29 patients with AIEP and 17 patients with ANP among 46 cases. Table 5 and Figure 5 shows their respective percentages for the number of patients.

Table 6 shows the results of the CT characteristics of AIEP. We observed bulky pancreas among 20 cases, 11 cases of pseudocyst, 9 cases of Peri-pancreatic fluid were observed. We also observed 7 cases of pleural effusion associated with cases of AIEP. Out of them, 4 cases belonged to Left Pleural effusion and
Table 8: Distribution of Pancreatic Necrosis

| Percentage of necrosis | Score | Number of cases | Percentage |
|------------------------|-------|----------------|------------|
| None                   | 0     | 0              | 0          |
| <30%                   | 2     | 9              | 52.94%     |
| >30%                   | 4     | 8              | 47.05%     |
| Total                  | 17    | 100%           |            |

3 cases belonged to Bilateral Pleural effusion. No patients were having Right Pleural effusion, Ascites and Vascular complications. Respective percentages of patients for each category are also given according to CT characteristics.

Acute Necrotic Pancreatitis

CT Features

Table 7 shows the results of the CT characteristics of Acute necrotic pancreatitis. We found Bulky pancreas among 6 cases, 11 cases of pancreatic necrosis, 4 cases of walled-off necrosis, 12 cases of Peripancreatic fluid. In ANP, we observed a total 4 cases of pleural effusion, out of them 1 case of Left Pleural effusion, 3 cases of Bilateral Pleural effusion. 4 cases reported with ascites in the present study.

There also was reported 1 case of Vascular complications among acute necrotic pancreatitis case, with necrotic effusion. No patients reported pancreatic Calcification, Atrophy, Right Pleural effusion and Ascites. Respective percentages of patients for each category are also given according to CT characteristics.

Pancreatic Necrosis

Among a total of 17 cases of Acute Necrotic Pancreatitis. Table 8 and Figure 6 show the distribution of these cases according to the Percentage of necrosis along with the score. 9 cases were having <30% of necrosis, while 8 cases were having a percentage >30% of necrosis. Percentages for each category are also shown in the Table 8.

Modified CT Severity Index

A total of 46 cases were classified according to the CT Severity index, as shown in Table 9. The index ranges from 0 to 10. To make the severity of acute pancreatitis clear, we classified the cases into mild-moderate and severe as shown in the Table 9 and grouped under 3 classes as Mild with index 0-2, Moderate with index 4-6 and Severe with index 8-10. 9 cases have a mild index, the majority (26 cases) have a moderate index, while 11 cases have severe
Diagram 2: Axial post contrast image of 37 yrs old male in pancreatic phase shows a heterogenous attenuation of the pancreas with necrotic fluid collection surrounding it suggestive of acute necrotizing pancreatitis with the necrotizing fluid collection.

Table 9: Classification of cases according to the Modified CT Severity index

| Class   | Score | Number of cases | Percentage  |
|---------|-------|-----------------|-------------|
| Mild    | 0-2   | 9               | 19.56%      |
| Moderate| 4-6   | 26              | 56.52%      |
| Severe  | 8-10  | 11              | 23.91%      |
| Total   |       | 46              | 100%        |

Table 10: Accuracy of CT Severity Index Against Clinical Outcome

| Correlation Between       | Correlation Coefficient | Correlation     |
|---------------------------|-------------------------|-----------------|
| CTSI and Clinical Outcome | r = 0.896               | Strong Positive |

index. The Table 9 also gives the percentages for each class of index.

Accuracy of CT Severity Index Against Clinical Outcome

In the present study, we analyzed the diagnostic accuracy of CT severity index in predicting acute pancreatitis by comparing CTSI for cases of acute pancreatitis with their clinical outcomes in Diagram1 and Diagram 2. We applied Spearman’s rank correlation methods to compare two ordinal parameters. In this statistical method, we ranked the observations and then calculated Spearman’s correlation coefficient. After comparison, we found that the differences in observations are statistically significant. (r = 0.896) in Table 10.

CT image Diagrams

Diagram 1 shows, A) On plain study, axial CT image shows a bulky pancreas in head and tail region with no areas of calcification or surrounding fluid collection. B) On axial post-contrast CT image, pancreatic parenchyma shows normal post contrast enhancement (100-120 HU). C) Sagittal section precontrast and D) Post contrast CT image shows Pancreatic duct in the body part appears dilated, however no e/o calculi within the duct.

CONCLUSIONS

From the observations from the present study, it can be concluded that: Computed tomography can be used to assess the severity of acute pancreatitis. Computed tomography can also be used to know the extent of disease within pancreatic parenchyma.
Additionally, computed tomography can be used to diagnose associated complications at an early stage. Moreover, computed tomography can be used to forecast the progress of pancreatitis. In this statistical method, we ranked the observations and then calculated Spearman’s correlation coefficient. After comparison, we found that the differences in observations are statistically significant (r=0.896). In this study, the cases associated with Gall stones were 21.73% to 95.65% of cases presented with abdominal pain, whereas 69.56% of cases presented with guarding and 84.78% cases presented with tenderness.

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Conflict of Interest

I hereby declare that there is no conflict of interest related to this manuscript.

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