

ORIGINAL RESEARCH

Role of multidetector computed tomography in acute pancreatitis

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ABSTRACT

Aim: To evaluate the role of multidetector computed tomography in acute pancreatitis and severity of the disease using Modified CT Severity Index.

Material and Methods: This prospective observational study was conducted in the department of Radio diagnosis, Imaging & Interventional radiology N.S.C.B Subharti Medical College, CSS Hospital, Meerut among 51 patients in any age group referred to the radiology department with clinical suspicion of acute pancreatitis for a period from October 2019 to August 2021. Detailed clinical history was taken from the patient relevant clinical examination done and serum urea and creatinine of the patient was checked. Severity of acute pancreatitis was analysed using MCTSI.

Results: Most common etiology was found to be gall stones (47.06%) followed by alcoholism (21.57%). In cases of acute pancreatitis vascular complications such as venous thrombosis were more commonly associated with acute necrotizing pancreatitis (15.79%) than acute interstitial pancreatitis (3.13%) and pseudo-aneurysm was seen in association with acute necrotizing pancreatitis. Majority of the cases were of moderate severity (52.94%). In subjects categorized as severe according to CT Severity index, recurrence, chronic pancreatitis and mortality were noted in 3, 5 and 2 subjects respectively. Hence, Modified CT Severity index was found to have excellent predictability (kappa value=0.85, p<0.01) of outcome among the subjects with pancreatitis.

Conclusion: MDCT proved to be the imaging modality of choice in patients of AP. MDCT successfully used to calculate MCTSI which revealed a strong correlation with clinical outcome and was helpful in assessing disease progression and patient mortality.

Keywords: Pancreatitis, MDCT, MCTSI

INTRODUCTION

Pancreatitis is defined as the inflammation of the pancreas and considered the most common pancreatic disease in children and adults. It is painful, develops quickly and can sometimes prove to be fatal. It leads to a wide range of local and systemic pathophysiologic alterations and large variability in the clinical manifestation and prognosis^{1,2}. It can be acute; representing an acute inflammatory process of the pancreas, or chronic; progressing slowly with continued, permanent inflammatory injury to the pancreas³ and acute on chronic.⁴

Pancreatitis is associated with a wide range of local complications affecting the pancreatic gland, the ductal system, surrounding vasculature. Systemic complications include multi organ dysfunction syndrome (MODS), systemic inflammatory response syndrome (SIRS),

disseminated intravascular complications (DIC), exacerbation of pre-existing co-morbidity, such as coronary artery disease or chronic lung disease precipitated by acute pancreatitis.^{5,6} Grading of the severity is done by single prognostic indicators (e.g. serum blood urea nitrogen, creatinine, hematocrit, levels of C-reactive protein, procalcitonin), Clinical scoring systems that incorporate physiologic and laboratory parameters (the Ranson score, Systemic Inflammatory Response Syndrome (SIRS), Bedside Index of Severity in AP (BISAP), and Acute Physiology and Chronic Health Evaluation (APACHE-II score) and imaging scoring systems.⁷

Besides the clinical and biochemical approach many imaging modalities are readily available to help narrow down the differentials and reach the diagnosis. Imaging plays a crucial role in reaching the diagnosis, assessing the severity and associated complications. In some cases it can further help guide intervention for management of these complications.⁷

CT is the modality of choice and is the gold standard imaging for staging and grading of acute pancreatitis and its complications and also for guiding interventions in certain cases. The ideal time for performing CT scan is atleast 72 hours after the onset of symptoms to best assess the full extent of the disease.⁸ However, it is expensive, exposes patient to ionizing radiation and has less sensitivity in identifying gallstones of biliary ductal stones. MRI is better in detecting mild acute pancreatitis and has a high sensitivity and specificity for choledocholithiasis and congenital pancreatic anomalies. MRI is superior to CT and ultrasound in this regard, with the advantage of not requiring IV contrast administration. The disadvantages however are that it is a costly investigation and has limited availability and takes longer.⁹

The use of both ERCP and MRCP has been increasing in the past decades. Advantage of MRCP is that it is non-invasive, can be performed without the use of intravenous contrast media and carries little risk whereas ERCP is an invasive procedure however, it can help in biliary decompression and thus prove to be therapeutic as well as diagnostic.¹⁰

The CT severity index was given by Balthazar et al in 1990, but initially it did not include extrapancreatic complications¹¹ and to overcome these drawbacks, in 2004 Mortelet et al introduced Modified CTSI (MCTSI), which is a more simpler and easier index which also takes into account extrapancreatic complications and has had better correlation with clinical outcome.¹²

With this background, the present study was conducted to evaluate the role of multidetector computed tomography in acute pancreatitis and severity of the disease using Modified CT Severity Index.

MATERIALS AND METHODS

The present prospective observational study was conducted in the department of Radio diagnosis, Imaging & Interventional radiology N.S.C.B Subharti Medical College, CSS Hospital, Meerut. The study was conducted on 51 patients for a period from October 2019 to August 2021.

The subjects were selected according to the following inclusion and exclusion criteria:

INCLUSION CRITERIA

- All patients in any age group referred to the radiology department with clinical suspicion of acute pancreatitis.
- Altered biochemical parameters (serum amylase, serum lipase) in favor of acute pancreatitis
- Ultrasonography suggestive of acute pancreatitis and known case of chronic pancreatitis with features of acute symptoms.

EXCLUSION CRITERIA

- Patients with chronic pancreatitis
- Other pancreatic pathology like pancreatic malignancy, cyst.
- Any previous pancreatic surgery.
- Contraindicated cases for contrast study.
- Pregnant females.

METHODOLOGY

- Detailed clinical history was taken from the patient relevant clinical examination done and serum urea and creatinine of the patient was checked.
- Informed consent was taken.
- The study protocol for all procedures was approved by the Institutional Review Board for Ethical Clearance of Chatrapati Shivaji Subharti Hospital and was performed in accordance with the Code of Ethics of the World Medical Association according to the Declaration of Helsinki of 1975, as revised in 2000. All patients were asked to sign a written consent form prior to commencement of the study.
- CT examination was done on Phillips Ingenuity 128 Slice (MDCT).



Figure 1: Philips Ingenuity Core 128 Multidetector CT scanner used in the study

- Imaging and diagnosis of Acute Pancreatitis was made as per departmental protocols. Axial sections were taken. Coronal and Sagittal reformatting was done. Care was taken to follow the As Low as Reasonably Achievable (ALARA) approach to keep patient radiation exposure to a minimum level.
- **Non contrast scan** was taken
- **Contrast scan**- Approximately 50 to 60 ml of 350mg I/ml nonionic iodinated contrast (Omnipaque) was administered IV for optimal study results according to the weight of the patients. Patients with deranged renal function were excluded from the study.

Assessment of Severity: It was analysed using MCTSI as mentioned below:

| 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 the following: Pleural effusion, ascites, vascular complications, parenchymal complications, or gastrointestinal tract involvement | 2 |

The MCTSI was calculated by summing these values and acute pancreatitis was then categorized as:

| | |
|-----------------------|------------------|
| Mild pancreatitis | MCTSI score 0-2 |
| Moderate pancreatitis | MCTSI score 4-6 |
| Severe pancreatitis | MCTSI score 8-10 |

- Data was collected in structured data collection forms.
- All the findings and observations were coded and entered in Excel master sheet.

STATISTICAL ANALYSIS

Data so collected was tabulated in an excelsheet, under the guidance of statistician and analysed using statistical analysis (SPSS 24.00 for windows; SPSS inc, Chicago, USA). Reliability was assessed using kappa analysis and the level of significance was set at $p < 0.05$.

RESULTS

Out of 51 subjects of any age group that were referred to the department, there was male preponderance accounting for 54.9% of the cases with females accounting for 45.1% of the total cases. The study group comprised of patients ranging from 6 to 79 years of age. The maximum number of patients was seen in the age groups of 31-40 (21.57%) and 51-60 (19.61%). Minimum subjects were from the age group of <10 years (1.96%) followed by 11-20 years (7.84%). Most common etiology was found to be gall stones (47.06%) followed by alcoholism (21.57%). Least common etiology was found to be drug induced (1.96%) pancreatitis followed by trauma (3.92%) as shown in table 1.

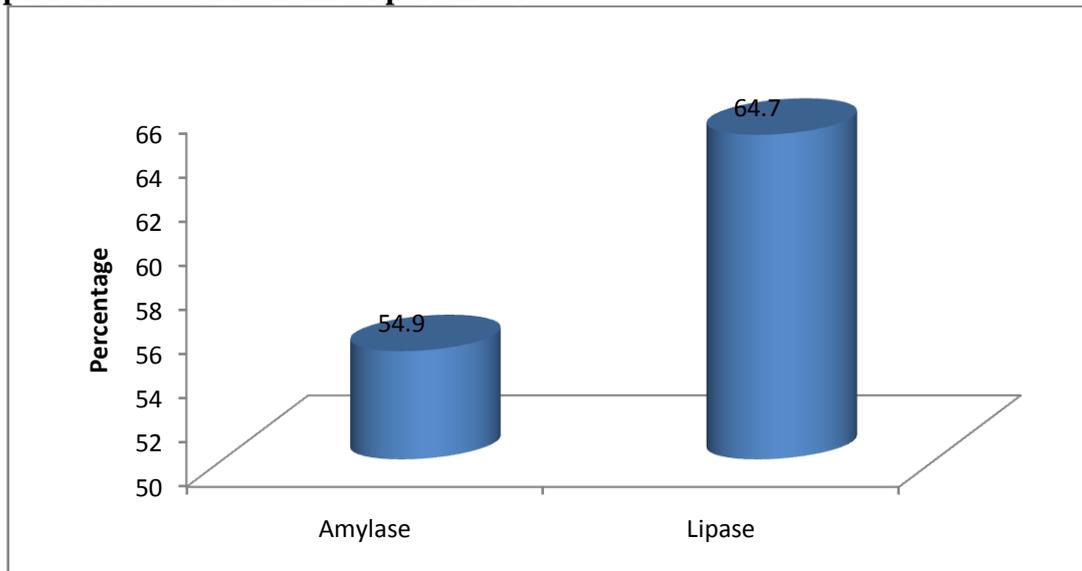
Table 1: Distribution of participants according to their presenting complaints and Etiological pattern in acute pancreatitis

| Clinical Features | N | % |
|----------------------------|----|-------|
| Pain in abdomen | 33 | 64.71 |
| Pain radiating to the back | 17 | 33.33 |
| Guarding | 13 | 25.49 |
| Tenderness | 22 | 43.14 |
| Fever | 11 | 21.57 |
| Vomiting | 31 | 60.78 |
| Etiology | | |

| | | |
|----------------|----|-------|
| Alcoholism | 11 | 21.57 |
| Gall stones | 24 | 47.06 |
| Trauma | 2 | 3.92 |
| Hyperlipidemia | 6 | 11.76 |
| Drug induced | 1 | 1.96 |
| Idiopathic | 7 | 13.73 |

Biochemical parameters viz. amylase and lipase was elevated in 54.9% and 64.7% of the patients. Elevated lipase levels were more commonly associated with acute pancreatitis (graph 1).

Graph 1: Elevated Biochemical parameters



According to CT, acute interstitial type of pancreatitis was seen in majority of the cases (62.7%) and acute necrotic pancreatitis was reported in fewer cases (37.25%). Amongst the CT findings in acute interstitial pancreatitis bulky pancreas, peripancreatic fat stranding and peri-pancreatic fluid were the most common findings and were seen in 81.25%, 68.75% and 59.38% of the cases respectively. Thickening of renal fascia and pleural effusion was revealed in 50% of the cases. Ascites (28.13%), inflammatory thickening of stomach and bowel wall (28.13%) and pseudocyst formation (18.75%) were less commonly seen imaging findings. Amongst the CT findings in acute necrotizing pancreatitis major findings were; bulky pancreas (73.68%), peripancreatic fat stranding (68.42%), peri-pancreatic fluid (52.63%) and pleural effusion (78.95%). Inflammatory thickening of stomach and bowel wall and ascites was revealed in 47.37% of the subjects each. Necrotic fluid collections and wall-off necrosis was found among 31.58% and 26.32% of the subjects respectively (table 2).

Table 2: Type of acute pancreatitis based on CT findings

| Pancreatitis | N | % |
|---|----|-------|
| Acute Interstitial Pancreatitis | 32 | 62.75 |
| Bulky pancreas | 26 | 81.25 |
| Peripancreatic fat stranding | 22 | 68.75 |
| Peri-pancreatic fluid | 19 | 59.38 |
| Pseudocyst | 6 | 18.75 |
| Thickening of renal fascial | 16 | 50.00 |
| Inflammatory thickening of stomach and bowel wall | 9 | 28.13 |
| Pleural Effusion | 16 | 50.00 |
| Ascites | 9 | 28.13 |
| Acute Necrotic Pancreatitis | 19 | 37.25 |

| | | |
|---|----|-------|
| Bulky pancreas | 14 | 73.68 |
| Peripancreatic fat stranding | 13 | 68.42 |
| Peripancreatic Fluid | 10 | 52.63 |
| Wall-off Necrosis | 5 | 26.32 |
| Necrotic fluid collections | 6 | 31.58 |
| Thickening of renal fascia | 9 | 47.37 |
| Inflammatory thickening of stomach and bowel wall | 8 | 42.11 |
| Pleural Effusion | 15 | 78.95 |
| Ascites | 9 | 47.37 |

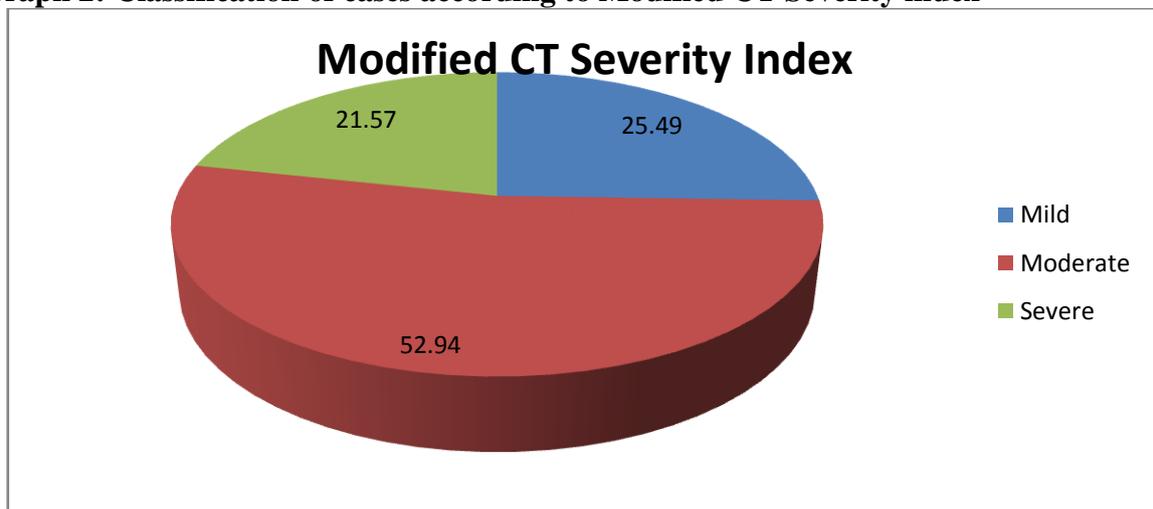
Amongst the cases of acute necrotizing pancreatitis majority of the cases reported less than <30% necrosis (63.16%). In cases of acute pancreatitis the extra-pancreatic complications were studied and vascular complications such as venous thrombosis were more commonly associated with acute necrotizing pancreatitis (15.79%) than acute interstitial pancreatitis (3.13%) and pseudoaneurysm was seen in association with acute necrotizing pancreatitis. GIT complications viz. wall thickening was revealed in major cases of acute necrotizing pancreatitis (42.11%) and small bowel obstruction was less commonly seen(10.53%). Systemic complications such as sepsis and multi-organ failure was revealed in 26.32% and 10.53% of the subjects with acute necrotizing pancreatitis as shown in table 3.

Table 3: Complications in Acute Pancreatitis

| Findings | Acute edematous | | Acute Necrotizing | |
|------------------------------|-----------------|-------|-------------------|-------|
| Vascular Complications | | | | |
| • Venous thrombosis | 1 | 3.13 | 3 | 15.79 |
| • Pseudoaneurysm | 0 | 0 | 1 | 5.26 |
| GIT complications | | | | |
| • Wall thickening | 9 | 28.13 | 8 | 42.11 |
| • Bowel Obstruction | 0 | 0 | 2 | 10.53 |
| • Gastric outlet obstruction | 0 | 0 | 1 | 5.26 |
| Sepsis | 2 | 6.25 | 5 | 26.32 |
| Multi-organ Failure | 0 | 0 | 2 | 10.53 |

The cases of acute pancreatitis were classified as mild, moderate and severe according to the modified CT severity index and majority of the cases were of moderate severity (52.94%) as shown in graph 2.

Graph 2: Classification of cases according to Modified CT Severity index



Association of Modified CT Severity index and the clinical outcome of patients was studied and in subjects categorized as mild according to CT Severity index, majority of the subjects were cured. In subjects categorized as severe according to CT Severity index, recurrence, chronic pancreatitis and mortality were noted in 3, 5 and 2 subjects respectively. Hence, Modified CT Severity index was found to have excellent predictability (kappa value=0.85, $p < 0.01$) of outcome among the subjects with pancreatitis (table 4).

Table 4: Association of Modified CT Severity index and clinical outcome

| Score | N=51 | Cured | Recurrence | Chronic Pancreatitis | Death | Kappa Value | p value |
|----------|------|-------|------------|----------------------|-------|-------------|---------|
| Mild | 13 | 10 | 2 | 1 | 0 | 0.85 | <0.01* |
| Moderate | 27 | 15 | 7 | 5 | 0 | | |
| Severe | 11 | 1 | 3 | 5 | 2 | | |

*: statistically significant

DISCUSSION

Computed tomography with contrast administration is the gold standard investigation and it elegantly documents the extent of parenchymal involvement, adjacent inflammatory changes and associated complications. It also helps categorize the cases as mild, moderate and severe according to the modified CTSI. Scan is done generally after 72 hrs of onset of clinical symptoms to best assess the full extent of the disease.¹³ The present prospective observational study was conducted in the Department of Radio diagnosis, Imaging & Interventional radiology N.S.C.B Subharti Medical College, CSS Hospital, Meerut among 51 patients in any age group referred to the radiology department with clinical suspicion of acute pancreatitis.

In the present study out of 51 subjects, majority (54.90%) of the patients were males. Similarly KapilSawarkaret al¹³, Sameer Raghuwanshi et al¹⁴ and Irshad Ahmad Banday et al¹⁵ in their study revealed male predominance in patients with acute pancreatitis. Like other studies, we observed that male participants outnumbered the female participants.

In our study; maximum subjects were from the age group of 31-40 years (21.57%) followed by 51-60 (19.61%) and 41-50 years (17.65%). Similarly KapilSawarkar et al¹³ in their study reported that majority of participants belonged to 31-40 years of age group, followed by group of 21-30 years. However MohdAltaf MIR et al¹⁶, observed that the majority of their patients were in the age range of 41-60 years.

In our study; pain in abdomen, vomiting, tenderness, pain radiating to the back, guarding and fever was found among 64.71%, 60.78%, 43.14%, 33.33%, 25.49% and 21.57% of the subjects respectively. According to KapilSawarkaret al¹³, almost all patients with acute pancreatitis presented with abdominal pain (95.65%), whereas 69.56% cases presented with guarding and 84.78% with tenderness. Block et al¹⁷, observed Triad of epigastric pain, nausea and vomiting was present in 75% of patients.

In the present study; the most common etiology was found to be gall stones (47.06%) followed by alcoholism (21.57%). Least common etiologies were trauma (3.92%) followed by drug induced (1.96%) pancreatitis. In males, alcohol was found to be most common aetiological agent. KapilSawarkar et al¹³ in their study revealed that majority of the cases were due to alcoholism (78.26%) and the second most common etiological factor was gall stones (21.73%). According to Steinberg et al¹⁸, biliary calculi and alcohol together constituted about 80-90% of the cases of acute pancreatitis. Similarly in our study major etiological factors were found to be gall stones and alcoholism.

In our study the lipase was the main biochemical parameter which was elevated in majority (64.7%) of the patients and was found to be more sensitive in detection of acute pancreatitis. The reported sensitivity of lipase varies in different studies. The range for its sensitivity is 85% to 100%. It is not clear whether it is more sensitive as compared to serum amylase.

Some studies show that it is more sensitive as compared to amylase, but others show it to be less. Lipase elevation is not specific for AP. There is a host of conditions besides AP where it is elevated. Despite this, overall it may be slightly superior to amylase in terms of specificity. However, it is now recognized that lipase can be elevated in as many conditions other than AP as amylase. Overall, to determine whether lipase is superior to amylase is a very challenging task and no study conclusively answer this question.¹⁹

According to CT, acute interstitial type of pancreatitis was seen in majority of the cases (62.7%) and acute necrotic pancreatitis was reported in fewer cases (37.25%). Above findings correlated well with KapilSawarkaret al¹³ who in their study also revealed that majority (63%) of the patients had acute interstitial edematous pancreatitis and 37% patients had acute necrotic pancreatitis.

In acute necrotizing pancreatitis majority of the patients reported < 30% necrosis (63.16%) and the major findings were; bulky pancreas (73.68%), peripancreatic fat stranding (68.42%), peri-pancreatic fluid (52.63%) and pleural effusion (78.95%). Inflammatory thickening of stomach and bowel wall and ascites was revealed in 47.37% of the subjects each. Necrotic fluid collections and wall-off necrosis was found among 31.58% and 26.32% of the subjects respectively. Vascular complications viz. venous thrombosis, pseudoaneurysm was found in 15.79% and 5.26% of the subjects with acute necrotizing pancreatitis. GIT complications viz. stomach and bowel wall thickening was revealed in 42.11% while sepsis and multi-organ failure was revealed in 26.32% and 10.53% of the subjects with acute necrotizing pancreatitis in our study. Findings in our study correlated well with the study of KapilSawarkar et al¹³ who in their study revealed that major imaging finding in AP was bulky pancreas (56.52%) and amongst the cases of acute necrotizing pancreatitis majority (52.94%) were having <30% of necrosis while 47.05% had necrosis > 30%.

BiswanathSahu et al²⁰ observed that 25% of the cases presented with >30% necrosis, 23.33% cases presented with >30% pancreatic necrosis and 51.66% cases did not have necrosis. According to MohdAltaf Miret al¹⁶, the most common finding on CECT was that of peripancreatic fluid collection, noted in 88% patients and infective necrosis which was seen in 4% of the patients. In a study by BandayIA et al¹⁵, infected necrosis occurred in 8%. Kapil Sawarkar et al¹³ in their study observed that majority of the cases of pleural effusion were associated with cases of acute interstitial pancreatitis. No patients had right sided pleural effusion, ascites or vascular complications. In acute necrotic pancreatitis, that majority of cases had bilateral pleural effusion. MohdAltaf MIR et al¹⁶ observed that the most common extra-pancreatic complication was pleural effusion observed in 12% of the cases. Sameer Raghuvanshi et al¹⁴ in their study reported that the pleural effusion was the most common extra-pancreatic complication with left sided pleural effusion being more common (46%). Among vascular complications, venous thrombosis in the portal vein followed by the splenic vein was the most common complication.

In our study the clinical outcome of the study participants was assessed and majority of the patients recovered (50.98%), while recurrence (23.53%), conversion to chronic pancreatitis (21.57%) were noted in some of the patients. Mortality was revealed in 3.92% of the subjects. KapilSawarkaret al¹³ in their study similarly found that majority of cases were clinically cured and discharged i.e. 47.82% . , 19.56% of the total study subjects reported recurrence of episodes of pancreatitis, while 30.54% of the total patients showed conversion into chronic pancreatitis. Mortality was reported in a case of acute necrotic pancreatitis with infected necrotic fluid died.

The cases of acute pancreatitis were classified as mild, moderate and severe according to the modified CT severity index and majority of the cases were of moderate severity (52.94%). Mild and severe cases of AP according to CTSI were depicted in 25.49% and 21.57% of the subjects respectively. Out of 13 subjects with mild CT Severity index majority of the patients

recovered, recurrence and conversion into chronic pancreatitis was less commonly seen. Amongst the patients categorized as severe under the CTSI, majority of the patients showed conversion to chronic pancreatitis followed by recurrence and mortality occurred in 2 subjects due to sepsis and multi-organ failure. Very few patients (9.09%) with severe score under CTSI completely recovered. Hence, Modified CT Severity index was found to have excellent predictability (kappa value=0.85, $p < 0.01$) of outcome among the subjects with pancreatitis in our study. Kapil Sawarkar et al¹³ in their study showed that 19.56% cases have mild index, majority (56.52% cases) have moderate index while 23.91% cases have severe index. They also found excellent correlation between modified CTSI and clinical outcome. These findings are similar to our study. Balthazar et al²¹, noted morbidity of 0% in patients with CTSI of 0-1, 8% in patients with modified CTSI of 2-3, 35% in patients with CTSI of 4-6, and 92% in patients with CTSI of 7-10. Irshad Ahmad Bandayet al¹⁵ in their study observed 18%, 38% patients as mild and moderate pancreatitis. Majority of the cases included in severe category according to modified CTSI (44%), followed by moderate (38%) followed by mild (18%).

The present study demonstrated a myriad of imaging findings, complications and was successful in establishing the usefulness of MDCT in acute pancreatitis and also the correlation of CTSI with the clinical outcome. However, it does have some limitations. This study was not aimed at deriving the intervention and management of the condition, nor was there any long term follow-up to establish the sequelae of these complications. Also, as the study was conducted in a single institute, it was limited to a smaller group of patients.

CONCLUSION

MDCT proved to be the imaging modality of choice in patients of AP. The faster scanning time and lack of respiratory misregistration allowed for better resolution and superior scan quality. The ability of Multidetector CT to scan in both arterial and venous phases with its post processing techniques allowed for excellent visualisation of the pancreas, biliary anatomy and peripancreatic vasculature. It was thus of great importance in reaching the diagnosis, assessing the severity and associated complications. MDCT successfully used to calculate MCTSI which revealed a strong correlation with clinical outcome and was helpful in assessing disease progression and patient mortality.

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