International Journal of Radiology and Diagnostic Imaging

E-ISSN: 2664-4444
P-ISSN: 2664-4436
www.radiologypaper.com
IJRDI 2022; 5(2): 35-38
Received: 16-02-2022
Accepted: 11-03-2022

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Comparative assessment of two imaging modalities and their application in the evaluation of pancreatic/peripancreatic changes due to acute pancreatitis

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DOI: http://dx.doi.org/10.33545/26644436.2022.v5.i2a.265

Abstract
Aim: Comparison of two imaging modalities and their application in the evaluation of pancreatic/peripancreatic changes due to acute pancreatitis.
Materials and Methods: The present comparative study was performed on 100 patients suspected of acute pancreatitis confirmed by elevated serum amylase and serum lipase levels, between November 2015 to May 2017 in the Department of Radiodiagnosis in Victoria Hospital and Bowring and Lady Curzon Hospital attached to Bangalore Medical College and Research Institute, Bengaluru. All patients underwent a real-time ultrasound scan of the abdomen using a curvilinear transducer of 2 to 6 MHz of Philips IU22 and triple-phase contrast-enhanced computed tomography of the abdomen by Philips INGENUITY 128 slice CT in Victoria hospital or Siemens SOMATOM 6 slice CT present in Bowring hospital.
Results: Most patients with acute pancreatitis (~30%) belonged to the age group 41-50 years while 28% each belonged to the age group 31-41 and 41-50 years respectively. Amongst males (n=88), 72% (n=64) were cases of acute pancreatitis and 28% (n=24) were the cases of acute on pancreatitis. On the other hand, of 12 females, 58% (n=07) were the cases of acute pancreatitis and 42% (n=05) were the cases of acute on chronic pancreatitis. Both ultrasonography (US) and MDCT were able to delineate normal-sized pancreas, increased size of head and body of pancreas and atrophic pancreas. While the US was able to identify only 17 cases, CT was able to detect 55 with a sensitivity of ~31%, which was statistically significant ($p<0.001$). Both CT and US detected equal cases of necrosis involving the body of the pancreas, while US detected one less case of necrosis involving the head of the pancreas than CT.
Conclusion: It is seen that both US and CT have roles to play in the diagnosis of pancreatitis and both are complementary to each other. However, MDCT was proved to be the imaging modality of choice in imaging pancreatitis and allowing accurate diagnosis of associated complications.

Keywords: Acute pancreatitis, Complications, MDCT, Ultrasonography

Introduction
Plain roentgenographs of the abdomen are part of the routine initial diagnostic workup of any acute abdominal pain. Conventional radiographic studies are of limited value for sensitivity and specificity in evaluating patients with acute pancreatitis. Erect and lateral decubitus films of the abdomen are taken to exclude perforated hollow viscus. Few of the nonspecific findings found in a case of acute pancreatitis on conventional radiographs are sentinel loop sign [1] which is a focal area of adynamic ileus close to an intra-abdominal inflammatory process and colon cut-off sign, which represents a paucity of gas distal to the splenic flexure. Peripancreatic extraluminal gas can be seen uncommonly in cases of pancreatic abscesses. Rifkind *et al*. [2] in a review of 73 cases, documented plain film findings such as pancreatic calcification, obscuration of the psoas margin, gastric curvature distortion, increased gastrocolic separation and pleural effusion being usually more on the left.
Over the past two decades, several radiologic prognostic scoring systems for pancreatitis have been developed. Among them, the CT severity index (CTSI), designed by Balthazar *et al*. [3] in 1990, is the most widely adopted for clinical and research settings. CTSI is a scoring system that quantifies and combines pancreatic and extra pancreatic inflammation with the extent of pancreatic necrosis.

In 2004, a modified CTSI was designed by the same author to address the several potential limitations which arose out of usage of the CTSI. [4]

In modified CTSI, extra pancreatic complications were added to the assessment and the way of quantifying the extent of pancreatic parenchymal necrosis was changed (none, ≤ 30%, or > 30%) and objectifying the presence or absence of peripancreatic fluid was simplified. In the initial study of 66 patients, MCTSI, when compared with the CTSI, showed a better correlation between the length of hospital stay and more importantly the development of organ failure, which is the primary determinant of outcome in the early phase of AP [5].

Materials and Methods

The present comparative study was performed on 100 patients suspected of acute pancreatitis confirmed by elevated serum amylase and serum lipase levels, over the period from November 2015 to May 2017 in the Department of Radiodiagnosis in Victoria Hospital and Bowring and Lady Curzon Hospital attached to Bangalore Medical College and Research Institute, Bengaluru.

Inclusion criteria

- All cases of acute pancreatitis confirmed by elevated serum amylase and serum lipase levels.
- Patients willing to give consent were subjected to the study

Exclusion Criteria

- Patient with contra-indication to intravenous contrast agents
- Patients who are pregnant
- Pancreatitis due to trauma

Methodology

Patients who were willing to give written informed consent were included in the study. Demographic, clinical, and laboratory data of all consecutive patients fulfilling the inclusion and exclusion criteria with a primary diagnosis of acute pancreatitis during the one-and-half-year study period were prospectively collected for this study. All of them underwent a real-time ultrasound scan of the abdomen using a curvilinear transducer of 2 to 6 MHz of Philips IU22 and triple-phase contrast-enhanced computed tomography of the abdomen by Philips INGENUITY 128 slice CT in Victoria hospital or Siemens SOMATOM 6 slice CT present in Bowring hospital as described below.

Protocol of the triple-phase contrast-enhanced computed tomography scan

CT evaluation for the pancreas is performed as a triple-phase dynamic scan of the entire pancreas. CT is performed from the liver dome through the iliac crest with 2.5 mm reconstructions using 5 mm-thick slices. A power injector is used to administer 120 to 150 mL of intravenous contrast at the rate of 4 to 5 mL/second through a 20 gauge angiocatheter. Optimally, each phase is performed during a single breath-hold.

- Arterial-phase scan of the upper abdomen is obtained 25 to 30 seconds 28 following the onset of contrast injection with 1.25 mm reconstructions using 2.5 mm thick slices. Both the liver and pancreas show arterial opacification with minimal contrast in the portal vein.
- The pancreatic or parenchymal phase of the upper abdomen is obtained 45 to 50 seconds 28 following the onset of contrast injection with 2.5 mm reconstructions using 5 mm thick slices.
- Portal-venous or hepatic phase scan of the entire abdomen is obtained 65-70 seconds 28 following the initiation of contrast injection with 2.5 mm reconstructions using 5 mm- thick slices.

Statistical analysis

Data for the study were entered into a master chart with a suitable appendix and then into a suitable contingency table. The observed difference between the data sets (i.e., the imaging findings appearances of various complications of acute pancreatitis in ultrasound and CECT) in the contingency table is analyzed by descriptive statistics and evaluated for statistical significance by the Chi-squared test.

Results

Table 1: Age distribution of acute and acute on chronic pancreatitis

Age (in Years)	Patients with Acute Pancreatitis N (%)	Patients with Acute on Chronic Pancreatitis N (%)
<20	6 (8.4)	3 (10.3)
21-30	16 (23.0)	7 (24.1)
31-40	16 (23.0)	8 (27.5)
41-50	21 (29.5)	8 (27.5)
51-60	7 (9.8)	2 (6.9)
>60	5 (7.0)	1 (3.5)
Total	71 (100.0)	29 (100.0)

In patients with acute pancreatitis, the age group of 41-50 years has the highest number of patients (~30%). Patients with acute on chronic pancreatitis, the age group of 31-41 and 41-50 years have the highest number of patients (~28% and 28% each), together forming ~56% of the total population.

Table 2: Gender distribution of acute and acute on chronic pancreatitis

Type of pancreatitis	Male	Female	Total
Acute pancreatitis	64	7	71
Acute on chronic pancreatitis	24	5	29
Total	88	12	100

Of the 100 cases included in the study, males were 88 in number, of which 64 (72%) were cases of acute pancreatitis and 24 (28%) were cases of acute on chronic pancreatitis. And, females were 12 in number, of which 7 (58%) were cases of acute pancreatitis and 5 (42%) were cases of acute on chronic pancreatitis.

Table 3: Distribution according to pancreatic size characteristics

Pancreatic size characteristics		Modality	
		US	MDCT
Normal		8	8
Bulky	Head	52	52
	Body	47	47
	Tail	17	55
Atrophic		15	15

Both US and CT were able to delineate normal-sized pancreas, increased size of head and body of pancreas and atrophic pancreas. However, US was able to identify only 17 cases, compared to 55 by CT with a sensitivity of ~31%, which was statistically significant (p <0.001).

Table 4: Distribution according to pancreatic/peripancreatic changes (Fluid collection)

Pancreatic/peripancreatic changes (fluid collection)		Modality	
		US	MDCT
Acute peripancreatic fluid collection (<4weeks)		28	35
Pseudocysts	Peripancreatic	20	21
	Hepatic	7	7
	Splenic	5	5
	Thoracic/mediastinal	0	5
	Lesser sac	4	5
	Psoas muscle	0	1
	Pararenal space (right/left)	10	10
	Peripancreatic	20	21
Total		46	53

US was able to detect 28 cases of acute peripancreatic fluid collection compared to 35 cases by CT with a sensitivity of ~80%. Both US and CT were able to detect an equal number of hepatic, splenic and pararenal space pseudocysts. US detected 4 cases of lesser sac pseudocyst compared to 5 cases by CT with a sensitivity of ~80% and 20 cases of Peripancreatic pseudocysts compared to 21 cases by CT with a sensitivity of ~95%. Both US and CT detected one case of hemorrhagic peripancreatic pseudocyst each.

However, all 5 cases of the mediastinal pseudocysts and 1 case of psoas pseudocyst were not detected by US, but were detected by CT (statistically significant, p<0.001).

Table 5: Distribution according to pancreatic/peripancreatic changes (Necrosis)

Pancreatic/peripancreatic changes (necrosis)		US	CT
Acute pancreatic necrosis (<4weeks)	Head	21	22
	Body	24	24
	Tail	2	14
Acute extra pancreatic necrosis (<4weeks)		5	9
Walled off necrosis (>4weeks)	Head	17	17
	Body	23	23
	Tail	3	13
	Lesser sac	0	1

Both CT and US detected equal cases of necrosis involving the body of the pancreas, while US detected one less case of necrosis involving the head of the pancreas than CT, where US detected 21 cases compared to 22 cases by CT with a sensitivity of ~95.5%.

However, US was able to detect only two cases of necrosis involving the tail of the pancreas with a sensitivity of ~14%, compared to 14 cases by CT (statistically significant, p<0.001).

Discussion

In the present study, the mean age of patients was 38.6 + 12.8years. This was comparable to the study by Silverstein *et al.* [6] in which the mean age was 32 years. These findings were concurrent with the previous studies [7-9].

In the present study, the maximum number of patients was in the age group of 28-37 years which consisted of 28 patients, accounting for 28%. Patients in the age group of 28-47 years were 55 in number (55%) accounting for more than half the cases. The minimum age of patients was 18 years, and the maximum age was 71 years.

In the present study, most of the patients were males (88 out of 100 patients, 88%) as compared to females (12%) with M: F ratio of 7:1. This ratio was higher as compared to the other studies [6, 9, 10]. The increase in the percentage of males could be attributed to alcoholism, which was the most common cause of acute pancreatitis.

In the present study, it was also noted that males with acute pancreatitis tended to be older (39.6±12 years) as compared to females (30.4±16 years). Silverstein *et al*. have noted that males with acute pancreatitis were older (mean age 41 years) than females (mean age 32 years) [6].

In the present study, US visualised normal pancreas in 8 cases, enlarged head in 52 cases, enlarged body in 47 cases and enlarged tail in 17 cases. The atrophic pancreas was seen in 15 cases. Compared to a study reported by Calleja G.A and J.S Barkin [11] where overlying bowel gas disturbances obscured the pancreas in 40% of patients. In the present study, the yield was comparatively better with

abnormality detected in US in 78% and obscured in 22%.

In the present study, US visualized acute peripancreatic fluid collection in 28 cases. Peripancreatic pseudocyst was detected in 20 cases, hepatic pseudocyst in 7 cases, splenic pseudocyst in 5 cases, pararenal pseudocysts in 10 cases and lesser sac pseudocysts in 4cases. In the present study, US was not able to detect one case of the mediastinal pseudocyst. US detected one case of a hemorrhagic peripancreatic pseudocyst.

Pseudocyst was detected by US in 46 patients (46%). In a study of 99 cases of pancreatitis conducted by Gonzalez *et al*. [12] pseudocyst formation occurred in 52.5% of cases. In the present study, US visualized 21cases of pancreatic necrosis involving the head, 24 cases involving the pancreatic body and 2 cases involving tail. In our study, US detected Acute extrapancreatic necrosis (<4weeks duration) in 5 cases. In the present study, US detected Walled off necrosis (>4weeks duration) in 17 cases in head, 23 cases in body and 3 cases in tail of pancreas. Peripancreatic walled-off necrosis was seen in 1 case.

Conclusion

The present study concluded that US had similar sensitivity to CT in detecting fluid collection and necrosis in pancreatitis, except in the region of the tail of the pancreas. However, US failed to detect mediastinal pseudocysts and infected necrosis, which can be attributed to its non-utility in thoracic imaging.

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