Scholars Journal of Applied Medical Sciences
Abbreviated Key Title: Sch J App Med Sci
ISSN 2347-954X (Print) | ISSN 2320-6691 (Online)
Journal homepage: https://saspublishers.com/sjams/

OPEN ACCESS

Radiology

Role of Multidetector Computed Tomography in Diagnosis and Evaluation of Pancreatic Lesions

Dr. Anmol Singh[1*], Dr. V. M. Kulkarni[2]

[1]Resident, Department of Radiology, Dr. D. Y Patil Medical College, Pune, Maharashtra, India
[2]Professor, Department of Radiology, Dr. D. Y Patil Medical College, Pune, Maharashtra, India

DOI: 10.36347/sjams.2020.v08i11.005 | **Received:** 21.10.2020 | **Accepted:** 01.11.2020 | **Published:** 06.11.2020

***Corresponding author:** Dr. Anmol Singh

Abstract **Original Research Article**

Computed tomography (CT) is one the primary imaging modalities for evaluating the pancreas along with ultrasound. This is a prospective observation study assessing the role of multidetector computed tomography in pancreatic lesions. The study was performed at Dr. D. Y. Patil Medical College, Hospital and Research Centre, Pimpri on Philips Ingenuity Core 128 slice CT machine. A total of hundred cases were studied. Pancreatic disorders on average were more common in males than in females. The commonest age bracket affected was between 30 – 49 years. The most common pancreatic lesion was acute pancreatitis followed by chronic pancreatitis and pancreatic carcinoma. Computed tomography is a sensitive and efficacious modality for detection and characterization of pancreatic lesions. Pancreatic parenchymal phase was useful in identifying necrotic areas in necrotizing pancreatitis and neoplastic encasement. Portal venous phase was useful in detecting vascular thrombosis and hypovascular metastasis in the liver.

Keywords: Multidetector computed tomography, pancreas, pancreatitis, pancreatic neoplasm, cystic neoplasm.

INTRODUCTION

Computed tomography (CT) an accurate and non-invasive imaging modality for evaluating the pancreas. It enables imaging of entire pancreas easily while differentiating from the surrounding fat and bowel air together. It also allows for simultaneous imaging of other abdominal organs. This allows for detection of unsuspected ancillary abnormalities that may be responsible for the clinical presentation. The pancreas was one of the last organs to receive attention of the anatomist, physicians, and surgeons. Located in the retro peritoneum the pancreas has often been called the "hidden" organ or "hermit" of the abdomen in the past [1].

Pancreatic lesions have a variable presentation and imaging plays a significant role in diagnosis and management. USG and CTabdomen are the most commonly employed imaging modalities. But USG is limited in obese patients or in case of extensive bowel gas. CT is modality of choice for non invasive imaging of pancreas sinceit does not suffer from these disadvantages. CT is more accurate in diagnosing and demonstrating the extent of pseudocysts [2]. CT helps determining the cause of endocrine and exocrine pancreatic insufficiency [3].

Pancreatitis is one of most clinically challenging of all abdominal disorders. The peak age of incidence was in the 30-49 year group. The mean age was found to be 41 years [4]. It is also a major diagnostic challenge as its clinical manifestation are very variable. As few as one in three of the severe cases of acute pancreatitis were recognized as severe on initial presentation and as many as 42% of fatal cases do not have correct diagnosis before autopsy [5]. The most importantfactor in morbidity and mortality in patients with acute pancreatitis is pancreatic necrosis [6, 7].

Pancreatic neoplasms have shown a marked increase in incidence worldwide in the recent years. But with the introduction of multidetector CT, diagnosis of small pancreatic carcinoma is now possible. Alec concluded in his study that CT was the primary diagnostic technique for evaluating pancreatic adenocarcinoma [8].

Evaluating pancreas by multidetector CT is useful as the organ lies deep in abdomen in the retroperitoneum. It is also in close contact to vessels like the portal vein, splenic and superior mesenteric artery. Contrast opacification of these vessels gives important information to aid in detecting pancreatic abnormalities as well as determining extent.

Multidetector CT also allows for acquisition of images in a single breath hold which minimizes respiratory misregistration artifact and prevents loss of important diagnostic information.

MATERIALS AND METHODS

The study was performed at Dr. D. Y. Patil Medical College, Hospital and Research Centre, Pimpri on Philips Ingenuity Core 128 slice CT machine. A total of hundred cases were studied. Patients with clinical history and laboratory data suggestive of pancreatic disease or finding suggestive of pancreatic pathology on other imaging modalities, especially ultrasound, were included.

All patients were called after 6 hours of fasting. Detailed history including history of drug allergies and atopy was obtained. Written informed consent was obtained from all patients after explaining the procedure and risk of possible contrast reaction. Oral contrast (30ml of diatrizoate sodium diluted in 1 liter of water) 600-800 ml was administered to patient, 45 min prior to scan.

The patient was placed on the gantry table in supine position with both arms raised above the head. An AP scanogram was obtained in arrested respiration. The AP scanogram was used to define the superior inferior extent of scan. Nonenhanced CT scan of abdomen was done by taking 5 mm thin axial sections of 5 mm interval from dome of diaphragm up to the level of aortic bifurcation. The patients were coached for breath holding prior to scan.

Contrast scan were obtained by injecting 1.5 ml/kg of Inj. Iomeron (400) at a rate of 3 ml per second using a pressure injector via 20G angiocath placed in antecubital vein and pancreas scanned with biphasic pancreatic protocol [9] and MDCT protocol for pancreatic mass according to pathology [10]. Scan delay was kept at 20 seconds for arterial phase, 40 seconds for pancreatic parenchymal phase and 65 – 70 seconds for venous phase.

OBSERVATIONS AND RESULTS

Out of a total 100 patients, 71 were male and 29 were female (Table-1).

Table-1: Age and sex distribution of patients with pancreatic disorders in our study

Age(Yrs.)	Male	Female	Total
0-9	1	1	2
10-19	1	-	1
20-29	14	4	18
30-39	22	11	33
40-49	21	4	25
50-59	9	5	14
60-69	2	4	6
>70	1	-	1

Acute pancreatitis was seen in 52 cases, chronic pancreatitis in 25 cases, 5 cases each of acute on chronic pancreatitis and isolated pseudocysts, 11 cases of pancreatic neoplasms, 2 cases of congenital pancreatic lesions and one case of pancreatic laceration (Table-2).

Table-2: Distribution of patients according to diagnosis

Pathology	No.
Acute Pancreatitis	52
Chronic Pancreatitis	25
Acute on chronic pancreatitis	5
Pseudocyst	5
Pancreatic Neoplasm	11
Congenital lesion	2
Trauma	1

Acute pancreatitis was seen more commonly in males belonging to the middle age group (Table-3).

Table-3: Age and sex distribution of patients with acute pancreatitis

Age (yrs.)	Male	Female
0-9	-	1
10-19	1	-
20-29	9	3
30-39	14	9
40-49	7	1
50-59	3	3
60-69	1	-
>70	-	-
TOTAL	35	17

Alcohol was found to be the commonest etiological factor associated with acute pancreatitis, seen in 35 of the cases. Followed by cholelithiasis in 9 patients (Table-4).

Table-4: Distribution of patients of acute pancreatitis according to etiology

Etiology	Patients	%
Alcohol	35	67.4
Cholelithiasis	9	17.3
Trauma	-	-
Unknown etiology	8	15.3

In patients with acute pancreatitis, pancreas showed diffuse enlargement in 43 patients, focal enlargement in 7 patients and normal size in 2 patients. The contour was found to be normal in 38 patients and irregular in 14 patients. Attenuation of the gland was homogeneous in 27 patients was heterogeneous in 25 patients. Peripancreatic fat stranding was seen in 50 patients. Acute fluid collections were seen in 35 patients. Pseudocysts were noted in 12 patients. Necrosis was seen in a total of 26 patients. Ascites was seen in 26 patients. Pleural effusion was seen in 11 patients. Venous thrombosis was seen in 11 patients.

Pseudoaneurysm formation was seen in one patient (Table-5).

Table-5: Distribution of computed tomography signs in the cases of acute pancreatitis

Sign		No.	%
Gland	Diffuse enlargement	43	82.7
	Focal enlargement	7	13.4
	Normal size	2	3.8
Contour	Regular	38	73.1
	Irregular	14	26.9
Attenuation	Homogeneous	27	51.9
	Heterogeneous	25	48.1
Necrosis	<30%	16	30.7
	>30%	10	19.2
Peripancreatic fat stranding		50	96.1
Peripancreatic fluid accumulation		35	67.3
Presence of gas/abscess		-	-
Pseudocyst		12	23.0
Ascites		26	50.0
Pleural effusion		11	21.1
Portal/splenic vein thrombosis		11	21.1
Pseudoaneurysm		1	1.9

In the study mild grade on according to modified CT severity score was assigned to 13 patients, moderate grade to 19 patients and severe grade to 20 patients. Pleural effusion and ascites were more commonly associated with higher grades of pancreatitis (Table-6).

Table-6: Distribution of cases of acute pancreatitis according to modified CT severity index

Grade	Patients	%
Mild(0-2)	13	22.8
Moderate (4-6)	19	40.3
Severe (8-10)	20	36.8

Intra-pancreatic pseudocysts were noted in the head of the pancreas in 2 patients, in the uncinate process in 1 patient, in head and body of pancreas in 2 patients, in the body and tail region in 4 patients and isolated in the tail of pancreas in 1 patient (Table-7).

Table-7: Distribution of patients according to location of pseudocyst in pancreas

Location	No. of patients
Head	2
Uncinate process	1
Head and body	2
Body and tail	4
Tail	1

Table-8: Distribution of patients according to location of pseudocyst in body

Location	No. of patients
Peripancreatic	10
Rest of abdomen	3
Pelvis	2
Mediastinum	1

Males in the middle ages were most commonly affected group in cases of chronic pancreatitis (Table-9).

Table-9: Age and sex distribution of patients with chronic pancreatitis

Age (yrs.)	Male	Female
0-9	-	-
10-19	-	-
20-29	3	-
30-39	8	2
40-49	10	2
50-59	3	-
60-69	-	2
>70	-	-
total	24	6

In cases of chronic pancreatitis gland atrophy was seen in 26 cases and gland enlargement was seen in 4 cases. Pancreatic duct was dilated in 27 cases. Common bile duct was dilated in 2 cases. Pancreatic parenchymal calcifications were seen in 27 cases. Pseudocysts were seen in 14 cases. Peripancreatic inflammatory changes were seen in 5 cases (Table-10).

Table-10: Distribution of signs of chronic pancreatitis

Sign		No.	%
Gland	Atrophic	26	86.7
	Diffuse enlargement	4	13.3
Pancreatic duct dilatation		27	90.0
Common bile duct dilatation		2	6.7
Pancreatic calcification		27	90.0
Pseudocyst		14	46.7
Alteration in peripancreatic fat/fascia		5	15.7

Most cases of pancreatic neoplasms were seen in the elderly age group without significant gender variation (Table-11).

Table-11: Age and sex distribution of patients with pancreatic neoplasms

Age(yrs.)	Male	Female
0-9	-	-
10-19	-	-
20-29	-	-
30-39	-	-
40-49	1	1
50-59	3	2
60-69	1	2
>70	1	-
Total	6	5

Neoplastic lesions were located in the head of pancreas in 5 cases, head and uncinate process in 2 cases, body of pancreas in 2 cases and tail of pancreas in 2 cases. The lesions were hypodense in 2 cases, isodense in 2 cases and heterogeneous in 7 cases. In 5 cases the size of the lesion was more than three centimeters and in 6 cases it was less than three centimeters in the greatest dimension. Main pancreatic duct was dilated in 7 cases. Contrast enhancement was seen in 9 cases. Calcifications were seen in 3 cases (Table-12).

Table-12: CT Sign in cases with pancreatic neoplasms

Sign		No.	%
Enlargement	Head	5	54.5
	Uncinate process	-	-
	Head and uncinate Process	2	18.1
	Body	2	18.1
	Tail	2	9.1
Density	Hypodense	2	18.1
	Isodense	2	18.1
	Heterogeneous	7	63.6
Size	>3cms	5	45.4
	<3cms	6	55.6
Dilatation of main pancreatic duct		7	63.6
Atrophy of proximal gland		-	-
Enhancement		9	81.8
Calcification		3	27.2

Peripancreatic infiltration was seen in 3 patients. Contiguous organ involvement was seen in one patient. Lymph nodal involvement was seen in 6 cases. Hepatic metastasis was seen in 2 cases. Intrahepatic biliary radical dilated was seen in 2 cases. Common bile duct dilation was seen in 5 cases. Vascular involvement, ascites or pleural effusion was not demonstrated in any patient.

Table-13: Extra pancreatic CT Sign in cases with pancreatic neoplasms

Sign		No.	%
Hepatic metastasis		2	18.1
Lymph node involvement		6	55.6
Vascular involvement	Encasement	-	-
	Occlusion	-	-
Peripancreatic infiltration		3	9.1
Involvement of contiguous organs		1	18.1
Ascites and Pleural effusion		-	-
Dilatation of CBD		5	45.4
IHBR dilatation		2	18.1

In our study we demonstrated one case of annular pancreas and one case of dorsal agenesis - these cases contributed to congenital lesion category. We also demonstrated one case of pancreatic laceration - this case contributed to traumatic lesion category.

Case Gallery

Fig-1: Acute Interstitial Pancreatitis. 29-year-old male with epigastric pain and history of chronic alcohol consumption. Axial contrast CT image shows bulky pancreas with surrounding fat stranding and acute fluid collections without any necrosis

Fig-2: Acute Necrotizing Pancreatitis.40-year-old male presenting with abdominal pain and distension. Axial contrast CT image shows bulky pancreas with extensive hypo-enhancing necrotic areas and surrounding necrotic collection

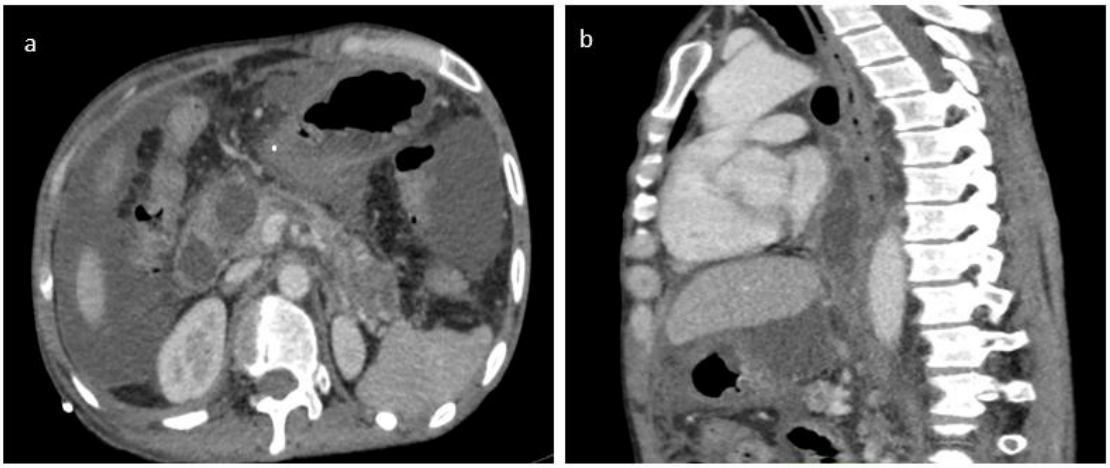

Fig-3: Acute on Chronic Pancreatitis with Mediastinal pseudocysts.47-year-old male presenting with breathlessness, fever, chest and abdominal pain. Axial (a) and sagittal (b) contrast CT images show Atrophic pancreas with dilated main pancreatic duct; peripancreatic fat stranding, intra pancreatic, extrapancreatic and mediastinal pseudocysts

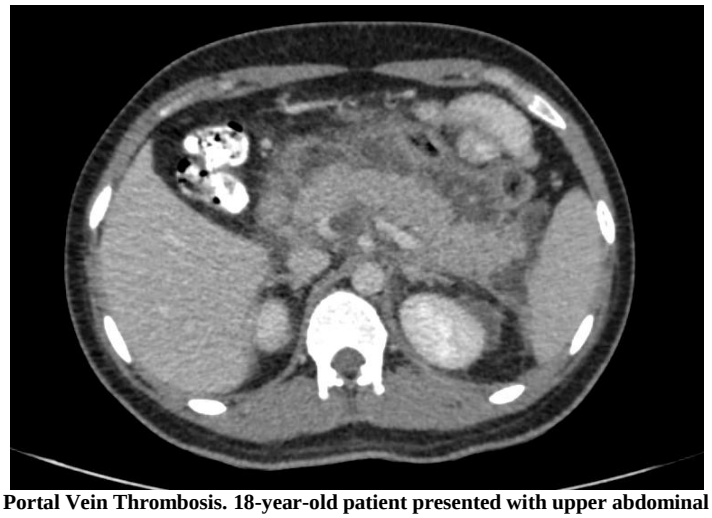

Fig-4: Acute Pancreatitis with Portal Vein Thrombosis. 18-year-old patient presented with upper abdominal pain. Axial contrast CT image shows bulky pancreas with peri-pancreatic stranding, acute peri-pancreatic fluid collections and filling defect in the portal vein

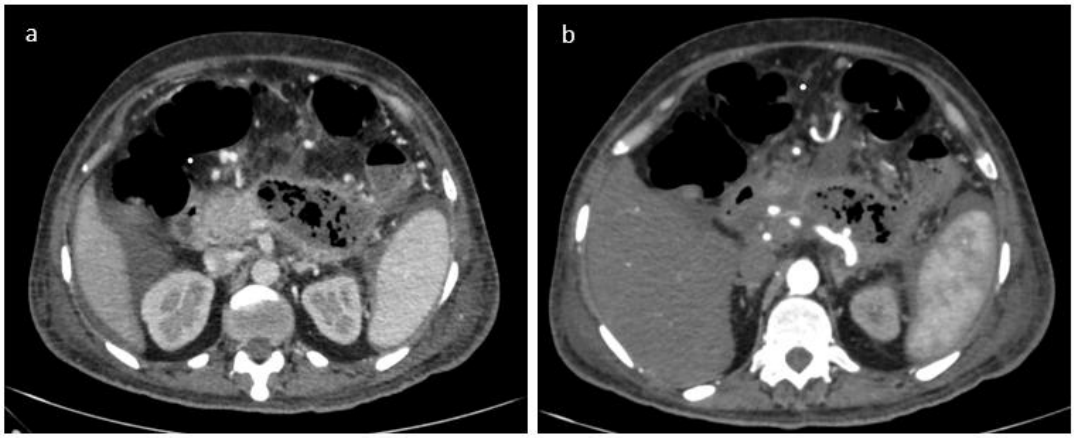

Fig-5: Pancreatic necrosis with Splenic Artery Pseudoaneurysm. 37-year-old male presented with fever, pain abdomen and altered sensorium. Axial contrast CT images show acute pancreatitis with large nonenhancing necrotic area in the body and tail of pancreas with air foci within (a). A saccular pseudoaneurysm along the splenic artery adjacent to the pancreatic necrotic component (b)

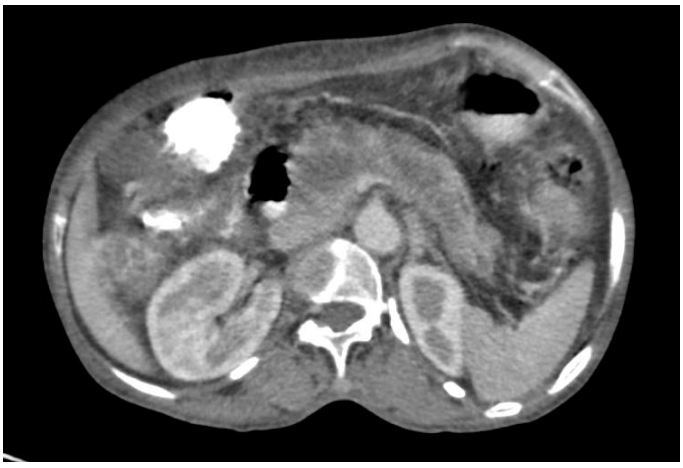

Fig-6: Adenocarcinoma of Pancreas. 65-year-old woman presenting with upper abdominal pain and jaundice. Axial contrast CT image shows heterogeneously enhancing lesion in the head of pancreas with hypo enhancing necrotic areas and upstream dilation of the pancreatic duct

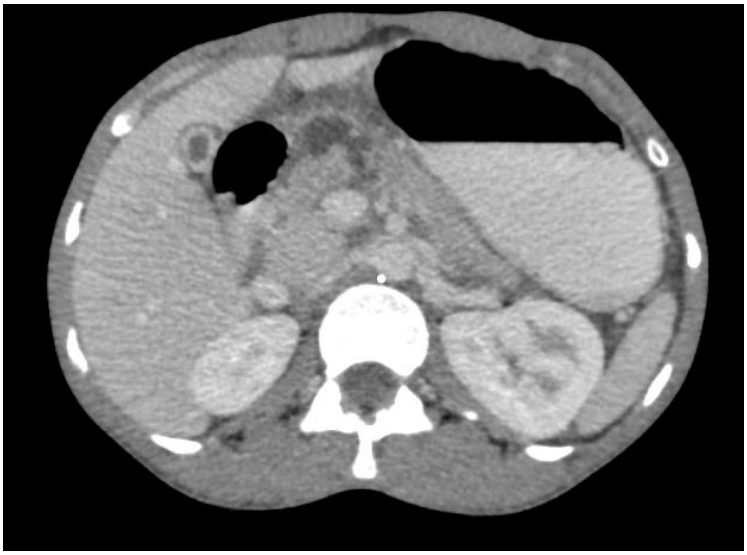

Fig-7: Pancreatic Laceration. 38-year-old male presented with history of blunt trauma to the abdomen with complains of pain in upper abdomen. Axial contrast CT image shows discrete thick linear hypodense cleft is seen running obliquely through the pancreatic body suggestive of deep laceration with high likelihood of duct injury

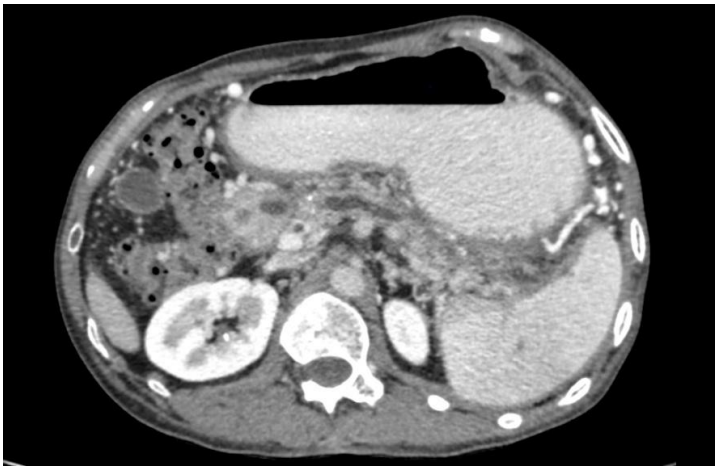

Fig-8: Annular pancreas with acute on chronic pancreatitis. 32 years old male presented with diffuse pain abdomen and vomiting. Axial contrast CT image shows bulky heterogeneous pancreas with fat stranding, pancreatic calcifications, and duct dilation. Pancreatic tissue with another dilated duct surrounding the second part of duodenum

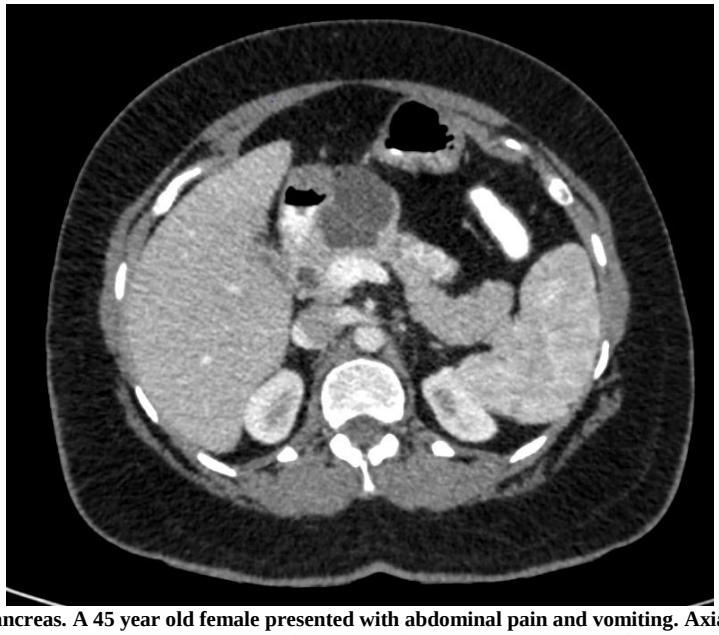

Fig-9: Cystic Neoplasm of Pancreas. A 45 year old female presented with abdominal pain and vomiting. Axial contrast CT image shows a multiloculated septated cystic pancreatic mass arising from head of pancreas, without significant post contrast enhancement

DISCUSSION

A total of 100 patients with pancreatic lesions were studied using multidetector CT. 71 patient were male, while 29 patients were female. The higher proportion in our study can be attributed to history of alcohol intake, which is more common in males and is a significant risk factor for acute pancreatitis.

We administered 1.5 ml/kg Iomeron non-ionic water-soluble contrast medium. This allowed good post contrast enhancement of the gland. This was similar to Dipti K. Lenhart and Emil J. Balthazar's study [11] in which they administered iodinated (300mgl/ml) non-ionic contrast 1.5 ml/kg.

Majority of literature agree that the use of non-ionic contrast medium is safer with less risk of occurrence of contrast reactions.

In our study, no patient developed any contrast reaction. In our study, arterial phase images were obtained after a delay of 25 seconds from onset of contrast injection. The average pancreatic parenchymal enhancement was found to be88 HU. In comparison, Michael D. Hollet *et al*., [12] demonstrated an average enhancement equal to 62 HU + 2HU on standard delay (49-70 seconds).

Additionally, the early phase scanning helps in dedifferentiating smaller low attenuation lesions from normally enhancing pancreatic parenchyma.

For evaluation of the peripancreatic venous architecture the patient was rescanned at a delay of 40-50 seconds. This allowed for good venous enhancement and visualization.

Multidetector CT allowed acquisition of images in a single breath hold, thus all patients were found to have satisfactory scans without any motion related artifacts. This was in accordance with Damien E Dupuy *et al*., study [13] which showed a far lower incidence of motion artifacts since the advent of spiral CT compared to previous systems.

ACUTE PANCREATITIS

In our study, out of 100 patients, 52 patients were diagnosed with acute pancreatitis. Majority of the patients were males. This can be attributed to a higher incidence of alcohol consumption in males. Alcohol consumption was found to be the leading cause of acute pancreatitis in our study. Similar findings were made by Brooke Jeffery *et al*., [14] in their study.

Highest incidence of acute pancreatitis was seen in the 30-49 years-age group. One patient was in the 0-9-year age bracket and another in the 10-19 year age group. This is comparable to B. Jeffery's study [4] where the mean age was found to be 41 years.

In our study, 50 out of 52 patients had pancreatic enlargement, most commonly diffuse enlargement. The pancreas was diffusely enlarged in 43 cases and focally enlarged in 7 cases. Two cases showed a normal sized pancreas with surrounding signs of inflammation. This correlates well with Brooke Jeffery *et al*., [4] who found that 31 out of 36 patients in their study had diffuse enlargement and only 2 patients had focal enlargement. Similarly, Mendez *et al.*, [14] studied 32 patients with acute pancreatitis, all of whom showed enlargement of the pancreas.

In our study, a majority of the patients demonstrated peripancreatic changes at 50 out of 52 total cases of acute pancreatitis (96.1%). Commonest areas of peripancreatic inflammatory changes included the lesser sac, anterior pararenal spaces and the mesentery and transverse mesocolon. In our study majority of the cases with acute interstitial pancreatitis as well as necrotizing pancreatitis had changes of peripancreatic inflammation and fat stranding. This was in contrast with study by Hill *et al*., [15] where they demonstrated peripancreatic inflammatory changes in only 11% cases of acute edematous pancreatitis, whereas 89% cases of necrotizing pancreatitis showed changes of peripancreatic inflammation.

This difference may be attributed to better capability of multidetector CT to demonstrate milder changes of inflammatory fat stranding and better ability to differentiate inflamed pancreas from the surrounding phlegmonous changes and reduction in incidence of motion artifacts.

In our study, acute fluid collections were demonstrated in 35 out of 52 patients (67.3%). Out of these 35 cases, only 8 cases had purely intra-pancreatic fluid collection while 27 had extra-pancreatic or both extra- and intra-pancreatic fluid collections. Commonest locations of extra-pancreatic fluid collection were the lesser sac and the anterior pararenal space. These findings have good correlation with Siegelman Stanley *et al*., [16] who reported pancreatic and extra-pancreatic collections in 54% of the cases, out which with 16% had intra-pancreatic and 42% had extra-pancreatic collections, respectively.

In our study out of the 52 patients diagnosed with acute pancreatitis, 12 had pseudocysts (23%). Body and tail region were the most common intrapancreatic site of pseudocyst and peripancreatic region was the most common extrapancreatic site of pseudocysts.

In our study, 13 patients were classified as mild grade (0-2), 19 as moderate grade (4-6), and 20 as severe grade (8-10) of pancreatitis based on modified CT severity index. This was in contrast to study by Koenraad J. Mortele *et al*., [17] where they found mild pancreatitis in 34, moderate in 22, or severe only in 10 out of the 66 patients assessed. Pleural effusion and ascites were associated with cases of moderate and severe pancreatitis.

In our study, there was a higher incidence of severe grade pancreatitis. This may be due to, in part, later presentation of patients. However, a possibility that high resolution and lower likelihood of artifacts on multidetector CT gives a higher sensitivity for picking up associated findings and complications leading to more accurate evaluation and grading of patients' needs consideration. However, bias in selection of patients undergoing scanning may also be a factor.

Pancreatic necrosis was seen in 26 out of 52 patients in our study, with 16 patients having less than 30% necrosis and 10 patients having more than 30% necrosis. Presence of necrosis naturally correlated with a higher grade of severity of pancreatitis and is not found in patients with mild grade. Similar conclusion was reached by Balthazar E. J *et al*., [18], that patient with severe pancreatitis exhibit necrosis.

Chronic Pancreatitis

Chronic pancreatitis is characterized by prolonged pancreatic inflammation and fibrosis, irreversible morphological and functional abnormalities. In our study a total of 30 patients were diagnose with chronic pancreatitis, 5 of which presented with acute on chronic pancreatitis.

Out of these, 24 patients were males and only 6 were females. Most of the patients were in the 30-49 years age bracket. The most common associated CT findings in chronic pancreatitis in our study were atrophy of the gland at 86.7% (26 out of 30 cases), dilation of pancreatic duct at 90.0% (27 out of 30 cases)

and calcification of pancreatic parenchyma at 90.0% (27 out of 30 patients). P Luetmer *et al*., [19] demonstrated an incidence of pancreatic duct dilatation in 68% cases, pancreatic calcification in 56% cases and gland atrophy in 54% cases studied by them. The higher incidence of these associated findings in our study may be attributable to higher sensitivity of current generation multidetector CT systems, thinner sections, and faster scanning time with reduced artifacts in detecting these findings. Biliary ductal dilatation was noted in only 2 out of 30 cases (6.7%).

Pancreatic calcifications were seen in 27 out of 30 cases (90%). Out of these, 5 patients had purely intraductal calcifications, 9 had purely parenchymal calcifications and 13 had both intraductal as well parenchymal calcifications. In contrast Ferrucci *et al*., [20], Kolamannskog *et al*., [21] and P Luetmer [19] reported wide-ranging incidence of calcification in chronic pancreatitis in their studies at 36%, 52% and 50%. Multidetector CT allows good differentiation of intraparenchymal from intraductal calcification. This distinction is of clinical significance and is important from the management point of view in chronic pancreatitis.

In our study 14 out of the 30 patients (46.7%) had pseudocysts. Most common intrapancreatic location was in the body region and most common extrapancreatic location was in the lesser sac. This incidence was slightly higher to that reported by 30% Ferrucci [20], 28% Kolmannskog [21] and P Luetmer [19] in their studies which stood at 30%, 28% and 30% respectively. This may be related to better capability of multidetector CT to detect small pseudocysts or to selection bias. Further investigation with a larger sample size may be of value in determining the exact incidence of pseudocysts in chronic pancreatitis.

Hemorrhagic pseudocysts have been previously reported by Ferrucci *et al*., [20]. In our study we did not demonstrate any cases with hemorrhagic pseudocysts.

Pancreatic atrophy was seen in 26 out of 30 cases (86.7%). Pancreatic duct dilation was seen 27 out of 30 cases (90%). Previous studies done by Ferrucci [20] and Luetmer [19] showed lower incidence of atrophy at 14% and 54% respectively.

In our study, 4 patients showed diffuse enlargement of the gland. All four of the patients had presented with acute pancreatitis overlapping with pre-existing chronic pancreatitis.

PANCREATIC NEOPLASMS

In our study, a total of 11 cases were diagnosed with pancreatic neoplasms. Out of these 9 cases were diagnosed with adenocarcinoma and 1 case each of insulinoma and serous cystadenoma. Most of the patients were in the 50 – 69 age brackets. We did not find any significant variation in incidence of pancreatic neoplasms based on gender in our study. Out of the 11 patients, 6 were males and 5 were females.

All cases with adenocarcinomas showed focal enlargement of the pancreas with contour deformity. Most common location was head of the pancreas, with six out of nine cases (66.7%) presenting with mass in the region of the head.

Out of the nine cases, seven showed heterogeneous attenuation (77.8%) and two were hypodense (22.9%) on plain non-enhanced images.

In our study, five out of the nine cases had size less than 3 cm and four cases had size more than 3 cm. Out of the four cases with size larger than 3 cm, two had metastases to liver and were found to be non-resectable at surgery. David A. Bluemke [23] found that the average size of resectable tumor was <3.1cms, with larger tumor size increasing the likelihood of complications like distant metastasis and vessel involvement that confer unresectability. None of the cases diagnosed with adenocarcinoma in our study had vascular involvement.

Upstream dilatation of the main pancreatic duct was seen in seven patients (77.8%) of our patients. None of the patients showed atrophy of the distal gland. Dilated common bile duct was seen in five patients (55.5%). In comparison, Patrick Freeny *et al*., [24] reported upstream dilatation of the main pancreatic duct in 68% patients with associated pancreatic atrophy in 82% and biliary duct dilation in 58%.

Patrick Freeny's [24] reported local tumor extension in 68% cases and contiguous organ involvement in 42%. In our study, peripancreatic infiltration and contiguous organ involvement infiltration was seen in 33.3 and 11.1% respectively. This may be attributed to earlier presentation and earlier diagnosis of smaller lesions possible with multidetector CT. Detecting pancreatic adenocarcinomas in the early stage is vital for good surgical outcomes and improved resectability rates.

Hepatic metastasis was seen in two patients (22.2%). Enlarged lymph nodes were seen in five patients (5.5%).

Ascites or pleural effusion was not found in any of the patients in our study. In our study, one patient with was diagnosed with insulinoma and one was diagnosed with cystic neoplasm of pancreas.

OTHER LESIONS OF PANCREAS

In our study we found five cases with isolated pancreatic pseudocysts with no signs of acute or chronic pancreatitis. These cases were likely late presentation in

case of acute pancreatitis, with the signs of pancreatic inflammation having subsided and acute inflammatory collections having matured into pseudocysts.

In our study we diagnosed one case of annual pancreas and one case of dorsal agenesis. We also diagnosed one case of pancreatic laceration.

CONCLUSION

Computed tomography is a sensitive and efficacious modality for detection and characterization of pancreatic lesions. In our study pancreatic disorders on average were more common in males than in females. The commonest age bracket affected was between 30 – 49 years. The most common pancreatic lesion was acute pancreatitis followed by chronic pancreatitis and pancreatic carcinoma. Diffuse enlargement, regular contour and homogeneous density were the most commonly observed findings in acute pancreatitis. Peripancreatic fluid accumulations, pseudocysts, ascites, and pleural effusion were the most common extrapancreatic manifestations. Chronic pancreatitis was more commonly seen in males. Pancreatic gland atrophy, pancreatic duct dilation, parenchymal calcifications and pseudocysts were the commonest signs observed in chronic pancreatitis. Pancreatic carcinoma was most commonly observed in elderly age group (>50 years). Focal enlargement was seen in all the cases; pancreatic head was the commonest site of involvement. On plain images majority of the adenocarcinomas were of heterogeneous attenuation. On contrast images most of them showed heterogeneous enhancement. Dilatation of pancreatic duct, calcifications and dilation of the biliary tree were associated lesions seen in Ca pancreas. Arterial phase was useful in detection of metastasis and insulinoma. Pancreatic parenchymal phase was useful in identifying necrotic areas in necrotizing pancreatitis and neoplastic encasement. Portal venous phase was useful in detecting vascular thrombosis and hypovascular metastasis in the liver.

REFERENCES

1. Frederick LH, Helena G, Nancy AH, Richard MG. Pancreas: normal anatomy and examination techniques. In: Textbook of gastrointestinal radiology, 3rd edition Richard MG, Marc SL (Eds). Saunders Elsevier Ltd. 2008; 2:1839-1854.
2. Willford ME, Foster WL, Jr., Halvorsen RA, Thompson WM. Pancreatic pseudocyst: comparative evaluation by sonography and computed tomography. AJR. 1983; 140:53-57.
3. Shuman WP, Carter SJ, Montana MA, Mack LA, Moss AA. Pancreatic insufficiency: role of CT evaluation. Radiology. 1986 Mar;158(3):625-7.
4. Jeffrey RB, Federle MP, Cello JP, Crass RA. Early computed tomographic scanning in acute severe pancreatitis. Journal of Computer Assisted Tomography. 1982 Aug 1;6(4):858.
5. Frank HM, Ana LK, Emil JB. Pancreatitis. In: Textbook of Gastrointestinal Radiology, 3rd edition Richard MG, Marc SL (Eds). Saunders Elsevier Ltd. 2008; 2: 1885-1914.
6. Jane AE, Robert AM. The pancreas. In: Grainger and Allison's Diagnosis radiology A Textbook of medical imaging. 5th edition. Adam A, Dixon AK (Eds). Churchill Livingstone, 2008; 1:793-796.
7. Beger HG, Rau B, Mayer J, Pralle U. Natural course of acute pancreatitis. World J Surg. 1997; 21(2) :130-135
8. Megibow AJ. Pancreatic Adenocarcinoma: designing the examination to evaluate the clinical question. Radiology. 1992; 183:297-303.
9. Rydberg J, Buckwalter KA, Caldemeyer KS, Phillips MD, Conces Jr DJ, Aisen AM, Persohn SA, Kopecky KK. Multisection CT: scanning techniques and clinical applications. Radiographics. 2000 Nov;20(6):1787-806.
10. Soto JA, Lucey BC, Stuhlfault JW. Pancreas divisum: Depiction with multi-detector row CT. Radiology. 2005; 235:503-508.
11. Dipti KL, Emil JB. MDCT of acute mild (non-necrotizing) pancreatitis: abdominal complications and fate of fluid collections. AJR. 2008 March; 190:643-649.
12. Hollett MD, Jorgensen MJ, Jeffrey Jr RB. Quantitative evaluation of pancreatic enhancement during dual-phase helical CT. Radiology. 1995 May;195(2):359-61.
13. Dupuy DE, Costello P, Eker CP. Spiral CT of the pancreas. Radiology. 1992; 183:815-818.
14. Mendez Jr G, Isikoff MB, Hill MC. CT of acute pancreatitis: interim assessment. American Journal of Roentgenology. 1980 Sep 1;135(3):463-9.
15. Hill MC, Barkin J, Isikoff MB, Silverstein W, Kalser M. Acute pancreatitis: clinical vs. CT findings. American Journal of Roentgenology. 1982 Aug 1;139(2):263-9.
16. Siegelman SS, Copeland BE, Saba GP, Cameron JL, Sanders RC, Zerhouni EA. CT of fluid collections associated with pancreatitis. American Journal of Roentgenology. 1980 Jun 1;134(6):1121-32.
17. Mortele KJ, Wiesner W, Intriere L, Shankar S, Zou KH, Kalantari BN, Perez A, VanSonnenberg E, Ros PR, Banks PA, Silverman SG. A modified CT severity index for evaluating acute pancreatitis: improved correlation with patient outcome. American Journal of Roentgenology. 2004 Nov;183(5):1261-5.
18. Balthazar EJ, Robinson DL, Megibow AJ, Ranson JH. Value of CT in establishing prognosis. Radiology. 1990; 174: 331-336.
19. Luetmer PH, Stephens DH, Ward EM. Chronic pancreatitis: reassessment with current CT. Radiology. 1989; 171:353-357.
20. Ferruci JT, Jr Wittenberg J, Black EB, Kirkpatrick RH., Hall Deborah A. Computed body

tomography in chronic pancreatitis. Radiology 1979; 130: 175-182.

21. Kolmannskog F, Schrumpf E, Bergan A, Larsen S. Diagnostic value of computer tomography in chronic pancreatitis. Acta Radiologica Diagnosis. 1981: 22(6).
22. Nisha S, Onofrio C, Dushyant S. Pancreas. In: CT and MRI of the whole body, pancreas 5th edition., John R Haaga, Vikram D, Michael F, Robert CG, Hyun KH, Murali S. (Eds). Mosby Elsevier, 2009; 2: 1599-1674.
23. Bluemke DA, Cameron JL, Hruban RH, Pitt HA, Siegelman SS, Soyer P, Fishman EK. Potentially resectable pancreatic adenocarcinoma: spiral CT assessment with surgical and pathologic correlation. Radiology. 1995 Nov;197(2):381-5.
24. Aspestrand F, Kolmannskog F. CT compared to angiography for staging of tumors of the pancreatic head. Acta Radiologica. 1992:33.