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Research article

ROLE OF COMPUTED TOMOGRAPHY IN EVALUATION OF PANCREATIC DISEASES

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ABSTRACT

Context: The evolving role of CT in the study of pancreas is not only in its ability to directly define the presence of an abnormality but it also surpasses the other imaging modalities in being able to demonstrate the extent of the disease and its spread to contiguous areas by virtue of its being a non-organ specific investigation. The ability of CT to image the pancreas adequately regardless of the bowel gas and fat gives it an advantage over ultrasound.
Objectives: To study age and size distribution in pancreatic diseases. To differentiate cystic from solid pancreatic lesions. To differentiate inflammatory and neoplastic conditions with their characteristic imaging features. To classify and grade pancreatitis with the help of CT imaging features. **Methods:** This study comprises 50 patients of different age groups in whom there was clinical suspicion of pancreatic disorder. This includes 35 male and 15 female patients. Each patient had been studied by using plain and contrast computed tomography. **Results:** Maximum no. of patients' age was from 23 – 30. Pancreatic diseases were more commonly found in males than in females. Inflammatory diseases were found to be more common than neoplastic masses. Chronic pancreatitis were showing pancreatic duct dilatation, pancreatic atrophy and pancreatic calcification. Pseudocysts were associated with chronic pancreatitis. Pancreatic carcinomas extent and metastases was studied accordingly. **Conclusion**: CT alone is an excellent noninvasive imaging modality with a sensitivity of about 94% in diagnosing pancreatic diseases when used judiciously in good clinical settings and accuracy of almost 100% when used in conjunction with other imaging modalities like endoscopic retrograde colangiopancreatography, angiography and biopsy whenever indicated.

Key words: pancreatic diseases, acute chronic pancreatitis, computed tomography

INTRODUCTION

Computed Tomography (CT) is a highly accurate, non-invasive imaging modality of choice in evaluating the pancreas[1]. CT enables the imaging of the entire pancreas easily from the surrounding fat and bowel air together with simultaneous imaging of other abdominal organs.[2] It also enables detection of unsuspected additional or ancillary abnormalities which may be responsible for clinical manifestations[3,4].

The evolving role of CT in the study of pancreas is not only in its ability to directly define the presence of an abnormality but it also surpasses the other imaging modalities in being able to demonstrate the extent of the disease and its spread to contiguous areas by virtue of its being a non-organ specific investigation. The ability of CT to image the pancreas adequately regardless of the bowel gas and fat gives it an advantage over ultrasound[5].

In present study the role of CT to evaluation of pancreatic disease by studying the following parameters. The normal anatomy of the pancreas and various CT appearances in pancreatic disease with regards to sizes, shape, position, margins (contour) volume, density characteristics, enhancement patterns, vascular landmarks, pancreatic and common bile ducts and the surrounding organs.

MATERIALS & METHODS

This was the prospective study carried out in the Department of Radio diagnosis, Dr. V.M.Govt. Medical College and Shri. Chatrapati Shivaji Maharaj General Hospital. Ethics committee clearance was obtained for the present study. Informed consent of patients also taken from each patient.

Inclusion criteria: This study comprises 50 patients of different age groups in whom there was clinical suspicion of pancreatic disorder complaining pain in abdomen, weight loss and increased serum amylase levels. This includes 35 male and 15 female patients.

General clinical history of each patient had been taken and CT scan was done by using plain and contrast dedicated pancreatic imaging on : Third Generation spiral CT- Philips Company (CT Model – CT vision, CT-secura).

The following finding were selected for the evaluation of pancreatic diseases

Ultrasonographic findings: CT findings

Contour (Regular / irregular/Nodular), Size (Focal enlargement, Diffuse enlargement, Diffuse atrophy, Focal atrophy), Attenuation (Plain, Arterial, Venous), Pancreas (Aorta, IVC), Density(Homogenous/ heterogenous, Focal Hypodense Areas, Focal Isodense areas, Focal hyperdense areas), Necrosis, Calcification (Parenchymal, Ductal, Both), Pancreatic duct (Size, Calculi), Commone Bile duct, (Size, Calculi), Pancreatic abscess, Pancreatic gas, Peripancreatic fat stranding, Phlegmonous changes, Mesentery, Transverse mesocolon, Anterior pararenal fascia, Lesser sac, Pelvis, Acute fluid Accumulations, Intrapancreatic/ Extrapancreatic, Psuedocyst, Ascites, Pleural effusion, Vascular structures,Varices, Fat plane around the vessels, Liver, Intrahepatic biliary radicals.Investigations: Biochemical investigations are done to rule out pancreatic diseases (BSL, Serum Amylase, Serum Bilirubin).

RESULTS

Table 1: Distribution of pancreatic Disorders Diagnosed on CT (n=50)

Age(years)	Male	%	Female	%
0-10	00	00	01	02
11-20	02	04	02	04
21-30	06	12	03	06
31-40	09	18	03	06
41-50	08	16	03	06
51-60	05	10	01	02
61-70	05	10	01	02
>70	00	00	01	02
Total	35	75%	15	30%

Comments: Pancreatic disorders were more common in males than in females in this study. The commonest age group affected was between 30 to 50 years.

Table 2 : Distribution of patients according to various pancreatic pathologies.

Pathology	No.	%
Acute pancreatitis	16	32
Chronic pancreatitis	24	48
Pancreatic carcinoma	09	18
Other	01	02
Total	50	100

Comments: The other constitute of only one case of pancreatic cyst associated with VHL (von Hipple Lindau) syndrome.The commonest pathology in this study was chronic pancreatitis followed by acute pancreatitis and pancreatic carcinoma.

Table 3: Age and sex distribution of acute pancreatitis (n=16)

Age (years)	Male	%	Female	%	Total	%
0-10	--	--	--	--	--	--
11-20	--	--	--	--	--	--
21-30	1	6.2	1	6.25	2	12.50
31-40	5	31.2	2	12.5	7	43.75
41-50	3	18.7	--	--	3	18.75
51-60	1	06.2	--	--	1	6.25
61-70	2	12.5	--	---	2	12.50
>70	--	--	1	6.2	1	6.25
Total	12	75%	4		16	100%

Comments: Acute pancreatitis was more common in males than in females in this study.The commonest age group affected was between 30-50 yrs.

Table 4: Showing the CT signs of acute pancreatitis.

Signs		No.	%
Gland	Normal	0	0
	Diffuse Enlargement	11	68.75
	Focal Enlargement	5	31.25
Contour	Irregular	10	62.5
	Regular	6	37.5
Density	Homogenous	5	31.25
	Heterogeneous	11	68.75
Necrosis	<30%	3	18.75
	30-50%	1	6.25
	>50%	2	12.50
Phlegmonous changes		7	43.75
Fluid accumulation	Intrapancreatic	3	18.75
	Extrapancreatic	4	25.00
	Both	2	12.50
Presence of gas/Abscess		0	0
Pseudocyst		3	18.75
Ascites		3	18.75
Pleural effusion		8	50.00

Comments: Fluid accumulation is defined as a localized collection of pancreatic fluid in the pancreas, lesser sac, anterior, pararenal space or subperitoneal space.4 patients had extrapancreatic fluid accumulation, while 3 patients had intrapancreatic fluid accumulation and 2 patients had both intra and extrapancreatic fluid accumulations. Extrapancreatic fluid collections noted in Lesser sac and subperitoneal space.

Table 5 : Distribution of patients of acute pancreatitis according to grade of pancreatits (n=16)

Grade [7]	No. of patients	%
A	0	--
B	4	25.00
C	3	18.75
D	7	43.75
E	2	12.50

Grading : [7]

Grade A: Normal pancreas

Grade B: Focal or diffuse enlargement of the gland, including contour irregularity, non homogenous attenuation of gland, dilatation of the pancreatic duct, foci of small fluid collections with in the gland.

Grade C: Intrinsic pancreatic abnormality associated with haziness and streaky densities representing inflammatory changes in the peripancreatic fat.

Grade D: single ill defined fluid collection.

Grade E: Two or multiple poorly defined fluid collections as presence of gas in or adjacent to pancreas.

Table 6 Distribution of Necrosis in various grades of Pancreatitis. (n=6) [5]

Grade	No. of patients	%
A	--	--
B	--	--
C	2	33.33
D	3	50.00
E	1	16.66
Total	6	100%

Comments: Necrosis is the non enhancing areas of pancreas on dynamic contrast CT. Necrosis is identified in 6 patients in this study.

Table 7 : Age and Sex distribution of chronic pancreatitis.

Age (years)	Male	%	Female	%	Total	%
0-10	--	--	01	4.16	01	4.16
11-20	02	8.33	01	4.16	03	12.5
21-30	05	20.83	02	8.33	07	29.16
31-40	04	16.66	--	--	04	16.66
41-50	03	12.5	01	4.16	04	16.66
51-60	03	12.5	--	--	03	12.5
61-70	01	4.16	01	4.16	02	8.33
Total	18	75%	06	25%	24	100%

Comments: Incidence of chronic pancreatitis was more in males as compared to females. The commonest age group affected was between 20-40 years.

Table 8: Distribution of signs of Chronic pancreatitis.

Signs		No.	%
Size	Normal	03	12.5
	Diffuse atrophy	13	54.16
	Focal atrophy	04	16.66
	Focal enlargement	04	16.66
Pancreatic duct	Dilatation	19	79.16
	Calculus	05	20.83
CBD	Dilatation	07	29.16
	Calculus	01	04.16
Pancreatic Parenchymal Calcification		03	12.5
Pseudocyst		20	83.33
Alternation in peripancreatic fat/fascia		04	16.66

Comments: Pancreatic ductal dilatation is defined as maximum AP diameter of the duct ≥ 5mm in the pancreatic head and ≥3mm in the body and tail.

Pancreatic Neoplasms

Table 9: Age and Sex distribution (n=9)

Age (years)	Male	%	Female	%	Total	%
31-40	00	--	01	11.1	01	11.1
41-50	03	33.3	02	22.2	05	55.5
51-60	01	11.1	01	11.1	02	22.2
61-70	01	11.1	00	--	01	11.1

Comments : The commonest age group affected in this study was elderly ie. Above 40 years with almost equal sex incidence.

CT signs of pancreatic carcinomas:

Table 10: CT signs of primary mass.

Sign		No.	%
Enlargement	Head	04	44.44
	Head +Uncinateprocess	01	11.11
	Body	01	11.11
	Head + Body	02	22.22
	Tail	01	11.11
Density	Hypodense	07	77.77
	Isodense	02	22.22
	Hyperdense	--	--
Size	< 3 cm	02	22.22
	> 3 cm	07	77.77
PD dilatation		06	66.66
CBD dilatation		05	55.55
IHBR dilatation		05	55.55
Associated pancreatic atrophy		07	77.77

Table 11: Extra pancreatic CT signs:

Signs	No.	%
Hepatic metastasis	05	55
Lymph node involvement	04	44
Vascular involvement		
Encasement	02	22
Occlusion	01	11
Peripancreatic infiltration	06	66
Involvement of Contiguous organs	03	33
Ascites	05	55
Pleural effusion	02	22

Comments: One patient showed presence of direct portal vein invasion and thrombosis. In 3 patients misdiagnosed as pancreatic head adenocarcinoma on USG, CT revealed periampullary carcinoma in one patient and cholangiocarcinoma in two patients. These patients are not taken in this study.

DISCUSSION

In our two and half years experience with patients referred for CT scanning of abdomen for pancreatic region, we singled out 50 patients for our study. We had a highly selected group of patients for CT study, because of the availability of US in the hospital and strongly clinically suspected patients were taken for CT examination. **Acute pancreatitis:** In our study 16 patients were diagnosed as having acute pancreatitis. (32%). 12 patients (75%) were of the male sex and this was correlated with the high incidence of alcohol abuse in these patients as being the commonest cause of acute pancreatitis. Brooke Jeffery et al (1982)[1] the cause of acute pancreatitis in 24 of 36 patients to be due to alcohol abuse, as was also noted by Gaston Mendez et al (1980) [2].

Peak age of incidence was noted in the 30-50 years age range. In B Jeffery study (1982) [1] the mean age was 41 years. In our study, 11 of 16 patients (68.75%) had diffuse enlargement of the pancreas, with focal enlargement of the pancreas seen in the 5 patients (31.25%). This correlated with Brooke Jeffery et al (1982) [1] study in which 31 of 36 patients showed diffuse enlargement and 2 patients showed focal enlargement. This also compared with Mendez et al (1980) [2] in which 32 patients showed gland enlargement.

In this study, peripancreatic phlegmonous changes were noted in 7 patients (43.75%) with involvement of mesenteric root in 5(71%), perinephric spaces in 4 (57%) lesser sac in 3(42%), paraconal spaces in 2(28%) and pelvis in 1 (14%) patient. Out of 7 patients 85.7% (6 patients) were of necrotizing pacreatitis and 14.28% (1 patient) of acute edematous pancreatitis. This correlated with Hill et al (1982) [3] in which phlegmonous changes were reported in 11% of acute edematous pancreatitis and 89% of necrotizing pancreatitis.

In our study, 9 patients (56.25%) had acute fluid accumulations, of which 3 patients (18.7%) had intrapancreatic, 4 patients (25%) had extrapancreatic fluid accumulations, and 2 patients (12.50%) had both extra and intrapancreatic fluid collections. Seigleman Stanley et al (1980)[4] also reported pancreatic and extrapancreatic fluid accumulations in 54% cases with 16% having intrapancreatic and 42%

having extrapancreatic collections. Balthazar E J et al [5] also reported acute fluid collections in 40% of patients early in the course of acute pancreatitis of which 50% resolved spontaneously. In our study, the natural history of acute fluid collections could not be followed up, as our patients could not afford rescans.

In our study we had 3 cases of pseudocyst, 2 in intrapancreatic locations and one in lesser sac. The commonest site of pseudocyst; a late sequlae of the disease, in our study was intrapancreatic location (66%) in acute pancreatitis. CT is a better investigation than US for detection of remote pseudocysts[6]. Kresses says that CT has 100% sensitivity while US has 50% in detection of extrapancreatic predocysts.

In our study, no patient had Grade A, 25% had Grade B, 18.75% Grade C, 43.75% Grade D and 12.50% Grade E pancreatitis. The patients who developed two or multiple poorly defined fluid collections were of Grade E pancreatitis. Further pleural effusion in 50% cases and ascites in 25% were found in more sever grades, Grade D and E pancreatitis. The patients of Grade A, B, C had no or less number of complications like pleural effusion and ascites. Balthazar E. J (1985) [7] reported the following: Grade A 14.5%, Grade B 22.9%, Grade C 25%, Grade D 14.5%, Grade E 27.7%. Our study correlated with the study of Balthazar E J (1985) [7] for the presence of pleural effusion and ascites like complications occurs more in Grade D and E pancreatitis. Pancreatic necrosis described as focal nonenhancing low attenuation areas was noted in 6 patients (37.5%) in our study. Necrosis was not found in Grade A and B pancreatitis, but was found 33.33% in Grade C, 50% in Grade D and 16.66% in Grade E pancreatitis. These findings correlated with Balthazar E J et al (1990) [5] noted total necrosis being 20.4%. Necrosis was not found in Grade A and B pancreatitis, but was found 25% in Grade C, 50% in Grade D and 25% in grade E. Most patients with Grade D and E pancreatitis exhibited higher incidence of pancreatic necrosis detected in our study could be attributed to spiral acquisition of data during peak pancreatic parenchymal enhancement, thus allowing good discrimination between necrosed and viable portions of the gland.

Chronic pancreatitis: In our study of total 24 patients were diagnosed on CT having chronic pancreatitis of these 18 were males (75%) and 6 were females (25%) with maximum patients being in the age range of 20 to 40 years (18-70 year range). The commonest findings of chronic pancreatitis in our study were pancreatic duct dilatation 79% (19 out of 24 cases), pancreatic atrophy (70%) (17 out of 24 cases), pancreatic calcification (Ducal and parenchymal) 33.33% (8 out of 24 cases). These findings co-related with the findings of P Luetmer et al (1989)[8] which were pancreatic duct dilatation (68%), pancreatic gland atrophy (54%) and pancreatic calcification (56%).

Pancreatic duct dilatation has been found with varying degrees of sensitivity on CT ranging from 4% (J. Ferrucci et al 1979) [9] to 68% (P Luetmer 1989) [8]. In our study the frequency of duct dilatation was found to be 79%. 5 out of 19 patients showed dilatation of the duct up to the Ampulla of Vater, While this sign is useful in ruling out a proximal pancreatic malignancy, it does not exclude an ampullary carcinoma (P Leutemer 1989) [10].

In our study pancreatic calcification was seen in 8 out of 24 patients (33.3%) showed presence of intraductal and parenchymal calcification. Intraductal calcification was noted in 5 patients while parenchymal calcification noted in 3 patients. This was in comparison to variable reported incidence of calcification in chronic pancreatitis from 36%[9], 52%[11], to 50%[8]. In our study we were able to differentiate intraparenchymal from intraductal calcification. This distinction could be important from the management point of view in patients with chronic pancreatitis [12].

Pseudocyst had an incidence of 83.3% in our study (20 out of 24 patients). We found 24 pseudocysts in 20 patients, with 14 being intrapancreatic located mainly in the head region and 10 being extrapancreatic region mainly in the lesser sac. One patient had the pseudocyst in the spleen. In our study incidence of preudocysts was higher as compared to other studies: 30%[9], 28% [11] and 30 %[8]. This could be attributed to later presentation of our patients of chronic pancreatitis with more severe disease and due to bias of clinical selection of patients undergoing CT. Of the 24 pseudocysts diagnosed, 9 were <6 cms size, while 15 were >6cms size. Patients with pseudocysts >6 cms presented with abdominal pain and an epigastria lump. 6 pseudocysts >6 cms were drained surgically and this correlated with the

findings of Yehoules Yeo and Augusto Batisdas (1990)[13].

Pancreatic atrophy was noted in 70% (17 out of 24) patients with chronic pancreatitis. Out of 17 patients, 13 patients shows diffuse atrophy and 4 patients shows focal atrophy. Of these patients, 45.8% had associated pancreatic ductal dilatation. Earlier study found frequency of atrophy to be 54%[8]. In this study, 4 patients showed focal enlargement (16.6%); 3 patients normal gland size (12.5%) but no one shows diffuse enlargement. This is comparable to the study of P Luetmer (1989) [8] (16.6%) reported foal enlargement in 30% with no diffuse enlargement.

Alterations in the peripancreatic fat and fascia were noted in 16.60% (4 patients) which correlated with P Luetmer et al (1989) [8] study, in which 9% showed fascial thickening.

Pancreatic neoplasms: Majority of the neoplasms are solid, adenocarcinomas representing 95% of these. They arise from the epithelium of the main pancreatic duct, accessory duct or their side branches.

In our study, a total number of 9 patients with pancreatic carcinomas were diagnosed (18%) with most patients presenting in elderly age group beyond 40 years. Sex incidence is almost equal (55.5% males and 44.4% females).

All tumors showed focal enlargement of the pancreas with contour deformation. The tumors were 4 (44.4%) from head, 2 from head and body and 1 each from head and uncinate process, body and tail regions of pancreas, which was in keeping with the findings of Patrick Freeny et al (1988) [14] in which 96% of pancreatic adenocorcinomas presented with focal mass, 62% of which were found in the region of the head.

In our study 77.7% of tumors were found to be hypodense and 22.2% were isodense compared to parenchyma. This was in accordance with Alec Megibow's study (1992)[15], in which 78% of patients had hypoattenuating lesion. This was attributed to the schirrous nature of the tumor, which was the same biologic characteristic that results encasement of vessels.

In our study 77.7% of patients had tumor size >3cms. These tumors were found to be non-resectable at surgery. This was in accordance with the findings of David A Bluemke (1995)[16] who found that the average size of resectable tumors was <3.1 cms. The larger size of tumors at presentation could be due to the fact that pancreatic neoplasms are notoriously asymptomatic when small and only on enlarging in size causes symptoms of obstructive jaundice, that they are detected.

Upstream dilatation of the main pancreatic duct was noted in 66.6% of our patients with associated pancreatic atrophy seen in 77.7% of cases. Dilatation of the common bile duct was seen in 55.5% patients with intrahepatic biliary dilatation noted in 55.5% of patients. Patrick Freeny et al (1988)[14] noted upstream dilatation of main pancreatic duct in 68% patients with associated pancreatic atrophy in 82%. Intrahepatic biliary ductal dilatation was noted in 58%.

As compared to Patrick Freeny's (1988) [14] study, of 68% local tumor extension and 42% contiguous organ involvement infiltration was noted in 66% and 33% respectively. This could be accounted for the better contrast difference between the tumor, the enhanced pancreas and the surrounding peripancretic tissue due to scanning in the peak enhancement phase of the pancreatic parenchyma using spiral CT, as compared to dynamic contrast enhanced scanning.

Hepatic metastasis was discovered in 55% and enlarged nodes in 44% of our patients. Patrick Freeny (1988)[14] in his study noted metastasis to liver (36%) and regional lymph nodes (nodes greater than 2 cm.) (28%).

Ascites was noted in 55% of our study patients. The above findings determined the presence of non respectable carcinomas.

Vascular involvement by pancreatic carcinomas was noted in 5 patients (55.5%). 2 patients showed loss of perivascular fat planes, 2 patients showed vascular encasement and soft tissue cuffing of the vessels. In 1 patient, portal vein thrombosis was noted. Thrombosis was due to direct infiltration of the tumor into the portal vein. David Bluemke et al (1995) [16] noted portal vein invasion in 2 of 19 patients. Patrick Freeny (1989) [14] showed vascular involvement in 84% of patients.

CONCLUSION

In present study an attempt has been made to evaluate the role of computed tomography for evaluation of pancreatic diseases. In this study, a total number of 50 patients of pancreatic pathology were studied using spiral CT (35 male and 15 female patients). 24

patients were diagnosed as having chronic pancreatitis, 16 acute pancreatitis, 9 pancreatic neoplasms and 1 had simple pancreatic cyst. In conclusion, therefore, CT alone is an excellent noninvasive imaging modality with a sensitivity of about 94% in diagnosing pancreatic diseases when used judiciously in good clinical settings and accuracy of almost 100% when used in conjunction with other imaging modalities like ERCP, angiography and biopsy whenever indicated.

Conflict of interest: Nil

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