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CT Imaging Features of Pancreatic Neoplasms

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Abstract

Background: Pancreatic neoplasms have highly variable clinical presentation and severity. Computerized Tomography (CT) is the modality of choice for investigating pancreatic neoplasms. **Objectives:** The objective of our study was to study the CT findings of pancreatic neoplasms in a tertiary care centre. **Materials and Methods:** CT scan of 20 patients with pancreatic neoplasms were studied after scanning on Siemens Somatom Perspective (128 slice). **Results:** Majority of the patients i.e., 45% had imaging features of epithelial tumours (Adenocarcinoma). Cystic neoplasms and endocrine tumours were the next most common seen in 30% and 15% of patients respectively. **Conclusion:** From this study we can infer that pancreatic neoplasms show characteristic findings on CT study & it enables us to assess, grade and stage pancreatic neoplasms with a fair degree of reliability non-invasively. It also helps in designing a management plan for better patient care.

Keywords: Cystic Neoplasm, Endocrine Tumor, Epithelial Tumor, Hematopoietic tumor

1. Introduction

Pancreatic neoplasms do not exhibit early symptoms and initial symptoms are often nonspecific. Classical presentation of these patients is present only in few patients[1]. Diagnosis and treatment of these pancreatic neoplasms is widely based on clinical symptoms, laboratory and radiological findings.

Conventional radiography and USG has a limited role and value in diagnosis of pancreatic neoplasms. MDCT with intravenous contrast is generally considered as the imaging procedure of choice for initial evaluation of most patients suspected to have pancreatic cancer[2]. Computed Tomography (CT) has greatly improved the visualization of pancreas. It is far superior to ultrasound as we can better visualise the pancreatic anatomy and surrounding structures and localize lesions[3]. This article focuses on the imaging modality of CT and on its application in the evaluation of pancreatic neoplasms to arrive at the results. The study was done over the period of 10 months.

2. Aims and Objectives

1. To study the Computed Tomography findings in cases of pancreatic neoplasms.
2. To categorize and classify pancreatic neoplasms.
3. To study and evaluate associated CT features of pancreatic neoplasms.

3. Materials and Methods

The present study was conducted over 10 months (January to October 2017), with due permission from the ethics committee. The Contrast Enhanced Computed Tomography (CECT) Abdomen of 20 patients was performed who were referred to the Department of Radio-diagnosis at Dr. Vasantrao Pawar Medical College, Hospital and Research Centre, Nashik with varied complaints. The clinical and demographic data were recorded after due consent to correlate the findings. The patients who were not willing to give consent were not included in the study.

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All the CT scans were done on Machine: Siemens Somatom Perspective (128 slice). CT scan of abdomen with axial and coronal reconstruction was performed which is a pre-requisite for detailed evaluation of pancreatic lesions.

A focused pancreatic protocol CT includes a pancreatic, portal venous and delayed phase was taken. In cases where a dedicated pancreatic protocol CT is performed, the use of neutral oral contrast media like water was preferred, as it allows superior image reconstruction. A Pancreatic phase refers to the late arterial phase which is taken after a delay of 40-45 sec after contrast injection. It is highly useful for differentiation as in this phase there is maximal tissue differentiation. Portal venous phase is taken after a delay of 60–65 sec after contrast injection (Image 1A to 1F).

4. Results

The present study was carried out at department of Radio diagnosis and imaging at a medical college hospital & Tertiary centre from January to October 2017. A total 20 patients were examined and their CT imaging features were studied with the aim of describing pancreatic neoplasms. The salient observations are as follows:

The study comprised of 45 % (n=9) males and 55% (n=11) females, between age groups of 21–70 years. Majority of the patients in this study i.e. 75% were in the age group of 51 to 70 years. The peak incidence was observed in the age group of 51-60 years (n=8) of patients (Figure 1).

The most common type of neoplasm found was epithelial tumour (adenocarcinoma) seen in 45% of patients followed by cystic neoplasms & endocrine tumours seen in 30% and 15% of the patients respectively (Figure 2). Hematopoietic tumours & metastasis were seen in 5% of the patients each. Amongst cystic neoplasms, two cases i.e. 33% of each mucinous cystadenoma and Intraductal Papillary Mucinous Neoplasm (IPMN) were seen (Figure 3). Of all the different types of Neuro-Endocrine Tumors (NET), the most common was insulinoma seen in 67% of these patients while one case of VIPoma i.e., 33% was seen (Figure 4).

Pain in abdomen showed association with 100% cases and was the most common complaint. Weight loss (60%) was the second most common complaint followed by fever (20%) and vomiting (10%) (Figure 5).

The most common finding in association with pancreatic neoplasms was pleural effusion seen in 40% followed by ascites seen in 30% of the patients (Table 1).

Location wise adenocarcinomas (Epithelial Tumor) & cystic neoplasms were seen to occur most commonly in the pancreatic head region i.e. 67% & 50% of these cases respectively.

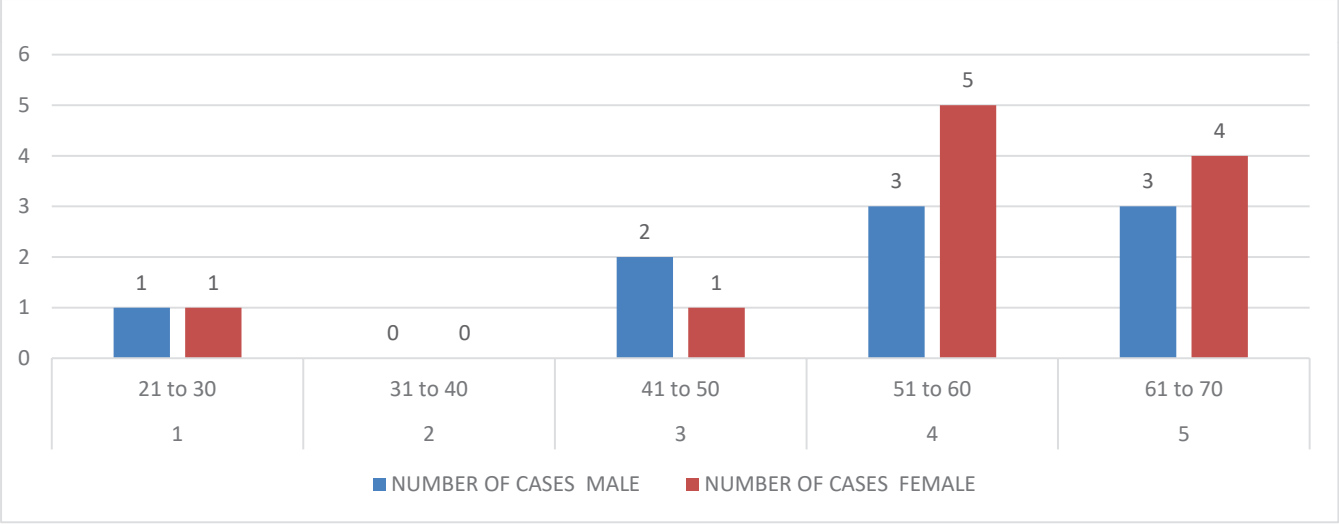


Figure 1. Age and Gender distribution of study participants.

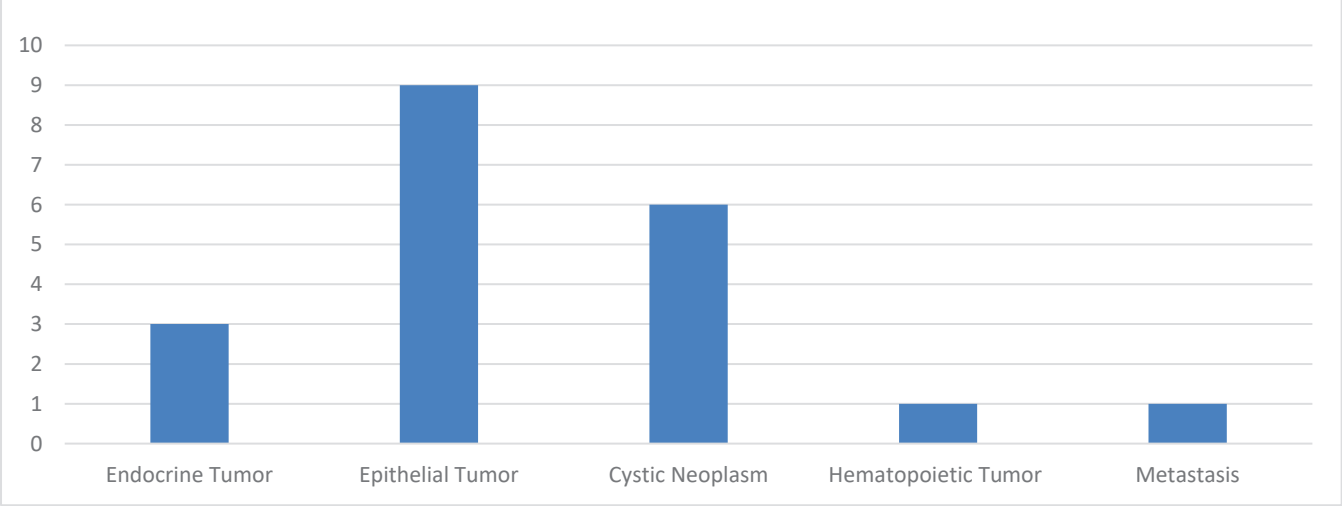


Figure 2. Types of pancreatic neoplasms on CT scan.

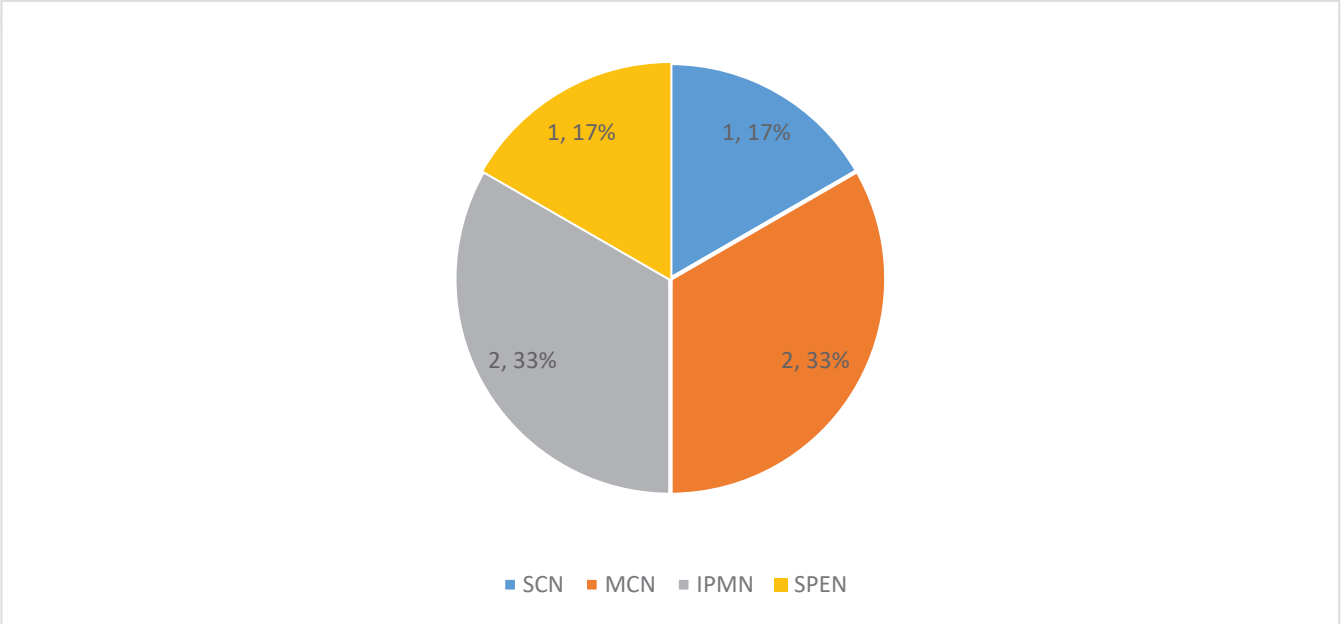


Figure 3. Types of cystic pancreatic neoplasms on CT scan.

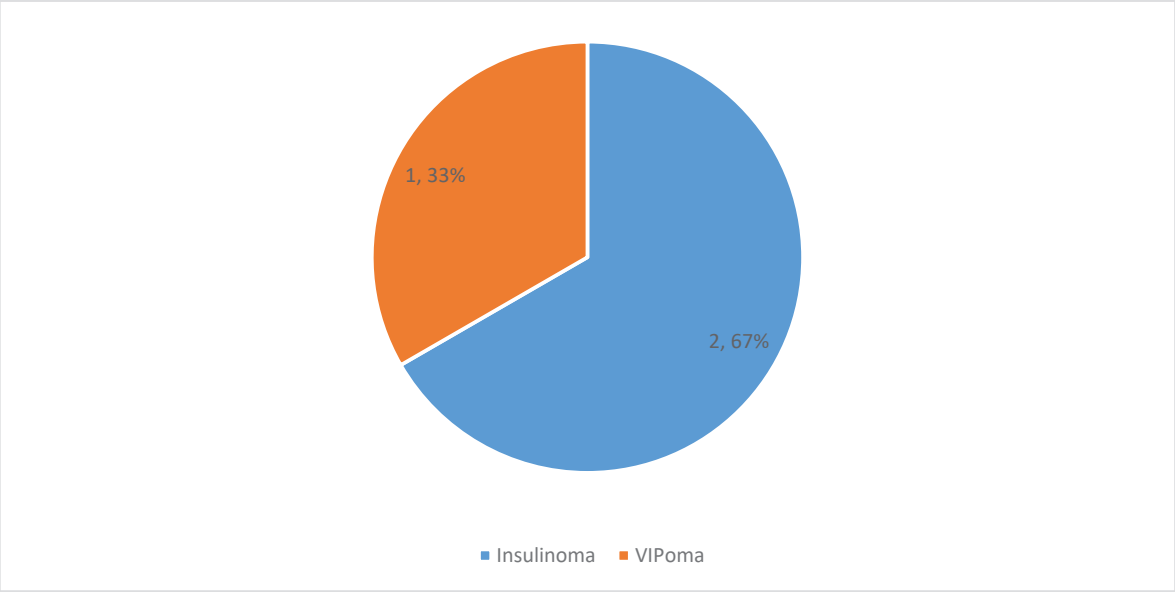


Figure 4. Types of pancreatic neuro-endocrine tumors (NET) on CT scan.

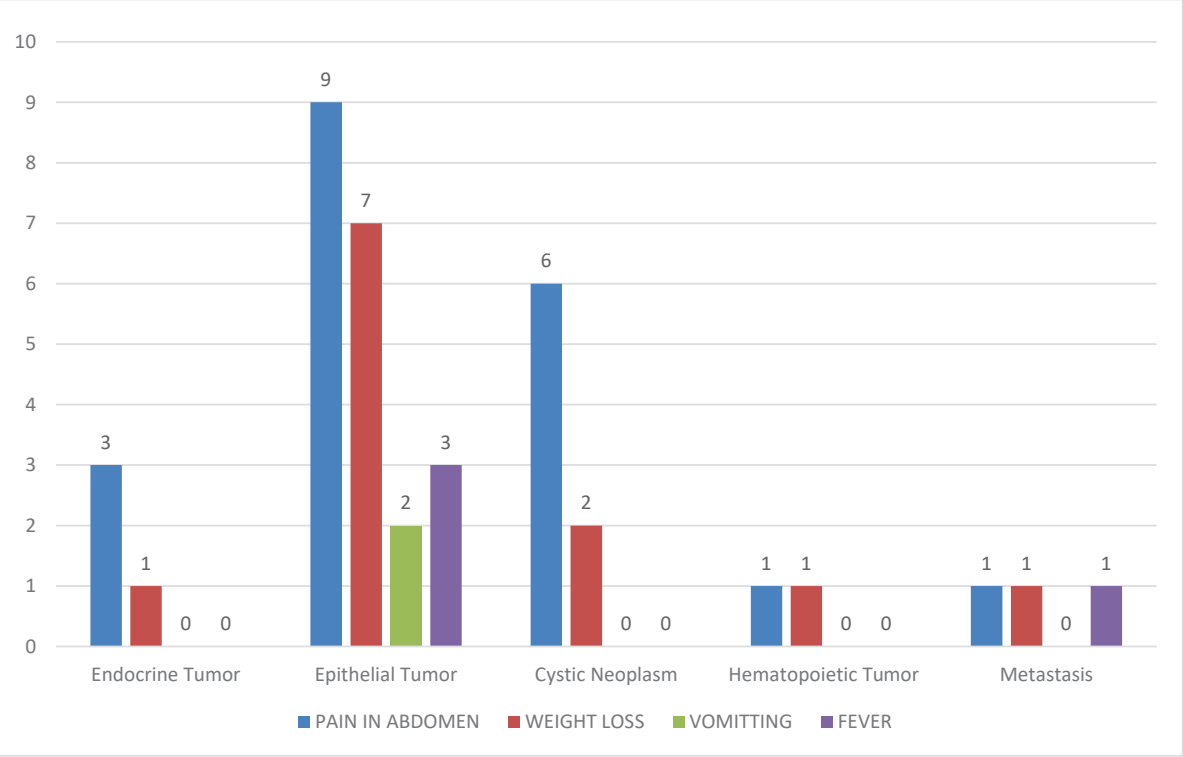


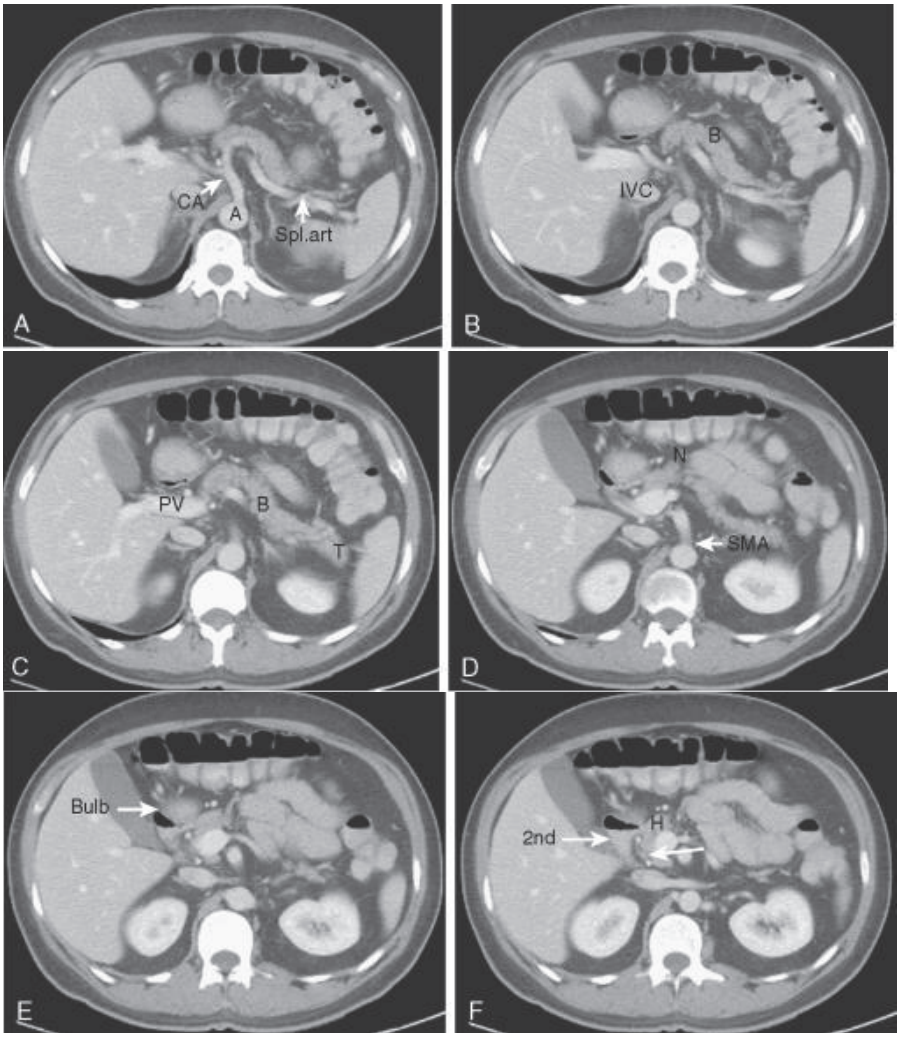
Figure 5. Associated symptoms with pancreatic neoplasms.

Table 1. Associated CT findings with pancreatic neoplasms

Types of Neoplasms	Associated Conditions				
	Pleural Effusion	Ascites	GIT	Portal vein thrombosis	Gall stones
Endocrine Tumour	0	0	0	0	0
Epithelial Tumour	6	4	1	1	0
Cystic Neoplasm	0	0	0	0	0
Hematopoietic Tumour	1	1	1	0	0
Metastasis	1	1	0	0	0
Total	8	6	2	1	0

5. Discussion

The pancreas is a retroperitoneal organ having exocrine as well as endocrine function. Since the pancreas is located relatively deep in the abdomen, its imaging by conventional methods has proved to be challenging. After the advent of Multidetector Computed Tomography (MDCT) detailed visualization and definition of deeper and smaller structures and subtle changes of density of the normal and abnormal pancreas are now possible. The scope of multiplanar reconstruction with MDCT scanners has improved remarkably the ability to visualize and understand complex anatomical structures and relationships (Figure 1A to 1F).



AXIAL CT SCAN CUTS:

CA-celiac artery.
A-aorta.
IVC-inferior vena cava.
B-body.
PV-portal vein.
H-Head of pancreas.
SMA-Sup. mesenteric artery.
T-Tail of pancreas.
2nd-2nd part of duodenum.

Image 1A to 1F. Normal anatomy of pancreas and its relations (axial cuts at the level of pancreas).

5.1 Classification of Pancreatic Tumours

Epithelial Cell Origin

Adenocarcinoma

Endocrine Tumours

A. Functional tumours
   a. Insulinoma
   b. Gastrinomas
   c. VIPomas
   d. Glucagonoma
   e. Somatostatinomas
   f. Others: Parathyroid hormone (PTH) and Adrenocorticotropic hormone (ACTH) hormone-secreting tumour.
B. Non-functional tumours

Exocrine Tumours

Acinar cell carcinoma

Haematopoetic

Lymphoma

Cystic Neoplasms

A. Common cystic pancreatic neoplasm
   a. Serous cystadenomas
   b. Mucinous cystic neoplasm
   c. Intraductal papillary mucinous neoplasm
B. Rare cystic pancreatic neoplasm
   a. Solid pseudopapillary neoplasm
   b. Acinar cell cystadenocarcinoma
   c. Lymphangioma
   d. Hemangioma
   e. Paraganglioma

Metastasis

a. Renal
b. Lung
c. Thyroid
d. Breast
e. Colorectal cancers
f. Melanoma

Pancreatic Adenocarcinoma

It comprises of 90% of the malignant tumors of the pancreas.

a. **Sites of occurrence:** 2/3rd of the tumors occur in head of the pancreas; the remainder is found in the body or tail.

It is associated with an intense desmoplastic reaction and tends to obstruct the pancreatic duct, with subsequent upstream duct dilation and parenchymal atrophy; if it arises in the head, the common bile duct can be stenosed, with biliary tree dilation[4].

Extensive infiltration of the retroperitoneum and the anatomic structures surrounding the pancreas can occur in pancreatic adenocarcinoma.

The clinical presentation - long-standing abdominal pain, asthenia, reduced appetite, and weight loss. New-onset diabetes mellitus is present in 10% of patients. Painless jaundice is present in 75% of patients at presentation.

For the diagnosis of adenocarcinoma of the pancreas Serum marker CA 19-9 is considered a sensitive but nonspecific marker.

The TNM classification for pancreatic cancer staging is in accordance with Table 2.

Table 2. AJCC TNM staging system for pancreatic cancer[5]

Stage	Description
Primary Tumor (T)	
Tx	Primary tumor not assessed
T0	No evidence of primary tumor
Tis	Carcinoma in situ
T1	Tumor limited to pancreas, ≤2 cm in greatest diameter
T2	Tumor limited to pancreas, >2 cm in greatest diameter
T3	Tumor extends beyond pancreas but without involvement of the celiac axis or superior mesenteric artery
T4	Primary tumor involves the celiac axis or the superior mesenteric artery (unresectable primary tumor)
Regional Lymph Nodes (N)	
Nx	Regional lymph nodes not assessed
N0	No regional lymph node metastasis
N1	Regional lymph node metastasis
Distant Metastasis (M)	
M0	No distant metastasis
M1	Distant metastasis present

b. Role of MDCT[6]

The pancreatic adenocarcinoma appears as a low-density lesion compared with the normal pancreatic parenchyma. In about 10% of cases the mass is isoattenuating with contrast enhancement and cannot be directly observed. In these cases, useful indirect signs include stenosis of the distal common bile duct, stenosis of the pancreatic duct with upstream ductal dilation, parenchymal atrophy, double duct sign (stenosis of both the common bile duct and the pancreatic duct, with subsequent upstream dilation), loss of lobulation of the pancreatic parenchyma, and deformity of the pancreatic contours.

MDCT pancreatograms and angiography constitutes a crucial part of the MDCT examination.

Pancreatic Endocrinal Tumours

Tumors arising from the type of pancreatic cells producing hormones are known as pancreatic endocrine tumors. Insulinomas has a slight predilection for the head of the pancreas, whereas other are more common in the tail.

6. Functional Tumors

a. Insulinomas

It is the most common functioning islet cell tumour comprising of 50% of all endocrine tumors of the pancreas. It is found in the age group of 30-60 years of age and is equally distributed between the sexes. Insulinomas are usually solitary, measure less than 2cm in 90% of cases.

Fasting hypoglycemia, symptoms of hypoglycemia and immediate relief of symptoms after the administration of IV glucose constitutes the clinical triad necessary for its diagnosis. Diagnosis is confirmed when there is fasting hypoglycemia with raised insulin levels. Multiplicity, malignant nature and features of hyperplasia rather than neoplasia are seen in approximately 10% of these tumours. They are usually small and hypervascular however those which are malignant are large. Calcification and cystic lesions occur infrequently.

b. Gastrinomas

It is the second most common functioning islet cell tumor comprising of 20% of the pancreatic endocrine tumors. Males are more commonly affected than female and predominance is seen in the 5th decade of life. Zollinger-Ellison syndrome show strong association with them. They usually present with peptic ulcer disease and diarrhea. Most of them are multiple, located outside the pancreas and tend to be malignant. They measure around 3-4 cm when located in the pancreas however lesions vary in size depending upon its location. Gastrinomas are difficult to locate but they may be identified on angiography and arterial phase CT as they show hypervascularity.

c. VIPomas

They are the 3rd in ranking functional tumor with a higher female preponderance than males. It is also known as Verner Morrison syndrome. It may be associated with multiple endocrine neoplasia type 1. The massive amounts of VIP cause profound and chronic watery diarrhoea resulting in dehydration, hypokalemia, achlorhydria (hence WDHA-syndrome, or pancreatic cholera syndrome), acidosis, vasodilation (flushing and hypotension), hypercalcemia and hyperglycemia.

d. Glucagonomas

They account for 1% of all endocrine tumors. Most of these lesions are malignant and present with equal incidence in middle-aged men and women. Most patients present with a necrolytic migratory rash and various other elements of the "glucagonoma syndrome" including diabetes mellitus, stomatitis, diarrhoea, anaemia, and weight loss. Tumour size is variable, but most are large and have metastasized at the time of diagnosis. Most are located in the distal pancreas and are vascular. Tumours may be solid or contain central low-attenuation areas on CT.

e. Somatostatinomas

This tumor shows preponderance in females as compared to males. It presents around 51 yrs of age. It has a pancreatic origin in 50% of patients and duodenal in the remaining 50%.

It shows association with neurofibromatosis type 1 in 50% of cases. These tumors may cause diabetes, gallbladder disease, and steatorrhea.

f. CT Imaging

- **Functional Endocrine Tumors**

  Small functional endocrine – On CT imaging appear isodense, showing strong post contrast enhancement during the arterial and portal phases. They sometimes, appear cystic and hypoenhancing. If they contain discrete calcification, it is highly suggestive of malignancy.

Some insulinomas may be hyper dense before contrast administration. Larger functional endocrine tumors – on CT show heterogeneous appearance on post contrast study. Areas of central necrosis, as well as calcifications and retroperitoneal invasion, may be found in the case of malignancy.

7. Nonfunctional Tumors

They present in 4th to 5th decades of life commonly at the pancreatic head. Patients present with clinical symptoms of: abdominal pain, anorexia and weight loss. They range from 3 to 24 cm in size. 90% of nonfunctioning pancreatic tumors are malignant. 83% of cases are associated with lymph node or distant metastasis at surgery.

8. Exocrine Tumours

a. Acinar Cell Carcinoma (ACC)

It is a rare pancreatic tumor, seen in about 1% of exocrine pancreatic neoplasms. It is characterized by the production of pancreatic enzyme by tumor cells. It shows a preponderance for Females as compared to males and commonly presents in the 7th decade of life.

Clinically the patients present with jaundice, abdominal pain, vomiting and weight loss. CA 19-9 is elevated in 30% of patients.

The most common site is the uncinate process and the head of pancreas. These tumors are mostly exophytic with a mean size of approximately 7 cm. A well-defined enhancing capsule circumscribes the tumor, which may present focal areas of discontinuity and infiltration into the surrounding organs. Central necrosis is a common finding, present in about 80% of cases.

On imaging, about 50% of tumors harbor calcifications in the form of central punctate or stellate calcifications or peripheral punctuations or plaques[7].

9. Haematopoetic Tumours

Lymphoma: Primary pancreatic lymphoma is a rare tumor. They have symptoms of abdominal pain, weight loss and jaundice. In some cases, CA 19-9 is elevated.

Males in the age group of 35 to 75 years (mean age, 55 years) are more commonly affected than females. It is most common site of location is noted in the head of pancreas (80%)[8].

CT imaging: It shows two appearances:

- A localized mass, which frequently extends to extrapancreatic regions, or
- Diffuse enlargement and replacement of the pancreas.

Both forms show diffuse, invasive growth pattern not respecting anatomic boundaries, infiltrating the retroperitoneal structures and gastrointestinal tract.

C. Cystic Neoplasms

Majority (90%) of these neoplasms include serous cystadenomas, mucinous cystic neoplasms, and intraductal papillary mucinous neoplasms (IPMNs).

a. Serous Cystadenoma (SCA)

Clinical presentation is often vague. They are usually benign in nature. They account for 30% of all cystic pancreatic neoplasms. Preponderance for female patients as opposed to male patients is seen. It is also known as grandmother lesions or lesions of the elderly with average age 65 yrs. This is a highly vascular tumour. Usually presents as a large calcified mass. A central fibrotic scar with sunburst pattern of calcification is characteristic. These lesions have a slight predominance for the pancreatic head and are often diagnosed incidentally. Multiple cysts (usually more than six) of varying sizes ranging from few millimeters to 2cm collectively gives rise to a polycystic or microcystic (honeycomb) pattern[9].

CT imaging

The lesion appears solid due to the compact arrangement of small cysts. External lobulations with septal enhancement with or without characteristic calcification (30%) is pathognomonic for serous cystadenoma. These tumors may appear as unilocular cyst, macrocystic or oligocystic variantsbeing rare (<10%).[10] Von Hippel-Lindau syndrome should be considered in rare cases of multiple SCAs.

b. Mucinous Cystic Neoplasms (MCNs)

They comprise about 44% to 49% of the cystic pancreatic lesions. Female are more commonly affected than males. They are also known as mother lesions affecting a mean age group of 47 yrs. Lesions appear as single or multiple mucin containing cysts with a predilection for the body and tail of the pancreas showing high vascularity.

Majority of the lesions have a multilocular and smooth contour with mean size of 5cm. They do not communicate with MPD. In most cases they are asymptomatic (75%).

Amorphous or curvilinear dystrophic calcifications are infrequently seen (10-20%). Malignant change needs to be considered when the cysts contain septae and have irregular walls.

CT imaging

These tumors enhance on post contrast study. Peripheral eggshell or septal calcifications seen on CT are specific for mucinous cystic lesions. Histologically theses lesions are classified into three categories: benign, borderline, and malignant[11] as provided in the chart 1.

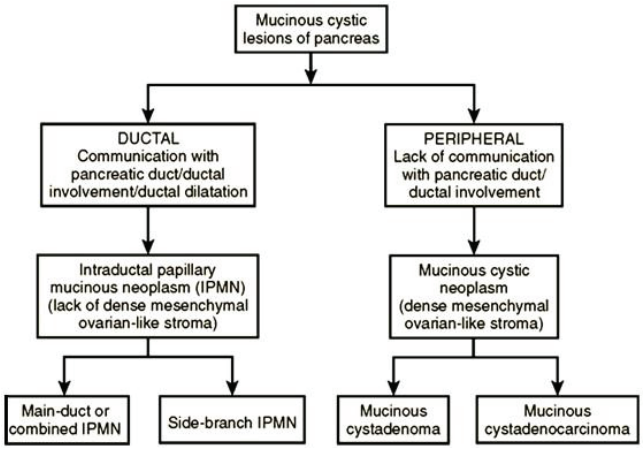


Chart 1. Types of Mucinous cystic lesions (MCN) of Pancreas

c. Intraductal Papillary Mucinous Neoplasms (IPMN)

IPMN is a mucin-producing tumor of the pancreas developing from the epithelial lining of the main pancreatic duct or its side branches, with variable ductal dilation. It has a relatively good prognosis. It comprises about 21% to 33% of cystic pancreatic neoplasms, affecting usually older men. Patients undergo intermittent ductal obstruction and present with abdominal pain, back pain, jaundice, weight loss and diabetes.

They are classified as main-duct, branch-duct (side-branch) or mixed IPMNs, depending on their morphology, site and extent of involvement. Main-duct IPMN most commonly occurs in the head of pancreas. It is a morphologically distinct entity and does not present as a cystic lesion. Owing to mucin production, there is partial or diffuse dilation of the main duct, which is filled with mucin with disproportionate to degree of parenchymal atrophy[12].

CT imaging

Excessive mucin secretion may result in bulging of major papillae into the duodenal lumen; this is considered a pathognomonic sign on cross-sectional imaging and is seen more often with malignant tumors. CT reveals diffuse or segmental dilation of the main pancreatic duct, with or without polypoid lesions. They can undergo malignant transformation. Side-branch or mixed IPMNs present as unilocular or multilocular cystic lesions that communicate with the main pancreatic duct.

d. Solid Pseudopapillary Tumors (SPT)

They are benign exocrine pancreatic tumors[13]. They occur in 2nd and 3rd decades of life with a higher incidence in female patients and are called daughter lesions. They are asymptomatic gradually enlarging nontender abdominal masses.

They are well encapsulated solid or cystic tumours arising from the pancreatic ducts showing features of low-grade malignancy. They may contain calcium. Cystic metastases may rarely occur.

CT imaging

They are well-encapsulated lesions with varying solid and cystic components owing to hemorrhagic degeneration. Enhancing solid areas are typically noted peripherally on CECT whereas; cystic spaces are usually located more centrally.

e. Lymphangioma

Less than 1% of all cystic pancreatic neoplasms are lymphangiomas. They are slow growing tumors[14]. Females are more commonly affected than males. They can affect any region of the pancreas. These patients are mostly asymptomatic. Acute presentations may be related to torsion of the pedicle, rupture or hemorrhage into the lymphangioma.

CT imaging

They appear as a septate fluid density lesion.

f. Hemangioma

It presents as a palpable abdominal mass, gastrointestinal bleeding, or a mass compressing adjacent structures such as the biliary tract or duodenum.

The role of CT is similar to that for lymphangioma.

Metastasis

It comprises of about 2% of pancreatic tumors. Renal, lung, thyroid, breast, and colorectal cancers and melanoma can metastasize to the pancreas.

CT imaging

They closely reflect the imaging appearance of the primary tumor. Metastases from a hypervascular primary tumor such as renal cancer show intense enhancement during the arterial phase of dynamic contrast imaging. If small, they appear homogeneous; if large, internal heterogeneity with necrotic areas is found. Metastases from the colon mimic pancreatic adenocarcinoma.

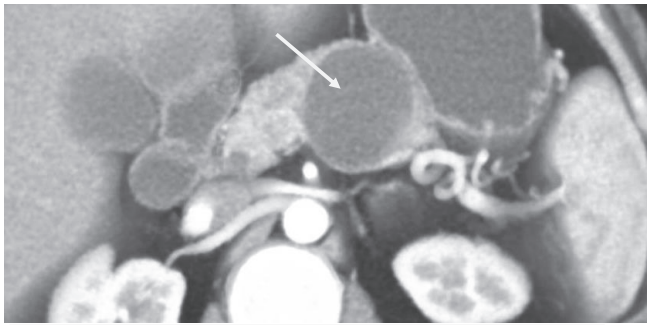


Image 2. Mucinous Cystadenoma in Pancreas (MCN).
Image Features
Straight arrow-Well defined enhancing lesion with a smooth contour.

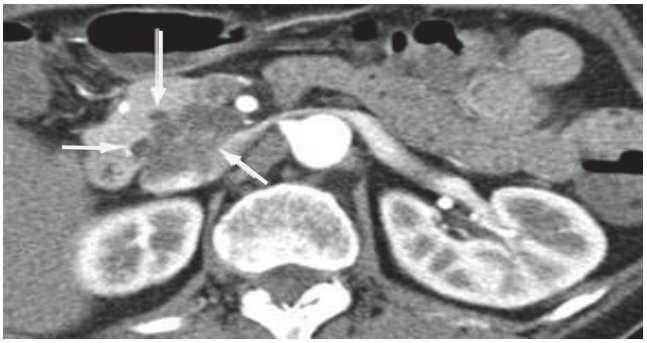


Image 3. IPMN in pancreatic head.
Image Features
Straight arrow-Well defined enhancing lesion multilocular lesion.

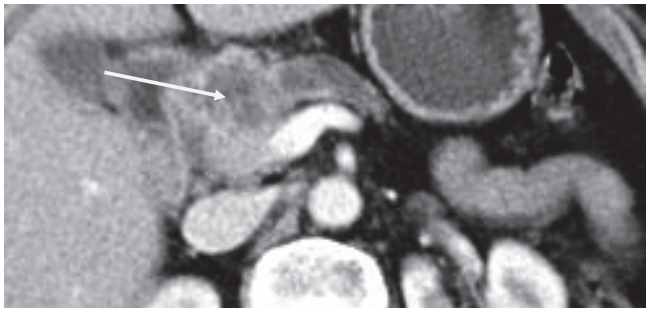


Image 4A. Neuroendocrine Tumor (NET) in arterial phase.
Image Features
Straight arrow-Well defined enhancing lesion in pancreatic head.

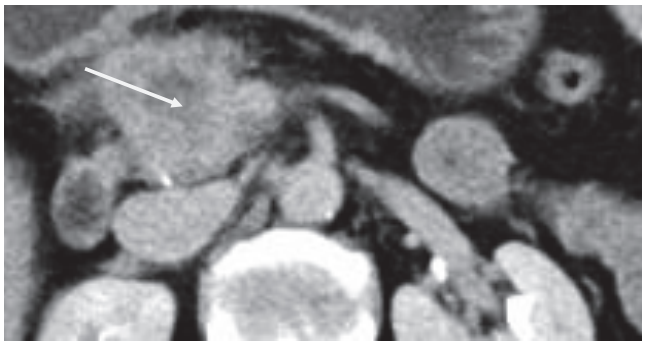


Image 4B. Neuroendocrine Tumor (NET) in venous phase.
Image Features
Straight arrow-Well defined strongly enhancing lesion in pancreatic head.

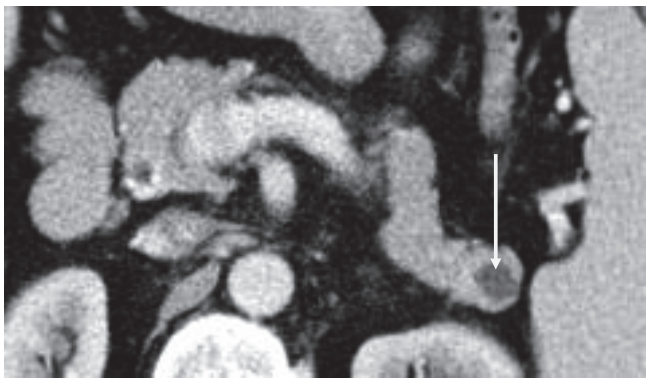


Image 5. Insulinoma in pancreatic tail.
Image Features
Straight arrow-Well defined lesion in pancreatic tail.

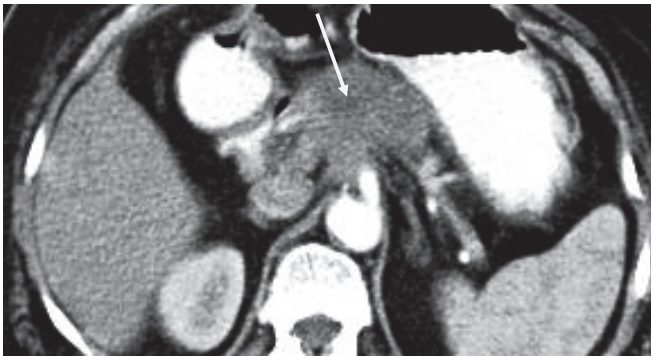


Image 6A. Arterial phase of adenocarcinoma of pancreas.
Image Features
Straight arrow-Ill defined hypo enhancing lesion noted in the head and body of pancreas.

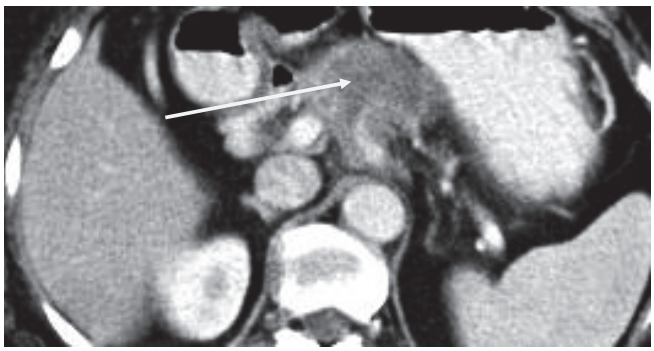


Image 6B. Venous phase of adenocarcinoma of pancreas.
Image Features
Straight arrow-on venous phase the lesion is showing mild enhancement in the head and body of pancreas.

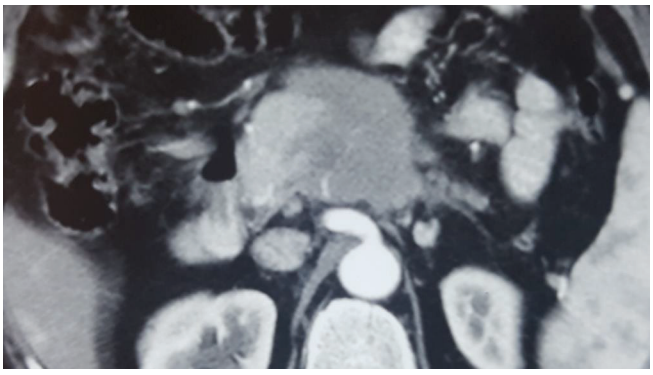


Image 7A. Lymphoma in pancreas.
Image Features
Straight arrow-Ill-defined minimally enhancing lesion in the head and body of pancreas.

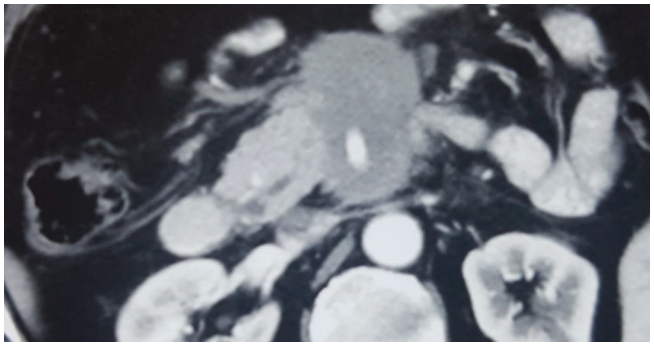


Image 7B. Lymphoma in pancreas.
Image Features
Straight arrow-The lesion is encasing the superior mesenteric artery.

10. Conclusion

- Clinical findings of pancreatic neoplasms overlap, so imaging plays a great role in diagnosis. CT is the imaging modality of choice for evaluation of pancreatic neoplasms and allows better tissue characterisation and anatomical delineation.
- From this study we can conclude that pancreatic neoplasms show characteristic findings on pre and post contrast CT study. Complications of pancreatic neoplasms can be better evaluated by CT which can help in the diagnosis as well as treatment planning.
- Combination of contrast enhanced CT, clinical and laboratory findings add much more information in differentiation and grading of the pancreatic neoplasms non-invasively.

11. Declarations

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Conflict of interest: None declared
Ethical approval: Not required

12. References

1. Jemal A, Siegel R, Xu J, Ward E. Cancer statistics, 2010. CA Cancer J Clin 2010; 60: 277–300. https://doi.org/10.3322/caac.20073.
2. Miura F, Takada T, Amano H, Yoshida M, Furui S, Takeshita K. Diagnosis of pancreatic cancer. HPB (Oxford) 2006; 8: 337–42. https://doi.org/10.1080/13651820500540949.

3. Williford ME, Foster Jr WL, Halvorsen RA, Thompson WM. Pancreatic pseudocyst: comparative evaluation by sonography and computed tomography. Am J Roentgenol;. 1983; 140(1): 53–57. https://doi.org/10.2214/ajr.140.1.53.
4. Yamada T, Alpers DH, Kountz WB, et al: Textbook of Gastroenterology, Philadelphia, Lippincott William & Wilkins, 2003.
5. From Edge S et al (eds): AJCC cancer staging manual,ed 7, New York, 2010, Springer-Verlag.
6. Gangi S, Fletcher JG, Nathan MA, et al: Time interval between abnormalities seen on CT and the clinical diagnosis of pancreatic cancer: Retrospective review of CT scans obtained before diagnosis. AJR Am J Roentgenol 2004; 182: 897–903. https://doi.org/10.2214/ajr.182.4.1820897.
7. ChiouYY, Chiang JH, Hwang JI, et al: Acinar cell carcinoma of the pancreas: Clinical and computed tomography manifestations. J Comput Assist Tomogr 2004; 28: 180–186. https://doi.org/10.1097/00004728-200403000-00005.
8. Nayer H, Weir EG, Sheth S, Ali SZ: Primary pancreatic lymphomas: A cytopathologic analysis of a rare malignancy. Cancer 2004; 102: 315–321. https://doi.org/10.1002/cncr.20488.
9. Sarr MG, Murr M, SmyrkTC, et al: Primary cystic neoplasms of the pancreas: Neoplastic disorders of emerging importance—current state-of-the-art and unanswered questions. J GastrointestSurg 2003; 7: 417–428. https://doi.org/10.1016/S1091-255X(02)00163-4.
10. Curry CA, Eng J, Horton KM, et al: CT of primary cystic pancreatic neoplasms: Can CT be used for patient triage and treatment?.AJR Am J Roentgenol 2000; 175: 99–103. https://doi.org/10.2214/ajr.175.1.1750099.
11. Kloppel G, Solcia E, Longnecker DS, et al: Histological typing of tumours of the exocrine pancreas: In World Health Organization International Histological Classification of Tumours, 2nd ed. New York, Springer-Verlag, 1998.
12. Tanaka M: Intraductal papillary mucinous neoplasm of the pancreas: Diagnosis and treatment. Pancreas 2004; 28: 282–288. https://doi.org/10.1097/00006676-200404000-00013
13. Kehagias D, Smyrniotis V, Gouliamos A, Vlahos L: Cystic pancreatic neoplasms: Computed tomography and magnetic resonance imaging findings. Int J Pancreatol 2000; 28: 223–230. https://doi.org/10.1385/IJGC:28:3:223.
14. Paal E, Thompson LD, Heffess CS: A clinicopathologic and immunohistochemical study of ten pancreatic lymphangiomas and a review of the literature. Cancer 1998; 82: 2150–2158. https://doi.org/10.1002/(SICI)1097-0142(19980601)82:11<2150::AID-CNCR9>3.0.CO;2-Z.

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