International Journal of Science and Research (IJSR)
ISSN: 2319-7064
Impact Factor 2024: 7.101

Role of CT in the Workup of Patients with Pancreatic Mass Lesions

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Abstract: ***Pancreatic lesions are increasingly identified serendipitously during cross-sectional imaging, particularly computed tomography (CT), performed for indications unrelated to suspected pancreatic disease. This rising detection rate is attributed to the widespread application of non-invasive, high-resolution imaging techniques. While many pancreatic lesions are clinically silent, a subset may represent significant pathologies, ranging from benign cysts and inflammatory processes to potentially malignant or pre-malignant conditions like pancreatic adenocarcinoma, neuroendocrine tumors, or various cystic neoplasms. The imperative to characterize these incidentally discovered pancreatic lesions on imaging is paramount, enabling appropriate further evaluation and timely management. Early detection and accurate characterization on CT can prevent misdiagnosis of related symptoms, such as unexplained weight loss or new-onset diabetes, which might otherwise be attributed to other common conditions, leading to delayed or inappropriate treatment.***

Keywords: Pancreas, benign, malignant, computed tomography, pancreatic adenocarcinoma, neuroendocrine tumor, intraductal papillary mucinous neoplasm

1. Introduction

The pancreas, an organ historically recognized yet challenging to evaluate, plays a critical role in human physiology. Despite its historical depiction as early as the Talmud, comprehensive anatomical understanding and functional studies emerged much later. Today, pancreatic masses present significant clinical challenges, often leading to high morbidity and mortality due to their insidious presentation and aggressive nature. Pancreatic carcinoma, for instance, remains a formidable "silent killer," ranking as the fourth leading cause of cancer death globally with a dismal 5-year survival rate of just 4%. The majority of these tumors are diagnosed late, with approximately 85% unresectable at presentation, underscoring the critical need for early detection.

While various imaging modalities, including ultrasonography (USG), endoscopic ultrasound (EUS), and magnetic resonance imaging (MRI), offer valuable insights, Contrast-Enhanced Multidetector Computed Tomography (MDCT) currently stands as the gold standard for evaluating pancreatic pathologies. Its affordability, speed, wide availability, and ability to maximize attenuation differences between neoplastic tissue and normal parenchyma make it an exceptionally effective tool. MDCT not only facilitates accurate diagnosis and staging but also provides crucial information regarding local resectability, thereby playing a pivotal role in guiding the management of pancreatic masses.

This publication aims to delve into the CT characteristics of various pancreatic lesions, emphasizing their detection, differentiation, and impact on patient care.

2. Justification of the Study

1) Primary Modality for Characterization: CT stands as the modality of choice for the comprehensive characterization of pancreatic lesions. Its rapid acquisition, excellent spatial resolution, and ability to visualize the entire gland and surrounding structures make it unparalleled for initial assessment.
2) Differentiation of Benign vs. Malignant Lesions: CT, utilizing non-enhanced, multi-phasic contrast-enhanced, and delayed scans, provides invaluable attenuation measurements and enhancement patterns. These features are often distinctive enough to differentiate a wide spectrum of pancreatic pathologies, including inflammatory conditions (e.g., pancreatitis, pseudocysts), benign tumors (e.g., serous cystadenomas, IPMNs), and critically, malignant neoplasms (e.g., pancreatic adenocarcinoma, neuroendocrine tumors).
3) Obviating Further Unnecessary Interventions: The detailed characterization afforded by CT, encompassing lesion morphology, internal architecture (e.g., presence of calcifications, septations, fat), vascularity, and relationship to adjacent structures, frequently allows for a confident diagnosis.

4) Comprehensive Categorization & Staging: CT accurately categorizes specific lesion types and is vital for precise staging of malignancies, guiding resectability assessment and treatment planning.
5) Impact on Clinical Management and Preventing Misdiagnosis: Early and accurate CT characterization prevents diagnostic delays and misdiagnosis, ensuring appropriate, targeted management for pancreatic conditions that might otherwise be overlooked.

3. Material and Methods

This retrospective prospective study was conducted from August 2023 to October 2024 in the Department of Radiodiagnosis and Imaging, Department of Radiology,

Pandit Deendayal Upadhyay Government Medical College & Civil hospital, Rajkot, Gujarat, India. This study was approved by the institutional ethics committee. A total of 82 patients were assessed in the study.

Inclusion Criteria
- Any patient undergoing CT abdomen and/or thorax without symptoms and signs denoting pancreatic pathology.
- Patients able to cooperate for the examination.

Exclusion criteria
- Any patient with signs and symptoms denoting pancreatic pathology or a patient with a known adrenal mass.
- Patients who are unwilling to cooperate for the procedure.

All the patients fulfilling selection criteria were explained about the purpose of study and a written informed consent was obtained to participate in the study before enrolment (Annexure I).

Data Collection
Thorough clinical history and clinical examination were done before CT scan. Details of the participants like age, sex, detailed history, were obtained and recorded on predesigned and pretested proforma (Annexure-II).

Preparation of Patients
After detailed explanation regarding the imaging procedure, a written informed consent was obtained from the patients prior to the scan, following which a detailed clinical history was taken and relevant clinical examination was done.

Scan Protocol for multi-detector row CT
CT imaging was performed using 128-slice single source CT scanner (CT Wipro GE 128 slice H-211) in all patients.

Axial plain sections of the thorax or abdomen (depending on what was asked for from the referring consultant) were taken using 5.0 mm sections and multiplanar reconstruction was done in 1.5 mm slice thickness.

The examination area extended from the lower chest to the iliac crest in CT abdomen; covering the entire pancreas, peripancreatic fat, and surrounding vascular structures. Oral contrast (water, 500-1000ml) was administered 30-60 minutes prior to enhance duodenal visualization.

Plain study was followed by i.v. contrast study using non-ionic water-soluble contrast medium, such as Iomeron 350 mg%, at a dose of 1 ml/kg body weight, injected at 3-5 ml/sec with a saline chaser.

Images were taken in pancreatic parenchymal (late arterial) and portal venous phases. Pancreatic phase scans were acquired at 35-45 seconds, optimized by bolus tracking in the aorta. Portal venous phase scans were acquired at 60-70 seconds from the start of contrast bolus. Delayed scans at 3-5 minutes were selectively performed when indicated for specific lesion characterization or washout assessment.

For all pancreatic lesions detected at CT (regardless of phase whether plain, enhanced or delayed), the attenuation was measured by using circular-region of interest (ROI) placed over the most enhancing viable portion of the lesion. The ROI circle was made as large as possible, avoiding cystic, necrotic, or calcified components and lesion edges to preclude partial volume effects.

Necrosis was defined as a region (within the lesion or parenchyma) with absent or significantly diminished enhancement (attenuation <30 HU) on contrast-enhanced CT, typically best visualized in the pancreatic phase. Calcification was defined as a region with an attenuation value > 100 HU at non-enhanced CT. Scans were reviewed in appropriate window settings, with multiplanar reconstructions.

4. Results

This study including 50 Patients with pancreatic pathology (except acute pancreatitis) was carried out in large tertiary care teaching hospital with large catchment area. This study included patients with history of abdominal complaints referred from surgery department.

Table 1: Gender Distribution

Gender of the Patient	Number of Patients	Percentage
Male	27	54%
Female	23	46%
Total	50	100

Most of the pancreatic tumors were seen in 60-69 years age group and 50-59 years age group. Mean age for male patients was higher than female patients. In our study, we observe that a greater number of male patients had pancreatic mass lesions than female patients.

Table 2: Location of Pancreatic Mass Lesions

Region	Number of patients	Percentage
Head	15	30%
Uncinate Process	1	2%
Body	8	16%
Tail	2	4%
Head and Uncinate process	9	18%
Body and Tail region	14	28%
Uncinate process and Body	1	2%
Total	50	100%

Most of the lesions were seen in head region of pancreas followed by body and tail region. In our study, we observe

that a greater number of pancreatic mass lesion were located in pancreatic head region than any other specific location.

Table 3: Symptoms Distribution

Symptoms	Number of patients	Percentage
Abdominal Distention	22	44%
Vomiting	18	36%
Abdominal Pain	43	86%
Jaundice	26	52%
Loss of appetite / weight	34	68%

Out of the 50 patients, most common clinical feature of pancreatic mass lesion was abdominal pain, followed by loss of appetite and weight. In our study, we observe that pancreatic mass lesion most commonly present with abdominal pain.

Many of patients with pancreatic mass lesion had personal history of alcoholism and smoking and disease history of diabetes mellitus. In our study, we observe that there is strong correlation between personal history of smoking and alcoholism & occurrence of pancreatic mass lesion.

Table 4: Density of Lesions on Non-Contrast CT Scan

Density	Number of Patients	Percentage
Isodense	8	16%
Hypodense	24	48%
Fluid Density	7	14%
Soft Tissue Density	11	22%

Out of the 50 patients, most common CT feature of pancreatic mass lesions was hypodense lesion which shows characteristic post contrast phase enhancement. In our study, we observe that most characteristic CT appearance of pancreatic mass lesion is hypodensity followed by characteristic post contrast phase enhancement.

Table 5: Spectrum of Pancreatic Mass Lesions

Histopathological Type	Number of Patients	Percentage
Adenocarcinoma	25	50%
Mucinous neoplasm	5	10%
Neuroendocrine Tumour	2	4%
Sarcomatoid Tumour	1	2%
Solid pseudopapillary epithelial neoplasm.	1	2%
Serous Cystadenoma Of Pancreas	1	2%
Mass forming chronic pancreatitis	2	4%
Metastasis	2	4%

Out of the 50 patients, ductal adenocarcinoma was the most common histopathological type of pancreatic mass lesion, followed by mucinous neoplasm, neuroendocrine tumor, metastasis, mass forming chronic pancreatitis. Less common histopathological type of the lesion was sarcomatoid tumour, solid pseudopapillary epithelial neoplasm, serous cystadenoma of pancreas.

Table 6: Complication of Pancreatic Mass Lesions

Complications	Number of Patients	Percentage
Vascular	22	44%
Lymph Nodal Metastasis	43	86%
Liver Metastasis	19	38%
Lung Metastasis	10	20%
Adrenal Metastasis	4	8%
Peripancreatic Inflammation	15	30%
Ascites + Pleural Effusion	11	22%

Out of the 50 patients, most of the pancreatic mass lesions showed characteristic complication of regional as well as distant metastatic lymphadenopathy followed by arterial or vascular complications. Other common complication of the lesions was liver metastasis followed by peripancreatic inflammation, ascites and pleural effusion, lung metastasis & adrenal metastasis.

5. Discussion

Multidetector CT is the most efficient noninvasive technique in the assessment of pancreatic cancer. It allows excellent visualization of the pancreatic cancer during the different stages of contrast enhancement, thereby facilitates detection of small pancreatic lesions and evaluation of peripancreatic structures.

Current study was an endeavor to evaluate the role of MDCT in the evaluation of different pancreatic mass lesions. It was conducted among 50 patients of suspected pancreatic mass lesion. All of them underwent CT scan for their current pathology and subsequently histopathology was performed in most of the patient. Histopathology report was used as a foundation for confirming the actual diagnosis of patients and was used as a gold standard for comparing the procedure.

In this study, pancreatic lesions were more common in males 54% than females 46%, this is in agreement with Jemal et al. (56) who stated that pancreatic neoplasm is greater in men than in women.

The age group mostly affected by pancreatic mass lesions in this study was 60-69 years. Jemal et al. (56) found that those aged 60-80 years are the most affected group with pancreatic neoplasm and uncommon in those younger than 40 years. In this study, the commonest age group among the patients was 60-69 years (34%) followed by 50-59 years age group (30%) patients.

Becher and Stommer (57) reported that 60% of pancreatic tumors occupied the head of pancreas, 10% the body, 5% the tail and the remaining 25% were diffusely involved. In the current study, 50% of tumors occupied the head & uncinate process of the pancreas, 16% involved the body, 4% involved the tail and 30% diffusely involved the organ.

Cancer.org (58) reported that pancreatic tumors commonly presented with jaundice and related symptoms, belly or back pain, weight loss and poor appetite, nausea and vomiting, gallbladder or liver enlargement and diabetes. In the current study, the most of the patients 43 (86%) were presented with abdominal pain followed by 34 (68%) patients with loss of appetite/weight.

Samir Gupta, Furong Wang, Elizabeth A. Holly, Paige M. Bracci et al. (59) reported that an association between heavy alcohol consumption and pancreatic cancer among men that may be mediated by dose, duration, and pattern of alcohol consumption, including binge drinking.

Stephen J. Pandol, 1 Minoti V. Apte, 2 Jeremy S. Wilson, 2 Anna S.Gukovskaya, 1 and Mouad Edderkaouil et al. (60) reported that smoking is a factor that promotes pancreatic cancer rather than initiates it.

Everhart et al. (61) concluded that pancreatic cancer could be added to the list of complications of diabetes.

In the current study, personal history of smoking was found in 23 patients (46%) of pancreatic mass lesions whereas personal history of alcoholism was found in 29 patients (58%). Disease history of diabetes mellitus was seen in 18 patients (36%) of pancreatic mass lesions.

Gavin Low et al. reported that solid lesions of the pancreas can have a broad spectrum of neoplastic and nonneoplastic causes. Accurate diagnosis can be challenging, and a multimodality imaging approach is often helpful. Knowledge of relevant clinical information and key radiologic features is essential for confident lesion characterization and differentiation.

In current study, 28 patients (56%) had malignant lesions whereas 11 patients (22%) had benign lesions. Out of 28 malignant cases, 25 (50%) had adenocarcinoma type of pancreas, 2 (4%) had carcinoma with metastasis and 1 (2%) patients had sarcomatoid type of malignancy. Out of 11 benign lesions, 5 (10%) patients had cystic mucinous neoplasm, 2 (4%) had inflammatory mass, 1 (2%) had serous cystadenoma, 1 (2%) had solid papillary epithelial neoplasm and 2 (4%) patient had neuroendocrine tumour.

In the current study, 22 patients (44%) of pancreatic mass lesions had vascular complications. Lu et al (62) proposed a CT-based grading system for determining vascular involvement by pancreatic carcinoma. The authors prospectively graded vascular involvement using the pancreatic phase. A scale of 0 to 4 was used based on the degree of circumferential contiguity of tumor to vessel, where 0 was no contiguity and 4 was >75% contiguity. These criteria were applied to both arteries and veins and it was found that if >50% of the vessel circumference (grades 3 and 4) was in contact with tumor, then there was a high likelihood of the tumor being unresectable. A sensitivity of 84% and a specificity of 98% were found for determining tumor resectability based on vascular involvement.

The use of MDCT improves the resolution of sagittal and coronal multiplanar reformatted images and allows for improved detection of changes in vessel caliber. Diehl et al (63) reported that helical CT with dual-phase imaging was able to detect vascular invasion in 35 of 40 (88%) patients with pancreatic adenocarcinoma and a negative-predictive value of 79% for determining nonresectability. Raptopoulos et al (64) obtained CT angiograms in 82 patients and found that CTA improved the accuracy of diagnosing unresectable pancreatic carcinoma. The addition of CTA to conventional axial helical CT resulted in a negative-predictive value for determining tumor resectability of 96% compared with 70% for conventional axial helical CT alone. Vargas et al (65) evaluated the resectability of pancreatic carcinoma using MDCT and found an overall negative-predictive value of 87%. The negative predicative value for detecting vascular invasion with the use of curved planar reformats was 100%.

The lymphatic drainage of the pancreas is primarily to the pancreaticosplenic nodes that accompany the splenic artery. Some drainage also occurs to the pancreaticoduodenal nodes and the superior mesenteric preaortic nodes. The main criterion used to assess tumor metastases to lymph nodes is nodal enlargement. However, all enlarged nodes do not necessarily contain tumor, and all normal-sized nodes may not necessarily be free of tumor. Zeman et al (66) found nodal staging accuracy to be only 58% when evaluating TNM staging of pancreatic carcinoma using helical CT. Muller et al (67) found a sensitivity and specificity of only 22% and 57%, respectively, for the detection of nodes involved by pancreatic cancer. A study by Diehl et al (68) showed that nodal involvement was detected in only 54% of cases, but the overall accuracy of CT for staging pancreatic cancer remained high at 91%. The accuracy of readers in determining resectable versus unresectable disease was much higher at 96% and 84%, respectively. Regional lymph nodes are typically resected at surgery; hence, nodal enlargement is not considered a contraindication to surgery if there are no other signs of advanced disease. In current study, significant number of patients, 43 (86%) patients with pancreatic mass lesion had either regional or distant lymphadenopathy.

J Magn Reson Imaging et al. (69) revealed that hepatic metastases from pancreatic adenocarcinoma show a range of enhancement patterns. Hypervascular metastases are not rare. Capsular based distribution, small diameter, and perilesional enhancement are common features. In current study, 19 patients (38%) with pancreatic mass lesions showed characteristic enhancing liver metastatic lesions.

6. Conclusion

Findings of this study support that the excellent soft tissue resolution, better evaluation of peripancreatic fat plane disruption or fascial plane thickening and extension or invasion of growth proved CT scan may be a useful tool for assessing and characterization of pancreatic mass lesions.

The introduction of MDCT and postprocessing techniques with 3D manipulation of the data set have greatly improved imaging of the pancreas. These advances should further facilitate early detection of small pancreatic lesions and are likely to impact the treatment of pancreatic tumors, especially pancreatic adenocarcinoma. The use of multiplanar reformatted images and 3D representation of the vascular structures helps in accurate staging of pancreatic tumors and aids in successful surgical resection.

Contrast enhanced CT Scan is also helpful to separate tumor tissue from normal enhancing pancreatic parenchyma.

Contrast enhanced CT Scan is more helpful than unenhanced scan in diagnosing and defining tumor extent and in differentiating solid tumor component and cyst.

Multidetector CT scan is also helpful for better detection of small amount of calcification.

Hypodense non-enhancing or poorly enhancing mass on CT that is poorly marginated, which may encase vessels and the common biliary duct favors ductal adenocarcinoma.

Large uni/multilocular cystic pancreatic neoplasm, communicating with the main pancreatic duct, favors mucinous cystic neoplasm.

Large/small well circumscribed, hypervascular tumour with cystic degeneration, necrosis and calcification, favors neuroendocrine tumor.

Multicystic, lobulated mass a characteristic enhancing central scar may be present which can show associated stellate calcification, favors serous cystadenoma of pancreas.

Well circumscribed mass which is iso to hypodense relative to normal pancreas on non-contrast scans. Enhancement is usually present and heterogeneous, but tends to be homogeneous in smaller lesions, and peripheral in larger lesions. This finding favors metastatic lesion of pancreas.

References

[1] Modlin, I.M., Champaneria, M.C., Chan, A.C.K. et al. The history of the pancreas, in: H.G. Berger, A.L. Warshaw, M.W. Büchler, (Eds.) The Pancreas: An Integrated Textbook of Basic Science, Medicine, and Surgery. 2nd ed. Blackwell Publishing Limited, Hoboken, NJ; 2008: 9-41.

[2] Howard, J.M. and Hess, W. History of the Pancreas: Mysteries of a Hidden Organ. Kluwer Academic, New York; 2002.

[3] Sainani N, Catalino O, Sahani D. Pancreas. In: Haage JR, Dogra VS, eds. CT and MRI of whole body. Philadelphia: ELSEVIER Mobsy, 2003: 1655-59.

[4] Adam EJ, Morgan R. The pancreas. In: Grainger RG, Allison D, Adam A, Dixon AR, eds. Textbook of Radiology. London: Churchill Livingstone, 2008: 1343-66.

[5] Brennan C, Curry CA, Eng J, Horton KM, Falconi M, Vamentini V, et al. Comprehensive preoperative assessment of pancreatic adenocarcinoma with 64-section volumetric CT. RG 2007; 27: 1653-68.

[6] Chaudary V, Bano S. Imaging of the pancreas Endo and Met 2011; 15: 25-32. recent advances. Ind J of.

[7] Wallner BK, Schumacher KA, Weidenmaier W et al. Dilated biliary tract: evaluation with MR cholangiography with a T2-weighted contrast-enhanced fast sequence. Radiology 1991; 181:805-808.

[8] Ahmet Mesrur Halefoglu et al. Magnetic resonance cholangiopancreatography: A useful tool in the evaluation of pancreatic and biliary disorders. World J Gastroenterol 2007; 13(18):2529-2534.

[9] Caroline Reinhold, Patrice M. Bret, Laurent Guibaud et al. MF cholangiopancreatography: Potential and clinical applications Radiographics 1996; 16:309-320.

[10] AJR Am J Roentgenol. 2015 Jan; 204(1): W37-W42: Impact of the Time Interval Between MDCT Imaging and Surgery on the Accuracy of Identifying Metastatic Disease in Patients With Pancreatic Cancer.

[11] Korean J Radiol. 2016 Jul-Aug;17(4):509-521. English: Comparison of Multidetector CT and Gadobutrol-Enhanced MR Imaging for Evaluation of Small, Solid Pancreatic Lesions.

[12] EUROPIAN COLLEGE OF RADIOLOGY 10.1594/ecr2017/C-1247.

[13] Boland GW, O'Malley ME, Saez M, Fernandez-del-Castillo C, Warshaw AL, Mueller PR, AJR Am J Roentgenol. 1999 Mar; 172(3):605-8.

[14] Lampropoulos P, Filippous G, Skafida E, Vasilakaki T. pancreas, a rare tumor entity: a case report. Cases J 2009; 2:9129.

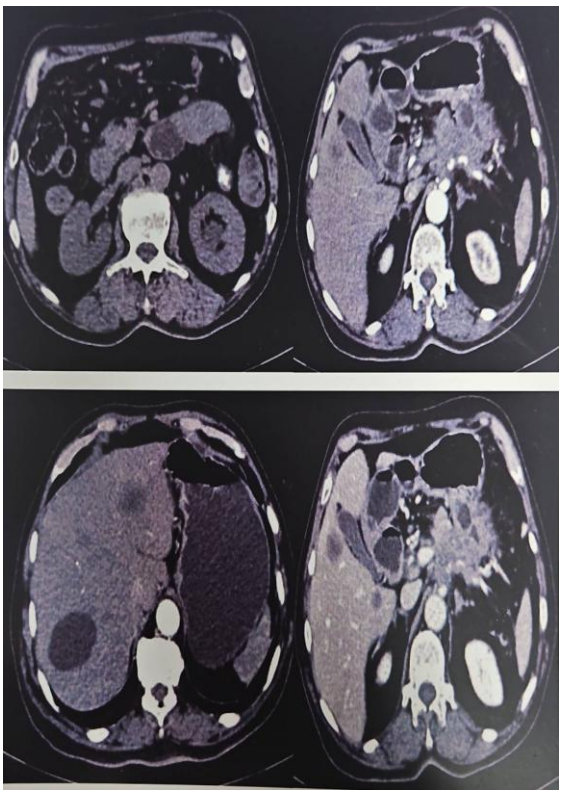
[15] AJR 2005; 184:511-519, 0361-803X/05/1842-511, CT and MRI Features of Pure Acinar Cell Carcinoma of the Pancreas in Adults.

[16] http://dx.doi.org/10.1155/2010/627360: Pleomorphic Giant Cell Carcinoma of the Pancreas with Hepatic Metastases.

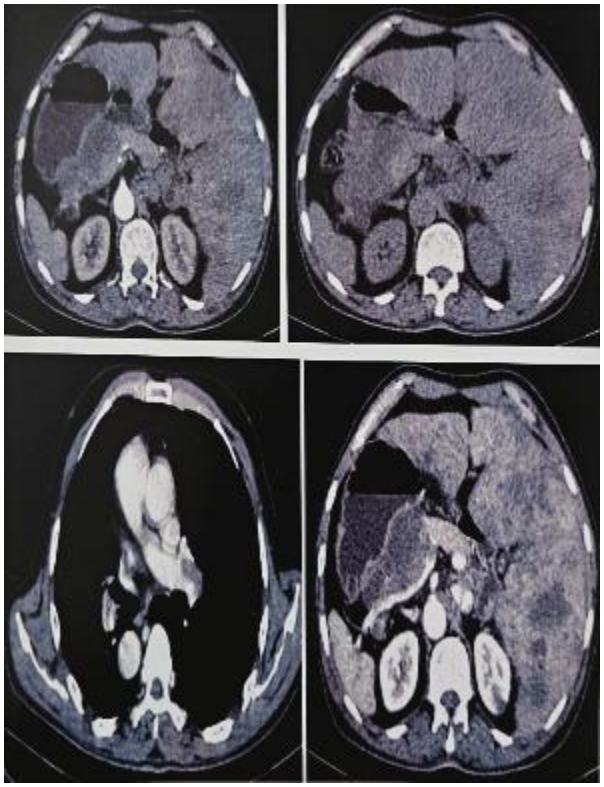
[17] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3299603 Primary small cell carcinoma of the pancreas: rare type of pancreatic cancer.

[18] American Journal of Roentgenology. 2009;193: W308-W313. 10.2214/AJR.09.2347: Colloid Carcinoma: A case report.

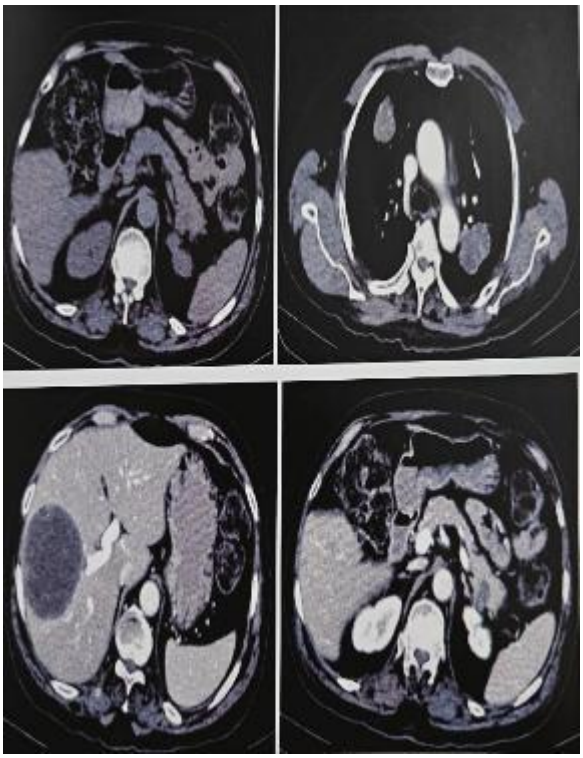
[19] American Journal of Roentgenology. 2000;174: 671-675. 10.2214/ajr.174.3.1740671



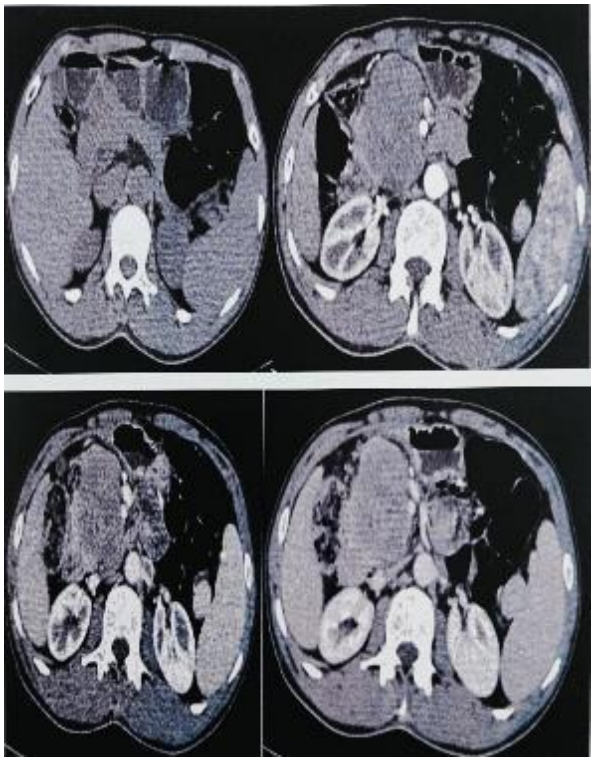
Case 1: Carcinoma of Pancreas with Liver Metastasis



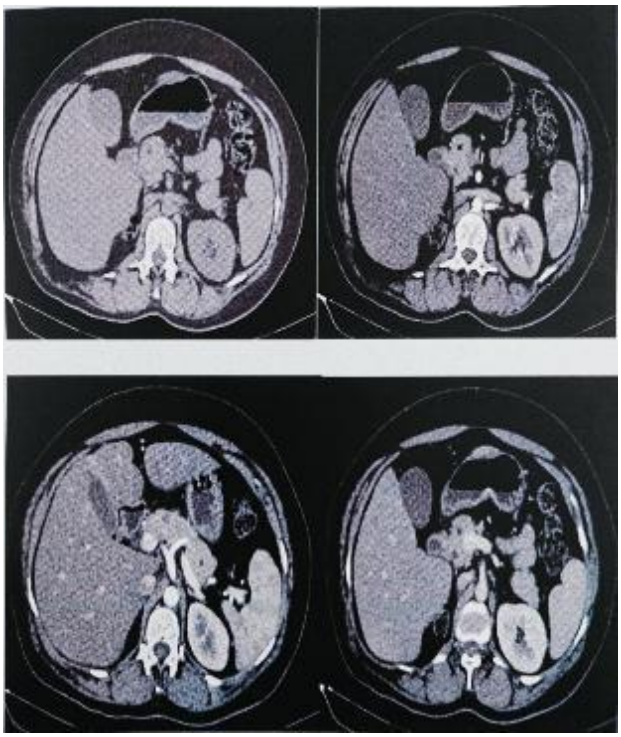
Case 2: Carcinoma of Pancreas with Lung and Liver Metastasis



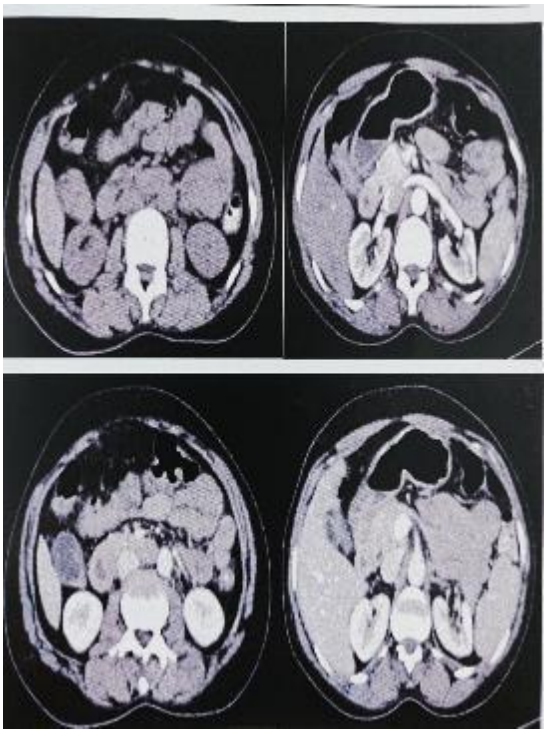
Case 3: Carcinoma of Pancreas with Liver Metastasis, Metastatic Lymphadenopathy and Pulmonary Thromoembolism



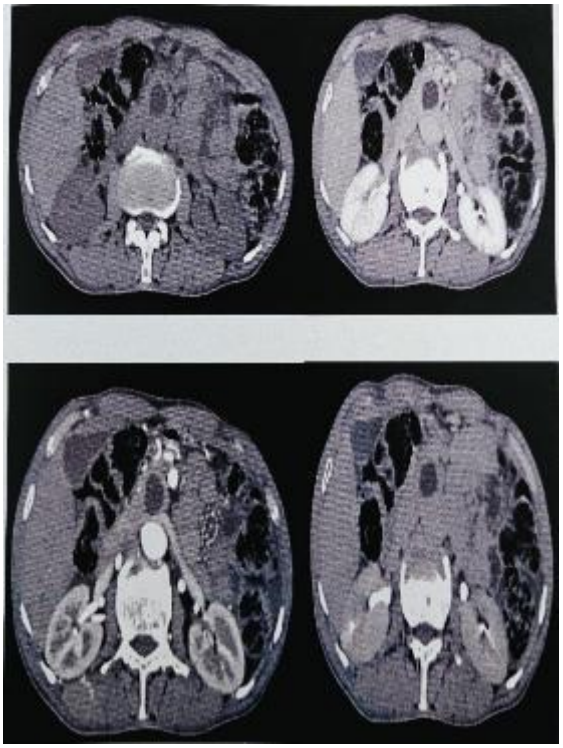
Case 4: Carcinoma of Pancreas with Peritoneal Ddeposits



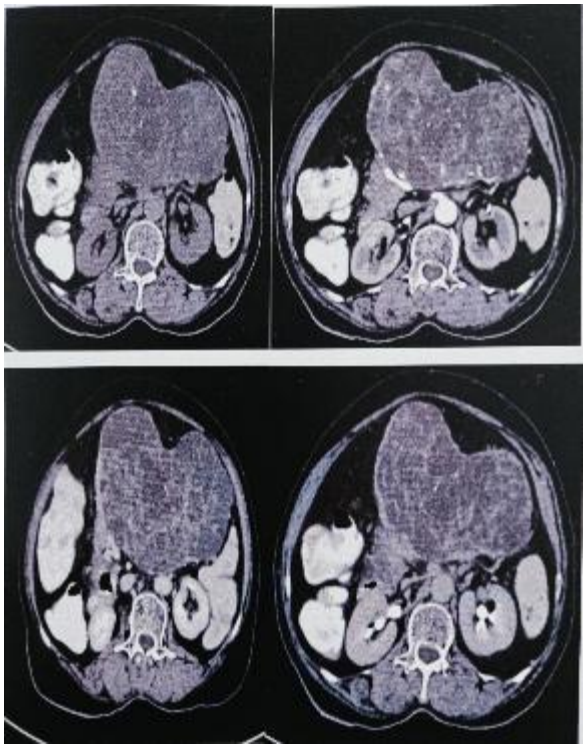
Case 5: Mucinous Cystadenoma of Pancreas



Case 6: Sarcomatoid Pancreatic Cancer



Case 8: Intraductal Papillary Mucinous Neoplasm



Case 7: Serous Cystadenoma of Pancreas