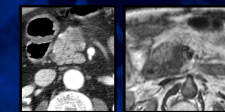


Early Pancreatic Cancers: Pearls, Pitfalls and Mimics

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PURPOSE

To display a spectrum of early and atypical presentations of adenocarcinoma of the pancreas, in addition to imaging pitfalls and mimics, in a case-based presentation and review.

BACKGROUND

Pancreatic cancer is the 2nd most common malignant tumor of the GI tract, and is the fifth leading cause of cancer death, with a median survival of 4–6 months. Surgical resection is the only chance for cure, with small tumor size being associated with long term survival. Early and small pancreatic cancers may present with subtle or atypical findings, which if unrecognized, will delay diagnosis. Conversely, several diseases are often erroneously confused with pancreatic cancer.

Imaging Technique

CT

- Biphase technique
 - Pancreatic phase – 45 sec after injection or 20 seconds after aortic peak
 - Hepatic phase – 65 sec after injection or 40 seconds after aortic peak

- Slice thickness ≤ 3mm
- Multiphase 2D review with 3D problem-solving

MR

- Axial and coronal SSFSE/HASTE/FIESTA to image the pancreatic and common bile duct
- T1w GRE imaging w/o and with FS
- Dynamic Gd-enhanced LAVA / VIBE

Typical Findings of Pancreatic Adenocarcinoma

- Mass
 - attenuation difference (usually hypo-attenuating compared to the gland)
 - disruption of fatty marbling
- Pancreatic ductal dilation and cutoff
- Double duct sign (obstruction of common bile and pancreatic duct)
- Atrophy of gland upstream to tumor
- Signs of locally advanced or distant disease
- Any combination of these findings

Overview and Test Cases

Atypical Findings of Pancreatic Cancer

- Isoattenuating mass
- Exophytic tumors
- Perineural and perivascular infiltration without mass
- Diffusely infiltrating tumors
- Cystic change

Pitfalls in Tumor Detection

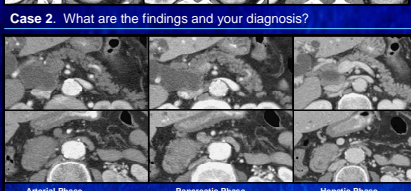
- Sub-optimal scanning
- Pancreatitis (acute or chronic)
- Occult neoplasms
- Presence of a stent

Pancreatic Cancer Mimics

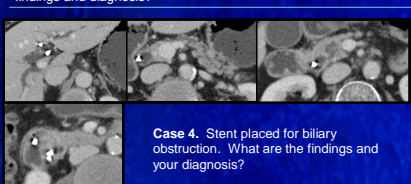
- Autoimmune pancreatitis
- Chronic pancreatitis
- Metastases
- Neoplasms that mimic pancreatic cancer
- Intrapancreatic splenule
- Focal fat



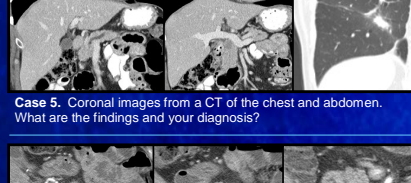
Case 1. Patient with symptomatic pancreatitis. CT and MR imaging are available. What are the findings and diagnosis?



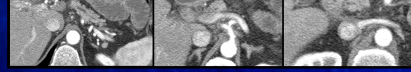
Case 2. What are the findings and your diagnosis?



Case 3. 85 year-old female with breast cancer. What are the findings and diagnosis?



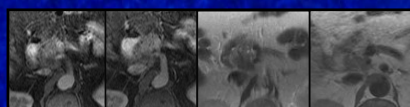
Case 4. Stent placed for biliary obstruction. What are the findings and your diagnosis?



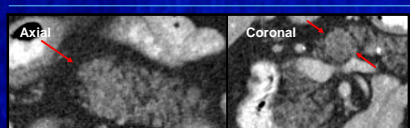
Case 5. Coronal images from a CT of the chest and abdomen. What are the findings and your diagnosis?



Case 6. What are the findings and your diagnosis?



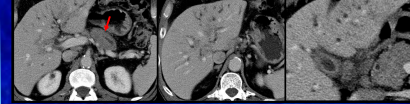
Case 7. What are the findings and diagnosis?



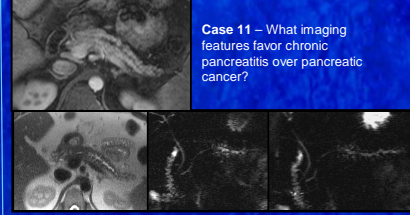
Case 8 – What is your differential? What is the next step?



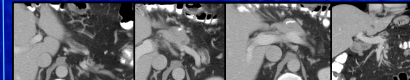
Case 9 – CT enterography performed for abdominal pain. What are the findings and diagnosis?



Case 10 – Known pancreatic ductal stricture (arrow). What is your diagnosis?



Case 11 – What imaging features favor chronic pancreatitis over pancreatic cancer?



Case 12 - What are the findings and diagnosis?

Atypical Findings

Isoattenuating Mass. Despite multiphase, thin section CT, approximately 10% of pancreatic adenocarcinomas are isoattenuating. In such instances secondary signs such as pancreatic duct dilation and cutoff, loss of fatty marbling, contour abnormality or atrophic distal pancreatic parenchyma must be relied upon to visualize the mass. Similarly, some pancreatic carcinomas may demonstrate isointense signal at MR. Case on the right with A2 cm pancreatic head carcinoma. CT (pancreatic phase right images) and MR post contrast LAVA (left images) show an isoattenuating and isoattenuating mass. Secondary signs of tumor include obstruction of the CBD (as evidenced by septal placement) and pancreatic duct (arrow).

Exophytic tumors. Exophytic tumors also account for a large number of missed pancreatic cancers. These tumors arise peripherally in the gland and do not cause typical bile duct or pancreatic duct obstruction or atrophy of the distal pancreas. Case on A shows a low attenuation rounded mass in the uncinate that was missed at initial review (A1) with A2 demonstrating growth of the mass with subsequent post-contrast and SMA invasion when the patient became symptomatic 3 months later. The pancreatic process should retain a sharp angulated margin. Case B shows a cancer arising exophytically off the pancreatic head posteriorly, while case C shows an exophytic cancer arising exophytically in the pancreatobodily groove. Differential will include groove pancreatitis (see Mimics).

Perineural and perivascular infiltration without mass. Tumor extension along the neural plexus is common. In one study, it was seen in 81% of patients of the pancreatic head. Neural plexus invasion can be recognized by soft tissue thickening or standing around the inferior pancreatoduodenal artery, SMA or celiac artery. While an associated pancreatic mass is usually seen, isolated abnormal soft tissue around these vascular structures should alert one of the possibility of an underlying pancreatic malignancy which may be isodense in some cases.

Diffusely infiltrating pancreatic cancers. The normal pattern of growth for pancreatic cancer is invasion of adjacent focal structures. Low attenuation tumor infiltration along the gland can easily be seen (arrow). Diffusely infiltrating pancreatic cancers can mimic other diseases, which can affect the entire gland, such as lymphoma, HP and metastases.

Cystic Masses – High grade and anaplastic pancreatic adenocarcinomas will rarely be cystic in appearance. MR imaging may be helpful, as cystic adenocarcinomas will not exhibit the typical homogeneous small cysts of microcystic serous cystadenomas. These appearances may overlap with cystic neoplasms with malignant potential (e.g., mucinous neoplasms, cystic metastases, cystic liver tumors, etc.).

Pitfalls

Suboptimal scanning. Surveillance imaging of the abdomen is not optimized to visualize the pancreatic duct or measure signal differences between the pancreatic parenchyma and tumors. The sensitivity of CT in detecting pancreatic cancer is related to slice thickness employed. When clinical suspicion for pancreatic neoplasm is high, dedicated biphase CT or MR of the pancreas should be obtained—even in the presence of a recent negative surveillance CT employing thicker slice thicknesses. The top row is from a surveillance CT of the abdomen that was interpreted as negative. In retrospect there is subtle dilation of the pancreatic duct in the tail and body of the pancreas. Dedicated pancreatic imaging was performed one day later (bottom) with thinner slice thickness and biphase CT, and clearly shows pancreatic ductal dilation and cutoff, and presence of a low attenuation mass in the pancreatic head.

Pancreatitis. Approximately 10% of pancreatic cancers are isoattenuating and are typically missed. The sensitivity may decrease. Opacities are due to pancreatic cancer. The sensitivity may decrease. Changes of pancreatitis can mask an underlying pancreatic cancer and distract the radiologist. Contrast enhancement of pancreatitis may mimic the tumor's isodensity. Opacities of pancreatitis may also be seen in the pancreatobodily groove. Case A shows a small Stage I pancreatic cancer (red arrow) with post-contrast pancreatic enhancement (green arrow) that mimics pancreatitis. The finding may be misinterpreted as a focal disease. Case B shows a pancreatic cancer (red arrow) with associated pancreatic body and tail and inflammatory changes in the adjacent pancreatobodily groove. Case C shows a pancreatic cancer (red arrow) with pancreatic head (green arrow) and inflammatory changes in the pancreatobodily groove. Case C shows change of post-contrast pancreatitis. The changes of pancreatitis obscure a subtle isoattenuating tumor (red arrow) in the pancreatobodily groove (green arrow) and cutoff with focal narrowing of the portal vein (green arrow).

Occult Neoplasms. Approximately 5% of pancreatic cancers will be occult at CT or MR despite use of appropriate technique. When clinical suspicion is high, endoscopic ultrasound (EUS) performed with a small and inflatable nozzle.

Common Bile Duct Stent. We believe that presence of a CBD stent may also affect tumor conspicuity by changing perfusational patterns or streak artifacts. When a CBD stent is present, radiologists should proceed in the absence of additional information the CBD obstruction was present prior to stent placement. In the presence of the CBD stent, radiologists should alert the radiologist to the presence of a pancreatic mass, even in the presence of a stent-appearing pancreatic head. This patient had a pancreatic carcinoma.

Discussion

Mimics

Autoimmune Pancreatitis (AIP). Characteristic imaging findings of AIP include diffuse pancreatic enlargement and periductal thickening. Focal enlargement of the pancreas is not uncommon and may be difficult to distinguish from pancreatic cancer. Endopancreatic involvement (focal duct narrowing or enhancement) is always found in AIP. In AIP, there is a diffuse inflammatory process. Inflammatory changes are relatively common and often is a clue to the correct diagnosis. In case A, body and tail of pancreas is segmentally enlarged with cutoff of the first part (A1). The duct wall shows abnormal thickening and enhancement (A2). Two solid renal cortical nodules are also present (A3). In case B, there is a diffuse enlarged pancreatic body. There is a subtle low-attenuation lesion in the center of the kidney (B3). This case is difficult to differentiate from carcinoma.

Mass-forming chronic pancreatitis may present as a low-density, amorphous mass and can be difficult to differentiate from pancreatic cancer. In mass-forming chronic pancreatitis, pancreatic duct can often be seen traversing the mass that represents cystic degeneration. In this case, the pancreatic duct is not included. Evidence of chronic pancreatitis elsewhere in or around pancreas is helpful. Case A shows a low-attenuating mass in the neck of pancreas (A1) mimicking pancreatic carcinoma. Pancreatic duct seen through the pancreatic mass (pancreatic duct) (A2). Contrast CT showed pancreatic calcification (A3) with thick MR MIP (A4). Case B shows a pancreatic mass with calcifications (A5). Case C shows a pancreatic mass with calcifications (A6).

Metastases to the pancreas are rare, occurring in 3-5% of asymptomatic cancer patients being treated for lung, breast, melanoma, GI tract, etc., and can manifest as a solitary mass, diffuse pancreatic enlargement, or multiple masses. The enhancement characteristics of the metastases closely resemble the primary pathology. Steps to rule them out include: large cancer to the pancreas head that resulted in biliary and pancreatic duct obstruction, mimicking a primary pancreatic cancer.

Lymphoma typically presents as a large low-density mass. Findings that may help differentiate lymphoma from carcinoma include large mass size, no ductal dilation, masses arising through the entire B1, lymphadenopathy below the level of the renal veins, normal tumor markers and other masses in other organs (B2).

Groove pancreatitis is focal chronic pancreatitis affecting the pancreatobodily groove. It is characterized by pancreatic duct dilation in the groove (A1), which typically shows delayed enhancement. It commonly results in duodenal stenosis or abrupt stenosis of the CBD. Cyst formation is common (A3). In this case, the pancreas and bile duct are not involved (A2, A3).

Serous cystadenomas are an uncommon benign epithelial tumors on contrast-enhanced study (A1, B1). T2WI can better demonstrate the mucous and cystic components of the neoplasms and aid in differentiating them from carcinoma (A2, B2).

Parapancreatic carcinomas may arise from ampulla, distal bile duct carcinoma, pancreas or duodenal/parapancreatic carcinoma of the small and may be difficult to detect on CT or MR, as it presents early with bile duct obstruction, pancreatic duct dilation, parapancreatic carcinomas. Mass may present predominantly in the duodenal lumen as in this case.

Intrapancreatic splenule appears as a well-circumscribed mass with peripheral and dorsal characteristics similar to those of the spleen in all sequences (A1, A2). It is often mistaken for hypovascular pancreatic tumors, such as well cell tumors and metastatic renal cell carcinomas. The signal of the lesion decreases on SPIO-enhanced T2WI (A3).

Focal fat within the pancreas may mimic a pancreatic cancer. Intrapancreatic fat within pancreatic carcinoma (A1) on MR post-contrast images. Presence of fat can be confirmed using in-phase opposed phase GRE imaging (A2, A3).

CONCLUSIONS

- Radiologists should be aware of atypical findings in pancreatic cancer, which should not preclude its diagnosis.
- Radiologists should be aware of potential pitfalls, which can lead to a failure to detect pancreatic cancer.
- Pancreatic cancer mimics can often be distinguished by paying attention to key differential points.