Pancreatic cancer or pancreatitis?

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Learning objectives

A common diagnostic problem is how to differentiate malignant solid pancreatic lesions from benign entities like pancreatitis. Especially if you are dealing with focal forms like paraduodenal pancreatitis (cystic dystrophy of the duodenum or groove pancreatitis) or autoimmune pancreatitis (IgG4 related pancreatitis).

Paraduodenal pancreatitis is a distinct form of chronic pancreatitis characterized by inflammation and fibrous tissue formation, affecting the groove area near the minor papilla between the head of the pancreas, the duodenal wall and the common bile duct. Paraduodenal pancreatitis has been divided into pure (the head of the pancreas is spared), segmental (the pancreatic head and the ducts are affected) and non segmental (secondary to established chronic pancreatitis) forms.

Autoimmune pancreatitis is distinct from calcifying and obstructive forms of chronic pancreatitis. Destructive changes of the pancreatic ducts characterized by multiple or single strictures without marked upstream dilatation are important features. Pancreatic calcifications and pseudocysts are usually absent.

We radiologists have the important role to differentiate these benign entities from pancreatic adenocarcinoma, neuroendocrine tumours, lymphoma and pancreatic metastases. The typical CT-findings and limitations will be demonstrated as well as the additional and complementary role of MRI. We will focus on morphological signs (pancreatic, peripancreatic and ductal), dynamic contrast behaviour and value/limitations of diffusion weighted imaging and ADC. Clues to a correct diagnosis will be given and pitfalls in imaging interpretation will be discussed.

Main

Pancreatic imaging: guidelines: MDCT or MRI?

- if pancreatitis: MDCT classically first line
- if suspicion of biliary pancreatitis and possible stone in the CBD: MRI
- if suspicion of a tumour: MRI # MDCT
- anatomic variants type pancreas divisum: MRI # MDCT
- ductal anomalies: MRI # MDCT
- MDCT + I MRI + Gd
- **Pro's of MDCT:** shows calcifications, generally less prone to technical and interpretive errors, faster, more available, more practical for acutely ill patients
- US, EUS, ERCP and PET/CT: no first line exam's
MDCT protocol for known/suspected pancreatic tumour

- water as oral contrast
- nonenhanced images (liver - pancreas)
- **pancreatic phase** (+/- 125ml C at 4ml/sec, 35-45sec delay, 1-2mm for angio and 3D ductal anatomy and 5mm)
- **hepatic parenchymal phase** (+/- 70sec delay)

MR protocol for known/suspected pancreatic tumour

- water as oral contrast [Fig. 1 on page 9]
- T2 +/- f.s., axial and coronal
- MRCP
- DWI (b 50-600-1000)
- GRE T1 in/op phase, axial
- 2D or 3D fat-suppressed GRE; +/- bolus dynamic Gd-enhancement (**pancreatic phase and hepatic parenchymal phase**)

Ductal adenocarcinoma: CT Findings [Fig. 2 on page 9]

- **Primary tumor**
  - focal mass (95%)
  - low density area (75%)
  - ill-defined borders

- **hypo-enhancing mass**

- **Secondary findings**
  - duct dilation
  - pancreatic duct (50%)
  - CBD (40%)

  - focal narrowing
  - "missing duct sign" at the level of the tumour

  - atrophy of the tail (20%)
- dilated collateral veins (12%)
- duodenal invasion

**Ductal adenocarcinoma: MR Findings** Fig. 3 on page 10 Fig. 4 on page 10

- **signal intensity**
  T1: usually hypointense, isointense if surrounding pancreatic tissue is abnormal (chronic pancreatitis)
  T2: iso- or slightly hyperintense
  - hypo-enhancing after I.V. Gd (rapid bolus)
  - **DWI:** hyperintense on high b-values & low ADC
  - **double duct sign:** in pancreatic head cancer
  - **missing duct sign**
    - stenosis or apparent occlusion
    - usually irregular with abrupt termination
    - length should correspond to size of mass

**Special types of pancreatitis mimicking adenocarcinoma:**

- Groove pancreatitis or paraduodenal pancreatitis
- Autoimmune pancreatitis

**Groove pancreatitis**

- special type of chronic pancreatitis near the minor papilla
- 3 types:
  - pure (head of the pancreas is spared)
  - segmental (pancreatic head and the ducts are affected)
- non segmental (sec. to established chron. pancreatitis)
  - hallmark: **scar tissue with fibrosis in the pancreaticoduodenal groove**
  - duodenum: involved by a chronic inflammatory process (**cystic dystrophy**)  

**imaging findings important to differentiate from carcinoma:**

- **sheet-like mass in the groove** (most important diagnostic clue !) Fig. 5 on page 11  Fig. 6 on page 11  
  - hypodense on CT  
  - MRI: T1: hypo  
  T2 & DWI: hypo-iso-hyper, depending on the stage  
  - Gd: homogeneous delayed enhancement < to the fibrous nature  
  - **inflammatory changes in the pancreatic parenchyma**  
  - CT: hypodense pancreatic head  
  - MRI: hypo T1 , hyper T2, DWI hyper  
  - enlargement  
  - **regular common bile duct tapering** Fig. 7 on page 12  
  - **normal pancreatic duct or duct penetrating sign** Fig. 8 on page 12  
  - **PET-scan** may be positive in an acute stage, mimicking a carcinoma Fig. 9 on page 13

**Cystic dystrophy of the duodenum** Fig. 10 on page 14

- **Imaging findings**
  - dilated stomach  
  - thickened duodenal wall  
  - deep location of the cysts  
  - narrowing of the duodenal lumen  
  - signs of groove pancreatitis
Autoimmune pancreatitis

- IgG4 related pathology, can be multifocal

**CT findings:** Fig. 11 on page 14 Fig. 12 on page 14

- edema with loss of the classical lobulation pattern
- no pseudocysts nor atrophy or major ductal dilatation
- no calcifications
- unenhanced CT reveals a slightly hypodense homogenous mass, **hypo-attenuating in the pancreatic contrast phase** (most important diagnostic clue to differentiate from neuro-endocrine tumour!), and becoming **homogeneously hyperdense at the delayed phase** (most important diagnostic clue to differentiate from adenocarcinoma!)
- dilatation of the common bile duct when pancreatic head is involved

**MR findings:** Fig. 13 on page 15 Fig. 14 on page 16

- diffuse enlargement (sausage-like) or focally swollen pancreas with loss of the classical lobulation pattern
- homogeneously hypointense on T1-weighted images even more pronounced with fat suppression implementation
- homogenous and slightly hyperintense on T2-weighted images and clearly hyperintense with fat suppression
- DWI: hyperintense & low ADC
- no peripancreatic fluid effusions nor pseudocysts
- no pancreatic atrophy
- moderate ductal compression and only minor upstream dilatation
- clear-cut demarcation of the lesion with the normal pancreatic parenchyma

**PET-scan** may be positive in an acute stage, mimicking a carcinoma

**NET: Neuro Endocrine Tumours**

- related with Multiple Endocrine Neoplasia (MEN)

- **pancreatic islet cell tumor MDCT findings:** Fig. 15 on page 17

- lesions:
• often < 2cm, and multiple in MEN1 (sens 70-80%)
• if > 2cm, calcifications: often malignant
• periampullary lesions: water as oral contrast necessary for optimal distension of the duodenum

- usually hypervascular (look also for liver mets)

- solid or ring-enhancement if cystic (delayed scans)

- only in advanced stages ductal involvement

- large tumours may show cystic & necrotic areas

  • pancreatic islet cell tumor MRI findings: Fig. 16 on page 17

  - lesions:

    • often < 2cm, and multiple (sensitivity MR > CT)
    • > 2cm: often malignant
    • SI:
      • T1: hypo
      • T2-: hyper (unless high collagen content-)
      • DWI: high SI & low ADC
      • dynamic contrast-enhanced sequences: usually hypervascular

  differential diagnosis NET:

  - (intra-peri)pancreatic accessory spleen Fig. 17 on page 18

  - aneurysms Fig. 18 on page 18

  - metastases Renal Cell Carcinoma or melanoma (see poster M. Eyselbergs ECR 2013)

clue to a correct diagnosis:

- same density/SI and contrast behaviour as spleen or vessels

- known RCC or melanoma

Pancreatic lymphoma

  • primary pancreatic lymphoma is rare (0.5-2% of pancreatic tumours)
• mostly high-grade B cell (up to 75%)
• non-specific clinical findings (abdominal pain and weight loss)
• primary vs direct extension from adjacent peripancreatic lymphadenopathy

Two patterns of pancreatic lymphoma are described:

• **large infiltrating lesion with poorly defined contours** *Fig. 19 on page 19*

< **DD pancreatitis**

*In patients with diffuse infiltration of the pancreatic gland without clinical or radiological signs of pancreatitis, the radiologist should be alert to the possibility of pancreatic lymphoma*

• **rounded, well-delineated mass** *Fig. 20 on page 19*

solitary

< **DD adenocarcinoma and neuro-endocrine tumours**

multiple

< **DD metastases and granulomatous disease**

**Radiological clues suggesting lymphoma**

< only mild dilatation of Wirsung's duct

< infiltration of retroperitoneal or abdominal organs

< enlarged lymph nodes below the renal veins

< encasement of blood vessels but no thrombus or occlusions

< enhancement after IV contrast is more pronounced in the pancreatic phase than in cases of adenocarcinoma but less than in cases of NETs.
<strong>diffusion restriction with low ADC.</strong>

**Images for this section:**

**Fig. 1:** 54-y-old man with a periampullary adenocarcinoma, value of duodenal distension after drinking tap-water. Note prominent dilatation of the Wirsung duct and excellent tumour delineation in the medial wall of the duodenum
Fig. 2: 70-y-old man with pancreatic adenocarcinoma. Upper row: old examination, chronic calcifying pancreatitis. Lower row: recent exam; obstructive jaundice, pancreatic head carcinoma (hypodense mass), distortion of the calcifications, dilatation bile ducts and Wirsung with parenchymal atrophy (corpus and tail).

Fig. 3: 70-y-old man with pancreatic adenocarcinoma (same patient as Fig.2) MRI: MRCP double duct sign (dilated proximal bile ducts and dilated proximal Wirsung duct) with missing duct at the tumour. The pancreatic head tumour is hypointense on T1 and slightly hyperintense on T2, hypovascular contrast behaviour, DWI bright on high b-values and short ADC.
**Fig. 4:** 65-y-old woman with pancreatic adenocarcinoma dorsal in the head (arrow). MRI: MRCP single duct sign (dilated proximal bile ducts and normal Wirsung duct) with missing duct at the tumour. The pancreatic head tumour is hypointense on T1 and hyperintense on T2, hypovascular contrast behaviour, DWI bright on higher b-values.

**Fig. 5:** 55-y-old man with groove pancreatitis. MDCT with IV contrast (pancreatic and portal-parenchymal phase): swollen pancreatic head with homogeneous contrast uptake and peripancreatic infiltration-effusion accentuated at the pancreatico-duodenal groove (sheet-like mass) (arrow). Note presence of a duodenal wall cyst in the ventral part (cystic dystrophy).
**Fig. 6:** 55-y-old man with groove pancreatitis. MRI GRE T1 fs -/+ Gd: swollen pancreatic head with loss of normal high SI, homogeneous contrast uptake and peripancreatic infiltration-effusion accentuated at the pancreatico-duodenal groove (sheet-like mass). Note presence of a duodenal wall cysts (arrow) in the ventral part (cystic dystrophy).

**Fig. 7:** 55-y-old man with groove pancreatitis. MRI moderately and heavily T2w-images and MRCP: swollen pancreatic head with slightly high SI and peripancreatic infiltration-effusion accentuated at the pancreatico-duodenal groove (sheet-like mass). Tapering of the distal part of the CBD (arrow) and Wirsung duct duodenal lumen narrowing with thick wall and cysts (cystic dystrophy).
Fig. 8: 61-y-old man with groove pancreatitis (more chronic form). MRI: dilatation of the bile ducts and Wirsung duct with narrowing and duct penetrating sign (arrow) in the pancreatic head (CBD & Wirsung duct), fibrotic retraction and narrowing of the duodenum D2.

Fig. 9: 58-y-old man with groove pancreatitis. FDG-PET scan: intense positive tracer captation, mimicking adenocarcinoma
**Fig. 10:** 64-y-old man with groove pancreatitis and cystic dystrophy of the duodenum. Gastric outlet obstruction due to thickened duodenal wall and cyst (arrow) with narrowing of the duodenal lumen. Swollen pancreatic head with signs of groove pancreatitis.

**Fig. 11:** 43-y-old woman with autoimmune pancreatitis of the tail. Unenhanced CT image (A) demonstrates a swollen pancreatic tail which appears slightly hypodense. Contrast-enhanced pancreatic phase image (B) shows marked hypoattenuation of the lesion. Note the clear demarcation of the focal autoimmune pancreatitis (arrow). Delayed imaging (C) shows homogeneous hyperdense pattern of the lesion with lack of extrapancreatic extension.
Fig. 12: 61-y-old man with multifocal autoimmune (IgG4-related) pancreatitis (tail and head). MDCT pancreatic phase: slightly swollen pancreatic head and tail (yellow arrows). Loss of pancreatic lobulation, no infiltration of the peripancreatic fat. Homogeneous contrast uptake and moderately hypodense appearance. Dilated Wirsung duct (blue arrow) without parenchymal loss at the pancreatic neck and body, no dilatation of the bile ducts.
Fig. 13: 61-y-old man with multifocal autoimmune (IgG4-related) pancreatitis (tail and head), same patient as Fig.12. MRI T2w images +/- fs, MRCP and DWI & ADC: slightly swollen pancreatic head and tail. No infiltration in the peripancreatic fat. Homogeneous signal and moderately hyperintense appearance on T2, persistent high signal on the DWI high b-values and low ADC. Dilated Wirsung duct without parenchymal loss at the pancreatic neck and body, no dilatation of the bile ducts.
**Fig. 14:** 61-y-old man with multifocal autoimmune (IgG4-related) pancreatitis (tail and head), same patient as Fig. 12&13. MRI: slightly swollen pancreatic head and tail. No infiltration/obliteration of the peripancreatic vessels. At the involved areas homogeneous signal and moderately hypointense appearance on T1, homogeneous contrast uptake with contrast pooling at the late phase. Dilated Wirsung duct without parenchymal S.I. loss at the pancreatic neck and body.

**Fig. 15:** 41-y-old woman with a non-functioning Neuro-Endocrine-Tumour. MDCT: large mass at the body-tail with focal calcification, vascular invasion and hypervascular nature. Note liver metastasis with same signal and contrast behaviour.
**Fig. 16:** 50-y-old man with a Neuro-Endocrine-Tumour. MRI: mass in the pancreatic tail, hyperintense on T2, hypointense on T1, low ADC and high SI on high b-values (arrow). Clear hypervascular nature of the lesion (arrow).

**Fig. 17:** 43-y-old woman with an accessory spleen. MRI. Note: S.I., DWI-pattern and contrast behaviour is always the same as the spleen.
**Fig. 18:** 63-y-old man with a pseudoaneurysm of the splenic artery. MDCT. Signs of chronic pancreatitis with calcifications and pseudocysts. Note same signal and contrast behaviour of the pseudoaneurysm as the aorta.

**Fig. 19:** 53-y-old man with high-grade B-cell lymphoma. Large infiltrating lesion at the tail with poorly defined contours. Note no vasculair obliteration and an important contrast enhancement in the pancreatic phase.
Fig. 20: 27-y-old man with AIDS related lymphoma. Lymphoma involvement of the duodenum and the pancreatic neck (arrow). Obstructive pattern of the bile ducts and the Wirsung duct. Note the excellent visualisation of the pancreatic neck lymphoma on the DWI high b-values and the very low ADC.
References


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