Focal mass-forming chronic pancreatitis: indistinguishable from pancreatic carcinoma?

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Section: Abdominal imaging
Area of Interest: Biliary Tract / Gallbladder / Pancreas
Procedure: Diagnostic procedure
Imaging Technique: Ultrasound
Imaging Technique: MR
Imaging Technique: CT
Special Focus: Inflammation
Case Type: Clinical Cases
Authors: Tonolini Massimo, MD; Matacena Giovanni, MD; Ippolito Sonia, MD; Roberto Bianco, MD.
Patient: 79 years, male

Clinical History:

79-year-old male with comorbidities including diabetes, hypertension, ischaemic heart disease, peptic gastritis and HCV positivity, suffering from upper abdominal pain, nausea and malaise. At admission, physical examination revealed jaundice (corresponding to 7.4 mg/dl total bilirubin, mostly direct). Laboratory abnormalities included increased serum creatinine (1.6 mg/dl), liver transaminases, gamma-glutamyltranspeptidase and alkaline-phosphatase.

Imaging Findings:

Sonography (Fig. 1) detected a 3-cm hypoechoic pancreatic head mass causing mild dilatation of common bile duct (CBD) and left lobe intrahepatic ducts. CT (Fig. 2) confirmed circumscribed, solid lesion with loss of normal pancreatic lobulations and parenchymal enhancement, atrophied upstream body and tail with dilated main pancreatic duct (MPD), without calcifications. MR-cholangiopancreatography (Fig. 3) depicted T1-hypointense, mildly T2-hyperintense pancreatic mass with restricted diffusion, biliary obstruction, dilated MPD and saccular dilatations of side branches, strongly suspicious for carcinoma. Endoscopic ultrasound (not shown) confirmed hypoechoic T2N1 mass with small-sized regional adenopathies. Despite inconclusive biopsies, considering elevated serum CA19-9 (122.5 U/ml after adjustment for bilirubin), Whipple pancreaticoduodenectomy was performed. Pathology diagnosed mass-forming chronic pancreatitis (MF-CP) with mixed fibrosis and inflammation, which could be suggested by low normalised apparent diffusion coefficient (Fig. 3g) and smoothly tapering MPD entering the mass ("duct-penetrating sign", Fig. 3i).

The table (Fig. 4) summarizes some useful features to discriminate between pancreatic head cancer and MF-CP.

Discussion:

Most commonly alcohol-related, chronic pancreatitis (CP) is characterised by progressive inflammatory damage with pancreatic fibrosis, resulting in irreversible exocrine and endocrine functional impairment. Anatomic changes may include atrophy, focal or diffuse enlargement, calcifications, dilatation of main pancreatic duct (MPD) and side branches. Clinical manifestations such as abdominal pain, anorexia and weight loss commonly suggest tumour, particularly in case of jaundice, elevated CA19-9 marker, or lacking history of pancreatitis [1, 2]. Furthermore, CP is associated with an increased risk of pancreatic carcinoma, which coexists in 1-6% of patients.
Unfortunately, despite state-of-the-art cross-sectional techniques, differentiation between CP and cancer is challenging when the former presents as focal mass without calcifications. As a result, 5-10% of patients having pancreatic-duodenectomy for suspected malignancy are ultimately found to have benign disease at pathology, and unnecessarily undergo high iatrogenic morbidity and non-negligible mortality. Therefore, correct preoperative diagnosis is crucial, and generally requires endoscopic ultrasound-guided biopsy, which however has limited (75-80%) yield [3, 4].

Often misinterpreted as tumour, mass-forming CP (MF-CP) shows hypo-to-isointense T1-weighted signal intensity reflecting chronic inflammation and fibrosis, is mostly T2-iso-to-hyperintense, shows variable dynamic patterns with loss of normal early homogeneous pancreatic enhancement, and may cause dilatation of MPD, common bile duct (CBD) or both. Albeit commonly regarded as characteristic of pancreatic head cancer, the “double-duct sign” (dilated MPD plus CBD) has 46-62% sensitivity and 78-83% specificity. With close inspection, a non-obstructed or smoothly tapering MPD entering through the mass (“duct penetrating sign”) favouring a MF-CP diagnosis may be differentiated from abrupt ductal cut-off suggesting tumour [3-6].

Current MRI protocols routinely include diffusion-weighted (DWI) acquisitions, which have been investigated for differentiating pancreatic carcinoma versus MFCP, reaching an overall 82% specificity in a meta-analysis; however, DWI results are questionable due to limited samples and technical inconsistencies. Pancreatic malignancies show restricted diffusion and significantly lower apparent diffusion coefficients (ADC) values than normal parenchyma and benign tumours, but their ADC increases when necrosis is present. Since MF-CP may contain variable proportions of fibrosis, the major DWI limitation is the inability to distinguish between inflammation and carcinoma due to overlapping ADC values. As in this case, normalisation of ADC (calculated as ratio of pancreatic lesion to apparently normal adjacent pancreas) has been reported to improve discrimination of MF-CP (range 0.708-0.890x10^-3 mm2/sec) from pancreatic tumours (0.895-0.985x10^-3 mm2/sec) [3, 7-10].

**Differential Diagnosis List:** Mass-forming, non-calcified chronic pancreatitis, Pancreatic head adenocarcinoma, Autoimmune pancreatitis, Groove pancreatitis, Nonfunctioning pancreatic neuroendocrine tumour, Solid pseudopapillary tumour, Pancreatic metastasis

**Final Diagnosis:** Mass-forming, non-calcified chronic pancreatitis

**References:**


**Figure 1**

**Description:** Sonography showed distended gallbladder (†) with normal mural thickness, dependent echogenic debris interpreted as biliary sludge; mild dilatation of common bile duct (CBD) and left lobe intrahepatic ducts (not shown). **Origin:** Tonolini M, Radiology Department, “Luigi Sacco” University Hospital – Milan (Italy)
Description: Sonography showed distended gallbladder (+) with normal mural thickness, dependent echogenic debris interpreted as biliary sludge; mild dilatation of common bile duct (CBD) and left lobe intrahepatic ducts (not shown). Origin: Tonolini M, Radiology Department, “Luigi Sacco” University Hospital – Milan (Italy)

Description: A 3-cm hypoechoic mass (arrowheads) was seen in the pancreatic head, with upstream dilatation of main pancreatic duct (MPD). Origin: Tonolini M, Radiology Department, “Luigi Sacco” University Hospital – Milan (Italy)
**Figure 2**

Description: Unenhanced images (a,b) confirmed distended gallbladder (+) with normal wall thickness and absent pericholecystic fluid, higher-than-water attenuation (approx. 50 Hounsfield units) content, atrophied pancreatic body (arrow) and tail. **Origin:** Tonolini M, Radiology Department, “Luigi Sacco” University Hospital – Milan (Italy)
**Description:** The dorsal pancreatic head showed a homogeneously solid appearance (arrowhead) with lost pancreatic lobulations, corresponding to sonographic finding. Note lack of pancreatic calcifications; absent ascites and adenopathies. **Origin:** Tonolini M, Radiology Department, “Luigi Sacco” University Hospital – Milan (Italy)
Description: The mass (arrowheads) at dorsal aspect of pancreatic head showed loss of expected pancreatic enhancement in arterial-dominant acquisition (c,d), without frank hypo- or hypervascularity and signs of vascular invasion. Origin: Tonolini M, Radiology Department, “Luigi Sacco” University Hospital – Milan (Italy)
Description: The mass (arrowheads) at dorsal aspect of pancreatic head showed loss of expected pancreatic enhancement in arterial-dominant acquisition (c,d), without frank hypo- or hypervascularity. Note mildly dilated CBD (1cm, thick arrow). Origin: Tonolini M, Radiology Department, “Luigi Sacco” University Hospital – Milan (Italy)
Description: In portal-venous phase images (e.g.) the pancreatic head mass (arrowheads) did not show hypo- or hypervascularity and signs of vascular invasion. No abnormal changes in liver parenchyma, spleen, adrenals and kidneys for age. Origin: Tonolini M, Radiology Department, “Luigi Sacco” University Hospital – Milan (Italy)
Description: In portal-venous phase images the pancreatic head mass (arrowheads) did not show hypo- or hypervascularity and signs of vascular invasion. Note atrophied body and tail (arrows) with dilated MPD, distended gallbladder (+). Origin: Tonolini M, Radiology Department, “Luigi Sacco” University Hospital – Milan (Italy)
**Description:** In portal-venous phase images (e...g) the pancreatic head mass (arrowheads) did not show hypo- or hypervascularity. Note atrophied body and tail (arrows) with dilated MPD, distended gallbladder (+), mildly dilated CBD (thick arrow). **Origin:** Tonolini M, Radiology Department, “Luigi Sacco” University Hospital – Milan (Italy)

**Description:** Finally, delayed excretory phase images (h,i) confirmed pancreatic head mass (arrowheads) without frank hypo- or hypervascularity, causing mild CBD dilatation (thick arrow in h). **Origin:** Tonolini M, Radiology Department, “Luigi Sacco” University Hospital – Milan (Italy)
Description: Finally, delayed excretory phase images (h,i) confirmed pancreatic head mass (arrowheads) without frank hypo- or hypervascularity, causing mild CBD dilatation (thick arrow in h).

Origin: Tonolini M, Radiology Department, “Luigi Sacco” University Hospital – Milan (Italy)
Description: On T2-weighted images (a...c) the gallbladder contained mixed, predominantly low-signal fluid (+), the dorsal pancreatic head mass (arrowheads) showed minimally increased signal intensity.

Origin: Tonolini M, Radiology Department, “Luigi Sacco” University Hospital – Milan (Italy)
Description: On T2-weighted images (a...c) the dorsal pancreatic head mass (arrowheads) showed minimally increased signal intensity. Note absent ascites and lymphadenopathies. Origin: Tonolini M, Radiology Department, “Luigi Sacco” University Hospital – Milan (Italy)
Description: On T2-weighted images (a...c) the gallbladder contained mixed, predominantly low-signal fluid (+). Note dilated CBD (thick arrow), atrophied pancreatic body and tail with dilated MPD (arrow).

Origin: Tonolini M, Radiology Department, “Luigi Sacco” University Hospital – Milan (Italy)
Description: T1-weighted images (d, fat-suppressed e) showed homogeneous hypersignal of gallbladder lumen (+) consistent with highly proteinaceous fluid or blood, with normal mural thickness.

Origin: Tonolini M, Radiology Department, "Luigi Sacco" University Hospital – Milan (Italy)
Description: On fat-suppressed T1-weighted images the dorsal pancreatic head mass (arrowhead) showed moderately decreased signal intensity compared to usual aspect of pancreatic parenchyma.

Origin: Tonolini M, Radiology Department, “Luigi Sacco” University Hospital – Milan (Italy)
Description: On high b-value (800) diffusion-weighted acquisition, the pancreatic head mass (arrowhead in upper image) showed visually increased intensity compared to pancreatic body and tail (lower image). Origin: Tonolini M, Radiology Department, “Luigi Sacco” University Hospital – Milan (Italy)
Description: Corresponding apparent diffusion coefficient (ADC) maps showed lower ADC values in pancreatic head mass (arrowhead, $1.47 \times 10^{-3}$ mm$^2$/sec) compared to remaining pancreatic parenchyma (lower image, $2.05 \times 10^{-3}$ mm$^2$/sec), yielding normalised ratio of 0.72. Origin: Tonolini M, Radiology Department, “Luigi Sacco” University Hospital – Milan (Italy)
Description: MRCP (without secretin administration) confirmed and depicted mild dilatation of left intrahepatic branches and CBD (thick arrow, 1 cm) plus dilated MPD (arrows) and side branches ("double-duct sign") above pancreatic head mass. Origin: Tonolli M, Radiology Department, "Luigi Sacco" University Hospital – Milan (Italy)
Description: Detail MRCP image showed smoothly tapering MPD (thin arrow) entering through the pancreatic head mass ("duct-penetrating sign"), diffuse saccular dilatation of MPD side branches. Origin: Tonolini M, Radiology Department, "Luigi Sacco" University Hospital – Milan (Italy)
### Description:

Some useful features which should be considered to try discriminate between pancreatic head cancer and mass-forming chronic pancreatitis. **Origin:** Tonolini M, Radiology Department, “Luigi Sacco” University Hospital – Milan (Italy)

<table>
<thead>
<tr>
<th>Feature</th>
<th>Proximal mass-forming chronic pancreatitis</th>
<th>Pancreatic head carcinoma</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pancreatic calcifications</strong></td>
<td>Usually present</td>
<td>Generally absent</td>
</tr>
<tr>
<td><strong>Pancreatic ductal system</strong></td>
<td>Unobstructed main duct coursing or smoothly tapering through lesion (“duct-penetrating sign”)</td>
<td>Abrupt truncation with obstructed upstream main duct</td>
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<tr>
<td></td>
<td>Diffuse saccular dilatation of side branches</td>
<td></td>
</tr>
<tr>
<td><strong>“Double-duct sign”</strong></td>
<td>May be present</td>
<td>Generally present</td>
</tr>
<tr>
<td><strong>Normalised ADC</strong></td>
<td>Median $0.839 \times 10^3$ mm$^2$/sec</td>
<td>Median $0.933 \times 10^3$ mm$^2$/sec</td>
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<td>(ADC value of region-of-interest in pancreatic lesion / ADC value of region-of-interest in apparently normal adjacent pancreas)</td>
<td>Range $0.708-0.890 \times 10^3$ mm$^2$/sec</td>
<td>Range $0.895-0.985 \times 10^3$ mm$^2$/sec</td>
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