Isolated pancreatic tuberculosis: A case report and radiological comparison with cystic pancreatic lesions

Anna L. Falkowski[1*], Judith Graber[2], Horst G. Haack[3], Philip E. Tarr[4], Helmut Rasch[1]

1. Department of Radiology and Nuclear Medicine, Kantonsspital Baselland, Bruderholz, Switzerland

2. Department of Medicine, Kantonsspital Baselland, University of Basel, Bruderholz, Switzerland

3. Gastroenterology and Hepatology, Kantonsspital Baselland, University of Basel, Bruderholz, Switzerland

4. Infectious Diseases Service, Kantonsspital Baselland, University of Basel, Bruderholz, Switzerland

* **Correspondence:** Anna L. Falkowski, Department of Radiology and Nuclear Medicine, Kantonsspital Baselland, 4101 Bruderholz, Switzerland
(*Falkowski.Anna@gmail.com*)

Radiology Case. 2013 Jan; 7(1):1-11 :: DOI: 10.3941/jrcr.v7i1.1292

ABSTRACT

Pancreatic tuberculosis is rare and can occur in the absence of evidence of tuberculosis elsewhere in the body. Here we review the radiological appearance of pancreatic tuberculosis and compare it with other cystic pancreatic lesions, including common lesions (pseudocysts, serous or mucinous cystadenomas, intraductal papillary mucinous neoplasm) and rare lesions such as solid pseudopapillary tumors, etc. Their typical localizations within the pancreas and their malignant potential are presented. Knowledge of these can assist radiologists and clinicians in selecting the best approach towards making the correct diagnosis.

CASE REPORT

CASE REPORT

A 29-year-old man presented with burning epigastric pain, raised temperature, night sweats, and headaches. There was no cough and chest radiograph was normal (Figure 1). Laboratory findings included alanine aminotransferase 70 U/L (normal, <50), alkaline phosphatase 160 U/L (<130), lipase 188 U/L (<51), LDH 376 U/L (<250), CRP 110 mg/L (<10). To exclude pancreatitis or cholecystitis, ultrasonography of the abdomen was performed, which revealed a non-vascular, 3,8 x 1,8 cm mass with cystic and solid components in the epigastrium next to the portal vein (Figure 2). Differentiation between a pancreatic lesion or an adjacent or infiltrating lesion from the porta hepatis was not possible because of its peripheral localization relating to the pancreatic head. Computed tomography (CT) showed a multi-cystic, partially solid mass with slight contrast enhancement in the area of the pancreas head, located in the branching of the celiac trunk and adjacent to the portal vein (Figure 3). No intra- or extrahepatic dilatation of the bile ducts, and no obstruction or thrombosis of blood vessels was seen. The etiology of the lesion remained unclear. Magnetic resonance cholangiopancreaticography (MRCP) was performed and confirmed the CT findings and showed clear contrast enhancement of the lesion (Figure 4 to 6), displacement of the pancreatic duct but no obstruction or ductal dilatation. Slightly enlarged lymph nodes at the porta hepatis and in the interaortocaval area were identified. A pancreatic pseudocyst seemed unlikely given the absence of findings suggestive of previous pancreatitis in all images. A pancreatic cystadenoma or a solid pseudopapillary tumor seemed unlikely given the raised temperature and elevated CRP.

Five years prior to presentation, he had immigrated from Eritrea to Switzerland. On further questioning, the patient's wife had been diagnosed with left sided cavitary pulmonary tuberculosis (TB) four years ago (Figure 7). Our patient was asymptomatic at that time, had no evidence of active TB on physical examination, had a normal chest radiograph, and a positive interferon gamma release assay (T.Spot.TB).

Therefore, latent tuberculosis was diagnosed and the patient completed a 9-month course of isoniazid. Furthermore four months before hospitalization of our patient, the patient's wife was diagnosed with right cervical tuberculous lymphadenitis, absence of cough and with a normal chest radiograph. Given the potential for a common source of infection for the patient and his wife, the raised temperature and night sweats, and the elevated CRP and LDH, a diagnosis of tuberculosis involving the peripancreatic lymph nodes was considered. Therefore, endoscopic upper abdominal ultrasonography was done, which showed a septated cystic lesion in the area of the pancreatic head (Figure 8). The pancreas itself appeared heterogeneous with a chunky pattern but without calcifications. Endoscopic ultrasound guided fine-needle aspiration (EUS-FNA) biopsy of the mass revealed necrotizing granulomatous infection and numerous acid-fast bacilli on microscopy (Figure 9), and was positive for Mycobacterium tuberculosis complex by polymerase chain reaction (PCR). M. tuberculosis grew in culture, and was sensitive to standard antituberculous agents.

The patient had rapid symptomatic improvement in response to treatment and completed a 6-month course of antitubercular therapy.

DISCUSSION

Epidemiology and pathogenesis:

Our patient clearly was at high risk for tuberculosis because of his origin from a country where tuberculosis is highly endemic (Eritrea) [1]. He had regular contact with immigrants from this country, and his wife was recently diagnosed with TB. Given that the patient was treated for latent tuberculosis 4 years before presentation, recently acquired tuberculosis seems more likely than reactivation disease. A major risk factor for tuberculosis reactivation is immunosuppression [2-4]; the patient was, however, not immunosuppressed and tested seronegative for HIV infection. More than half of patients with pancreas tuberculosis in the world literature are <30 years old [5], as was our patient. As regards the gender ratio there are conflicting reports, suggesting that pancreatic TB is more common in men [5] and also reports that it is more common in women [2].

Isolated tuberculosis of the pancreas is rare, even in countries with a high prevalence of tuberculosis [6]. Fewer than 100 cases have been reported worldwide [5] and it is not yet clear how the infection can only affect the pancreas. Pancreatic secretions have been reported to have an antitubercular effect in vitro, suggesting a potential protective mechanism for the rare pancreatic involvement with tuberculosis [7, 8]. Nonetheless, several possible mechanisms for pancreatic location of tuberculosis have been discussed. These include hematogenous spread, based on the observation that, in the setting of miliary tuberculosis, 4.7 percent of patients had pancreatic involvement [9]; disseminated tuberculosis in the setting of advanced immunosuppression, and reactivation of previous abdominal tuberculosis located in adjacent lymph nodes [6, 10, 11].

Imaging findings:

The most important differential diagnosis includes pancreatic malignancy. Therefore, it is important to obtain tissue for appropriate histological and microbiological analyses, highlighting the need for laparoscopy or laparotomy in most published cases of pancreatic tuberculosis. A more recent development includes endoscopic ultrasound-guided fine-needle aspiration for histological and microbiological tuberculosis diagnosis; thereby, major surgery may be avoided [12] in order to make the diagnosis of TB - an infection that carries an excellent prognosis in most cases, provided there is no resistance to antituberculous drugs [2, 5]. The aim of the following section is to review the imaging findings of pancreatic TB and the most important diseases in the differential diagnosis.

Pancreatic tuberculosis most commonly presents as a solitary lesion with multiple cystic components. It is typically located in the pancreatic body or head; peripancreatic lymphadenopathy can be found [5, 11]. Its cystic components mostly appear hypoechoic (sometimes hypo-isoechoic) on ultrasound, hypodense on CT, and hypointense on T1-weighted MR images, and hyperintense on T2-weighted images [5]. The associated lymph nodes can have a necrotic center (rim enhancement) and/or form conglomerate masses [5, 11]. The appearance of the pancreatic tissue can be heterogeneous. Calcifications or dilatation of the pancreatic duct are uncommon features [5, 11]. Additional findings of gastrointestinal tuberculosis may be present, such as ascites, ileocecal wall thickening (the ileocecal area is the most common location of gastrointestinal tuberculosis), peritoneal or mesenteric masses, splenic and hepatic lesions [5, 13]. None of these associated findings were present in our patient.

Differential diagnosis:

Particularly in patients who present without symptoms and signs typically associated with tuberculosis, most notably raised temperature, night sweats, weight loss or cough, a range of cystic pancreatic lesions may need to be considered:

"Simple" epithelial cystic pancreas lesions are typically asymptomatic and thus found incidentally in most instances [14]. A predominant localization within the pancreas has not been reported. In general, they present as an encapsulated homogeneous fluid collection with water Hounsfield units [15]. Thus, they are anechoic on ultrasound (US), hypodense on CT, hypointense on T1-weighted MR and hyperintense on T2-weighted MR images. Because of the absence of an enhancing solid mass within the cyst they show no inner enhancement [16, 17]. Pancreatic epithelial cysts can occur congenitally; in most cases, they are associated with systemic diseases or syndromes (often multiple cysts), such as von Hippel-Lindau disease [15, 18] or autosomal dominant polycystic kidney disease [15, 17]. Age and gender distribution depend on the underlying cause.

By far the most common single cystic lesion of the pancreas is the pancreatic pseudocyst, which usually results from prior pancreatitis [17-20]. Therefore, pancreatic calcifications, irregular pancreatic duct dilatation and inflammatory changes in the peripancreatic fat should be

looked for. Pseudocysts are typically located in the tail or body of the pancreas [21].

In contrast to simple pancreatic cysts, "complicated" cysts may have an attenuation suggesting a protein-rich fluid content (> 20 Hounsfield units) or a partially solid content. Complicated cysts may be septated or calcified and their wall or septa can be well enhancing. Therefore, a heterogeneous appearance and contrast enhancement can occur. The presentation of these cystic masses can be highly variable, e.g. multicystic, lobulated, smooth, pleomorphic, with or without an internal septation, etc. [22].

Ninety % of common primary cystic pancreatic tumors are covered by three entities: serous or mucinous cystadenoma and intraductal papillary mucinous neoplasm [18]. These will be described below:

Serous cystadenoma, is typically located in the pancreatic head, and may present with a honeycomb pattern. Presumably because of the small diameter of the associated microcysts (<2mm) it can mimic a solid mass, especially on CT. Thus T2-hyperintensity on MRI can be helpful in the differentiation [23]. In 20-30% of the cases, a central star-like "scar" with calcifications can be seen [6, 23]. This fibrous part can show late contrast enhancement [24]. One third of patients may present with macrocysts, thereby mimicking a mucinous cystadenoma whose cysts usually have a diameter of >2cm [6, 23].

Mucinous cystadenoma mostly presents in the tail or the body of the pancreas. It presents with macrocysts (>2cm) and also in contrast to serous cystadenoma, show peripheral calcifications of the cysts walls in 10-25%, which are thick and can be uni- or multilocular [20, 23].

Intraductal papillary mucinous neoplasm (IPMN) presents as a cluster of micro- and macrocystic lesions with septations [20, 23]. In contrast to the previously mentioned entities is its connection with the pancreatic duct. This is best seen on MRCP. The connection can occur to the main duct, the branch duct or both and thus lead to ductal dilatation and pancreatitis [20, 25]. Typically, IPMN is located in the pancreatic head, in particular in the uncinate process and patients are usually over 60 years old [20, 23].

Solid pseudopapillary tumors are among the rare cystic pancreatic neoplasms [18, 24, 26]. A change of their appearance over time has been described in case reports, i.e. an increase in the cystic components [20] and even "transformation" into a completely cystic lesion [27]. This underscores the importance of comparison of radiological images with previous findings. Solid pseudopapillary tumors are approximately equally distributed within the tail and the head of the pancreas [28]. Peripheral calcifications are present in approximately one third of cases [15] - similar to mucinous cystadenomas. They have a thick, well-defined capsule and may hemorrhage, which can result in a heterogeneous appearance in which fluid-debris might be seen [20, 23, 24, 26, 29]. Therefore, its pattern of contrast enhancement is described as highly characteristic and can contribute to the diagnosis: peripheral rim enhancement in their thick fibrous capsule and progressive heterogeneous fill-in on dynamic enhanced images [15, 30].

Because of the female predominance, and differing age predilection, three cystic pancreatic lesions have been described, as typical "daughter" (20-40 years, solid pseudopapillary tumor), "mother" (40-60 years, mucinous cystadenoma) or "grandmother" (>60 years, serous cystadenoma) lesions [23].

Islet cell tumors are most commonly located in the pancreatic tail [6]. They can cause various endocrine symptoms or may be clinically silent. Functioning islet cell tumors may in the early stages be difficult to diagnose radiologically due to their small size, but they may already be clinically apparent due to excess hormone production [31, 32]. Non-functioning islet cell tumors mostly present as partially cystic lesions [32, 33]. They cause no or few clinical symptoms in the early stages. The diagnosis is therefore typically made when their increasing size leads to local complications such as pancreatic duct obstruction [32, 33]. Large islet cell tumors tend to lead to hemorrhage, necrosis and even calcifications [15]. They may show a characteristic enhancement, i.e. strong arterial enhancement in their peripheral solid part [15, 34]. The typical mean age at presentation is 70 years; however, younger patients, predominantly females [34], may also be affected, e.g. in the setting of multiple endocrine neoplasia type 1 (MEN 1) [15]. Islet cell tumors have a malignancy rate that ranges from 60 to over 90% [31]. Invasion of the portal vein can occur at an early stage [35]. Thus many cases are only diagnosed when hepatic, pulmonary or lymph node metastases have occurred [31, 32, 36].

Mucinous cystadenoma, IPMN and solid pseudopapillary tumor have a lower malignant potential [18, 20]. Of note, cystic degenerations of metastases in the pancreas have been reported [18].

TEACHING POINT

Isolated pancreatic tuberculosis is rare, even in countries with a high incidence of tuberculosis. Therefore, diagnosis is a challenge, calling for a team approach with the goal of making the diagnosis non-invasively: Laparatomy might be avoided if tuberculosis can be diagnosed via EUS-FNA. Radiologically, pancreatic tuberculosis presents typically as a solitary lesion located in the body or head with peripancreatic lymph nodes. The lesion mostly appears with multiple cystic components that are typically hypoechoic on ultrasound, hypodense on CT, hypointense on T1- and hyperintense on the T2-weighted MRI.

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FIGURES

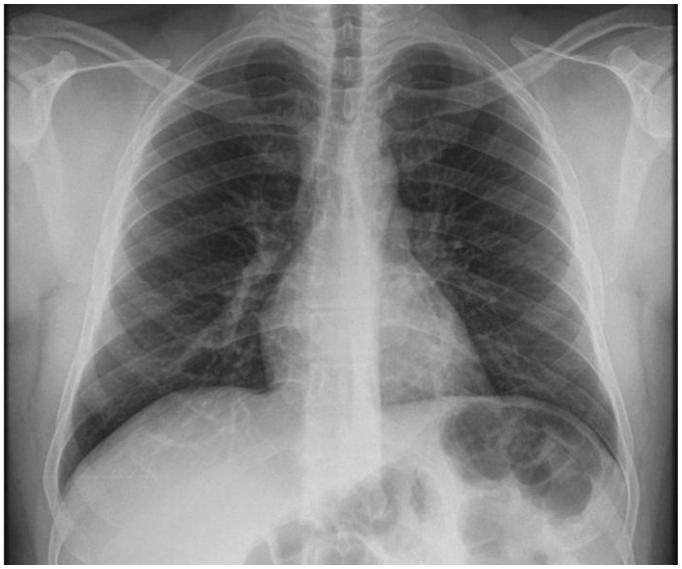

Figure 1: 29-year-old male with isolated pancreatic tuberculosis. Normal posterior-anterior chest radiograph with absence of tuberculosis related findings.

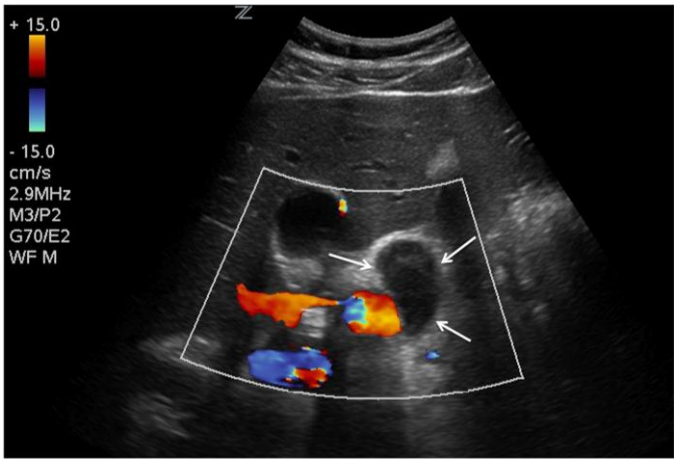

Figure 2: 29-year-old male with isolated pancreatic tuberculosis. Ultrasonography was performed using a 3,5MHz convex transducer; color-Doppler image shows no perfusion of a well defined 3,8 x 1,8 cm mass (arrows) with cystic and solid components.

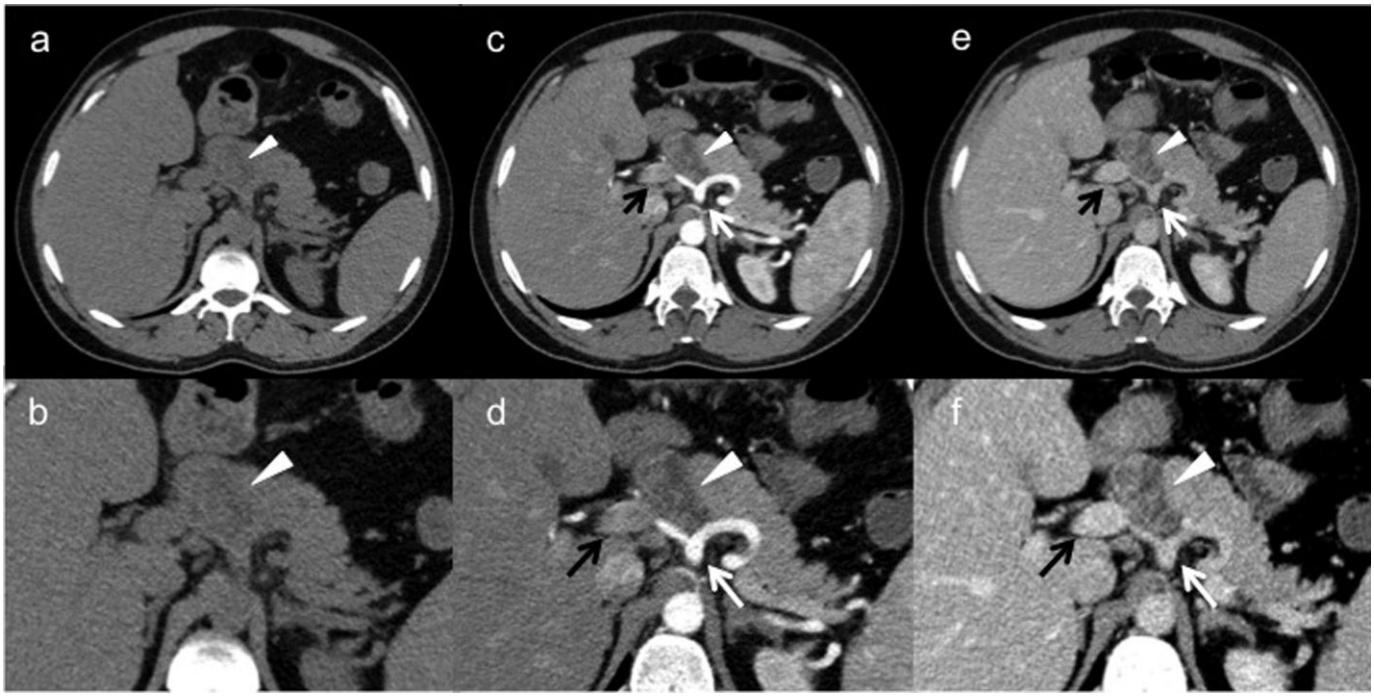

Figure 3: 29-year-old male with isolated pancreatic tuberculosis. Axial computed tomography - unenhanced (a-b) and enhanced images (c-d arterial phase and e-f portal phase), obtained by a multidetector scanner (Protocol: 120 Kv, with a max. of 184 miliamperes, slice thickness = 2,5 mm, contrast medium Iomeprol 400 mg/ml, total dosage of contrast 80 ml). The images reveal a multi-cystic 4,6 x 2,9 cm mass (arrowhead) in the pancreatic head. In figure 3a and 3b the mass appears slightly hypodense. After contrast administration, enhancement in its solid and septated areas can be seen. Figure 3c - 3f show its location directly adjacent to the branching of the celiac trunk (white arrow) and its bordering to the portal vein (black arrow), without any obstruction.

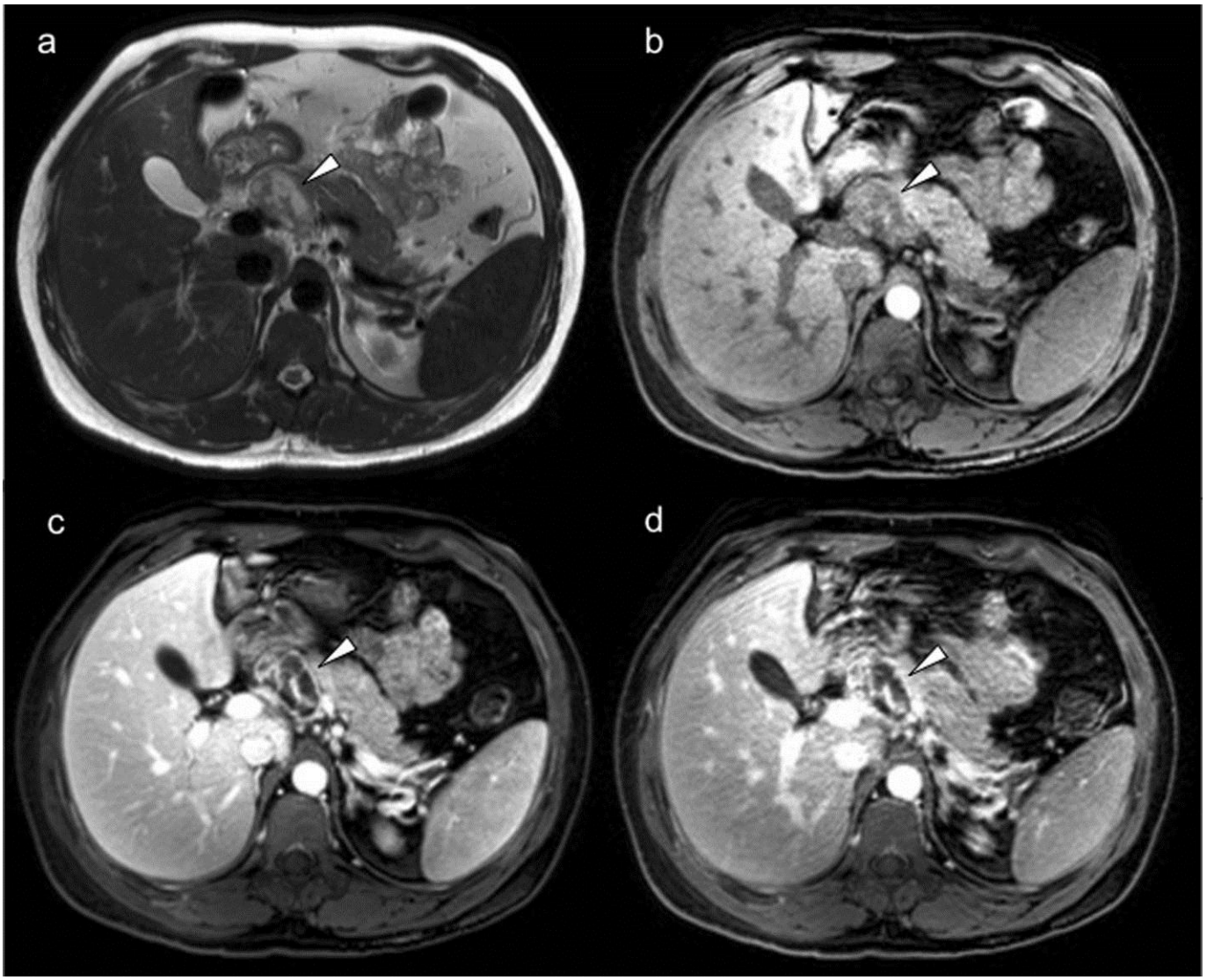

Figure 4: A 29-year-old male with isolated pancreatic tuberculosis. Axial T2 weighted MR image (a) and Volume Interpolated Gradient Echo MR images after contrast administration during the arterial (b), portal (c) and the equilibrium phase (d) show a well defined multi-cystic 4,6 x 2,9 cm lesion in the pancreatic head (arrowhead) with progressive enhancement in its solid components, e.g. its septations. 3T, (a) 5mm slice thickness, TE=80, TR=1372; (b-d) 4mm slice thickness, TE=1,4, TR=3,0, 7,5 ml intravenous Gadobutrolum 1,0

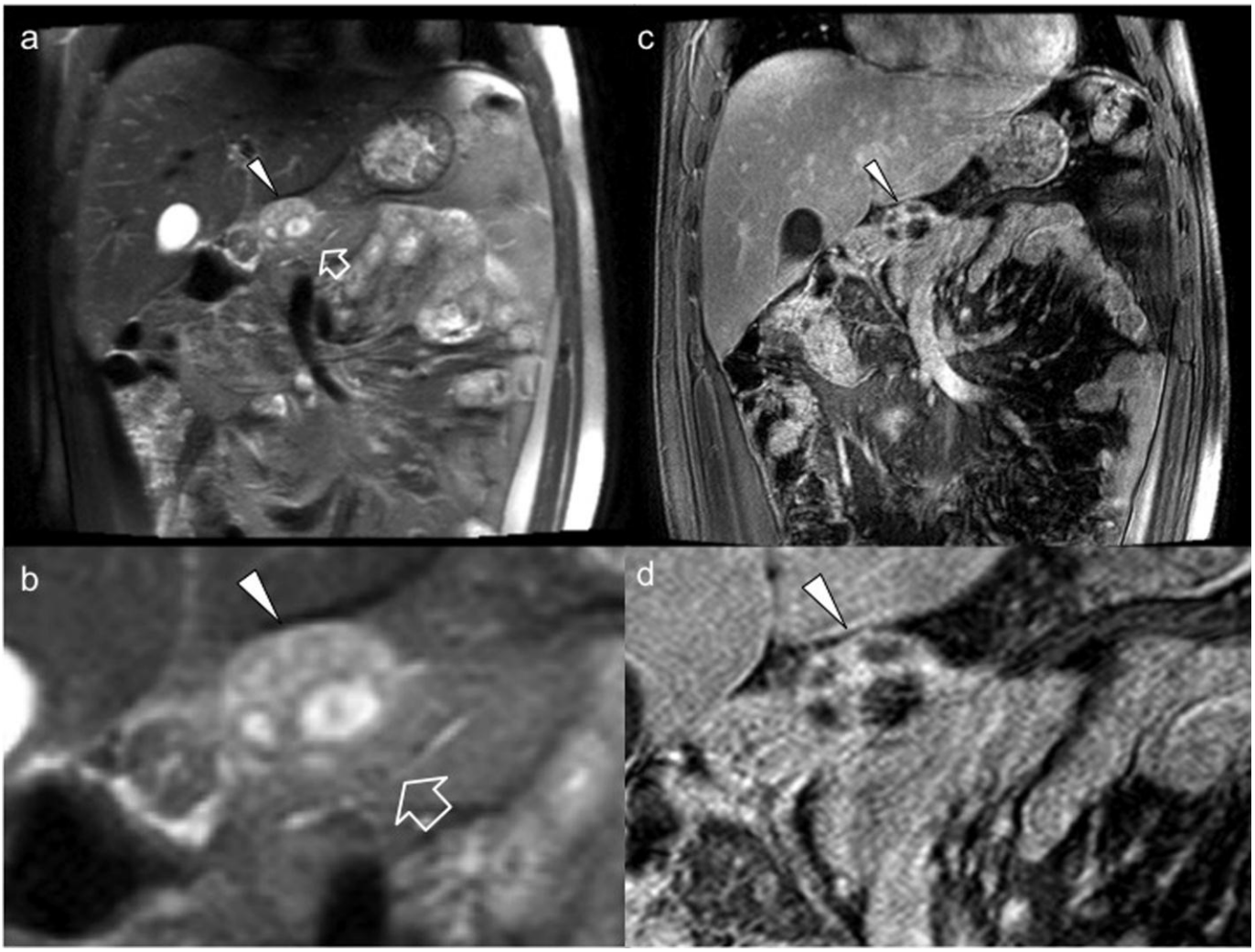

Figure 5: A 29-year-old male with isolated pancreatic tuberculosis. Coronar T2 weighted (a-b) and Volume Interpolated Gradient Echo (c-d) MR images showing a multi-cystic lesion with septations (arrowhead). The pancreatic duct is not dilatated (open arrow). 3T, (a-b) 5mm slice thickness, TE=80, TR=2040; (c-d) 4mm slice thickness, TE=1,8, TR=3,6, 7,5 ml intravenous Gadobutrolum 1,0

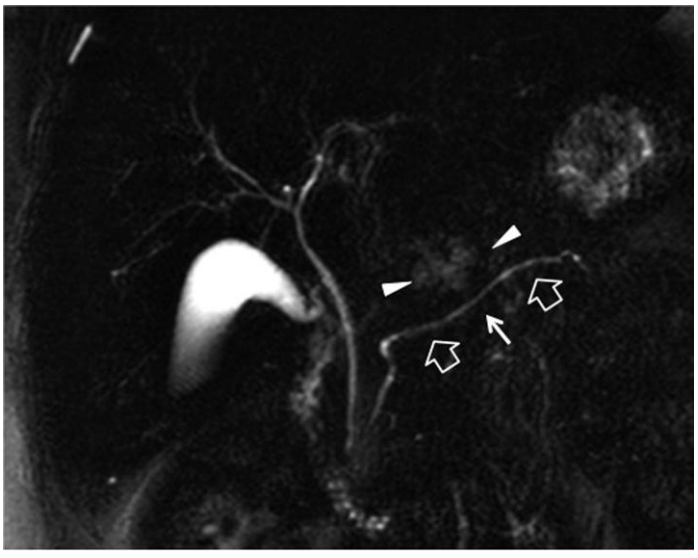

Figure 6 (left): A 29-year-old male with isolated pancreatic tuberculosis. Single-Shot radial MRCP showing the pancreatic lesion (arrowheads) which leads to a displacement of the pancreatic duct (arrow) but without obstruction or dilatation (open arrows). 3T, 50mm slice thickness, TE=740, TR=9449, 7,5 ml intravenous Gadobutrolum 1,0

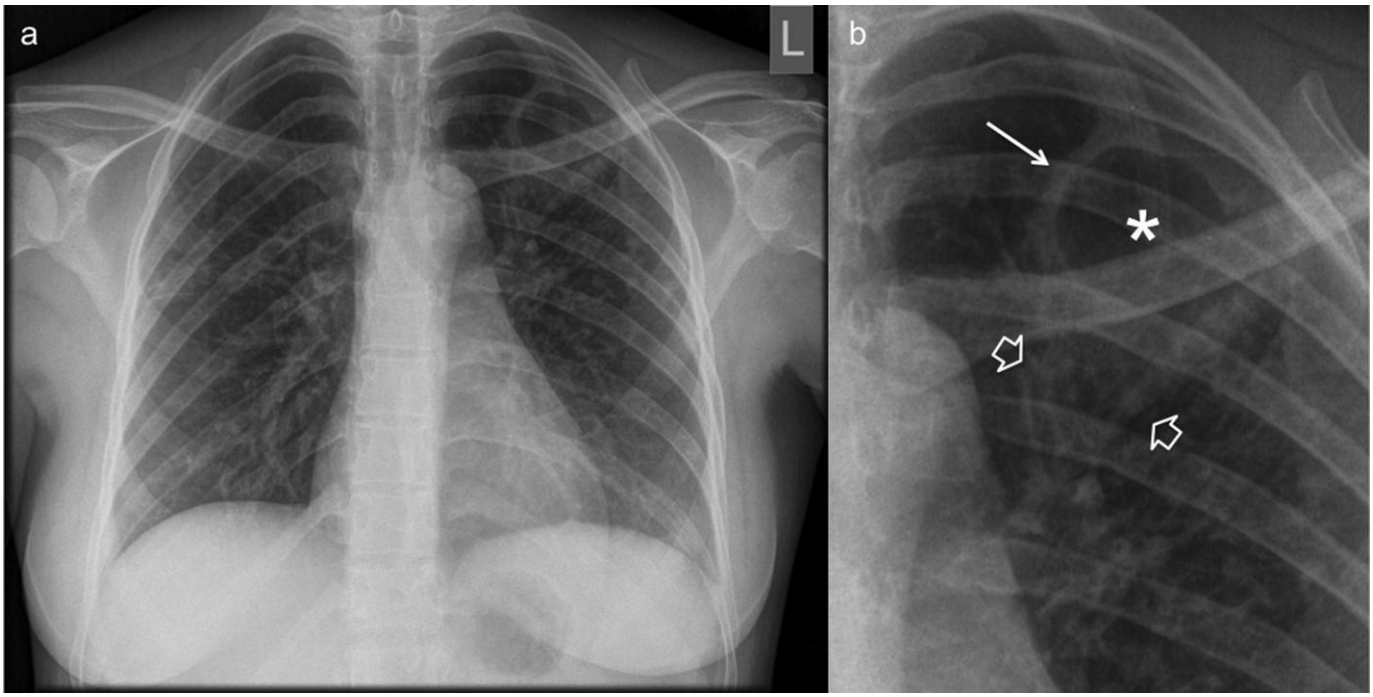

Figure 7: Four years prior to presentation of his isolated pancreatic tuberculosis the 24-year-old wife of the patient was diagnosed with pulmonary tuberculosis. Posterior-anterior chest radiograph of the patient's wife (a) and magnification view (b) showing a cavity in the left upper pulmonary lobe (asterisk) with surrounding inflammatory changes (long arrow) and indurations between the hilum and the cavity (short open arrow). Sputum cultures grew M. tuberculosis, allowing the diagnosis.

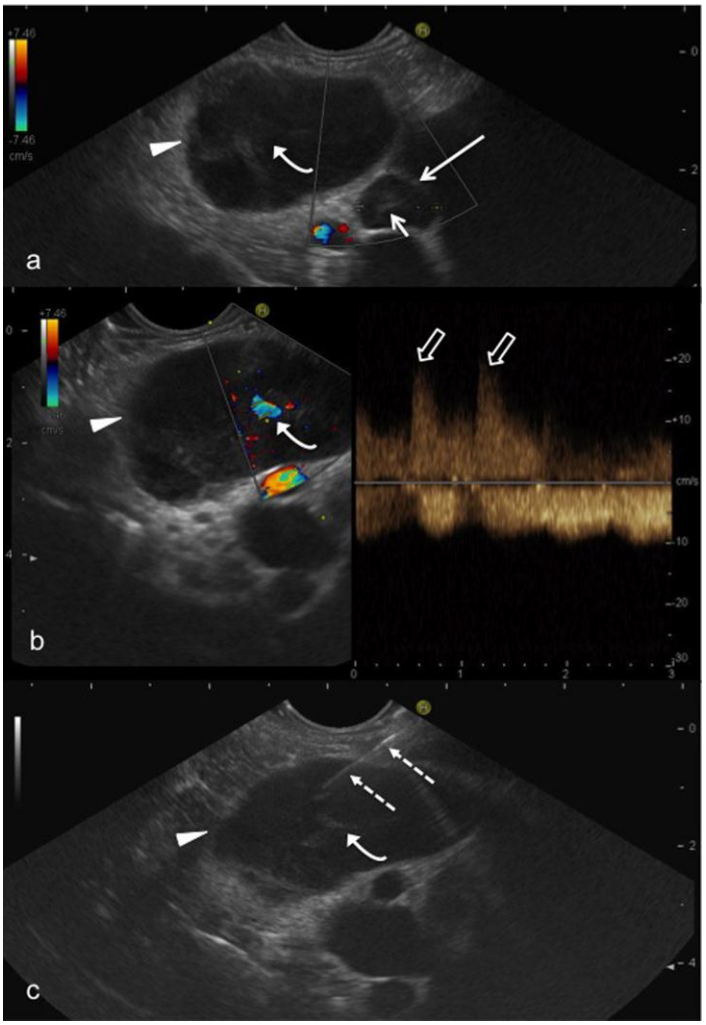

Figure 8 (left): A 29-year-old male with isolated pancreatic tuberculosis. Endoscopic ultrasound (a) shows a heterogeneous ca. 3 x 1,8 cm mass (arrowhead in a-c) with septations (curved arrow) and an adjacent 13 x 10 mm lymph node (long arrow) with a positive hilar fat sign (short arrow). Color sonography (b) verified the presence of vessels within the septations (curved arrow) and showing an arterial signal in the duplex (open arrows). 8c shows the endoscopic ultrasound guided fine-needle aspiration biopsy in which the needle (dashed arrows) was clearly distant to the well perfused septation (curved arrow). Endoscopic ultrasound, 5MHz longitudinal transducer

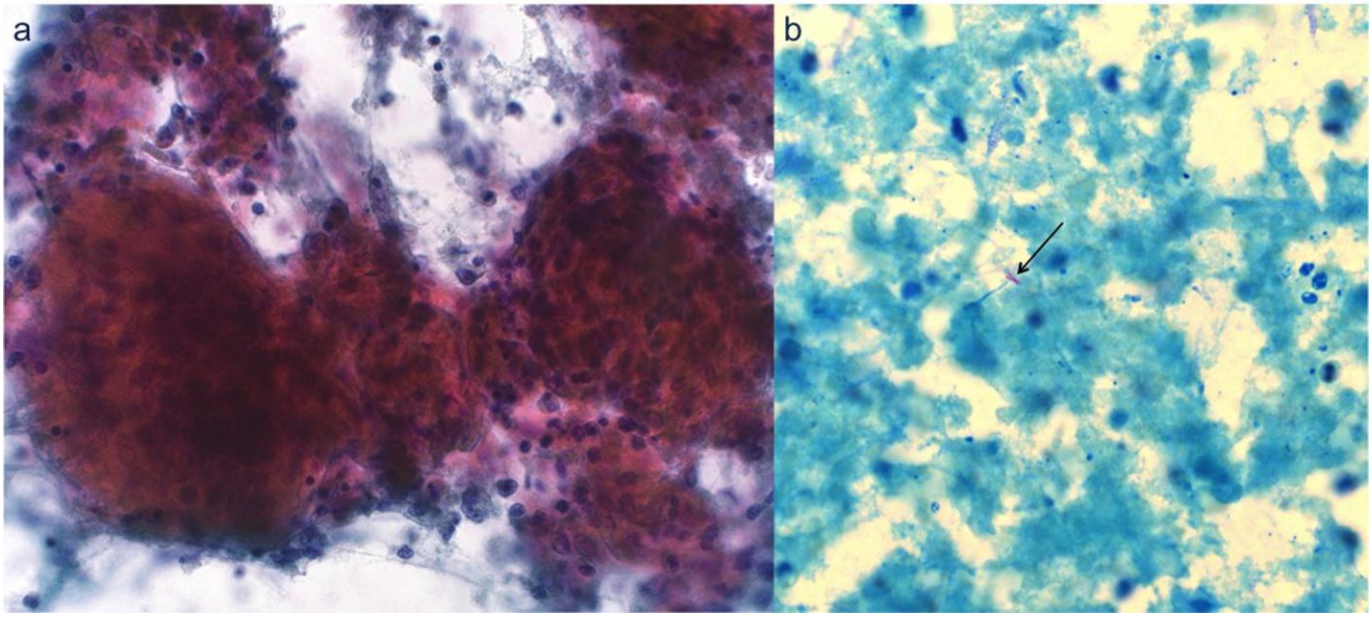

Figure 9: A 29-year-old male with isolated pancreatic tuberculosis. Biopsy material of the pancreatic multi-cystic mass, obtained via endoscopic ultrasound guided fine-needle aspiration. Histopathological examination revealed a necrotizing granulomatous infection (a) and acid-fast bacilli (arrow) (b). (a) Papanicolaou-stain, original magnification x 400; (b) Fite stain, original maginification x 600
Pathology images courtesy Dr. Daniela Kaup, Cantonal Institute of Pathology, Liestal, Switzerland

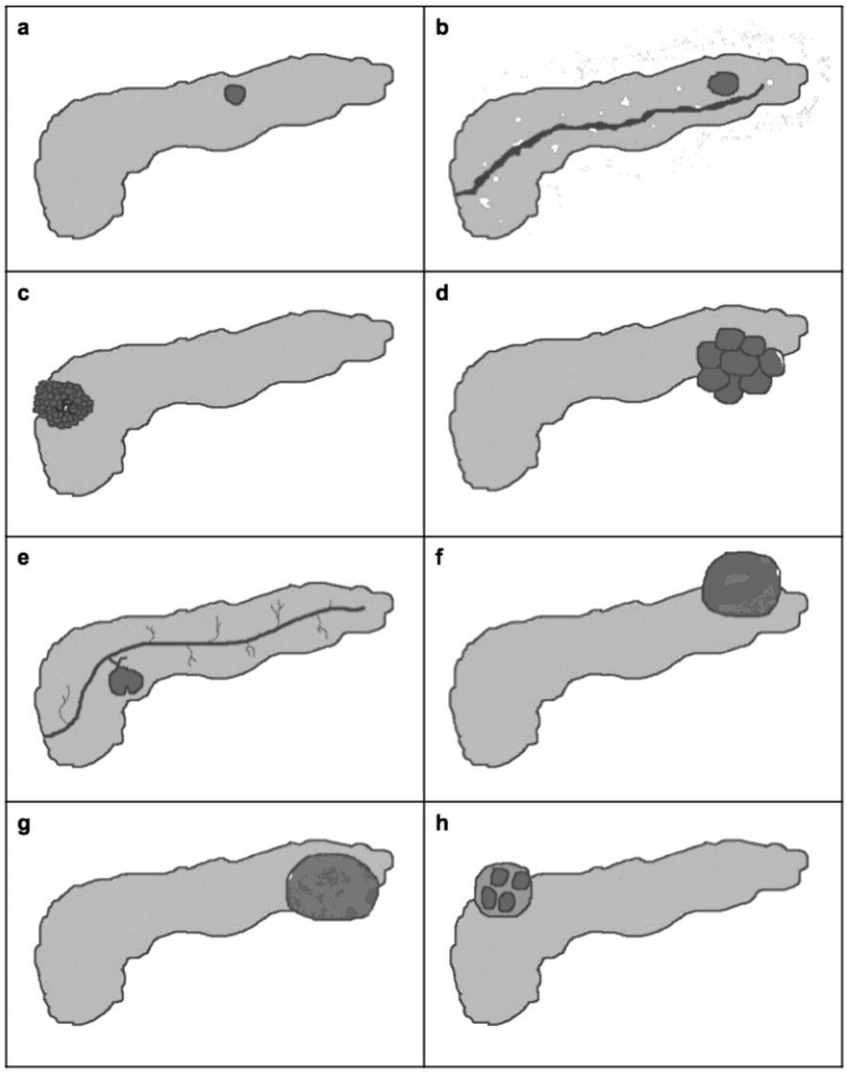

Figure 10 (left): Schematic illustrations of cystic pancreatic lesions: (a) epithelial cyst; (b) pseudocyst typically results from pancreatitis, which can also lead to calcifications of the pancreas (white), to irregular pancreatic duct dilatation and to inflammatory changes in the peripancreatic fat; (c)* serous cystadenoma consists of microcystic lesions with a star-like scar (black) with calcifications (white) in the center; (d)* mucinous cystadenoma presents with macrocystic lesions with peripheral calcification (white); (e)* intraductal papillary mucinous neoplasm of the side-branch, which leads to pancreatic duct dilatation because of its communication with the pancreatic duct; (f and g) a solid pseudopapillary tumor and a non-functioning islet cell tumor are extremely difficult to differentiate in images, because both tend to hemorrhage (grey filling), can show calcifications (white) and can have a varying amount of cystic components (dark grey); (h) pancreatic tuberculosis, a solid mass with multiple cystic components.
All illustrations prepared by Anna L. Falkowski; *Modified from Acar et al [23]

Etiology	• Infection with Mycobacterium tuberculosis. • May occur in the setting of disseminated tuberculosis, hematogeneous spread (miliary tuberculosis), penetration of the pancreas by tubercular growth in adjacent abdominal lymph nodes, reactivation of previous abdominal tuberculosis [6, 10, 11].
Incidence	Rare. Fewer than 100 cases published worldwide [5, 6]. Reported in 4.7% of patients with miliary tuberculosis [9].
Gender ratio	Conflicting information on possible gender predominance reported in literature [2, 5].
Age predilection	50% of the reported cases are <30 years old [5].
Risk factors	Exposure to patients with contagious forms of tuberculosis; immunosuppression (e.g. HIV infection) as a risk factor for reactivation of previously latent tuberculosis [2-4].
Treatment	Antituberculous drugs [2].
Prognosis	Excellent, with complete clinical resolution, if the diagnosis is made, specific antimycobacterial therapy is instituted, and the organisms are not multidrug resistant [5].
Imaging findings	• Mostly solitary lesions with multiple cystic components, located in the pancreatic body or head and/or in peripancreatic lymph nodes [5, 11]. • The cystic components of the lesion itself are typically hypoechoic (sometimes hypo-isoechoic) on ultrasound, hypodense on CT, hypointense on T1-weighted MRI and hyperintense on T2-weighted MRI [5]. • Contrast enhancement occurs in septations and also rim enhancement in the peripancreatic lymph nodes [11]. • Pancreatic duct is typically not dilated. • The appearance of the pancreas may be heterogeneous, typically without calcifications [5, 11]. • Associated findings might be ascites, mural thickening of the ileocecal region, peritoneal, mesenteric masses and splenic and/or hepatic lesions [5, 13].

Table 1: Summary table of pancreatic tuberculosis

Diagnosis	**Head**	**Body**	**Tail**	**Gender ratio**	**Age predilection**	**Malignant potential**
Epithelial cyst	o	o	o	o	o	-
Pseudocyst	.	+	+	M	young and middle aged adults	-
Serous cystadenoma	+	.	.	F	> 60 “grandmother”	-
Mucinous cystadenoma	.	+	+	F	40 – 60 “mother”	+
IPMN	+	.	.	M	> 60	+
Solid pseudopapillary tumor	+	.	+	F	20-40 “daughter”	+
Non-functioning islet cell tumor	.	.	+	F	70, earlier in patients with MEN 1	+
Isolated tuberculosis	+	+	.	(F = M)*	< 30	-

Table 2: Common localizations of cystic lesions in the pancreas (+/. : most/rare localization; o: no predominance found in literature), their typical gender ratio (F: female, M: male) and age predilection, as well as their malignant potential (+/-: present/absent). *Conflicting information in literature.

Diagnosis	US	CT	MRI	Contrast enhancement
Epithelial cyst	anechoic	hypodense	T1: hypointense, T2: hyperintense	might have mild enhancement of the thin epithelial wall
Pseudocyst	anechoic or hypoechoic, pancreatic calcifications might be seen	hypodense, pancreatic calcifications and inflammatory changes in the peripancreatic fat might be seen	T1: hypointense, T2: hyperintense, Debris or hemorrhage can change the intensity	might have mild enhancement of the thin fibrous capsule, no inner enhancement
Serous cystadenoma	inhomogeneous, hypoechoic or anechoic mass	hypodense, central calcified scar (20-30%), honeycomb pattern due to multiple microcysts, microcysts can mimic solid mass	T1: hypointense, T2: hyperintense, honeycomb pattern due to multiple microcysts	in the fibrous scar (late enhancement), wall and septa
Mucinous cystadenoma	hypoechoic, macrocystic (>2cm)	hypodense, uni- or multilocular, peripheral calcification (10-25%)	T1: hypointense (fluid-like content) but may vary if cysts content gets thicker, T2: hyperintense, uni- or multilocular	in septa and cyst wall
IPMN	hypoechoic, pancreatic duct dilatation	hypodense, pancreatic duct dilatation	T1: hypointense, T2: hyperintense, pancreatic duct dilatation, communication of cystic mass with the pancreatic duct best seen on MRCP	usually absent, may occur in septa
Solid pseudopapillary tumor	heterogeneous mass with anechoic or hypoechoic (cystic areas) and hyperechoic (solid areas) components	heterogeneous hypodense thick-walled mass, varying amount of cystic components, peripheral calcification (30%)	heterogeneous, due to varying amount of solid, cystic and hemorrhagic components	in the solid parts, peripheral rim enhancement in thick fibrous capsule, progressive heterogeneous fill-in on dynamic enhanced images
Non-functioning islet cell tumor	heterogeneous mass with anechoic (cystic areas) and hyperechoic (solid areas) components	heterogeneous, varying amount of cystic and necrotic components, calcifications	heterogeneous, due to varying amount of solid, cystic and hemorrhagic components	strong arterial enhancement in solid periphery
Isolated tuberculosis	mass with multiple hypoechoic (sometimes hypo-isoechoic) cystic components	mass with multiple hypodense cystic components	mass with cystic components which presents T1: hypointense T2: hyperintense	in septa, rim enhancement of lymph nodes

Table 3: Differential diagnosis table of pancreatic tuberculosis

ABBREVIATIONS

CRP = C-Reactive Protein
CT = Computed tomography
EUS-FNA = Endoscopic Ultrasound Guided Fine-Needle Aspiration
HIV = Human Immunodeficiency Virus
IPMN = Intraductal papillary mucinous neoplasm
LDH = Lactate Dehydrogenase
MEN 1 = multiple endocrine neoplasia type 1
MR = Magnetic resonance
MRCP = Magnetic resonance cholangiopancreaticography
MRI = Magnetic resonance images
PCR = Polymerase Chain Reaction
TB = Tuberculosis
TE = Echo Time
TR = Repetition Time

KEYWORDS

Pancreas; pancreatic tuberculosis; cystic pancreatic lesion; ultrasound; CT; MRI; EUS

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