Pancreatic fistula after pancreaticoduodenectomy: CT findings and significance
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Section: Abdominal imaging
Area of Interest: Pancreas Paediatric
Procedure: Contrast agent-oral
Procedure: Staging
Procedure: Cholangiography
Procedure: Endoscopy
Procedure: Surgery
Imaging Technique: MR
Imaging Technique: CT
Special Focus: Fistula Neoplasia Prostheses Case
Type: Clinical Cases
Authors: Tonolini Massimo, M.D.
Patient: 72 years, male

Clinical History:

Prolonged postoperative hospitalization after Whipple pancreaticoduodenectomy with cough, intermittent fever, persistent output from drainage, without abdominal pain and blood loss. Surgery had been performed to remove a pT3N1 ductal adenocarcinoma of the pancreatic head, which had been previously treated at another hospital with positioning of a plastic biliary stent (Fig. 1).

Imaging Findings:

Early postoperative upper gastrointestinal study with ingested water-soluble contrast (Fig. 2) opacified the patent gastrojejunostomy, excluding extraluminal contrast leakage.

With increasing amylase levels in fluid from drainage positioned nearby the pancreatico-jejunal anastomosis (PJA), on postoperative day 9 multidetector CT (Fig. 3) showed basal pneumonia, expected postsurgical imaging findings, and a mixed-attenuation collection extending upwards from the PJA site between the pancreatic body-tail remnant and jejunal loop, consistent with the clinicobiologic diagnosis of postoperative pancreatic fistula (POPF).

Conservative treatment including intensive antibiotics allowed prompt clinical improvement, decrease of drainage output and near-complete resolution of CT changes (Fig. 4).

Before discharge, the patient experienced “sentinel” haematemesis, which was stopped with endoscopic clipping (Fig. 5) under general anaesthesia with the PJA reached through the gastrojejunostomy. Days later, a life-threatening bout of post-POPF bleeding from the PJA was successfully treated by emergency laparotomic haemostasis.

Following discharge, the patient did well and distant follow-up CT (Fig. 6) excluded signs of neoplastic recurrence.

Discussion:

A complex surgery, pancreaticoduodenectomy (PD) represents the standard treatment and only chance for cure for tumours of the pancreatic head, extrahepatic bile duct, ampulla and duodenum. The pylorus-preserving technique differs from the classic Whipple PD, which involves removal of the pancreatic head, neck and uncinate process.
along with distal bile duct, gallbladder, gastric antrum, duodenum and proximal jejunum, plus regional lymph node dissection [1].

While perioperative mortality is currently limited (<3%) at high-volume centres, morbidity remains high (30-50%). Post-PD complications commonly result in prolonged hospitalization, failed discharge (20-25%), need for reoperation (9-14%) or interventional procedures, and non-negligible mortality (3-9%). The commonest adverse events are delayed gastric emptying (20-50% of patients) and postoperative pancreatic fistula (POPF), followed by biloma (9%), early or delayed bleeding, abscesses, pancreatitis, venous thrombosis in descending order of frequency [1-4].

More common after PD for ampullary rather than pancreatic tumours, POPF corresponds to leaking pancreatic secretions at the pancreatico-jejunostomy (PJ) and represents the most important source of postoperative morbidity (reported rates vary up to 30%) with substantial mortality. According to the International Study Group, POPF is defined by any measurable output from peripancreatic drainage on or after postoperative day 3 with amylase content >3 times the serum amylase, or alternatively diagnosed at reoperation or percutaneous drainage. Risk factors include intraoperative blood loss, obesity, soft pancreas, fatty infiltration of abdominal viscera and paraspinal muscles, small pancreatic duct size [2, 4-7].

The above-described clinico-biologic criterium diagnoses POPF on average 7 days after PD with 70-75% sensitivity. Unfortunately, POPF may manifest after discharge or resumption of oral feeding. Use of CT is valuable to decrease the occurrence of occult or delayed POPF, which is heralded by a focal collection with variable attenuation in the surgical bed, particularly abutting the PJ. Routine CT screening on day 7 in high-risk patients resulted in diagnosis of POPF in 54% of cases with 63% sensitivity and 83% specificity. False-positive collections were those smaller than 2 cm, without air bubbles and disappearing at follow-up; conversely false negative scans resulted from drainage tube placed immediately adjacent to the anastomosis [8-11].

Almost 90% of POPF cases can be managed nonsurgically with parenteral nutrition until fistula closure, or with percutaneous drainage of dominant collections. Importantly, POPF is associated (incidence 51% versus 21% in patients without POPF) with occurrence of other nonfistulous complications such as pancreatitis, abscess formation, haemorrhage, wound infection, sepsis, bile leak and reoperation [4, 12-14].

**Differential Diagnosis List:**  Pancreatic fistula after pancreaticoduodenectomy for pancreatic head adenocarcinoma, Normal postoperative course and imaging appearances, Bile collection (biloma), Postoperative abscess collection, Intra / extraluminal haemorrhage, Postoperative acute pancreatitis of gland remnant

**Final Diagnosis:**  Pancreatic fistula after pancreaticoduodenectomy for pancreatic head adenocarcinoma

**References:**


Description: Preoperatively, MRI performed at another hospital showed a 3.5 cm round mass lesion (arrowheads) in the pancreatic head, with moderately high heterogeneous T2 signal intensity. Origin: Tonolini M., Radiology "Luigi Sacco" University Hospital, Milan (Italy)
Description: MR-cholangiographic images depicted severe dilatation of intrahepatic and common bile ducts caused by the pancreatic head mass lesion, plus dilatation of the Wirsung pancreatic duct. Origin: Tonolini M., Radiology "Luigi Sacco" University Hospital, Milan (Italy)
Description: The pancreatic head mass (arrowheads) showed restricted diffusion as seen in the B800 image (c), with corresponding low apparent diffusion coefficient (ADC) (d). Origin: Tonolini M., Radiology "Luigi Sacco" University Hospital, Milan (Italy)
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**Description:** The pancreatic head mass (arrowheads) showed hypointense T1 signal intensity (e) and poor inhomogeneous (predominantly peripheral) vascularization after intravenous gadolinium contrast (f). **Origin:** Tonolini M., Radiology "Luigi Sacco" University Hospital, Milan (Italy)
**Description:** The pancreatic head mass (arrowheads) showed hypointense T1 signal intensity (e) and poor inhomogeneous (predominantly peripheral) vascularization after intravenous gadolinium contrast (f). **Origin:** Tonolini M., Radiology "Luigi Sacco" University Hospital, Milan (Italy)
**Description:** Before surgery, radiographic image showed plastic biliary stent (arrows) positioned endoscopically at another hospital. **Origin:** Tonolini M., Radiology "Luigi Sacco" University Hospital, Milan (Italy)
Figure 2

Description: On 6th postoperative day, ingestion of water-soluble contrast opacified the moderately distended stomach (*) and patent gastrojejunostomy (thick arrow), without extraluminal contrast leakage. Origin: Tonolini M., Radiology "Luigi Sacco" University Hospital, Milan (Italy)
Description: Distant follow-up CT excluded signs of neoplastic recurrence. The haemostatic endoscopic clips were removed during emergency surgery. Stable findings concerning the site of resection and the pancreatic gland remnant (arrowheads). **Origin:** Tonolini M., Radiology "Luigi Sacco" University Hospital, Milan (Italy)
**Description:** Distant follow-up CT excluded signs of neoplastic recurrence. Stable findings concerning the site of resection, the pancreatic gland remnant (arrowheads), anastomised jejunal loop (arrows), and mesenteric lymph nodes (short arrows). **Origin:** Tonolini M., Radiology "Luigi Sacco" University Hospital, Milan (Italy)
Description: Distant follow-up CT excluded signs of neoplastic recurrence. Stable findings concerning the site of resection, the pancreatic gland remnant (arrowheads), anastomised jejunal loop (arrows), and mesenteric lymph nodes (short arrows). Origin: Tonolini M., Radiology "Luigi Sacco" University Hospital, Milan (Italy)
Description: Detailed image confirmed stability over time of sub-centimetre mesenteric lymph nodes (short arrows). Origin: Tonolini M., Radiology "Luigi Sacco" University Hospital, Milan (Italy)
Description: On unenhanced CT images a pneumonic-atelectatic consolidation was noted at the right lung base, without associated pleural effusion. Origin: Tonolini M., Radiology "Luigi Sacco" University Hospital, Milan (Italy)
**Description:** Arterial-phase images (b..e) showed expected postoperative findings including intrahepatic pneumobilia (arrow), scanty perihepatic fluid (*), stapled gastrojejunostomy (short arrows).

**Origin:** Tonolini M., Radiology "Luigi Sacco" University Hospital, Milan (Italy)
Description: Additionally, a mixed-attenuation collection (+) with gas bubbles (thin arrows) was seen extending upwards from the site of the pancreatico-jejunal anastomosis. Note the pancreatic gland remnant (arrowheads). Origin: Tonolini M., Radiology "Luigi Sacco" University Hospital, Milan (Italy)
Description: A mixed-attenuation collection (+) without signs of active bleeding was seen extending upwards from the site of the pancreatico-jejunal anastomosis. Note the pancreatic gland remnant (arrowheads), anastomised jejunal loop (arrow). Origin: Tonolini M., Radiology "Luigi Sacco" University Hospital, Milan (Italy)
Description: A mixed-attenuation collection (+) with gas bubbles (thin arrows) was seen extending upwards from the site of the pancreatico-jejunal anastomosis. Note the pancreatic gland remnant (arrowheads), anastomised jejunal loop (arrow). Origin: Tonolini M., Radiology "Luigi Sacco" University Hospital, Milan (Italy)
Description: Portal venous phase images (f...h) confirmed mixed-attenuation collection (+) extending upwards from the site of the pancreatico-jejunal anastomosis, interposed between pancreatic gland remnant (arrowheads) and anastomised jejunal loop (arrow). Origin: Tonolini M., Radiology "Luigi Sacco" University Hospital, Milan (Italy)
Description: Portal venous phase images confirmed mixed-attenuation collection (+) with gas bubbles (thin arrow) extending upwards from the site of the pancreatico-jejunal anastomosis. Note the pancreatic gland remnant (arrowheads). Origin: Tonolini M., Radiology "Luigi Sacco" University Hospital, Milan (Italy)
Description: Portal venous phase images confirmed mixed-attenuation collection (+) with gas bubbles (thin arrow) extending upwards from the site of the pancreatico-jejunal anastomosis. Note the pancreatic gland remnant (arrowheads). Origin: Tonolini M., Radiology "Luigi Sacco" University Hospital, Milan (Italy)
**Description:** Portal venous phase images confirmed mixed-attenuation collection (+) with gas bubbles (thin arrow) extending upwards from the pancreatico-jejunal anastomosis. Note the pancreatic gland remnant (arrowheads), anastomised jejunal loop (arrow). **Origin:** Tonolini M., Radiology "Luigi Sacco" University Hospital, Milan (Italy)
Description: After endoscopic haemostasis, repeated contrast-enhanced CT showed a metallic clip in the site of pancreatico-jejunal anastomosis (thin arrows); stable findings concerning pancreatic gland remnant (arrowheads) and jejunal loop (arrows in b). **Origin:** Tonolini M., Radiology "Luigi Sacco" University Hospital, Milan (Italy)
Description: After endoscopic haemostasis, repeated contrast-enhanced CT showed a metallic clip in the site of pancreatic-jejunal anastomosis (thin arrows); stable findings concerning the pancreatic gland remnant (arrowheads) and jejunal loop (arrows in b). Origin: Tonolini M., Radiology "Luigi Sacco" University Hospital, Milan (Italy)
Figure 6

Description: Axial (a) and coronal (b) post-contrast images showed near-complete resolution of the collection (thin arrows) at the pancreatico-jejunal anastomosis. Note pancreatic gland remnant (arrowheads) and jejunal loop (arrow in b). Origin: Tonolini M., Radiology "Luigi Sacco" University Hospital, Milan (Italy)
Description: Axial (a) and coronal (b) post-contrast images showed near-complete resolution of the collection (thin arrows) at the pancreatico-jejunal anastomosis. Note the pancreatic gland remnant (arrowheads) and jejunal loop (arrow in b). Origin: Tonolini M., Radiology "Luigi Sacco" University Hospital, Milan (Italy)