

Vascular complications of acute pancreatitis - imaging features and interventional management.

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Learning objectives

Acute pancreatitis is an inflammatory condition of the pancreas which is associated With significant morbidity and mortality. There are a number of causes of acute pancreatitis, the most common aetiology in Europe is alcoholic pancreatitis followed by gallstone pancreatitis.

There are two types of acute pancreatitis:

- Interstitial oedematous pancreatitis
- Necrotising pancreatitis

The aims of this educational exhibit are as follows:

- 1. Discuss the cross-sectional imaging features of acute pancreatitis and associated complications.**
- 2. Outline the role interventional radiology plays in the treatment and Management of complicated acute pancreatitis using cases as examples**

Background

Internationally, the incidence of acute pancreatitis is increasing. Data suggests the range in incidence of acute pancreatitis across Europe is 4.6 – 100/100,000 population.

The approach to the diagnosis and management of pancreatitis is multi-disciplinary, with diagnostic and interventional radiology fundamental to both. The clinical presentation of acute pancreatitis is variable (epigastric pain, nausea, vomiting and rigors). An elevated serum amylase (or lipase) greater than 3 times the normal level is a diagnostic marker of acute pancreatitis. Surgeons use the Glasgow IMRIE score or the APACHE 2 score as a prognostic tool in the evaluation of the patients clinical course. The Balthazar and the revised Atlanta 2012 are imaging prognostic tools which can be used.

Cross-sectional imaging particularly computed tomography (CT) is used for identifying pancreatic necrosis, peri-pancreatic collections / inflammation and vascular complications.

Walled off pancreatic necrosis, collections and vascular complications are often treated in by interventional radiology. The vascular complications can be broadly classified as arterial or venous.

Background

CT Severity assessment index (Balthazar score + pancreatic necrosis).

Balthazar score -

- A: Normal pancreas: 0
- B: Enlargement of pancreas: 1
- C: Inflammatory changes in pancreas and peripancreatic fat: 2
- D: Ill-defined single peripancreatic fluid collection: 3
- E: Two or more poorly defined peripancreatic fluid collections: 4

Pancreatic necrosis-

- None: 0
- $\leq 30\%$: 2
- $>30-50\%$: 4
- $>50\%$: 6

The maximum score is 10.

The revised Atlanta 2012 classification is a further tool to identify interstitial oedematous pancreatitis from necrotising pancreatitis.

Background

Severity is classified as Mild, Moderate or Severe which has prognostic implications as outlined below.

Acute pancreatitis	Mild	Moderate	Severe
Structural changes	Interstitial oedema	Interstitial oedema Necrosis	Interstitial oedema Necrosis
Local or systemic complications	No	Yes	Yes
Functional changes	No organ failure (OF)	Transient OF	- Persistent OF - Transient or persistent multi-organ failure
Morbidity	Low	High	High
Mortality	No	Low	High

Background



←→ Axial CT post IV contrast. The pancreas is thickened and enlarged with loss of the normal fat lobulations. There is diffuse peri-pancreatic fat stranding and inflammation extending into the retroperitoneum. The gland enhances homogeneously without necrosis on this image.



← Axial CT post IV contrast. There is a rim enhancing hypoattenuating collection replacing the normal pancreatic parenchyma consistent with walled off necrosis. Marked peri-pancreatic inflammation.

Imaging findings / procedure details

CT has an important role to play in confirming the diagnosis of pancreatitis, identifying possible aetiologies as well as identifying vascular (both arterial and venous) and other complications. Prognosis can be guided using the Balthazar score. CT features of acute pancreatitis include diffuse glandular enlargement, irregular contour, focal hypodense regions of necrosis/oedema, increased density of peri-pancreatic fat and peri-pancreatic fluid collections.

The conventional modalities for the imaging and diagnosis of vascular complications arising in pancreatitis include (i) Ultrasound (ii) CT (iii) Angiography: CT angiography, DSA and catheter angiography. Catheter angiography is required for the management of some of the vascular complications arising in pancreatitis.

Vascular complications of pancreatitis include:

- Haemorrhage
- Pseudo-aneurysm
- Venous thrombosis
- Vascular erosion

Imaging findings / procedure details

The use of CT angiography (CTA) can rapidly identify the vascular complications associated with pancreatitis and assist with planning definitive treatment. Digital subtraction angiography (DSA) and catheter angiography are also used for the diagnosis of these complications and used for therapeutic interventions such as embolisation. CTA is favored for the treatment of pseudo-aneurysms (figure 1 and 2).

CT Pancreatitis Protocol:

Oral contrast: Consider water only

IV contrast: Rate to 3 cc/sec

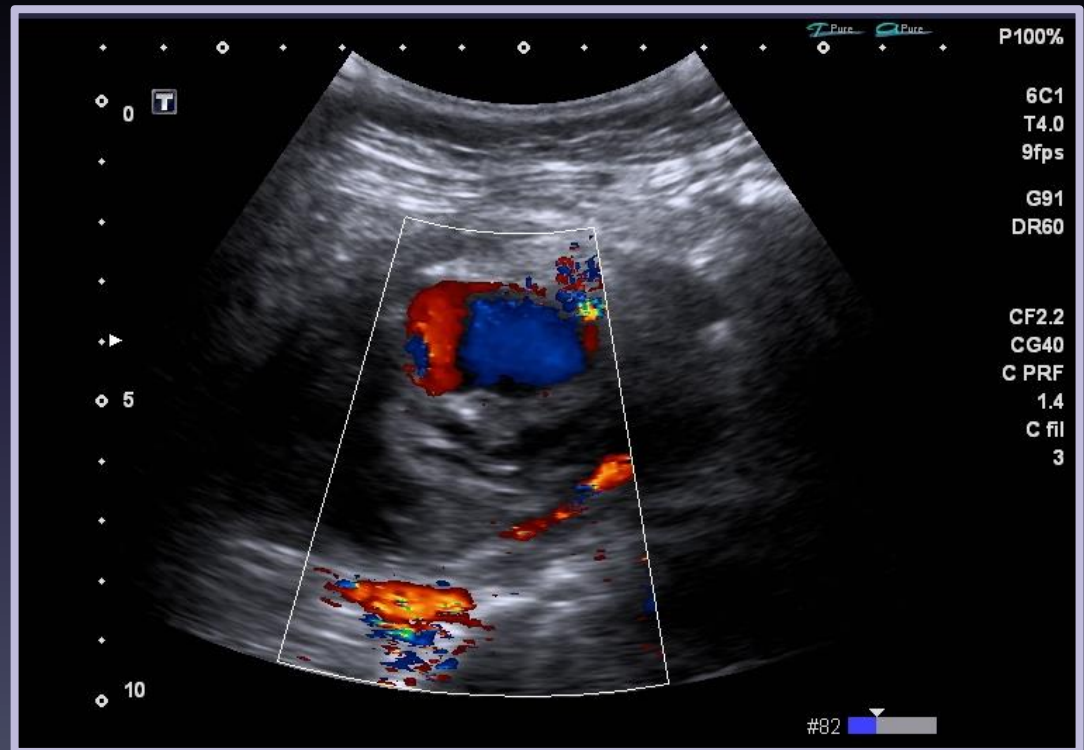
Acquisitions: consider dual-phase through upper abdomen at 30 sec and 70 sec

Slice thickness: 3-5 mm

Imaging findings / procedure details

Conventional ultrasound can be useful in the detection and treatment of peri-pancreatic fluid collections. These can be further characterised with the application of duplex USS, which can identify aneurysms. A hypoechoic mass with turbulent blood flow is highly suggestive of a pseudo-aneurysm. Doppler ultrasound can also identify splenic vein thrombosis.

Ultrasound image of a pseudo-aneurysm at the pancreatic head secondary to acute pancreatitis. Doppler colour flow shows the characteristic features of a pseudo-aneurysm.

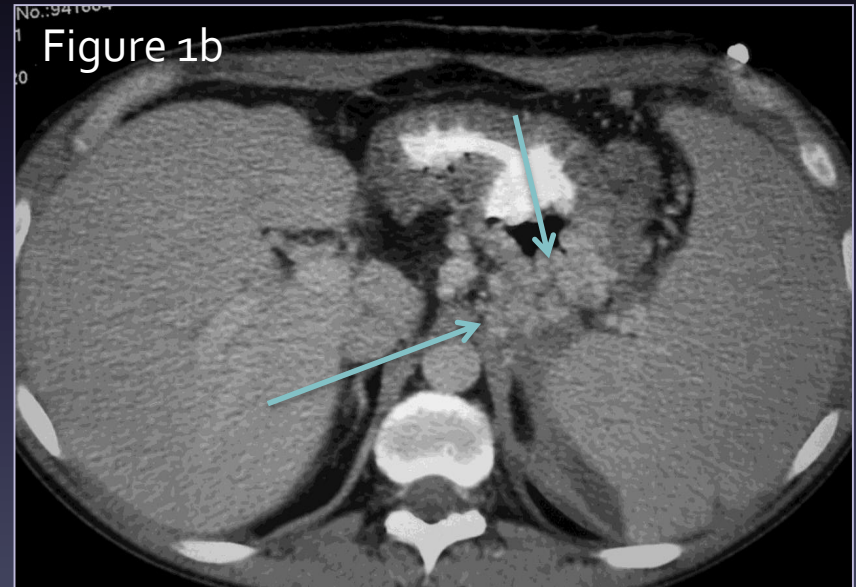


Imaging findings / procedure details

Venous complications include thrombosis of the splanchnic venous system with or without associated varices. Splanchnic thrombosis may be seen in up to 25% of necrotising pancreatitis patients. The splenic vein is most consistently cited as the most frequently affected followed by the superior mesenteric vein and portal veins. Significant haemorrhage can also ensue in the setting of venous thrombosis where gastric, colonic or mesenteric varices develop.



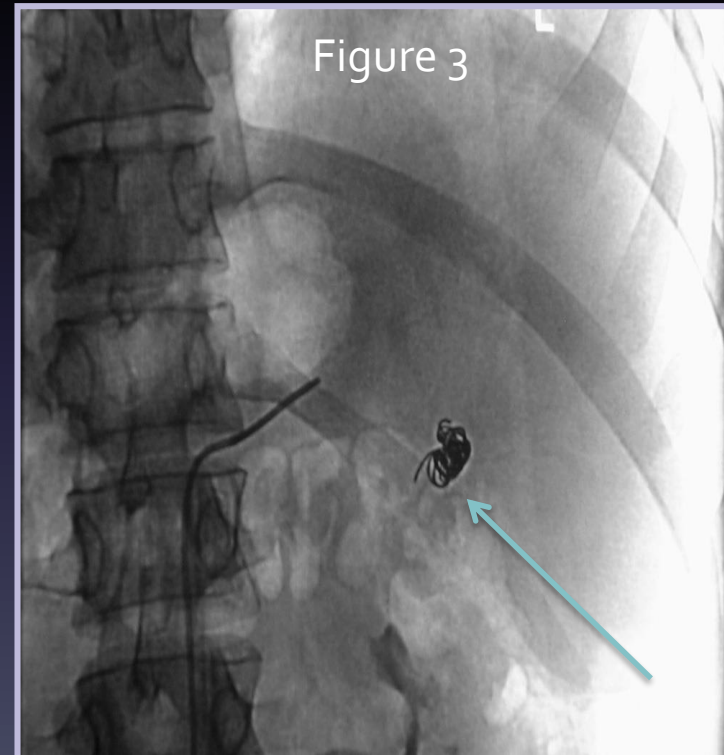
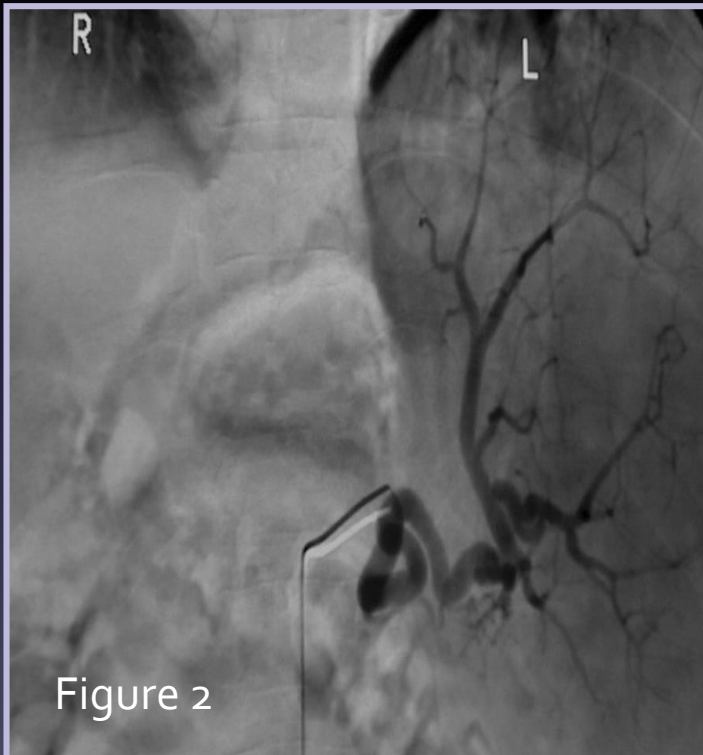
White arrow points to a thrombosed portal vein



The blue arrows point to gastric and oesophageal varices secondary to portal vein occlusion

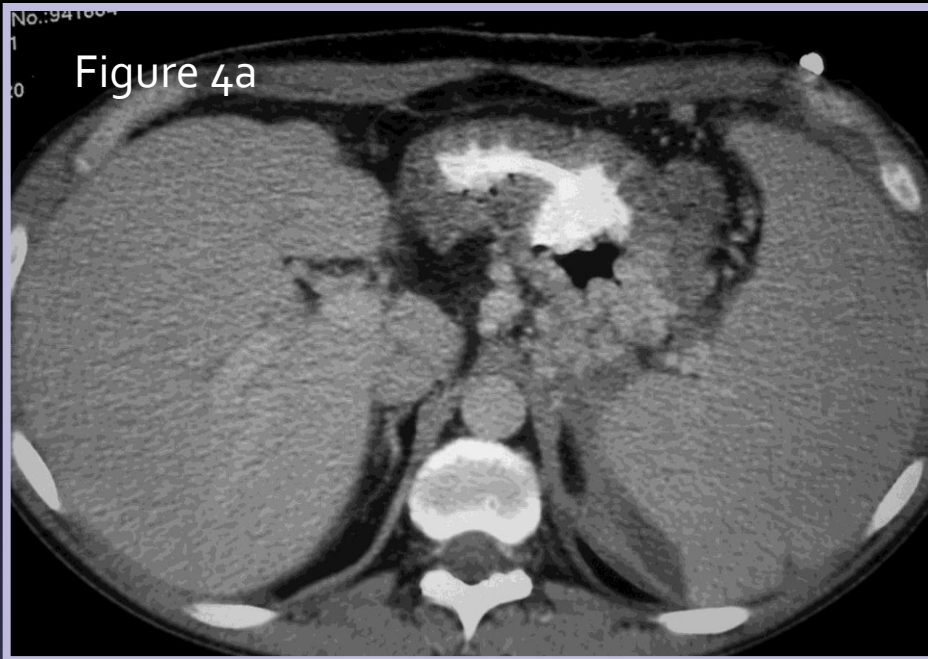
Imaging findings / procedure details

Venous complications the patient featured in figures 3a and 3b was referred to Interventional Radiology following two large variceal bleeds. He was deemed not to be a surgical candidate. A catheter angiogram on the splenic arterial system was performed (Figure 4). The patient proceeded to a coil embolisation of the splenic artery (figure 5). Balloon-occluded retrograde transvenous occlusion is an emerging IR technique for the treatment of gastric varices that is currently being used in Japan (BORTO).

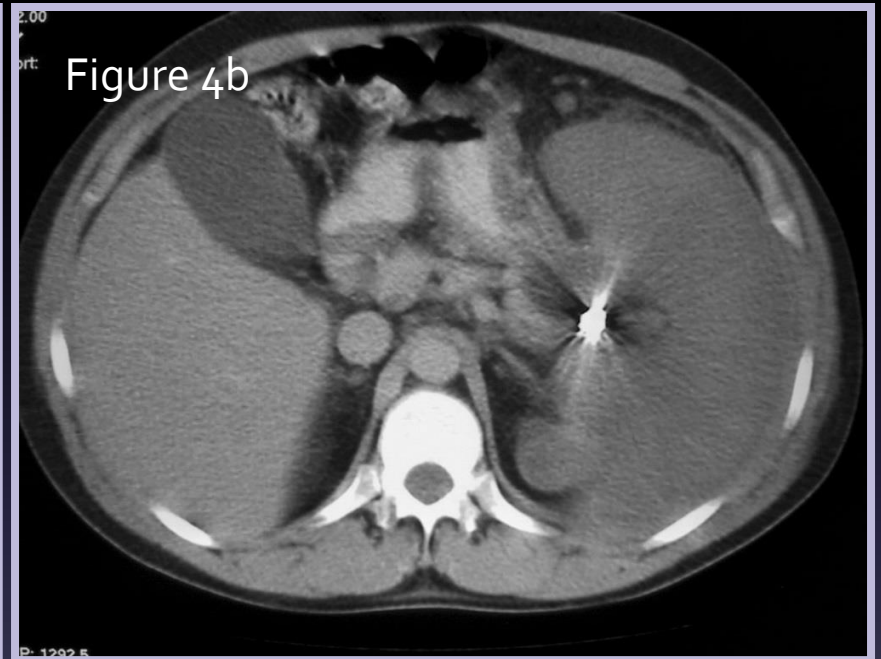


Imaging findings / procedure details

Venous complications



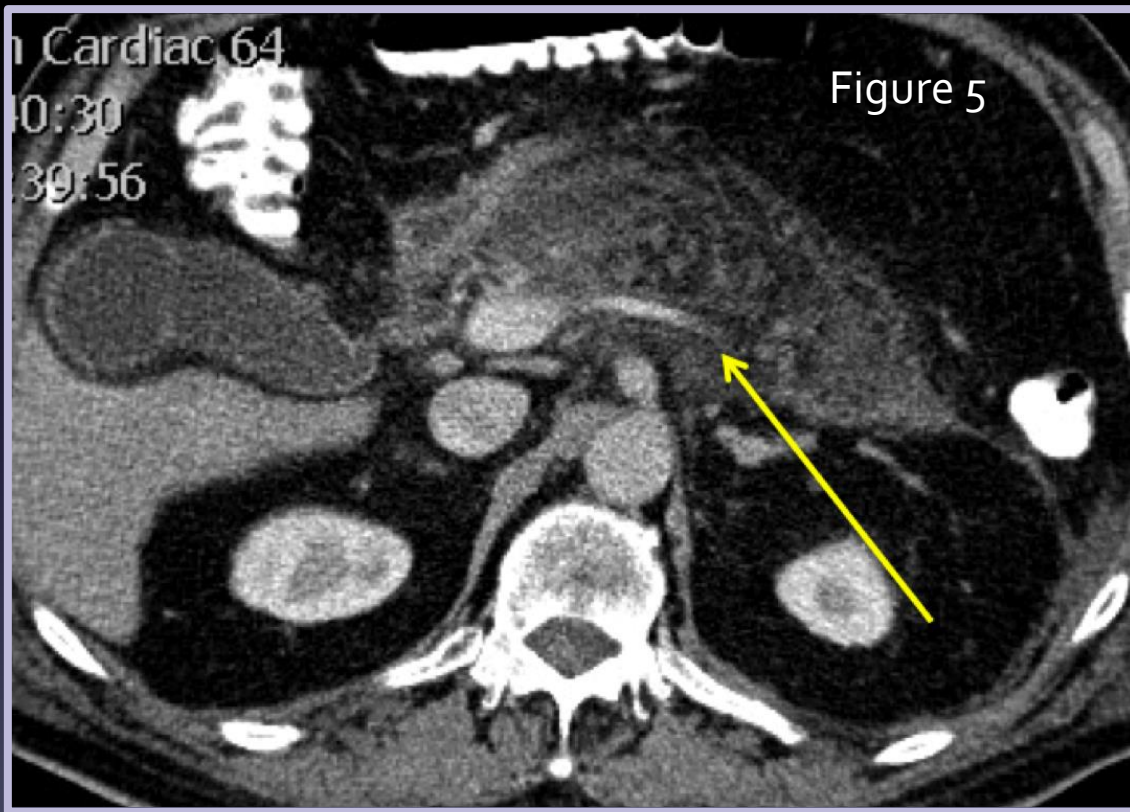
Pre-embolisation CT



Post-embolisation CT.
Coil seen at splenic hilum

Imaging findings / procedure details

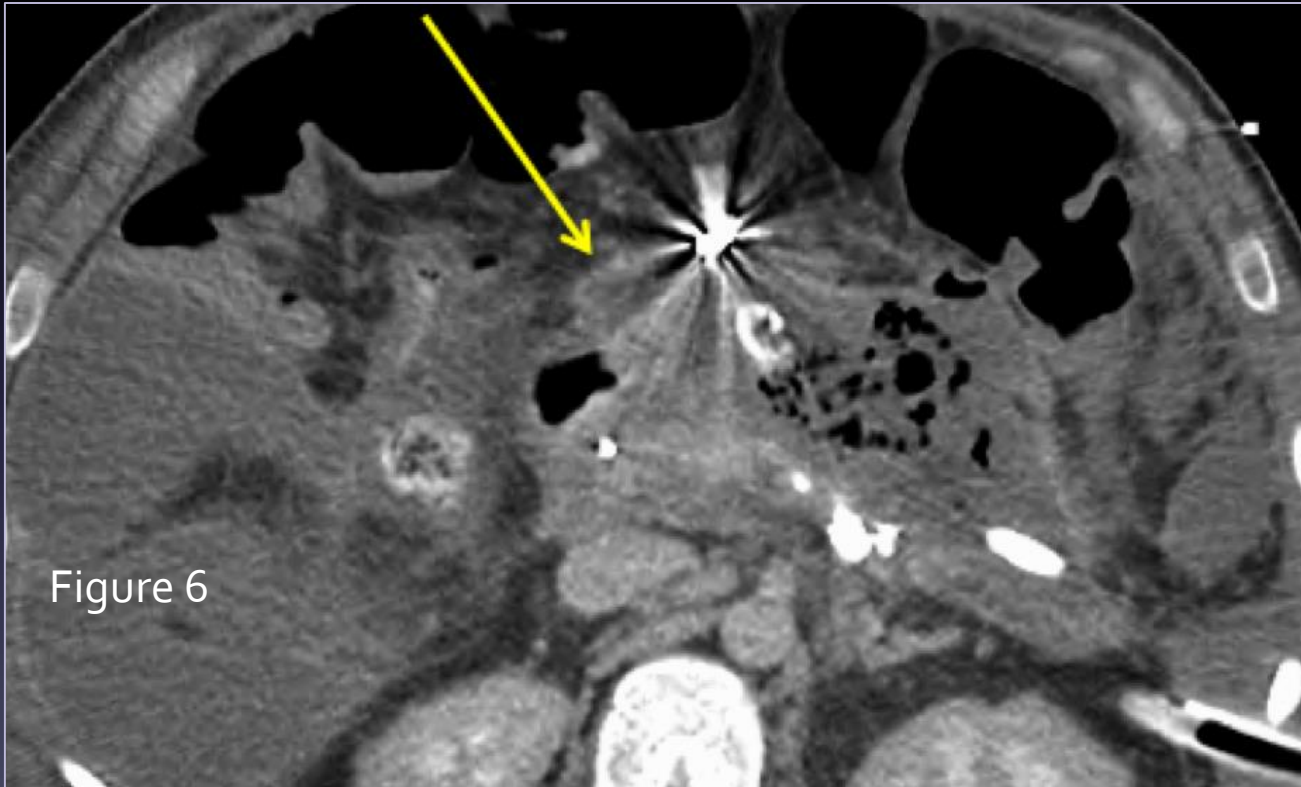
Venous complications



Further example of splenic vein thrombosis (yellow arrow).

Imaging findings / procedure details

Venous complications

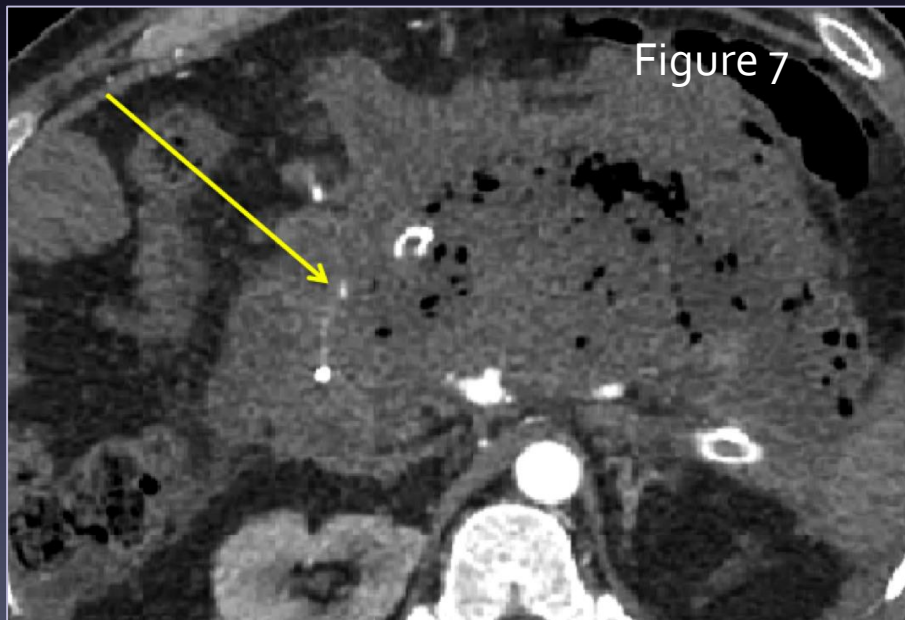


Example of super mesenteric vein thrombosis (yellow arrow).

Figure 6

Imaging findings / procedure details

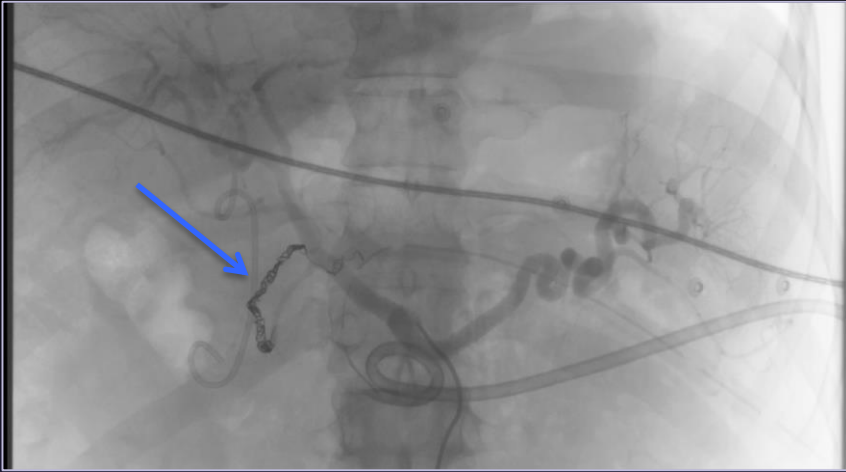
Arterial complications encompass direct erosion into a local artery, pseudoaneurysm formation as well as local and distant ischemic sequelae. Data suggests that 5% of cases of pancreatitis are complicated by peri-pancreatic haemorrhage . Pseudoaneurysms can arise as a result of enzymatic digestion of the vessel wall, or, when a visceral artery becomes incorporated into the wall of a pseudocyst . The splenic artery is most frequently associated with the formation of pseudoaneurysms in the setting of pancreatitis. The gastroduodenal artery, pancreaticoduodenal, left gastric and hepatic arteries can also be affected.



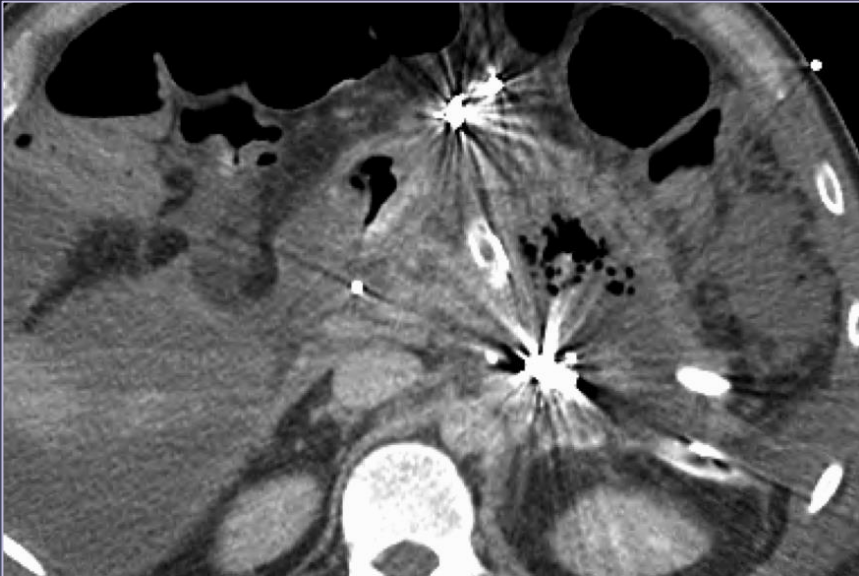
Necrotising pancreatitis complicated by Infection. The yellow arrow demonstrates a blush of arterial phase contrast consistent with active arterial haemorrhage.

Imaging findings / procedure details

Arterial complications: Below are images from the same patient depicted in figure 7.



Selective catheter angiography of the coeliac artery. There has been a coil embolisation of the gastroduodenal artery (blue arrow).



Portal venous phase axial CT post coil embolisation with streak artefact noted from coils. There is persistent peri-pancreatic inflammation and necrosis. With interval insertion of a percutaneous drain of the walled off necrosis.

Imaging findings / procedure details

Arterial complications:

Figure 9a.



Figure 9b.



Figure 1. Axial CT pre and post IV contrast. Figure 1a demonstrated a large pseudo-aneurysm centred at the pancreatic head (white arrow). There is significant associated peri-pancreatic inflammation and free fluid. Figure 2b demonstrates CT a percutaneous thrombin injection to treat the pseudo-aneurysm .

Imaging findings / procedure details

Arterial complications:

Figure 10

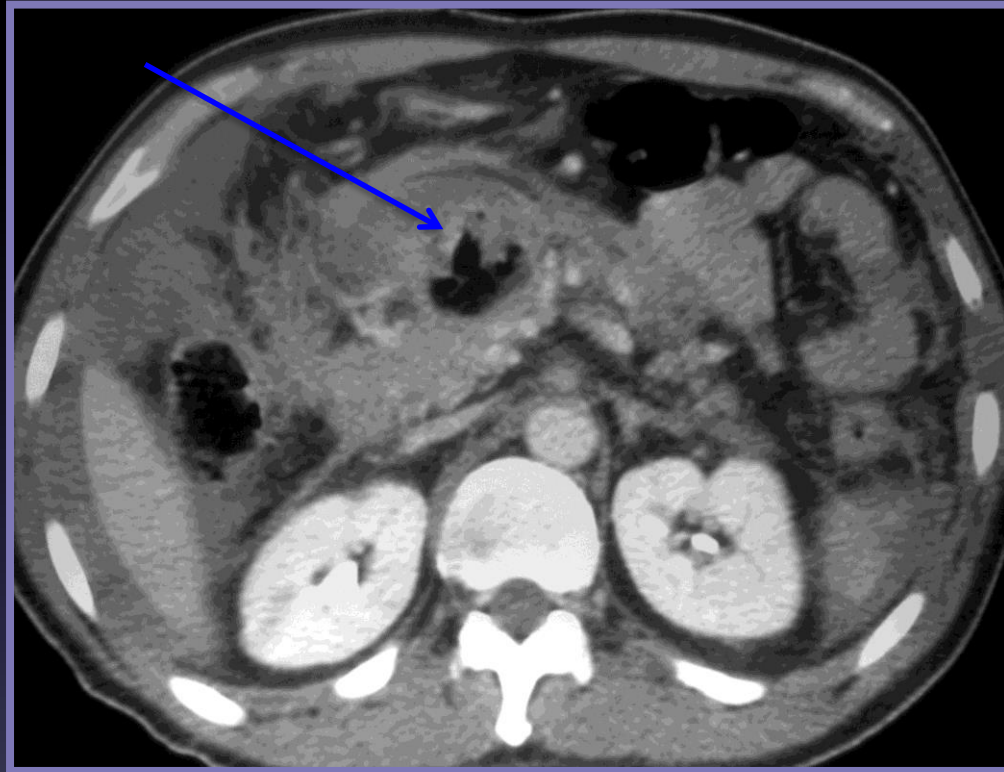
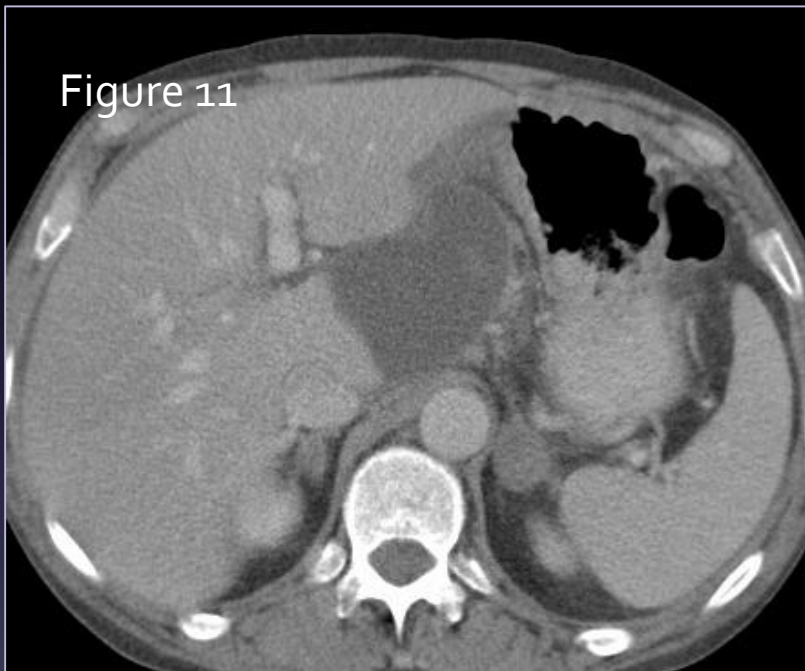


Figure 2. Axial post IV contrast CT post thrombin injection of the pancreatic head pseudo-aneurysm demonstrating successful treatment of the pseudo-aneurysm. There is no residual vascular flow within the lesion (blue arrow). There are persistent features of acute pancreatitis – peri-pancreatic free fluid, inflammation and fat stranding.

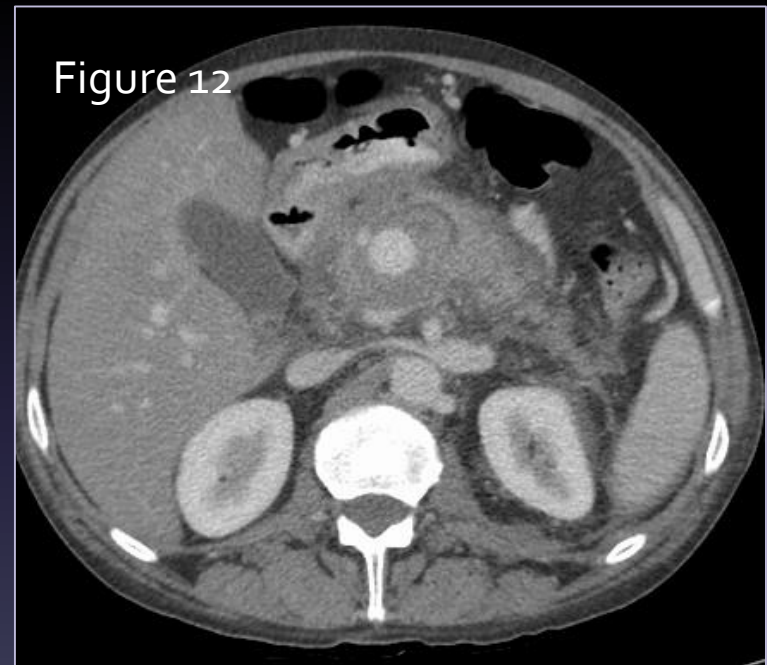
Imaging findings / procedure details

Arterial complications:

65 year old man with necrotising pancreatitis complicated by a walled off necrosis and an arterial pseudo-aneurysm of the gastro-duodenal artery



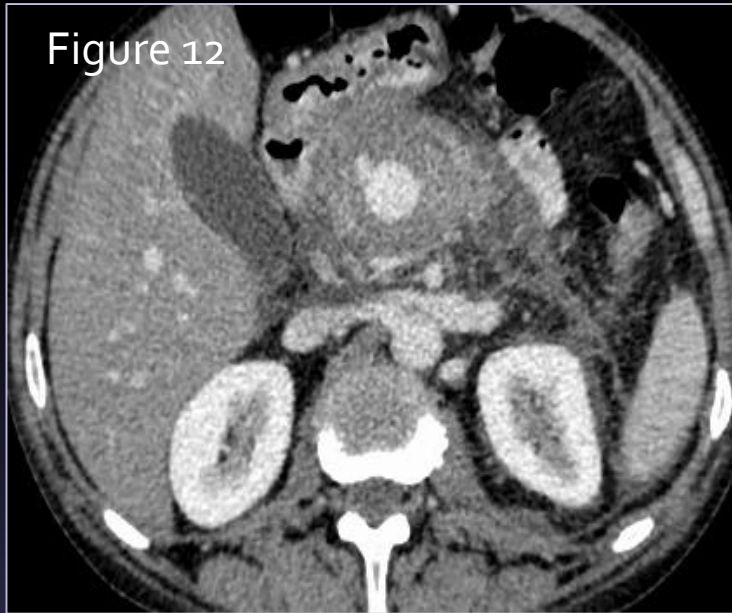
Day 5 axial CT - acute necrotising pancreatitis with walled of necrosis centred at the pancreatic head.



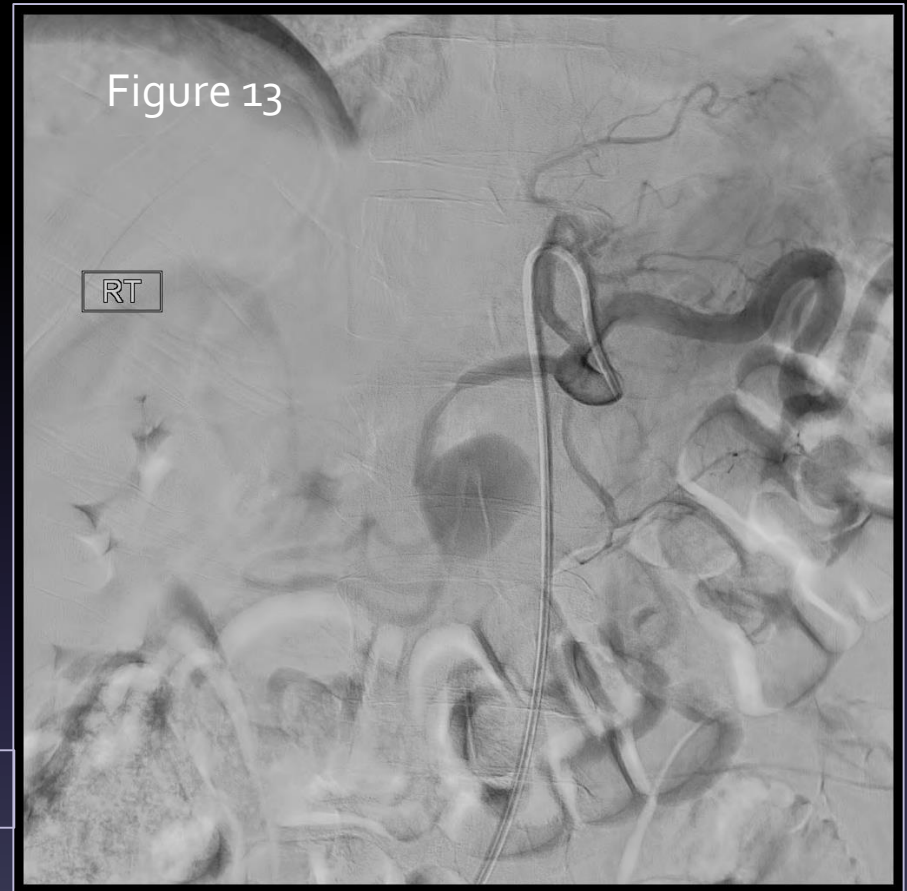
Day 14 – GDA pseudo-aneurysm has developed with the necrotic pancreatic tissue.

Imaging findings / procedure details

Arterial complications:



Arterial phase CT – GDA pseudo-aneurysm



Selective catheter angiography the the coeliac axis
Demonstrating the GDA pseudo-aneurysm

Imaging findings / procedure details

Arterial complications:

Figure 14



Selective catheter angiography of the coeliac axis post coil embolisation of the GDA pseudo-aneurysm.

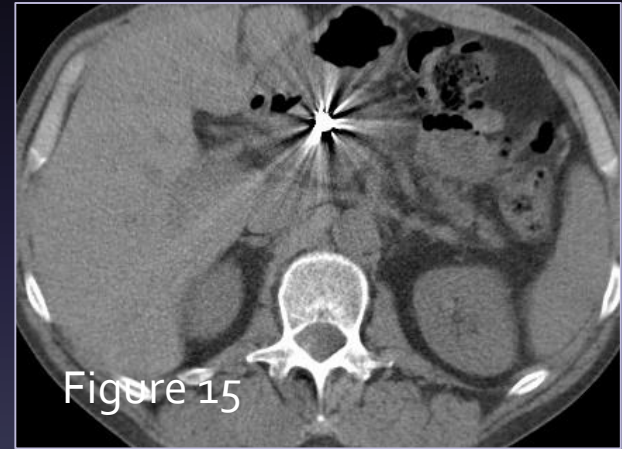


Figure 15 – post embolisation CT
Coils at the GDA causing metallic
streak artefact

Imaging findings / procedure details

Arterial complications:

55 year old man with acute necrotising pancreatitis. The patient had a drop in haemoglobin and a CT confirmed a pseudo-aneurysm and active haemorrhage within the necrotic pancreatic parenchyma. Selective catheter angiography was performed and the bleeding vessel was not identified. The patient was treated with ultrasound guided thrombin injection of the pseudo-aneurysm.

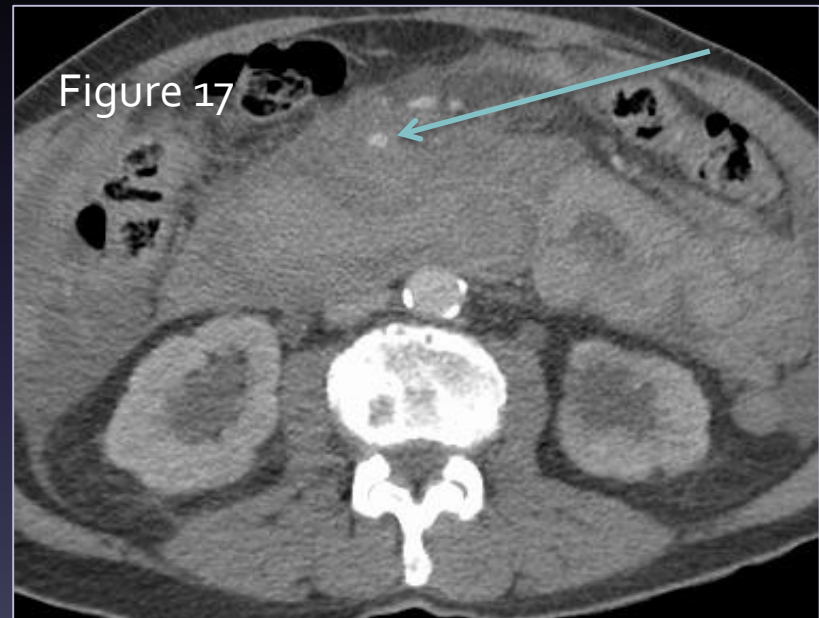


Figure 15 demonstrates a pseudo-aneurysm at the level of the uncinate process.
Figure 16 demonstrates a focus of active extravasation from an acute bleed (blue arrow)

Imaging findings / procedure details

Arterial complications:

Ultrasound evaluation of the pseudo-aneurysm pre and post thrombin injection.

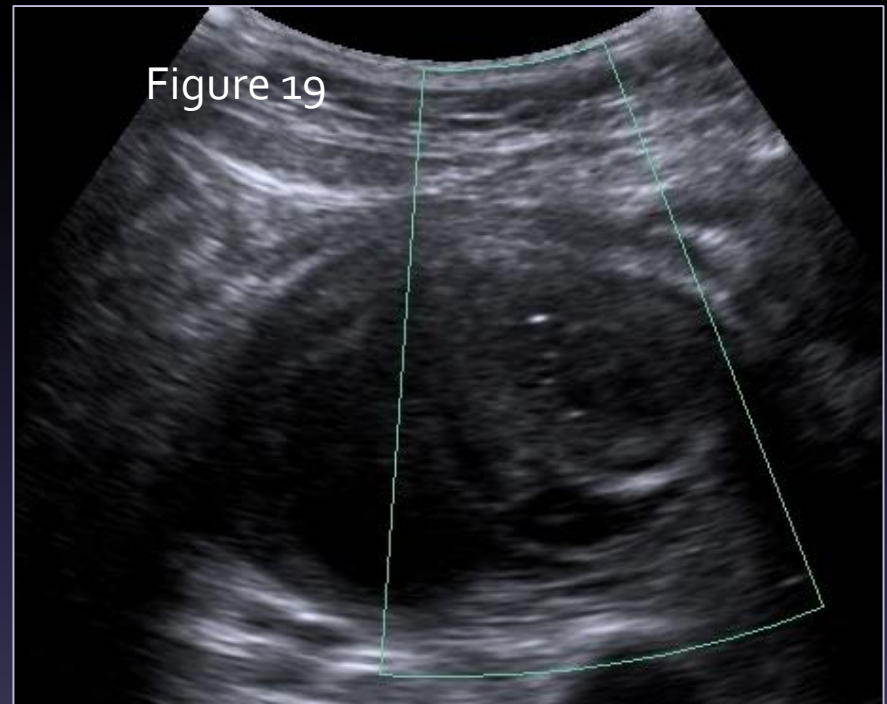
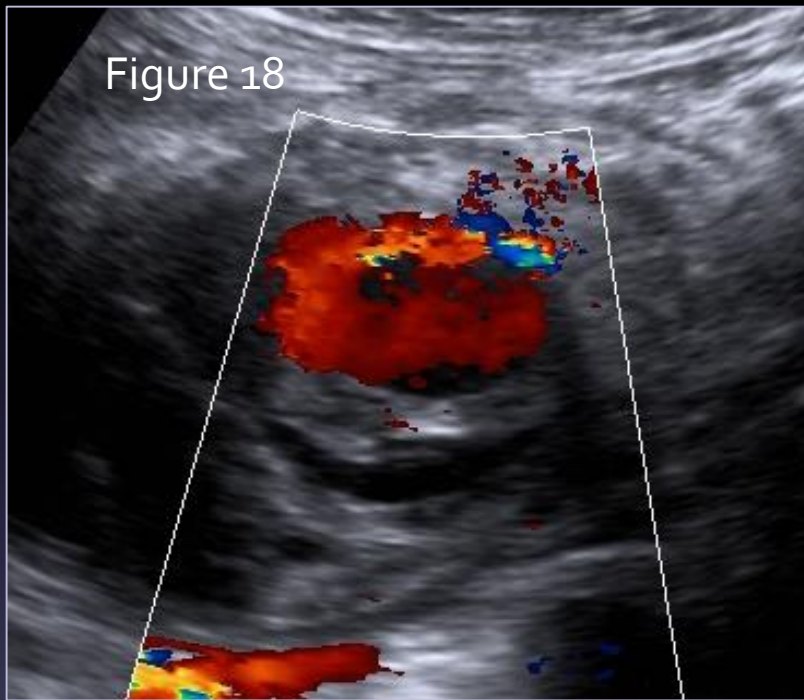


Figure 18 – Doppler flow within a psuedo-aneurysm

Figure 19 – No residual Doppler flow post ultrasound guided thrombin injection of the pseudo-aneurysm

Conclusion

Acute pancreatitis is an inflammatory condition of the pancreas which is associated with significant morbidity and mortality. Although initial diagnosis is clinical and biochemical radiology plays an important role in the assessment of severity and to identify complications. Imaging is pertinent to differentiate interstitial oedematous pancreatitis from necrotising pancreatitis. Necrotising pancreatitis is associated with increased morbidity and greater complications as outlined by the image examples. Close liaison with interventional radiology is essential for the treatment and management of these complications particularly the vascular complications.

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