Gallstones - what do they do and where do they go? What the radiologist needs to know.

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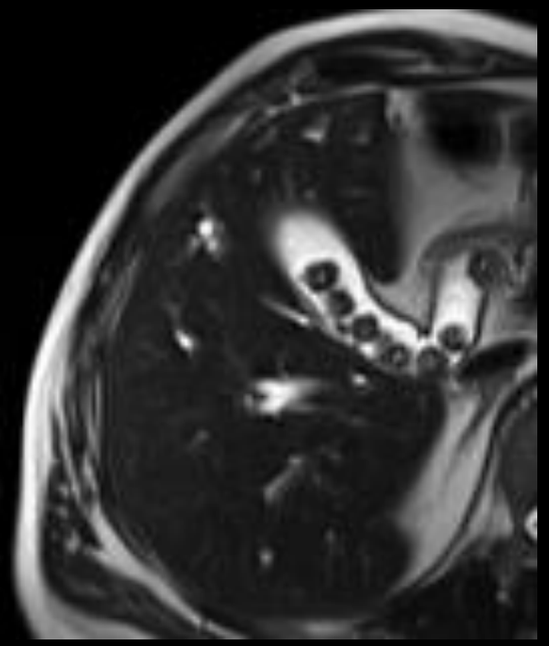
Introduction

- Gallstones are solid rounded particles composed of a combination of cholesterol and bilirubin
- In the USA 8.6% of caucasian men and 16.6% of women have gallstones. The incidence is increasing with obesity.
- 3 types - Cholesterol (10%), Bile (10%) and mixed (80%).
- Majority asymptomatic.
- 10-15% become symptomatic over 10 years.
- Symptoms range from mild to severe.



Risk Factors

Risk factors for gallstone formation	Comment
Age	the incidence increases with age but symptomatic presentation is most common in middle age.
Gender	more common in females by a ratio of 2:1.
Race	more common in western caucasian, hispanic and native american populations.
Family History	A first degree relative with a history of gallstones doubles the risk.
Obesity	Increased risk of cholesterol stone formation
Rapid Weight loss	Bile stasis due to reduced calorie intake and increased cholesterol mobilisation.
Haemolysis	there is an increased incidence of associated with haemolytic disorders such as sickle cell disease and the thalassemias.
Oral Contraceptives and Oestrogen replacement therapy	
Pregnancy	
Raised serum lipids	Increased risk of cholesterol stone formation
Raised serum bilirubin	Increased risk of pigmented stone formation.
Cirrhosis	
Gallbladder stasis	Stasis of flow allows stones time to form
Diabetes Melitus	Insulin resistance increases circulating cholesterol
Crohn’s disease	
Certain medications	

Factors protective against gallstone formation	Comment
Statins	Reduce bile cholesterol concentration
Ascorbic acid	Alters cholesterol catabolism
Unsaturated fats	Alters bile acid composition
Coffee	Alters cholesterol catabolism
Vegetable proteins and nuts	Increase ascorbic acid levels

Imaging modalities in gallstones

<u>Ultrasound</u>

- Best imaging modality for cholelithiasis and associated gallbladder pathology.
- Gallstones are characteristically echogenic with posterior acoustic shadowing.
- dynamic study, stone mobility can be demonstrated.
- No radiation dose to the patient.

<u>CT</u>

- Often hypoattenuating relative to bile
- Calcified stones are hyperattenuating relative to bile - readily identifiable.
- Many are isoatennuating relative to surrounding bile and may be occult c CT.
- CT is very effective at evaluating extrabiliary complications of gallstones.

<u>MRI</u>

- Low signal or signal void on T2 weighted imaging surrounded by T2 hyperintense surrounding bile
- MRCP is performed using heavily T2-weighted sequences, helpful in delineating ductal anatomy.

Plain radiography

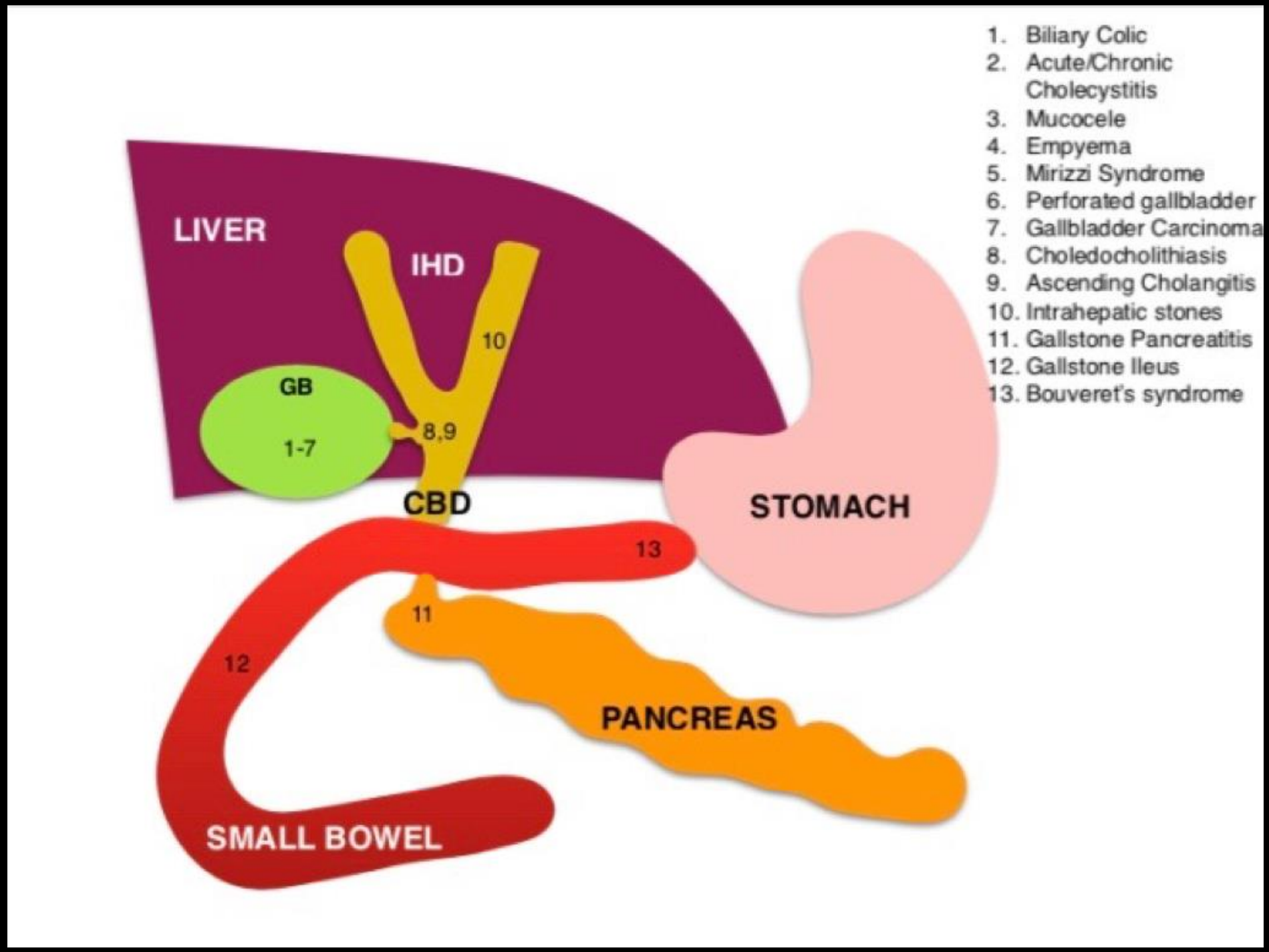
- Only 15-20% of gallstones are radio-opaque on x-ray.
- “Mercedes Benz sign” which is an outer radio-opaque rim with a radiolucent centre which is caused by calcification of the gallstone rim

Nuclear Medicine

- Imaging with scintigraphy and with SPECT/CT can be used in select cases in the assessment of biliary flow. Technicium-99 labeled mebrofenin is administered which is taken up in bile allowing dynamic assessment of biliary flow and and may demonstrate biliary obstruction secondary to gallstones.

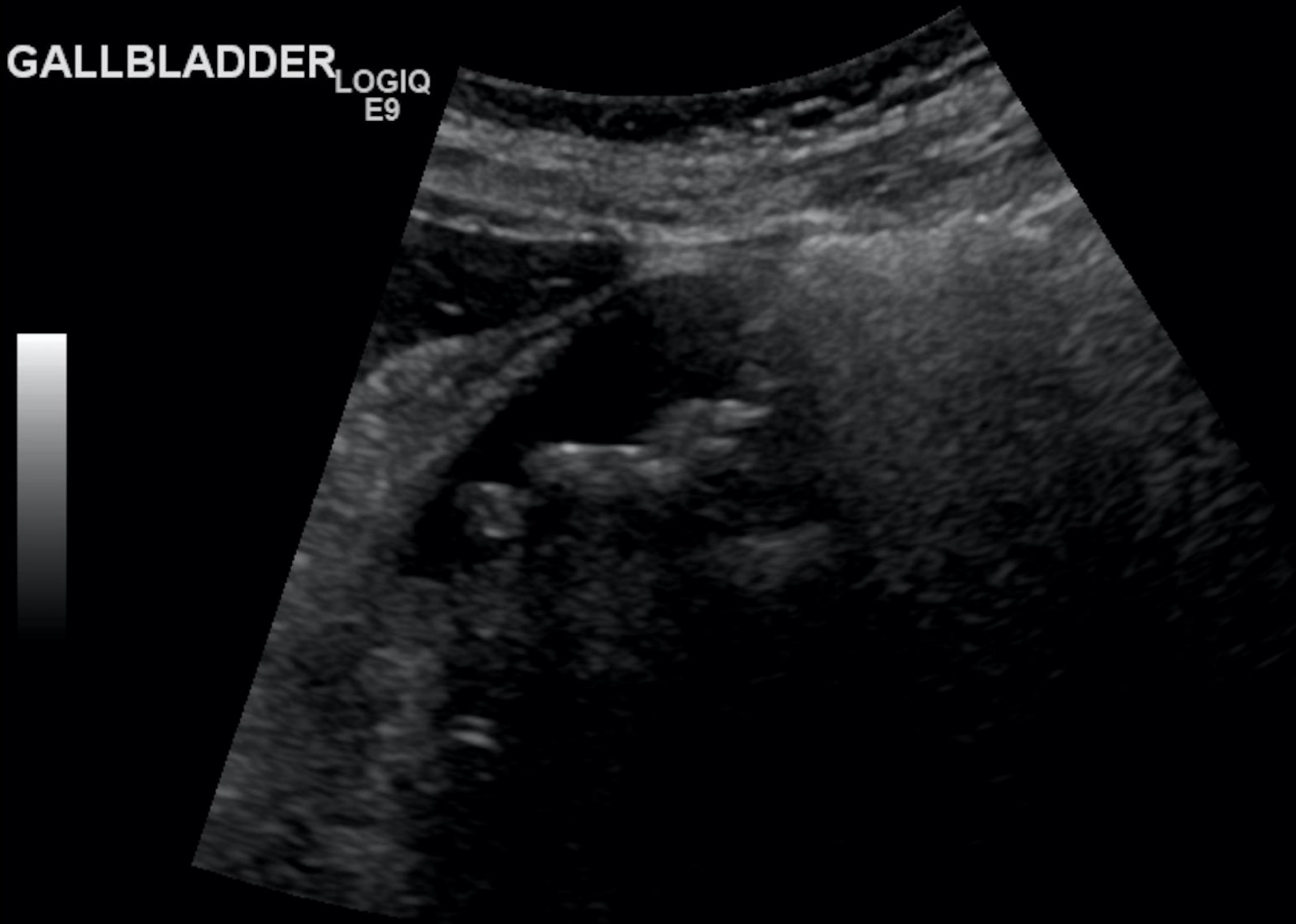
Interventional Radiology

- Percutaneous cholecystostomy is a temporising measure in critically ill patients.
- It is increasingly therapeutically being used in an ageing population.
- Cholangiogram can be performed per cholecystostomy which demonstrates filling defects within the biliary system caused by stones.
- PTC with biliary stenting is an effective treatment to decompress the biliary system in the case of obstructing choledocholithiasis, frequently in cases not amenable to endoscopic retrograde choloangiopancreatography (ERCP).
- Active role in management of complications of pancreatitis and abscesses secondary to cholecystitis through drain insertion and management and in the management of post cholecystectomy complications.

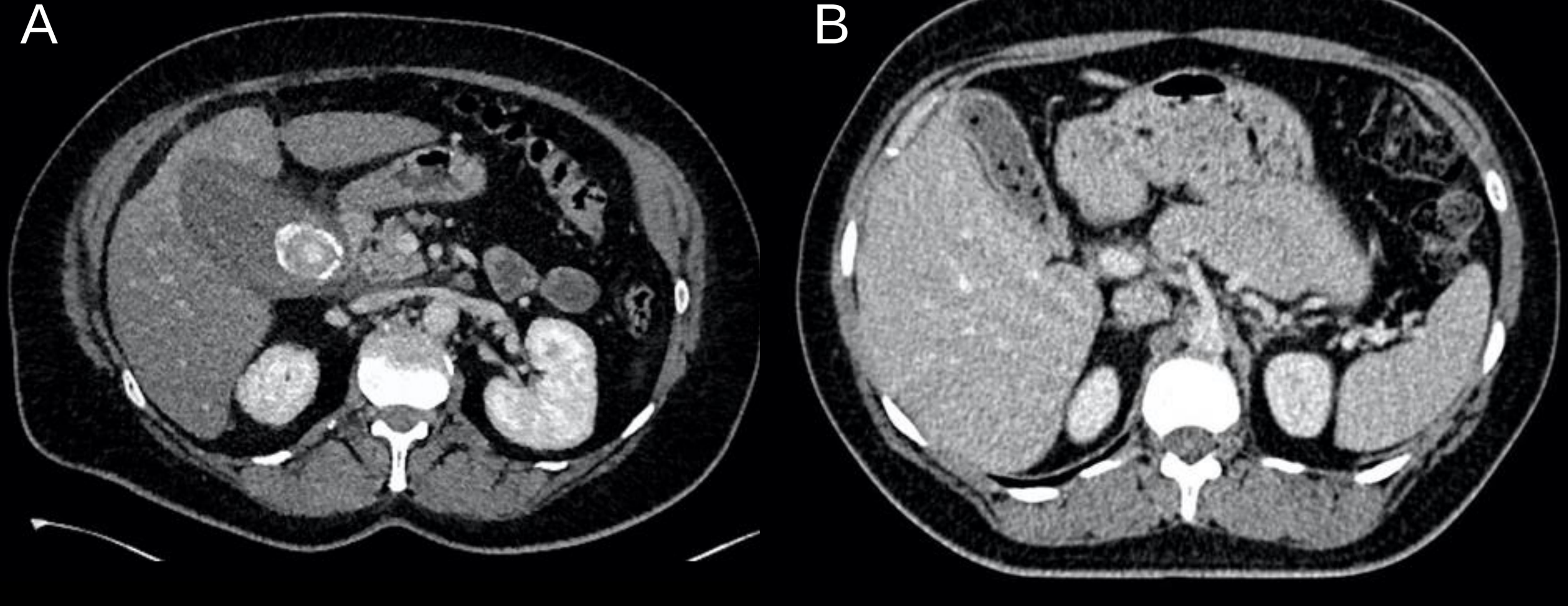


This diagram depicts the broad range of gallstone pathology based on the location where they occur.

Gallstones within the gallbladder



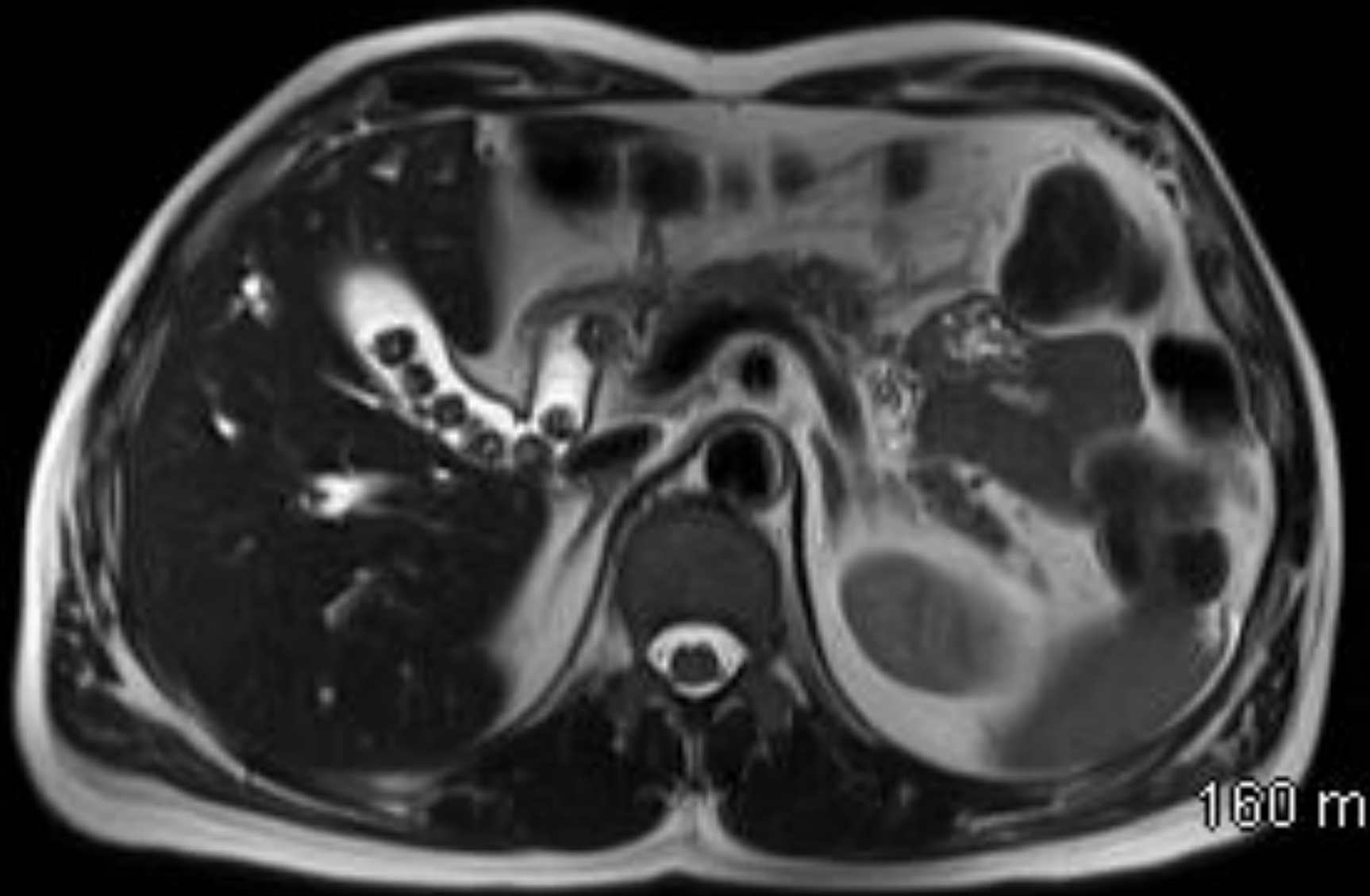
Sagital ultrasound image of the gallbladder. There are multiple echogenic foci within the gallbladder which demonstrate posterior acoustic shadowing. These imaging findings are classical of gallstones



Axial contrast enhanced CT of the abdomen

A. There is a large single calcified gallstone hyper attenuating relative to bile.

B. There are multiple small gallstones which are hypo attenuating relative to bile

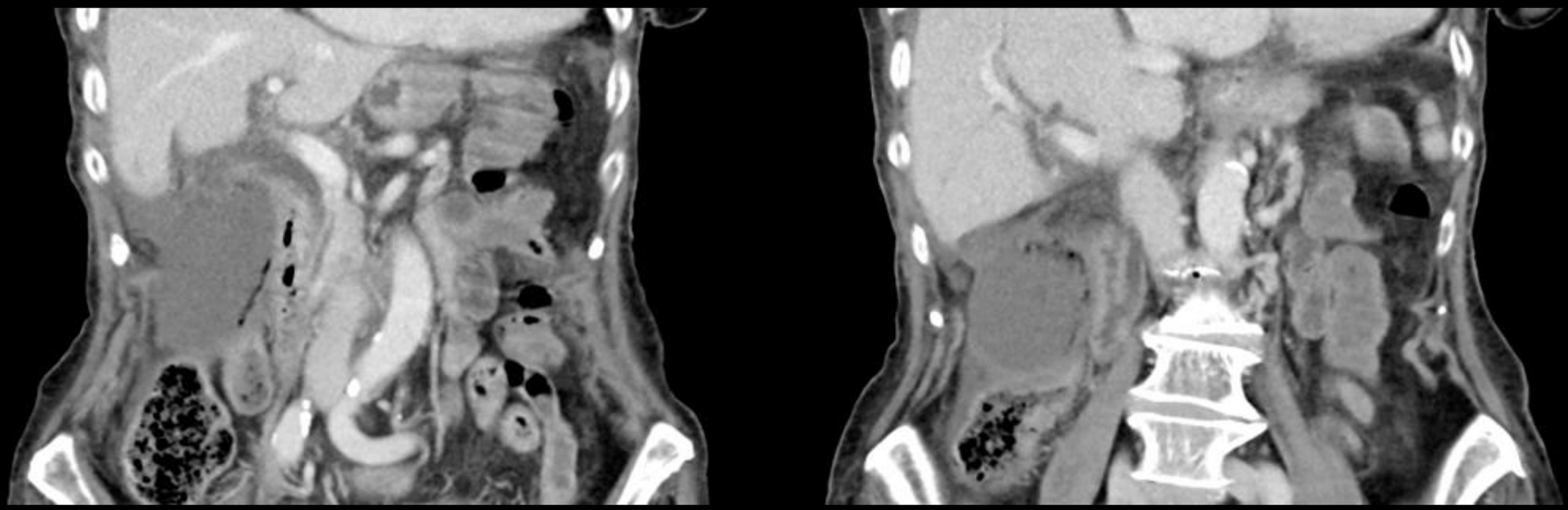


Axial slice of a heavily T2 weighted MRI abdomen. There are multiple foci of low signal within the gallbladder relative to the surrounding high signal bile. This is classic for gallstones on MRI.

Acute Cholecystitis

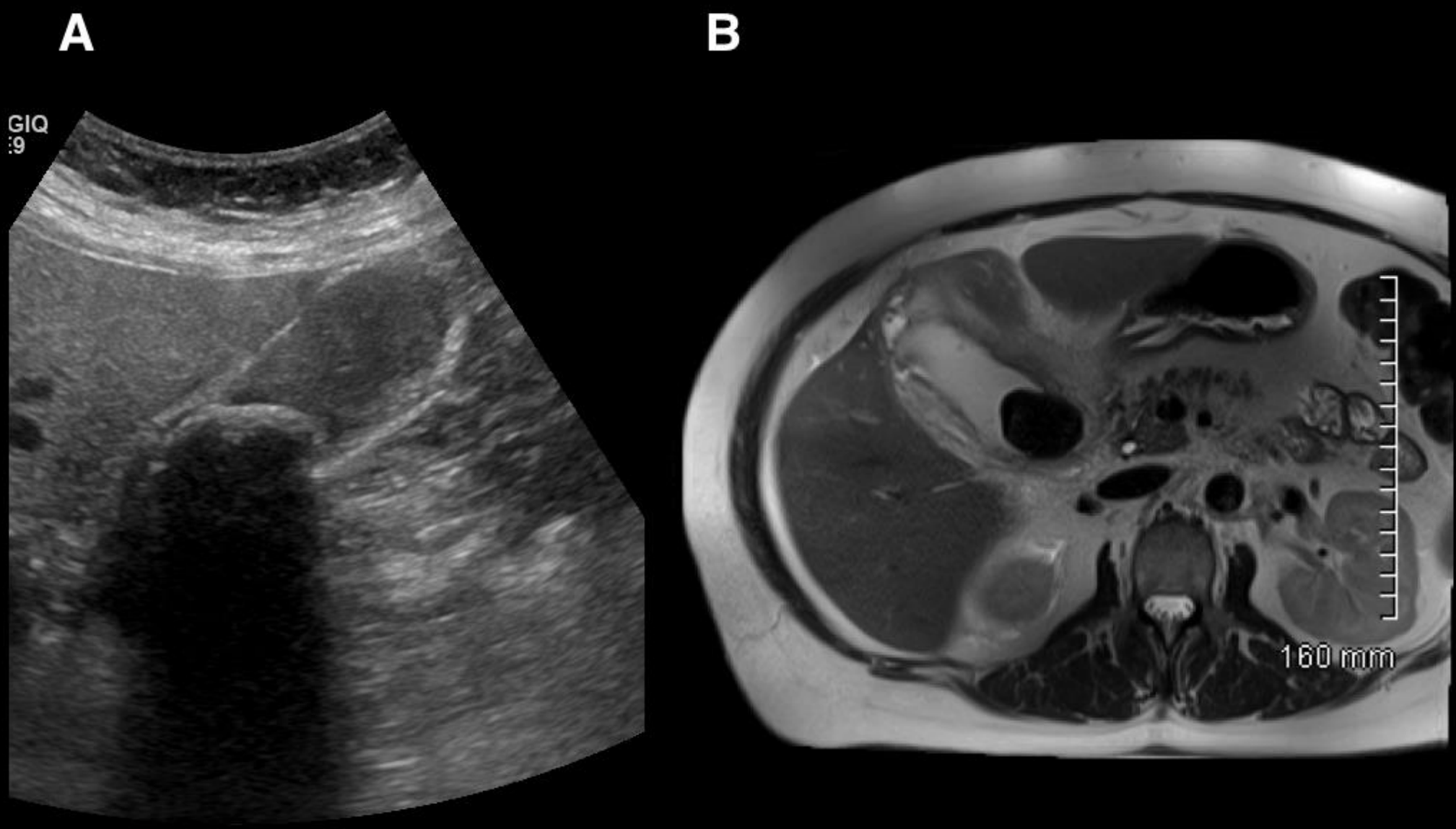
Sagittal US of a distended gallbladder. The gallbladder wall is thickened and there is a rim of pericholecystic fluid. These findings are consistent with acute cholecystitis.

Emphysematous Gallbladder



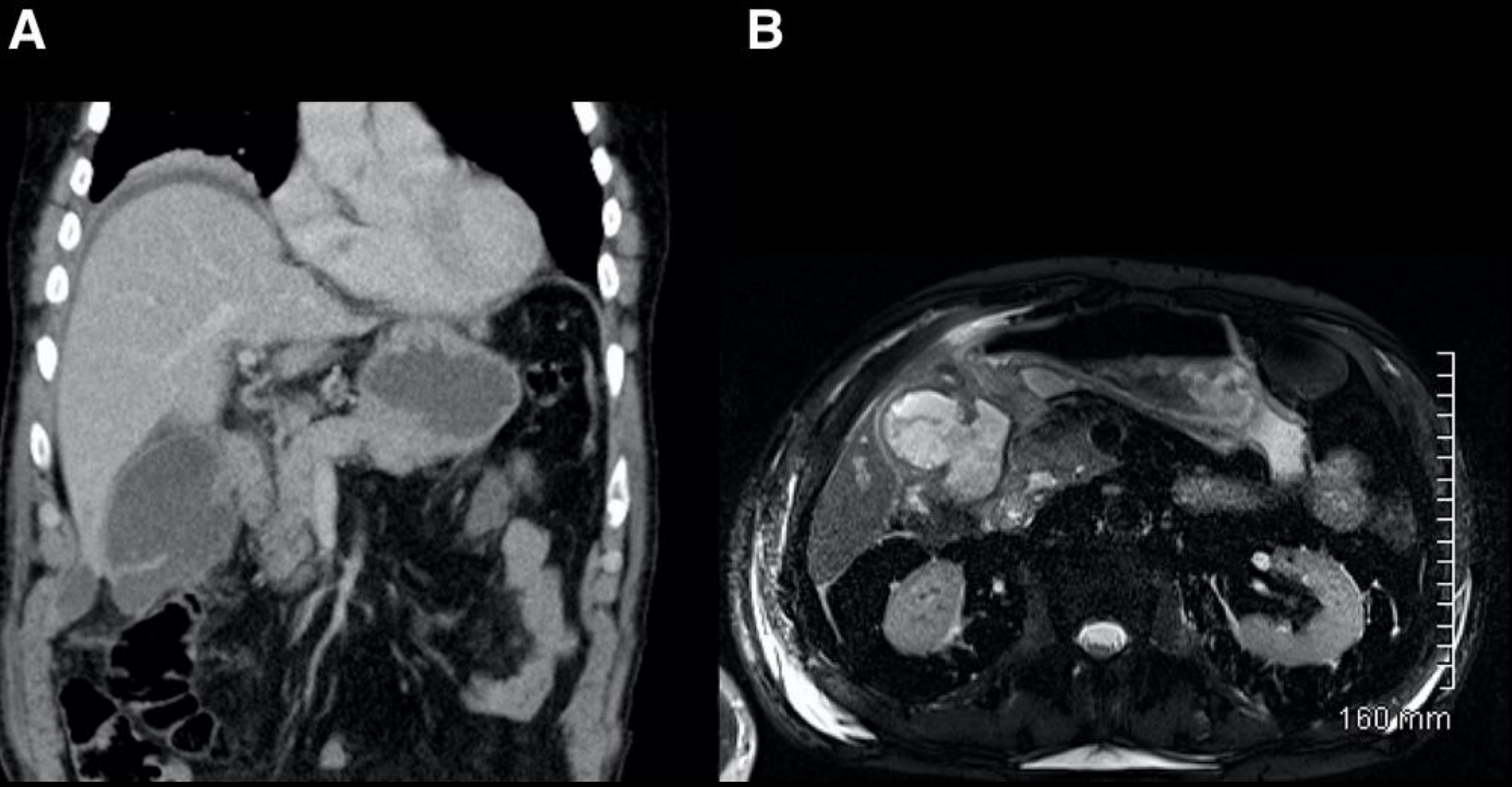
Two slices of a coronal contrast enhanced CT abdomen. The gallbladder is dist

Gallbladder Mucocele



A. Sagital US of the gallbladder revealing a large stone in the gallbladder neck which demonstrates posterior acoustic shadowing. The gallbladder is significantly distended.
B. Axial slice of a T2 weighted MRI of the abdomen again shows a large low signal stone in the neck of the distended gallbladder. Imaging findings are consistent with a gallbladder mucocele.

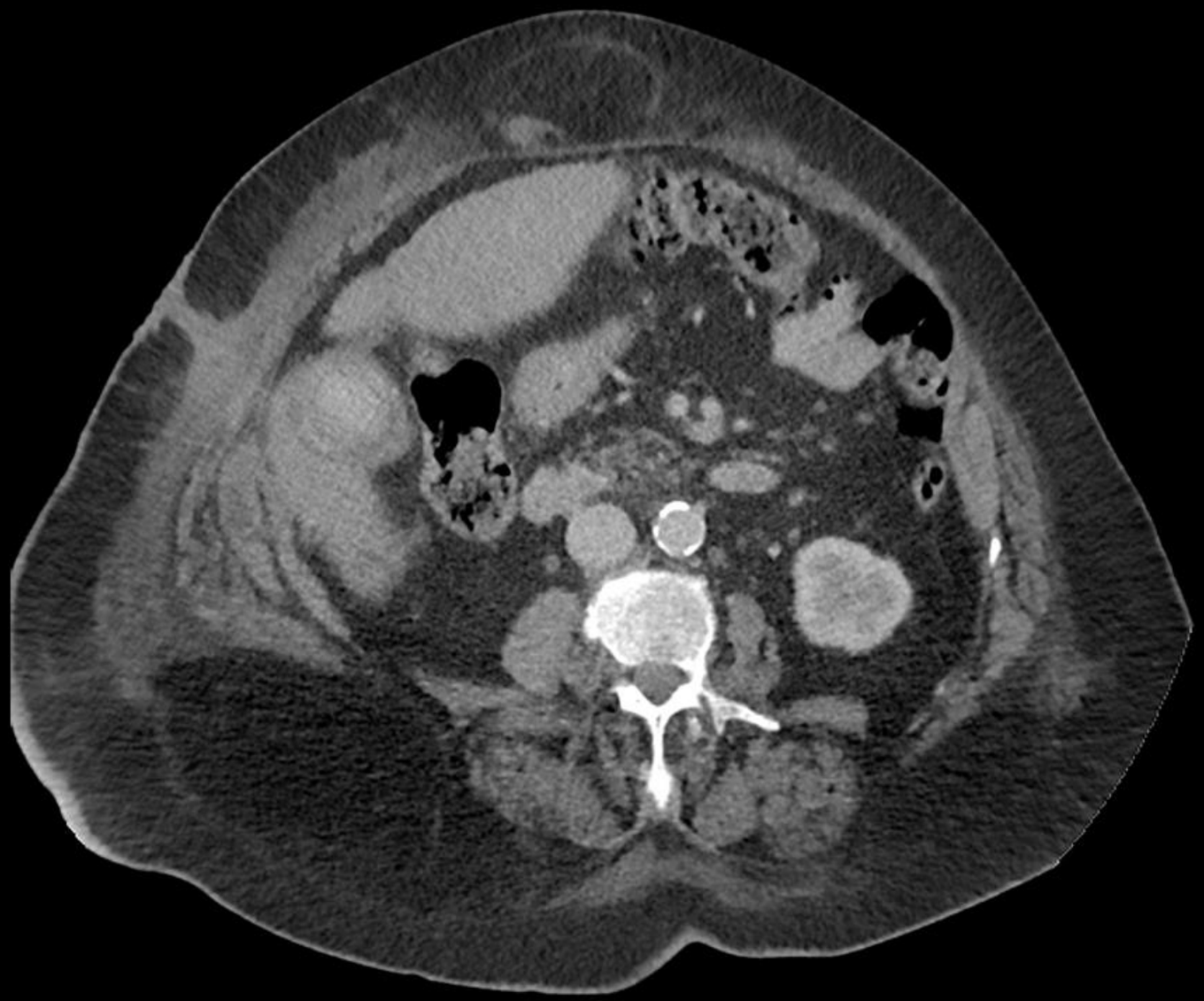
Gallbladder Perforation



A. Coronal contrast enhanced CT abdomen. The gallbladder is distended with surrounding fat stranding. There is a large defect in the gallbladder wall with an adjacent intrahepatic fluid collection.
B. Axial T2 weighted MRI abdomen of the same patient reveals a defect in the gallbladder wall with extensive T2 high signal within the liver.

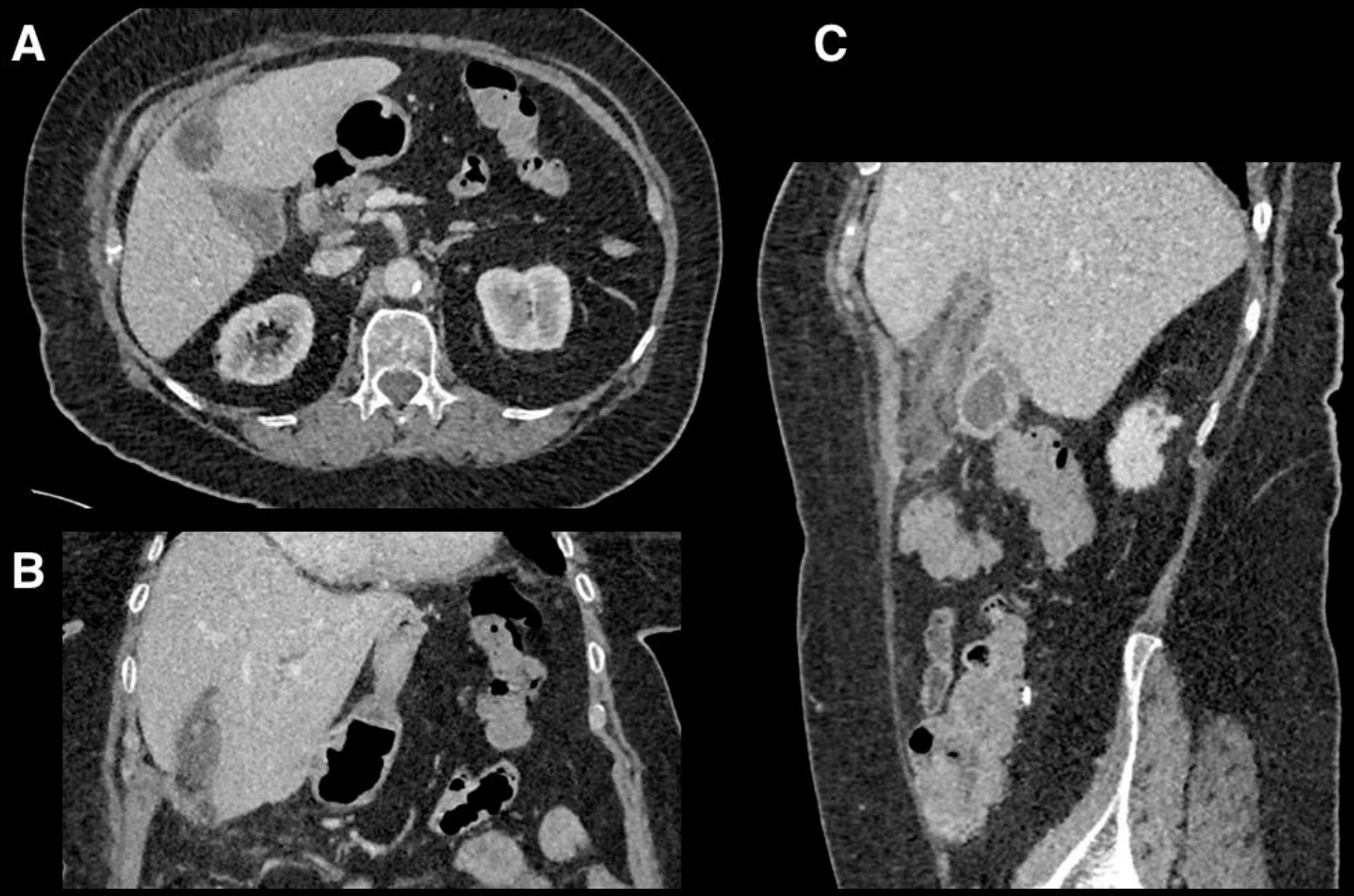
Overall findings are consistent with a perforated cholecystitis with associated hepatic abscess.

Cholecysto-cutaneous Fistula



Axial contrast enhanced CT abdomen in a patient with cholecystitis. There is significant fat stranding and inflammation in the gallbladder wall which extends through the abdominal wall to skin. Finding are consistent with a cholecysto-cutaneous fistula.

Thropbophelbitis of umbilical vein.

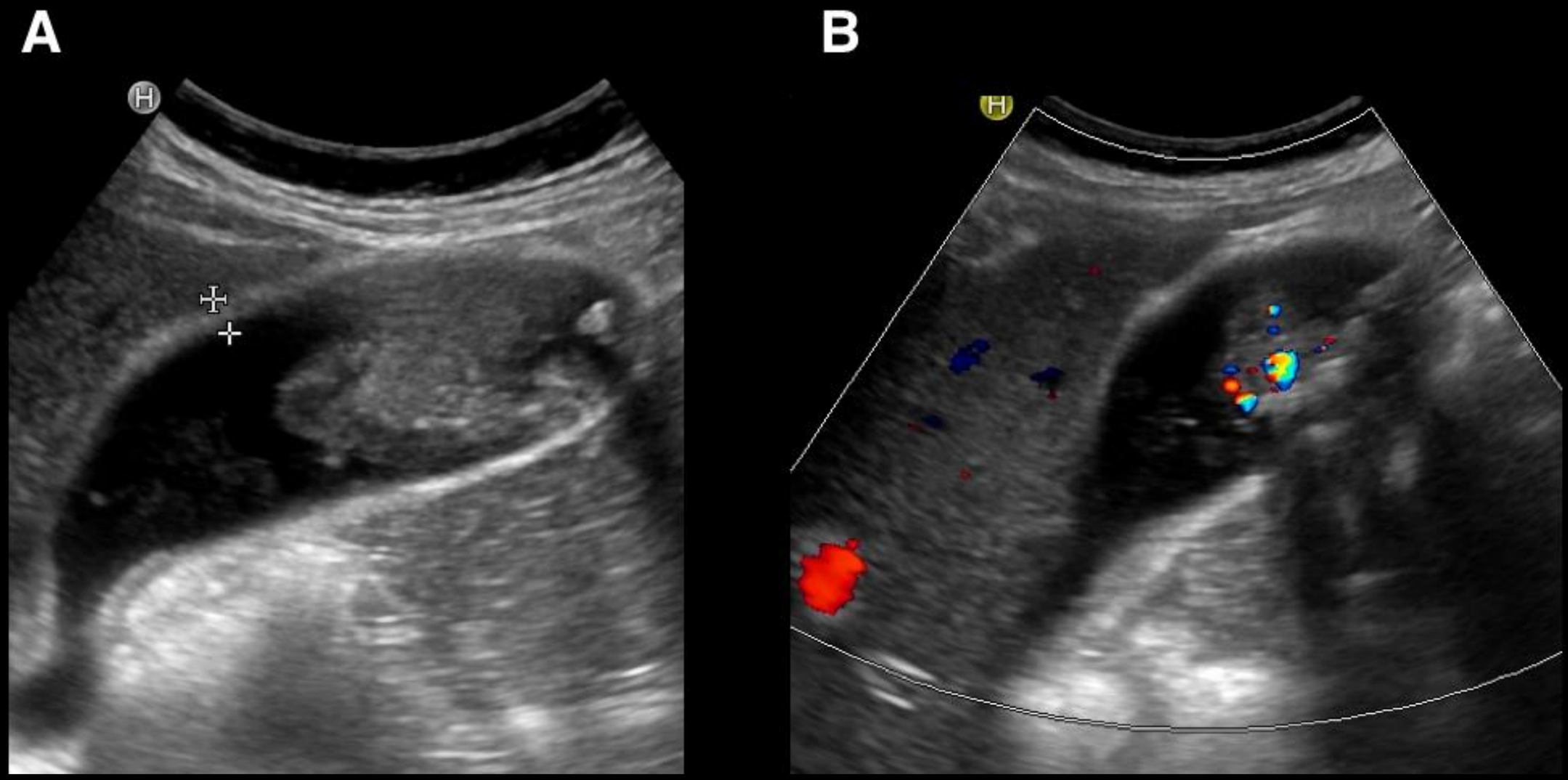


Axial, coronal and sagittal images from a contrast enhanced CT of the abdomen in a patient with acute cholecystitis. The falciform ligament is dilated and containing fluid. There is a central linear area of relative high attenuation extending throughout it's course. Findings are consistent with a thrombophlebitis of a recanalised umbilical vein secondary to infection.

Porcelain Gallbladder

Axial and sagital slices of a contrast enhanced CT of the abdomen. There is diffuse calcification within the wall of the gallbladder. This is the classical imaging hallmark of porcelain gallbladder.

Gallbladder Carcinoma



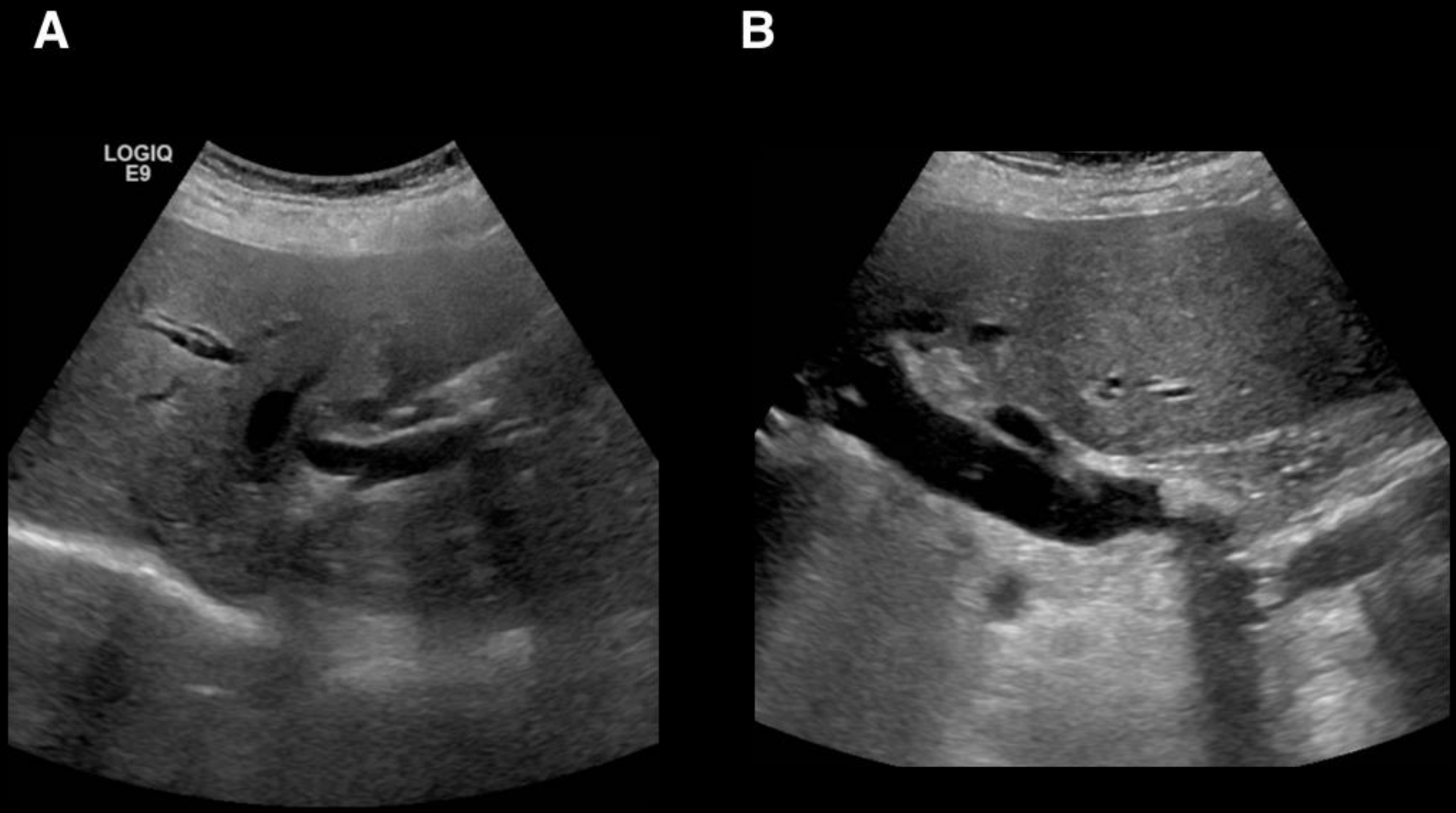
Sagittal US of the gallbladder reveals a heterogenous irregular mass within the gallbladder. Colour flow doppler reveals internal vascularity. The patient proceeded to cholecystectomy and histology confirmed gallbladder carcinoma.

Mirrizzi Syndrome

A Coronal MIP image of the biliary tree at MRCP. There is the impression of a large gallstone at the neck of the gallbladder. There is significant intrahepatic biliary dilatation however the common bile duct is of normal calibre. The diagnosis of Mirizzi syndrome was later confirmed.

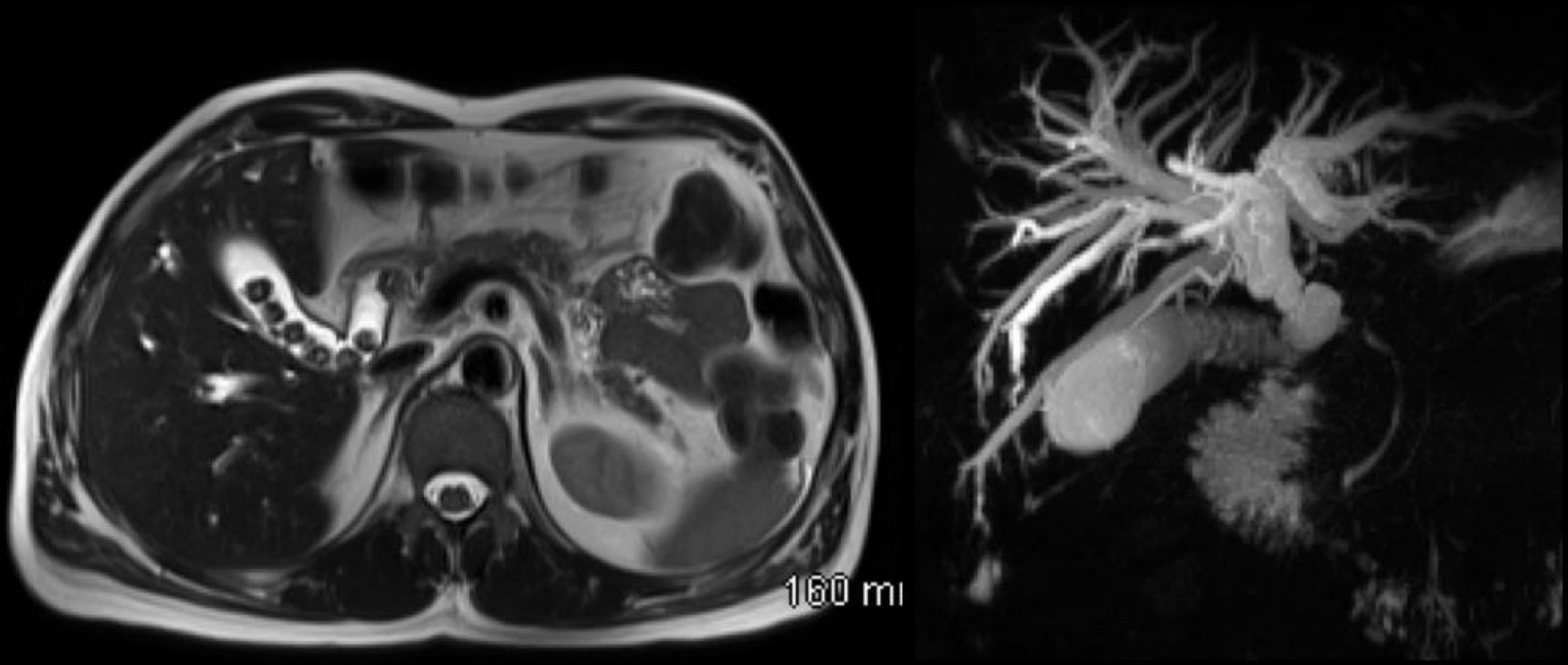
Gallstones within the pancreaticobiliary system

Choledocholithiasis



A. Sagittal US of the liver reveals dilated intrahepatic ducts and a dilated common bile duct. While no stone can be identified findings suggest biliary obstruction.
B. Sagittal US delineating the common bile duct. There is significant CBD dilation and an echogenic stone demonstrating posterior acoustic shadowing can be identified at the pancreatic head.

Choledocholithiasis



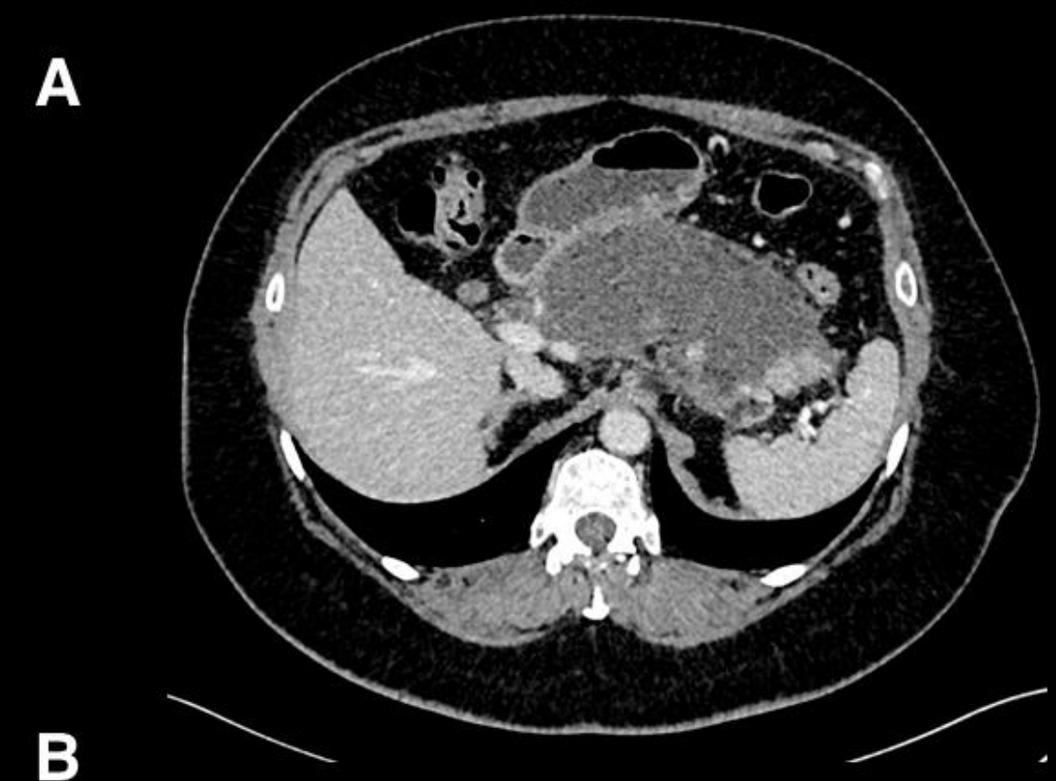
Left: Axial heavily T2 weighted MRCP demonstrates multiple low signal gallstones within the gallbladder There is also a stone within the CBD and associated biliary dilatation.
Right: Coronal MIP image of the biliary tree from MRCP shows a dilated common bile duct and associated intrahepatic biliary dilatation. There is a filling defect within the common bile duct consistent with an obstructing stone.

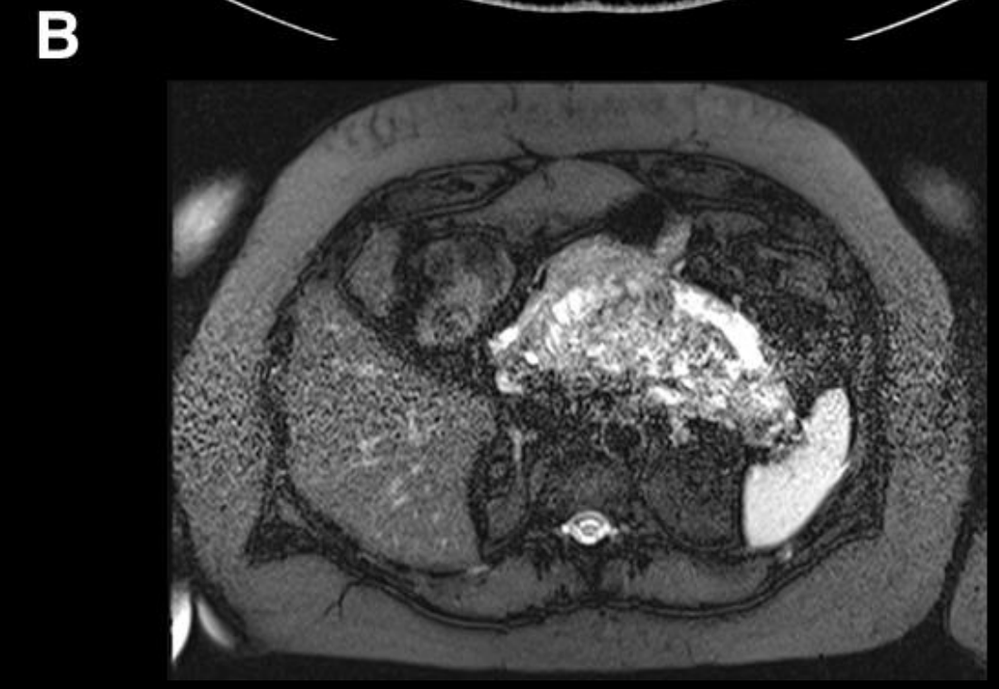
Choledocholithiasis

Fluoroscopic digital acquisition of the biliary tree at ERCP. There are multiple well rounded filling defects within the biliary tree consistent with choledocholithiasis.

Gallstone Pancreatitis

A. Axial contrast enhanced CT of the abdomen demonstrating a 9.8x5.2 cm fluid collection interposed between the right hepatic lobe and the splenic hilum in the pancreatic bed.
B. Axial T2 weighted MRCP of the same patient again revels a high signal collection in the pancreatic bed. There are also splenic vein collaterals without an identifiable splenic vein and stones within the gallbladder. Overall imaging findings are consistent with a pancreatic pseudocyst and splenic vein thrombosis as a delayed complication of gallstone pancreatitis.



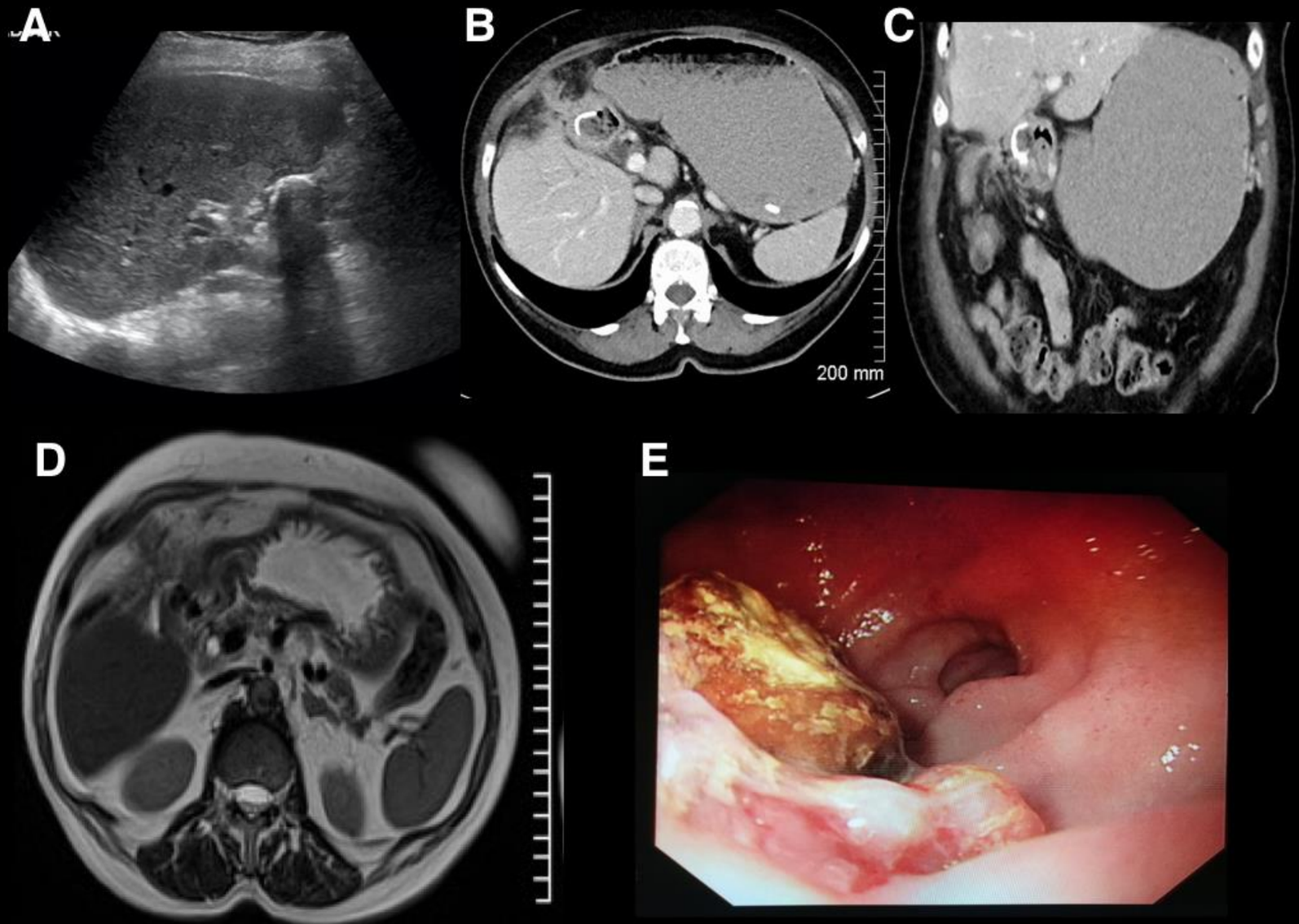


Extrabiliary gallstones

Gallstone Ileus.

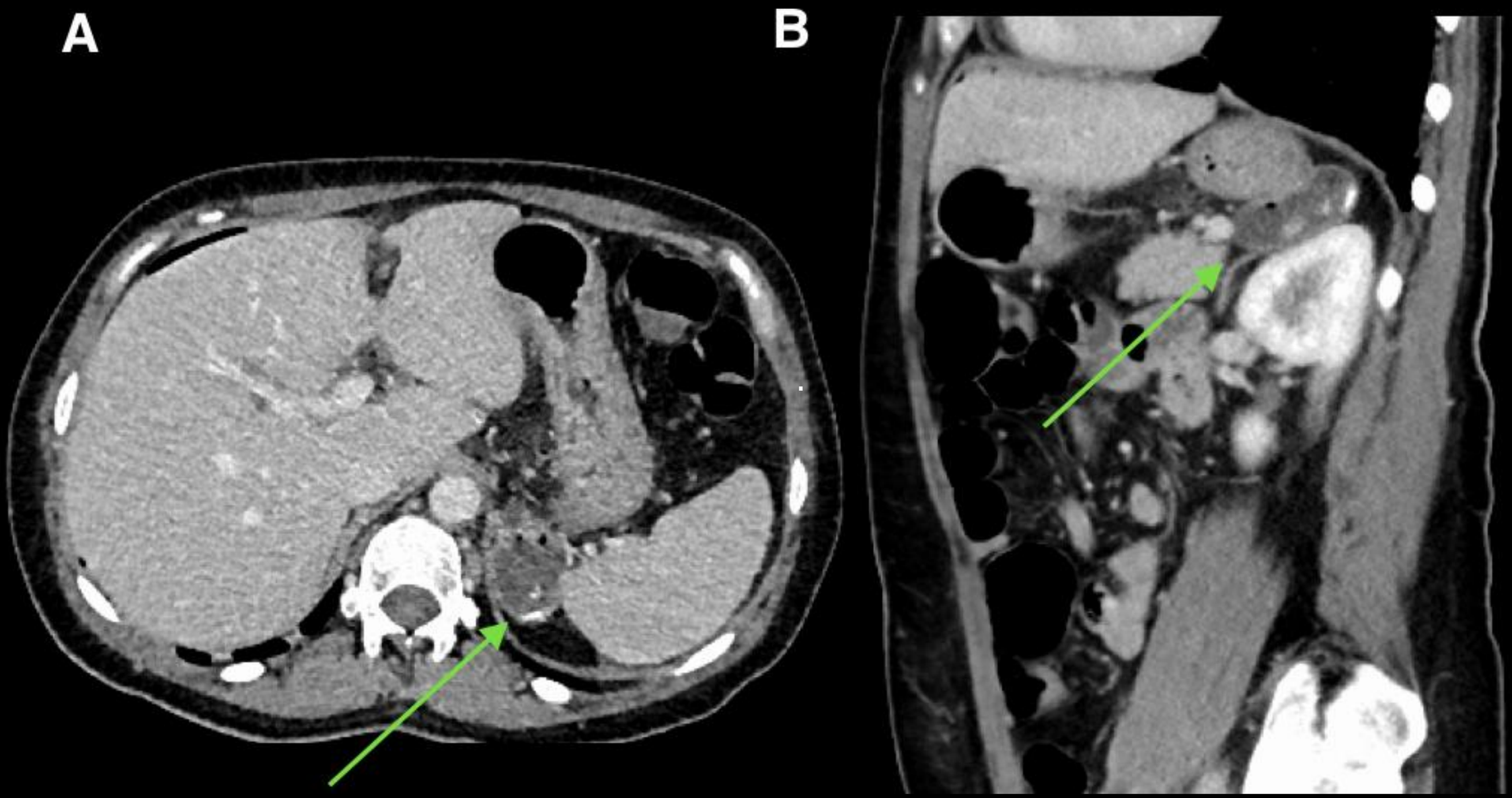
Coronal and axial images of a contrast enhanced CT of the abdomen. There are dilated loops of small bowel with a transition point in the jejunum secondary to a large calcified obstructing gallstone. There is also air within the gallbladder secondary to a cholecysto-enteric fistula. Findings are consistent with a gallstone ileus.

Bouveret's syndrome



A. Sagittal US of the abdomen reveals a large gallstone with posterior acoustic shadowing external to the biliary system B + C.Axial and Coronal contrast enhanced CT of the abdomen reveals a gallstone impacted in the duodenum causing proximal obstruction with a significantly dilated stomach. D. Axial T2 weighted MRI of the abdomen confirmed the CT findings of large gallstone in the duodenum causing gastric outlet obstruction. E. The endoscopic findings from the same patient demonstrating an obstructing stone in the duodenum. Overall imaging findings are consistent with Bouveret's syndrome

Laparoscopic Dropped Gallstones



Axial and sagittal contrast enhanced images of the abdomen in a patient 1 week post laparoscopic cholecystectomy. There is a left subphrenic rim enhancing collection of fluid with foci of high attenuation within. Findings are consistent with an abscess secondary to laparoscopic dropped gallstones.

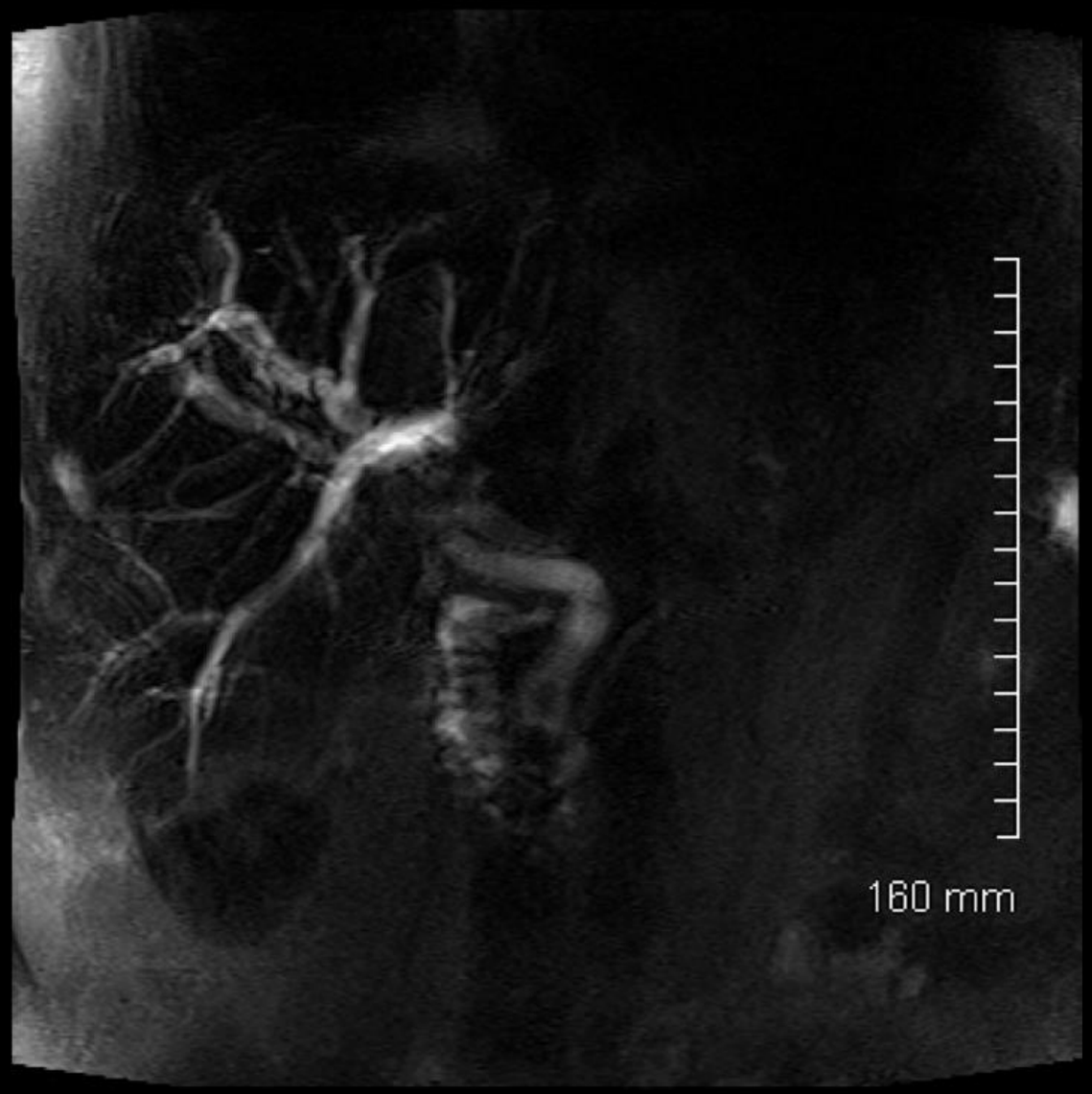
Laparoscopic Dropped Gallstones

Axial and sagittal contrast enhanced CT of the abdomen in a patient with prior history of cholecystectomy. On axial images
(A) there is a rim enhancing perihepatic collection extending into the soft tissues of the abdomen. On Sagittal imaging (B) we can see that the perihepatic collection is extensive and extends to a fistulous communication with the skin. There are no radio-opaque gallstones identified however the patient was taken to theatre where multiple stones were found within the abscess cavity.

Post Operative Haematoma

Axial and coronal contrast enhanced CT of the abdomen in a patient several hours post laparoscopic cholecystectomy. There is a large collection of fluid around the liver. When the hounsfield units are measured the collection is most consistent with haemorrhage. The combination of timing post surgery and imaging findings are consistent with a post op bleed. The patient was returned to theatre.

Post Cholecystectomy Choledocholithiasis



Coronal MIP of the biliary tree in an MRCP in a patient post cholecystectomy. Images are slightly degraded by motion artefact however there is intra and extra hepatic biliary dilatation with filling defects in the distal common bile duct. Findings are consistent with a post cholecystectomy choledocholithiasis.

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Thank You