Magnetic resonance cholangiopancreatography: Pearls and pitfalls

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1. Learning objectives
2. Background
   - Technical considerations
   - Anatomy
3. Main imaging findings
   - Indications
     - Biliary tract
     - Pancreas
     - Gallbladder
     - Indirect MRCP
   - Pitfalls
4. Conclusions
5. References

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LEARNING OBJECTIVES

Learning objectives

Magnetic resonance pancreatography (MRCP)

To review:

- Technical considerations
- Biliary tract anatomy
- Main indications and main imaging findings
- Pitfalls

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BACKGROUND

Background

Results comparable to endoscopic retrograde cholangiopancreatography (ERCP) for the evaluation of extra-hepatic bile ducts and pancreatic duct [1]

Background

MRCP vs ERCP

Advantages[2]	Disadvantages[2]
• Faster and less operator dependent • No ionizing radiation • Evaluation of ducts proximal to the obstruction • Detection of extraductal disease • Evaluation of the biliary tract after surgical intervention	• Diagnostic only • May delay treatment • Less spatial resolution➔ *lower sensibility for intra-hepatic biliary ducts and peripheral pancreatic ducts* • Physiologic evaluation ➔ no distention of the biliary tree ➔ *lower sensibility for subtle lesions*

Background

Allows evaluation of bile-ducts and pancreatic duct [1]:

- **calibre**
- **content**
- **borders**
- **stenosis**

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Background- Technical considerations

Heavily T2-weighted pulse sequences →highlight stationary fluid-filled structures in the abdomen with reduced signal intensity of the surrounding tissue – **classic MRCP** [1]

T1-weighted sequence after intravenous administration of hepatobiliary contrast agents excreted through the biliary tree- **functional MRCP** [1]

Background- Technical considerations

- **Classic MRCP** [1,3]
  - Direct MRCP
  - No contrast in the biliary tract
  - Images depend on contrast between liquid in the biliary tract/pancreatic duct and adjacent tissues

- **Functional MRCP** [1,3]
  - Hepatospecific contrast agent injection → fills the biliary tract in the hepatobiliary phase →hepatobiliary function and excretion assessment
  - Secretin injection→ pancreatic exocrine function. Detection and characterisation of pancreatic ductal anomalies and strictures (not used at our institution)

Background- Technical considerations

This review is based mainly on direct MRCP

Some cases of functional MRCP using hepatospecific contrast agent will be showed further on

Our institution has no experience with secretin induced MRCP and thus it will remain outside the scope of this presentation

Background- Technical considerations

Direct MRCP

T2W (volumetric imaging) *3D*
Liquid➔ white
All the rest➔ black

Background- Technical considerations

Variable protocols at different institutions

At our institution:

Could be enough for [1,3]:

- Bile duct stone study
- Follow-up of benign cysts
- Evaluation of anatomic variants

1. **Direct MRCP sequences**
   - Volumetric acquisition: T2W 3D coronal plane (1mm slabs) + *maximum intensity projections (*MIPs)

Background- Technical considerations

Volumetric acquisition [3]

- 1mm slab thickness
- Respiratory *gating*
- Acquisition time: up to 10 min
- Any orthogonal plane possible
- Multiplannar reconstructions and MIPs

Background- Technical considerations

Volumetric acquisition

VIDEO: T2w 3D coronal plane

Background- Technical considerations

Volumetric acquisition

VIDEO: T2W coronal MIP reformat

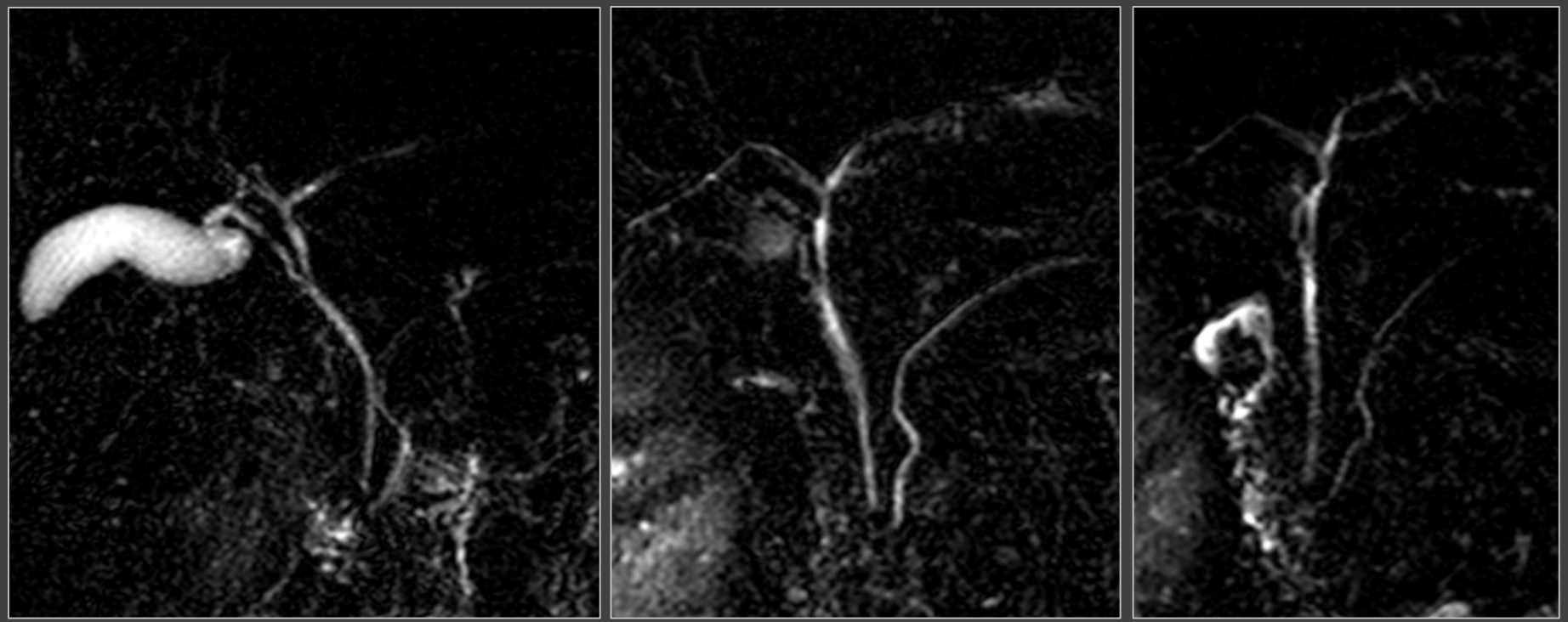
Background- Technical considerations

Thick slabs [3]

- Each slab with several cm (4cm)
- Faster acquisition
- 1 to 2s breath hold
- Preferred for uncooperative patients
- Less spatial resolution

Background- Technical considerations

Thick slabs



Examples of T2w coronal thick slab MRCP

Background- Technical considerations

- 4 hour fasting [1]
  - ↓ fluid in stomach
  - ↓ peristaltism
  - ↑ gallbladder distention

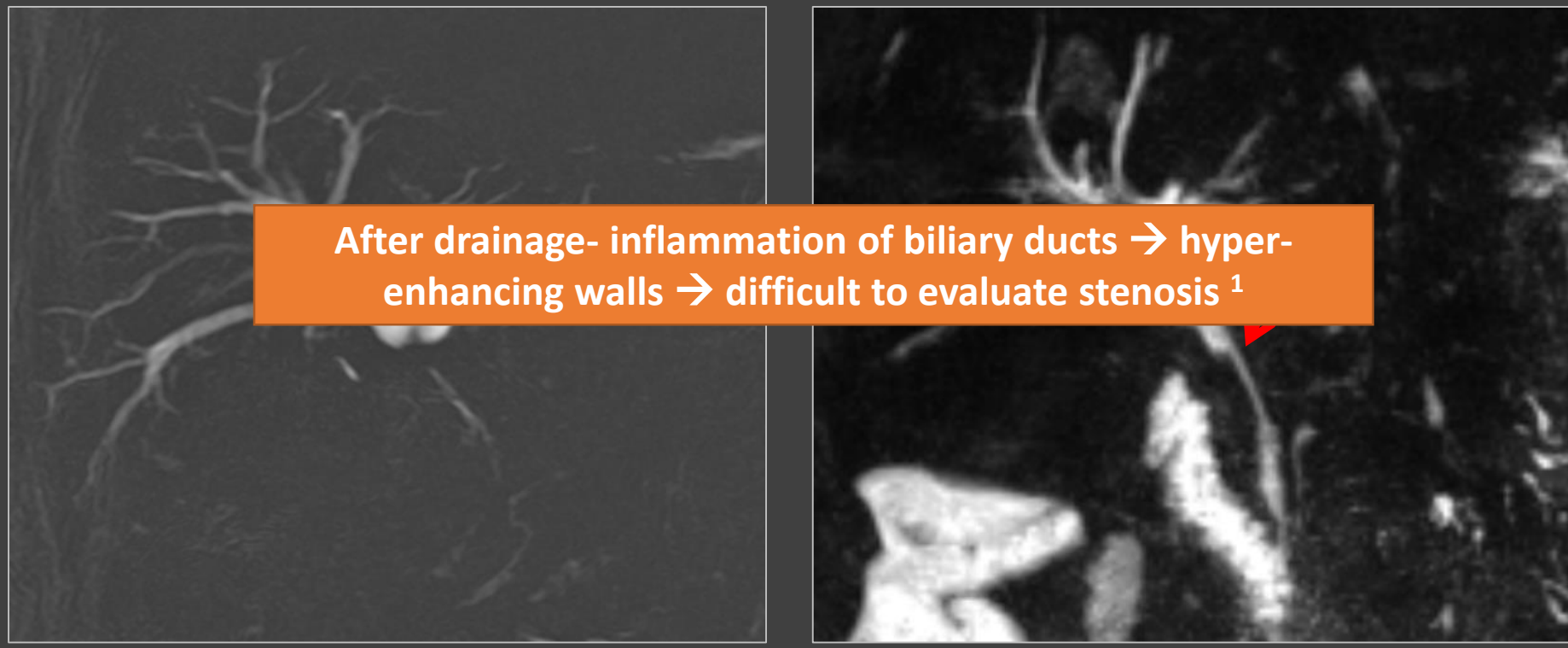
- Negative oral contrast (e.g. grape juice) and/or anti-peristaltic agent [1]

  → optional

Background- Technical considerations

- Same contraindications as other MR exams [3]
  - claustrophobia, pacemakers, metallic implants
- Drainage of peritoneal fluid before is encouraged [3]
- MRCP should be carried out before any drainage of the biliary tract [3]

Background- Technical considerations



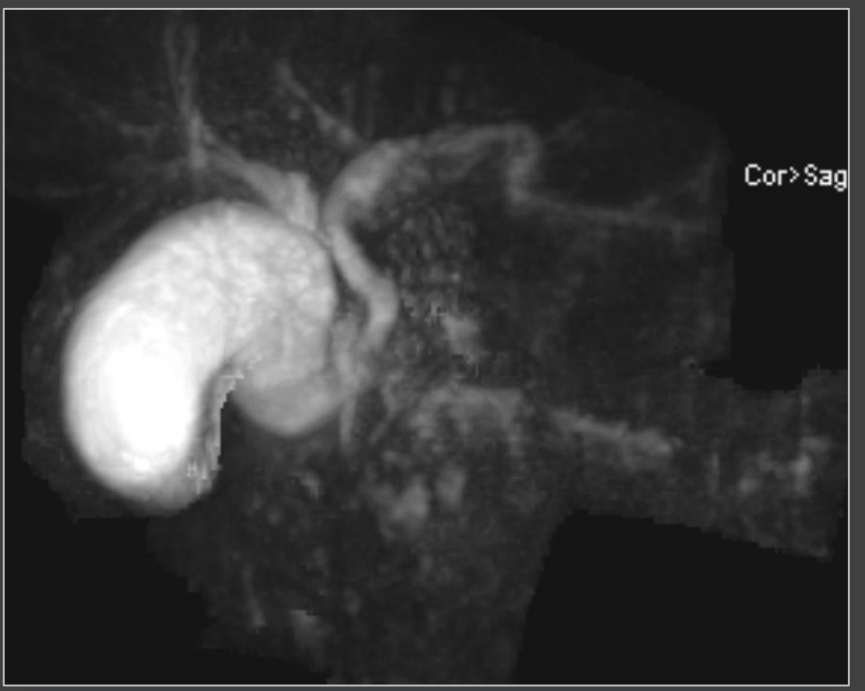
After drainage- inflammation of biliary ducts → hyper-enhancing walls → difficult to evaluate stenosis [1]

MRCP T2w MIPs before drainage (left) and after drainage of the biliary tract (right). Note that the stenosis is less conspicuous after drainage (arrow)

Background- Technical considerations

Patient cooperation is important [1]!

Example of a T2w coronal MIP reformat of a cooperative patient



Example of a T2w coronal MIP reformat of an uncooperative patient (note the motion artifacts)

Background- Technical considerations

Variable protocols at different institutions

2. **Complement of abdominal magnetic resonance (MR) sequences:**
   - **T2W coronal + axial + sagittal plane (6mm slabs)**
   - **T2W fat sat axial plane (6mm slabs)**
   - **Diffusion Weighted Imaging (DWI) b= 0-800 and ADC map**
   - **T1W in phase + out of phase axial plane**
   - **Pre contrast T1W fat sat axial plane**
   - **Dynamic imaging after paramagnetic gadolinium-based intravenous contrast injection**
     - **T1W fat sat axial plane at 20s, 45s, 90s, 5 min and 10 min**

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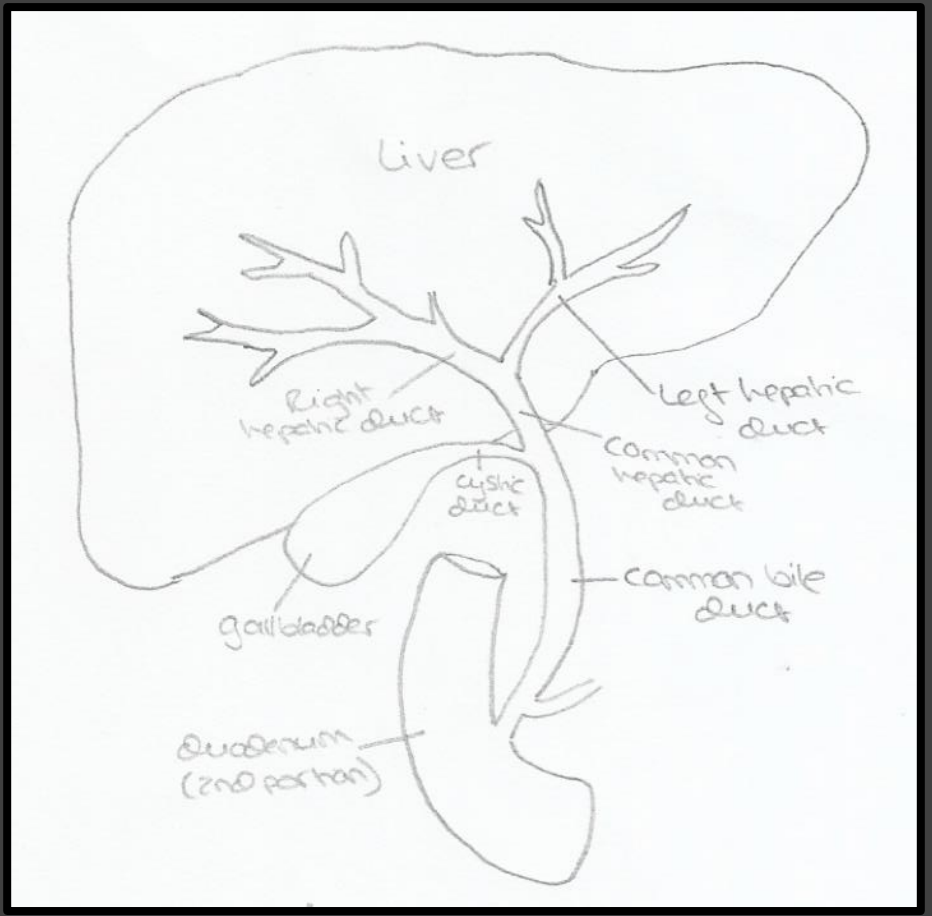
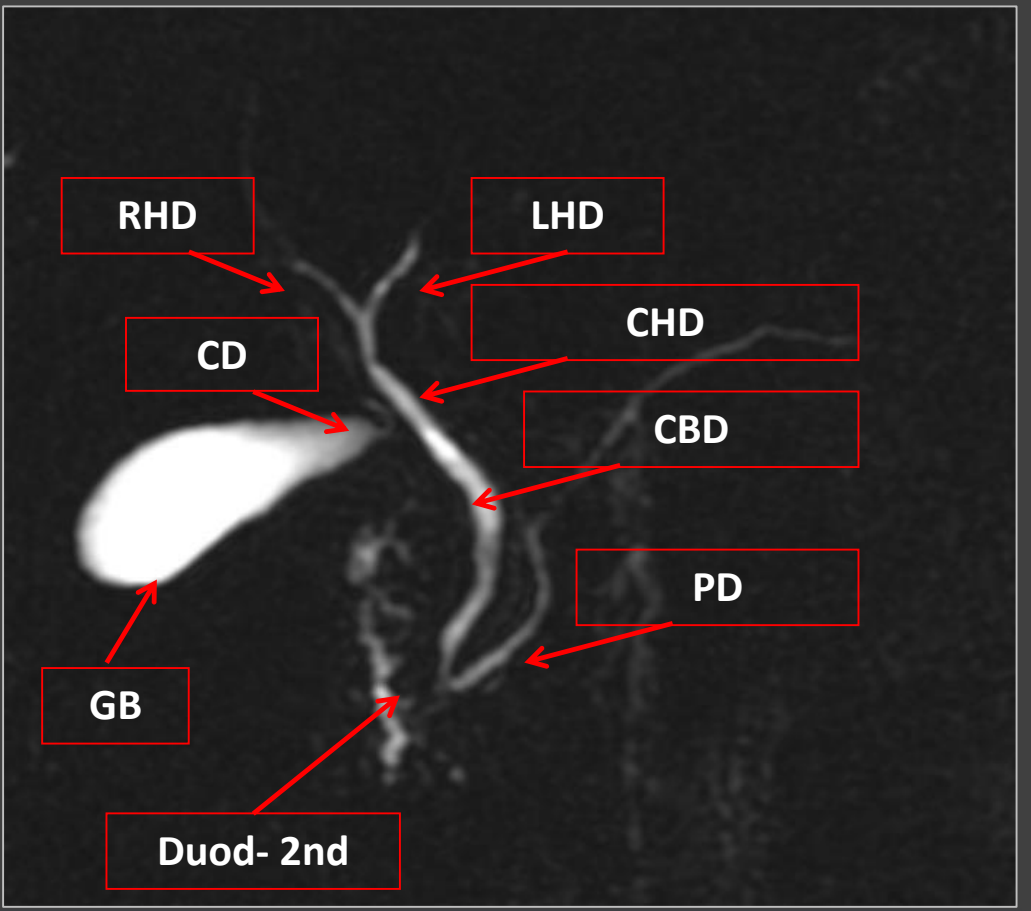
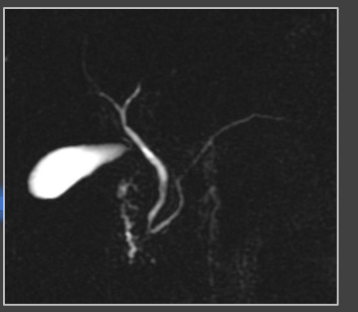
Background- Anatomy





Right: Schematic diagram of the biliary tract anatomy . **Left:** T2w coronal MIP reformat. RHD- Right hepatic duct; LHD- Left hepatic duct; CHD- Common hepatic duct; CBD- Common biliary duct; CD- Cystic duct; PD- Pancreatic duct; GB- Gallbladder; Duod-2nd- Second portion of duodenum

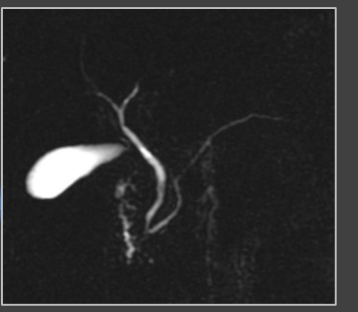
Background- Anatomy



Biliary tract [1,3,4]

- Only central intra-hepatic biliary ducts (1st order) are visualised → normal < 3mm
- 98% of the extra-hepatic biliary tract is visualised → normal < 7mm
- After cholecystectomy→ normal < 10mm

Background- Anatomy



Pancreas[1,5]

- Visualisation of pancreatic duct
  - Head and neck– 97%
  - Tail – 83%
- …. but non visualisation is not necessarily pathologic
- Secondary ducts are only visualised in a small % of cases (< 20%)
- Normal pancreatic duct < 2-3mm

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MAIN IMAGING FINDINGS

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Main Imaging Findings- Indications

Biliary Tract

1. Anatomic variants
2. Biliary lithiasis
3. Stenosis
4. Primary sclerosing cholangitis and main differential diagnosis
5. Development diseases
    - Biliary hamartomas
    - Caroli ‘s disease
    - Choledochal cysts
6. Post surgical evaluation of biliary anastomoses
    - Iatrogenic lesion

Main Imaging Findings- Indications

Biliary Tract

1. Anatomic variants [1,4]

- Normal anatomy= only 58% population
- Important to know the variants → major resection surgery/ transplants
- Most frequent variant= right posterior hepatic duct draining into left hepatic duct (19%)
- Cystic duct variants→ higher risk of iatrogenic lesion during ERCP or cholecystectomy

Main Imaging Findings- Indications

Biliary Tract

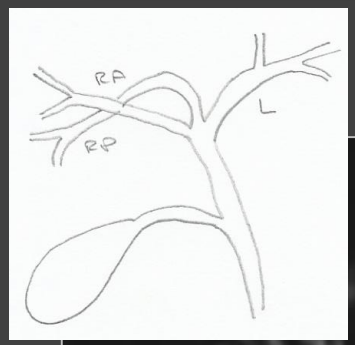
1. Anatomic variants

Examples [1]:

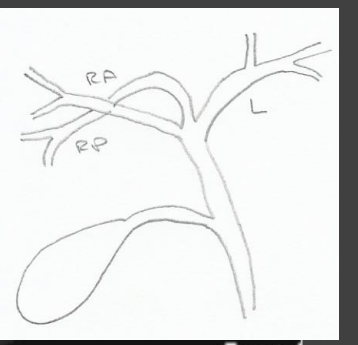
- Posterior hepatic duct:
  - Right posterior hepatic duct draining into left hepatic duct (19%)
  - Triple confluence (11%)
- Cystic duct variants
  - Medial and or low insertion into the common bile duct

Main Imaging Findings- Indications

Biliary Tract



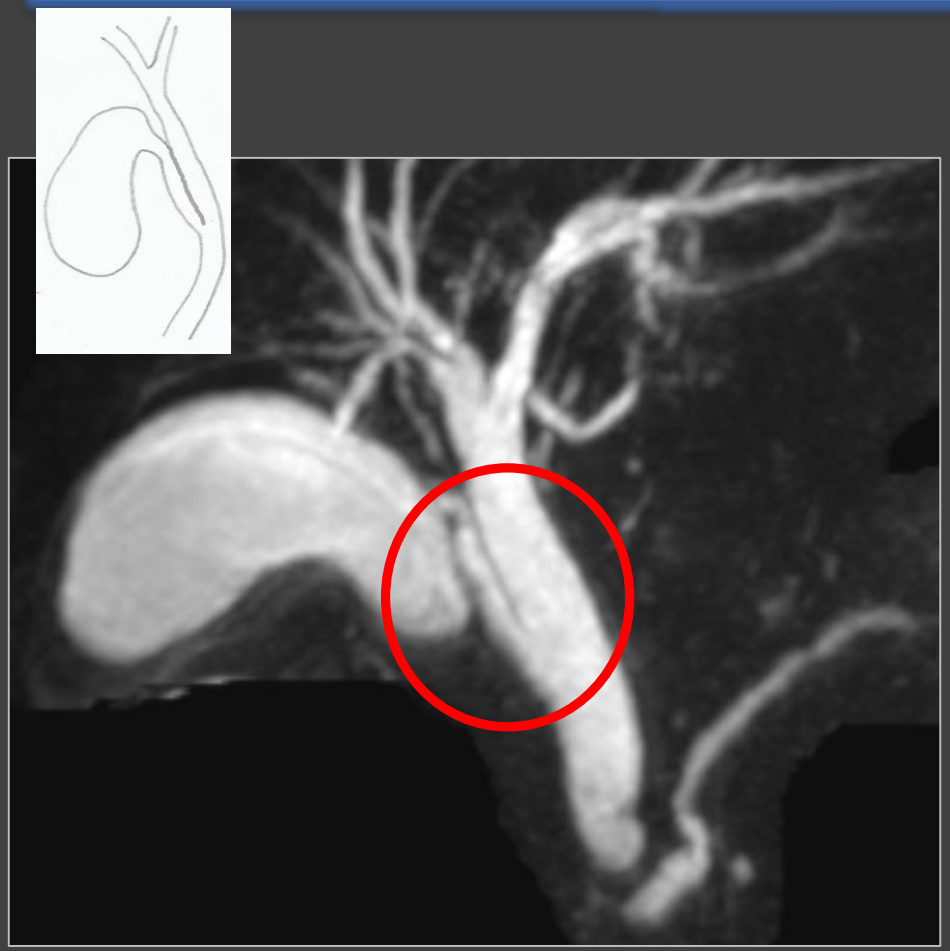
T2w coronal MIP reformat showing **insertion of the posterior hepatic bile duct onto the left hepatic bile duct** (red arrow)



T2w coronal MIP reformat showing the **posterior hepatic duct inserting together with the left and right hepatic duct at a triple confluence** (red arrow)

Main Imaging Findings- Indications

Biliary Tract



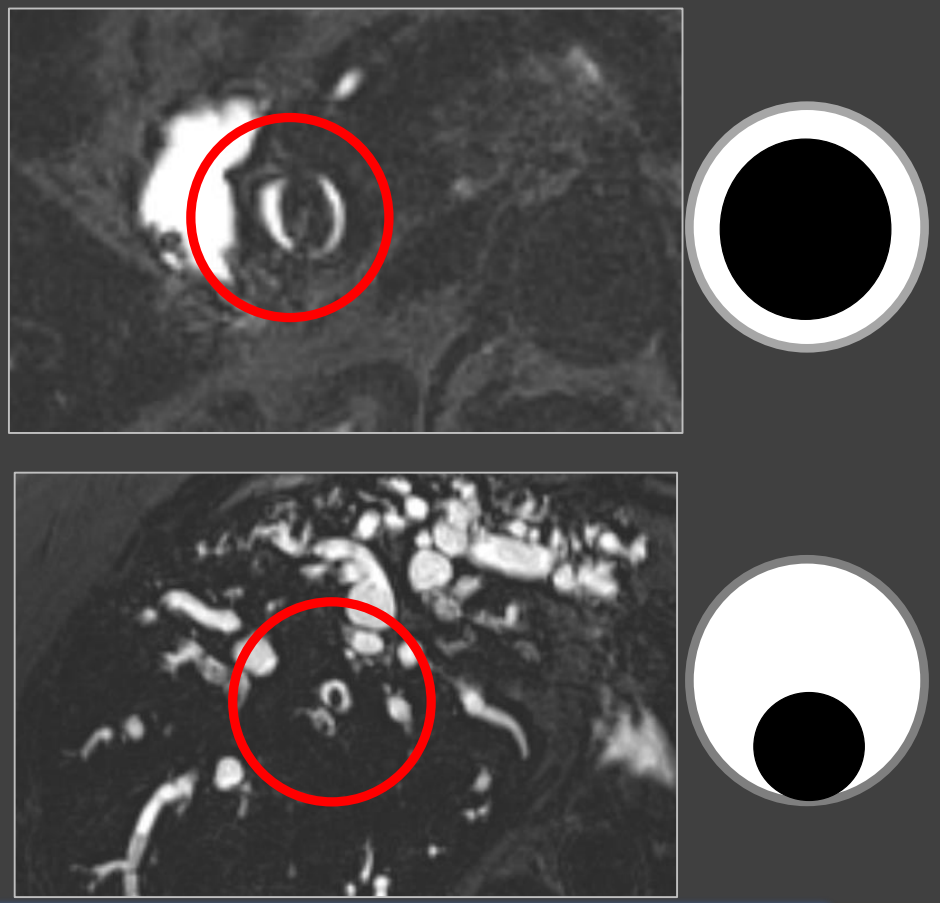
T2w coronal MIP reformat showing **the cystic duct (>2cm) coursing parallel to the common hepatic duct (c**ircle)

T2w coronal MIP reformat showing **a low and medial insertion of the cystic duct onto the common bile duct** (red arrow)

Main Imaging Findings- Indications

Biliary Tract

2. Biliary lithiasis- intraluminal filling defects



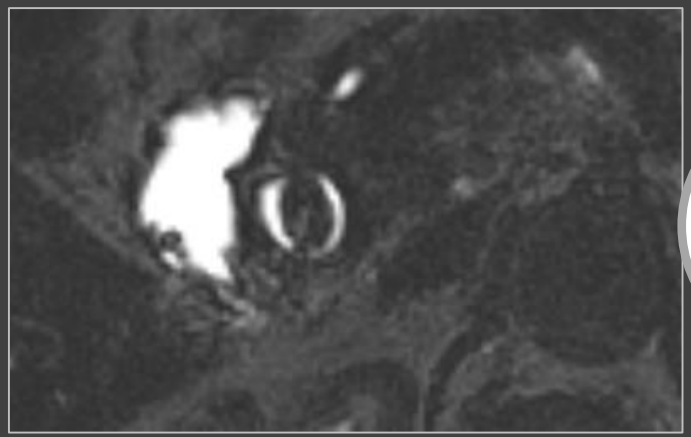
T2w axial MRCP images showing a central filling defect (top) and a dependent filling defect (down)

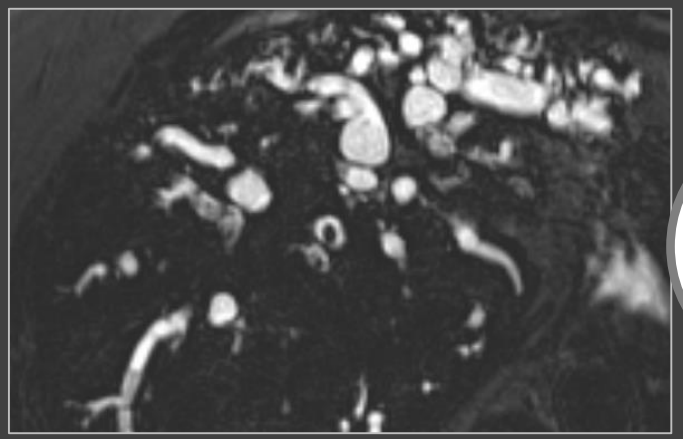
T2w MIP reformat showing a filling defect of the common bile duct (red arrow)

Main Imaging Findings- Indications

Biliary Tract

Lithiasis vs Pneumobilia



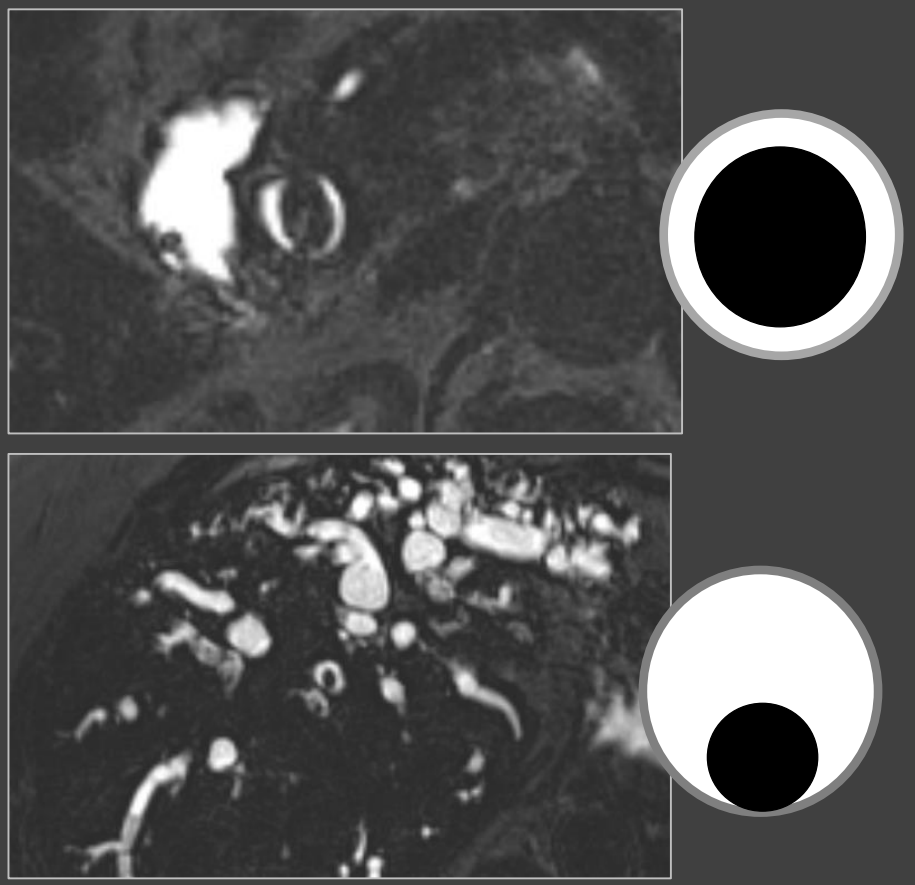


T2w axial MRCP images showing a non-dependent filling defect with a air-fluid level (circle)

Main Imaging Findings- Indications

Biliary Tract

Lithiasis vs Pneumobilia



T2w axial MRCP images showing a non-dependent filling defect with a air-fluid level (arrows)

Main Imaging Findings- Indications

Biliary Tract

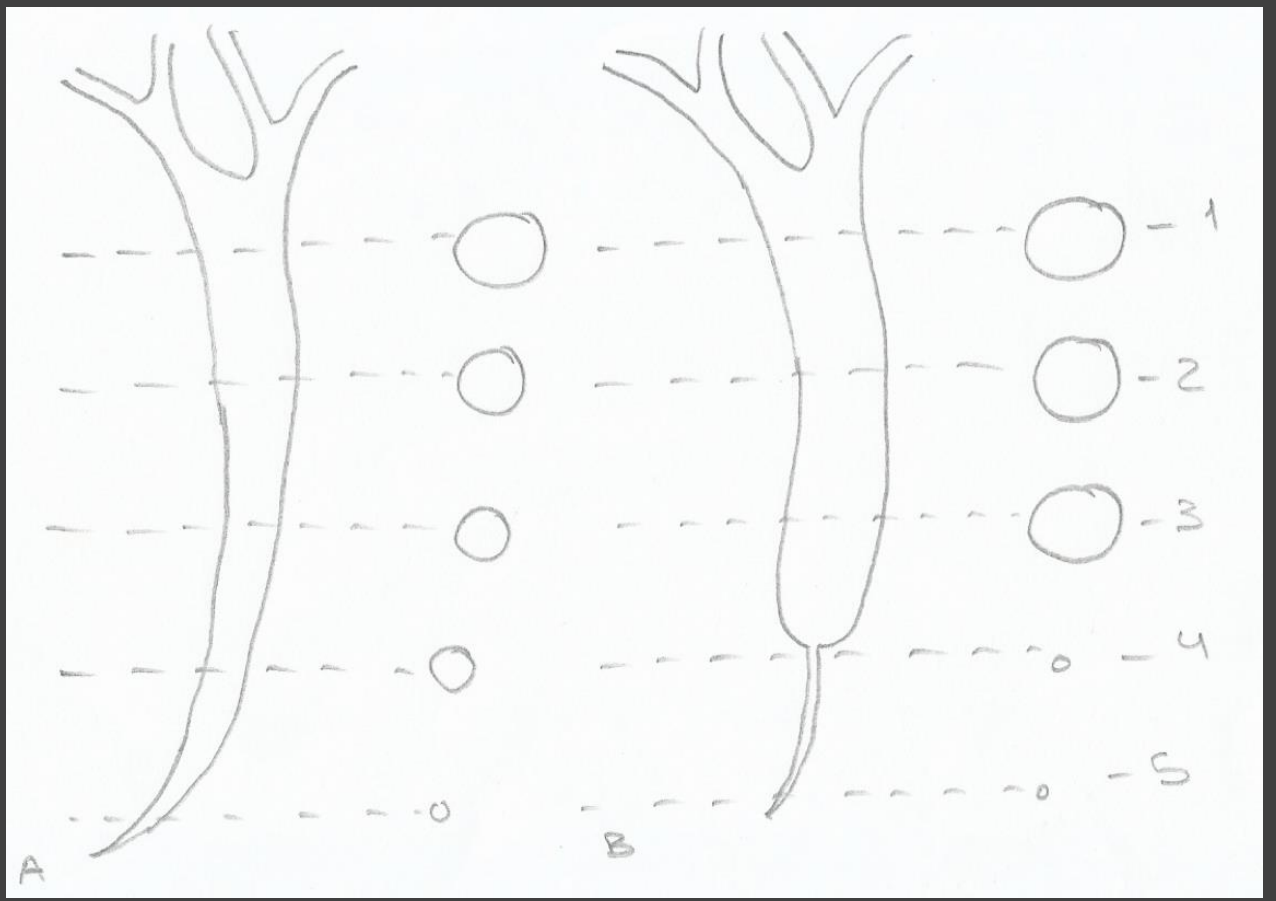
3. Stenosis [1,4]

- Number
- Location
- Extension
- Characteristics (malignant vs benign)
- Associated findings (+ abdominal MR)

Distal stenosis→
GREAT IMAGING CHALLENGE !!

Main Imaging Findings- Indications

Biliary Tract

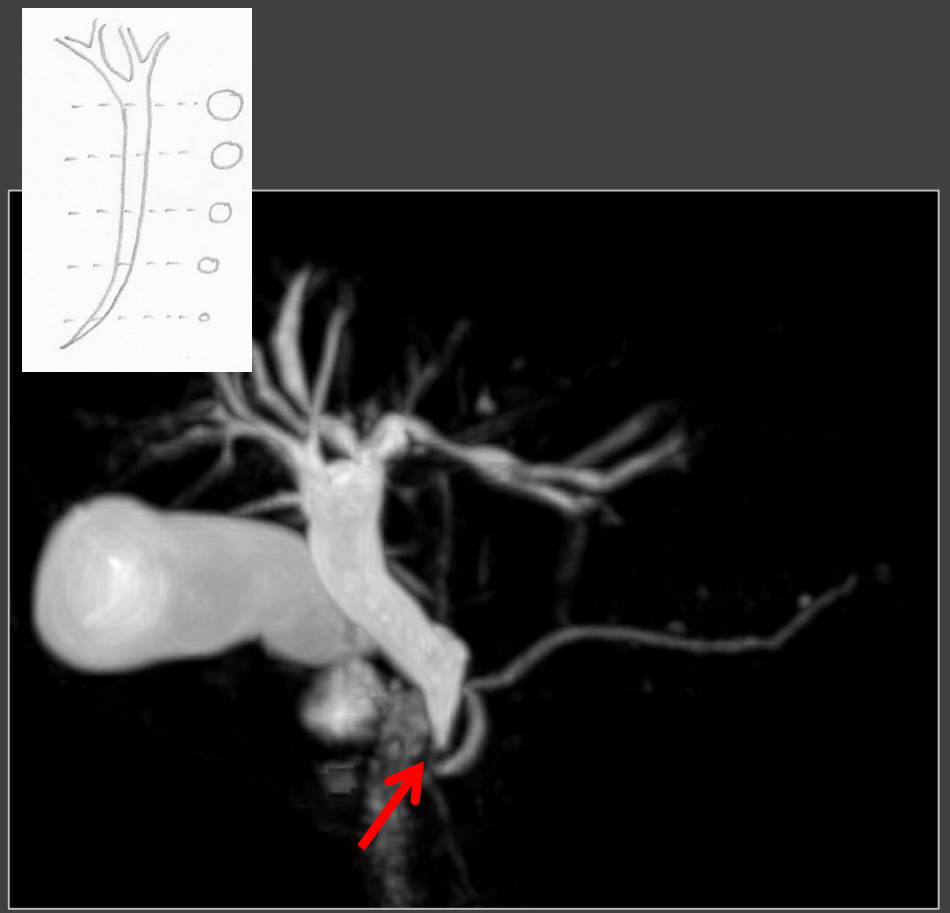


“Pencil tip”
BENIGN

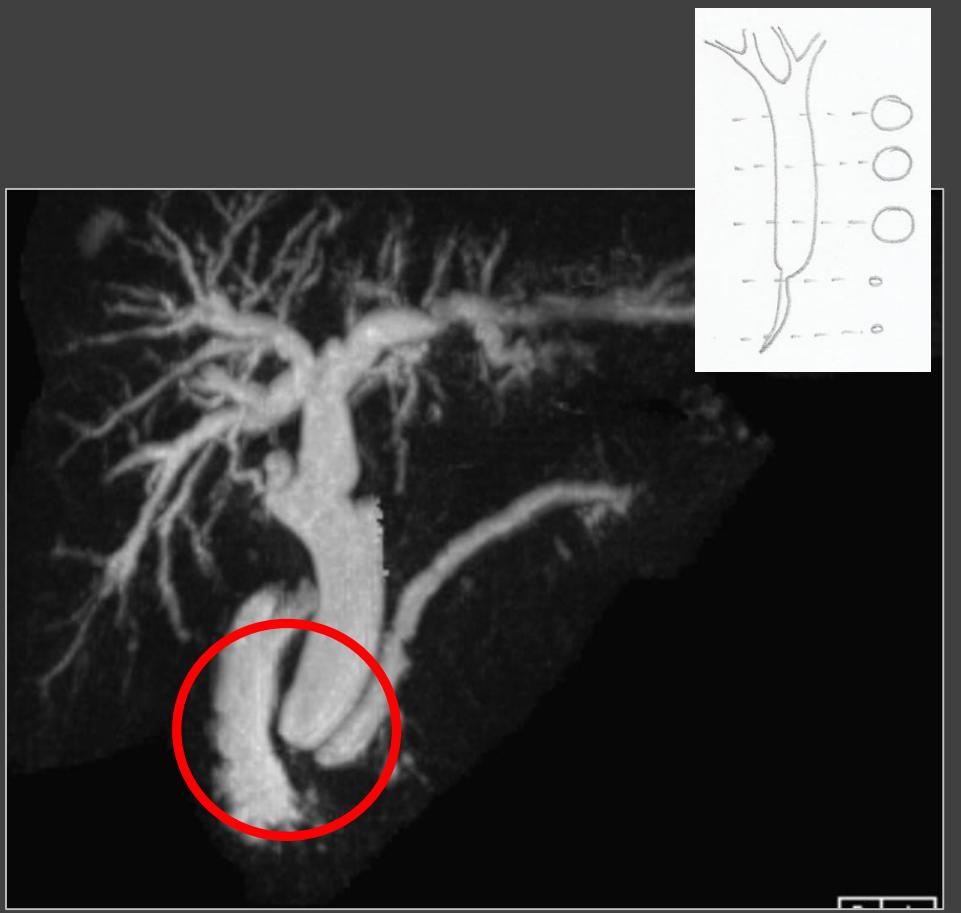
“rat tail”
MALIGNANT

Main Imaging Findings- Indications

Biliary Tract



T2w MIP reformat showing a benign stricture with a progressive narrowing mimicking a pencil tip (arrow)

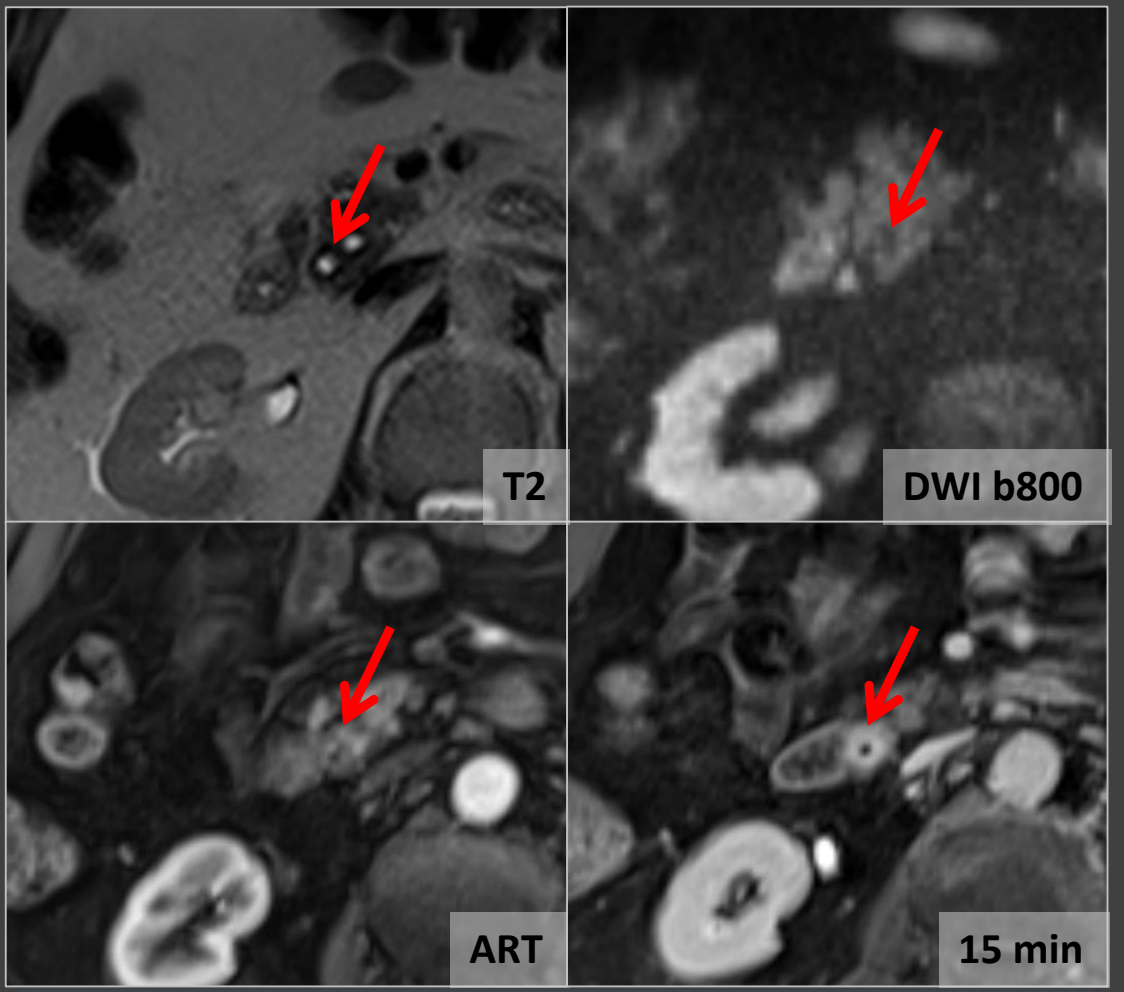


T2w MIP reformat showing a malignant stricture with an abrupt luminal narrowing mimicking a rat tail (circle)

Main Imaging Findings- Indications

Biliary Tract

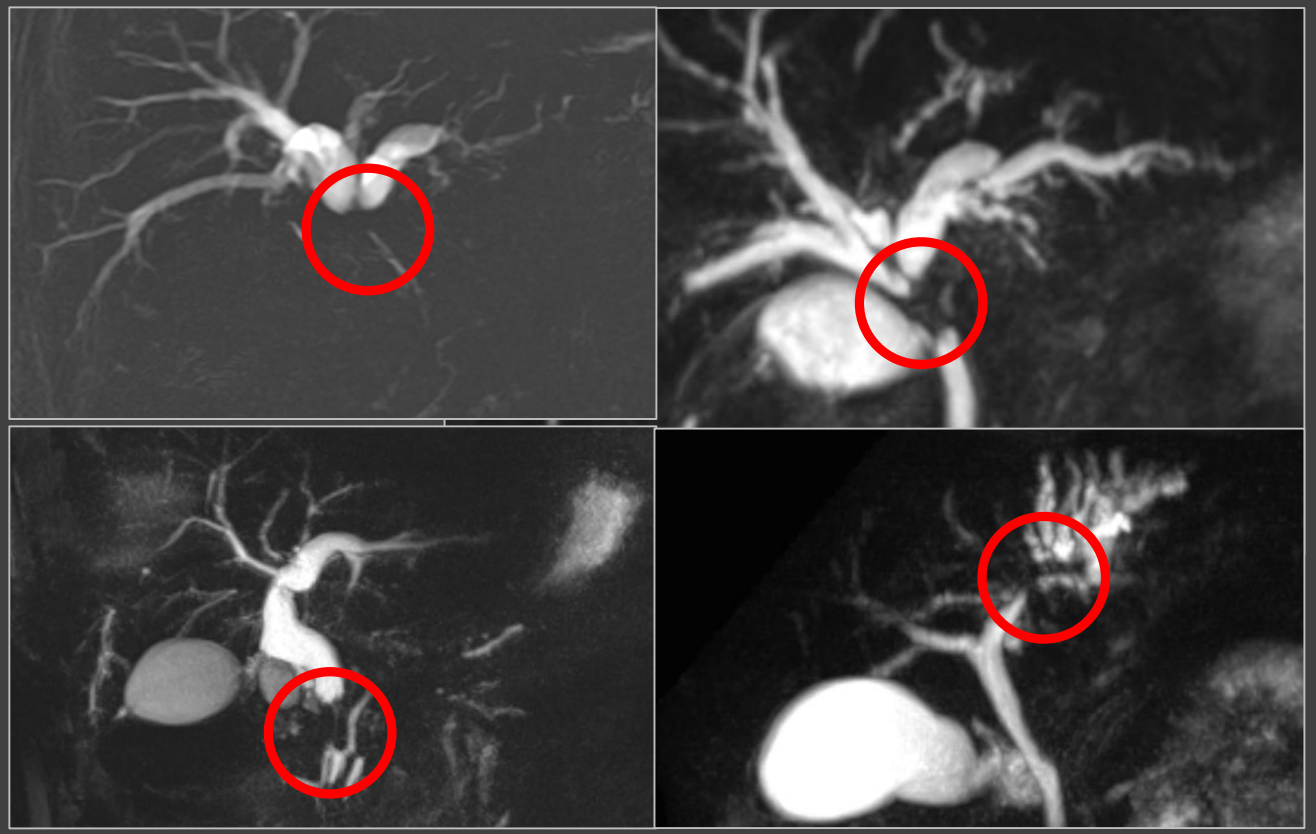
T2w MIP reformat showing a filling defect distally in the CBD corresponding to choledocolithiasis. Note the difficulty in evaluating a possible distal stenosis (circle)



T2w axial images showing a distal stenosis of the CBD with gadolinium-based contrast uptake at 15 minutes (bottom right), suggestive of a fibrotic stenosis (arrows)

Main Imaging Findings- Indications

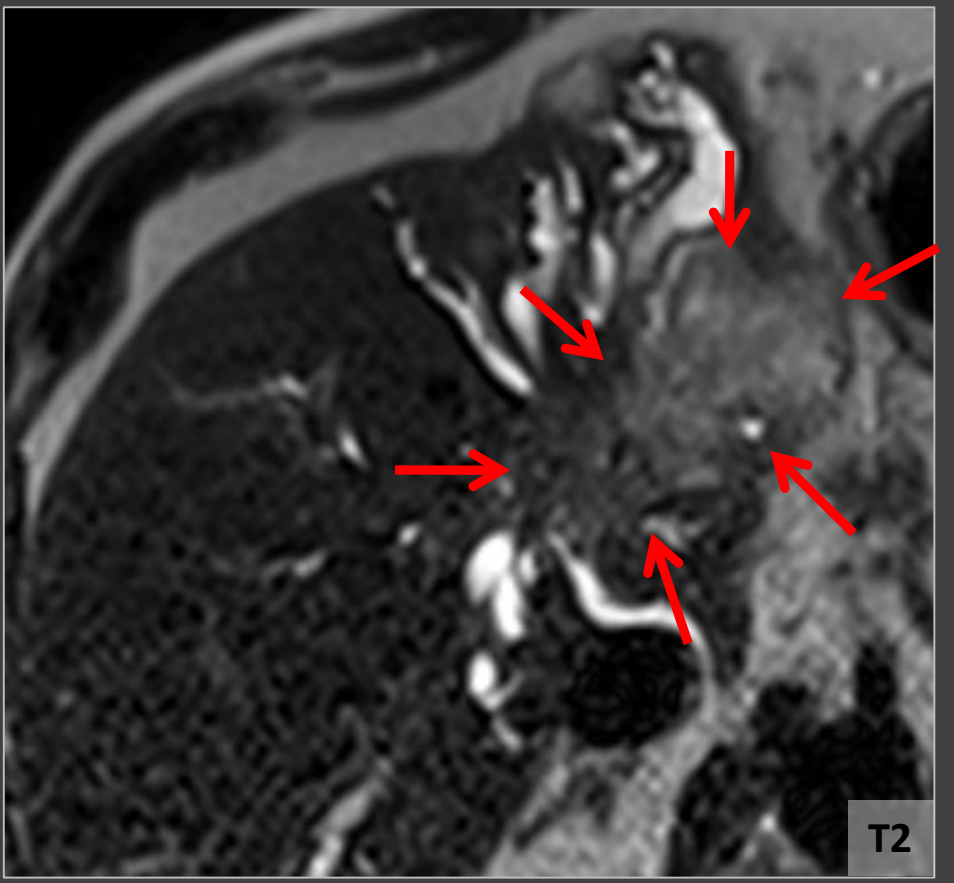
Biliary Tract



Cholangiocarcinomas: T2w MIP reformats. Top left and right: hilar stenosis (Klatskin tumour). Bottom left: distal CBD stenosis. Bottom right: Left hepatic duct stenosis. All show an abrupt calibre reduction with “rat tail” sign, and dilation of the upstream biliary tract, corresponding to malignant strenosis (circles)

Main Imaging Findings- Indications

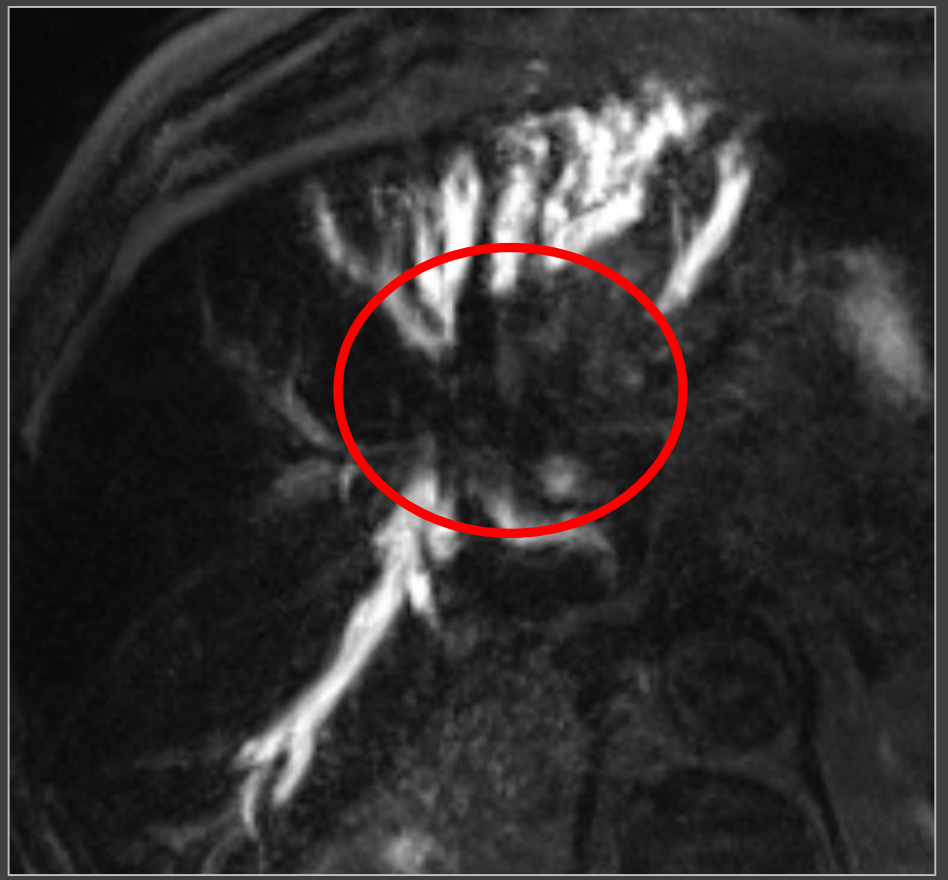
Biliary Tract



T2w axial images showing dilation of the right and left lobe intra-hepatic bile ducts with a “stop” sign at the hepatic hilum (circle) corresponding to a Klatskin tumour (arrow)

Main Imaging Findings- Indications

Biliary Tract



The Diffusion Weighted Image (right) shows restriction to diffusion of the Klatskin tumour and of a satellite nodule that corresponds to a hepatic metastasis (arrow)

Main Imaging Findings- Indications

Biliary Tract

T2w MIP reformat (left) and axial DWI b800 (right) showing a CBD stenosis corresponding to involvement of the CBD by a gallbladder neoplasia. The extension might occur directly through the hepato-duodenal ligament or secondary to adenopathy compression

Main Imaging Findings- Indications

Biliary Tract

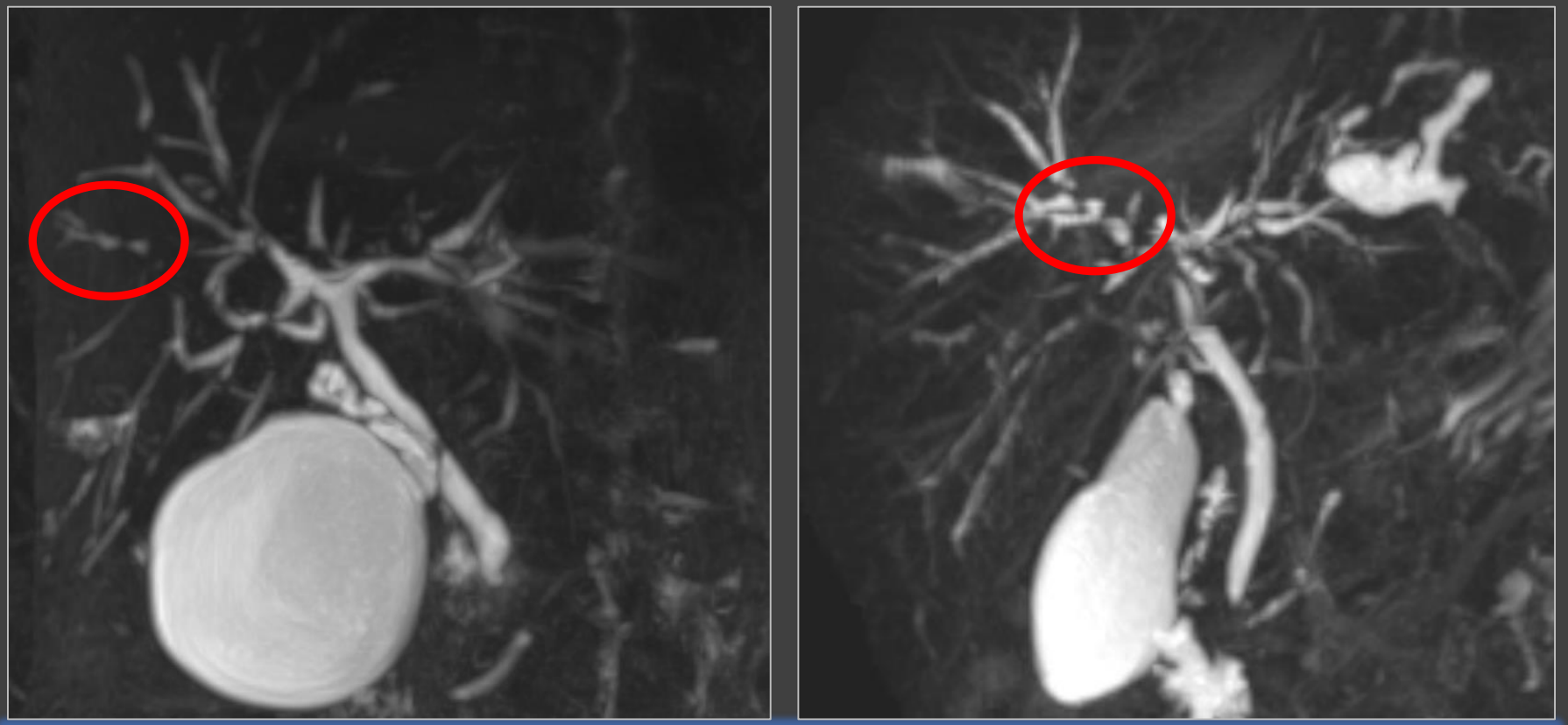
5. PSC [6]

- Male sex predominance
- 30-40y
- 70% with inflammatory intestinal disease
- 15% develop cholangiocarcinoma
- Affects mainly both intra and extra-hepatic bile ducts (but can affect one or the other)

Main Imaging Findings- Indications

Biliary Tract

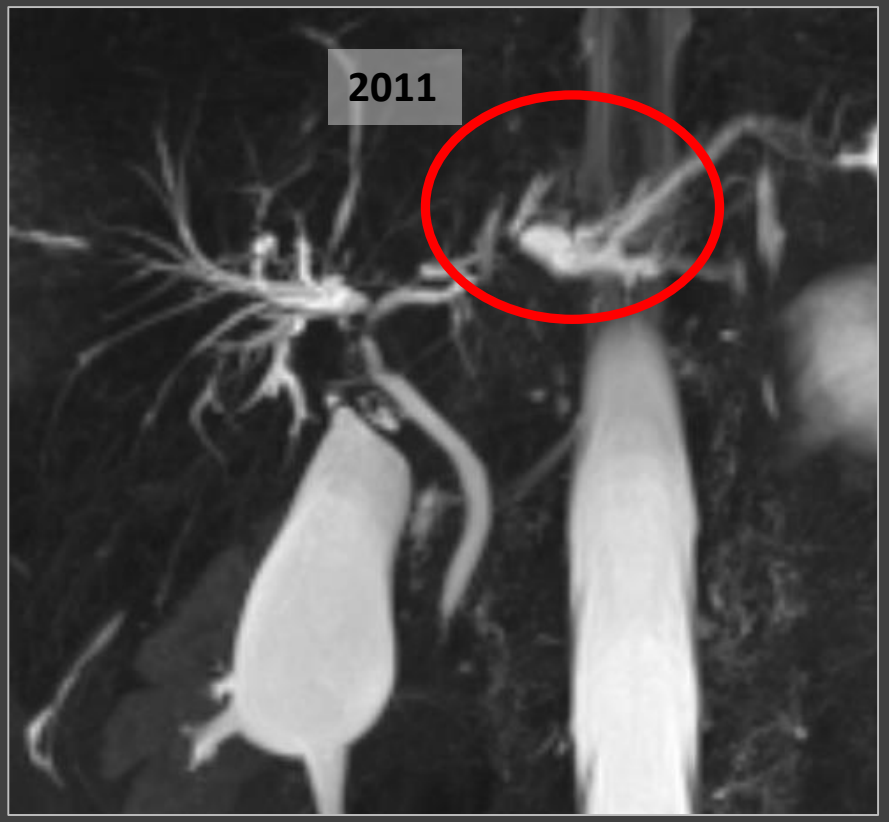
5. PSC [6]

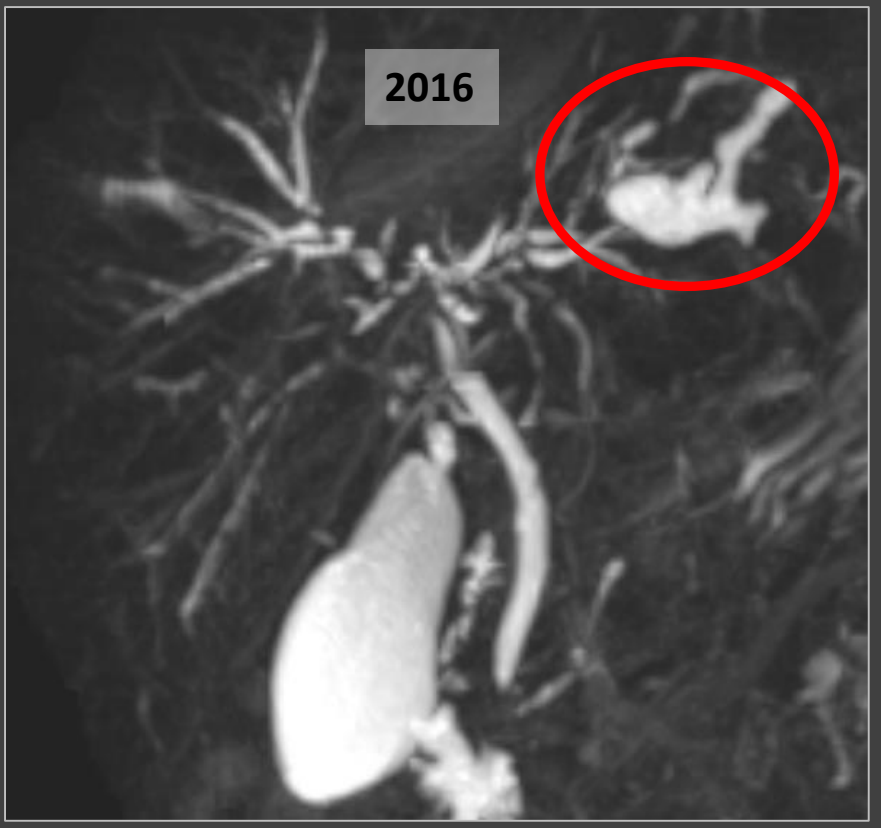


T2w MIP reformats showing contour deformities of intra-hepatic biliary ducts with multifocal strictures with intervening normal or slightly dilated ducts with a “beaded” or ”pruned tree” appearance (circles) corresponding to PSC

Main Imaging Findings- Indications

Biliary Tract



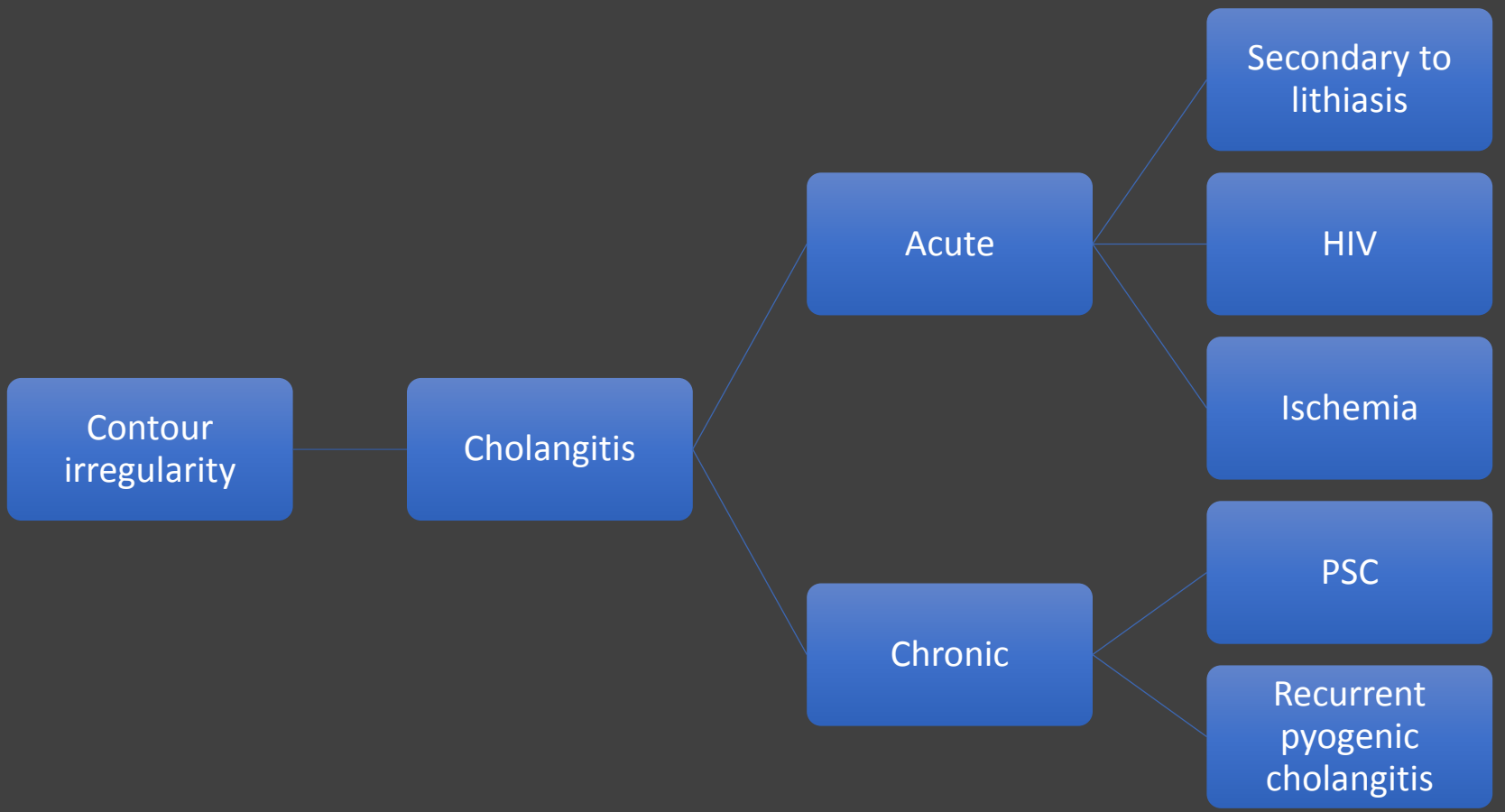


T2w MIP reformats showing the changes of the biliary stenosis and dilations in a case of PSC following 5 years

Main Imaging Findings- Indications

Biliary Tract

Main differential diagnosis → IgG4-related sclerosing cholangiopathy



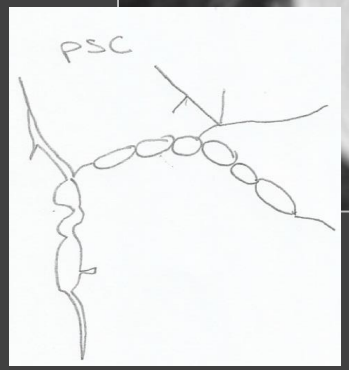
Main Imaging Findings- Indications

Biliary Tract

PSC vs IgG4 [7]

IgG4 related sclerosing cholangitis:

- older patients
- frequently accompanied by pancreatic or extrapancreatic lesions
- may include obstructive jaundice
- More frequent in the intra-pancreatic segment of the CBP
- often resolves with steroid therapy



T2w coronal MIP reformats showing beaded appearance of PSC - left (circle) compared to long and continuous strictures found in IgG4 related sclerosing cholangitis- right- (arrows)

Main Imaging Findings- Indications

Biliary Tract

6. Development diseases

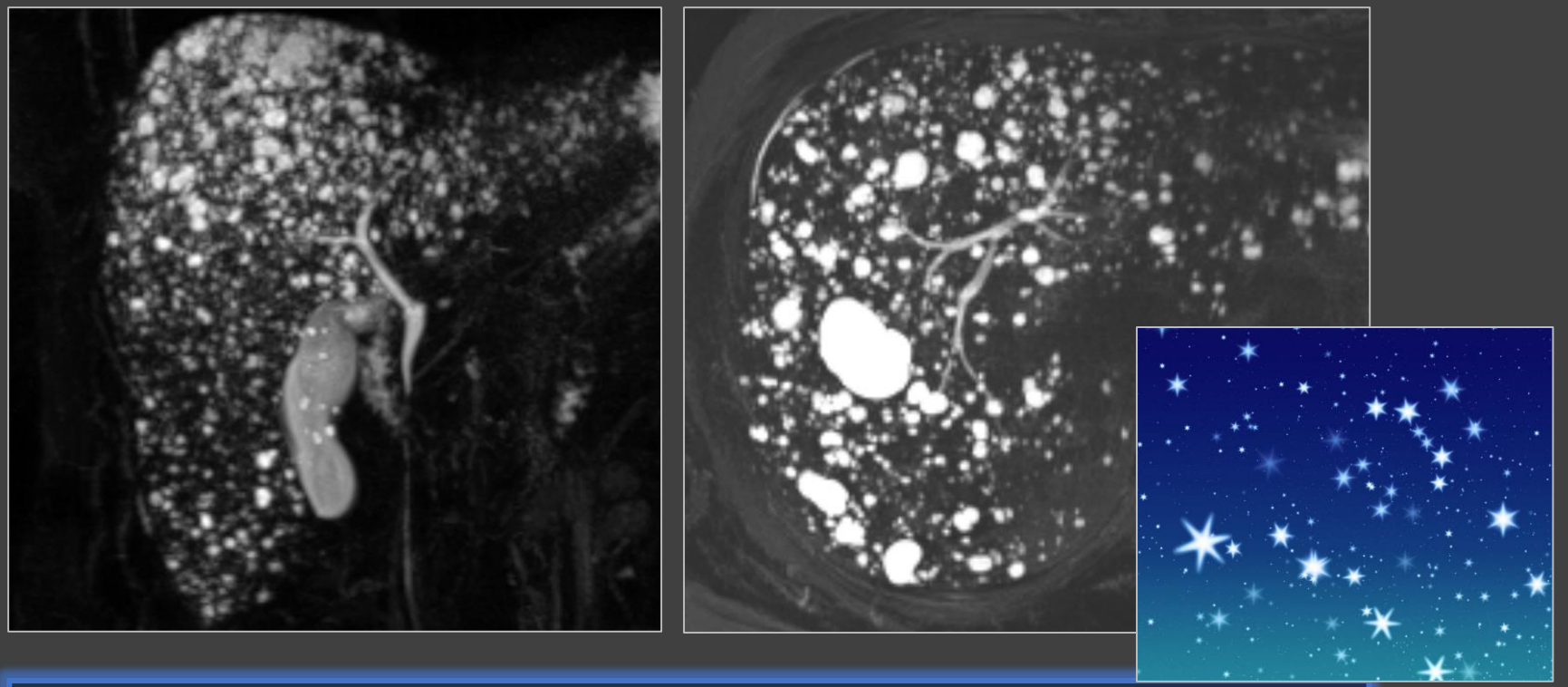
Biliary hamartomas [8]

- Ductal plate defect – fibrocystic disease
- Smaller biliary ducts- interlobular small dilated ducts involved by fibrosis
- Cystic lesions inferior to 15mm
- Fibrotic component= contrast uptake
- No communication with bile duct

Main Imaging Findings- Indications

Biliary Tract

Biliary hamartomas



T2w coronal and axial images showing multiple millimetric hepatic cystic lesions corresponding to *von meyenburg complexes. Note the "starry sky"* appearance

Main Imaging Findings- Indications

Biliary Tract

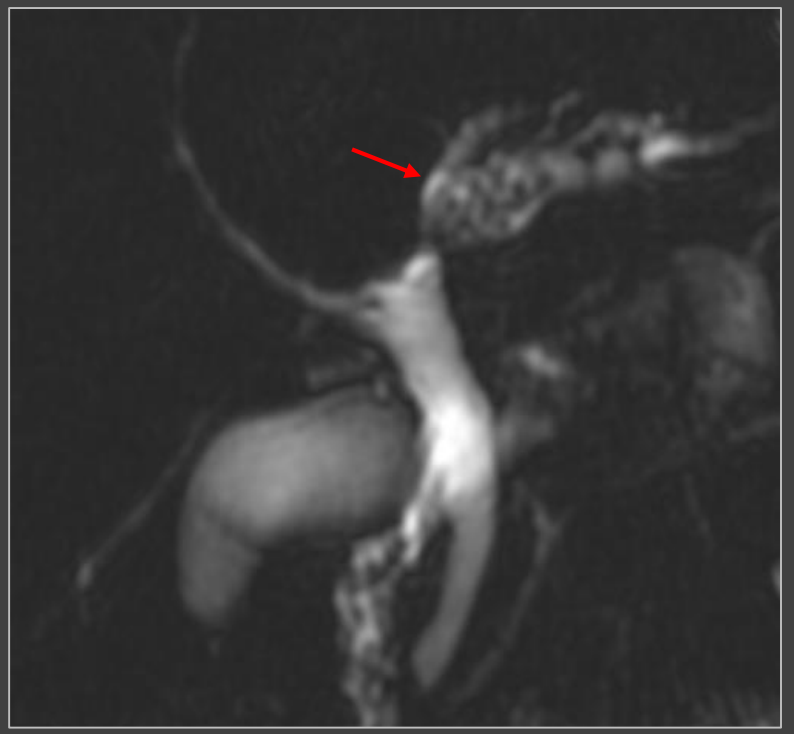
Caroli's disease [8]

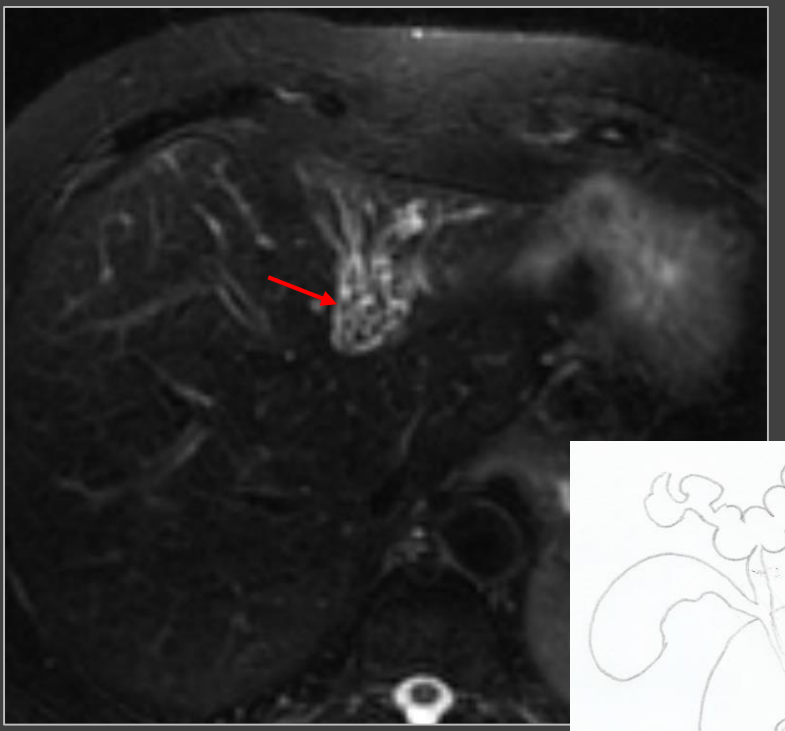
- Ductal plate defect
- Affects larger calibre intra-hepatic bile ducts
- Sporadic (Caroli's disease) or autossomic recessive (Caroli's syndrome)
- Cysts communicate with biliary tree (central dot sign)
- May have liquid-liquid level
- 100x > risk of cholangioarcinoma

Main Imaging Findings- Indications

Biliary Tract

Caroli's disease





T2w coronal MIP reformat (left) and axial image showing focal dilation of intra-hepatic bile ducts and intra-hepatic lithiasis (arrows)

Main Imaging Findings- Indications

Biliary Tract

Choledochal cysts [8]

- Ductal plate defect or anomaly of the bilio-pancreatic junction
- One of the differential diagnosis of CBD dilation without stenosis

Main Imaging Findings- Indications

Biliary Tract

Choledochal cysts [8] – Todani Classification

I	Fusiform dilation of the extrahepatic bile duct • **Ia:** entire extrahepatic bile duct • **Ib:** focal dilatation of extrahepatic bile duct **Ic:** dilatation of the CBD
II	Bile duct true diverticulum
III	Choledococele: protrusion of a focally dilated, intramural segment of the distal CBD into the duodenum
IV	Multiple communicating cysts of the intra and extrahepatic bile ducts • **IVa:** fusiform dilation of the entire extrahepatic bile duct + intrahepatic bile ducts • **IVb:** multiple cystic dilations involving only the extrahepatic bile duct
V	Caroli's disease

More frequent, 15% risk of cholangiocarcinoma

Main Imaging Findings- Indications

Biliary Tract

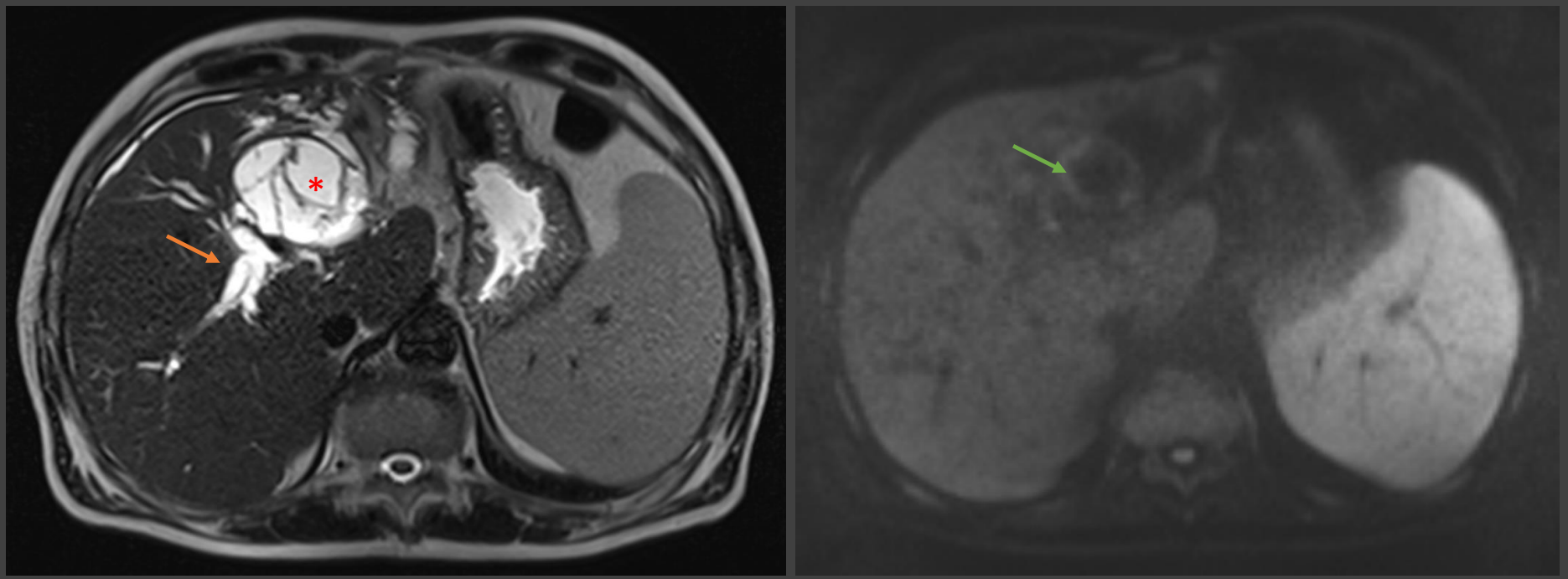
Choledochal cysts

T2w coronal MIP reformat showing a type Ia choledochal cyst with fusiforme dilation of the entire extra-hepatic bile duct with unproportional dilation of the CBD compared to the intra-hepatic ducts

Main Imaging Findings- Indications

Biliary Tract

9. Intraductal papillary neoplasm of the biliary tract- IPN-B



Left: Axial T2W image showing a cystic dilation of the bile duct draining the lateral segment of the left hepatic lobe, with a maximum calibre of 5cm, with intraductal papillary projections (asterix). Associated diffuse dilation of the intra-hepatic bile ducts is noted (orange arrow). Right: Axial DWI showing some areas with higher restriction to diffusion corresponding to the intraductal papillary projections found within the bile duct dilation (green arrow)

Main Imaging Findings- Indications

Biliary Tract

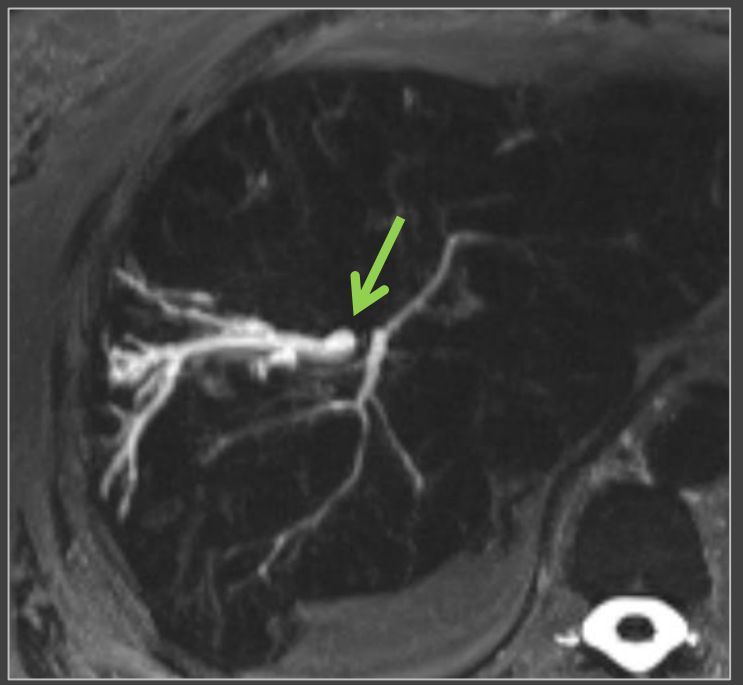
10. Iatrogenic lesions [10]

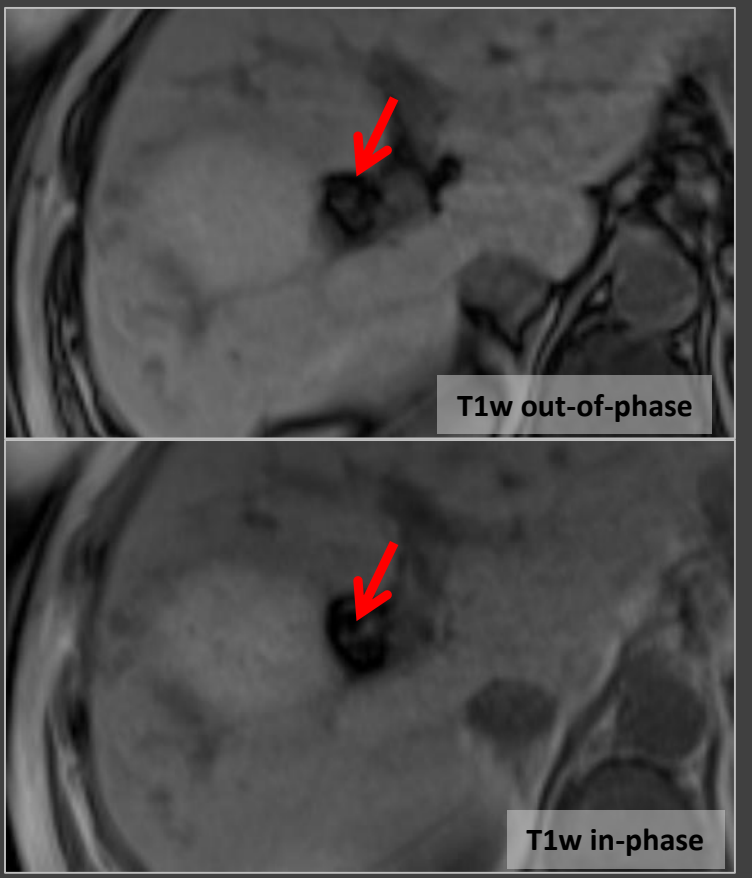
- Middle third of the CBD +++
- Secondary to surgical clips or ischemic stenosis

Main Imaging Findings- Indications

Biliary Tract

10. Iatrogenic lesions





Left: T2w axial image showing dilation f the right anterior intra-hepatic bile ducts with “stenosis” (green arrow). Right: T1w in and out-of-phase axial images showing susceptibility artifact at the site of stenosis corresponding to surgical clips (red arrows)

1. Learning objectives
2. Background
   - Technical considerations
   - Anatomy
3. **Main imaging findings**
   - Indications
     - Biliary tract
     - **Pancreas**
     - Gallbladder
     - Indirect MRCP
   - Pitfalls
4. Conclusions
5. References

Main Imaging Findings- Indications

Pancreas

1. Anatomic variants
2. Cystic lesions (characterisation and duct relationship)
    - Serous cystadenoma
    - Mucinous cystadenoma
    - Intraductal papillary mucinous neoplasm (IPMN)
3. Pancreatic head and periampullary lesions
4. Acute pancreatitis complications
5. Chronic pancreatitis (diagnosis and complications)
6. Auto-immune pancreatitis

Main Imaging Findings- Indications

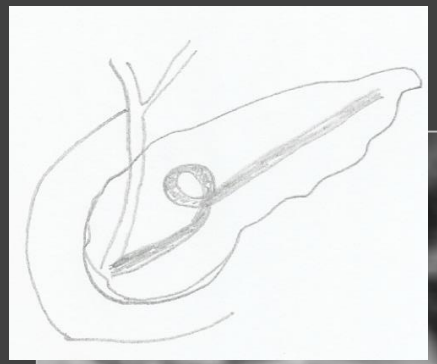
Pancreas

1. Anatomic variants [11]

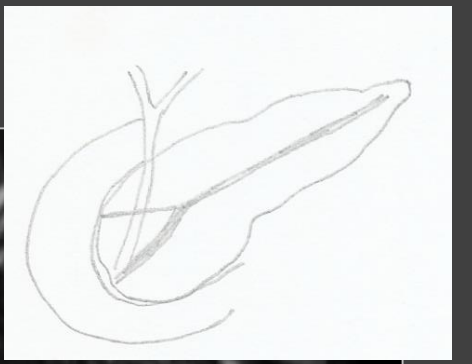
- Important to diagnose in patients with persistent abdominal pain and nausea
- Duct variations:
  - Path
    - Descending (+++)
    - Vertical
    - Sigmoid
    - Loop
  - Configuration→ most frequently bifid (persistent Santorini duct with dominant Wirsung duct)
  - Bilio-pancreatic junction
- Pancreatic development anomaly → *pancreas divisum* (4-14%)
  - Drainage of the majority of the pancreas through the Santorini duct
  - 3 types: both ducts totally separated/ absent Wirsung/ thin communication
  - Rarely associated with santorinocele

Main Imaging Findings- Indications

Pancreas



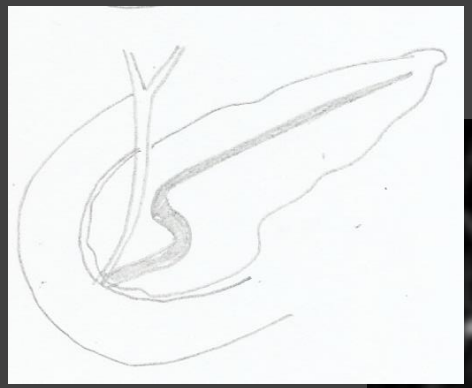
T2w coronal MIP reformat showing a *loop* of the pancreatic duct (circle)

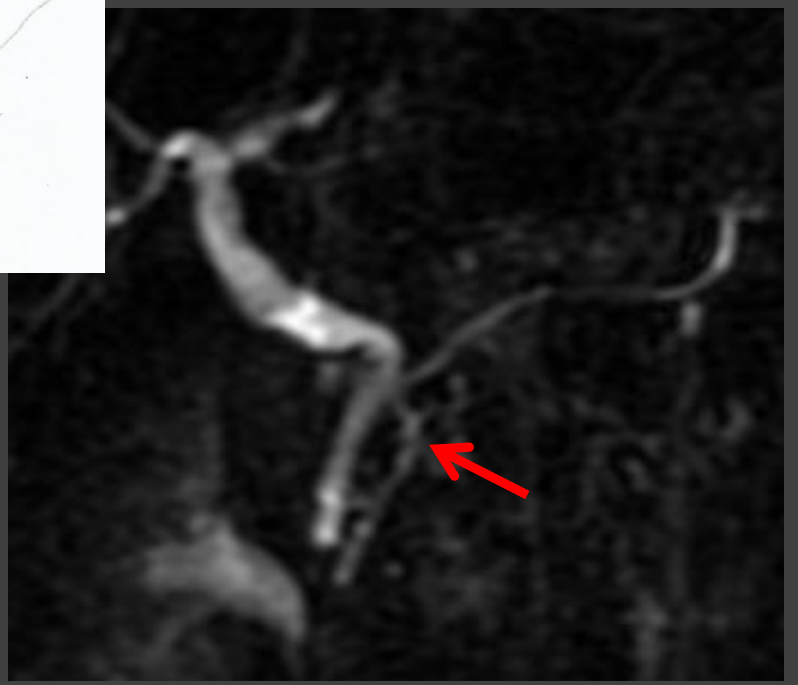


T2w coronal MIP reformat showing a persistent *Santorini* duct (arrow)

Main Imaging Findings- Indications

Pancreas

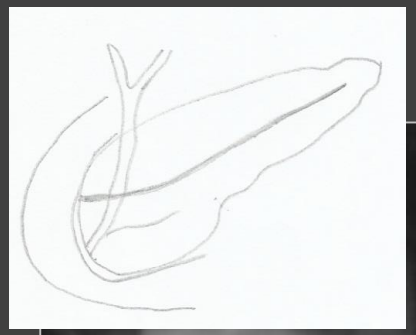




T2w coronal MIP reformat showing a *sigmoid* pancreatic duct (arrow)

Main Imaging Findings- Indications

Pancreas



T2w coronal MIP reformat showing the Santorini duct (arrow) responsible for the main pancreatic drainage and the Wirsung duct (arrowhead) draining pancreatic head/ uncinate process: Pancreas *divisum*.

Adapted from: Mortelé, K. J., Rocha, T. C., Streeter, J. L., & Taylor, A. J. (2006). Multimodality Imaging of Pancreatic and Biliary Congenital Anomalies. *RadioGraphics, 26*(3), 715-731.

Common channel >15mm→ greater risk of choledochal cyst and cholangiocarcinoma[1]

T2w coronal MIP reformat showing an abnormal bilio-pancreatic junction: the pancreatic duct and CBD unite outside the duodenal wall forming a long common channel (arrow)

Main Imaging Findings- Indications

Pancreas

2. Cystic Lesions

- Number
- Location
- Size
- Relation to pancreatic duct / duct calibre
- Characteristics
  - Unilocular/multilocular/multicystic
  - Septi
  - Liquid content (+ abdominal MR)
  - Nodules/tecidual component (+ abdominal MR)

Main Imaging Findings- Indications

Pancreas

2. Cystic Lesions [11]

- Non tumoural lesions
- Tumoural lesions
  - Ductal cell line
  - Acinar cell line (acinar cell cistoadenocarcinoma)
  - Intraductal tubular carcinomas
  - Neuroendocrine tumours
  - Indeterminate cell line (solid pseudopapillary tumours)

Main Imaging Findings- Indications

Pancreas

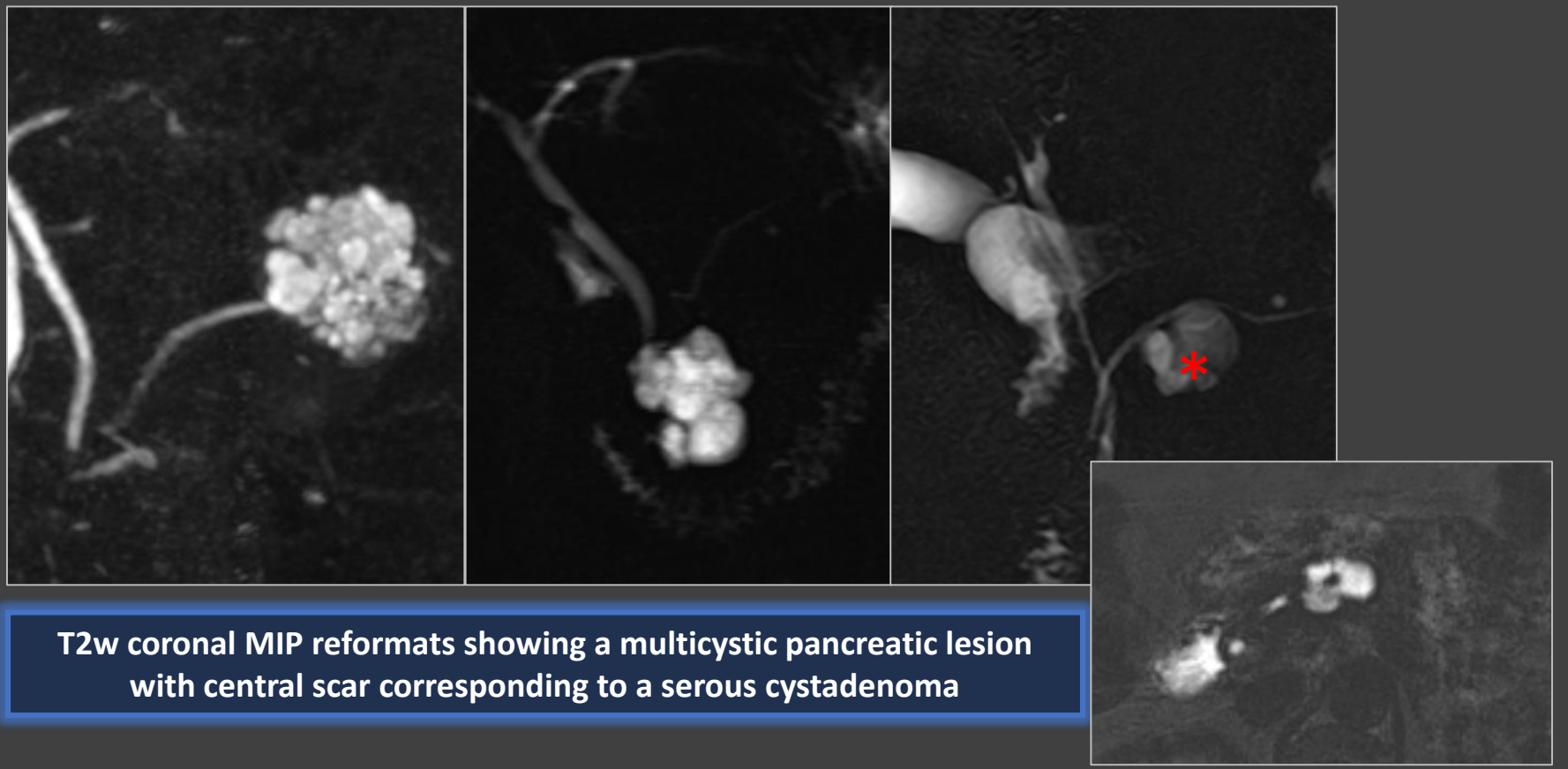
	Serous cystadenoma	Mucinous cystic neoplasms	Intraductal mucinous neoplasm (IPMN)
Demographics	Typically older women >60 years	Typically younger women 30-50 years	Peak age 6th decade, no gender bias
Site of tumour	Anywhere in the pancreas, especially the head	75% in body/tail	Side branch type: usually pancreatic head/uncinate process, less frequently in the tail; tumour communicates with the main pancreatic duct Main duct type: segmental or diffuse involvement of the main pancreatic duct
Morphology	>6 cysts (<2 cm each), thin septations, central scar (calcification), does not communicate with the pancreatic duct	Cysts >2 cm, unilocular or multilocular, does not communicate with the pancreatic duct	Side branch type: macrocystic or microcystic appearances
		Features of malignancy on MR denoted by thick septations, soft tissue nodules, and/or pancreatic duct dilatation	Main duct type: diffuse duct dilatation due to gross mucin production, micropapillary studding, pancreatic atrophy
Average size	5 cm	6-10 cm	Larger size with malignant tumours
Signal characteristics	Fluid signal	High signal intensity on T1 and T2 (mucin/blood)	High signal intensity on T1 (mucin), intermediate signal intensity on T2
Comments	Usually benign	Malignant in 50%	Side branch type: usually associated with benign adenomas Main duct type: malignant in 40%

From: Griffin, N., Charles-Edwards, G. and Grant, L. (2011). Magnetic resonance cholangiopancreatography: the ABC of MRCP. *Insights into Imaging*, 3(1)

Main Imaging Findings- Indications

Pancreas

Serous Cystadenoma

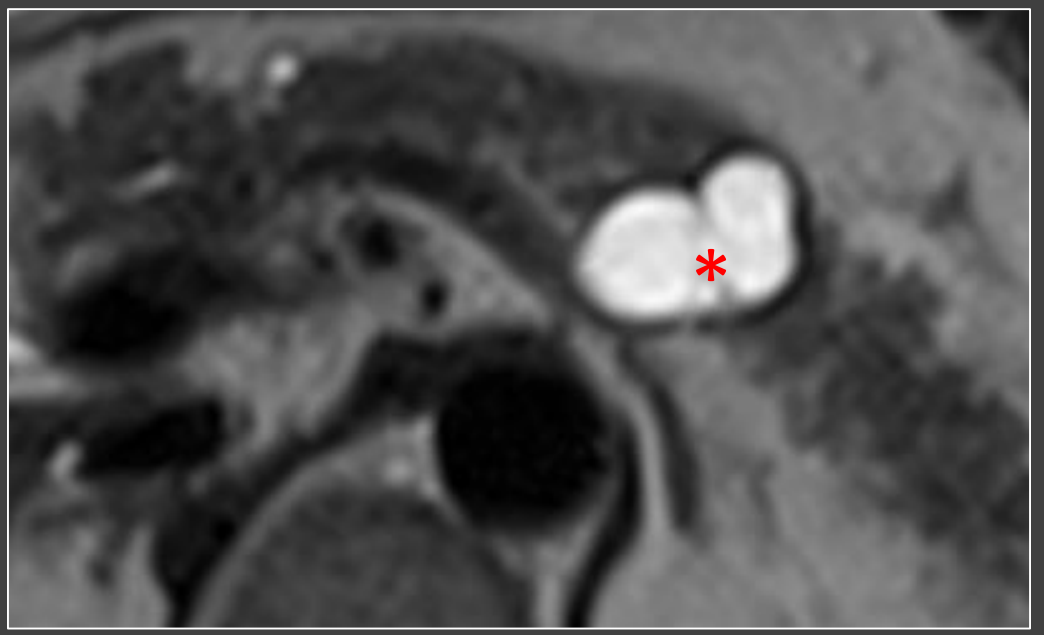


T2w coronal MIP reformats showing a multicystic pancreatic lesion with central scar corresponding to a serous cystadenoma

Main Imaging Findings- Indications

Pancreas

Mucinous cystadenoma

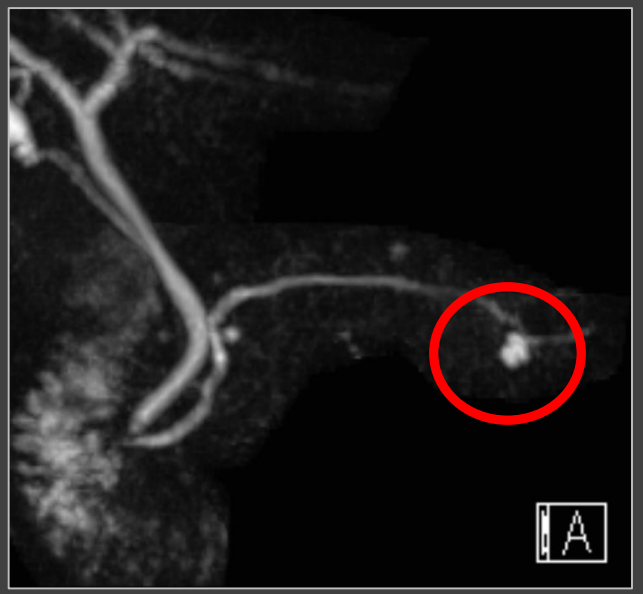


T2w axial image showing a unilocular cystic pancreatic lesion (asterix) corresponding to a mucinous cystadenoma

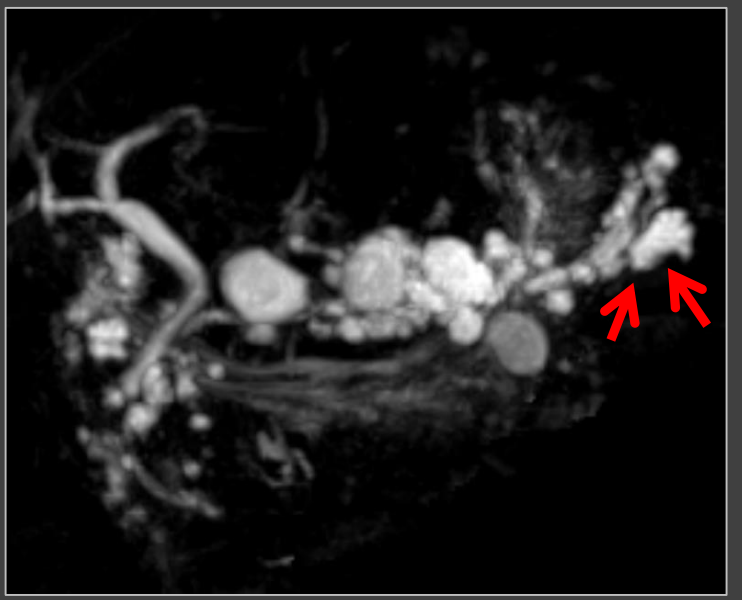
Main Imaging Findings- Indications

Pancreas

IPMNs



T2w MIP reformat showing a pancreatic cystic lesion (circle) corresponding to a IPMN *side branch*



T2w reformat showing multiple cystic pancreatic lesions with involvement of the pancreatic duct (mixed IPMN) (arrows)

Main Imaging Findings- Indications

Pancreas

Worrisome Features [1]

- Cyst ≧3cm
- Enhancing mural nodule <5mm
- Thickened/enhancing cyst walls
- Main duct size 5-9mm
- Abrupt change in calibre pancreatic duct with distal pancreatic atrophy
- Lymphadenopathy
- Increased CA19-9
- Cyst growth rate ≧5mm/2yrs

Endoscopic ultrasound

High risk stigmata [1]

- Obstructive jaundice in a patient with cystic lesion of the head of the pancreas
- Enhancing mural nodule ≧5mm
- Main pancreatic duct ≧10mm

Surgery

Main Imaging Findings- Indications

Pancreas

3. Pancreatic head and periampullary lesions

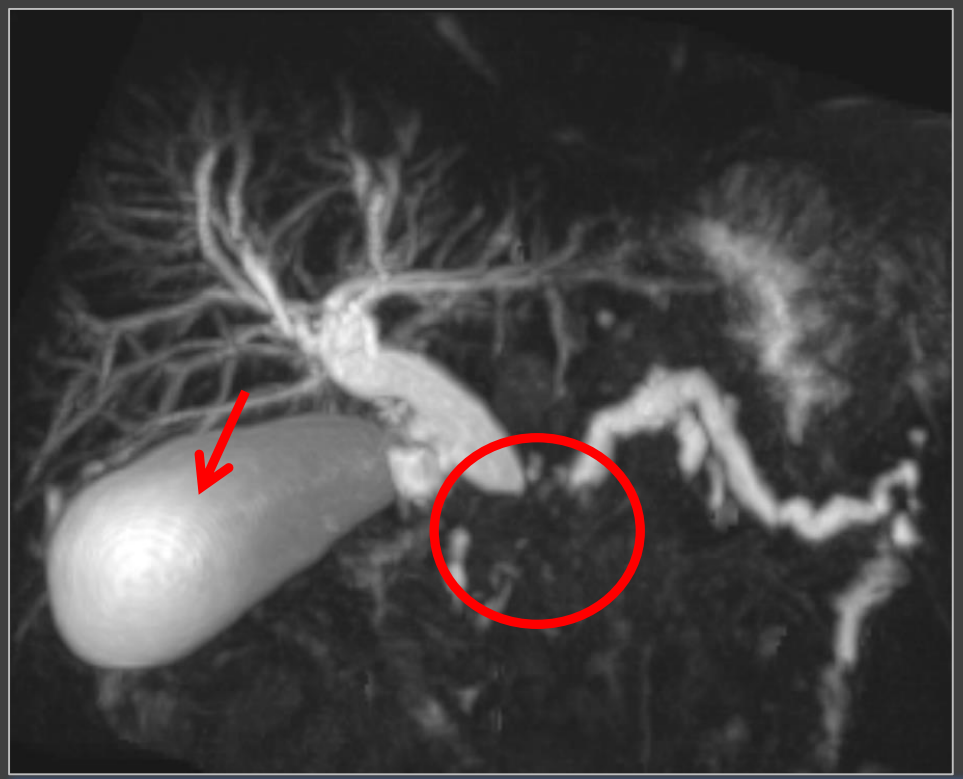
- Pancreatic head tumours
- Ampullary tumor
- Distal cholangiocarcinoma
- Lymphoma
- Metastasis
- Chronic pancreatitis
- Ampullary stenosis

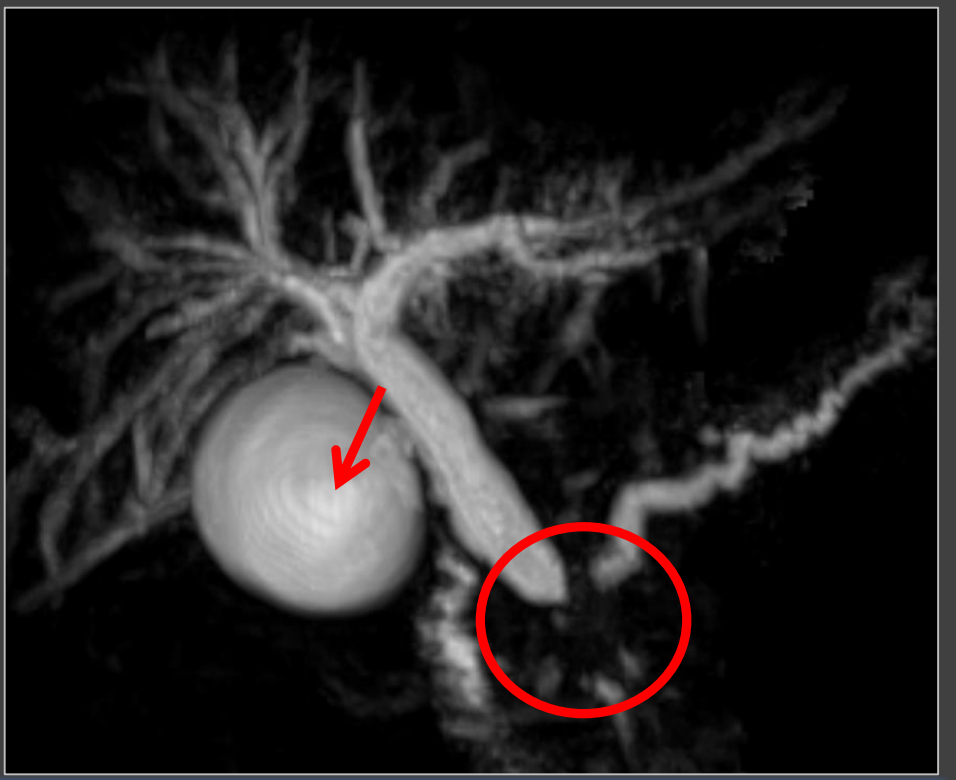
- Double duct sign
- Abrupt calibre reduction of CBD
- Courvoisier gallbladder

Main Imaging Findings- Indications

Pancreas

3. Pancreatic head and periampullary lesions



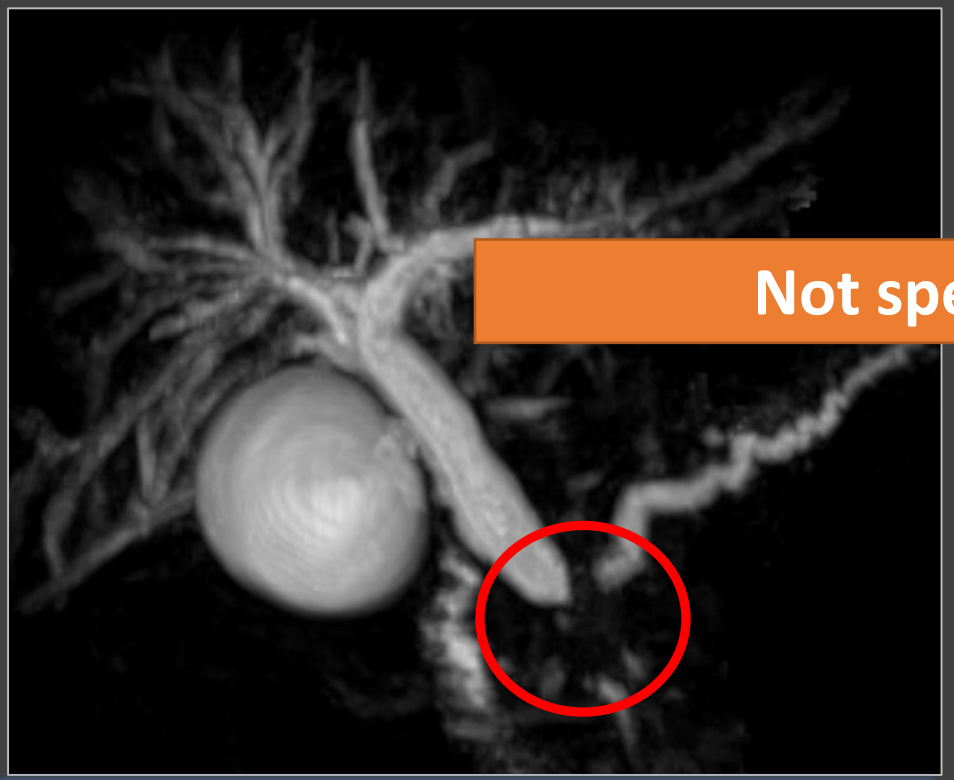


T2w MIP reformats showing double duct sign (circle), abrupt calibre reduction of CBD and Courvoisier gallbladder (arrows)

Main Imaging Findings- Indications

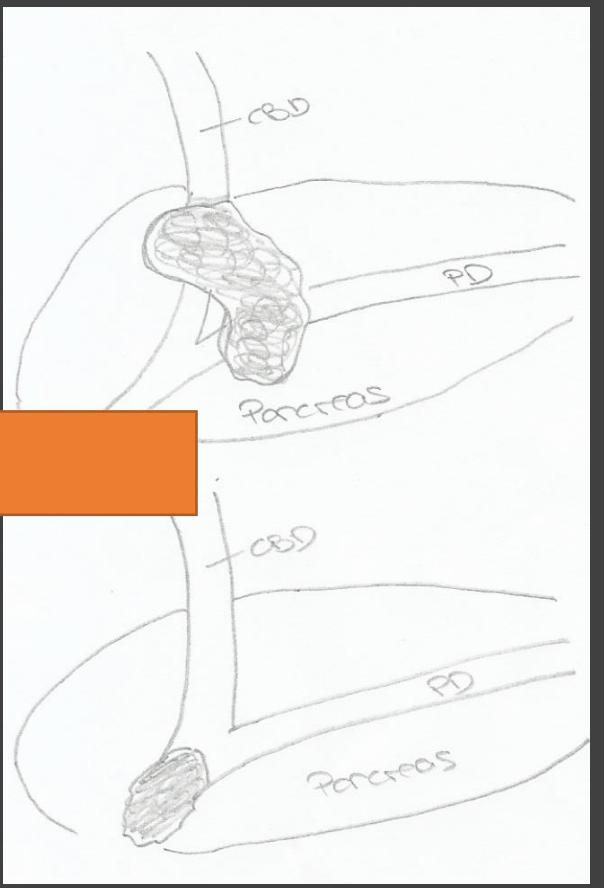
Pancreas

Double duct sign [11]



T2w MIP reformat showing double duct sign (circle)

Not specific!



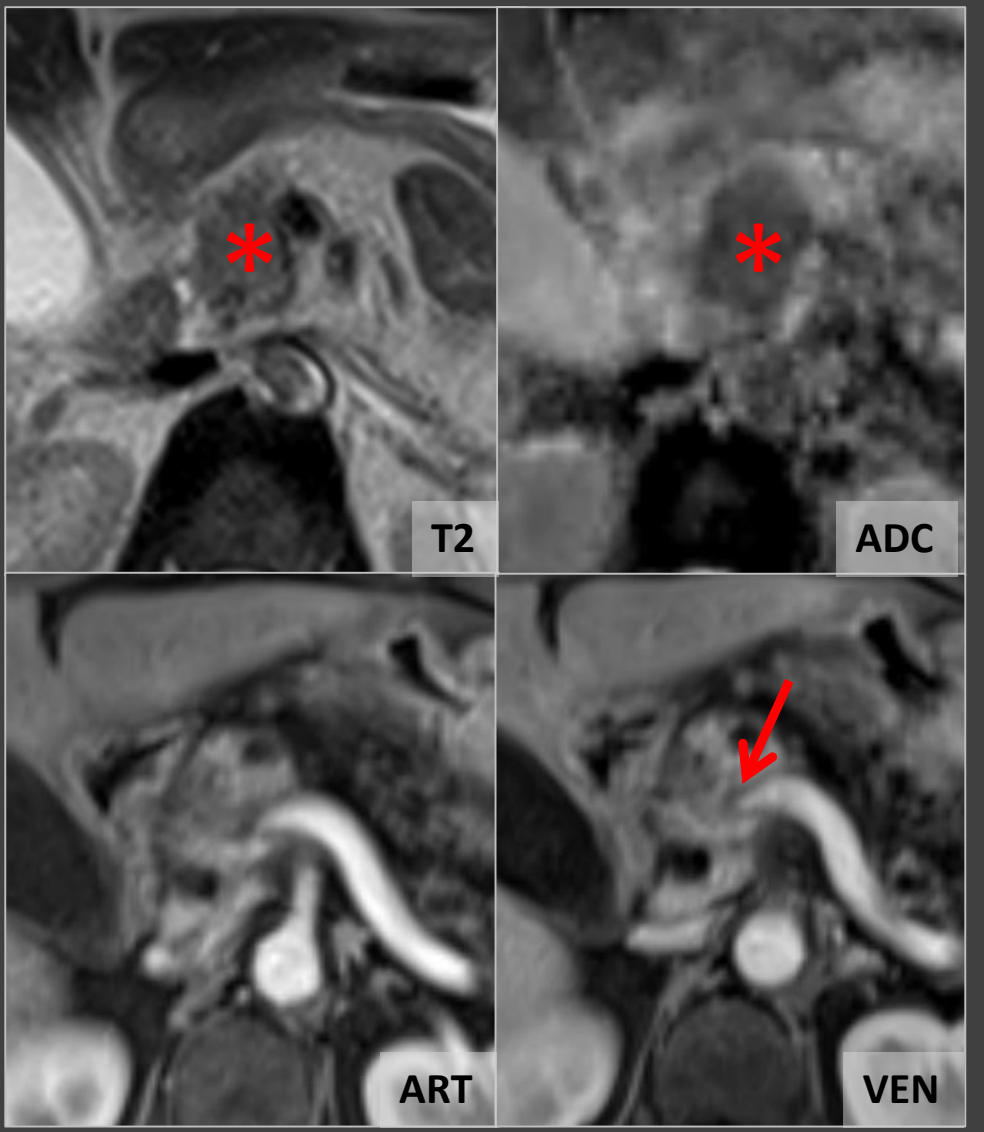
77% → pancreatic head tumor
50%→ ampullary tumor

Main Imaging Findings- Indications

Pancreas

Pancreatic head adenocarcinoma

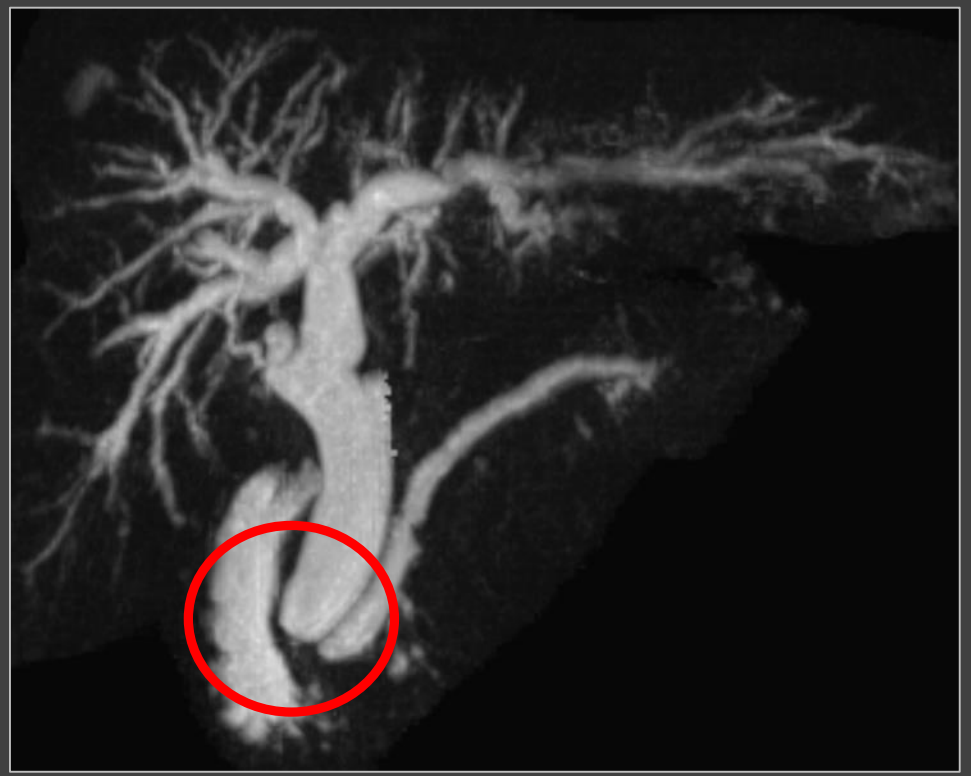
Top left: T2w axial image, Top right: ADC map, Bottom: T1w axial post gadolinium- based contrast injection -left-arterial phase - and right venous phase- showing a pancreatic head mass (asterix), with restriction to diffusion and encasement of the portal vein

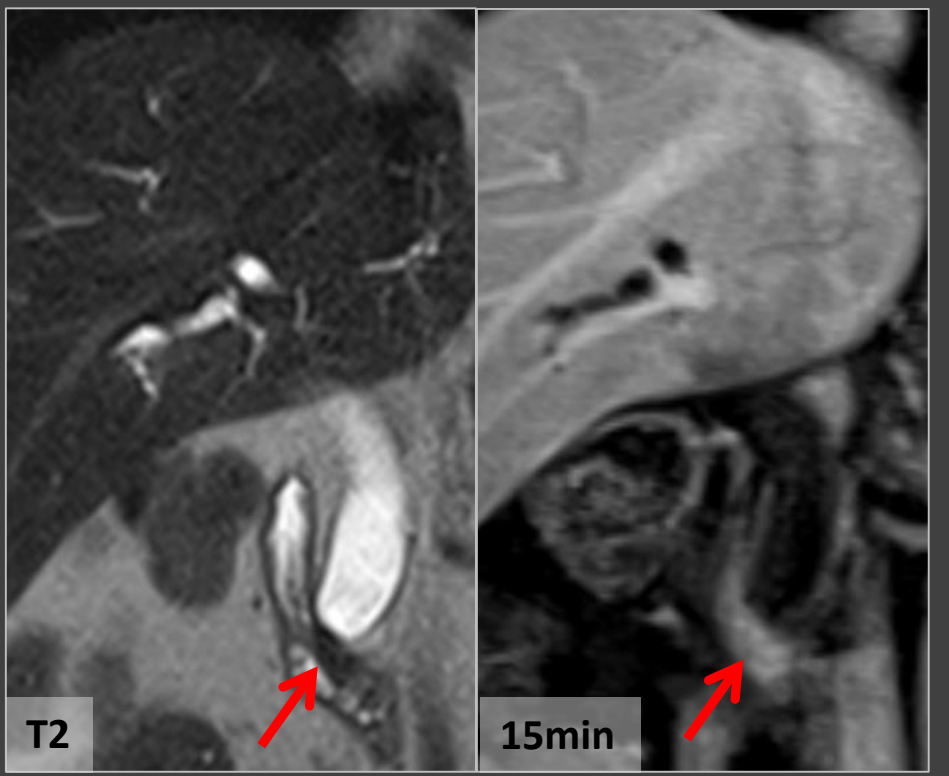


Main Imaging Findings- Indications

Pancreas

Ampullary tumour



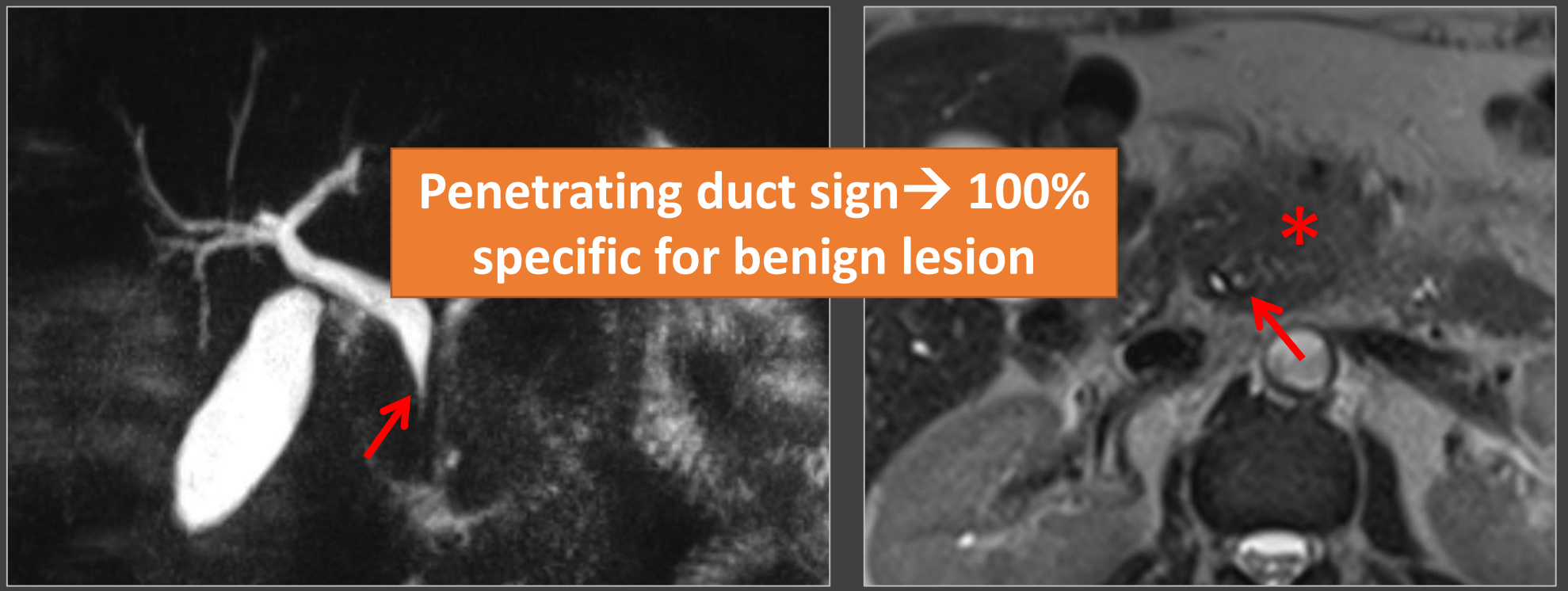


Left: T2w MIP reformat showing double duct sign (circle). Right: same patient- T2w axial and T1w post gadolinium-based contrast injection at 15min showing a mass in the ampullary region with progressive and late enhancement (arrows)

Main Imaging Findings- Indications

Pancreas

Groove pancreatitis

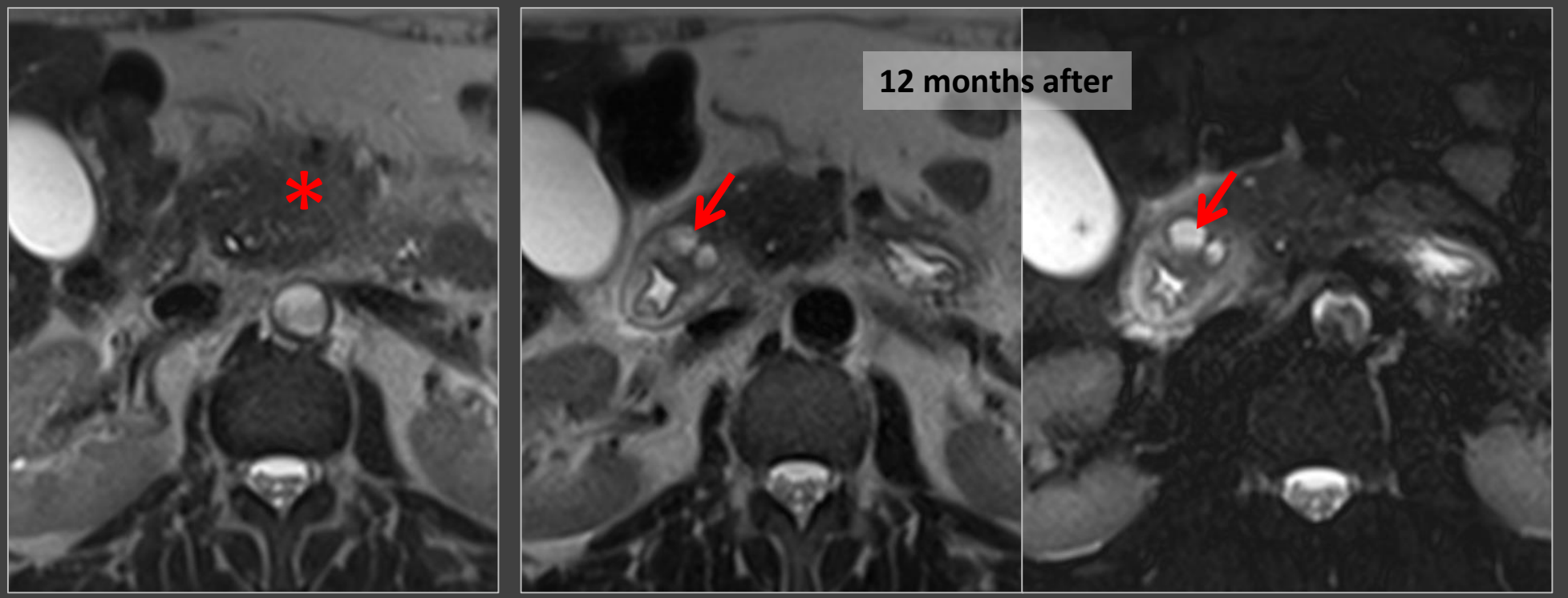


T2w MIP reformat (left) and axial image (right) showing a penetrating duct sign (arrow), a “mass” in the head of the pancreas (asterix) and cysts of the duodenal wall (arrow)

Main Imaging Findings- Indications

Pancreas

Groove pancreatitis

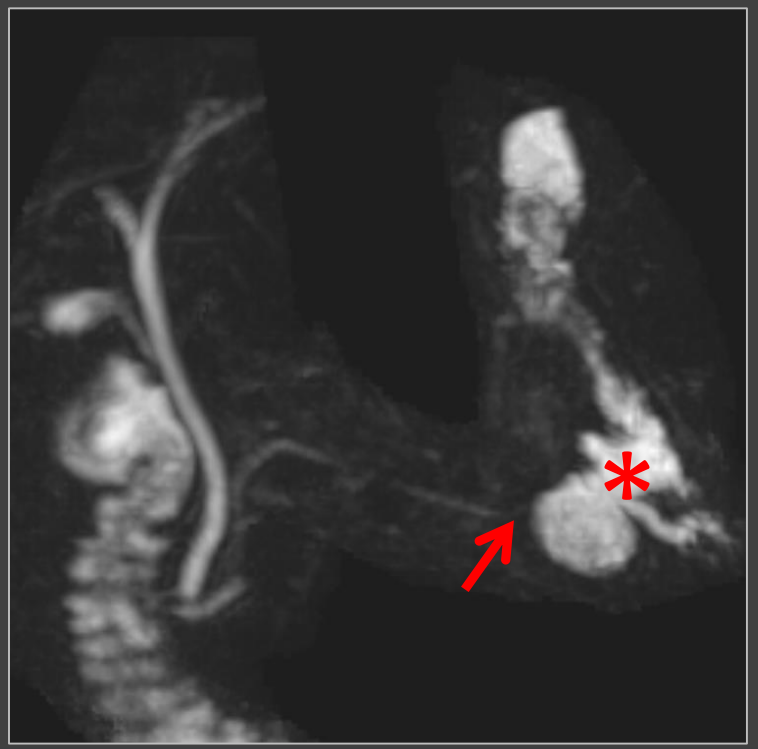


T2w axial images showing resolution of the pancreatic head “mass” (asterix) after 12 months, with duodenal wall thickening, groove and peri-duodenal oedema, and duodenal wall cysts (arrows)

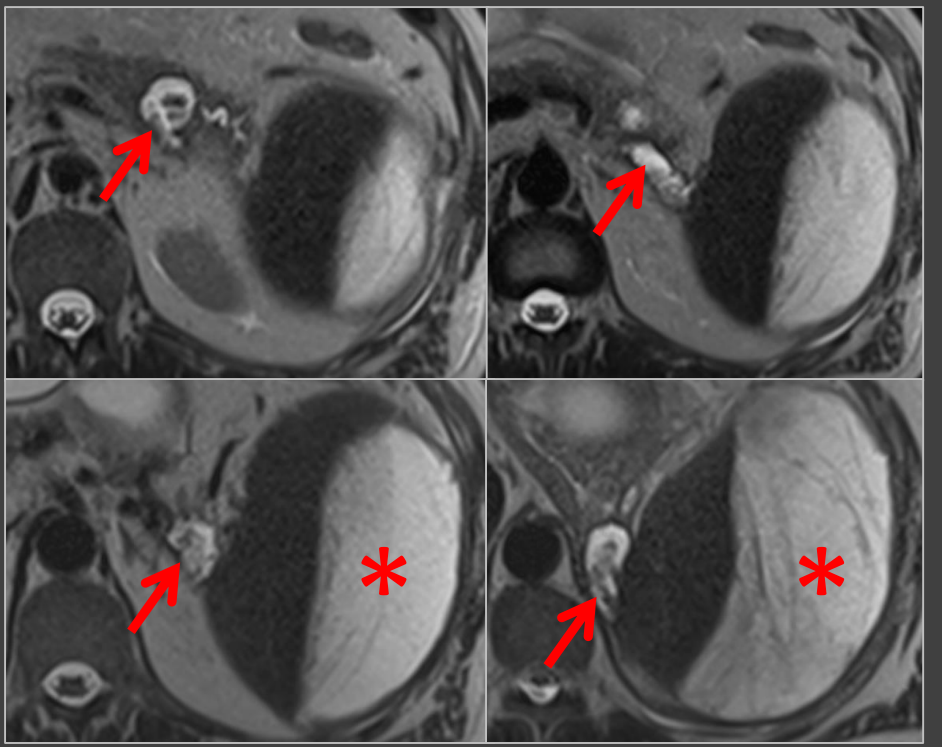
Main Imaging Findings- Indications

Pancreas

4. Acute pancreatitis complications



T2w MIP reformat showing “interruption” of the pancreatic duct (arrow) and a fluid collection (asterix)

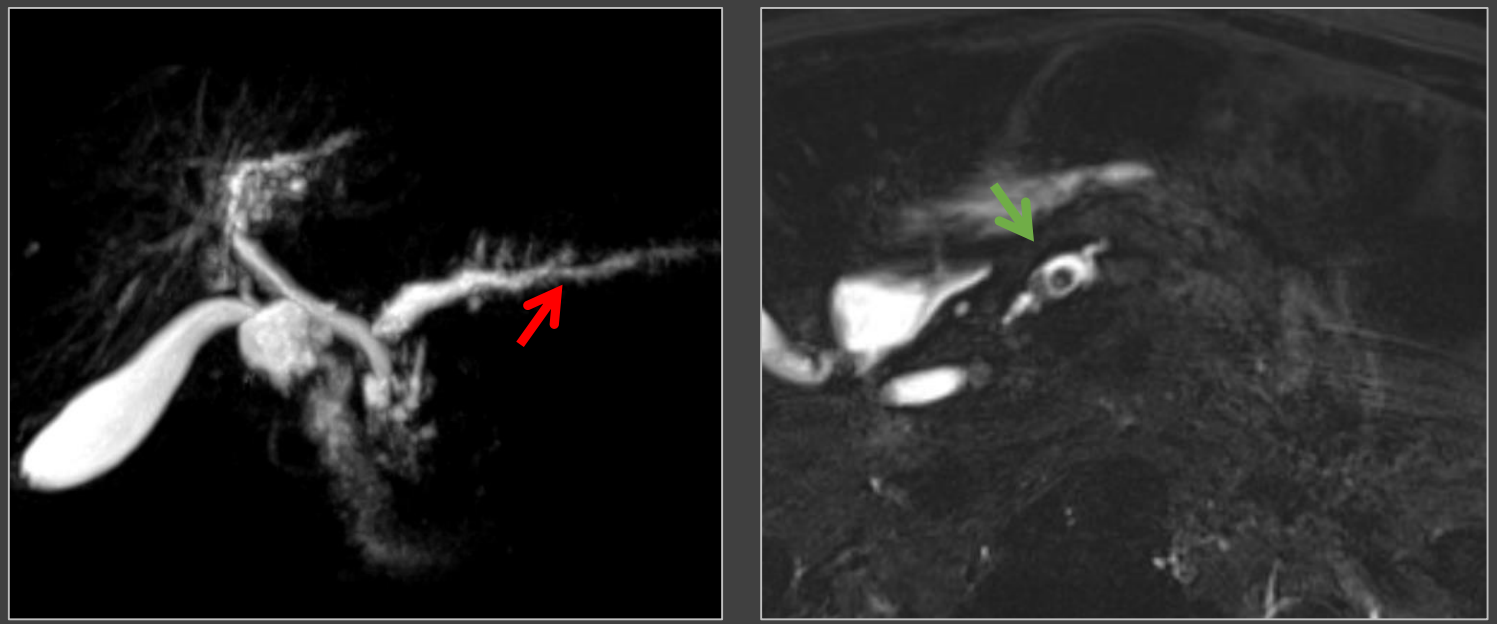


T2w axial images showing a pancreatic fistula with debris (arrows) and an hematic perisplenic collection (asterix)

Main Imaging Findings- Indications

Pancreas

5. Chronic pancreatitis

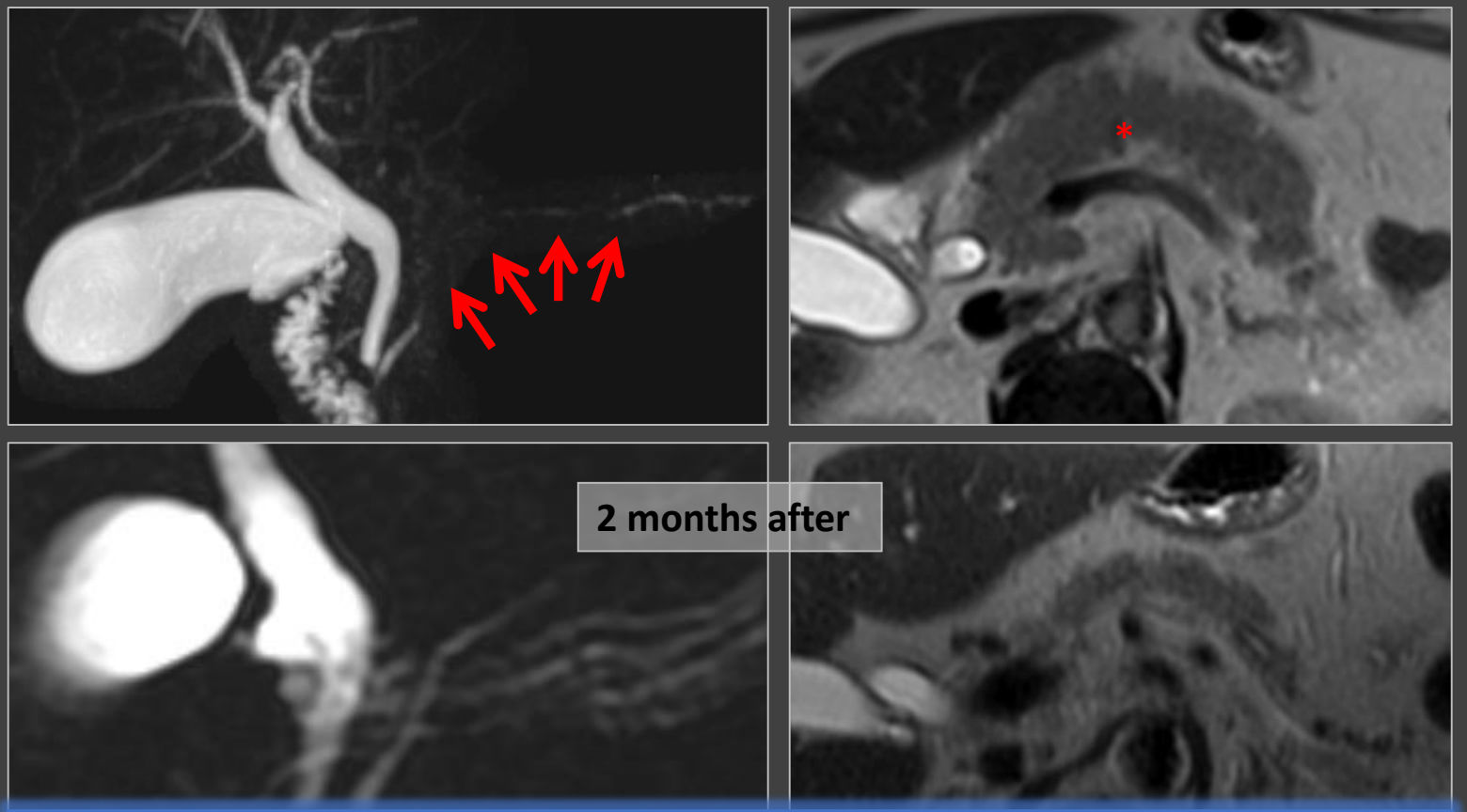


Left: T2w MIP reformat showing dilation of the main pancreatic duct and of secondary ducts (red arrow). Right: T2w axial image showing stenosis and filling defects (green arrow)

Main Imaging Findings- Indications

Pancreas

6. Auto-immune pancreatitis – IgG4



Top left: T2w MIP reformat showing a long stenosis of pancreatic duct (arrrows), Top right: T2w axial image showing a diffusely enlarged pancreas (asterix). Bottom right and left: resolution of the lesions

1. Learning objectives
2. Background
   - Technical considerations
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3. **Main imaging findings**
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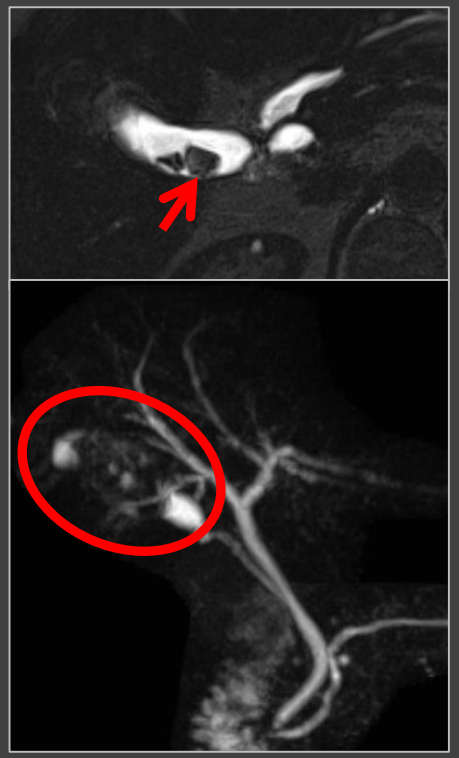
     - **Gallbladder**
     - Indirect MRCP
   - Pitfalls
4. Conclusions
5. References

Main Imaging Findings- Indications

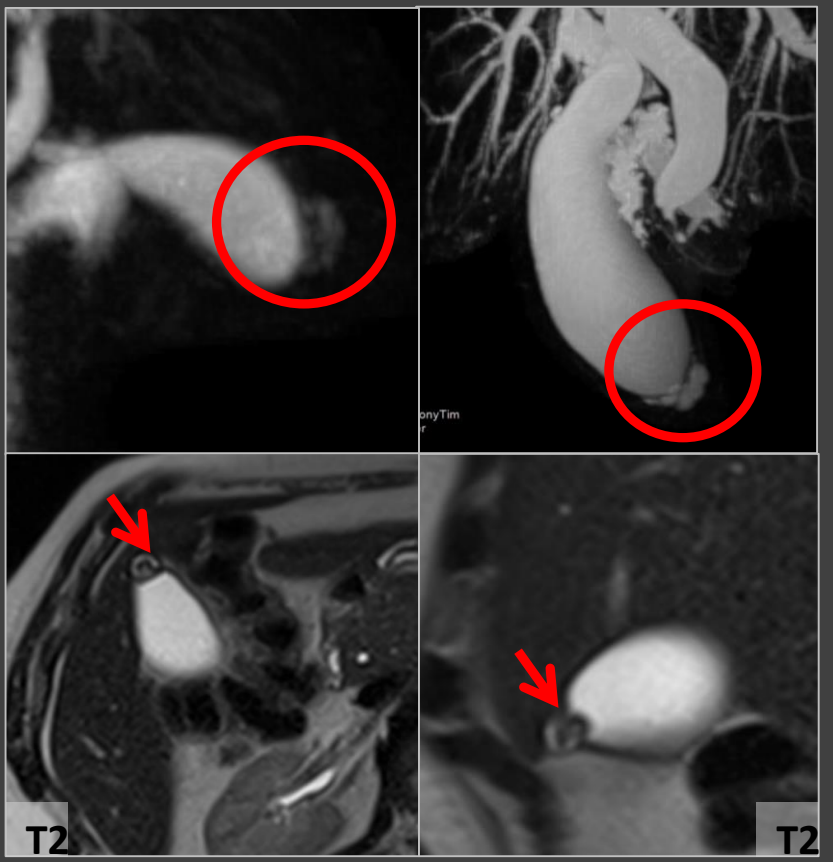
Gallbladder

1. Stones



T2w MIP reformats showing filling defects inside gallbladder (arrow and circle)

2. Adenomyomatosis



T2w MIP reformats and T2 axial images showing focal mural thickening of gallbladder (arrows) with multiple rounded hyperintense intraluminal cavities (circle)- pearl necklace sign

1. Learning objectives
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Main Imaging Findings- Indications

Indirect MRCP [1]

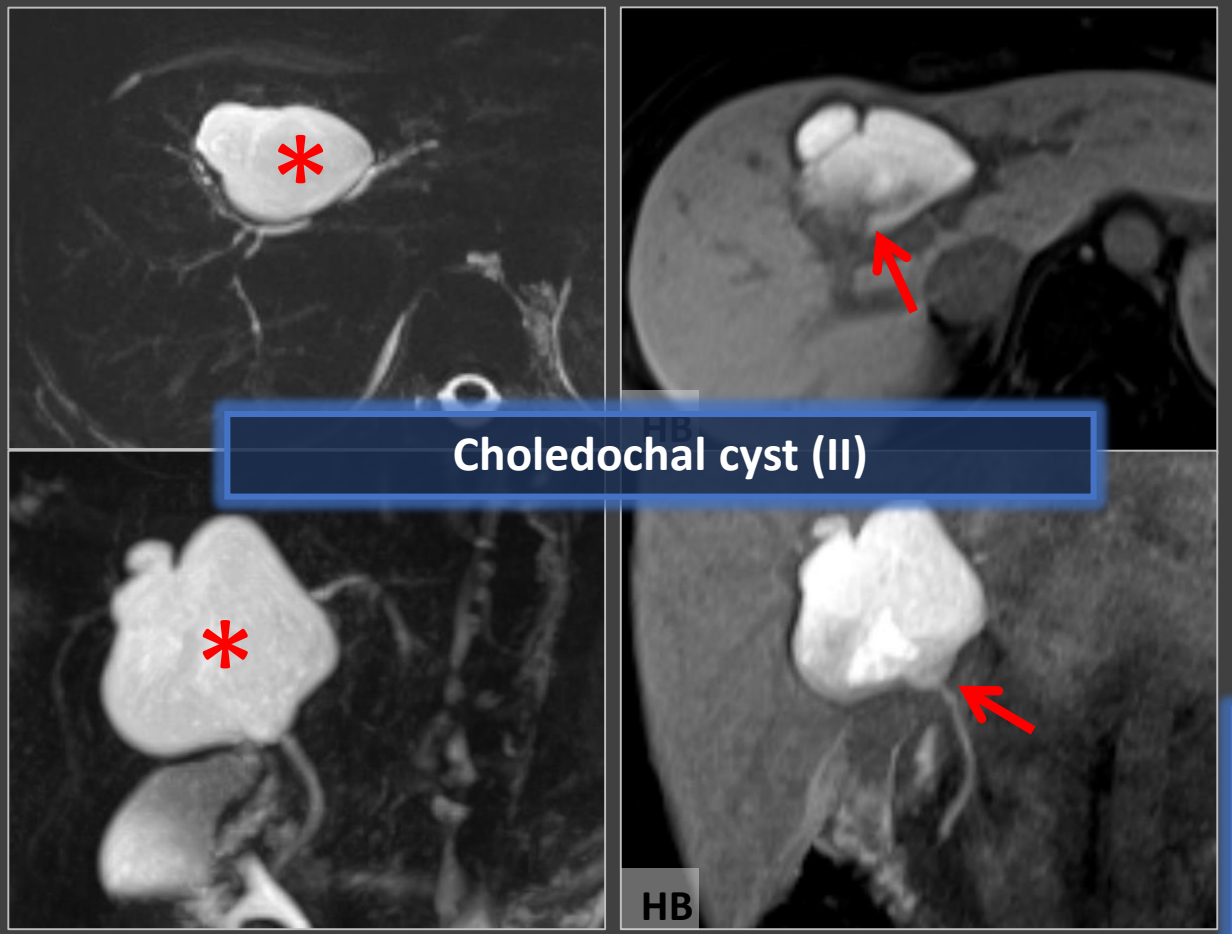
1. Evaluation of possible communication between cystic hepatic/peri-hepatic lesion and the biliary tract
2. Evaluation of bilio-digestive anastomosis
3. Biliary leaks *

* Not approved by FDA (*Food and Drug Administration*)

Main Imaging Findings- Indications

Indirect MRCP

1. Communication with biliary tract

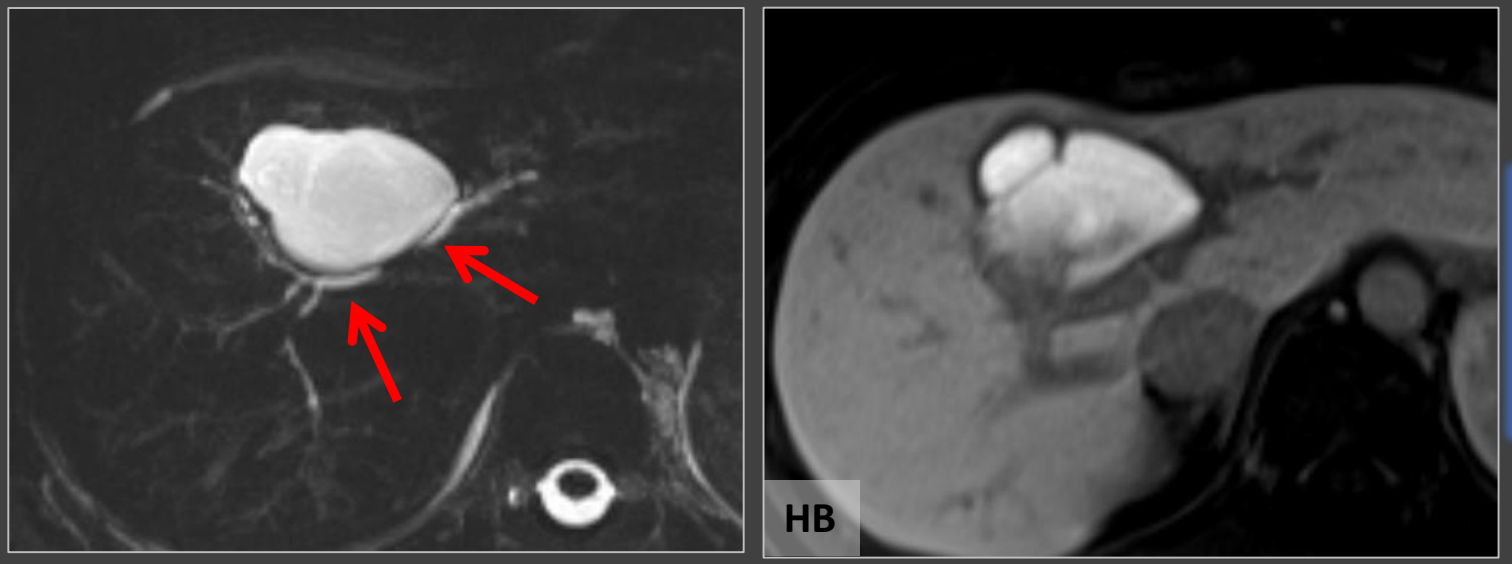


Choledochal cyst (II)

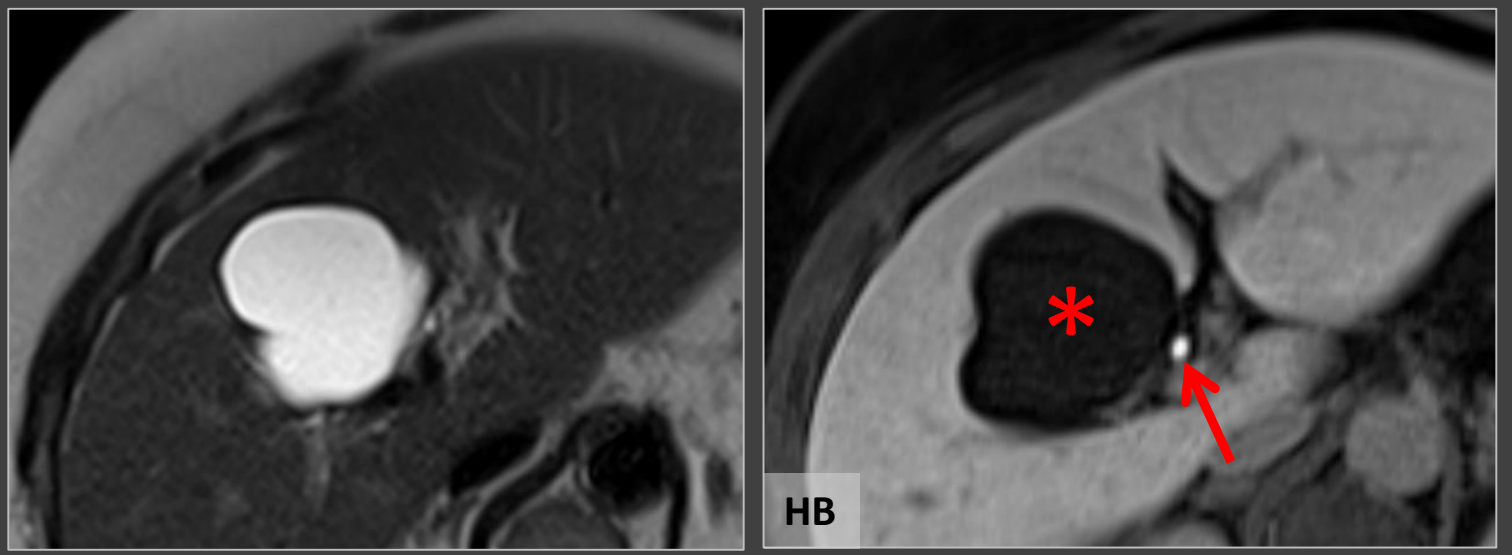
Left: T2w images showing a cystic hepatic lesion (asterix) with communication to the biliary tract. Right: Communication best seen best seen in the T1w post-hepatospecific contrast agent injection at the hepatobiliary phase (arrows)

Main Imaging Findings- Indications

Indirect MRCP [1]



T2w axial (left) and T1w axial post hepatospecific contast agent injection at the hepatobiliary phase (right) showing a communicating cystic lesion

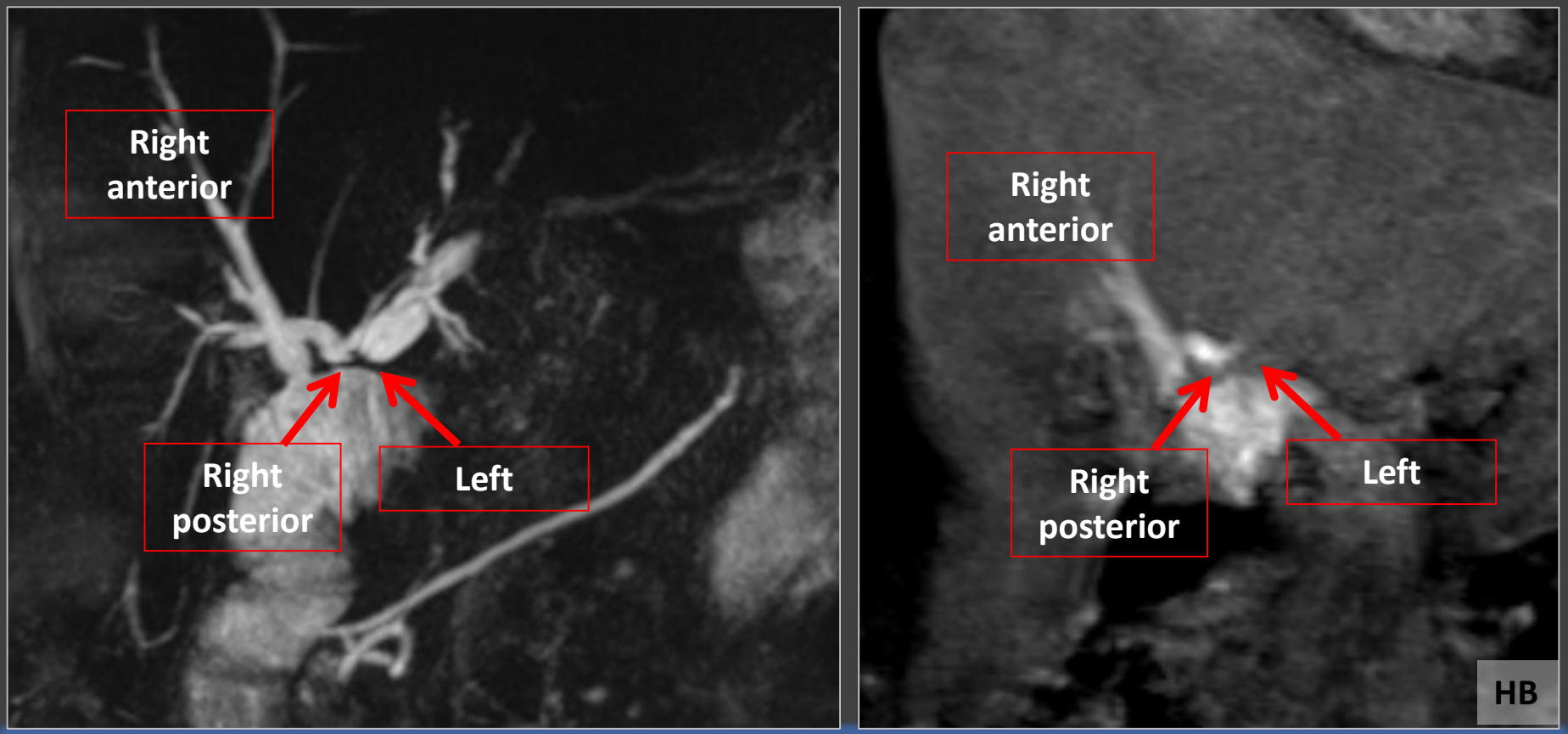


T2w axial (left) and T1w axial post hepatospecific contast agent injection at the hepatobiliary phase (right) showing a cystic lesion with no communication

Main Imaging Findings- Indications

Indirect MRCP [1]

2. Biliary tract anastomosis

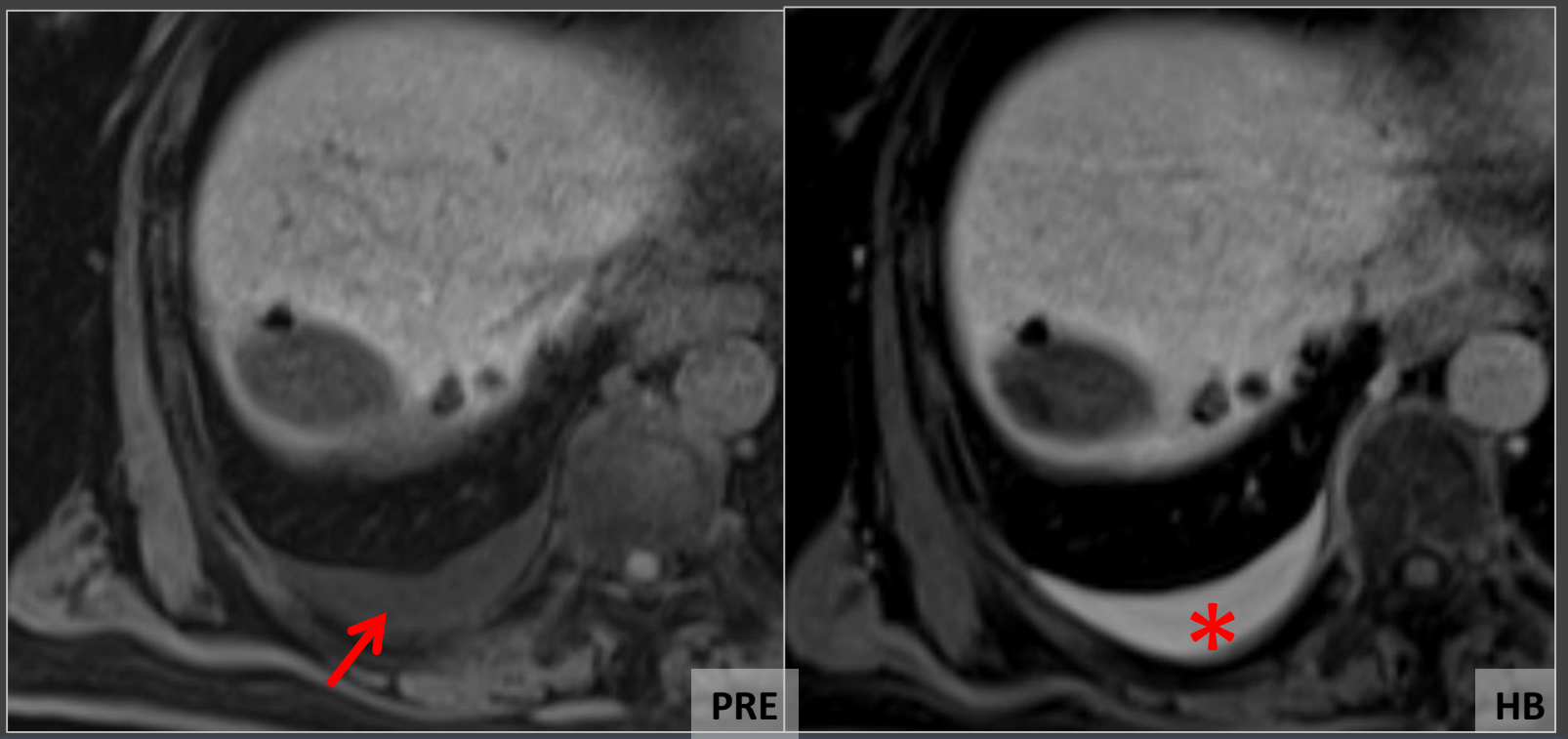


T2w MIP reformat (left) showing a triple biliary anastomosis. T1w axial image after hepatospecific contrast agent injection at the hepatobiliary phase (right) shows stenosis of the left and posterior right intra-hepatic ducts (arrows)→ no left side excretion

Main Imaging Findings- Indications

Indirect MRCP [1]

3. Biliary leaks



Patient after right lobe hepatectomy : T1w axial pre-contrast (left) and after hepatospecific contrast agent injection at the hepatobiliary phase (right) showing a right pleural effusion (arrow) with leakage of contrast in the hepatobiliary phase (asterix)

1. Learning objectives
2. Background
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3. **Main imaging findings**
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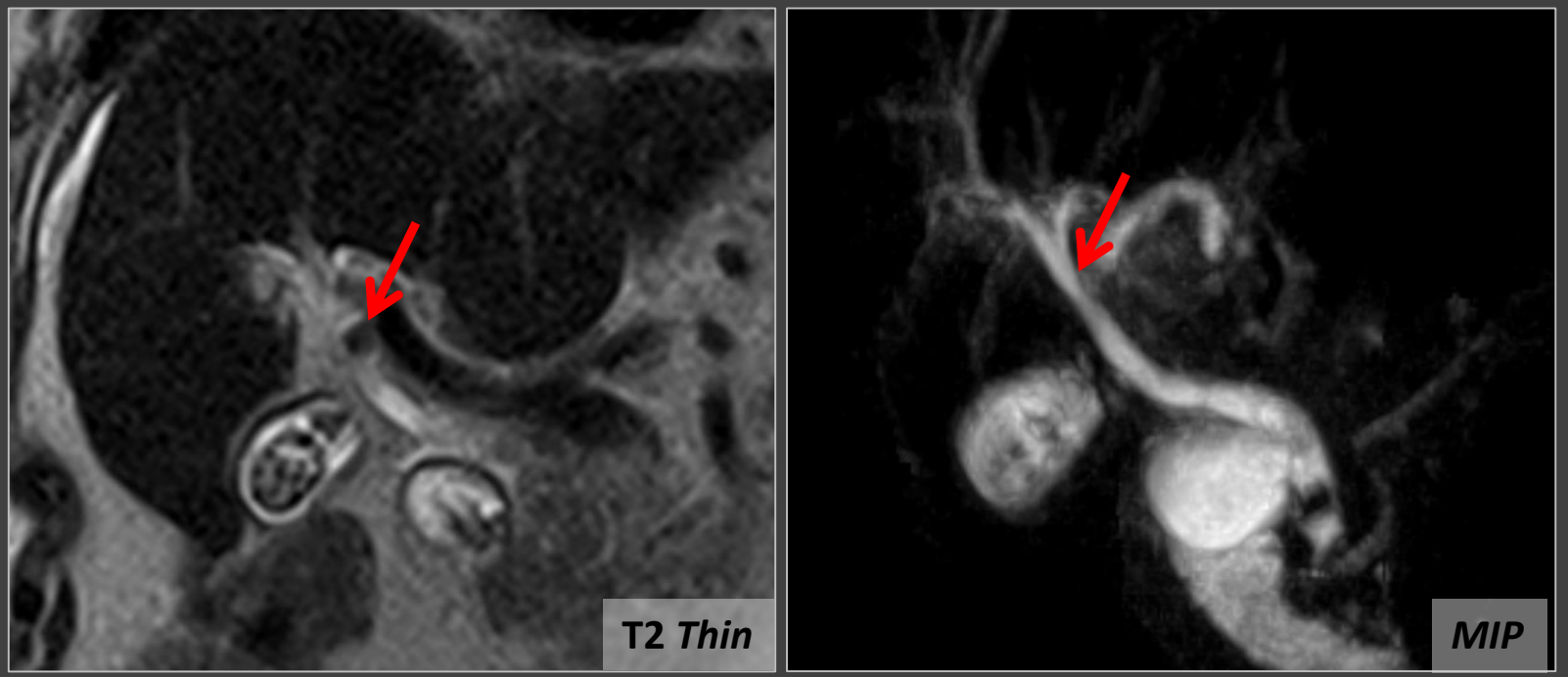
Main Imaging Findings- Pitfalls

- Technique and reconstruction artifacts
- Anatomical variants
- Intraductal factors
- Extraductal factors

Main Imaging Findings- Pitfalls

Thin vs thick slabs: Thick slabs may obscure small luminal defects due to partial volume artifact [1]

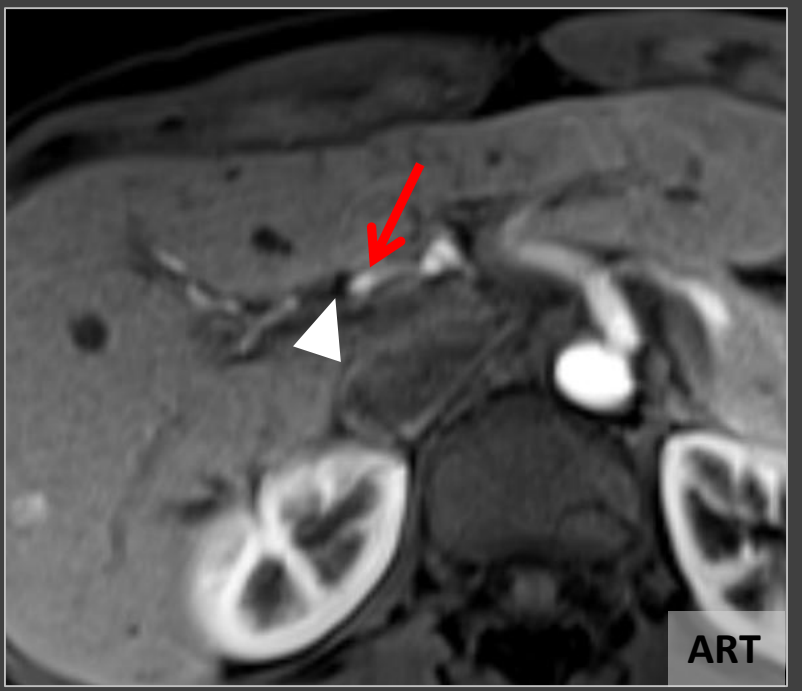


Left: T2w thin axial image showing a filling defect. Right: T2w MIP reformat of the same patient not showing the filling defect (arrows)

Main Imaging Findings- Pitfalls

“Pseudo-stenosis” due to arterial pulsatility

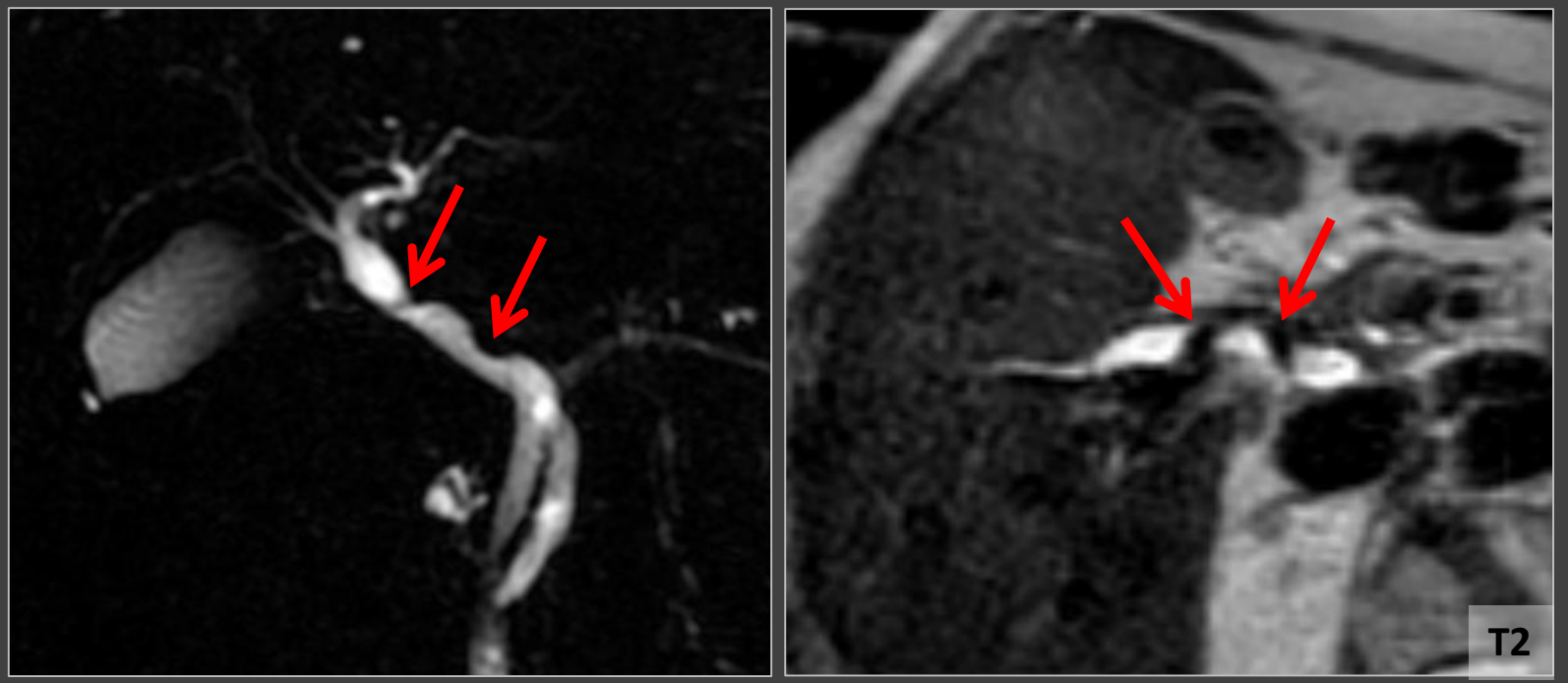
T2w MIP reformat shows and apparent stenosis of the common hepatic duct (circle)



T1w after contrast gadolinium-based injection in an arterial phase shows that the “stenosis” is due arterial pulsatilty

Main Imaging Findings- Pitfalls

Contour deformity due to arterial pulsatility



T2w MIP reformat (left) and T2 axial image (right) shows contour deformity of the common bile duct (arrows) caused by arterial pulsatility

1. Learning objectives
2. Background
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5. References

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

- Non-invasive evaluation of the biliary tree and pancreatic duct
- < sensitivity than ERCP for the evaluation of intra-hepatic biliary ducts → attention to Klatskin tumours
- Important to know main indications
- Important to know main limitations and pitfalls
- Direct vs indirect MRCP

Recommendations

- Patients have to be collaborative
  - Other studies or sedation
- Drainage of intraperitoneal fluid before
- MRCP before drainage of the biliary tract
- Additional abdominal MR
  - Except for study of anatomic variants; stones; follow-up of benign cysts

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Thank you for you attention!