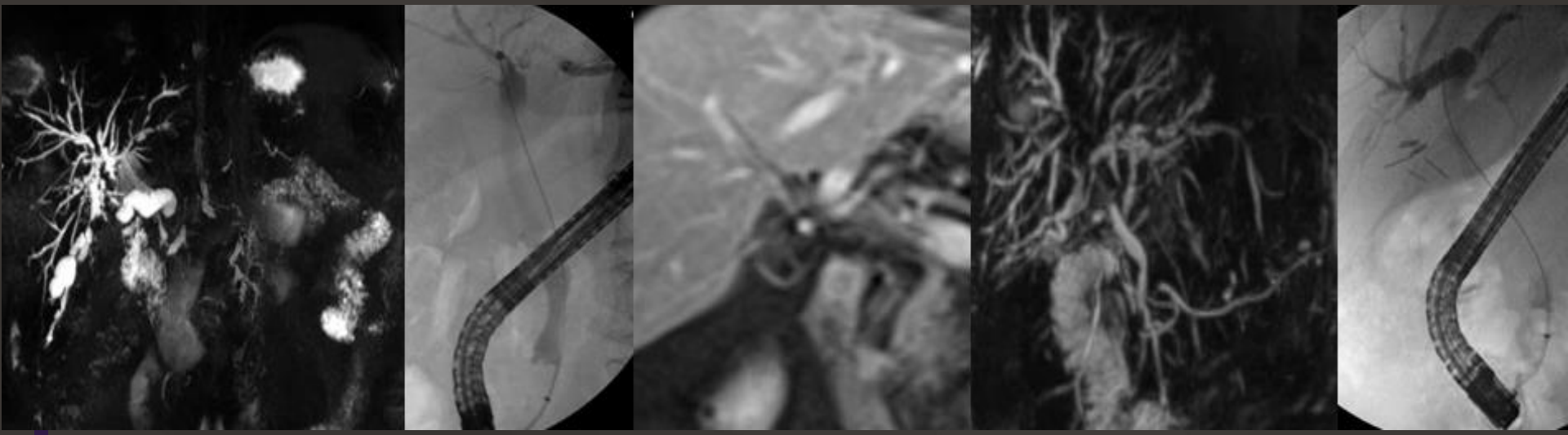

Primary sclerosing cholangitis: Emphasis on role of MRI in assessing evolution and complication.

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Learning objectives:

1. Describe pathophysiology, associations, diagnostic criteria and spectrum of imaging manifestation of primary sclerosing cholangitis (PSC).

2. Recognize imaging manifestations, evolution and complications of PSC.

3. Identify multidisciplinary literature, and international guidelines which can facilitate decision making, and develop appropriate pathways for patients with clinical suspicion for PSC and related complications.

Target audience: Residents, Fellows, Practicing radiologists and Gastroenterologists, HPB Surgeons.

Background:

1. PSC is a chronic cholestatic liver disease characterized by inflammation and fibrosis of both intrahepatic and extrahepatic bile ducts [1].

2. Temporal evolution of PSC causes pruned tree appearance, mural irregularity, diverticula, bile stasis, hepatic fibrosis, cirrhosis, end stage liver disease and also has a higher risk of developing cholangiocarcinoma (Cca).

3. We, did a 10 year retrospective institutional analysis of 400 patients with PSC in whom an MRCP +/-contrast enhanced MRI was done, to depict the spectrum of imaging manifestation of PSC.

4. Clinical history (including personal/family history of IBD) & distribution of cholangiographic findings should be considered in initial MRCP or cholangiographic diagnosis of PSC. Awareness of differential diagnosis, risk factors and patterns of secondary cholangitis[2] is essential.

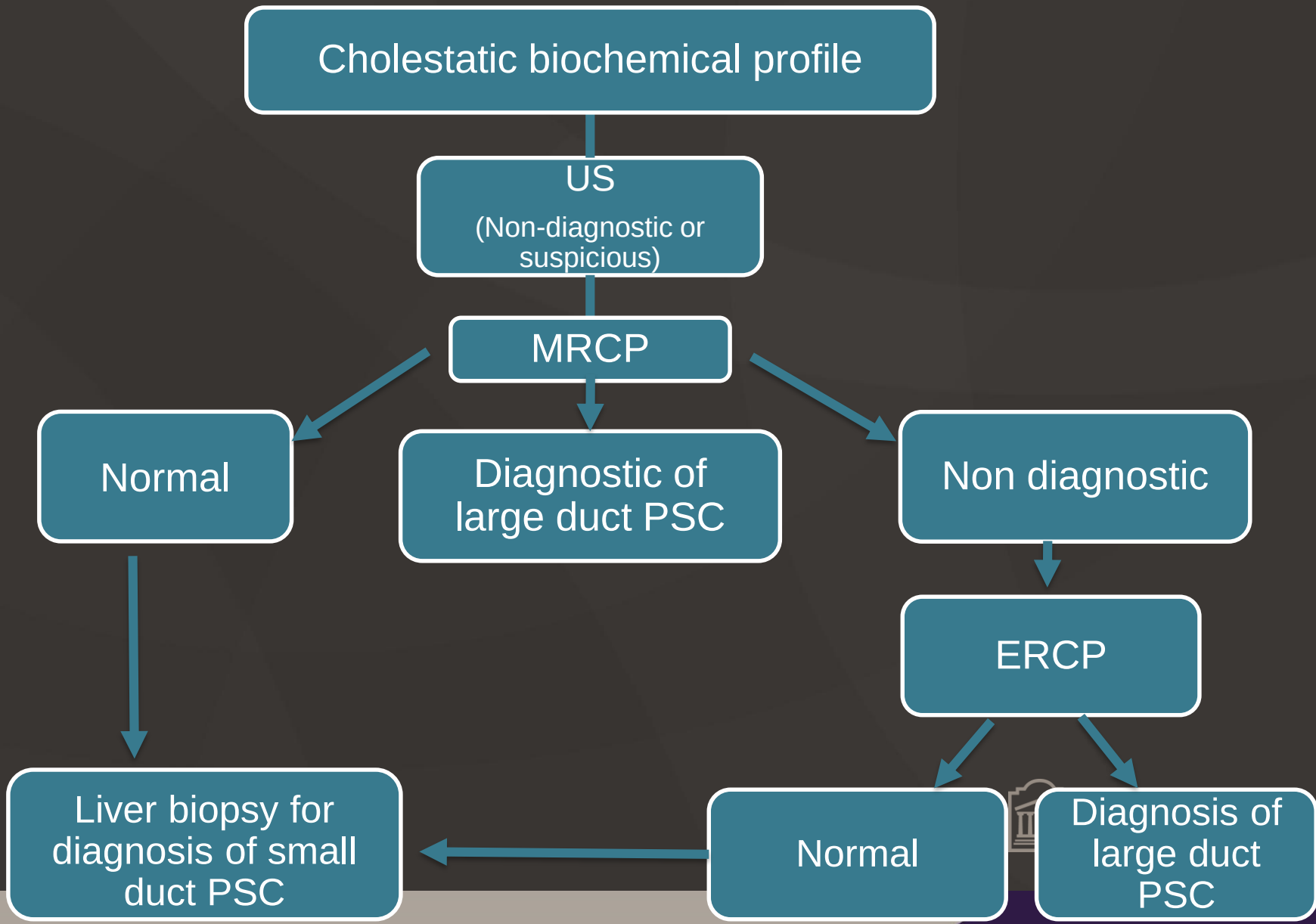
Secondary causes of cholangitis/ Differentials	
• AIDS cholangiopathy	• Intra-arterial chemotherapy
• Choledocholithiasis	• Ischemic Cholangitis
• Diffuse intrahepatic metastasis	• Mast cell cholangiopathy
• Eosinophilic cholangitis	• Portal hypertensive biliopathy
• Hepatic inflammatory pseudotumor	• Recurrent pancreatitis
• Histiocytosis X	• Recurrent pyogenic cholangitis
• IgG4-associated cholangitis	• Surgical biliary trauma.

- Our institutional protocol optimized for biliary tract imaging:

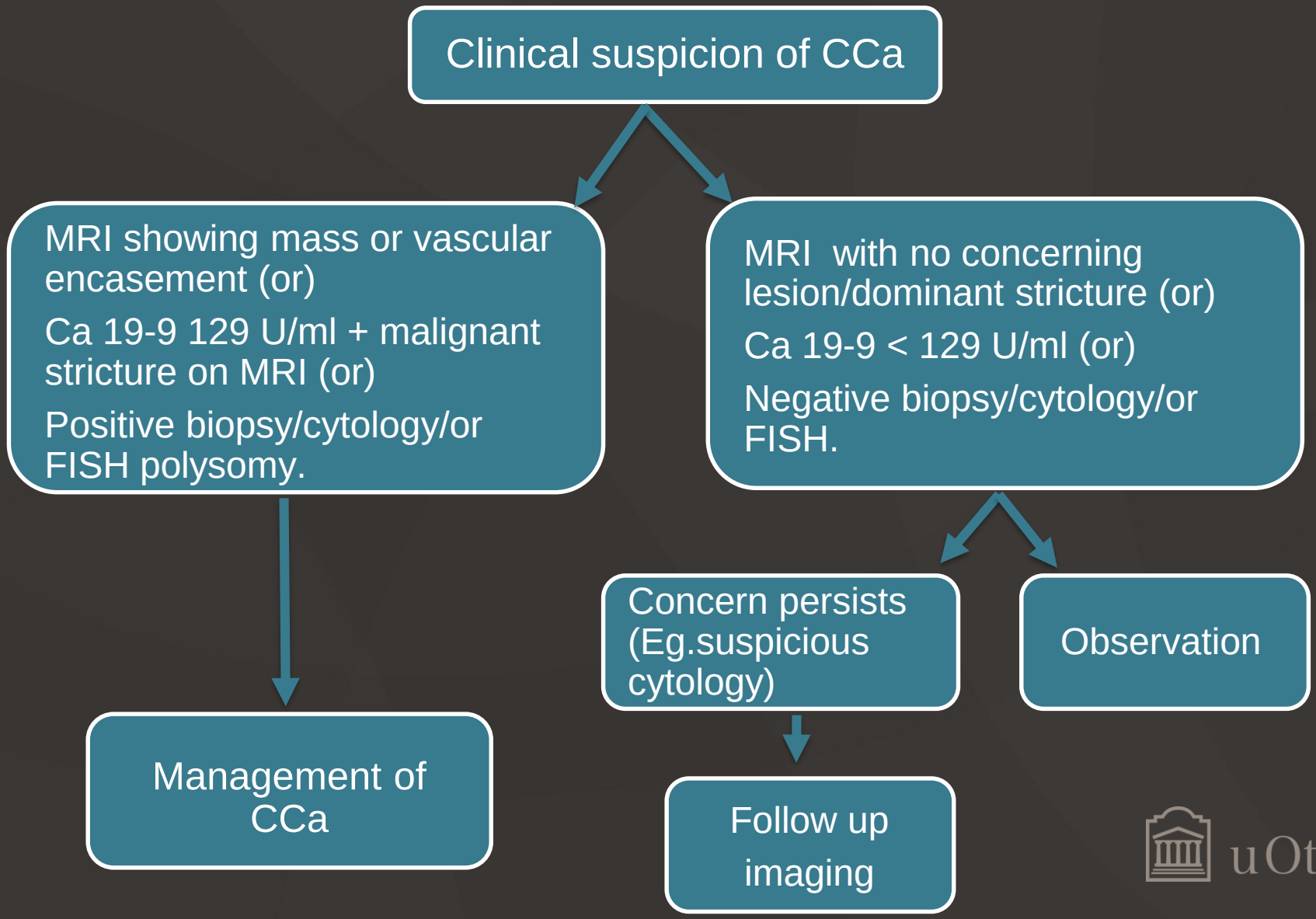
Section	Sequence
Coronal	T2-HASTE T1-VIBE- portal venous phase 3D-MRCP MRCP
Axial	T1- VIBE IN/OUT of phase T2-HASTE T2-FSE-FatSat T1-FatSat T1-VIBE dynamic , +10 min delay DWI, ADC

- CE-MRI is ordered, only if there has been evidence of interval progression of disease ascertained clinically or radiologically and Heptobiliary contrast is reserved for suspected post-op biliary leaks.

AASLD algorithm for diagnostic work up of PSC [3]



AASLD Algorithm for work up of suspected Cca [3]



Options for tissue sampling to r/o biliary malignancy[12]

Suspected proximal obstruction on USG

MRI/MRCP

Hilar mass

ERCP**+/- SOC & biopsy

No malignancy

EUS- FNA

No malignancy

IDUS

Surgery

Close observation & follow up

Suspected distal obstruction on USG

CT

Mass +

Surgery or EUS-FNA

No mass

EUS-FNA

No malignancy

ERCP**

No malignancy

Consider repeat ERCP with other modalities (SOC with biopsy, IDUS, CLE)

Mass forming hepatic lesion

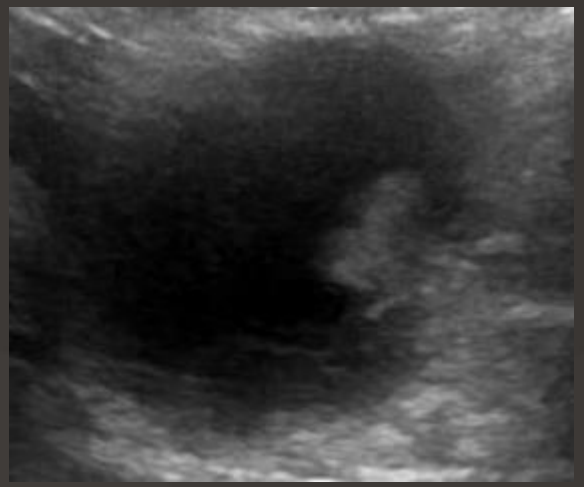
Percutaneous targeted cutting needle biopsy or FNA

CLE- Confocal laser endomicroscopy
SOC- Single operator cholangioscopy
IDUS- Intraductal USG.
ERCP- biliary brushings, fluoroscopic biopsy, needle aspiration**

AASLD recommendations on treatment [3]:

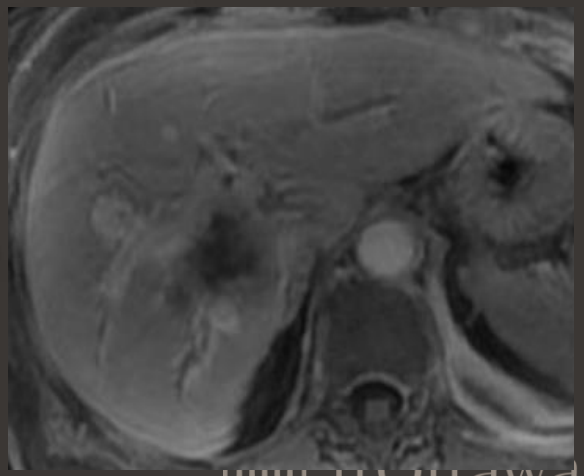
Gall bladder:

- Annual USG to detect mass lesions in GB.
- Cholecystectomy as a treatment in GB lesions regardless of lesion size, if the underlying disease permits.



Cholangiocarcinoma:

- Presence of Cca and absence of cirrhosis, a surgical resection is to be considered.
- Early stage Cca not amenable to surgical resection, should be considered for liver transplantation



Imaging findings:

(a) Pattern of involvement of intra- and extra-hepatic bile ducts

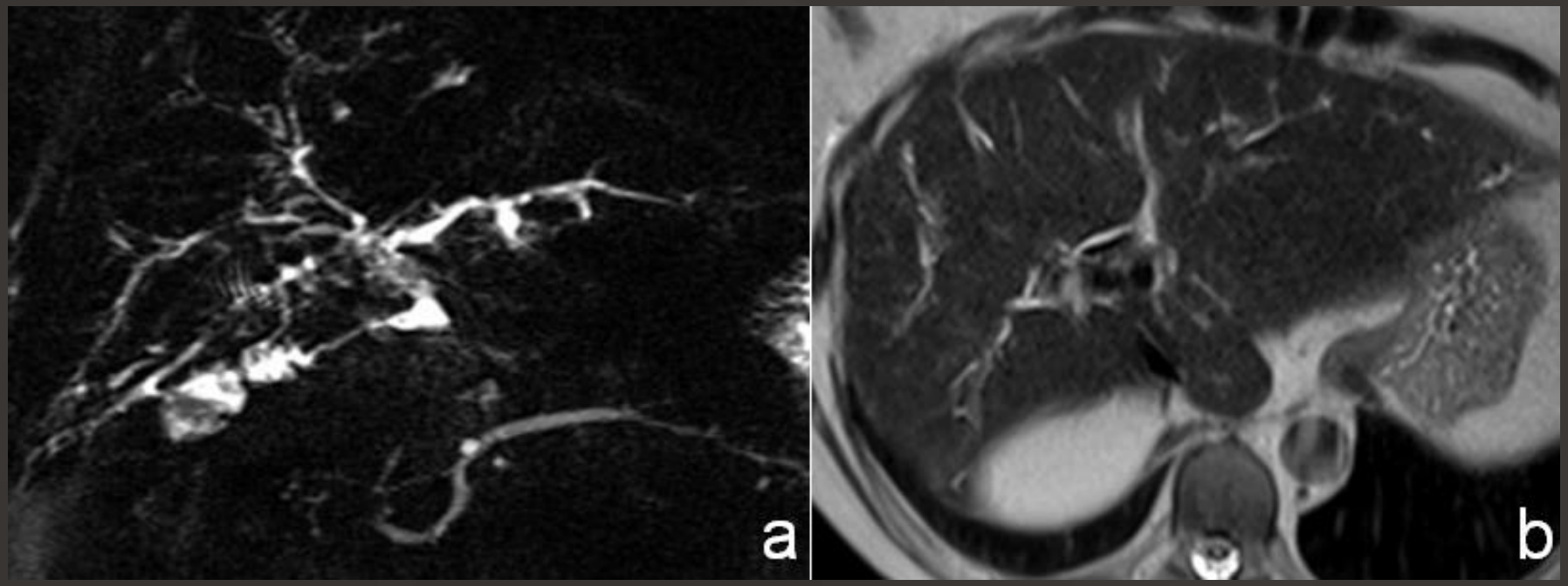
1. Focal or segmental fibrosis causing multifocal, short annular strictures alternating with normal or slightly dilated tracts causing "beaded pattern".

2. Dominant stricture: Stenosis with diameter of <1.5mm in CBD or < 1mm in hepatic duct [4,5].

3. Bacterial cholangitis: Due to recent instrumentation or dominant stricture causing bile stagnation resulting in colonization.

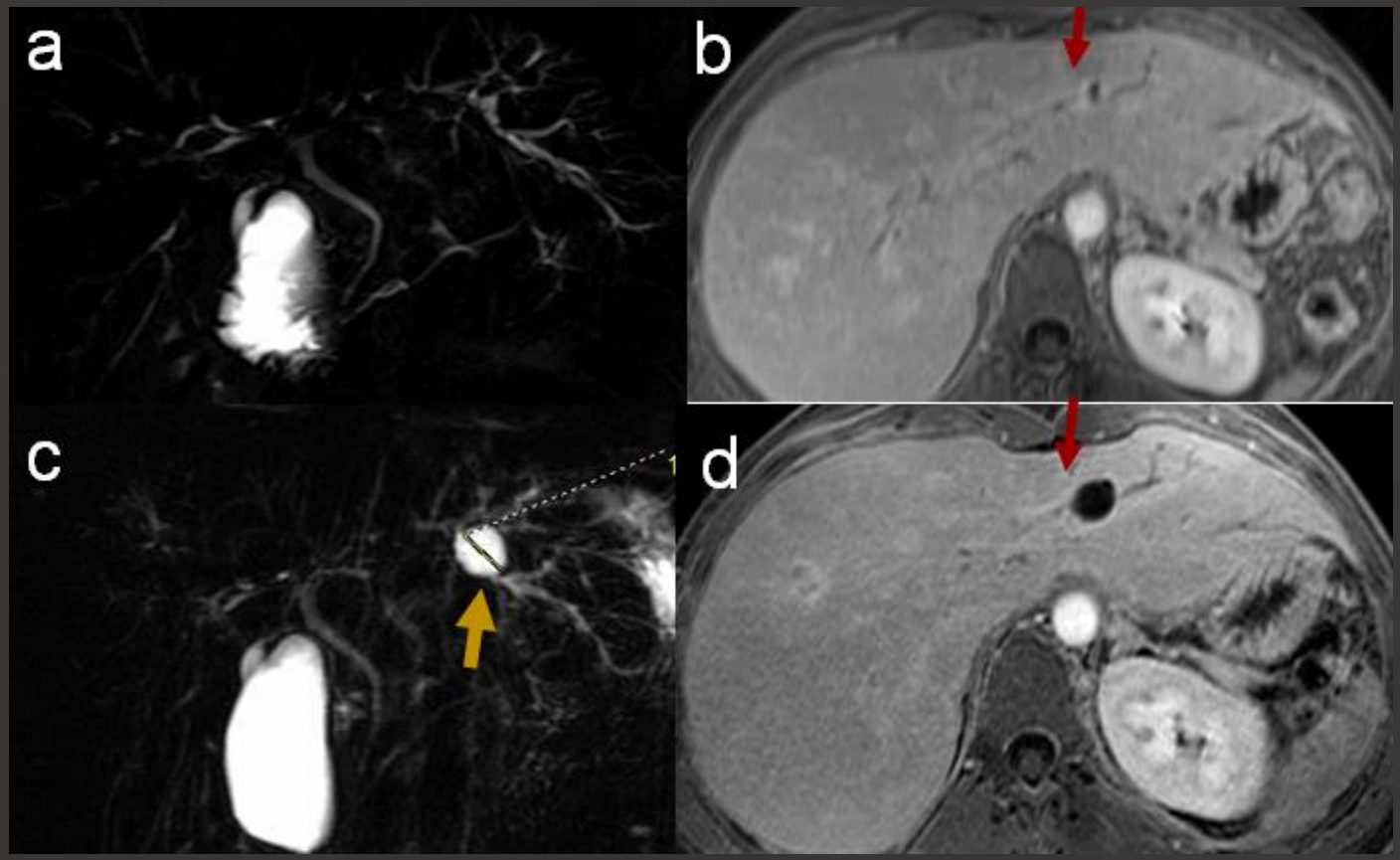
4. PSC recurrence occur in 20-25%, after 5 to 10 years post transplantation [13,14]. AASLD recommends to consider alternate causes of biliary stricture in the setting of post transplant [3].

Case:1 32 yr/female, with history of ulcerative colitis. Now presenting with altered liver enzymes, to MRCP to rule out PSC.



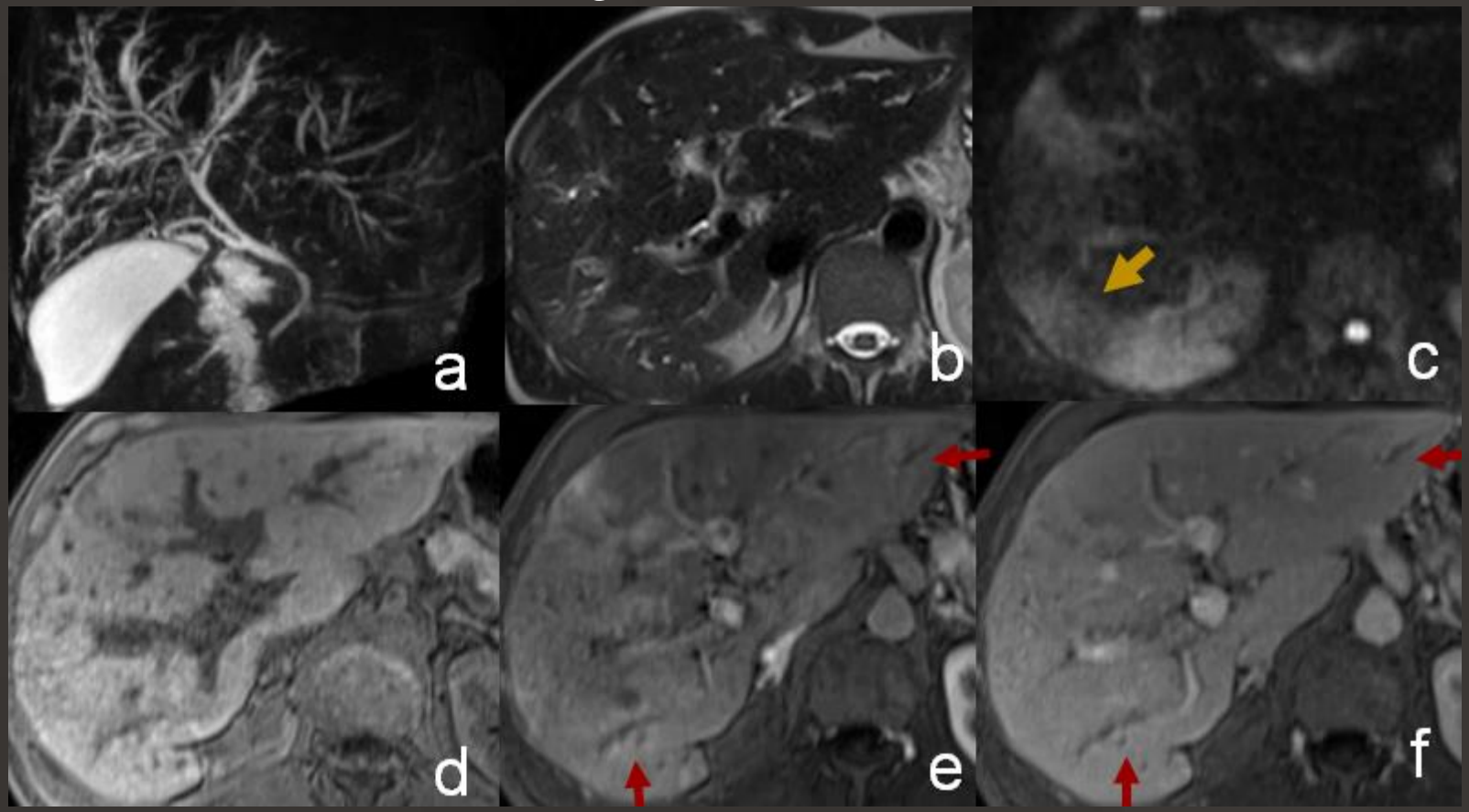
(a) MRCP; (b) T2w axial images, showing "**pruned**" intra- and extra-hepatic bile ducts in keeping with **PSC**.

Case:2 27 yr/female, Known Crohn's disease and PSC. CE- MRI for cholangiocarcinoma (CCa) surveillance .



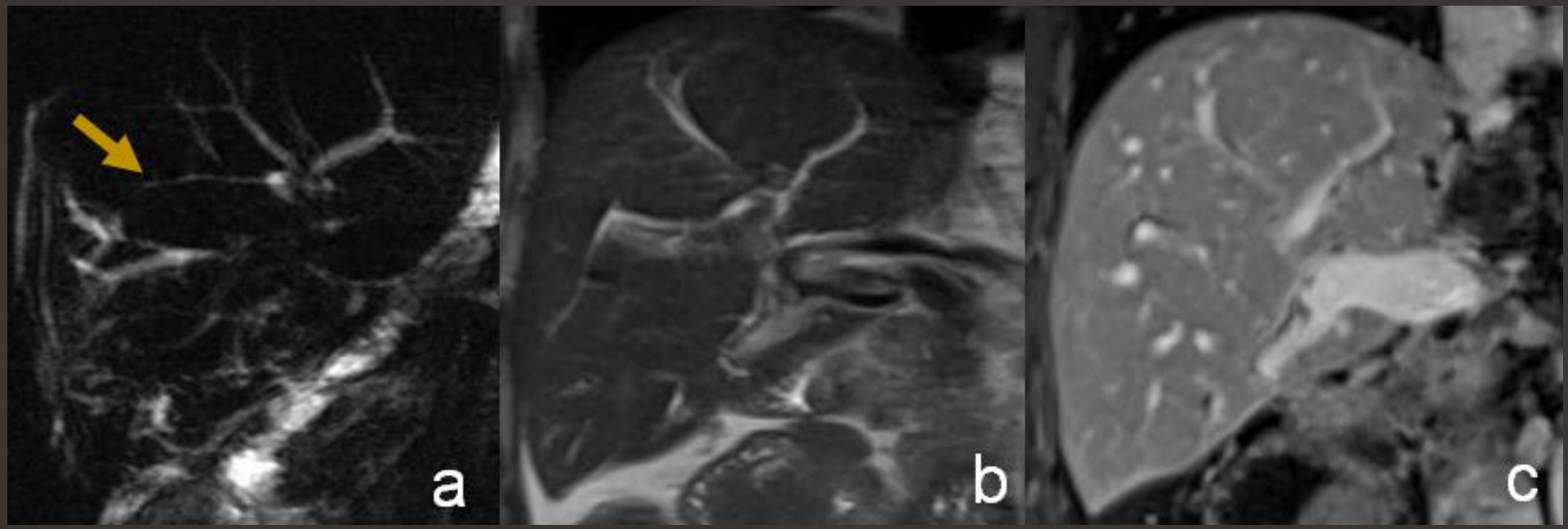
(a) MRCP: pruned appearance; (b) T1+C-FS: focal peribiliary enhancement at left upper duct due to **dominant stricture** causing distal saccular biliary dilatation; (c) MRCP & (d) T1+c-FS: 1 year later showing progressed stricture with dilatation. Biopsy did not reveal CCa.

Case:3 49 yr/male, Known PSC with recent ERCP. Now with altered LFT and fever, to rule out cholangitis/abscess.



(a- MRCP; b-T2W): pruned biliary tract dilatation; (c) DWI: geographic areas of hyperintense signals ; (d-T1-FS-pre contrast; e-Arterial; f-portal-venous phase) showing persistent diffuse peribiliary enhancement in both hepatic lobes. Keeping in with **Cholangitis**.

Case:4 50 yr/male, Known PSC post liver transplant since 8 years, rising alkaline phosphatase and GGT. To r/o anastomotic stricture or mass lesion.



(a- MRCP; b-T2W Cor): mild irregularity (a-arrow) and dilatation of intrahepatic biliary tract from hepatic hila; (c) T1-FS-post contrast: No evidence of peribiliary enhancement or mass lesion. Findings keeping in with hepatico-jejunostomy anastomic stricture and less likely to be an evolving PSC in a post transplant setting.

(b) Hepatic parenchymal & Vascular changes

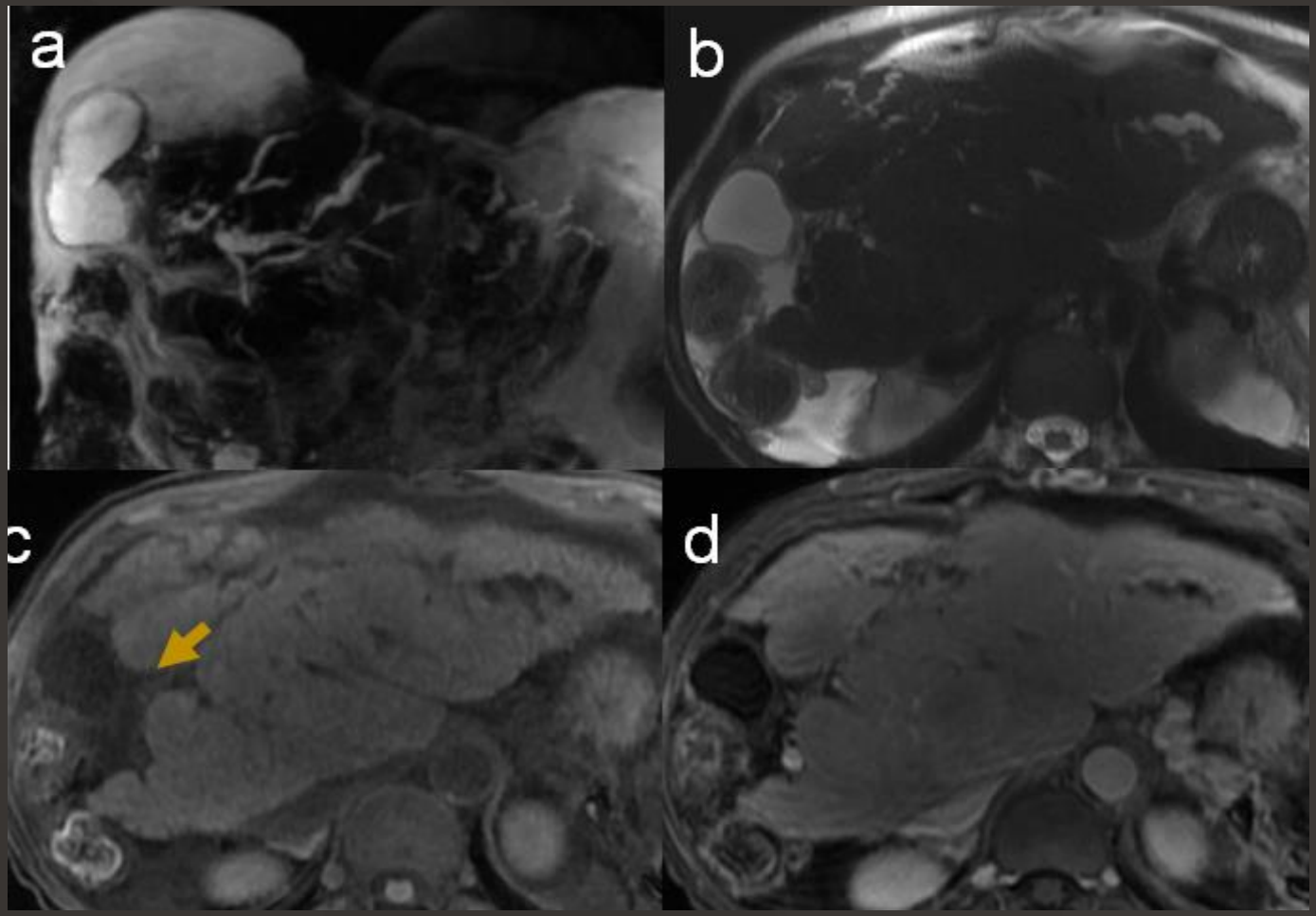
1. Cirrhotic liver is the end result of PSC characterized by atrophy of entire liver with hypertrophy of caudate lobe [6].

2. Hepatic parenchymal fibrosis

3. Portal hypertension, can occur with or without cirrhosis in PSC [3]. Newly diagnosed PSC has 36% incidence of varices [7]

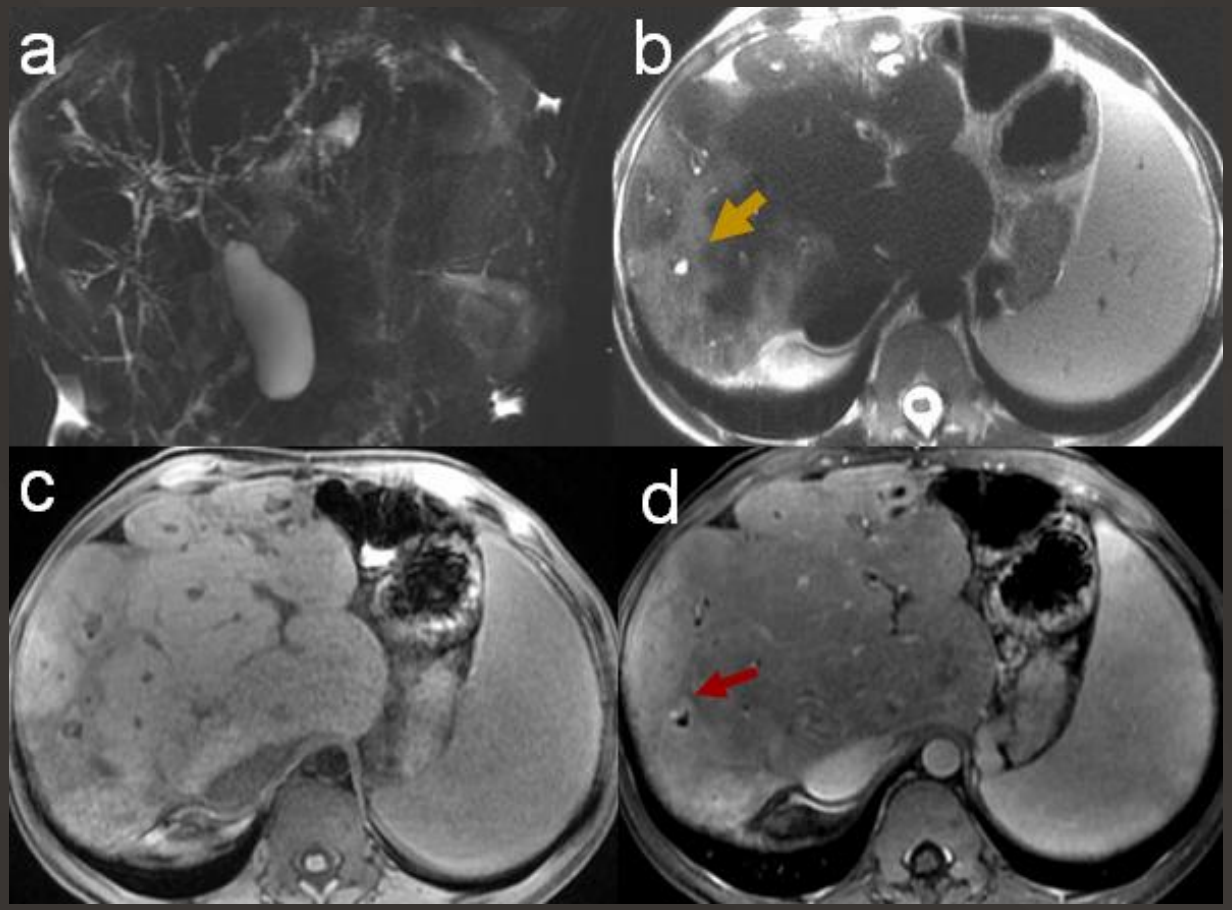
4. PSC-Autoimmune hepatitis (AIH) overlap syndrome is characterized by clinical, biochemical and histological features of AIH in a background of PSC imaging findings.

Case-5: 73 yr/female, Known UC & PSC cirrhosis with increasing bilirubin, to rule out Cca.



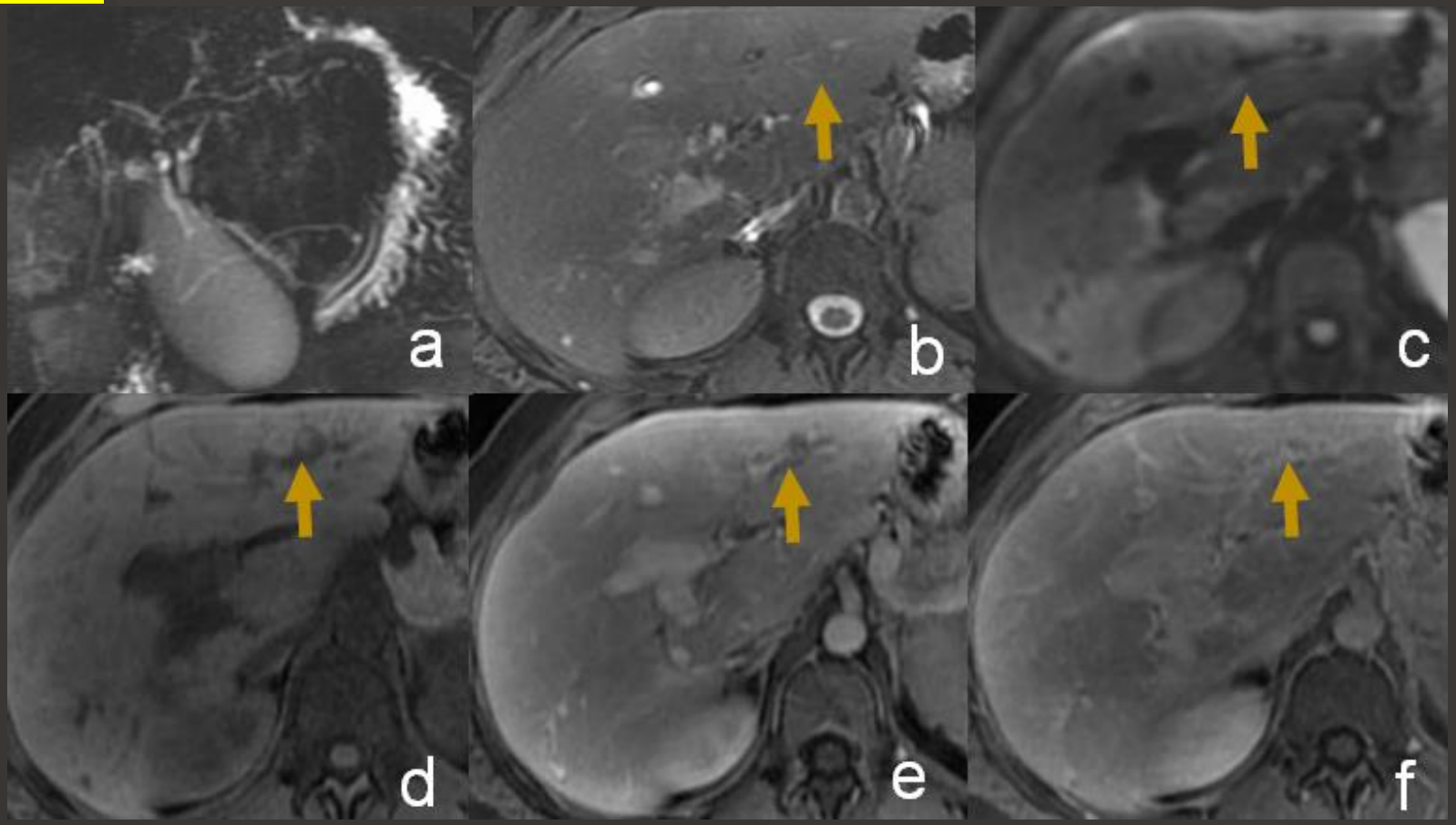
(a) MRCP- Pruned intrahepatic bile ducts; (b)T2W (c) T1W(d) Post contrast T1+C-FS showing **cirrhosis** with **severe atrophy** of right lobe(arrow) with volume redistribution. No evidence of Cca or dominant stricture.

Case-6: :20yr/Male, Known autoimmune hepatitis and PSC, screening for Cca and HCC.



(a) MRCP- Pruned intra and extrahepatic bile ducts; MRI showing **cirrhosis** with **global parenchymal atrophy**; (b)T2W: hyperintense along periphery of right lobe (yellow arrow); (c) T1W: hypointense ; (d) Delayed post contrast T1+C-FS with enhancement (red arrow), in keeping with **Fibrosis**.

Case-7: 73 yr/female, Known PSC, for Cca screening



(a) MRCP- Pruned intra/extrahepatic bile ducts; (b) T2W:isointense nodular focus (arrow); (c) DWI: isointense; (d)T1W-FS: hypointense ; (e) Portal phase- rim enhancement; (f) Delayed T1+C-FS with internal enhancement, a tiny Cca was suspected. Pathological Dx of Liver segmentectomy **overlap syndrome (PSC + AIH) with fibrosis and bile pseudocyst.**

(c) PSC precipitated malignancies:

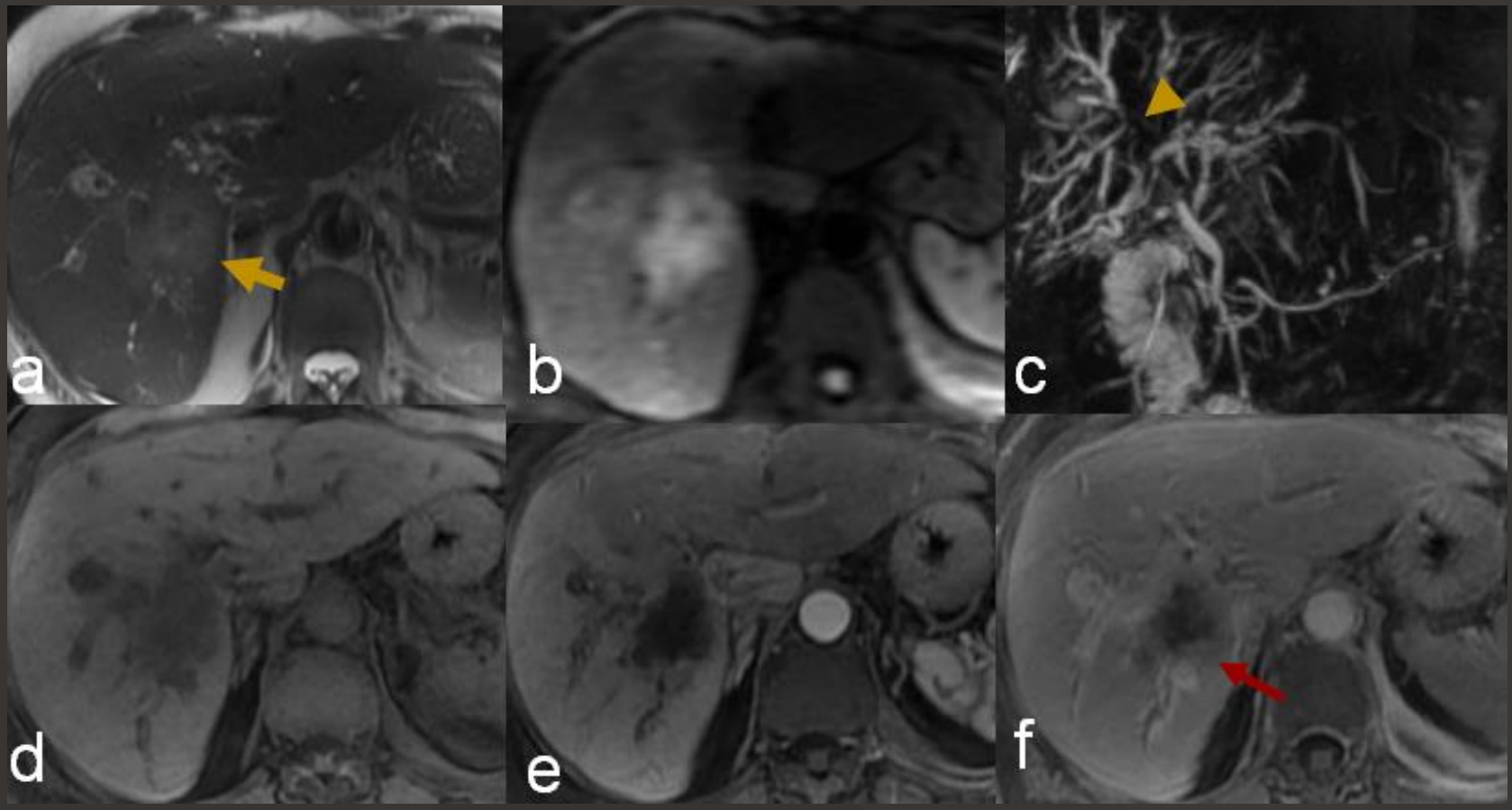
1. Patients with PSC are at risk for developing superimposed cholangiocarcinoma, with a 10 year cumulative risk of approximately 7-9% [8,9].

2. Increased risk of gallbladder neoplasia including adenoma, dysplasia and carcinoma. Prevalence of GB lesion in PSC is 6%, and > 50% of these are found to be malignant [10].

3. Increased risk of HCC in PSC patients with cirrhosis, with a reported incidence of 2% in patients undergoing liver transplantation with a background of PSC[11].

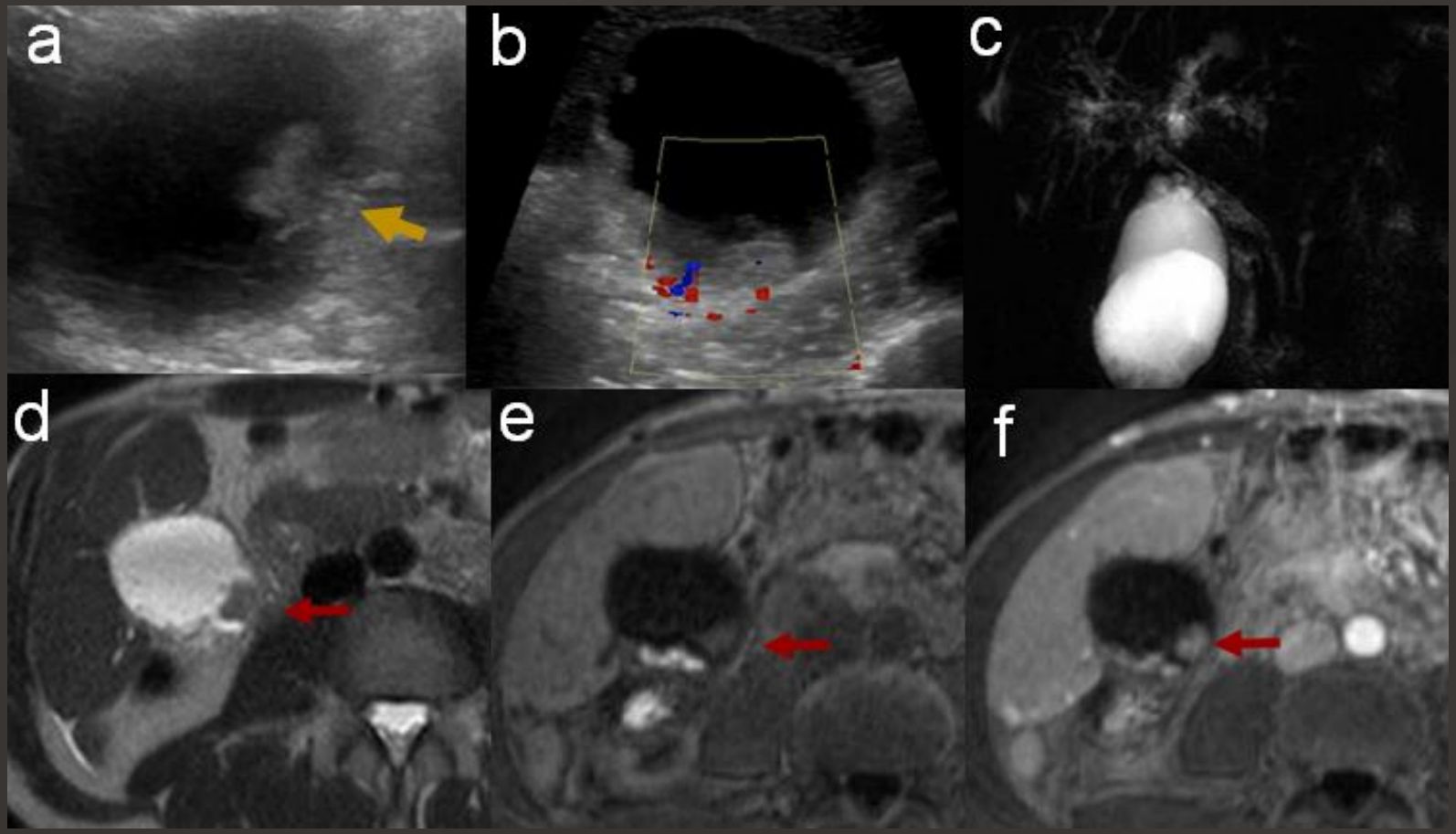
4. Rare associations of PSC with Hodgkins lymphoma has been reported [15].

Case-8: 77 yr/female, known PSC, recent USG showing focal lesion. CE-MRI for characterization.



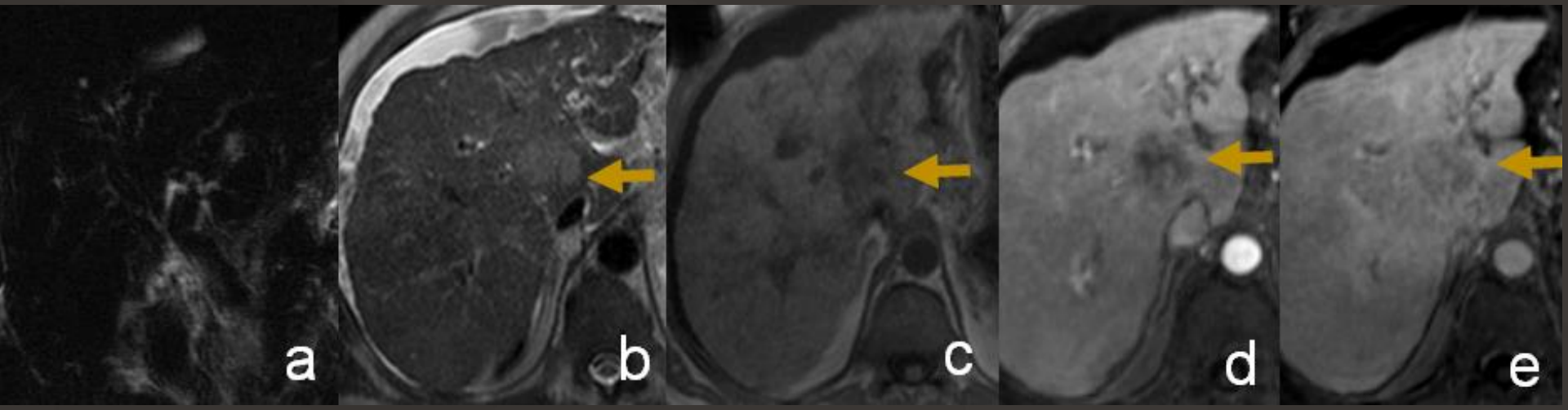
(a)MRI, T2 hyperintense infiltrative lesion in segment 7 (yellow arrow); (b) diffusion restriction; (c) MRCP -pruned tree appearance with RPD cut off (arrow head); (d-pre; e-arterial; f-delayed T1+c-FS) showing delayed uptake (red arrow) keeping with infiltrative mass forming **cholangiocarcinoma.**

Case-9: 57 yr/male, known PSC, USG 3 months back showed polyp Vs tumefactive sludge. Interval USG and CE-MRI for characterization.



Duplex: (a) intraluminal isoechoic polypoidal lesion with (b) internal vascularity; (c) MRCP - pruned intra-and extrahepatic ducts; (d) GB lesion is Isointense on T2W (red arrow); (e) isointense on T1W ; (f) enhancement on post contrast T1W-FS. Pathological diagnosis of **Gallbladder carcinoma**.

Case-10: 64 yr/male, known PSC, presented with sepsis. CT detected a mass in left lobe, CE-MRI for characterization.



(a) MRCP- Pruned intra and extra-hepatic bile ducts; (b)T2W: Hyperintense lesion in segment 4a (arrow) in background of cirrhosis with ascites (c) T1W: hypointense; (d) Arterial phase: Rim enhancement; (e) 10 min delayed post contrast T1+C-FS: internal enhancement suggestive of cholangiocarcinoma. Pathological diagnosis- **Diffuse large B-cell lymphoma.** Mimics Cca with malignant periductal obstructing mass.

Conclusion:

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1. Systematic imaging approach combined with appropriate clinical settings and biochemical results is useful in diagnosis & monitoring of PSC related complications. This has become an essential skill for body radiologists.

2. We have used case material to illustrate specific clinical scenarios in which an MRI/MRCP was ordered to evaluate the progression and complications of PSC.

3. The position of the American Association for the Study of Liver Diseases (AASLD) is that ''in the absence of evidence based information, many clinicians screen patients with an imaging study plus a CA 19-9 at annual intervals [3]'' This is an area for further research and consensus.

4. Based on these current guidelines MRCP/ and CE-MRI are frequently used to monitor parenchymal fibrosis/strictures, portal hypertension, and complications from obstruction, sepsis and malignancy.

5. Radiologist and clinicians should be aware that there is a very high risk of Cca (9% over 10 years), increased risk of Ca GB, and also HCC (after cirrhosis) in this population.

6. Dominant strictures, and any mass forming lesion in the liver or gallbladder require close scrutiny and urgent workup to ensure timely diagnosis and management.

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