

# Liver Masses Non-cirrhotic



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# Financial Disclosures

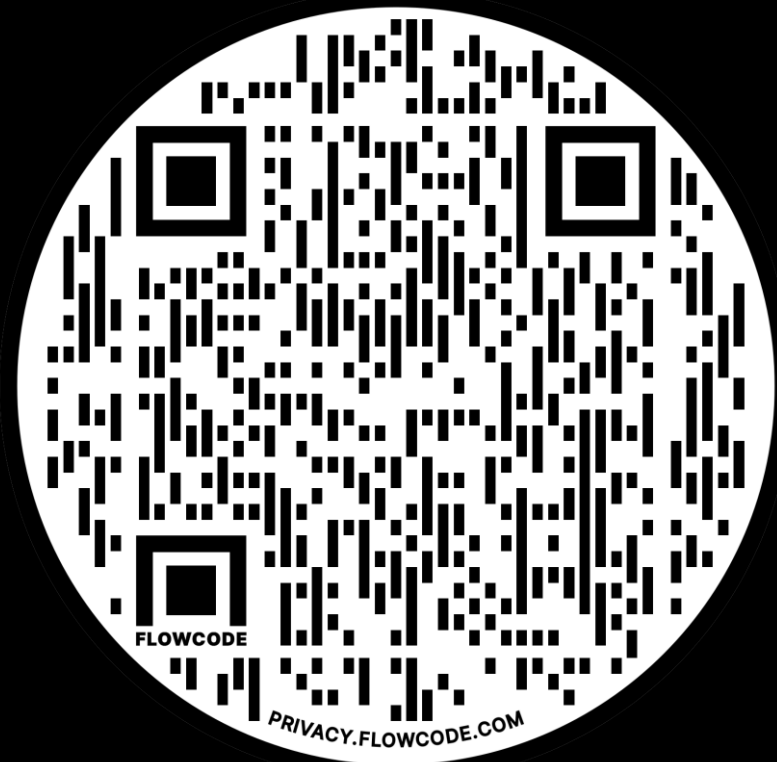
- Consulting: Epigenomics, GE, Bayer
- Institutional Grant Support: GE, Bayer, Median, Pfizer

# Resources

HEPATOLOGY  AASLD  
AMERICAN ASSOCIATION FOR  
THE STUDY OF LIVER DISEASE

**Magnetic Resonance Imaging of Focal Liver Lesions:  
Approach to Imaging Diagnosis**

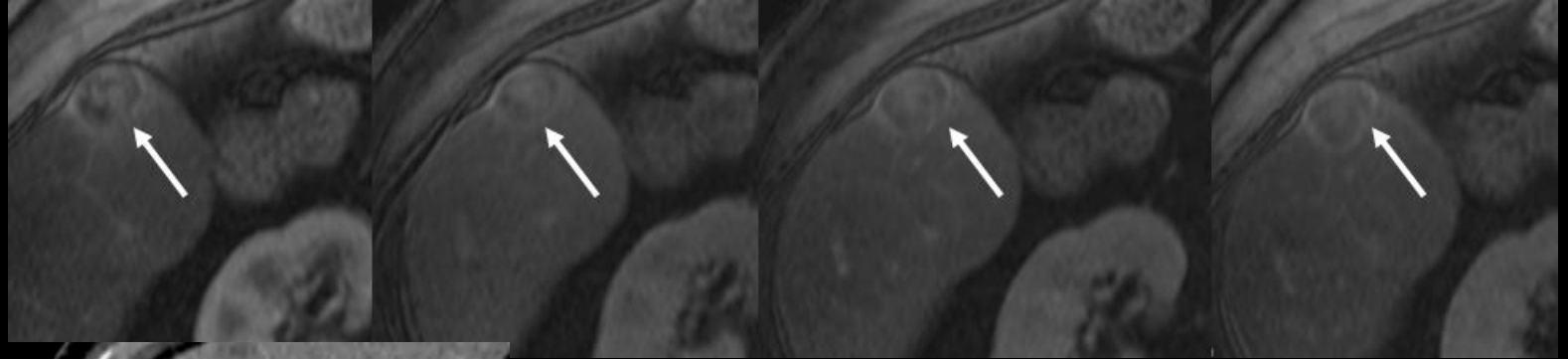
Kathryn J. Fowler, Jeffrey J. Brown, and Vamsi R. Narra



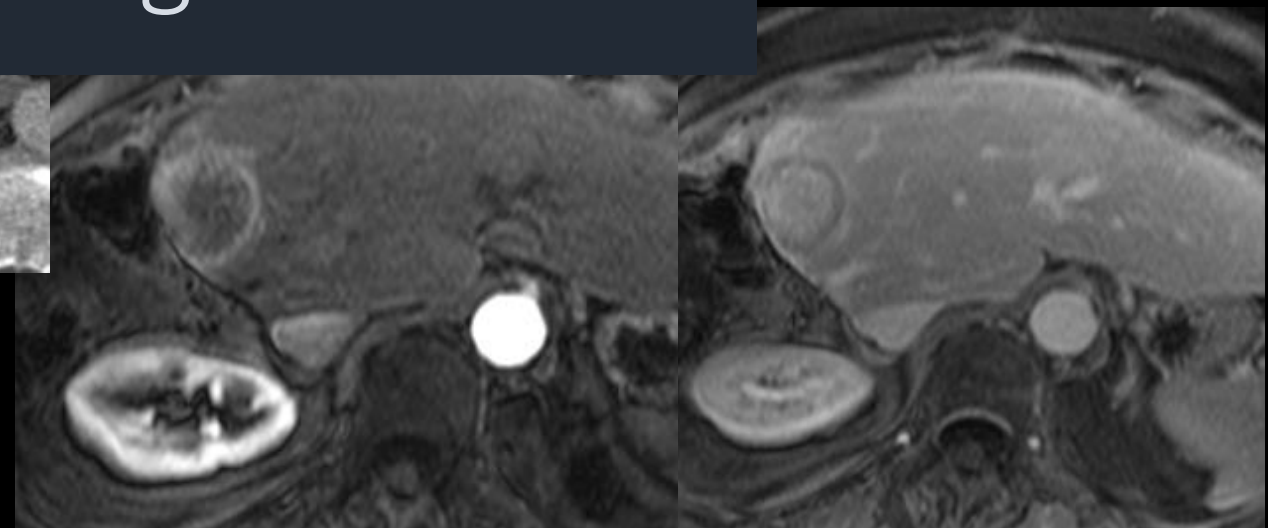
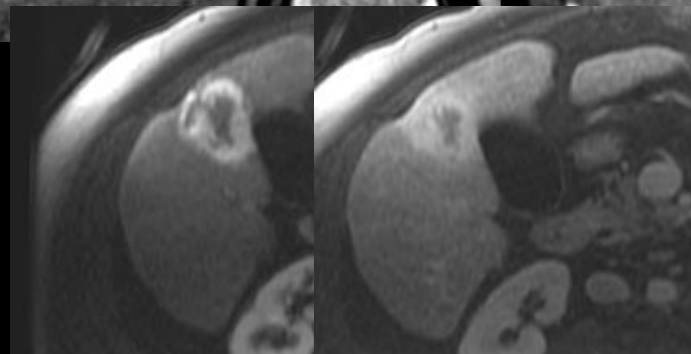
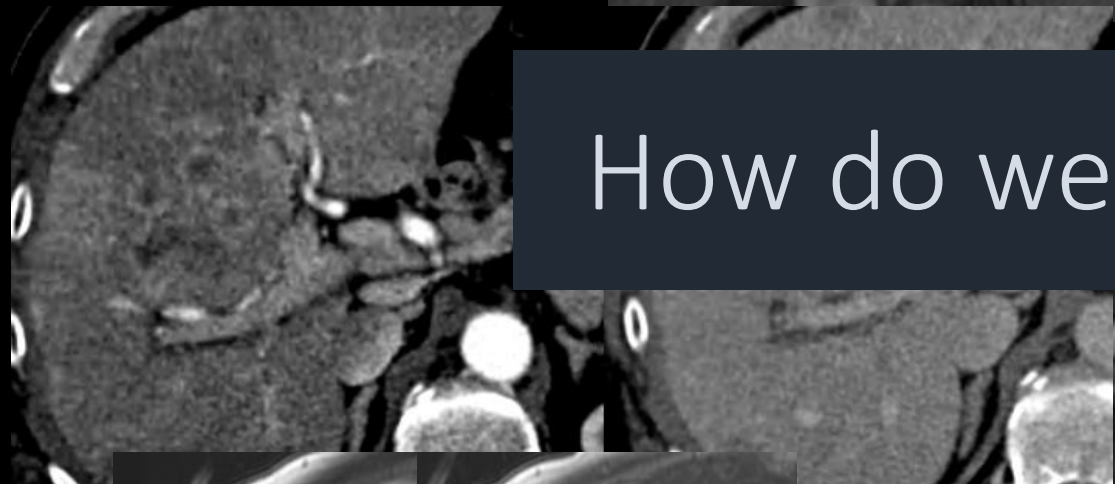
LI-RADS ACR website

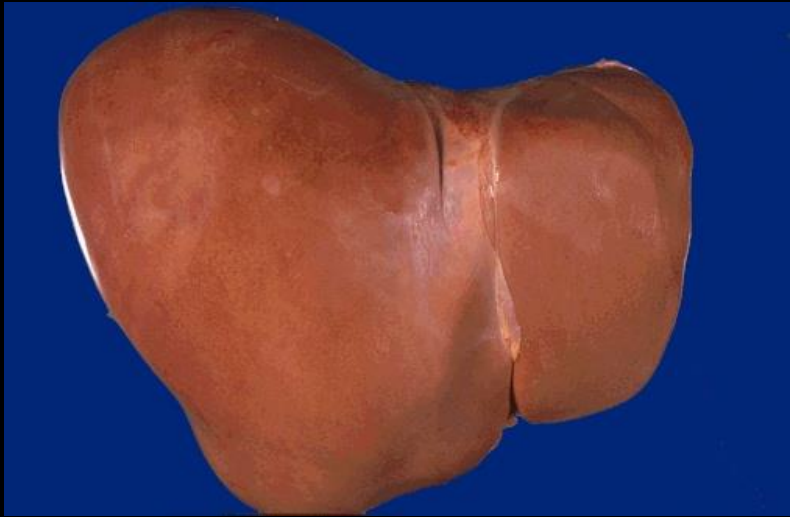


# What's that?



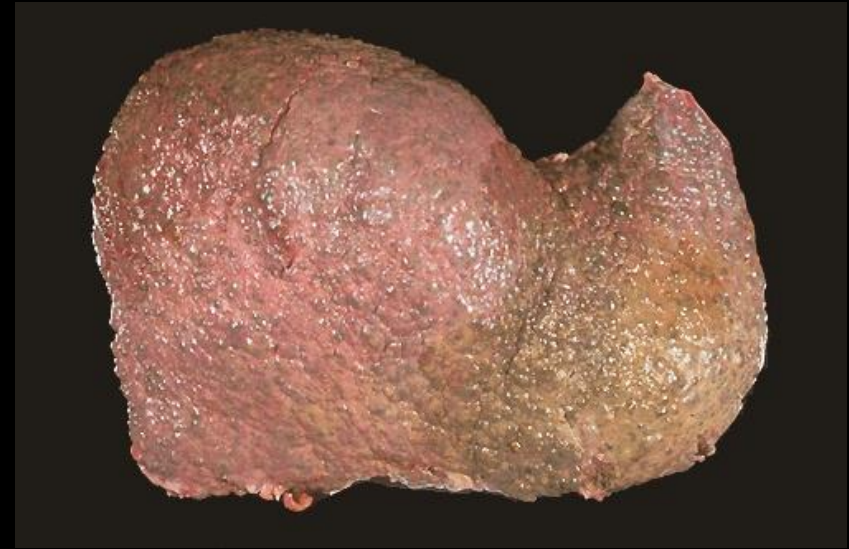
How do we figure it out?





Benign lesions!

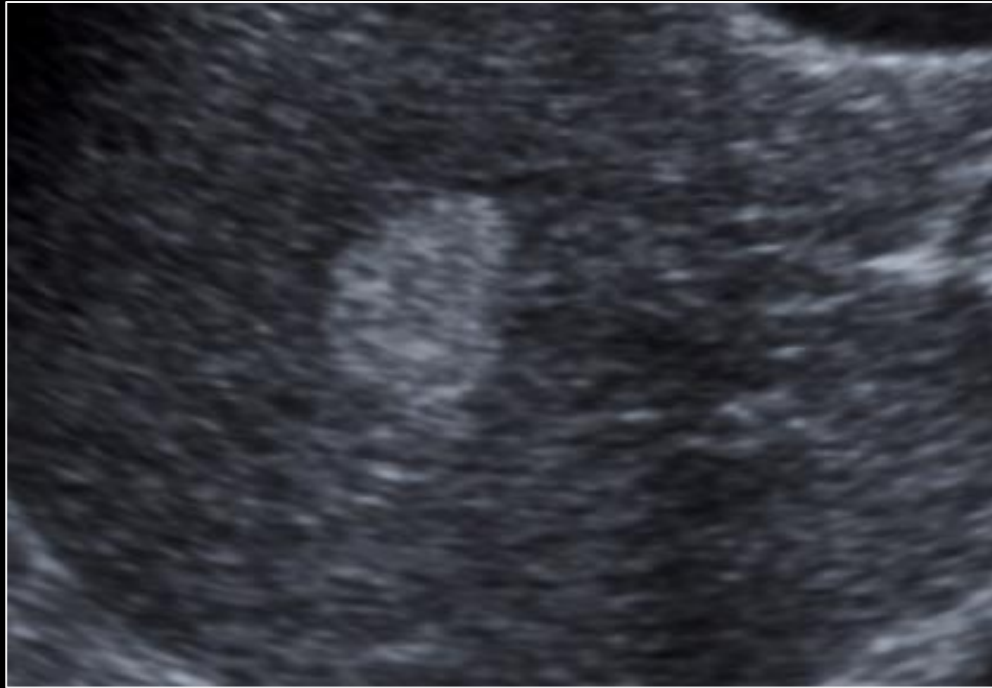
Cancer is rare\*



Cancer!  
-HCC, ICC

Metastatic disease-RARE

# Step 1: Determine Risk Factors



- Hyperechoic, lobular lesion with posterior acoustic enhancement

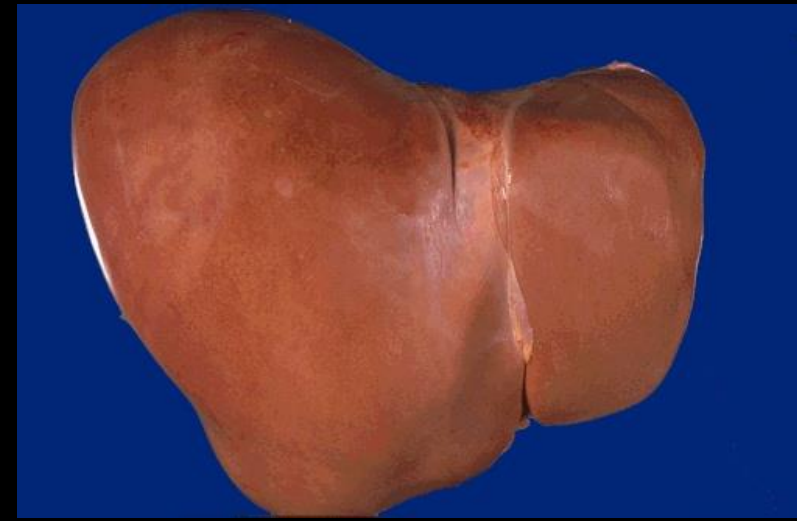
What is the most likely diagnosis?

**Caution!**

Not specific in setting of RF  
or clinical history of cancer

# No known risk factors CLD

- Differential considerations favor benign
- Lesions with classic imaging features can be definitively diagnosed
  - Hemangiomas
  - Cysts
  - FNH
  - Adenomas\*



# Approach to Ultrasound

- Classically benign
- Probably benign
- Indeterminate



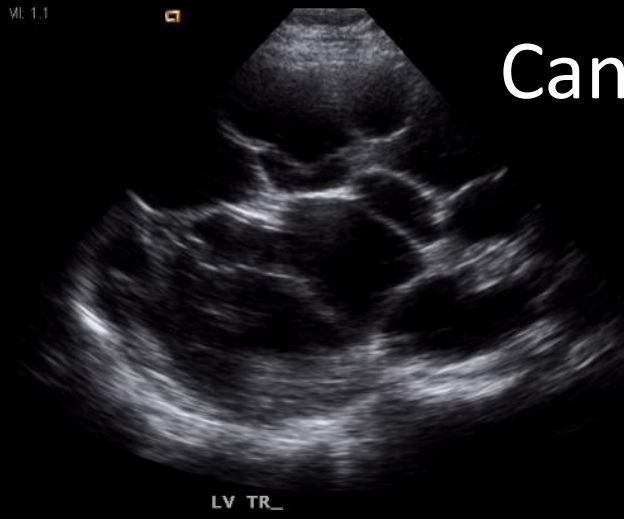
# Classically Benign

Focal liver mass US

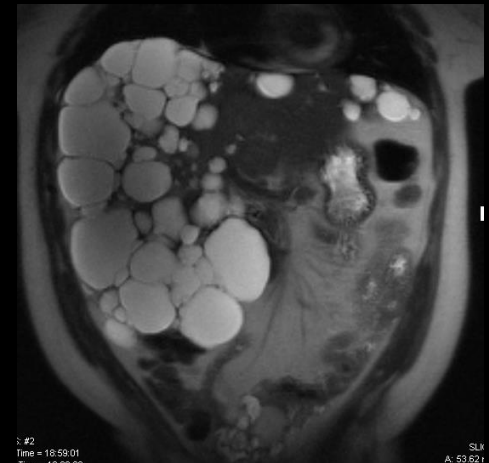


## Hepatic Cyst

Classic Features: Anechoic, wall, increased thru transmission



Can be complex



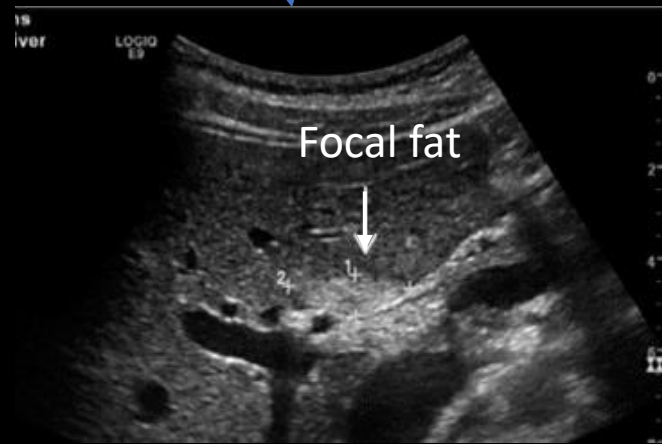
## Classically Benign

Focal liver mass US

# Focal Fat or Fatty Sparing

Classic Features: **non-masslike** area in classic location adjacent to:

- gallbladder fossa
- falciform ligament
- portal veins
- posterior surface left lateral section



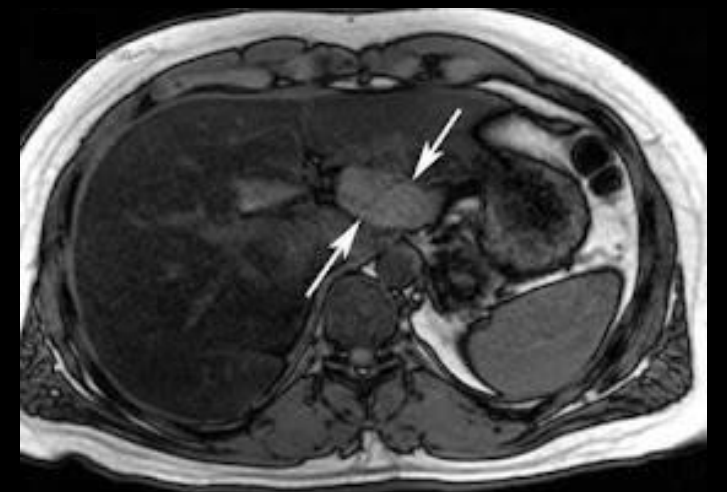
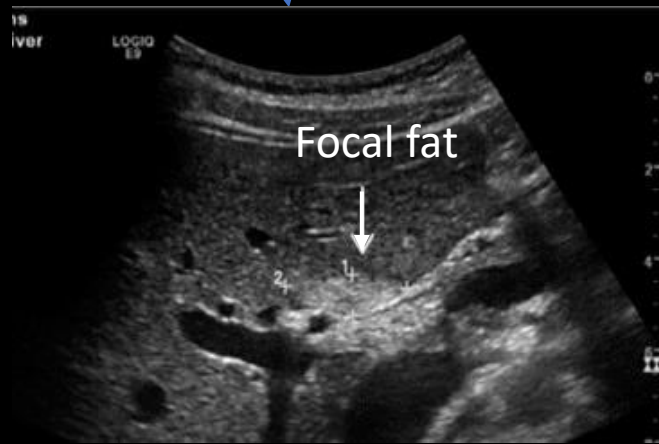
# Classically Benign

Focal liver mass US

## Focal Fat or Fatty Sparing

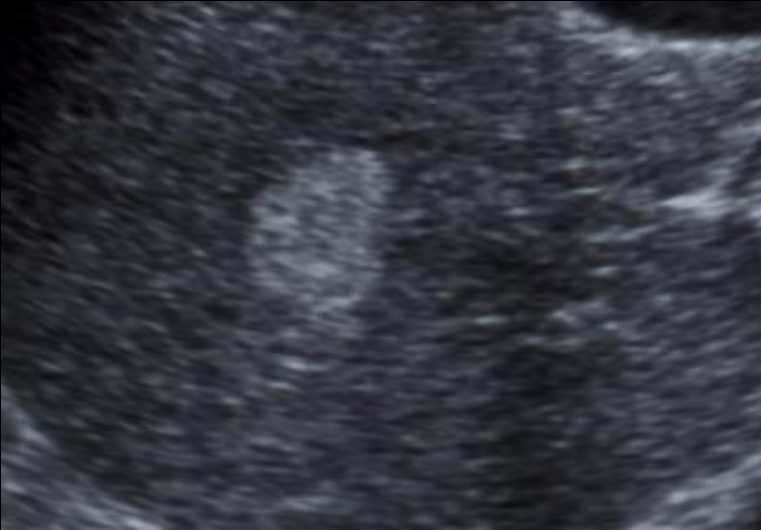
### Non-masslike

no mass effect on capsule or structures  
undistorted vessels  
geographic, indistinct margins



Probably Benign

Focal liver mass US



## Hemangioma

Classic features: lobular, hyperechoic, solid, posterior acoustic enhancement

**Caution!**

Not specific in setting of RF or clinical history of cancer

## Indeterminate

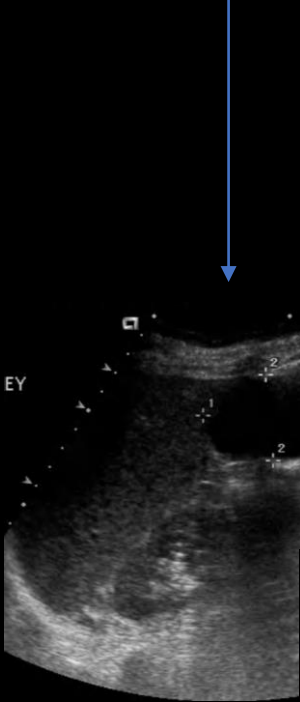
Focal liver mass US



## Other Solid masses

Definitive diagnosis is challenging and further work up with contrast enhanced x-sectional

# Focal liver mass US



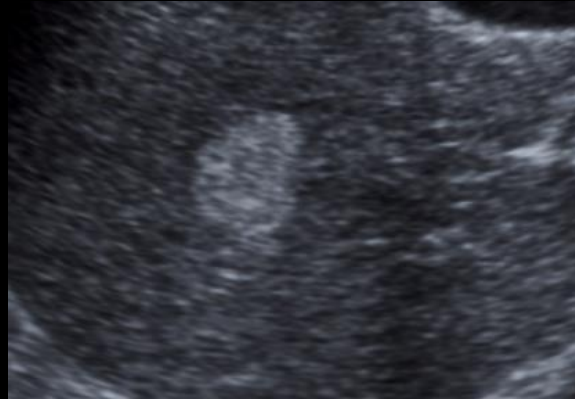
4C1  
H4.0MHz  
Abdomen  
NTHI Gener  
70dB T1/  
Gain= 19dB  
Store in pr.



Classically Benign



Indeterminate



Probably Benign

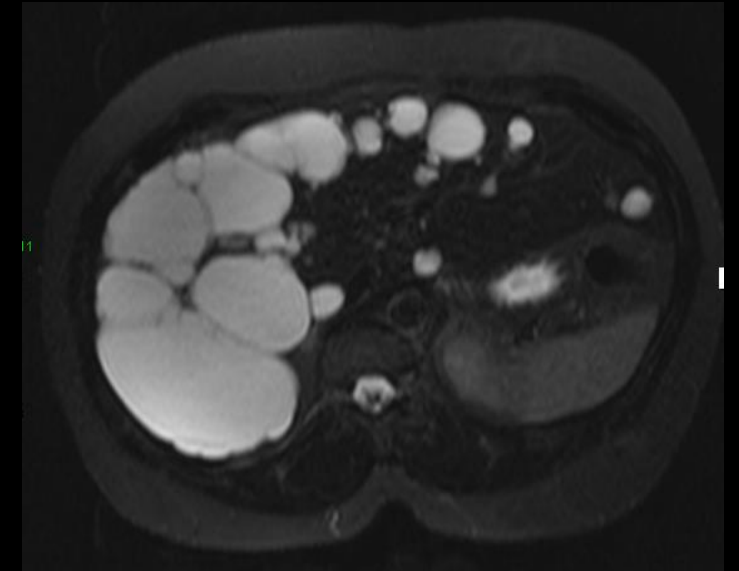
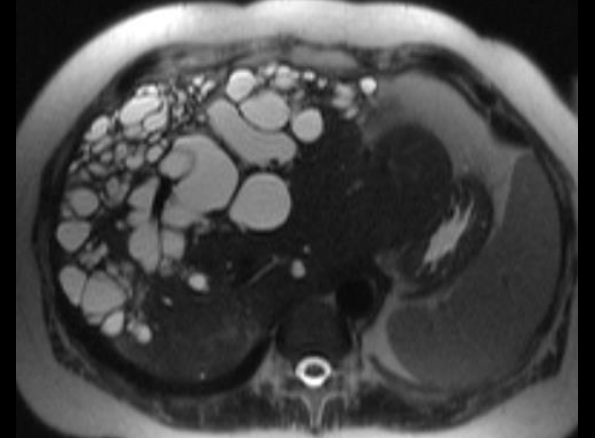
# Approach to CT/MRI

- Classically benign entities
  - Cysts
  - Focal Fat/Fatty Sparing
  - Hemangiomas
  - FNH



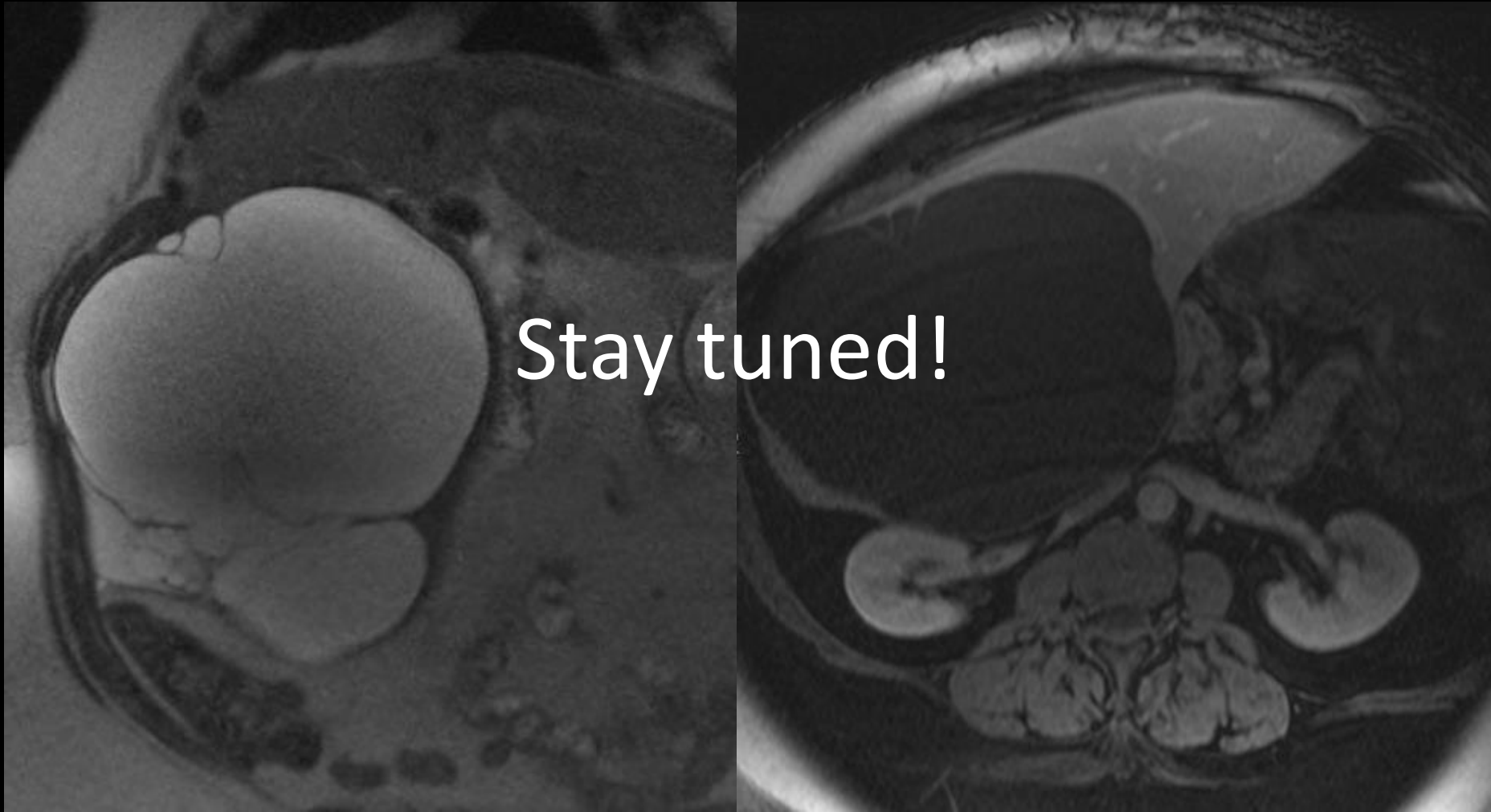
# Hepatic Cysts

- Most common FLL
  - Derived biliary epithelium without communication with bile ducts
  - Symptomatic cysts-unroofed, sclerosed
- Ddx: biliary hamartomas, peribiliary cysts, biliary cystadenomas





What if they are complex?

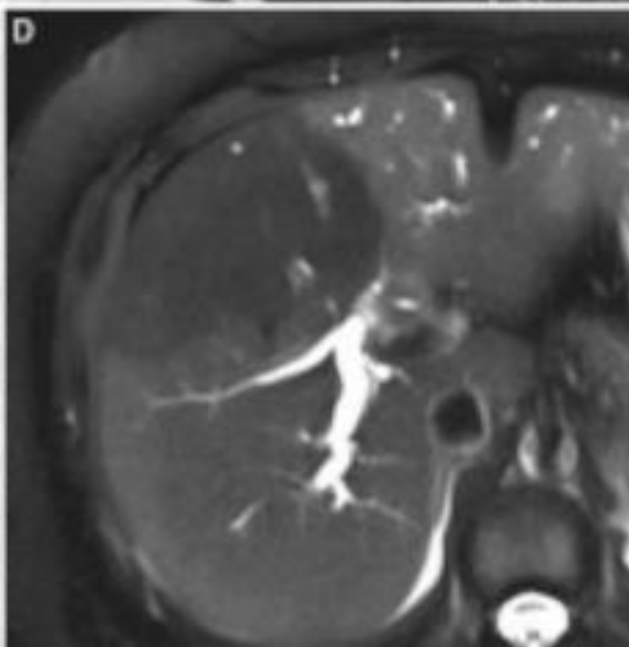
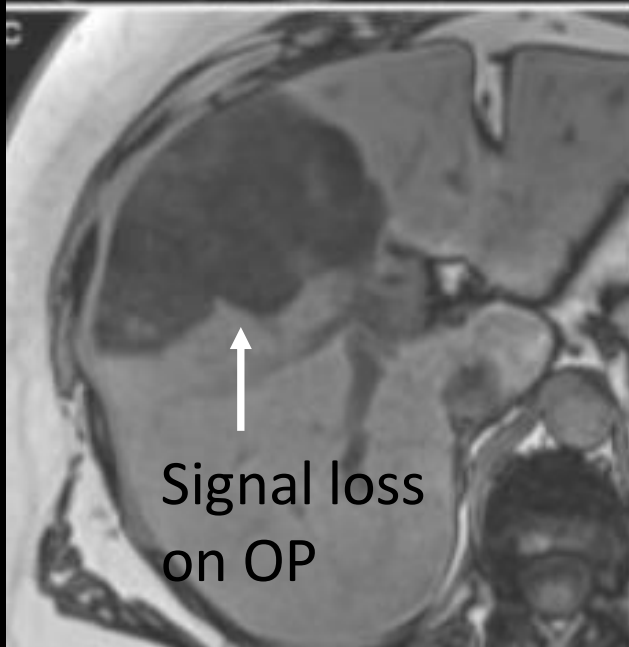
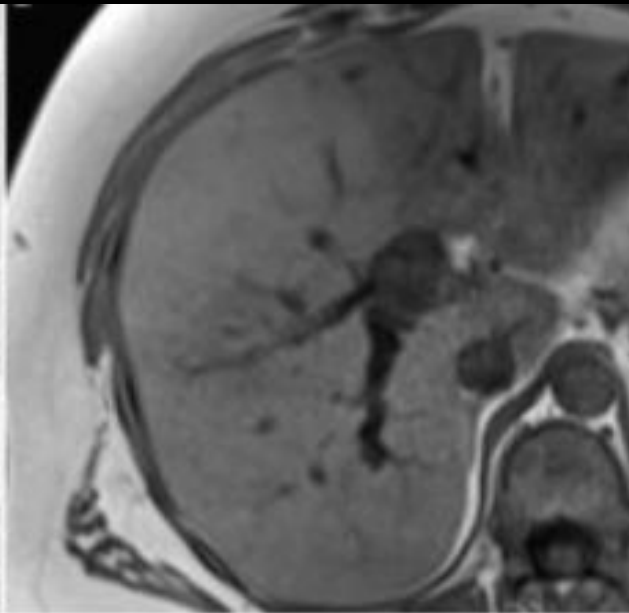
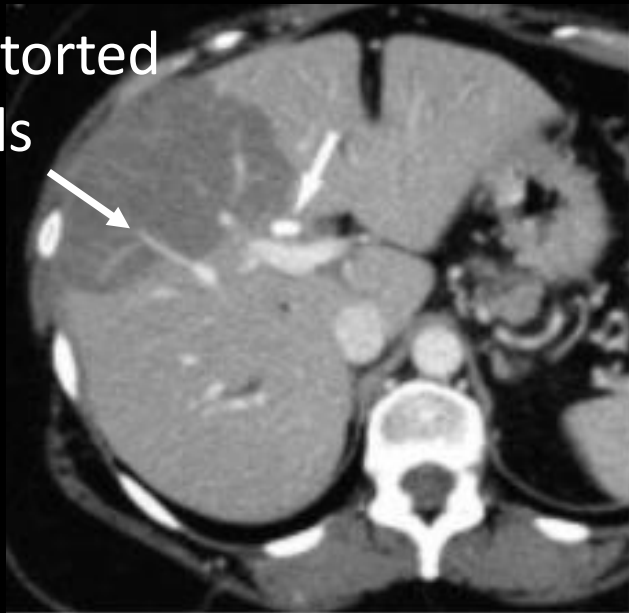


# Focal Fat

Geographic, non-masslike!

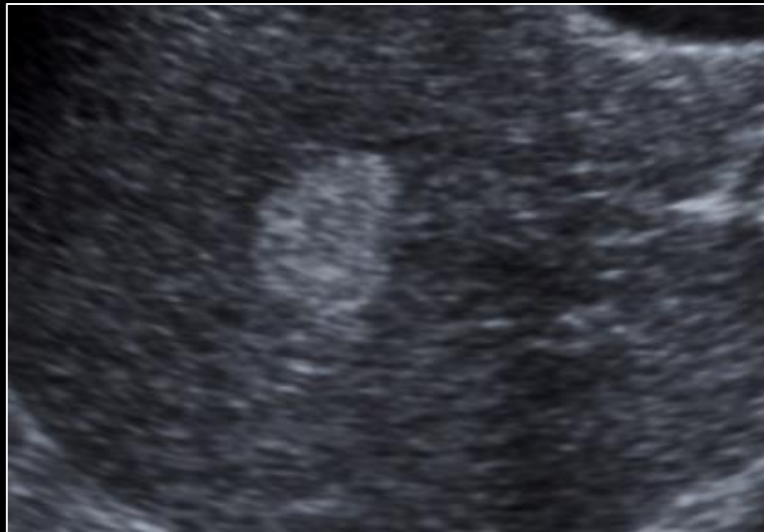
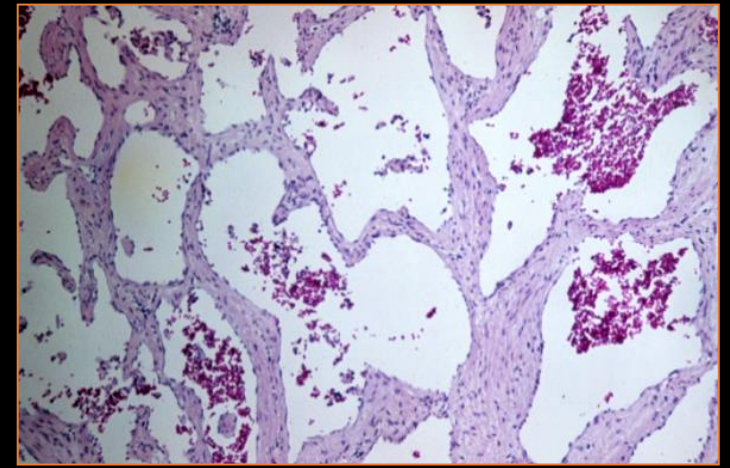
- CT: attenuation less than background liver
  - $\leq 40$  HU or  $\geq 10$  HU less than spleen on unenhanced
- MRI:
  - Signal loss on out-of-phase compared to in-phase
  - Signal loss on fat suppresses compared to non-fs
  - PDFF  $\geq 5\%$

Undistorted  
vessels



# Hemangiomas

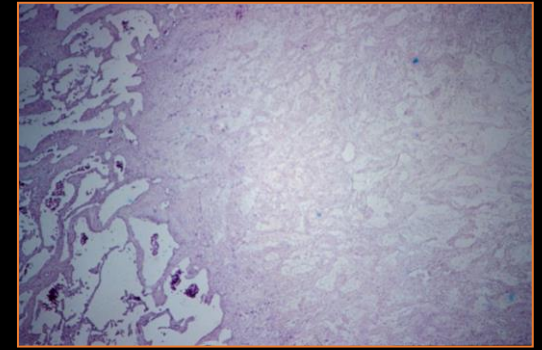
- Most common liver tumor
- US-hyperechoic, lobular margins, posterior acoustic enhancement
- Overlapping features with HCC, AML, Mets



**Caution!**

Not specific in setting of RF or  
clinical history of cancer

# Hemangiomas

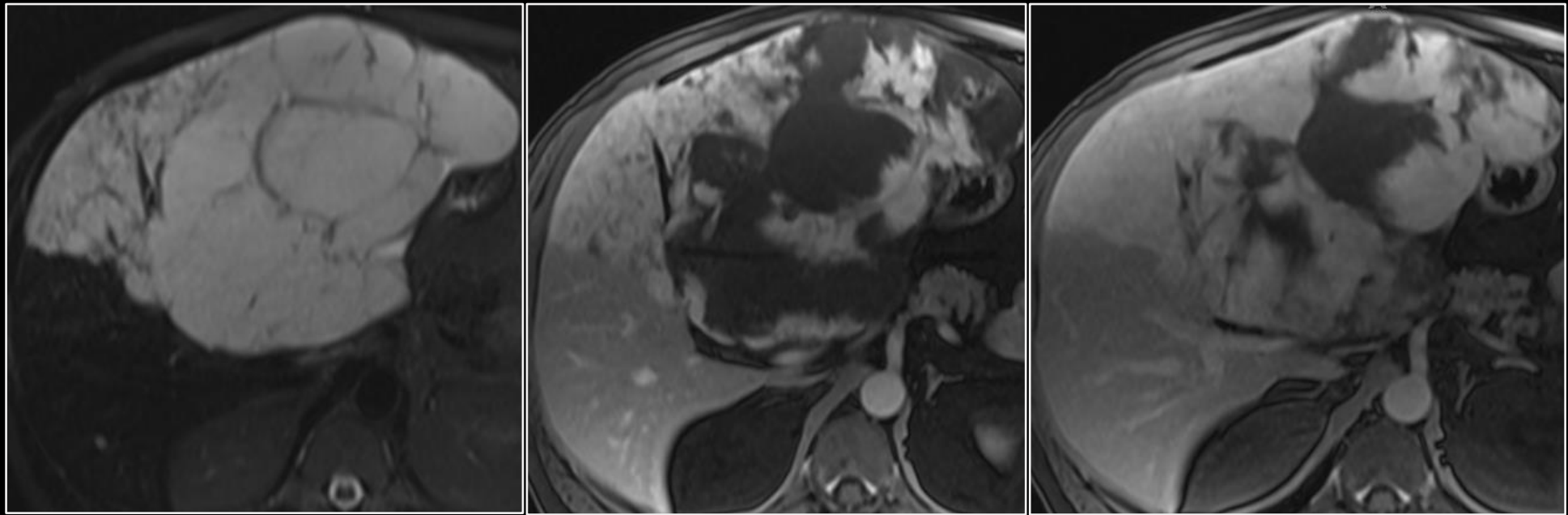


- CT/MRI-
  - Classic enhancement pattern (centripetal complete, incomplete, flash-filling)

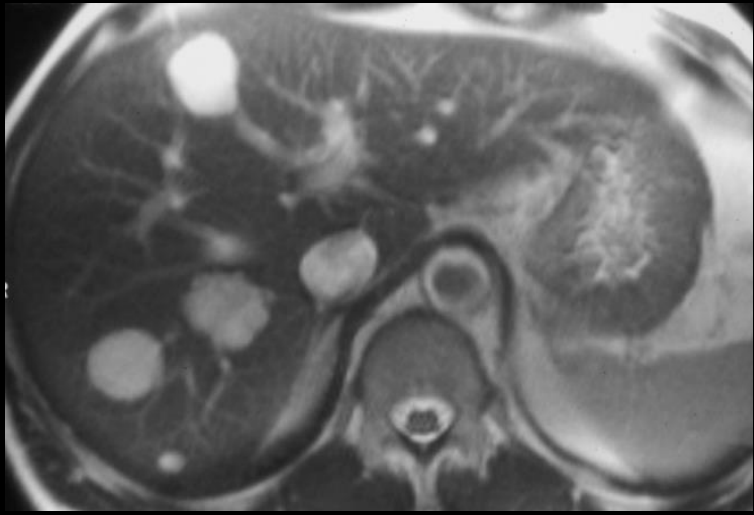


# Hemangiomas

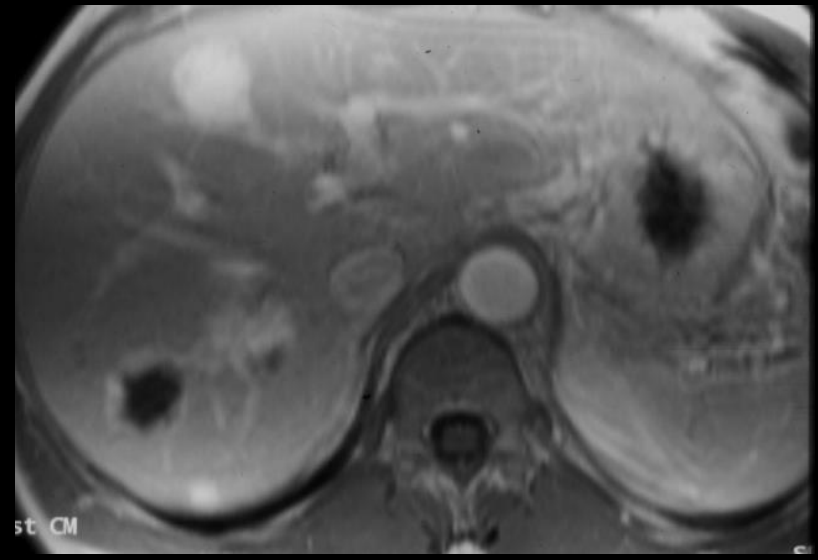
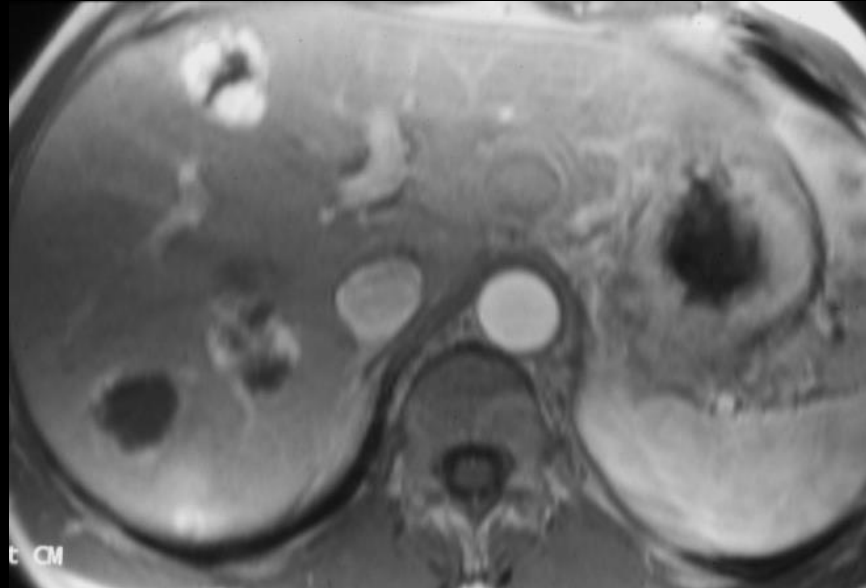
- MRI-
  - Classic enhancement pattern plus T2 intensity

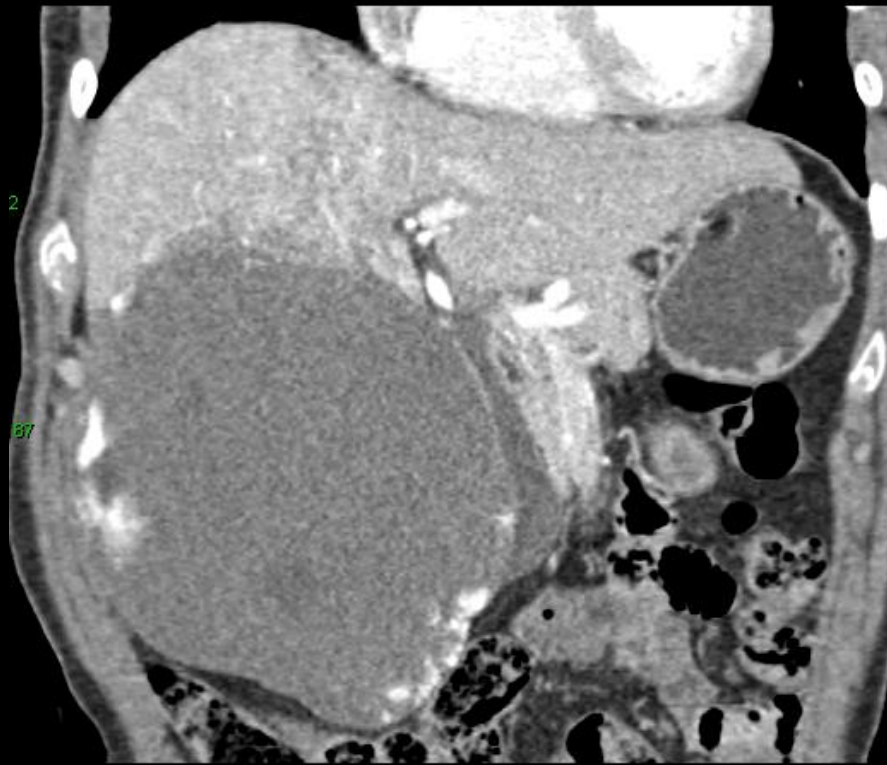




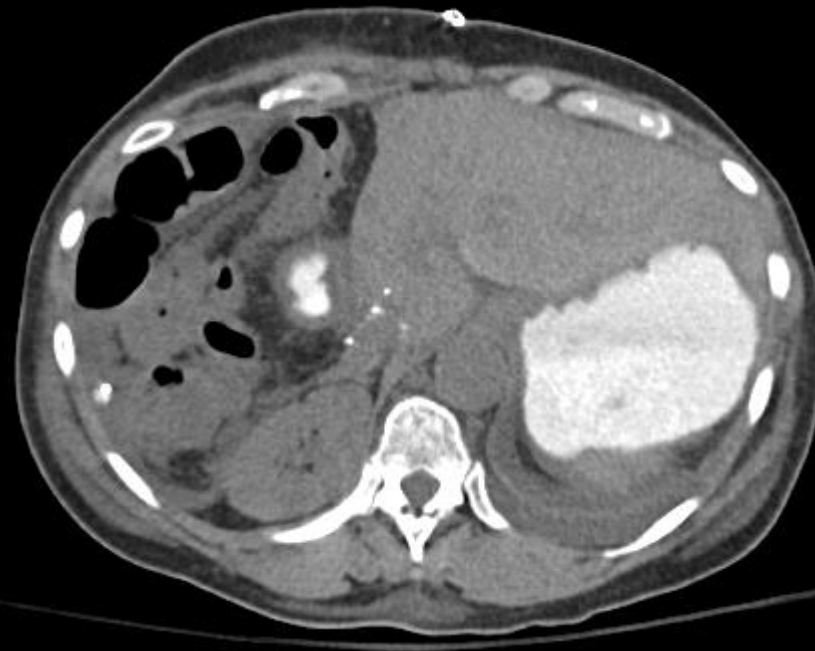


May be multiple





- Giant hemangioma can be symptomatic
- Thrombosis, hemorrhage, rupture





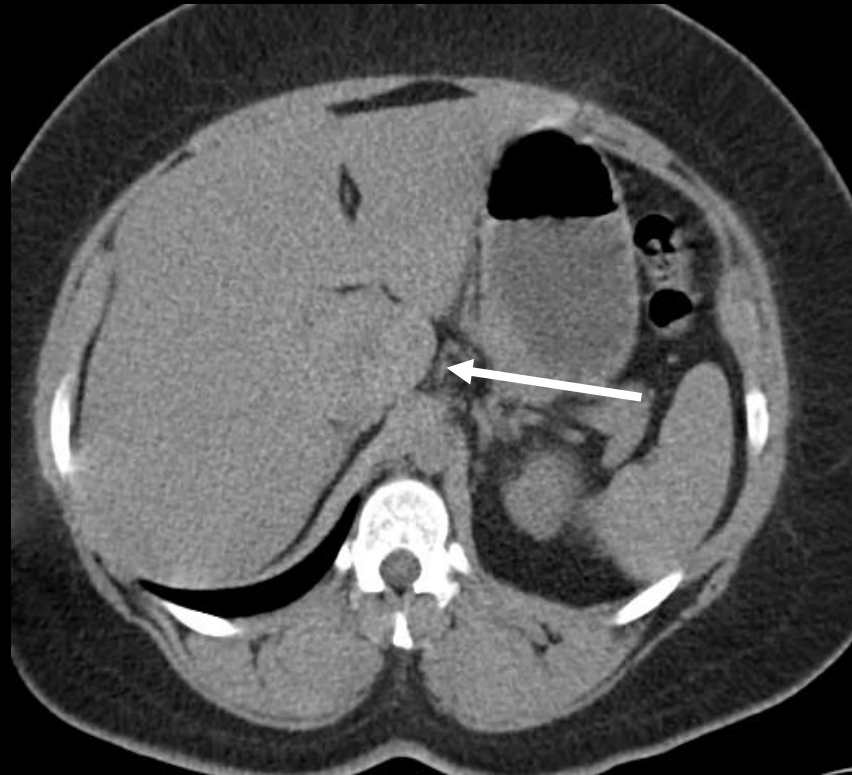
# Focal Nodular Hyperplasia

- 2<sup>nd</sup> most common B9 liver mass
  - Non neoplastic hepatocytes
  - Stellate central fibrous scar
  - Abnormal portal supply
- Common in young, asymptomatic females
- OCP may stimulate growth



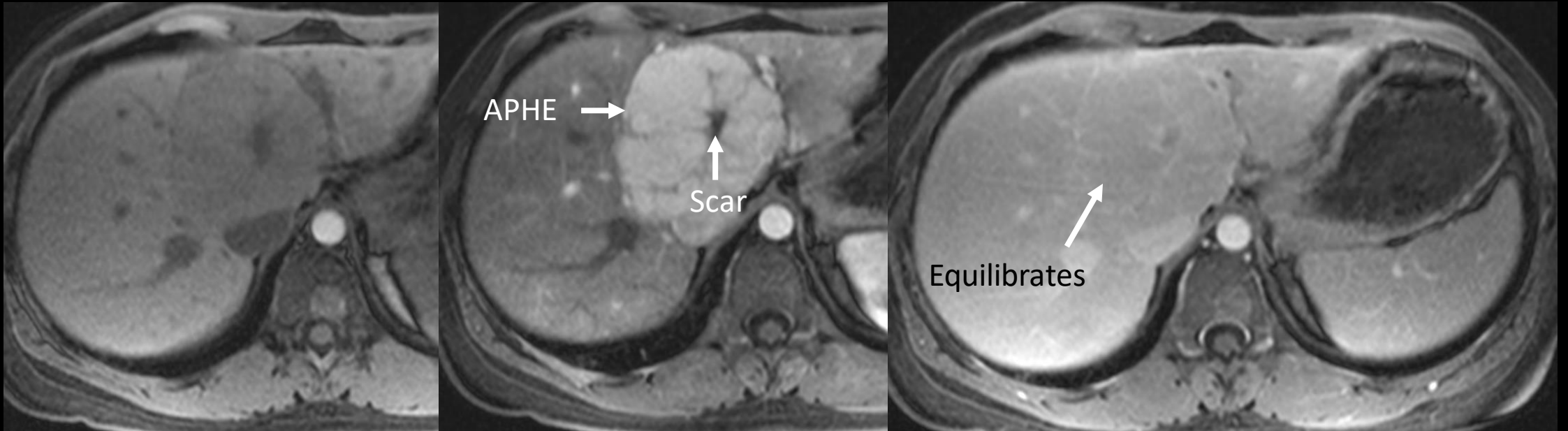
# Focal Nodular Hyperplasia

- Classic Imaging Appearance:
  - Stealth on non-contrast images (made of hepatocytes)



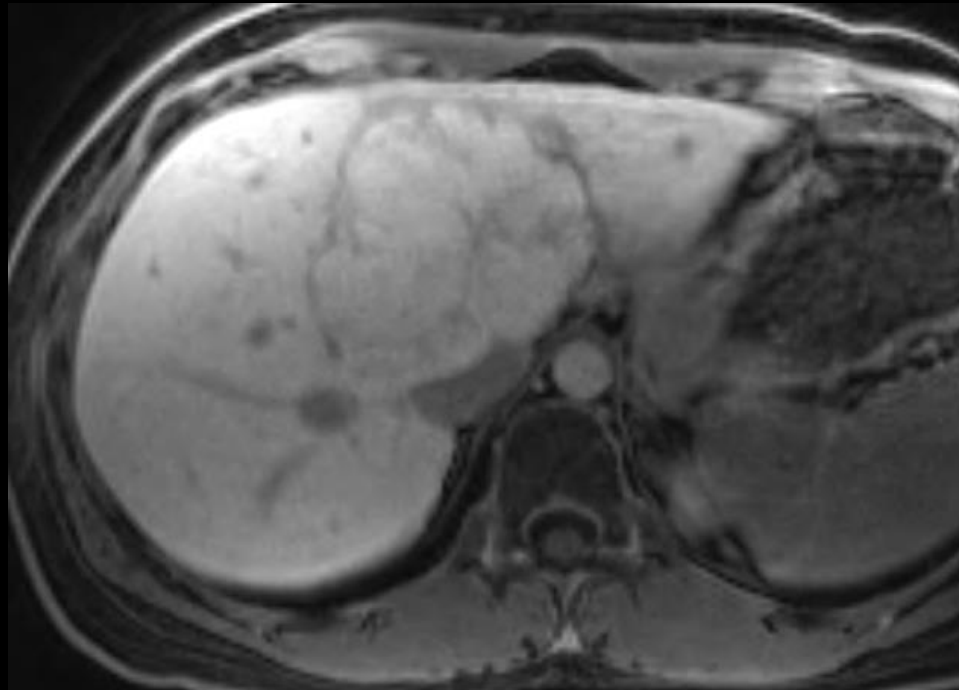
# Focal Nodular Hyperplasia

- Classic dynamic enhancement pattern:
  - Homogeneous APHE (spares central scar)
  - Equilibrates during PV and delayed phases
  - Scar may enhance on delayed images



# Focal Nodular Hyperplasia

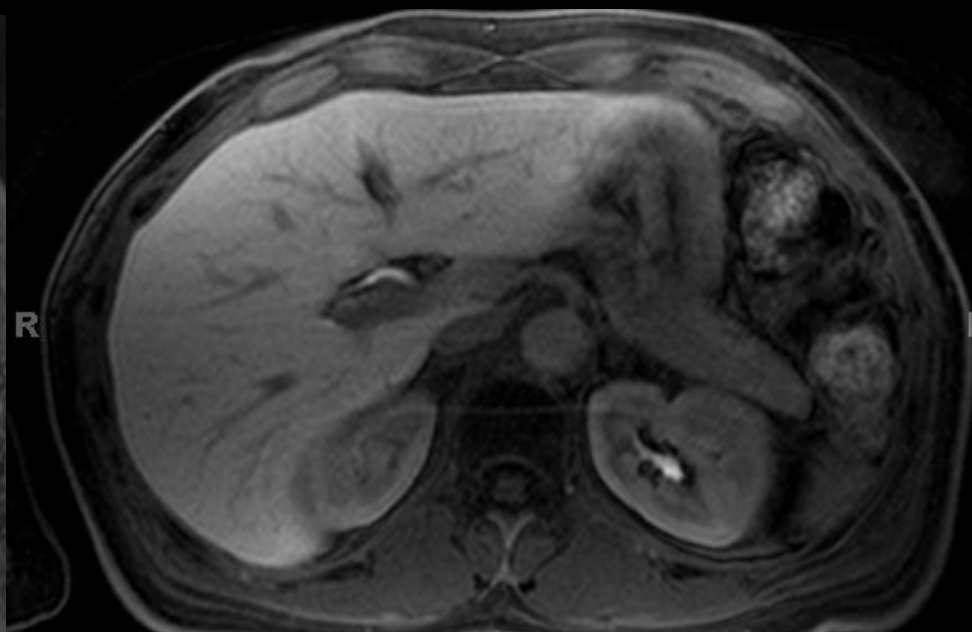
- Classic Hepatobiliary Phase Uptake
  - Eovist (20 min) or Multihance (1 hr)
  - FNH takes up contrast similar to or brighter than background liver



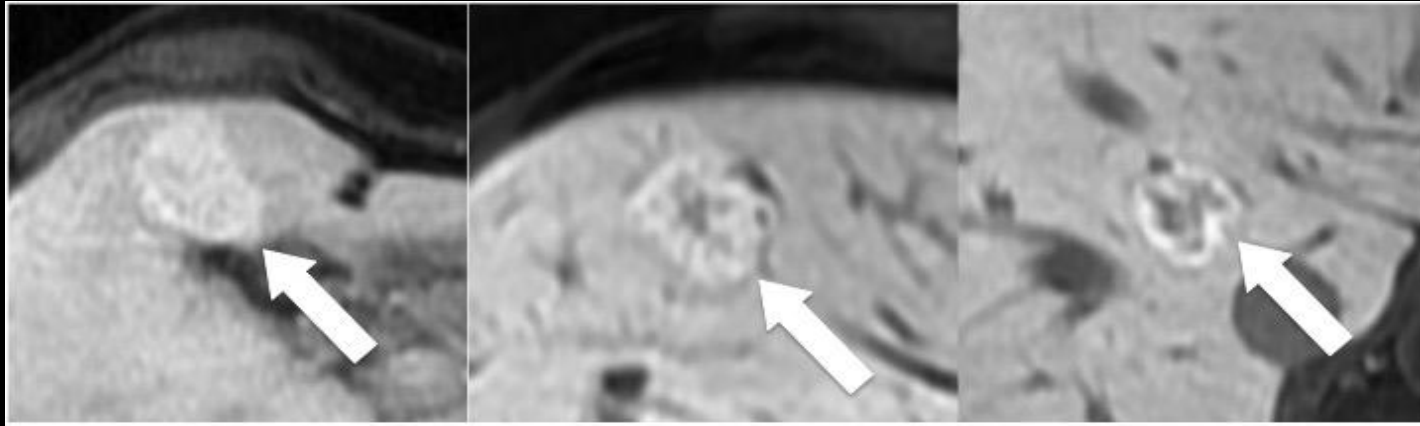
# Hepatobiliary Contrast Agents

- Multihance-2-4% excreted in bile (1-hr delay)
- Eovist-50% excreted in bile (20-min delay)
  - Eovist likely better at differentiating FNH from other lesions (HCA)

Vanhooymissen I, JMRI 2019



# Typical FNH



Hepatobiliary phase images

If all imaging features are not present

- atypical FNH
- hepatocellular adenoma subtype

# Focal Nodular Hyperplasia

- Beware the “new” lesion on AP



Current CT

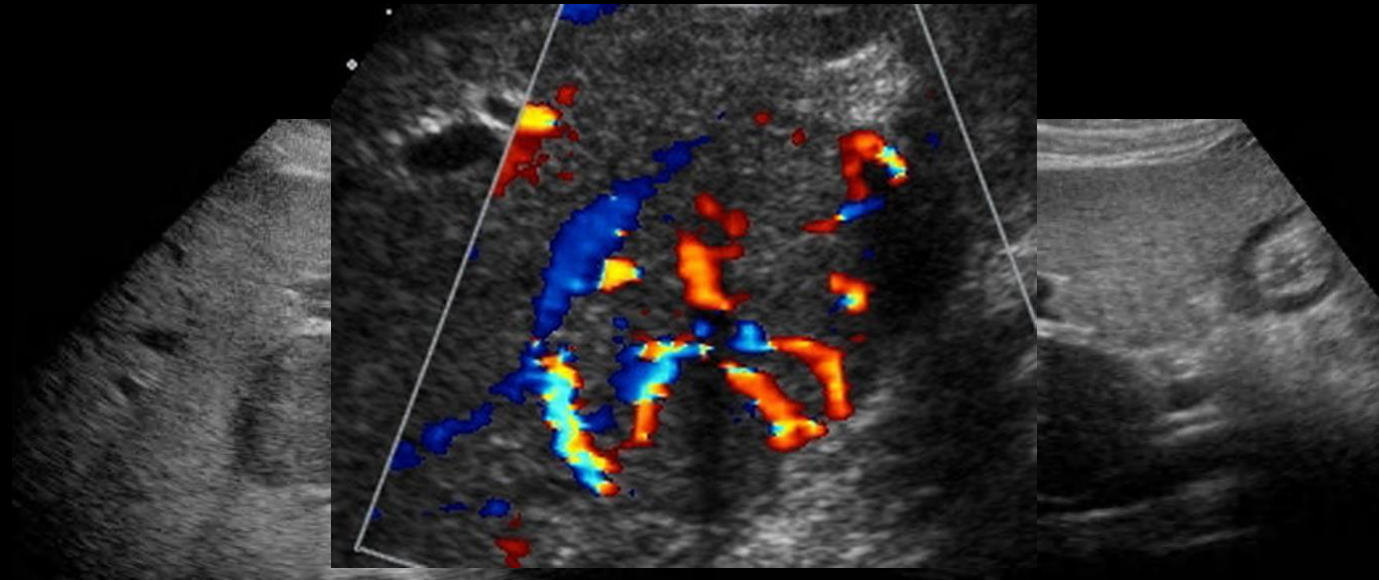


Prior CT



# US-FNH

- Isoechoic
- homogenous mass +/- hypoechoic scar
- spoke-wheel pattern color Doppler





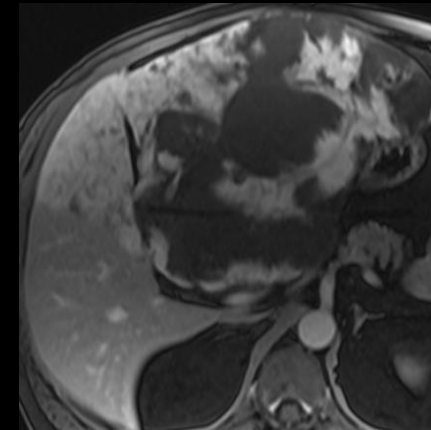
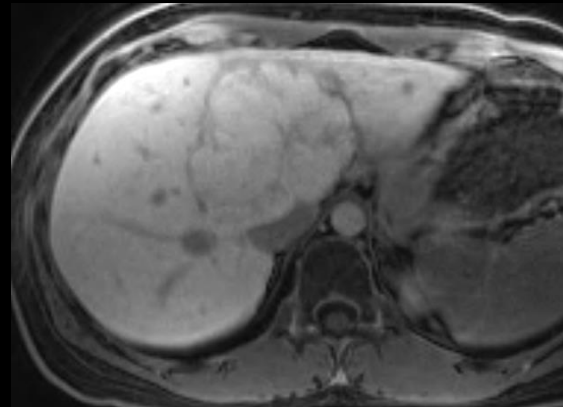
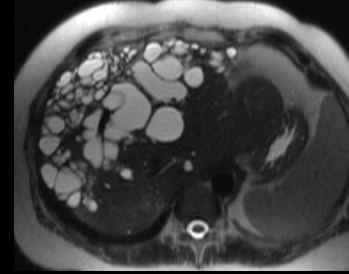
# CEUS-FNH



- Classic stellate arteries
- Sustained enhancement

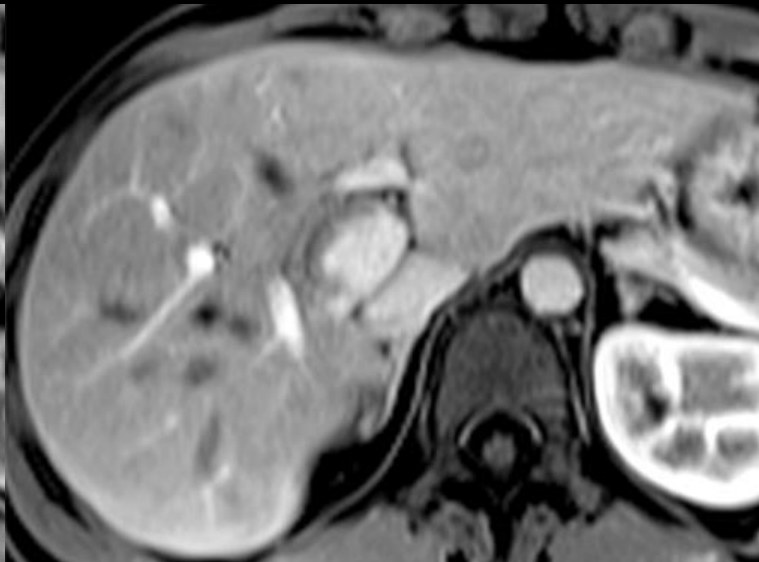
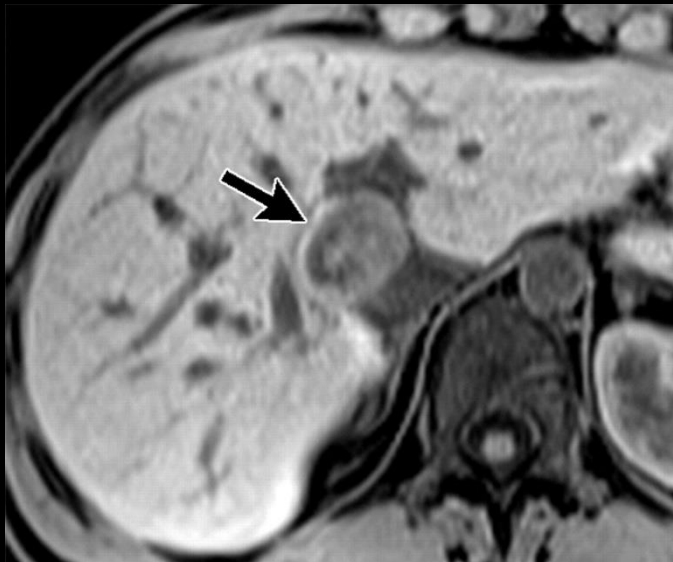
# Approach to CT/MRI

- Classically benign entities
  - Cysts
  - Focal Fat/Fatty Sparing
  - Hemangiomas
  - FNH



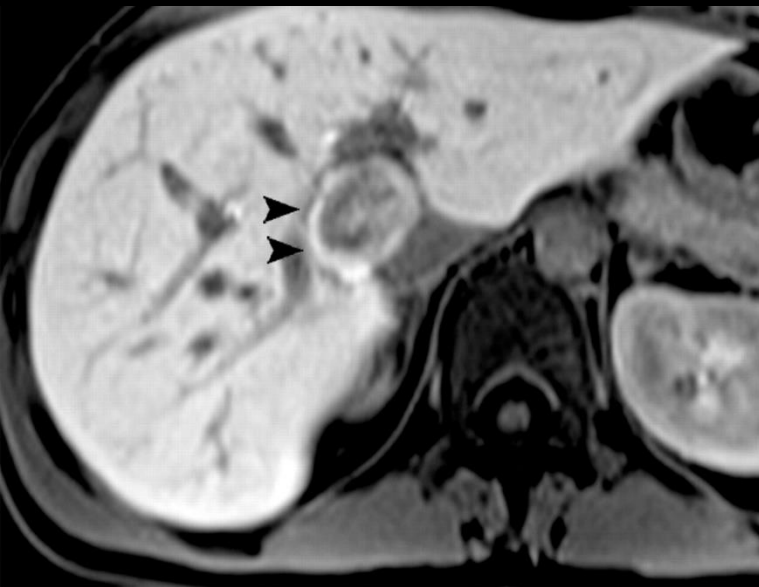
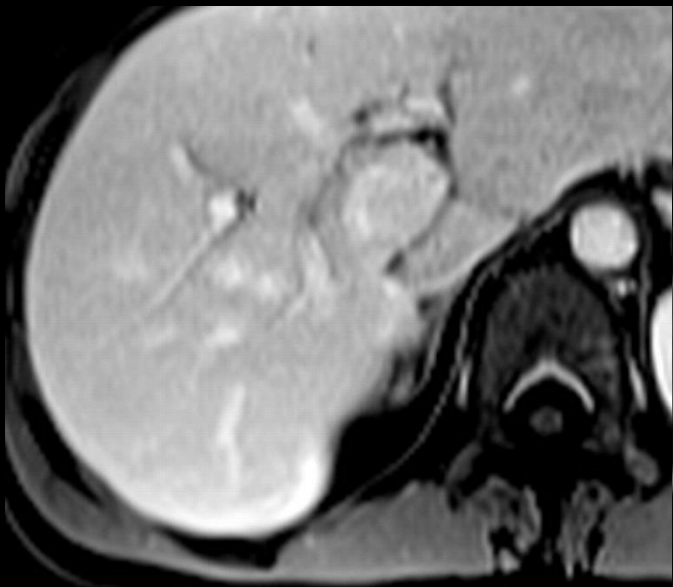
# Approach to CT/MRI

- Classically benign entities
  - Cysts
  - Focal Fat/Fatty Sparing
  - Hemangiomas
  - FNH
- Probably benign entities
  - Adenomas
  - Biliary cystadenomas
  - Abscess/Infection

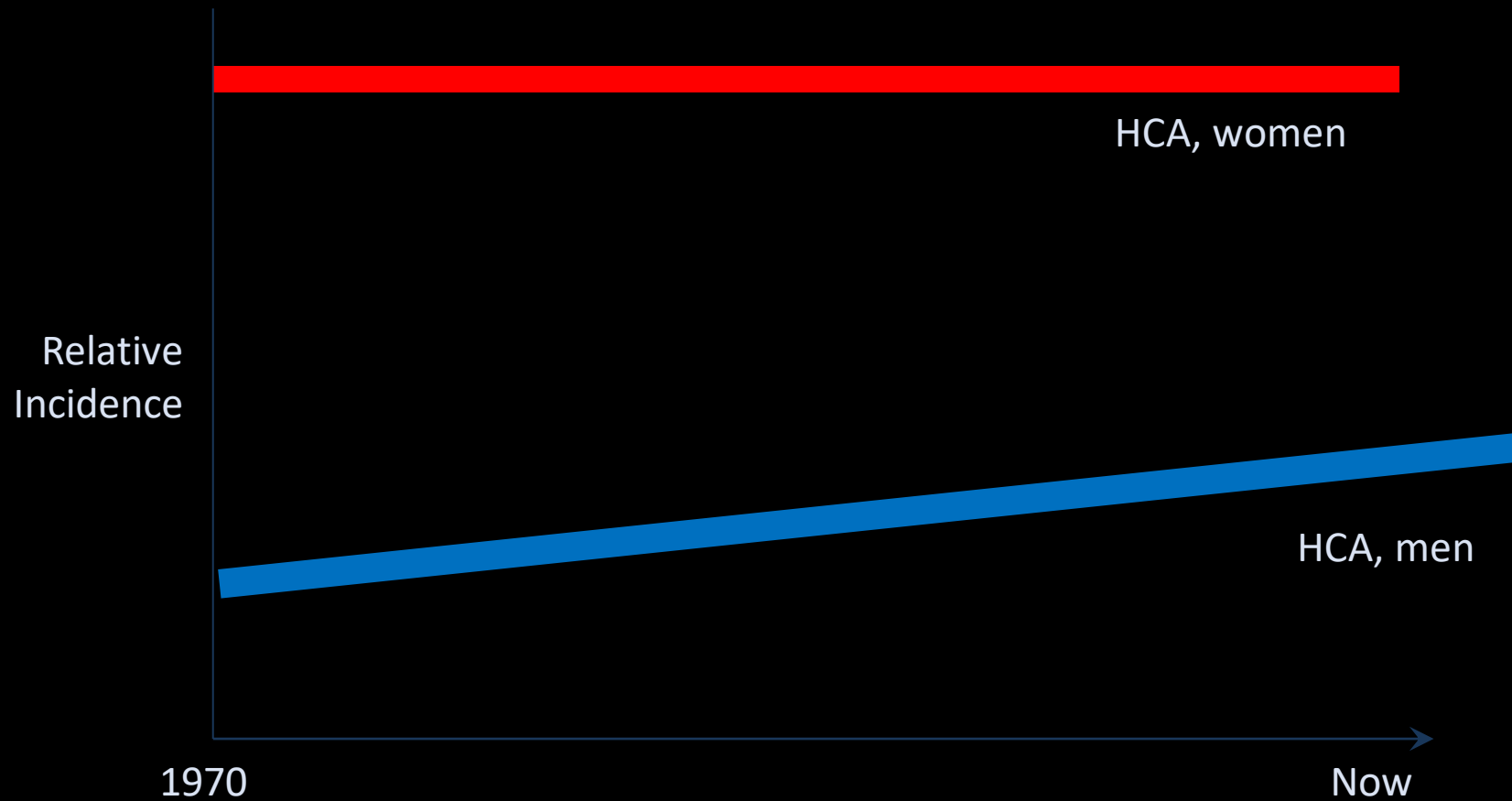


Inflammatory HCA

FNH?



# The epidemiology of HCA is changing...



# Pathomolecular classification

	Epidemiology & Ecology		Molecular Classification		Clinical Manifestations	
HCA classification	H-HCA 34%	$\beta$ -IHCA ex 7/8 4%	$\beta$ -IHCA ex 7/8 3%	$\beta$ -IHCA ex 3 8%	sh-HCA 4%	Unclassified 7%
Molecular pathway	HNF1A inactivation	Weak $\beta$ -catenin activation	JAK/STAT pathway activation	$\beta$ -catenin activation	Sonic hedgehog activation	No association
Mutation(s)	<i>HNF1A</i> biallelic	<i>CTNNB1</i> exons 7 or 8	<i>IL6ST, STAT3, FRK, GNAS, JAK1</i>	<i>CTNNB1</i> exon 3	<i>INBHE/GLI1</i> fusion	No association
Histology	Steatosis Microadenoma Less hemorrhage	Atypia No malignant transformation Hemorrhage Cholestasis	Inflammation Sinusoidal dilation Dystrophic arteries Fatty liver	Atypia $\pm$ Malignant transformation Cholestasis	Hemorrhage Fatty liver	No association
IHC	Negative liver-type fatty acid binding protein	Faint glutamine synthase	Positive C-reactive protein Positive serum amyloid A	Positive glutamine synthase	Positive prostaglandin D synthase	No association

# Clinical Meaning

	Epidemiology & Etiology		Molecular Classification			Clinical Manifestations		
HCA classification	H-HCA 34%	$\beta$ -HCA ex 7/8 4%	$\beta$ -IHCA ex 7/8 3%	$\beta$ -IHCA ex 3 8%	IHCA 30%	$\beta$ -HCA ex 3 8%	sh-HCA 4%	Unclassified 7%
Risk factors	Most are sporadic HNF1A germline mutations (MODY) <u>Not</u> glycogenosis	Unknown	Obesity Alcohol Glycogenosis OCP?	Androgens Vascular disorders	Obesity OCP?	No association	No association	No association
Presentation	Female "Adenomatosis"	Female Young	Male or female Older Asymptomatic Inflammatory syndrome (labs): high GGT, alk. phosphatase	Male or female Young <b>Malignant transformation</b>	Female <b>Bleeding</b>	No association	No association	No association
				<b>"High-Risk HCA"</b>				

# Hepatic Adenomas

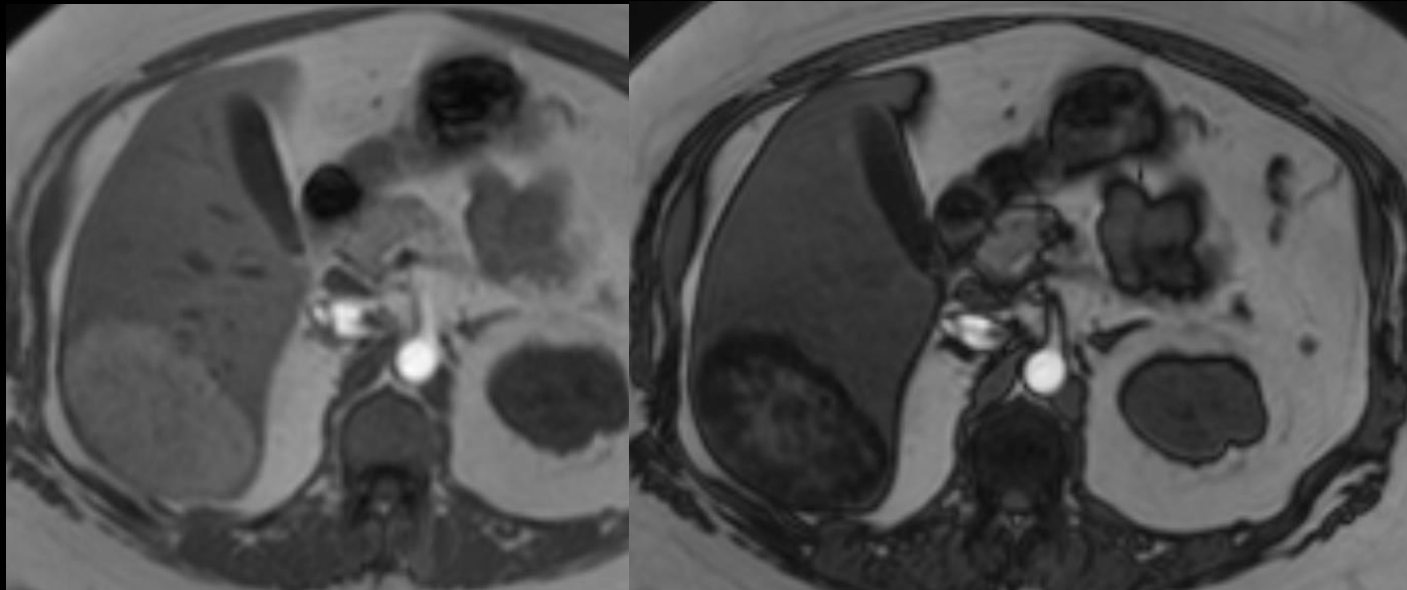
- Sub-classified by IHC/genotypes
  - HNF-1a (steatotic)
    - Diffuse fat in tumor
  - Inflammatory (pka-telangiectatic)
    - Atoll sign, T2 intensity, persistent enhancement
  - Beta-catenin
    - Central retention of HBP contrast
  - Sonic Hedgehog
    - Hemorrhage





# HNF-1 $\alpha$ mutated (HHCA)

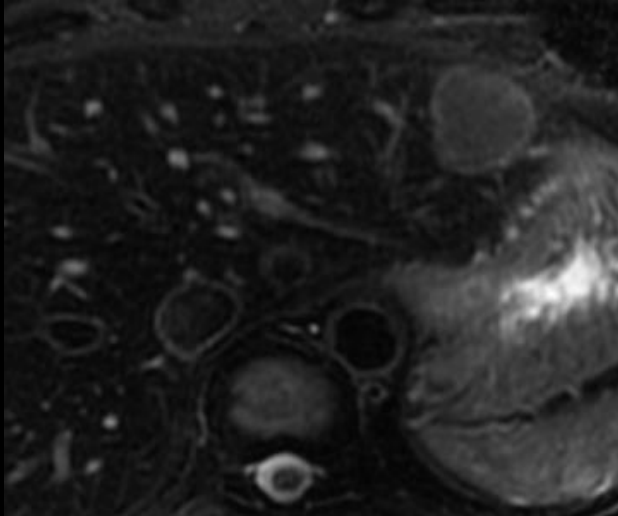
Diffuse fat



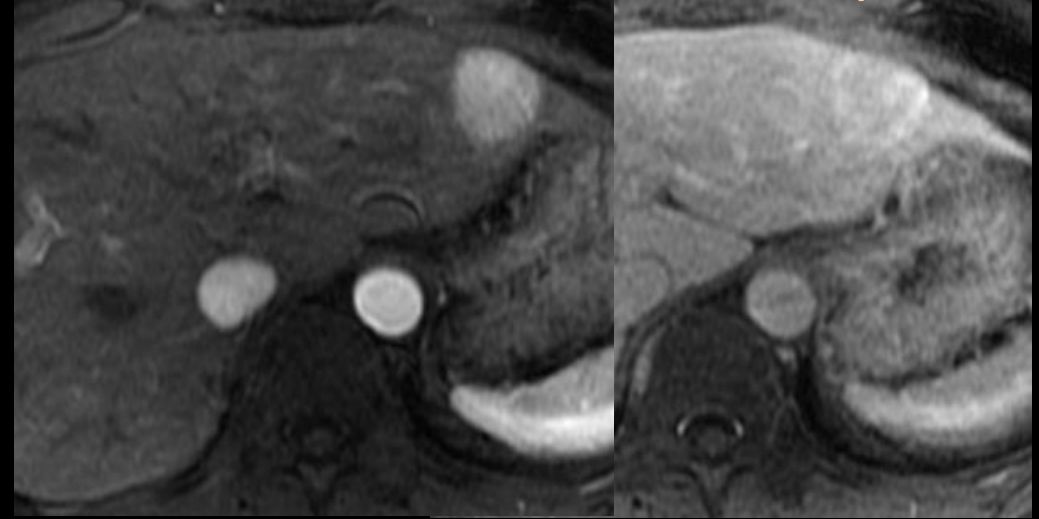
- *Beta catenin activation excluded.*

# Inflammatory Adenoma (IHCA)

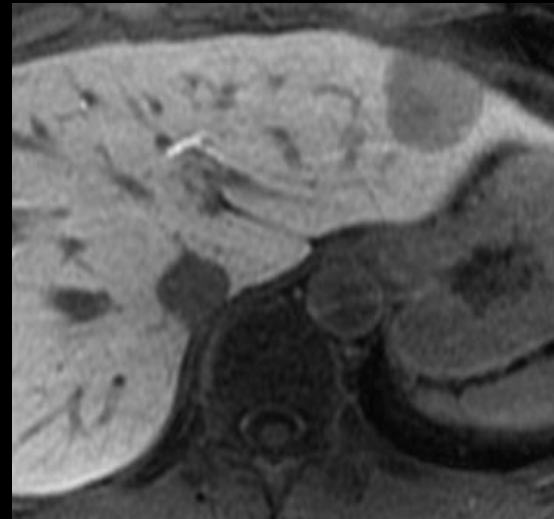
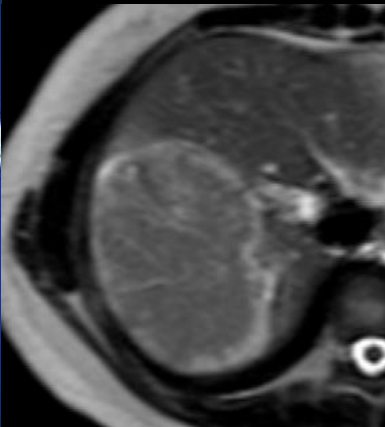
T2 hyperintense-Atoll Sign



Sustained enhancement Dyn



+/- central retention on HBP



# Hemorrhage

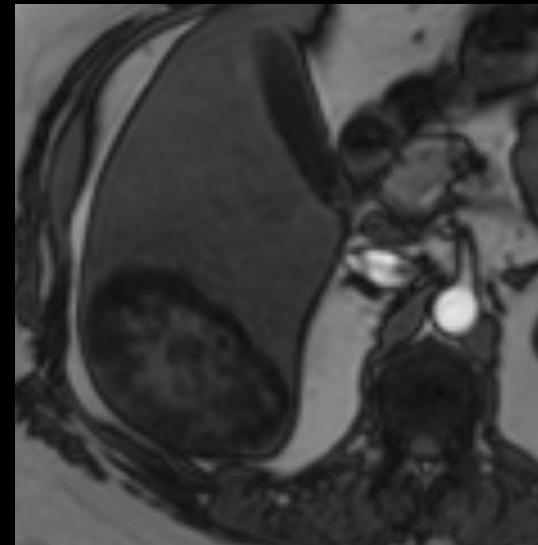


Sonic hedgehog and IHCA's

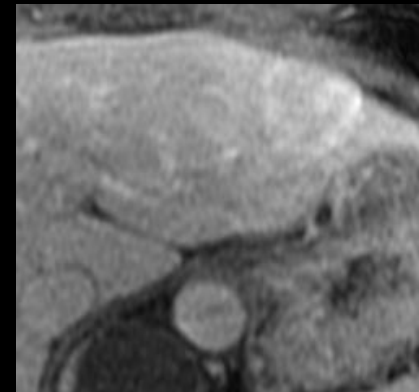
Risk of hemorrhage, increased with increase in size

# Imaging pearls for HCAs

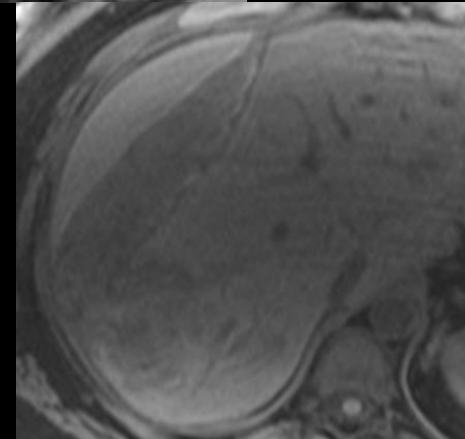
Diffuse intravoxel fat →  
➤ H-HCA, beta catenin activation excluded.



Sustained enhancement on dynamic CT/MR →  
➤ I-HCA, beta-catenin activation not excluded



Hemorrhage →  
➤ I-HCA or sh-HCA

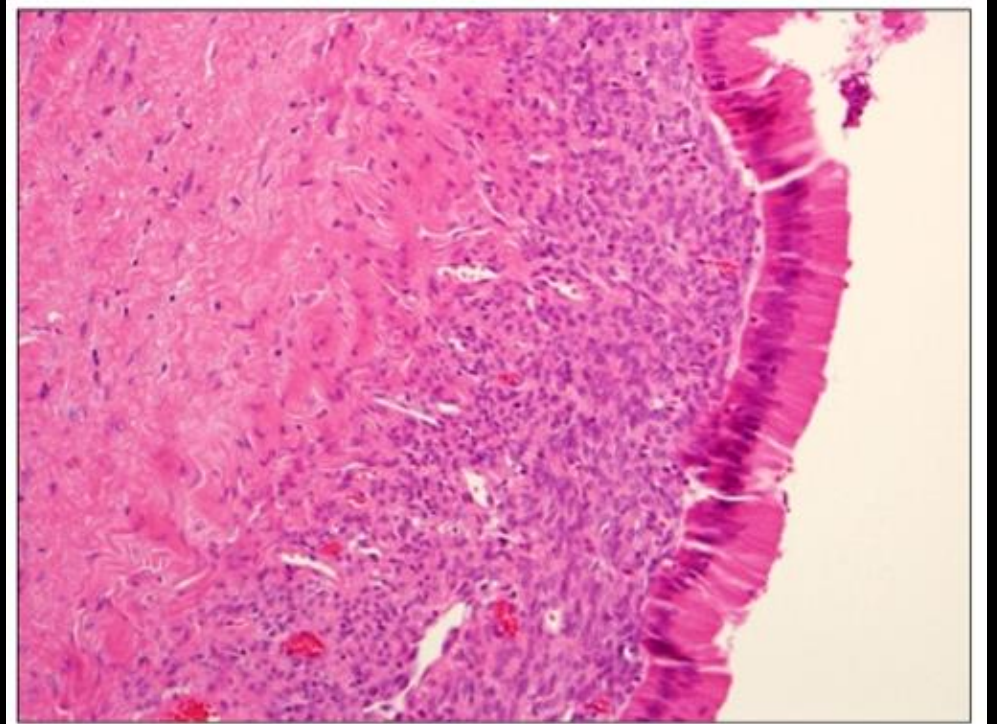


# Mucinous Cystic Neoplasms

- PKA: biliary cystadenoma
- Diagnosis can be challenging
  - Aspiration not sufficient
  - Frozen sections often re-read later
  - Complete excision as a rule

May be lined/surrounded by a layer of highly cellular, mesenchymal tissue that resembles ovarian stroma (H&E, ×400).

Mucinous cystadenoma of the liver with ovarian-like stroma:  
the need for complete resection  
Yoon MH, Yoon JW, Han BH - J Korean Surg Soc (2011)





# Mucin-producing Cystic Hepatobiliary Neoplasms: Updated Nomenclature and Clinical, Pathologic, and Imaging Features

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Meghan G. Lubner, MD  
Hardik U. Shah, MD  
Srinivasa R. Prasad, MD  
Kristina A. Matkowskyj, MD, PhD  
Perry J. Pickhardt, MD

**Abbreviations:** CBD = common bile duct, IPMN = intraductal papillary mucinous neoplasm, IPNB = intraductal papillary neoplasm of the bile duct, MCN = mucinous cystic neoplasm of the liver, MRCP = MR cholangiopancreatography, OLS = ovarian-like stroma, SHC = simple hepatic cyst, WHO = World Health Organization

RadioGraphics 2021; 41:1592-1610

<https://doi.org/10.1148/rg.2021210011>

Content Codes: **CT** **GI** **MR** **OI**

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Cystic hepatobiliary neoplasms with mucin-producing epithelium—mucinous cystic neoplasm of the liver (MCN) and intraductal papillary neoplasm of the bile duct (IPNB)—are rare and distinct entities that have unique clinical, pathologic, and imaging features. They are differentiated pathologically by the presence of subepithelial ovarian-like hypercellular stroma (OLS), which is the defining histopathologic feature of MCN. MCN is commonly a benign, large, solitary, symptomatic, multiloculated cystic mass without biliary communication that occurs in middle-aged women. On the other hand, IPNBs are a heterogeneous spectrum of tumors, which are commonly associated with invasive carcinoma, occur in older patients, and can be differentiated from MCN by communication with the biliary tree, intraductal masses, associated biliary ductal dilatation, and absent OLS. Understanding of these rare neoplasms has grown and evolved over time and continues to today, but uncertainty and controversy persist, related to the rarity of these tumors, relatively recent designation as separate entities, inherent clinicopathologic heterogeneity, overlapping imaging features, and the fact that many prior studies likely included MCN and cystic IPNB together as a single entity. Confusion regarding these neoplasms is evident by historical inconsistencies and nonstandardized nomenclature through the years. Awareness of these entities is important for the interpreting radiologist to suggest a particular diagnosis or generate a meaningful differential diagnosis in the appropriate setting, and is of particular significance as MCN and cystic IPNB have overlapping imaging features with other more common hepatobiliary cystic masses but have different management and prognosis.

Online supplemental material is available for this article.

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## SA-CME LEARNING OBJECTIVES

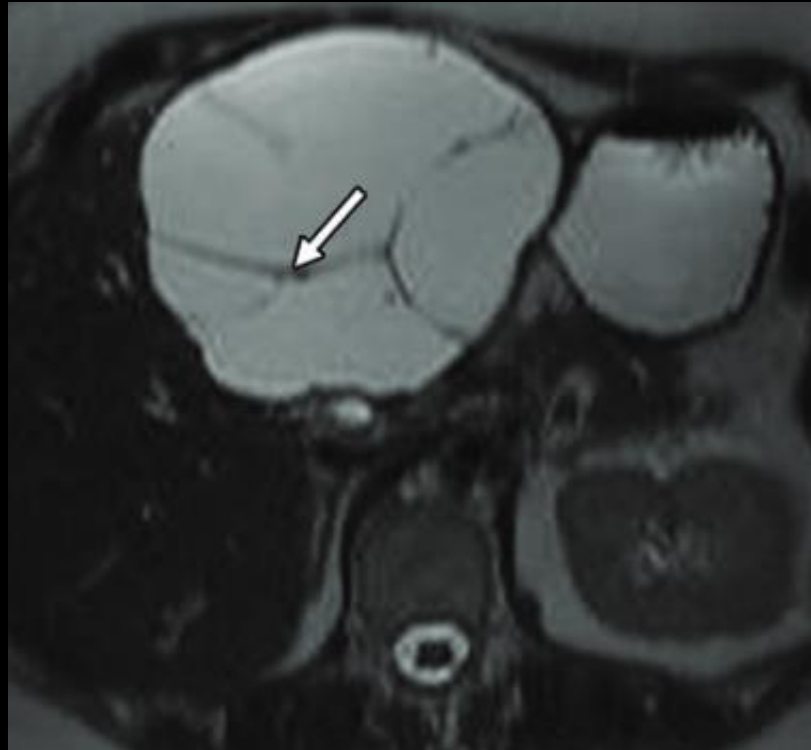
After completing this journal-based SA-CME activity, participants will be able to:

- Identify the distinguishing clinical and pathologic features of MCN and IPNB.
- Describe the characteristic imaging features of MCN and IPNB and how to differentiate these entities from other hepatobiliary cystic masses.
- Recognize differences in workup, management, and prognosis of MCN and IPNB.

See [rsna.org/learning-center-rg](http://rsna.org/learning-center-rg).

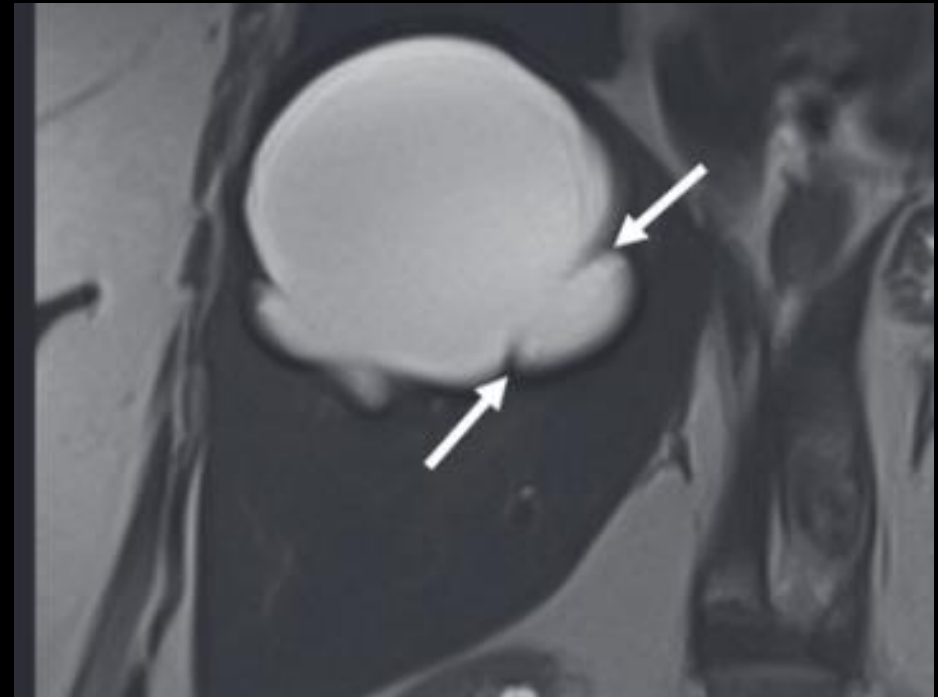


## Mucinous cystic neoplasm



Smooth border

## Benign septated cyst

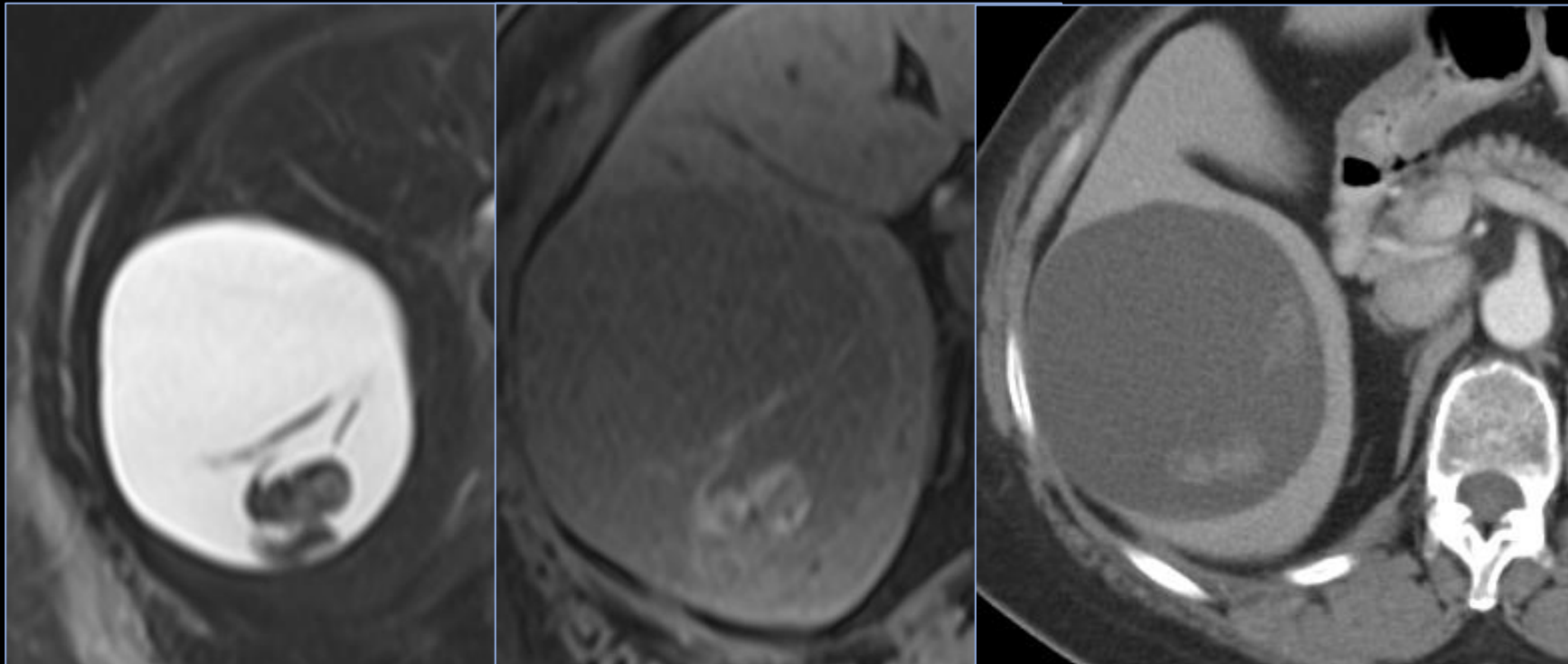


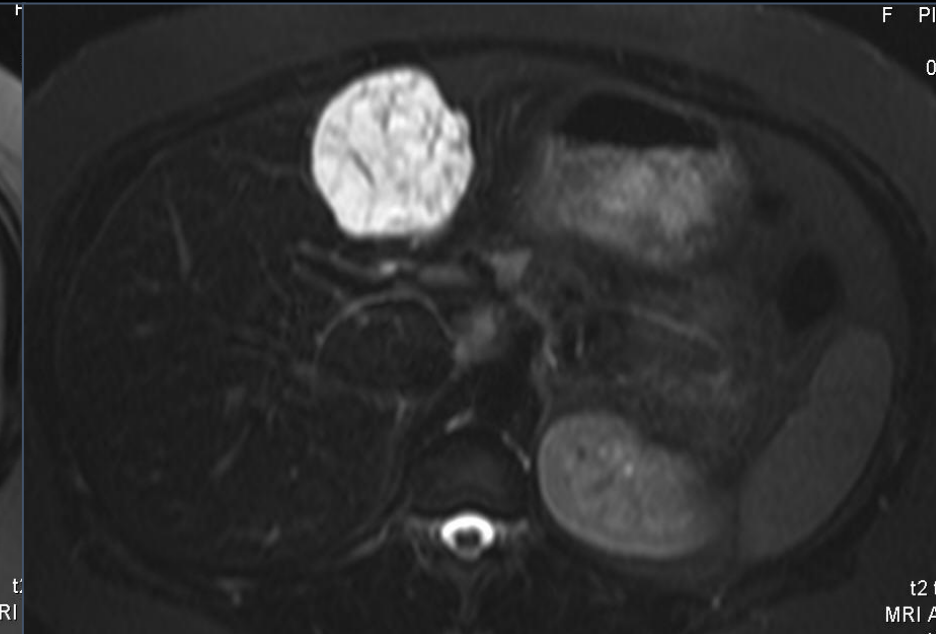
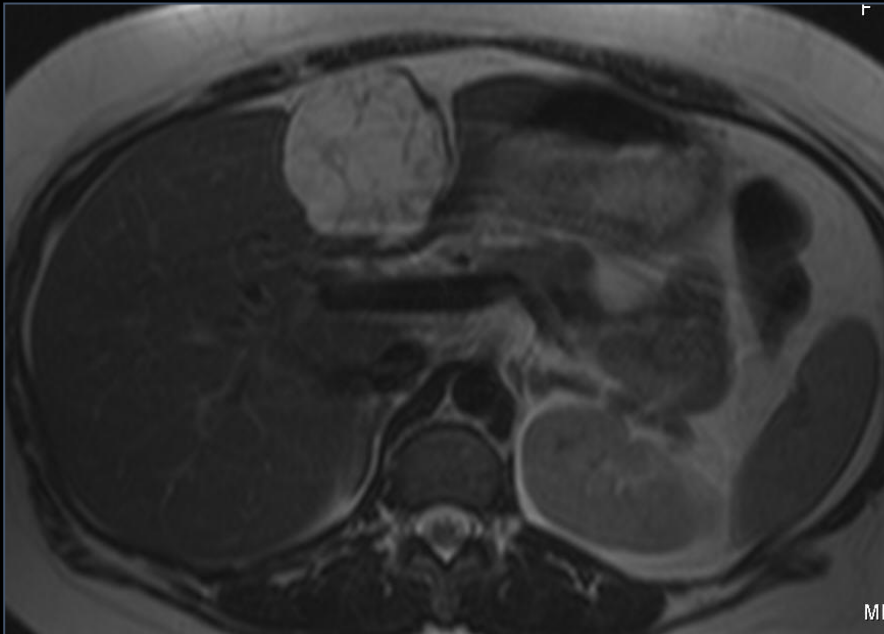
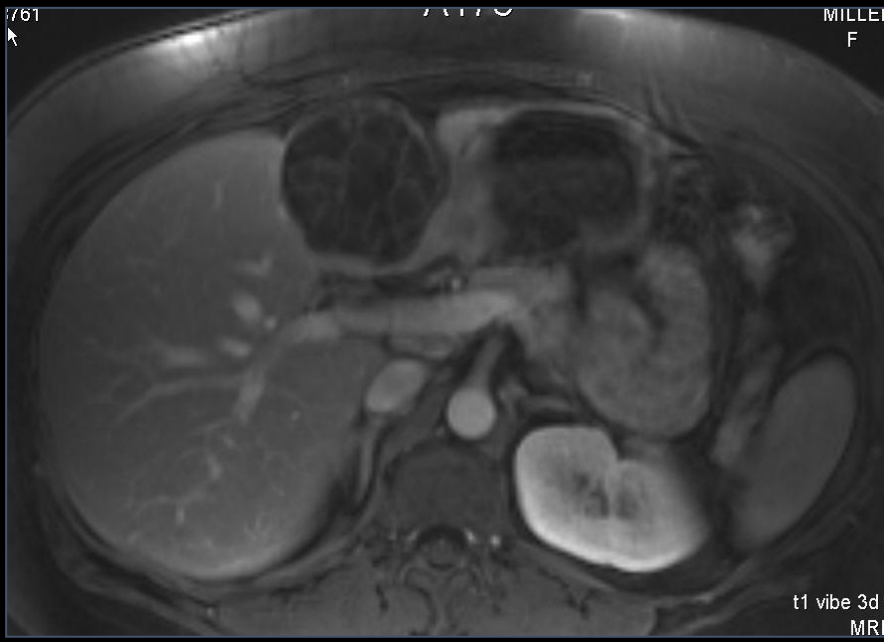
lobulated border, septations arise from lobulations



# Biliary Mucinous Cystic Neoplasm

- Cystic lesion with internal septations, mural nodules, calcifications





DDX: echinococcal cyst,  
abscess, prior hemorrhage,  
ciliated hepatic foregut  
duplication cyst, complex  
hepatic cysts

# Features concerning for malignancy



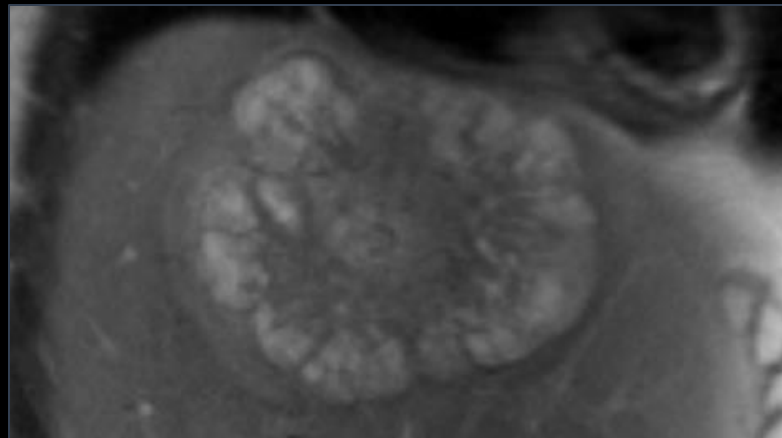
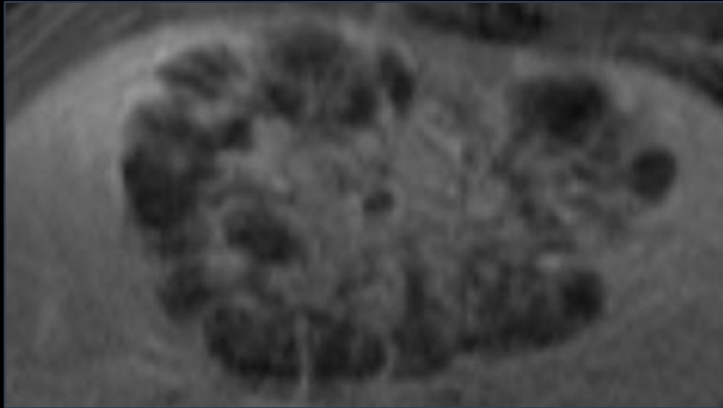
- Solid mural nodules
- Wall enhancement
- Calcifications
- Invasion of liver parenchyma

# Liver Infections

- Pyogenic or amebic abscess
- Echinococcal
- Schistosomiasis
- Candidiasis

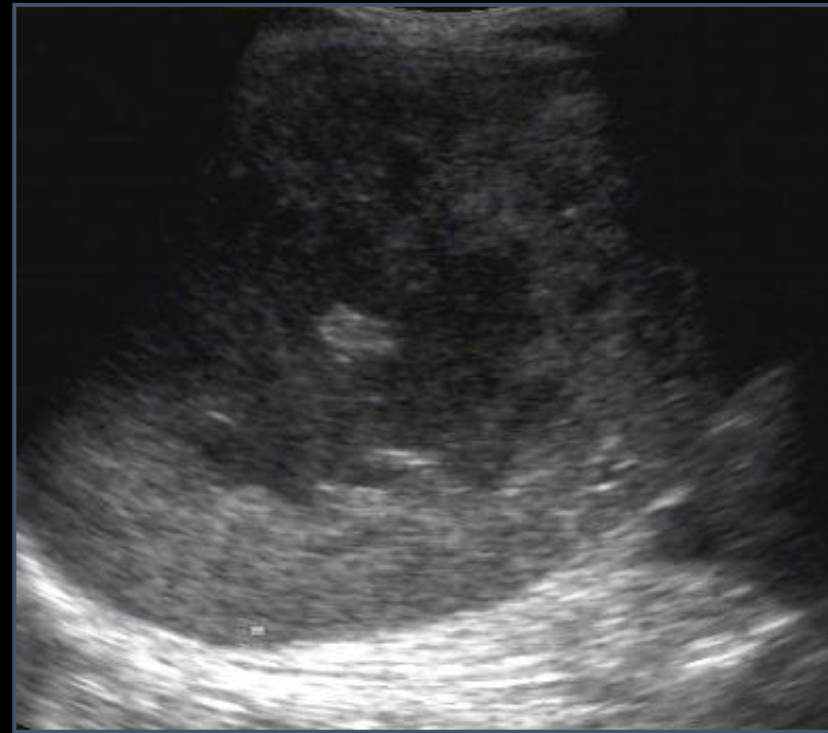
# Pyogenic Abscess

- Clinical setting-
  - Fevers, chills, WBC, instrumentation
  - May be apathetic in elderly
  - Variable imaging appearance depending on time course

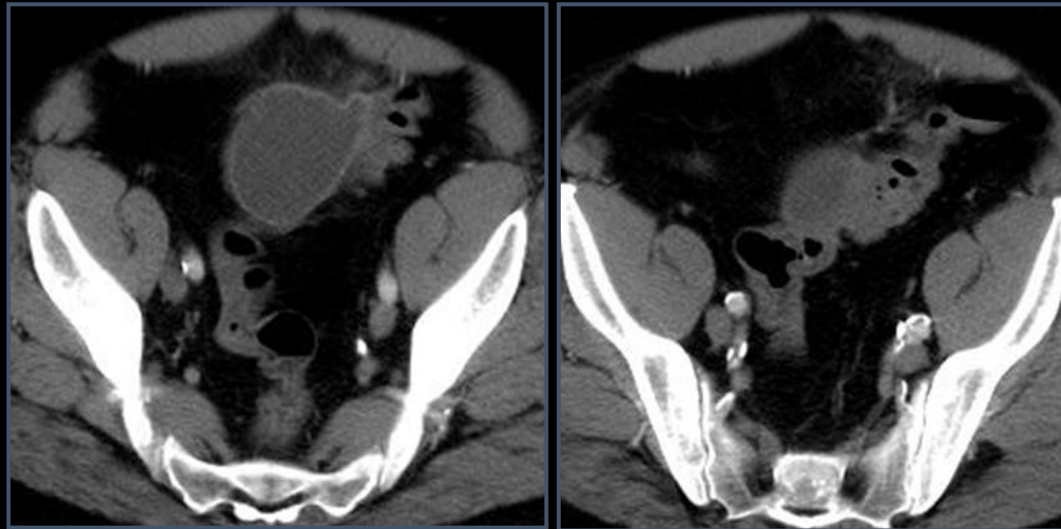
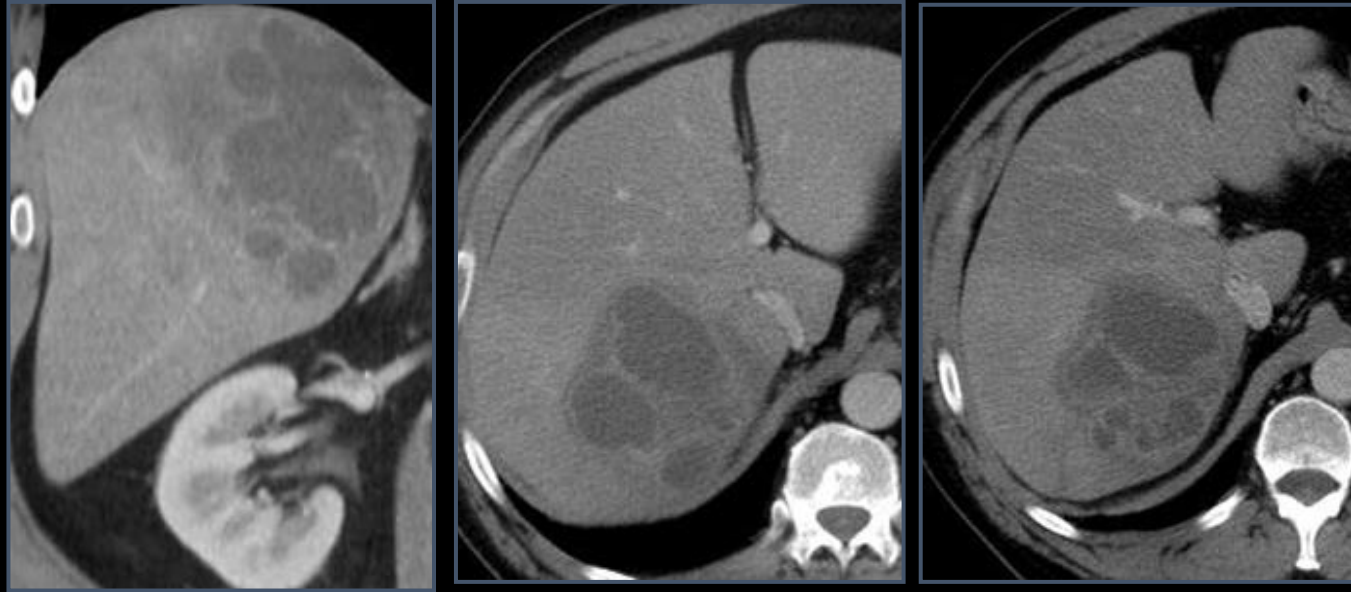


# Pyogenic Abscess

- US-hypoechoic, internal echoes/debris



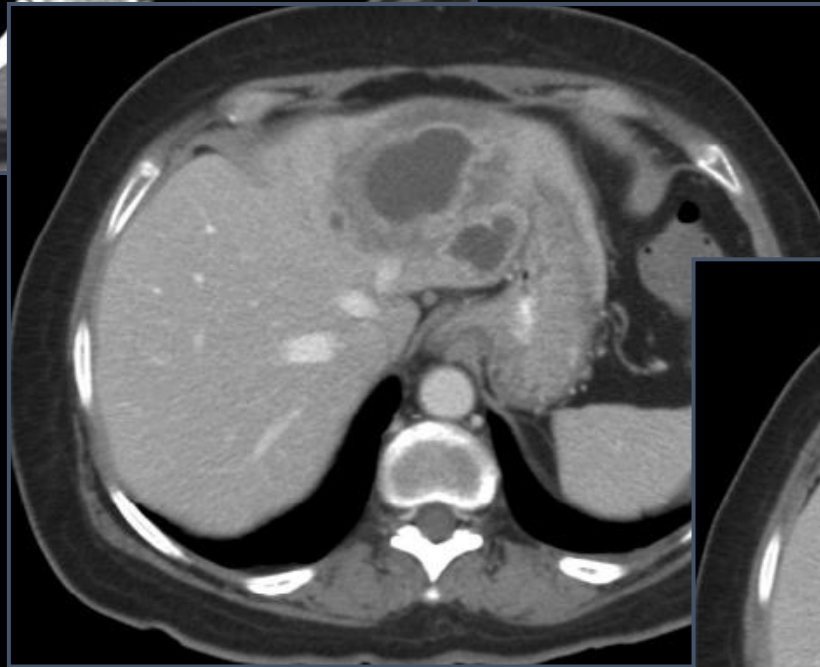
# Pyogenic abscess





# Amebic abscess

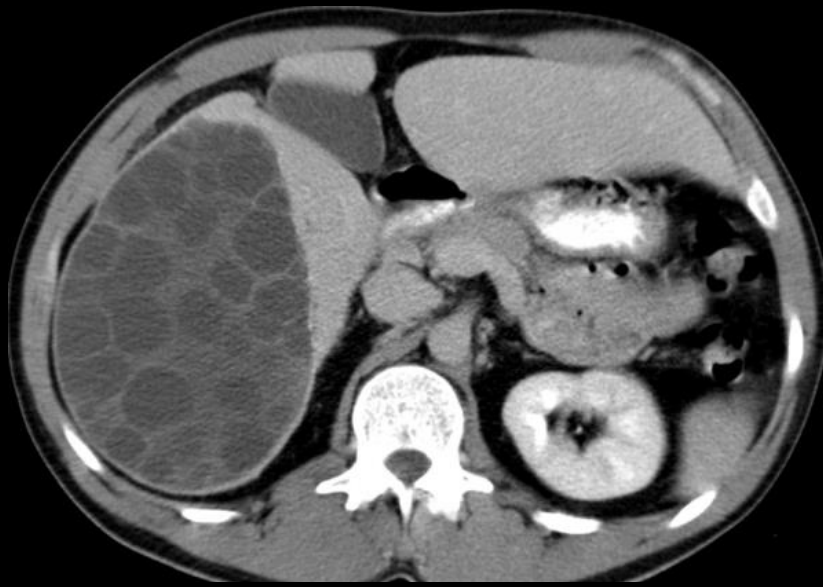
Fever, hepatomegaly,  
tropical travel



# Echinococcus

- Travel history-Africa, Asia, S/Central America
- Ingestion of infected food or water
- Often asymptomatic
- Fever, RUQ pain
- Rupture-can lead to anaphylaxis, dissemination

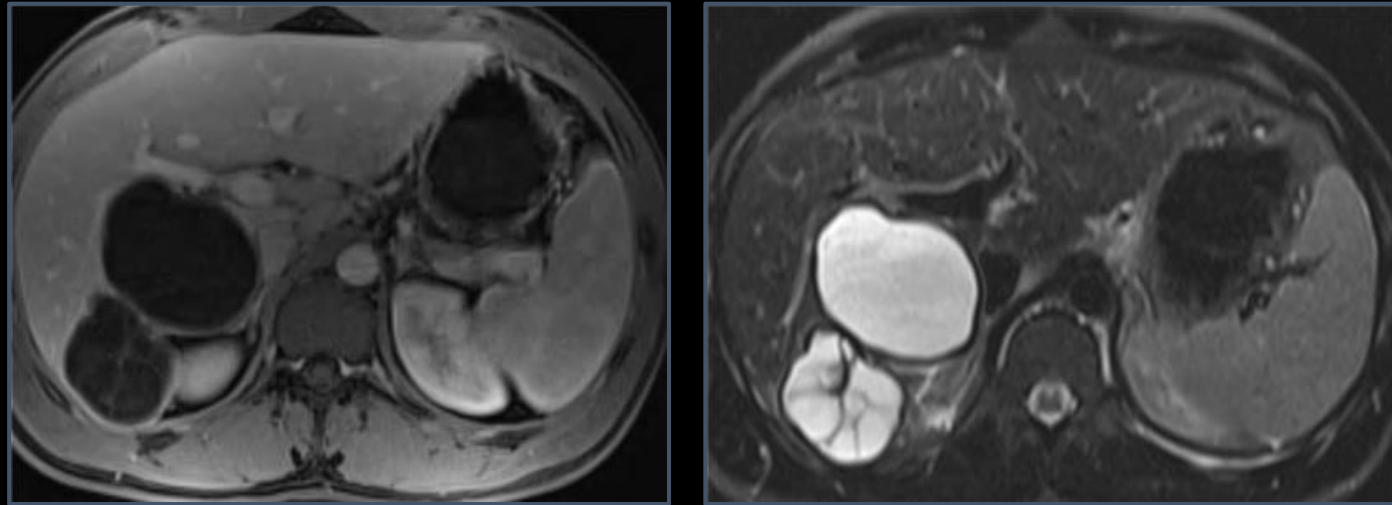




*Right lobe is the most common site for hydatid cyst development.*

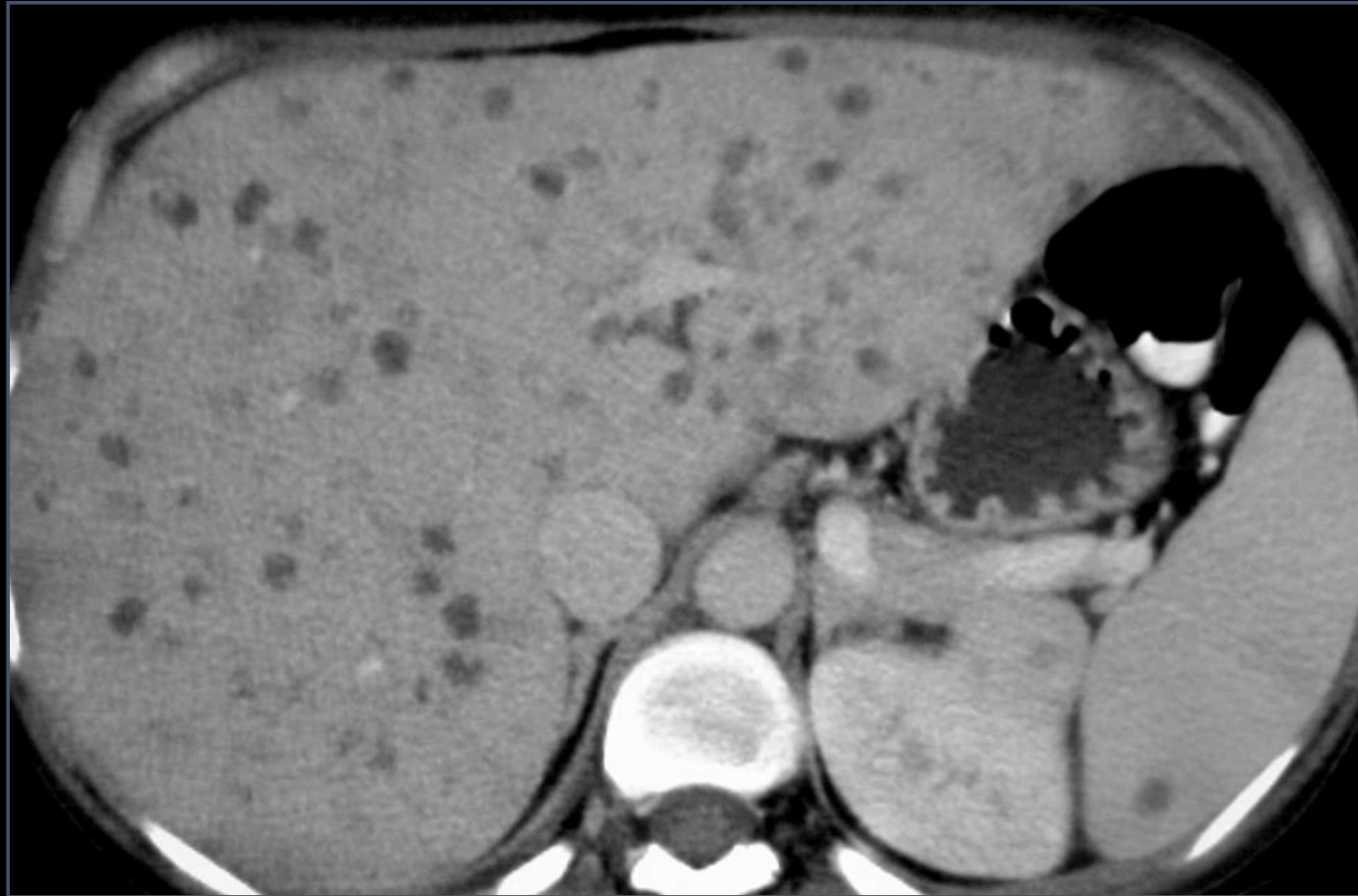


# Echinococcus





# Disseminated Candidiasis

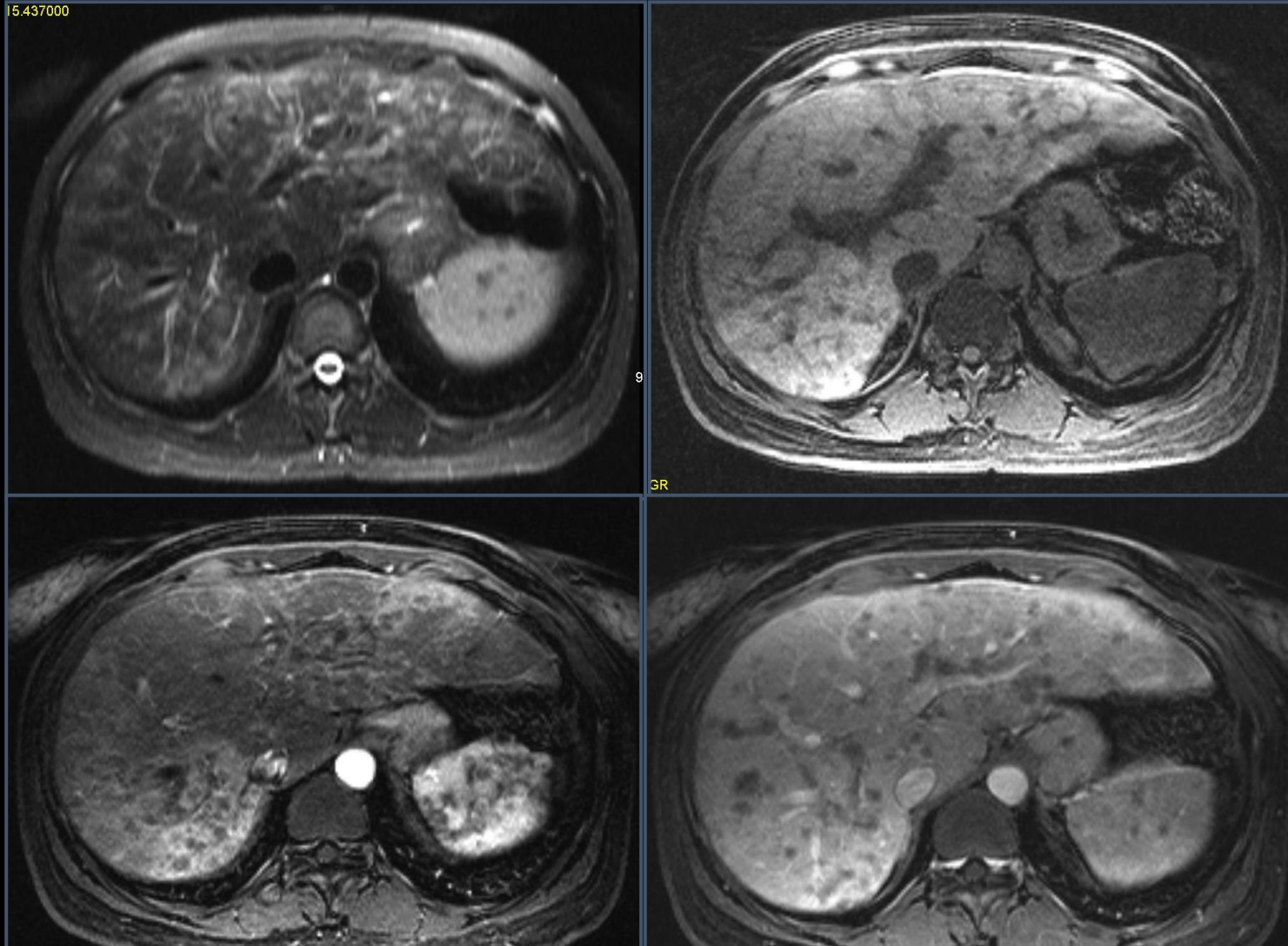


# Miliary TB



Immunocompromised, HIV, fever, lung involvement

# Disseminated Histoplasmosis

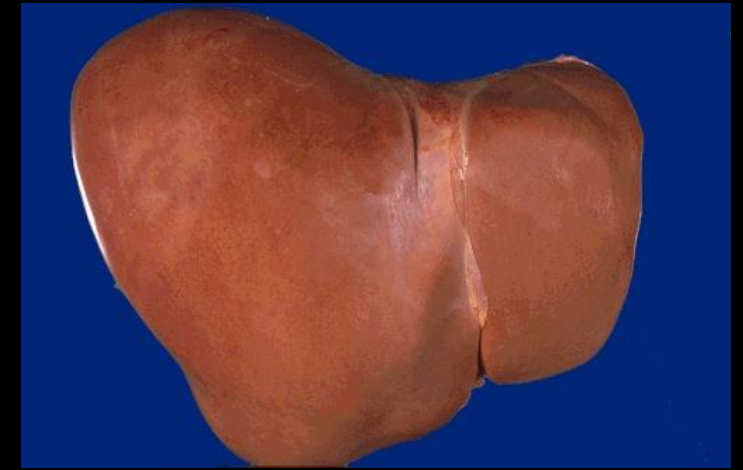


Immunocompromised, fever, elevated liver enzymes



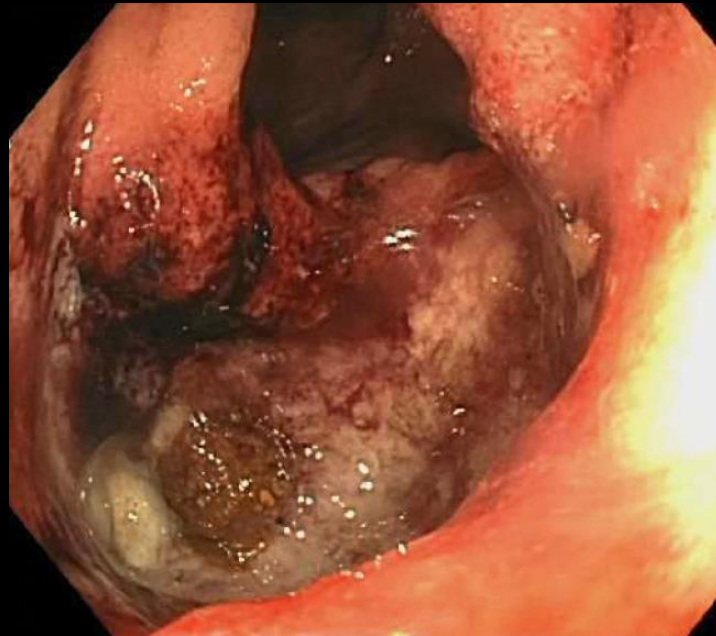
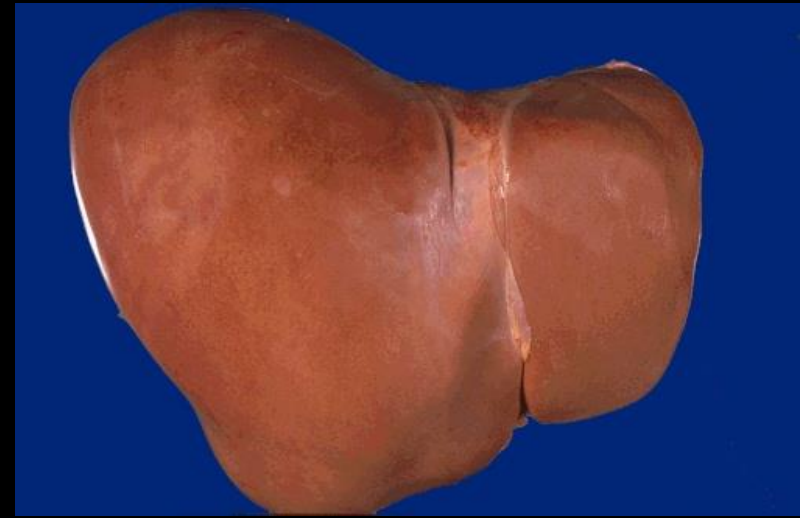
# No known risk factors

- Differential considerations favor benign
  - Lesions with classic imaging features can be definitively diagnosed
    - Hemangiomas
    - Cysts
    - FNH
  - Lesions that are probably benign
    - Adenomas
    - Biliary cystadenomas
    - Infections



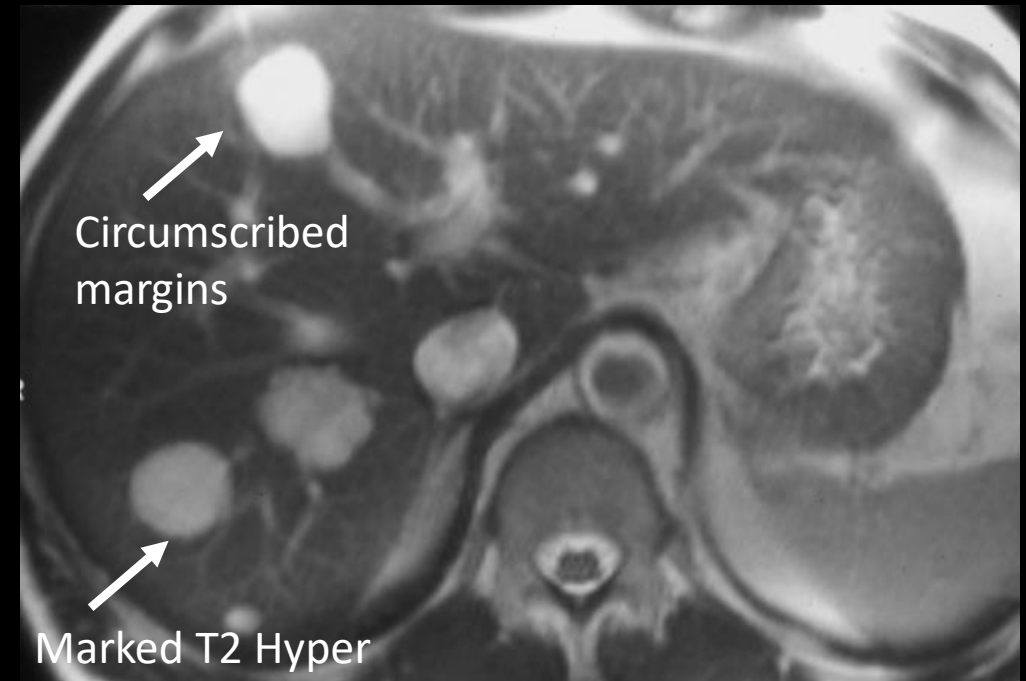
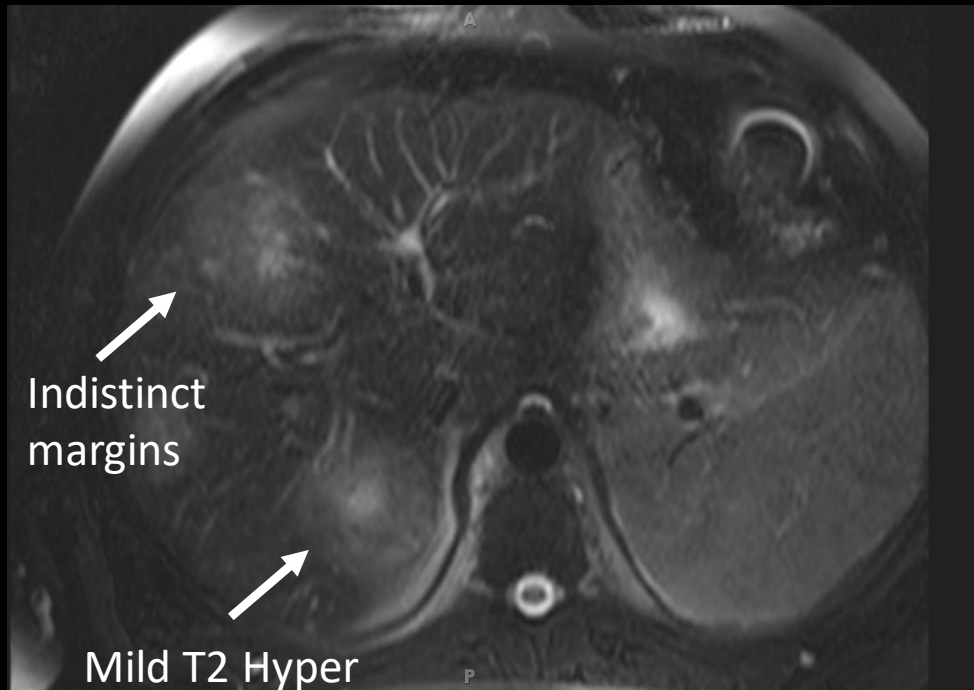
# Known risk factors!

- Primary extrahepatic cancer



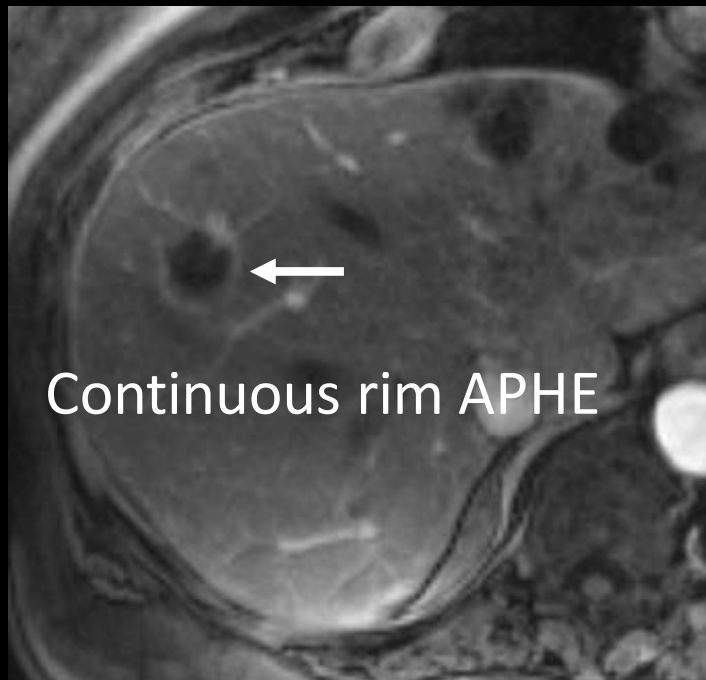
# Metastases

- Do NOT meet criteria for B9 entities
- Often multiple, history of primary malignancy



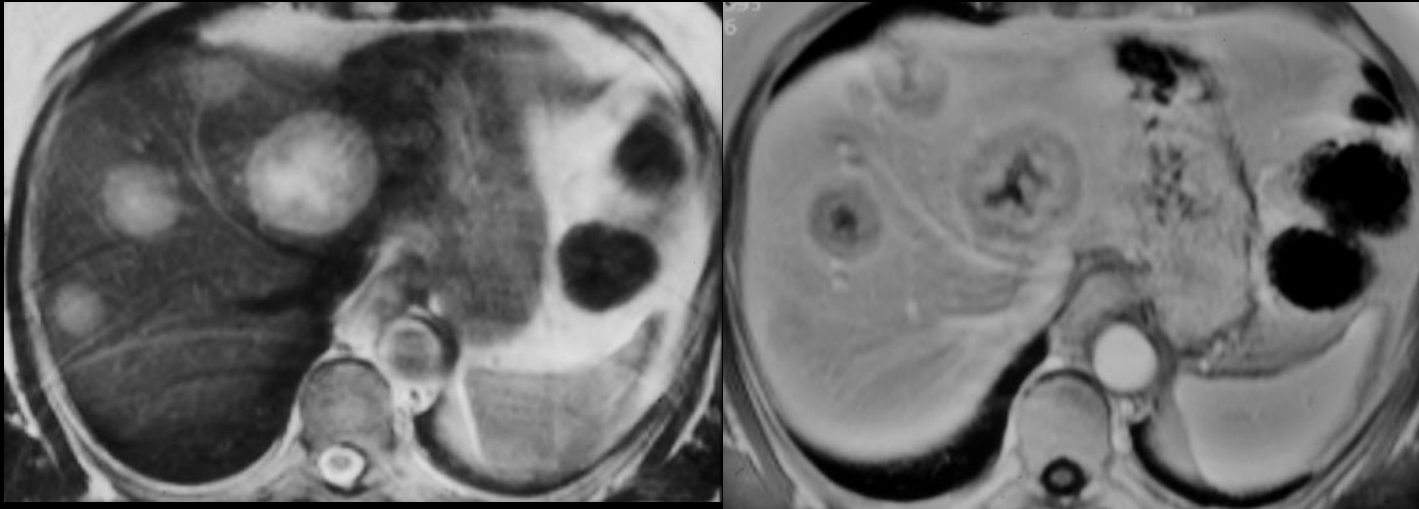
# Metastases

- Do NOT meet criteria for B9 entities

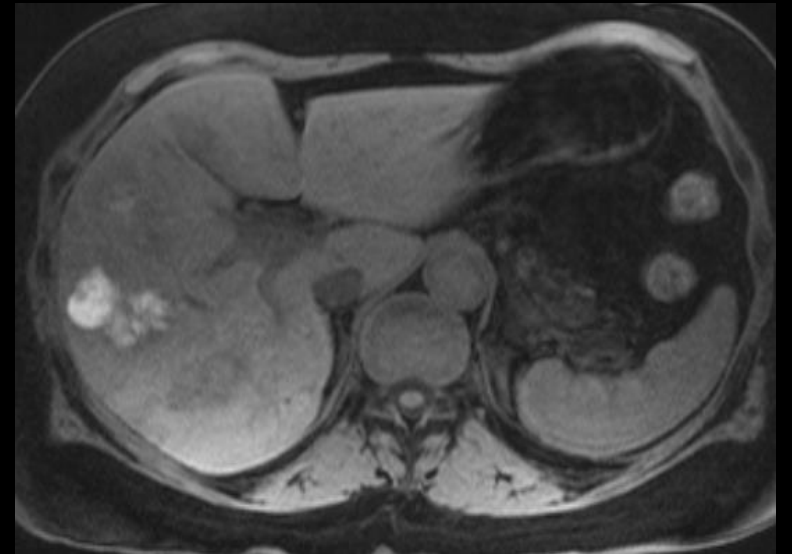


# Metastases

Targetoid



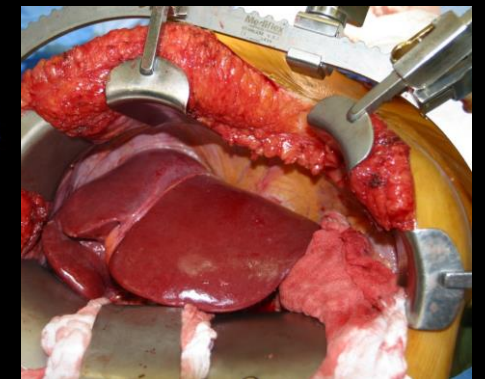
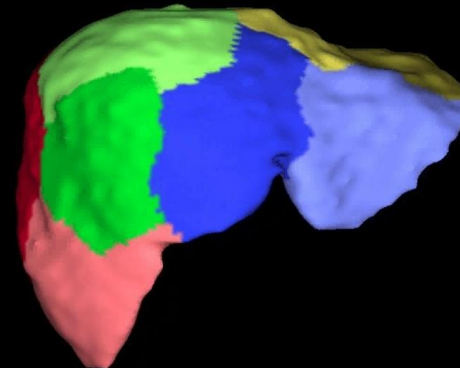
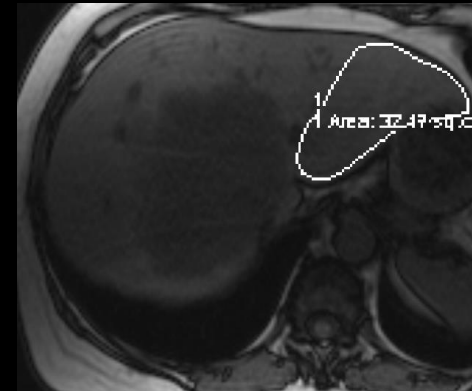
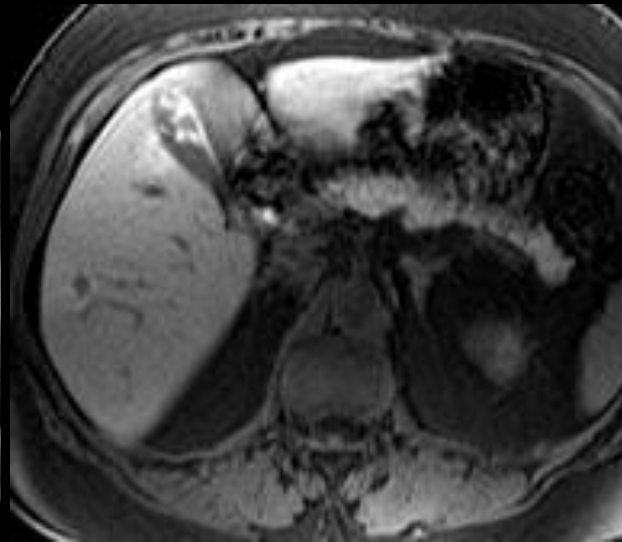
Melanoma

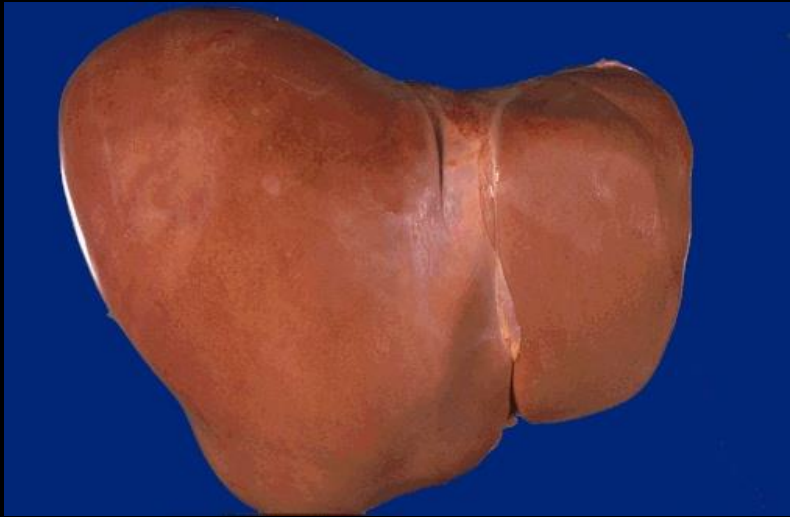




# Metastases

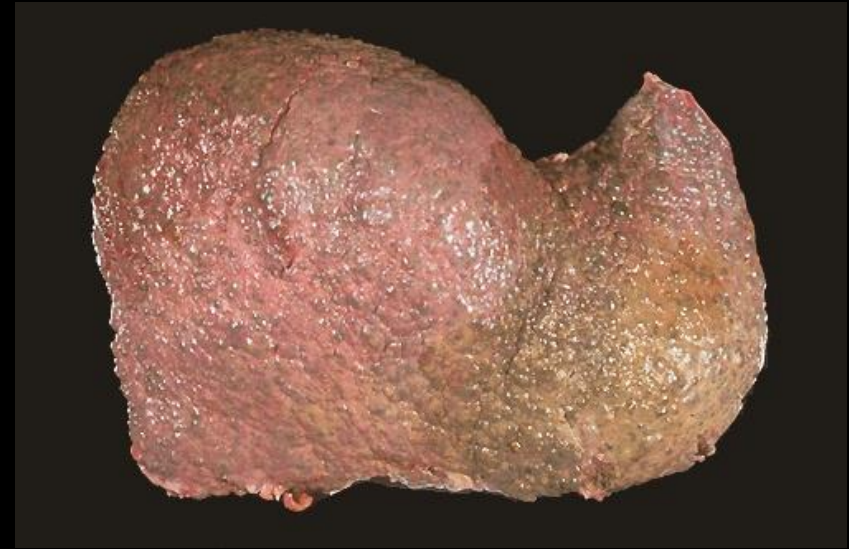
- Eovist and DWI MRI most sensitive for detection





Benign lesions!

Metastatic disease

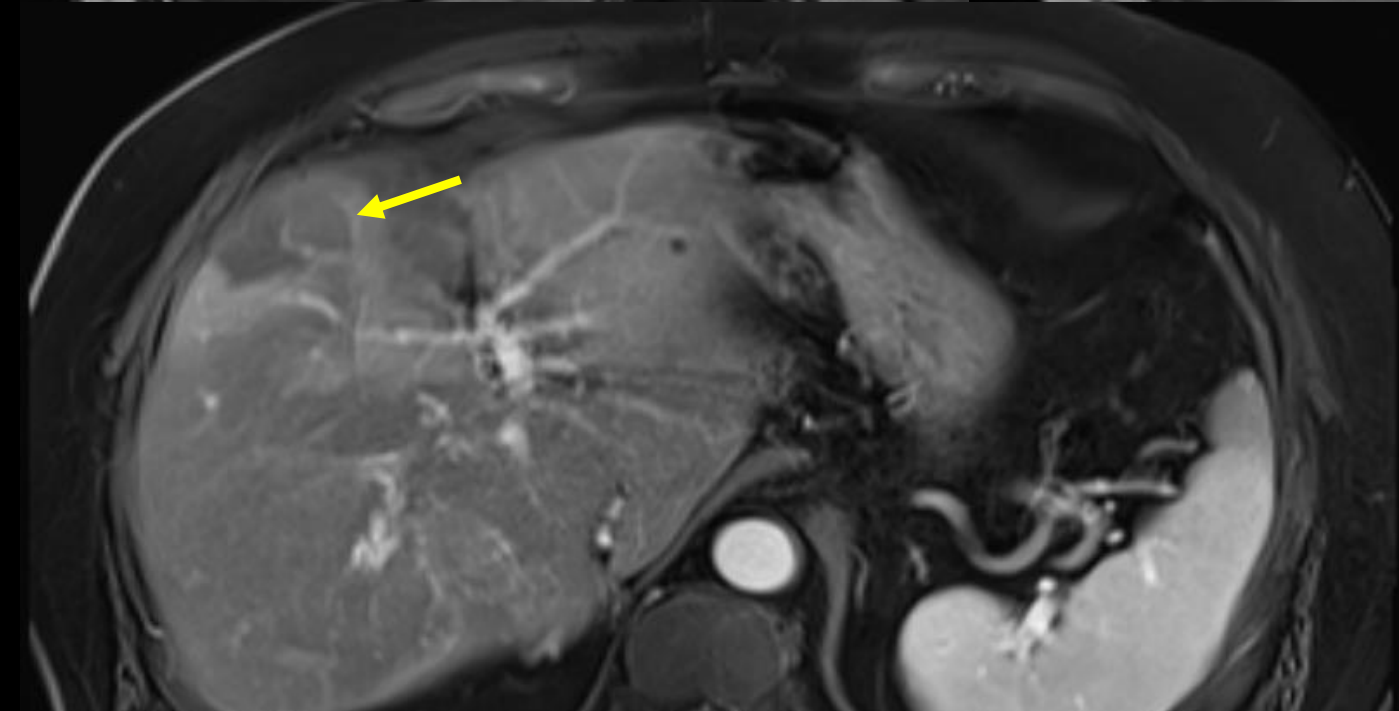
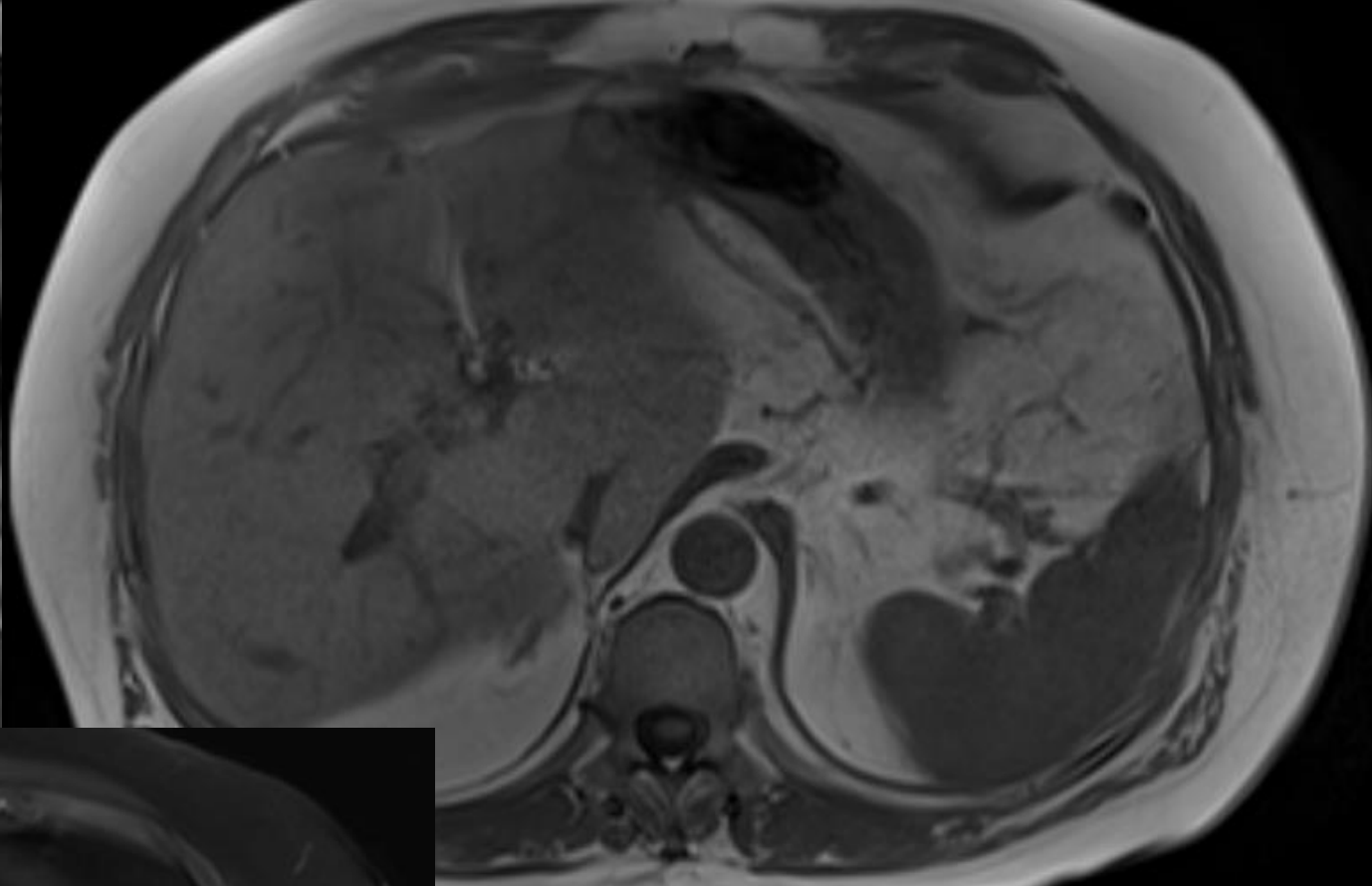
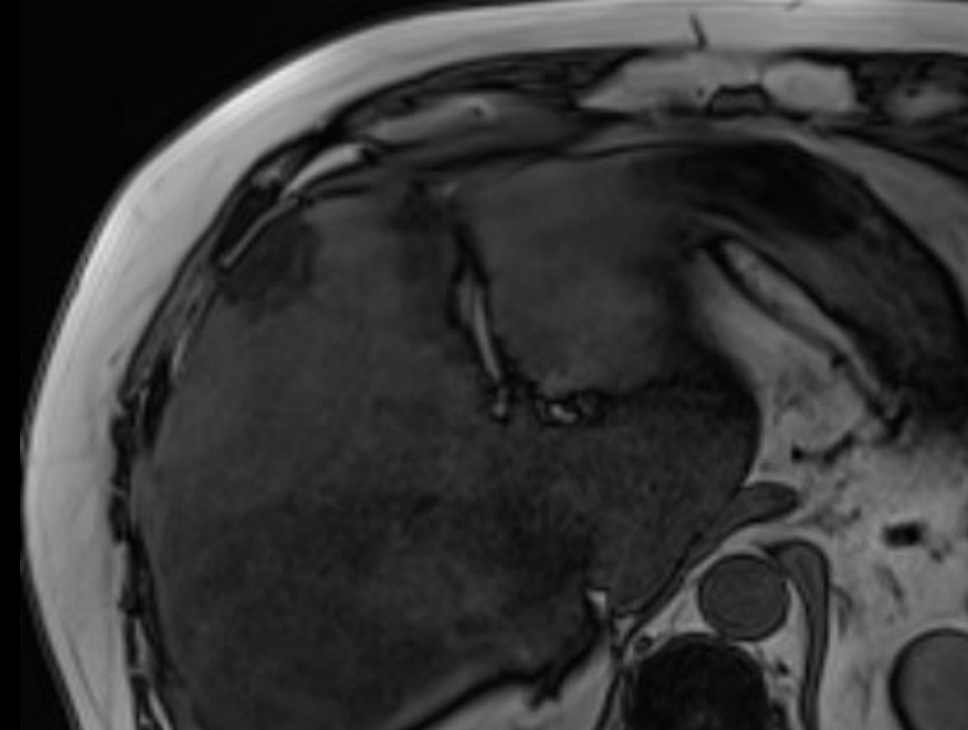


Cancer!  
-HCC, ICC

Metastatic disease-RARE

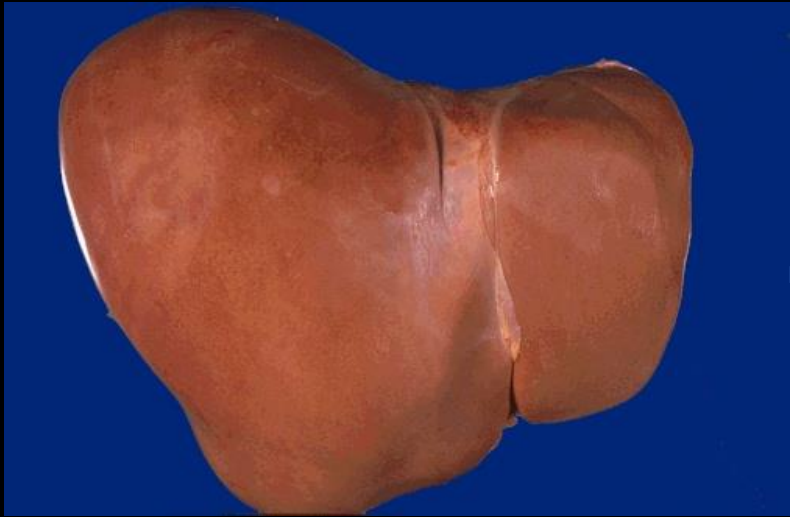


Let's review what we learned



Incidental lesion

NO Risk Factors



Probably B9 lesions  
Adenomas  
Biliary cystadenomas  
Abscess/Infections

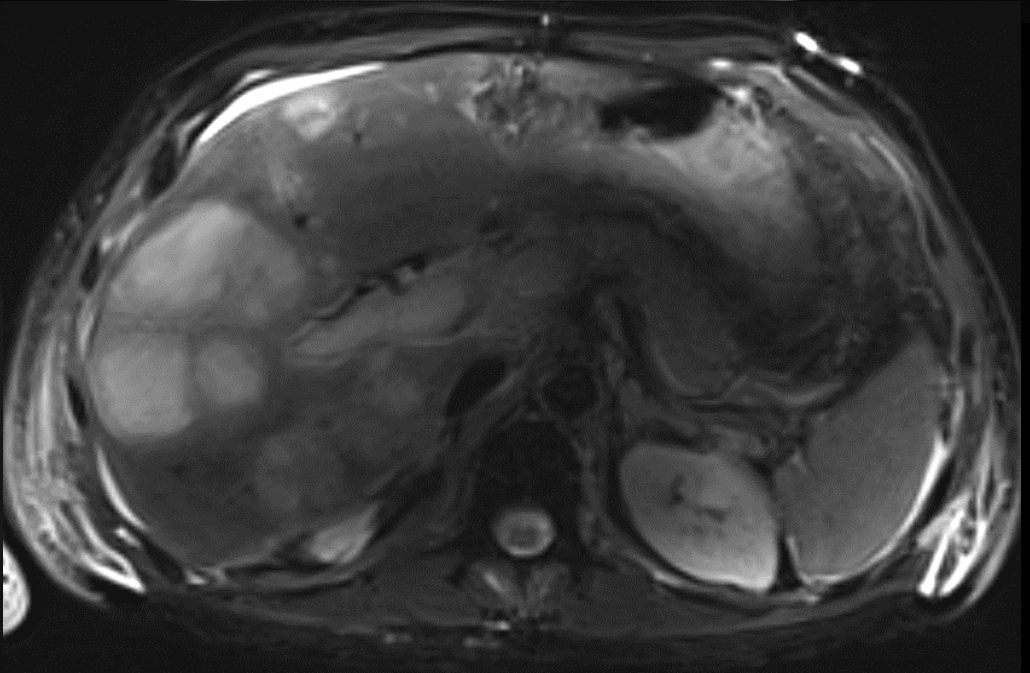
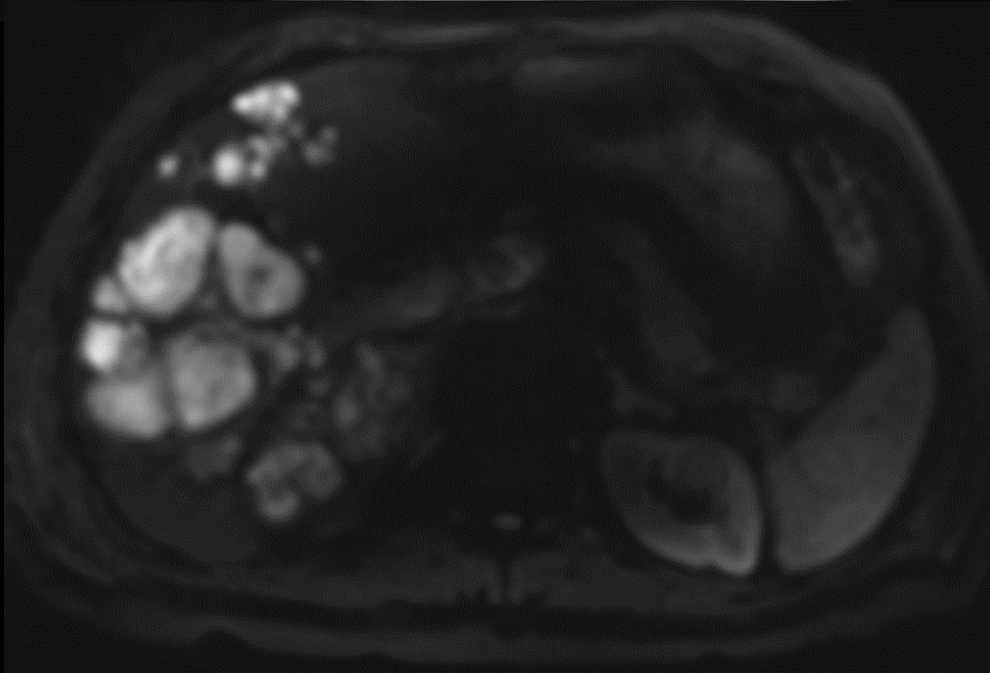
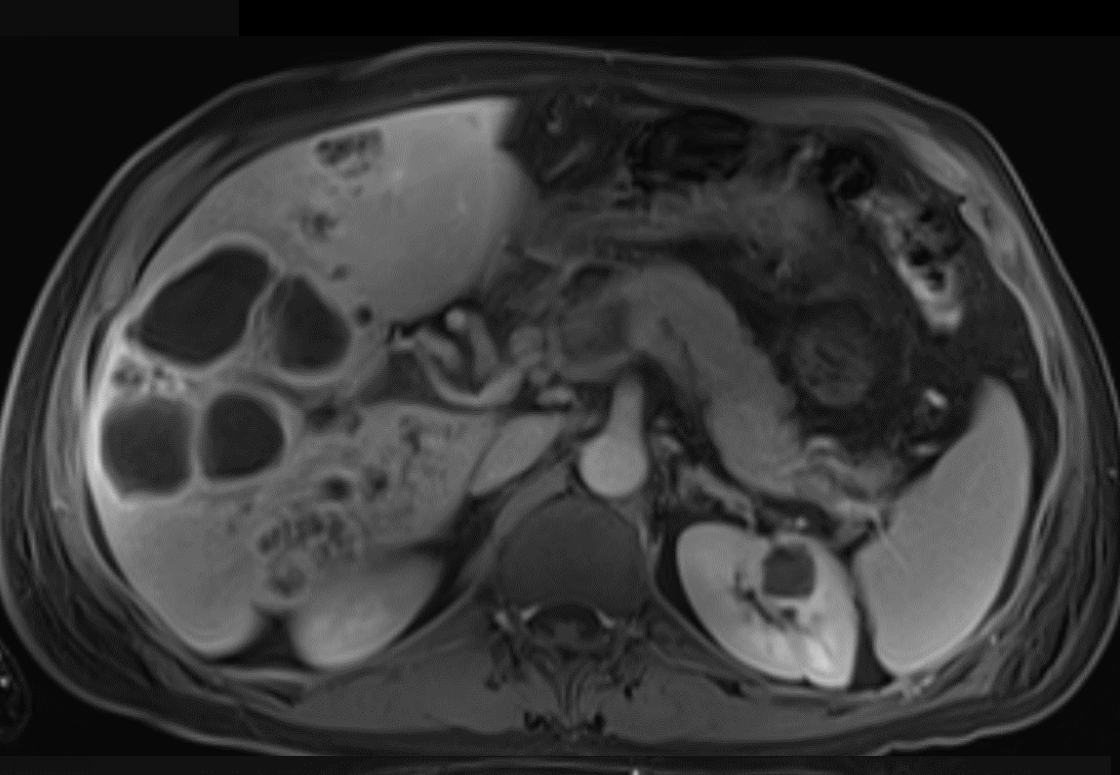
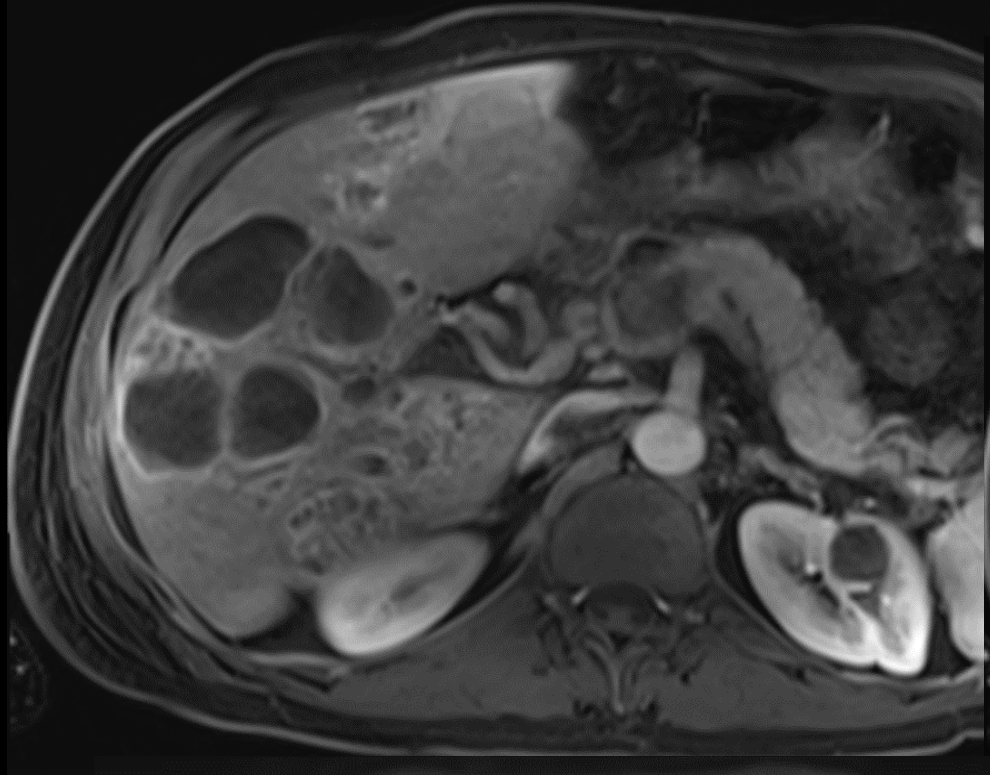
Classically B9 lesions

Cysts

Hemangiomas

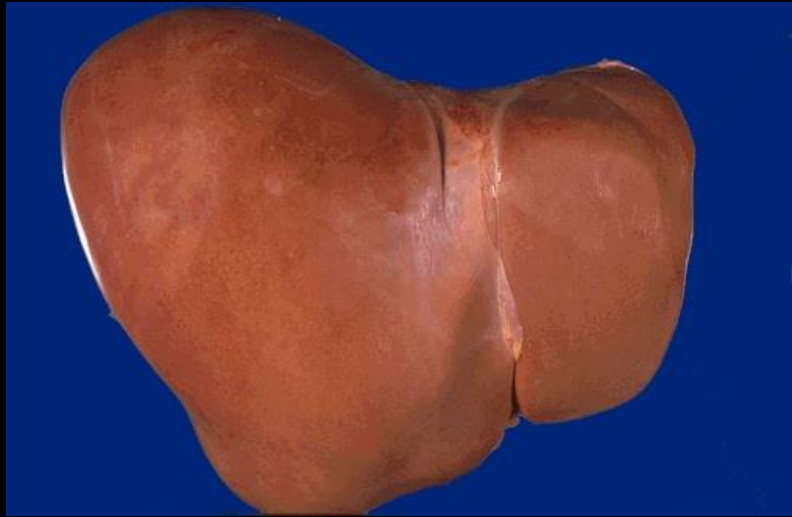
FNH

Focal Fat



Fevers and  
chills

NO Risk Factors



Probably B9 lesions

Adenomas

Biliary cystadenomas

Abscess/Infections



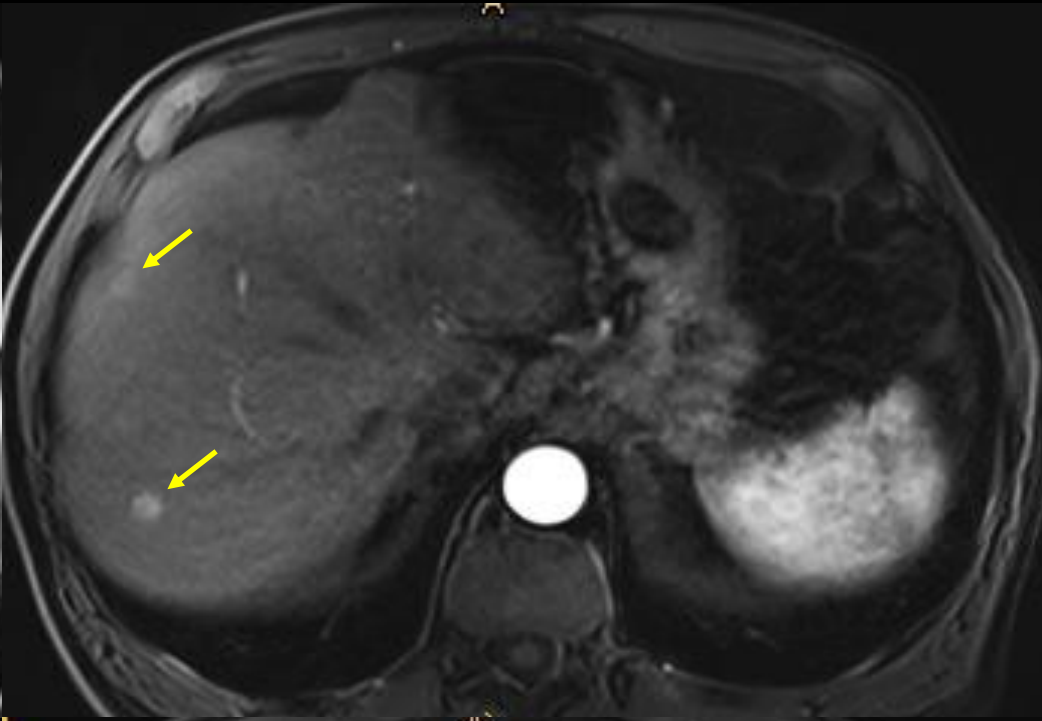
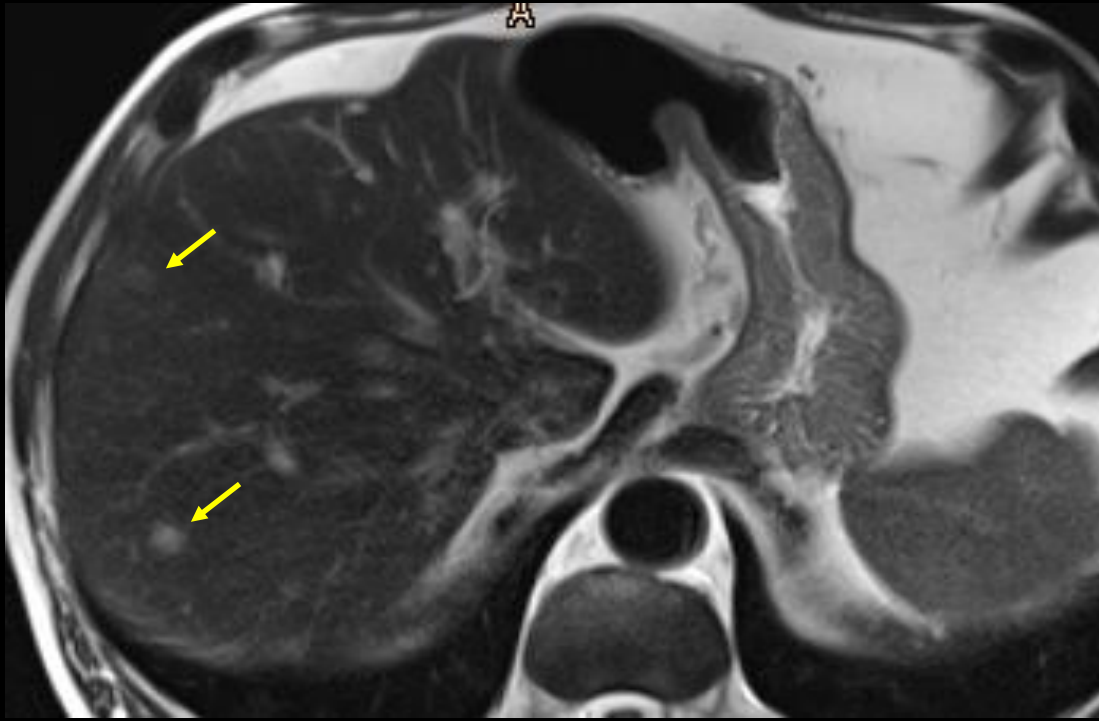
Classically B9 lesions

Cysts

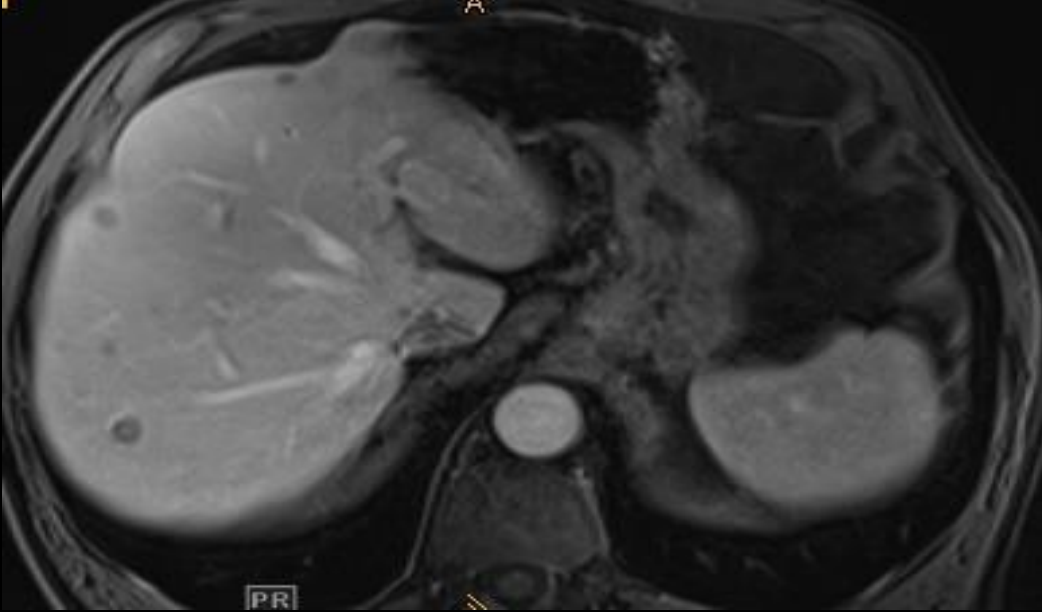
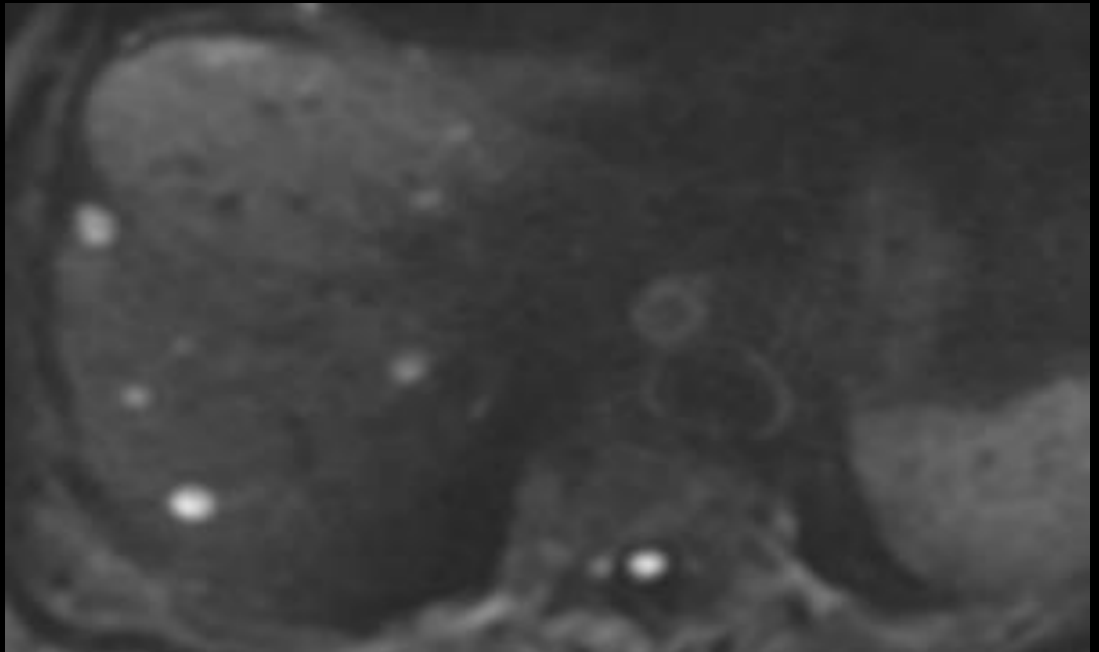
Hemangiomas

FNH





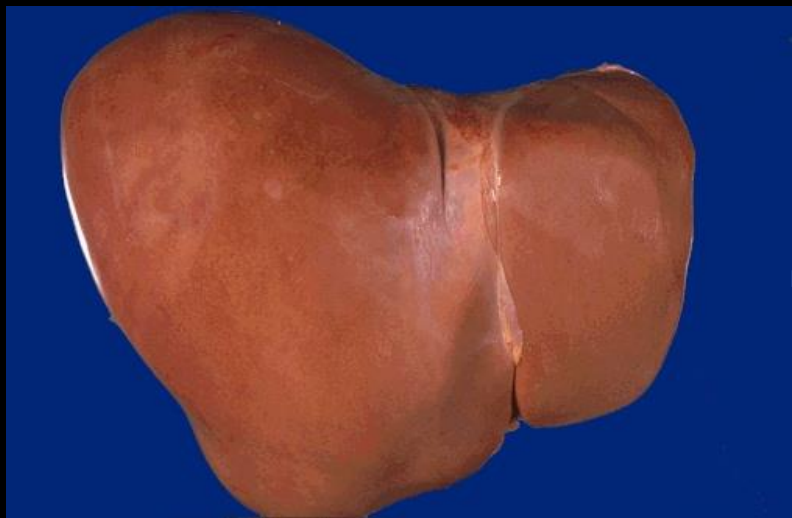
Diarrhea,  
flushing...



Incidental liver  
lesions



NO Risk Factors

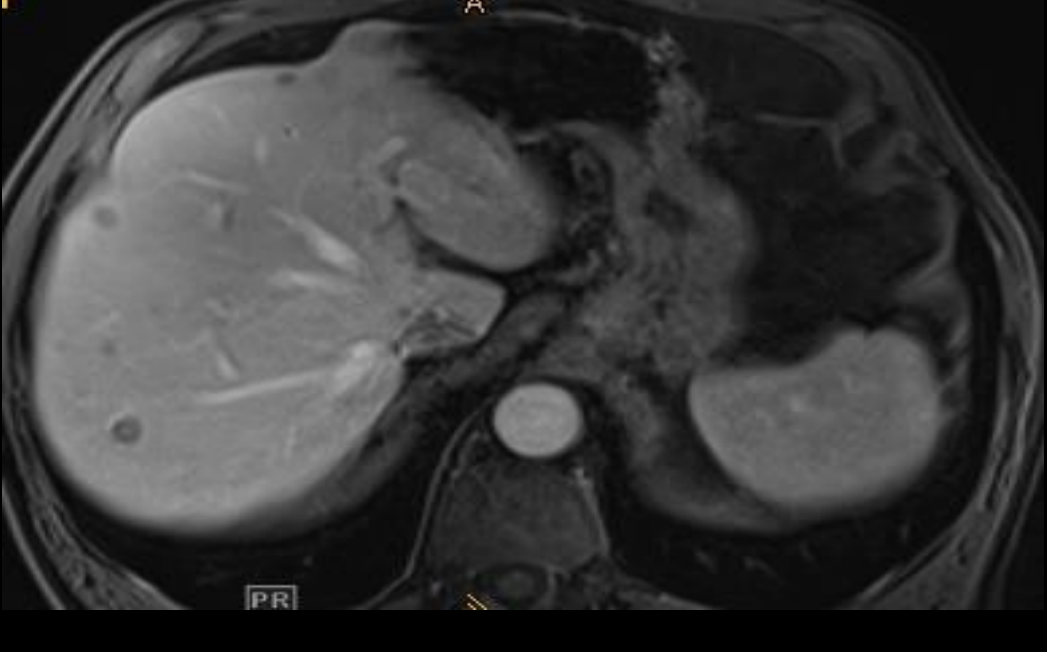
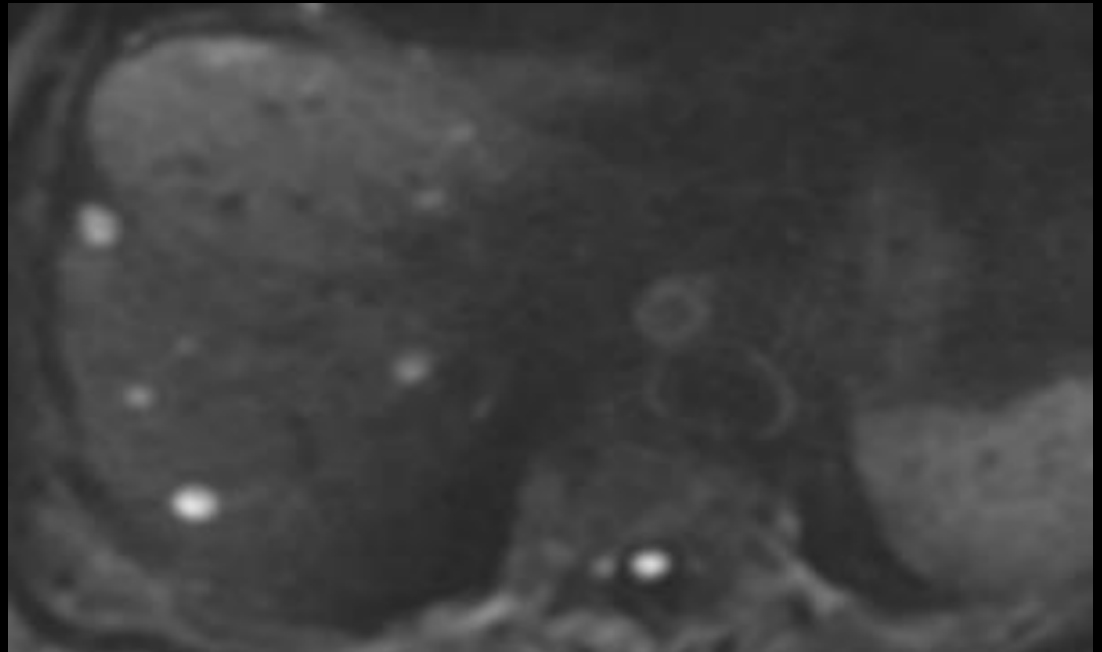
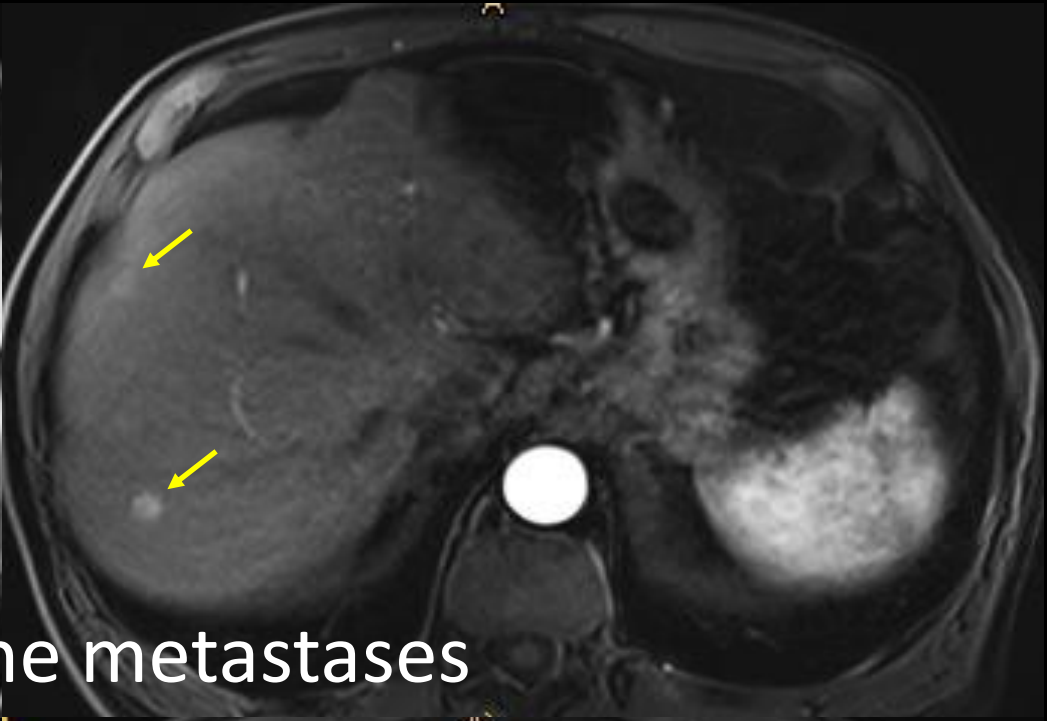
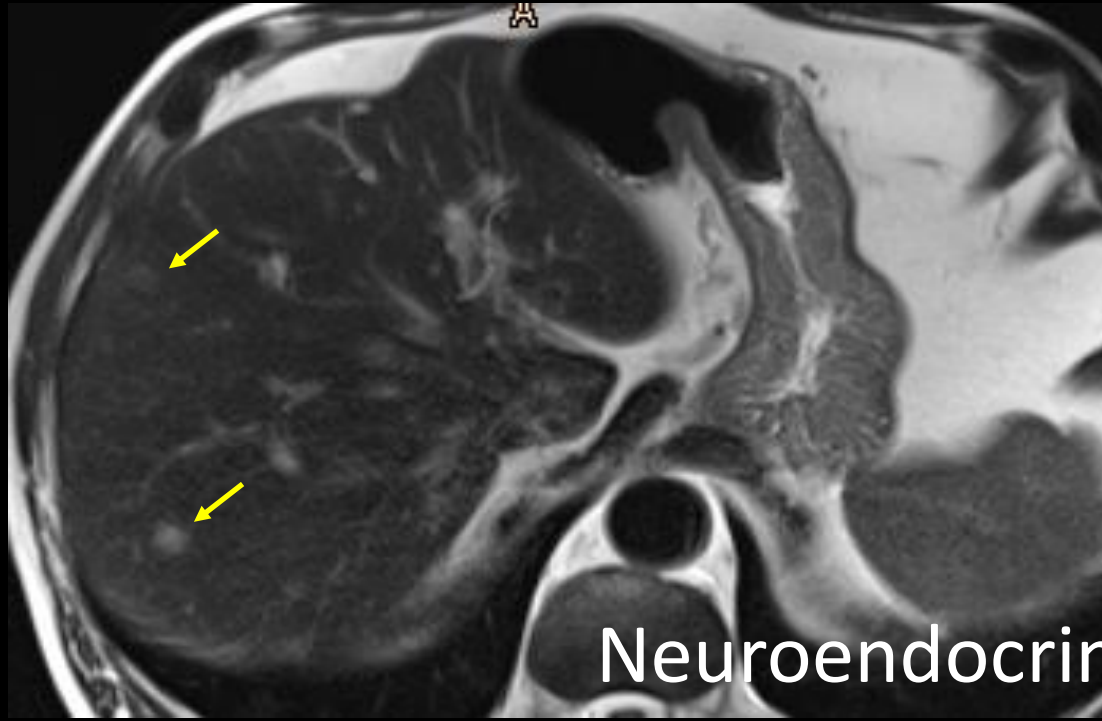


~~Probably B9 lesions  
Adenomas  
Biliary cystadenomas  
Abscess/Infections~~

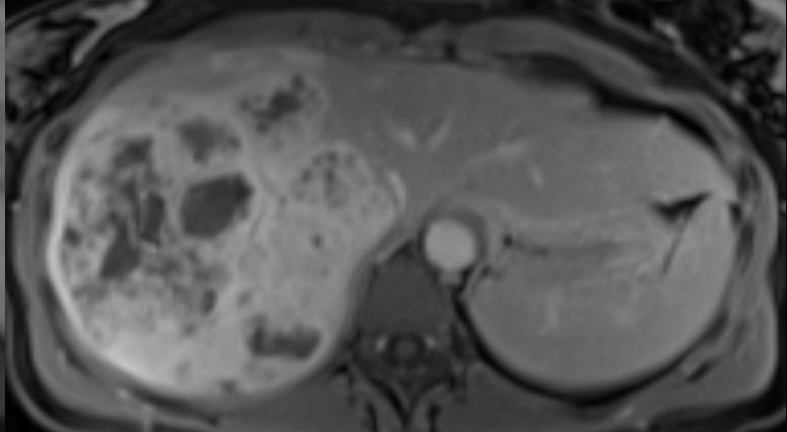
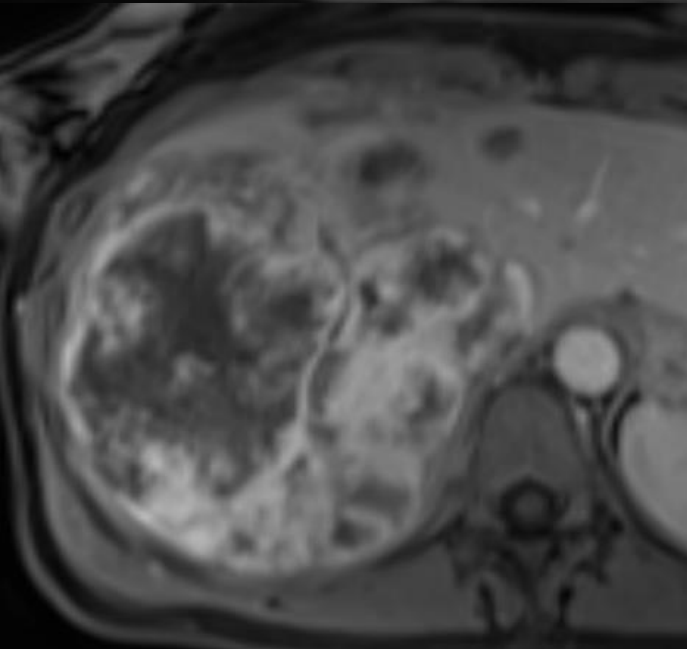
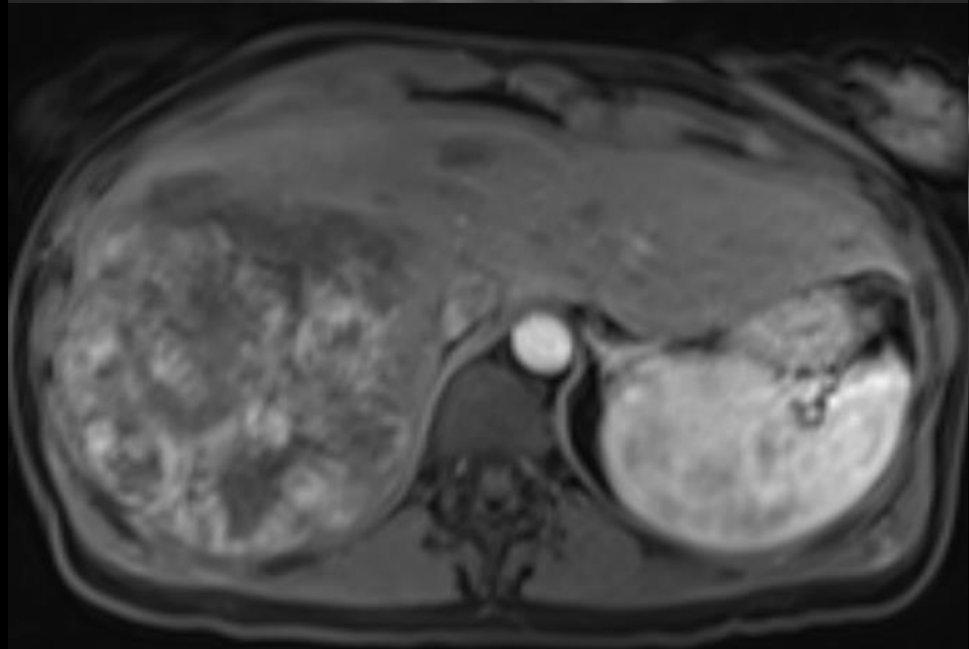
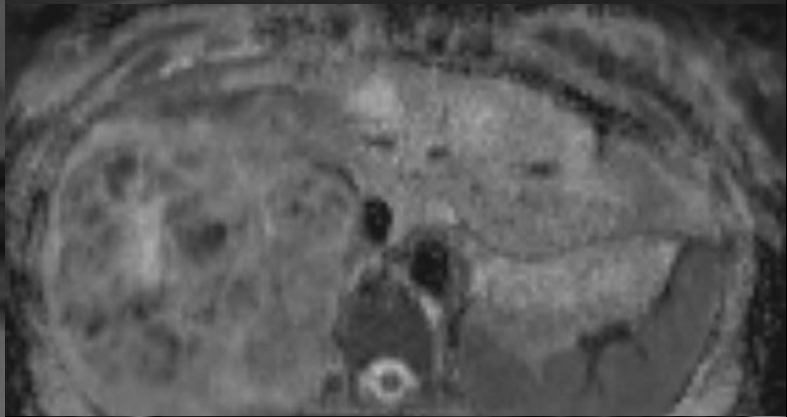
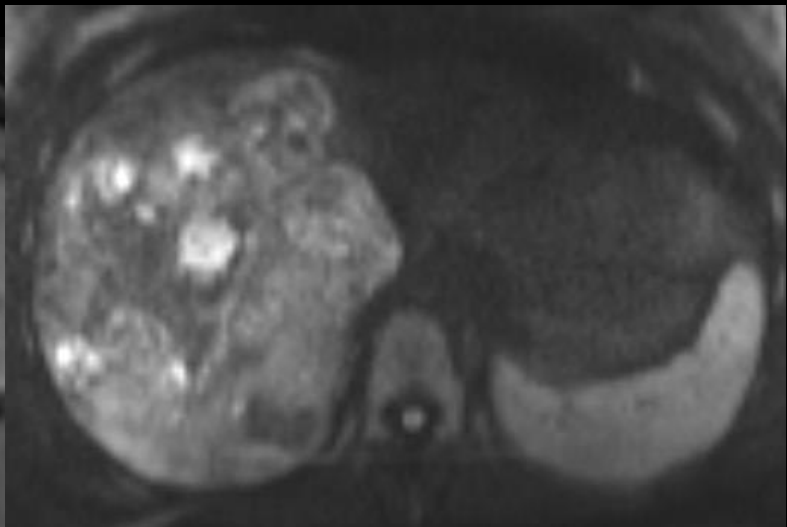
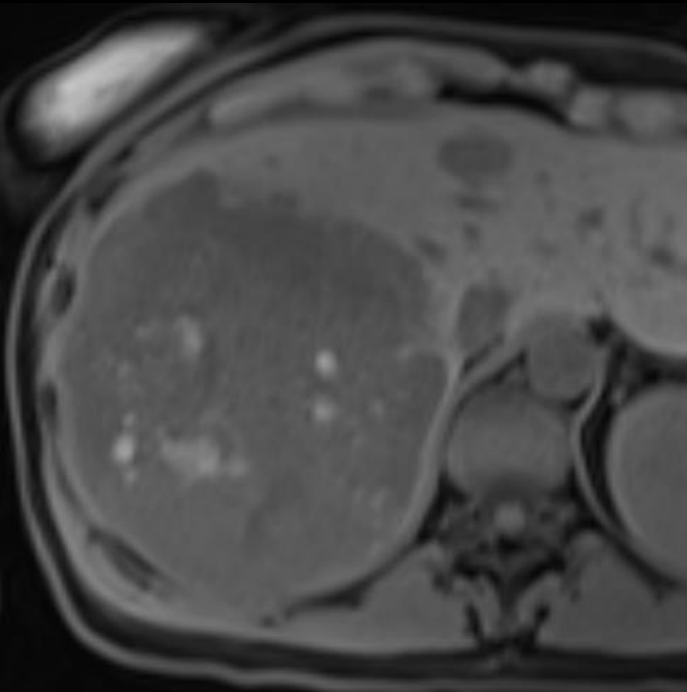
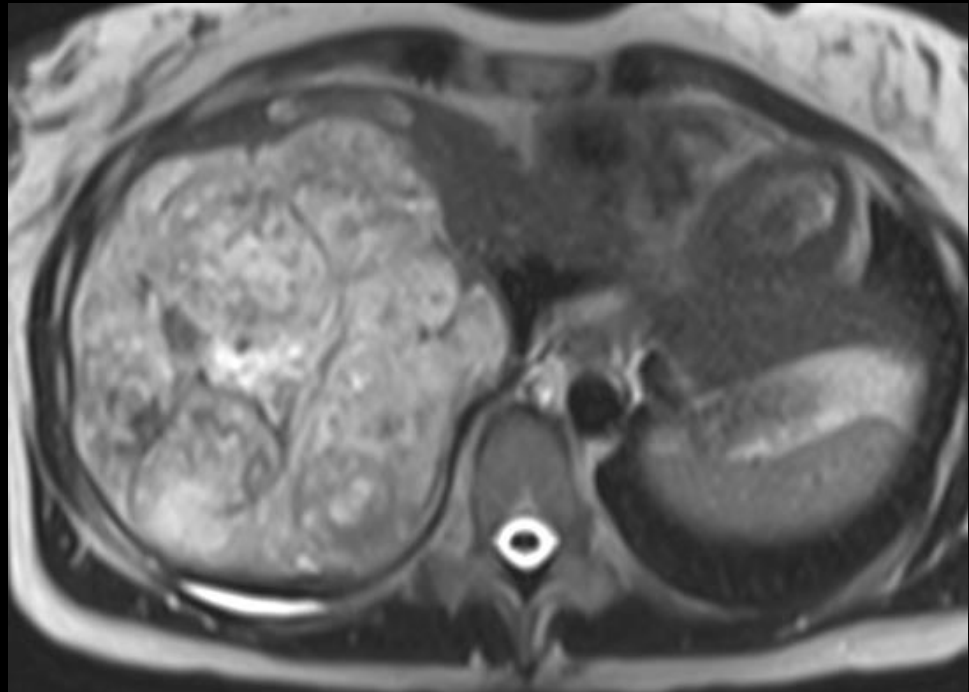


~~Classically B9 lesions  
Cysts  
Hemangiomas  
FNH~~

Look for Classic imaging features!



# Abdominal pain



NO Risk Factors

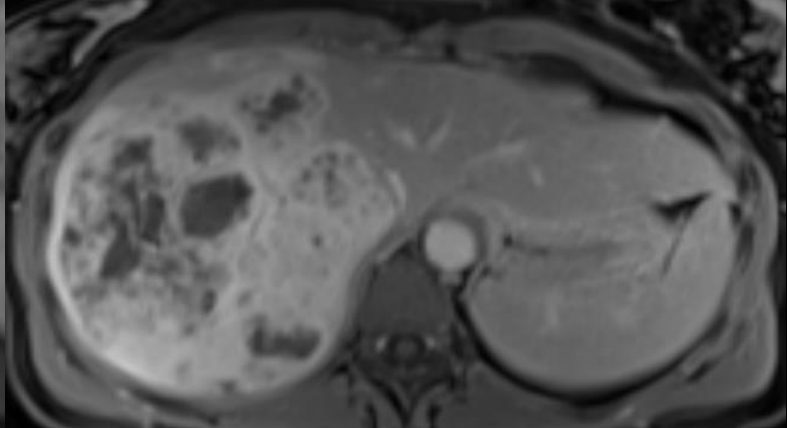
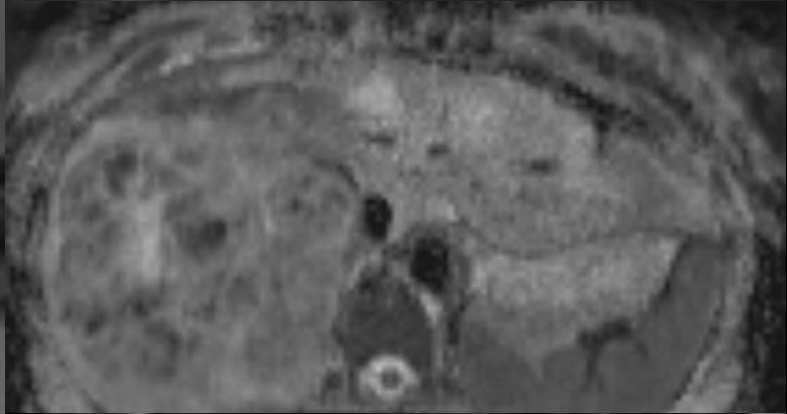
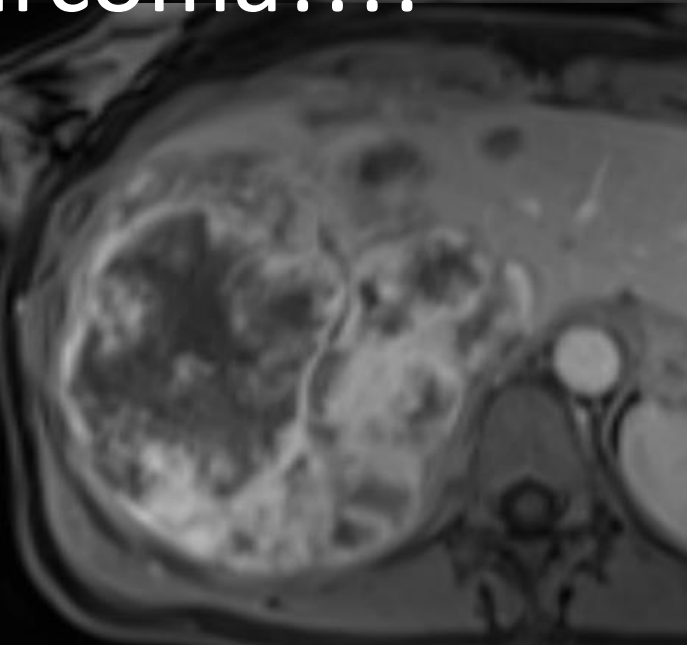
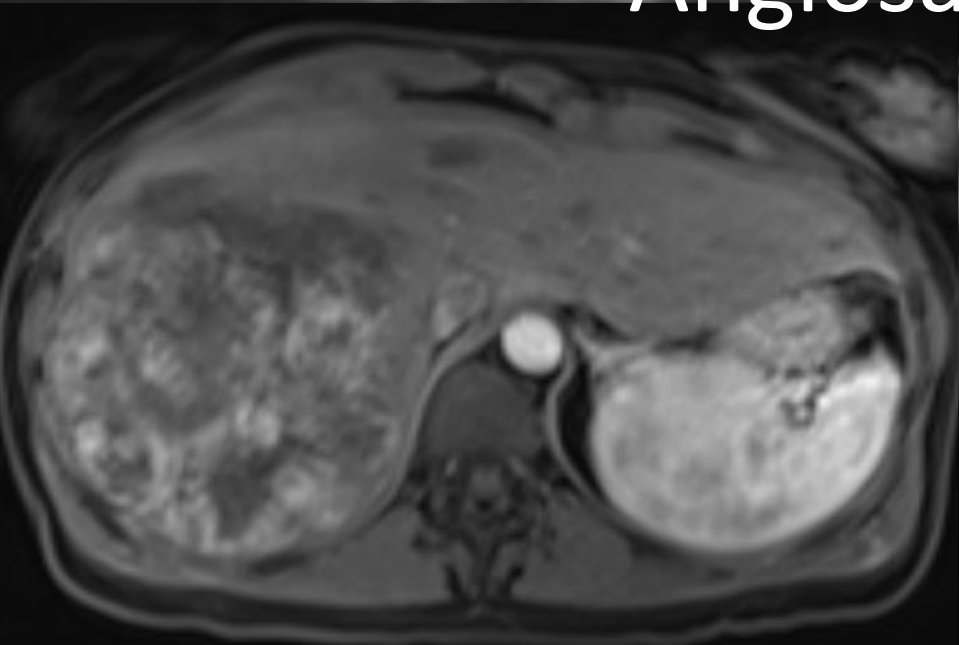
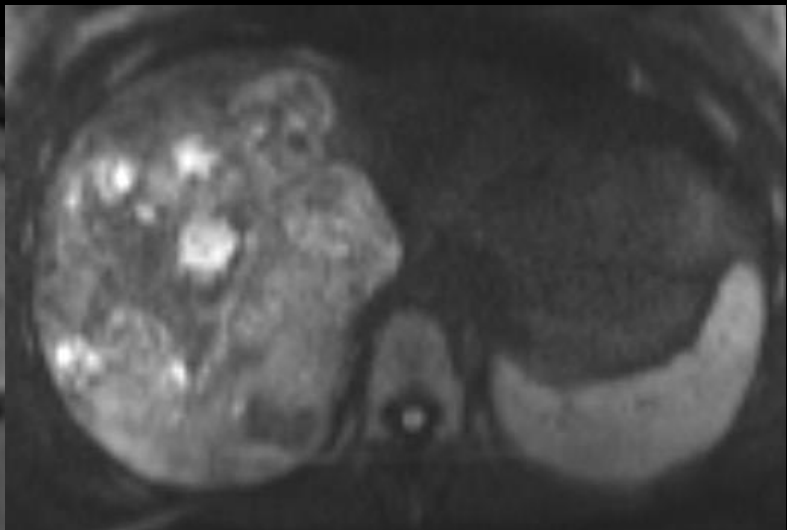
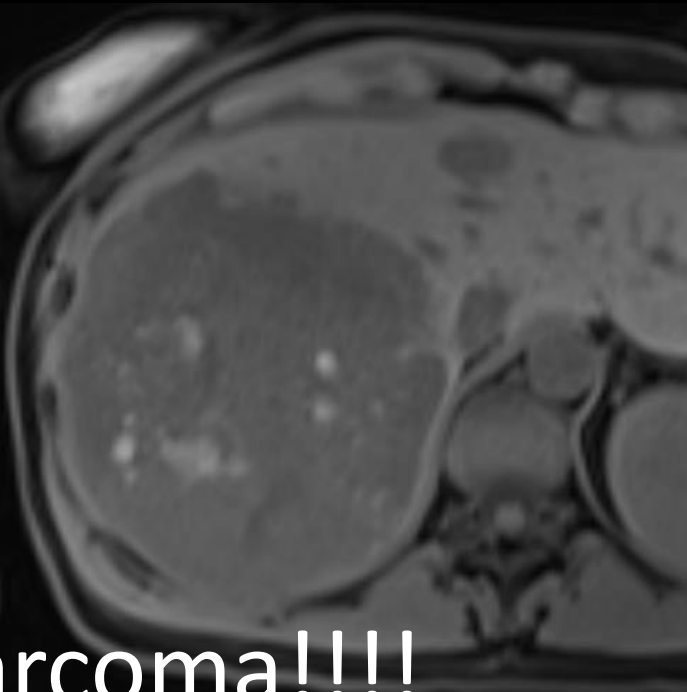
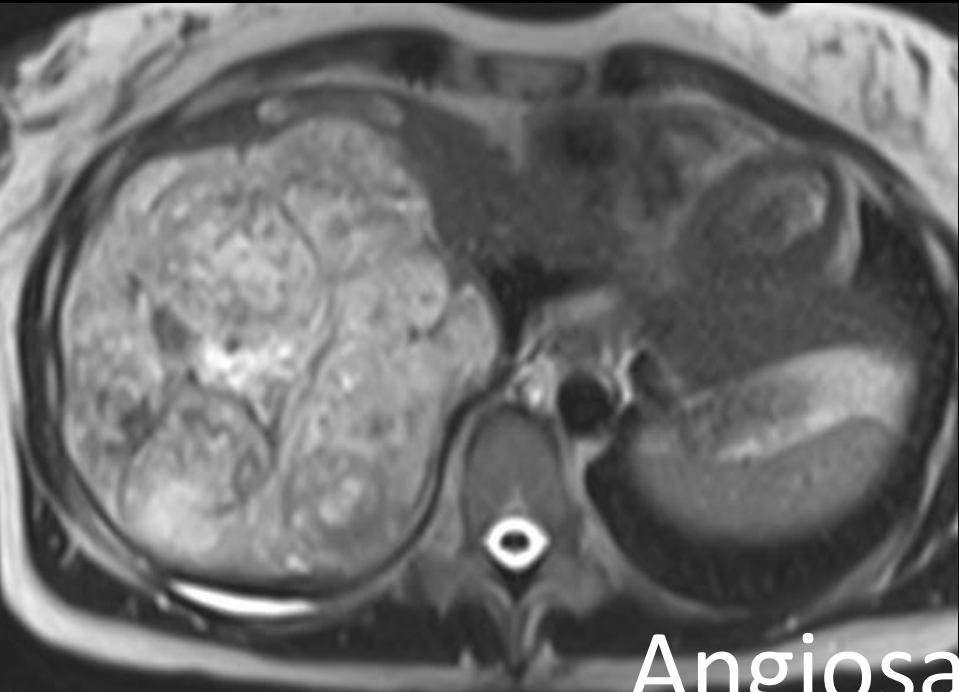


~~Probably B9 lesions  
Adenomas  
Biliary cystadenomas  
Abscess/Infections~~



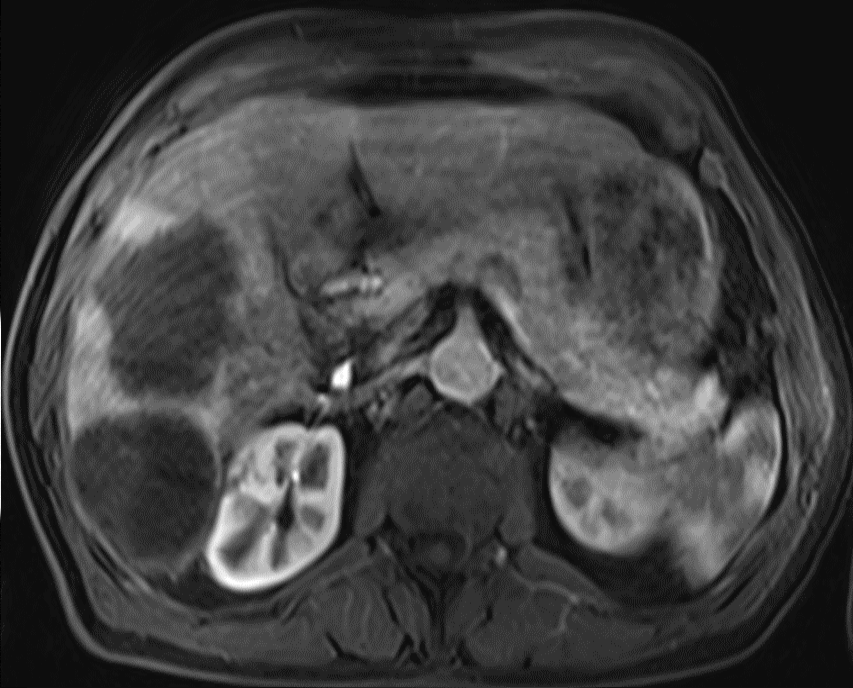
~~Classically B9 lesions  
Cysts  
Hemangiomas  
FNH~~

Look for Classic imaging features!

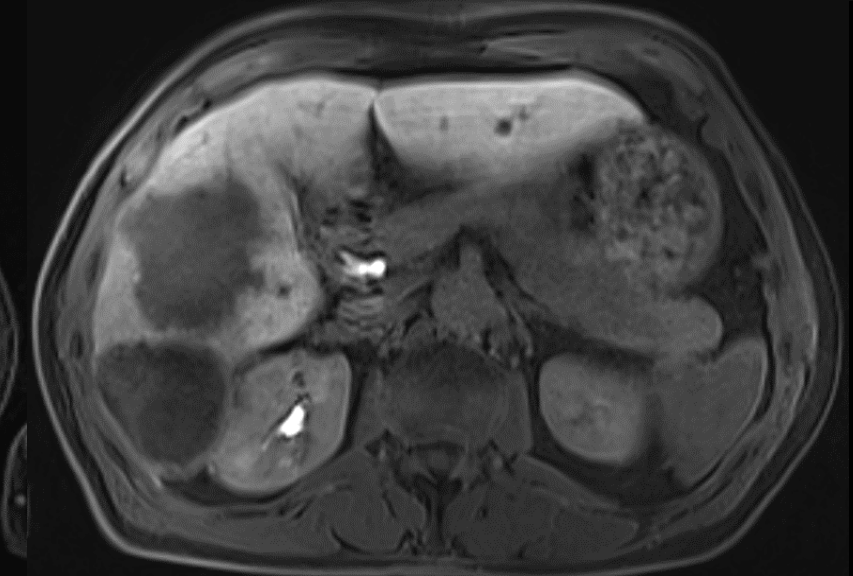
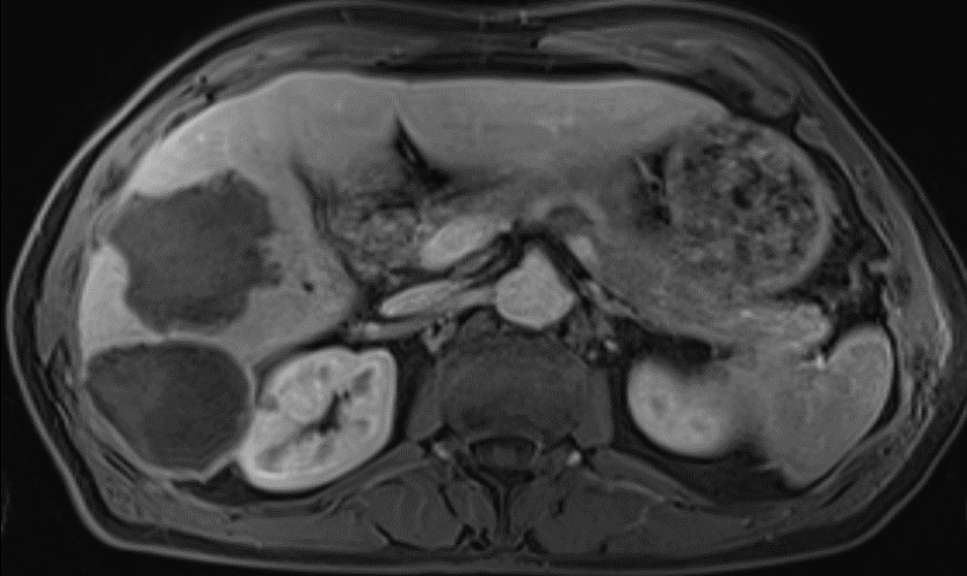


Angiosarcoma!!!!





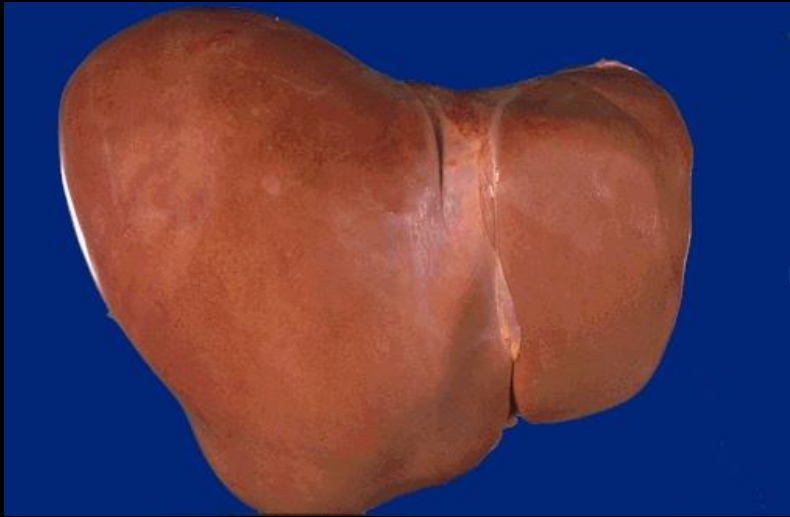
- No known cancer



- Incidental liver lesions



NO Risk Factors



~~Probably B9 lesions  
Adenomas  
Biliary cystadenomas  
Abscess/Infections~~



~~Classically B9 lesions  
Cysts  
Hemangiomas  
FNH~~

Look for Classic imaging features!

# Alveolar echinococcosis

- Broad differential, would need to correlate with travel history
  - Elevated eosinophils
- 
- Don't biopsy if you're considering this diagnosis...

# Take a break!!!!

- Next up, FLL in cirrhosis