

Imaging for Acute Cholecystitis and Choledocholithiasis

Daniel R. Bacon, MS4 2021

Patient History

- Ms. C is a 27-year-old G1P1 woman status post uncomplicated cesarean delivery 1 month ago who presents to the ED for 1 day of severe epigastric pain associated with nausea and vomiting.
- T: 36.9C, HR: 73, RR: 16, BP: 93/50, SpO2: 97% room air, BMI: 22.7
- Exam: Uncomfortable, epigastric tenderness, negative Murphy's sign, no rebound or guarding. Non-distended.
- Labs: WBC: 8, lipase: nl, **AST: 105, ALT: 55, Alk phos: 162**, T.bili: 0.9
- Differential?

ACR Appropriateness Criteria for RUQ pain.

Variant 1: Right upper quadrant pain. Suspected biliary disease. Initial imaging.

Procedure	Appropriateness Category	Relative Radiation Level
US abdomen	Usually Appropriate	○
CT abdomen with IV contrast	May Be Appropriate	☢☢☢
MRI abdomen without and with IV contrast with MRCP	May Be Appropriate	○
MRI abdomen without IV contrast with MRCP	May Be Appropriate	○
Nuclear medicine scan gallbladder	May Be Appropriate	☢☢
CT abdomen without IV contrast	May Be Appropriate	☢☢☢
CT abdomen without and with IV contrast	Usually Not Appropriate	☢☢☢☢

<https://acsearch.acr.org/docs/69474/Narrative/>

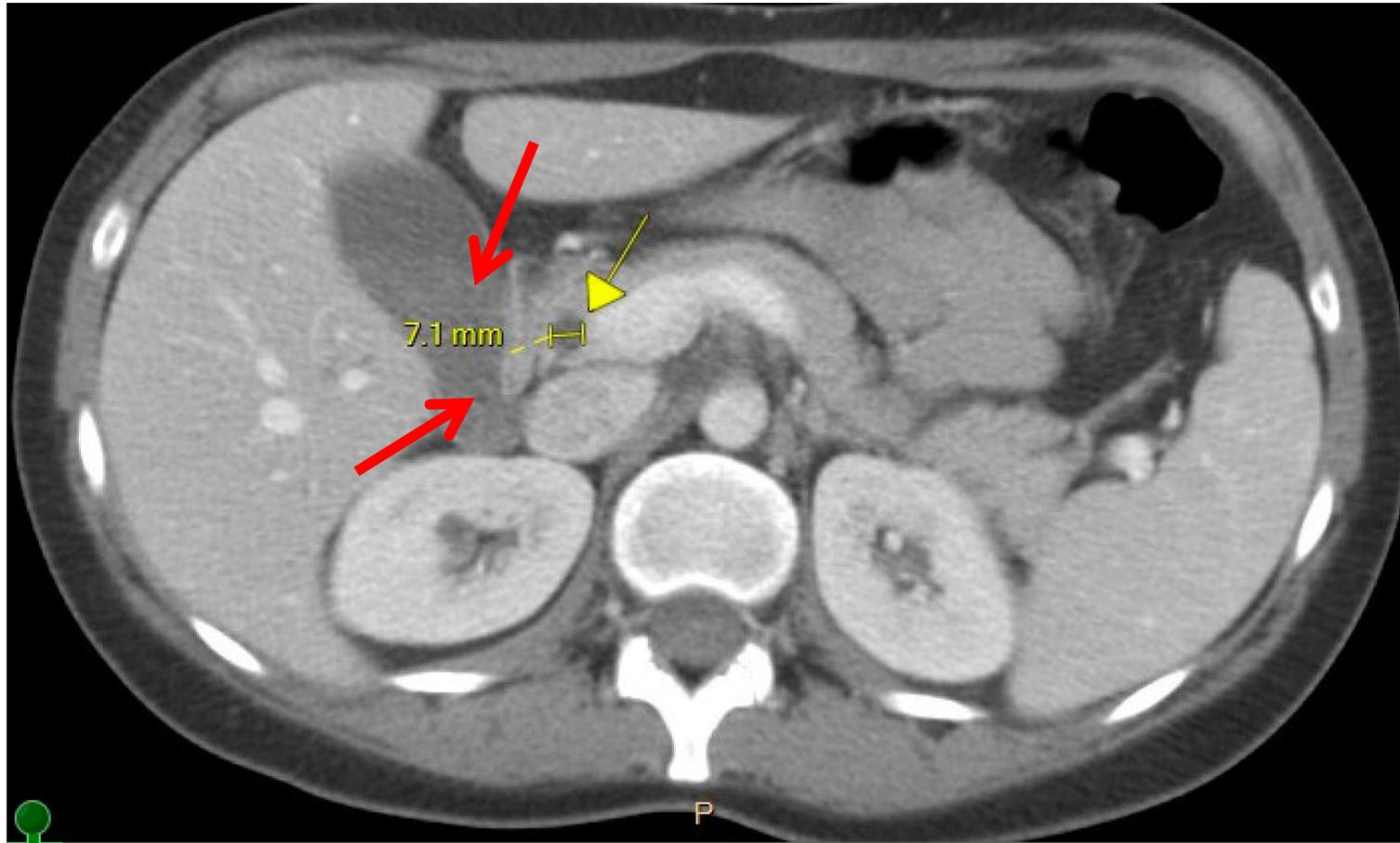
List of imaging studies

- CT Abdomen and Pelvis with contrast
- MRCP

CT Abdomen and Pelvis w contrast

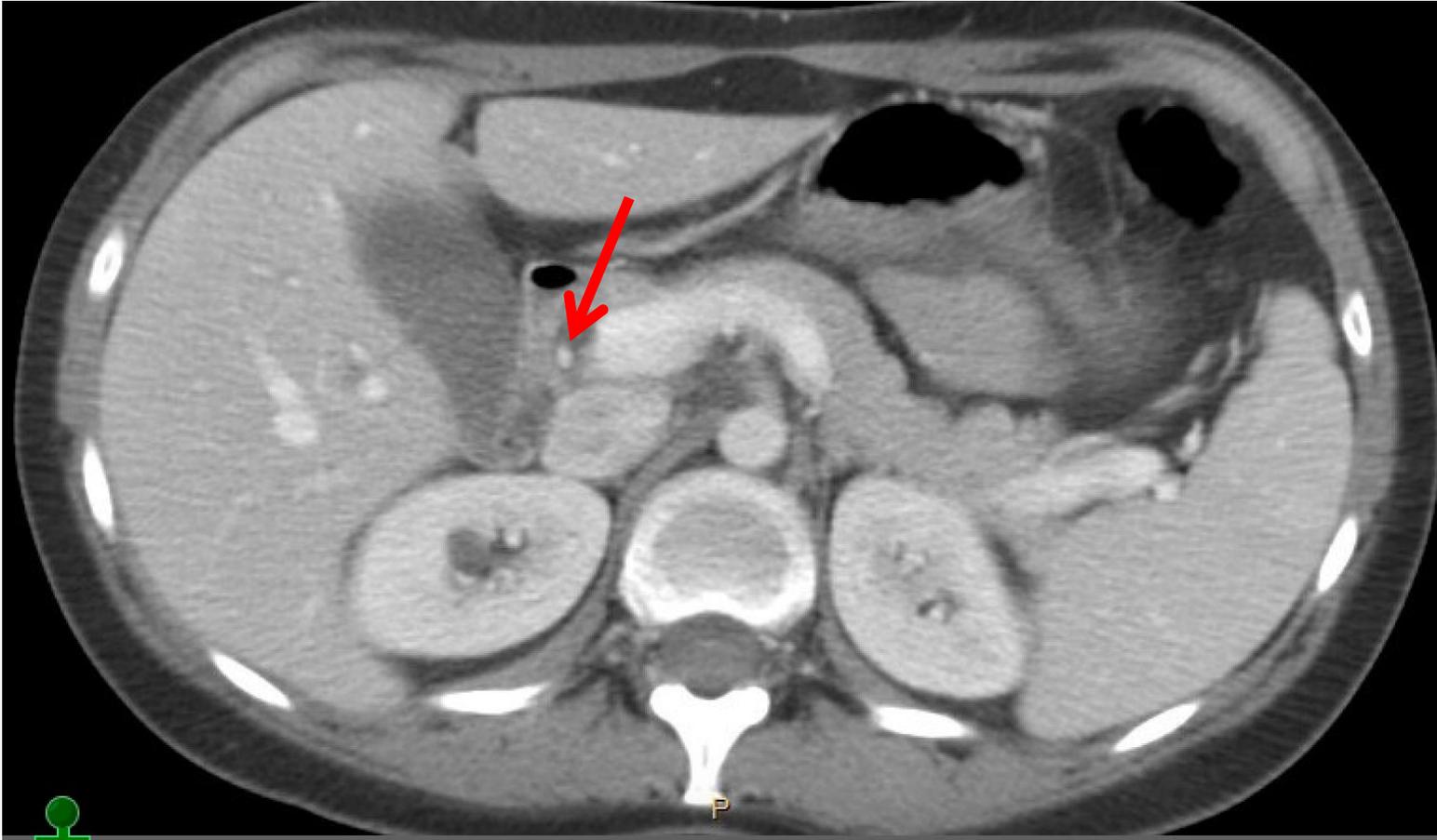


CT Abdomen and Pelvis w contrast



- Dilated Common bile duct >6mm
- Heterogenous density in GB: ?stone ?sludge
- Normal GB wall, no pericholecystic fluid

CT Abdomen and Pelvis w contrast



- ?Cholelithiasis
Not reported on CT
read.

14 Hours Later . . .

- Clinically stable
- Worsening LFT's
 - ❖ AST: 105 -> 285
 - ❖ ALT: 55 -> 248
 - ❖ Alk phos: 162 -> 214
 - ❖ T.bili: 0.9 -> 1.0

Differential: Acute cholecystitis **with or without** choledocholithiasis vs symptomatic cholelithiasis.

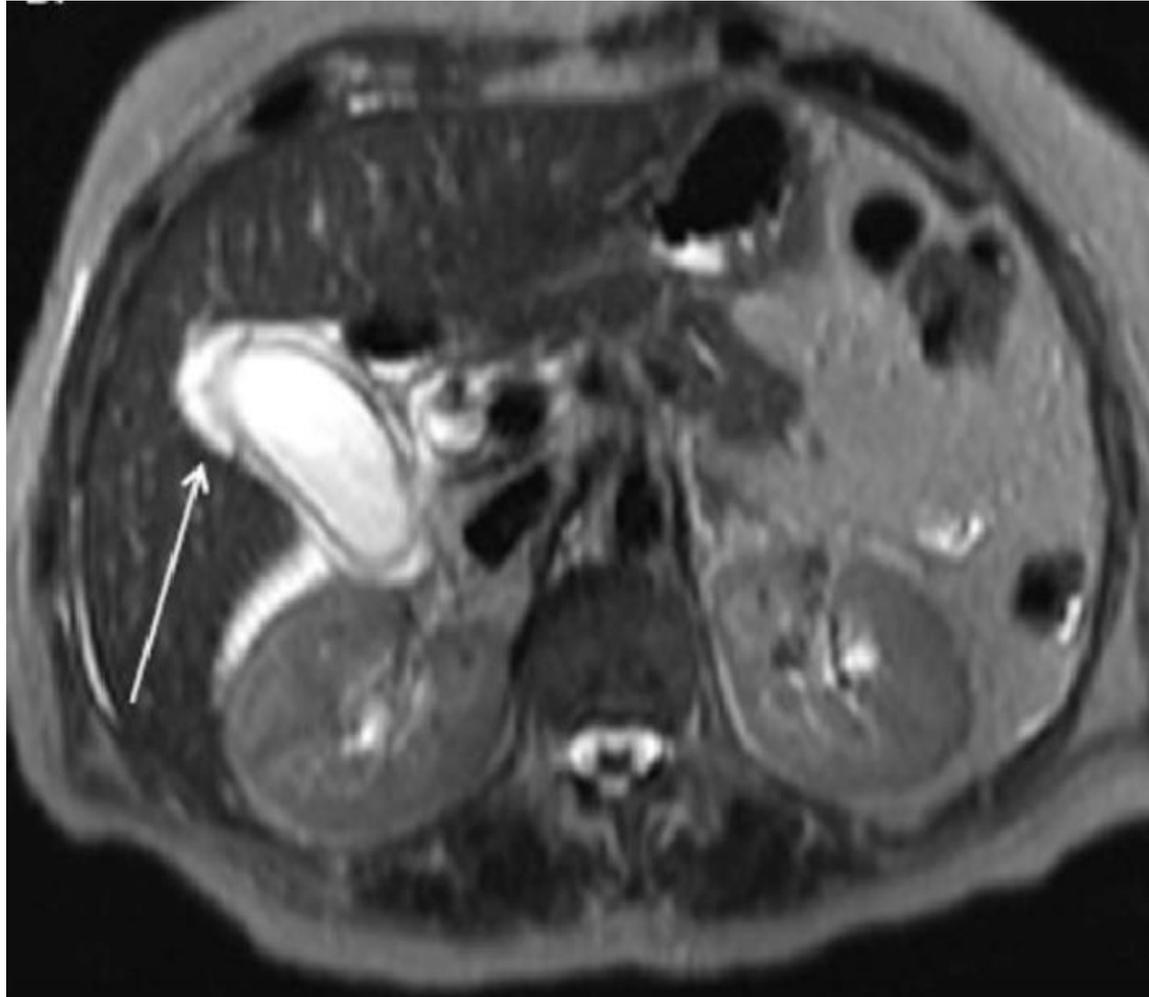
Next Step: MRCP

MR - T2 weighted



- Numerous stones in GB extending to cystic duct
- Mild pericholecystic fluid hyperintensity surrounding fundus

Companion Image MR Pericholecystic Fluid



Patient Treatment and Outcome

Diagnosis

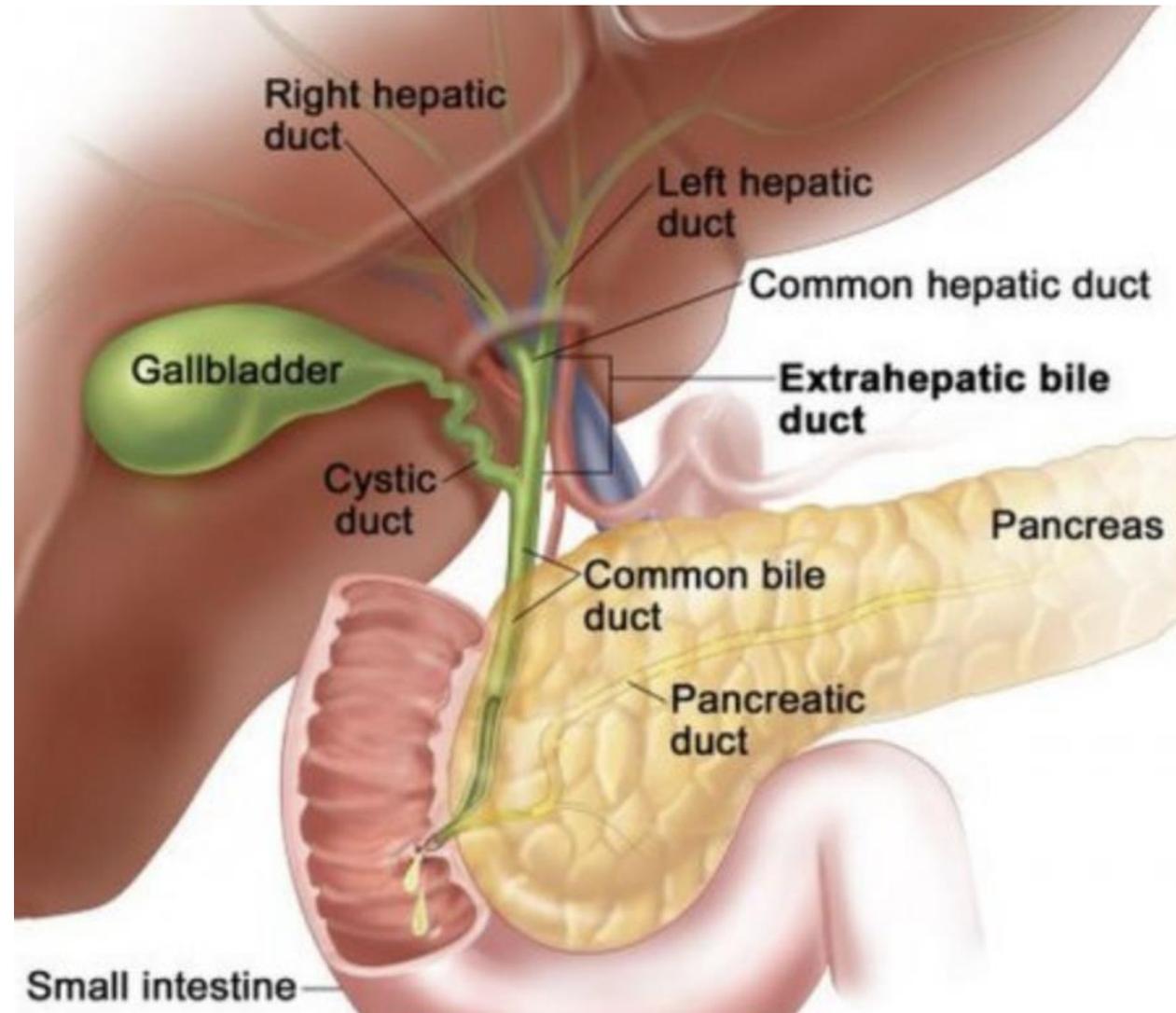
- Acute calculous cholecystitis

Treatment¹

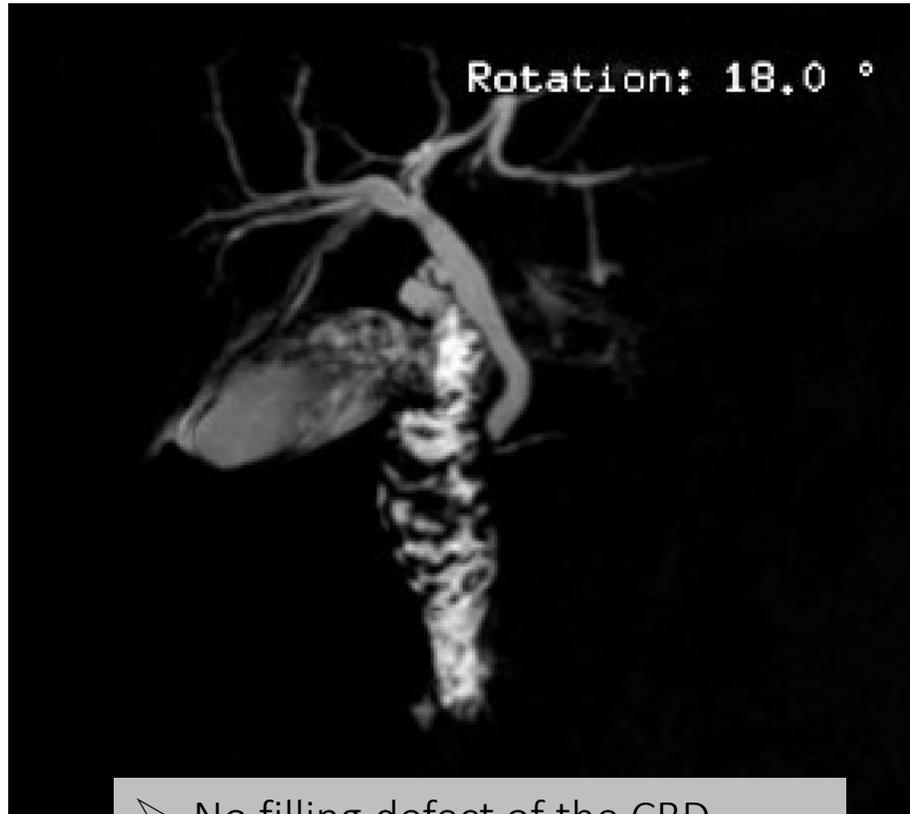
- High risk for choledocholithiasis (>50%): ERCP followed by elective cholecystectomy vs elective cholecystectomy with concurrent common bile duct exploration.
- Intermediate risk (10-50%): MRCP followed by elective cholecystectomy if CBD stone ruled out.
- Low risk (<10%): elective cholecystectomy

Arain MA et al. Choledocholithiasis: Clinical manifestations, diagnosis, and management. Uptodate.com Accessed 8/12/2021.
https://www.uptodate.com/contents/choledocholithiasis-clinical-manifestations-diagnosis-and-management?search=risk%20of%20choledocholithiasis&source=search_result&selectedTitle=1~150&usage_type=default&display_rank=1#H17164108

Hepatobiliary Anatomy

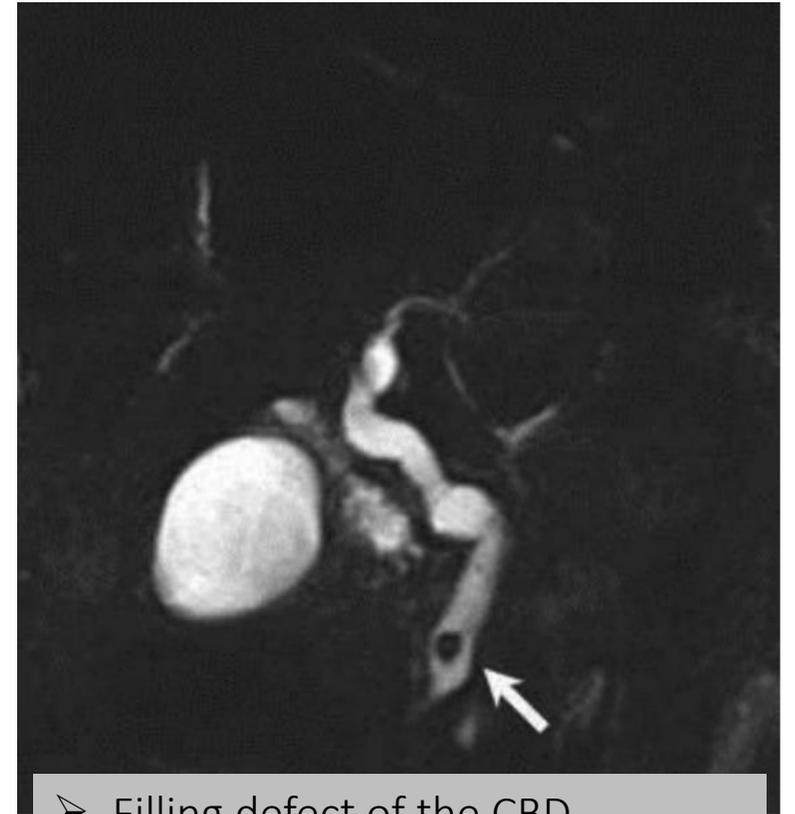


ERCPC



- No filling defect of the CBD indicative of choledocholithiasis
- CBD maximal dimension 5mm

Companion Case



Standard Imaging Workup: RUQ Ultrasound

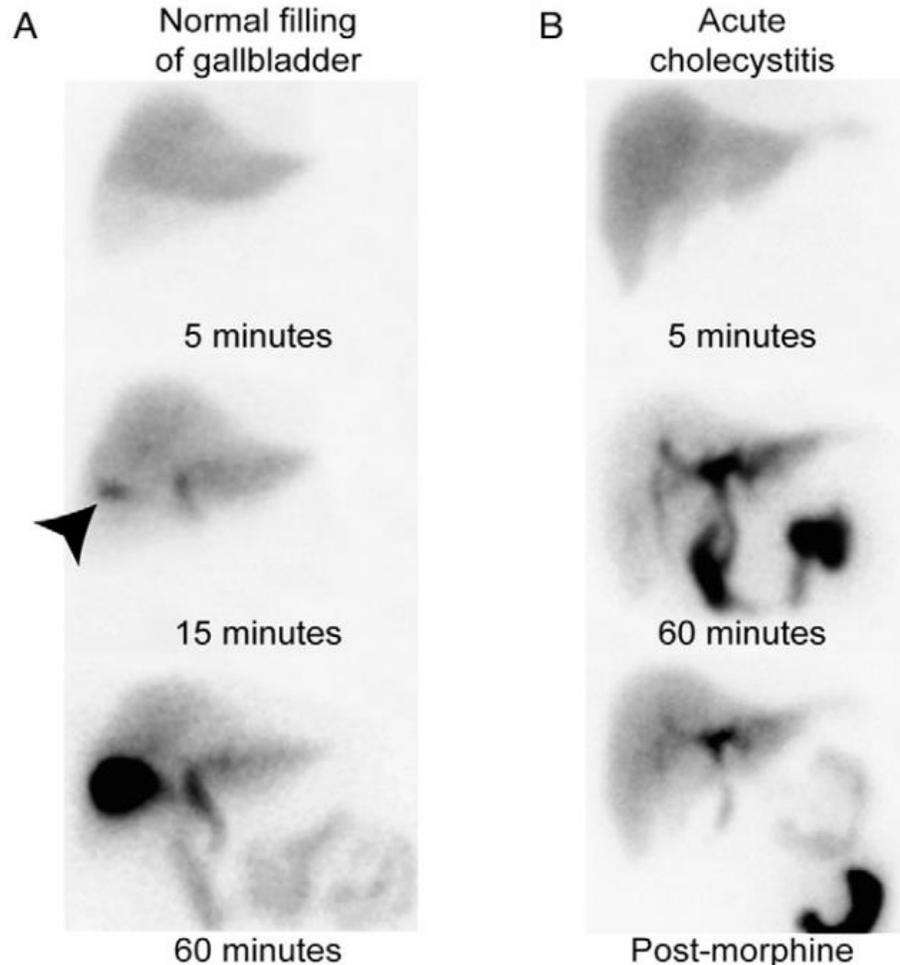


- Sensitivity: 88%, Specificity: 80% on systematic review,¹ but remember user dependence.
- Cost: ~\$410²
- Classic findings:
 - ❖ wall thickening (>3mm)
 - ❖ pericholecystic fluid
 - ❖ air in gallbladder wall/lumen
 - ❖ stones with posterior shadowing
 - ❖ obstructive stone in cystic duct
 - ❖ sonographic Murphy's sign

¹Shea JA, Berlin JA, Escarce JJ. Revised estimates of diagnostic test sensitivity and specificity in suspected biliary tract disease. Arch Intern Med. 1994;154(22):2573-81.

²<https://www.mdsave.com/procedures/ultrasound/d781f5ca>

Standard Imaging Workup: HIDA Scan



- HIDA = 99mTc Hepatic Iminodiacetic acid administered IV, selectively taken up by hepatocytes and excreted in bile.
- Visualization of gallbladder (GB) within 30-60 minutes if there is patency of the cystic duct. Absence of filling is diagnostic of acute cholecystitis.
- Morphine contracts sphincter of Oddi to create favorable pressure gradient for GB filling. Avoids false positives in critically ill patients.
- Sensitivity: 90-97%; Specificity: 71-90%¹
- Cost: ~\$1400;² Radiation: 4 mSv³

¹Shea JA, Berlin JA, Escarce JJ. Revised estimates of diagnostic test sensitivity and specificity in suspected biliary tract disease. *Arch Intern Med.* 1994;154(22):2573-81.

²<https://www.mdsave.com/procedures/hida-scan-hepatobiliary-imaging/d784f4cb/north-carolina>

³Radiation and Medical Procedures, PMID: 29025806

Did We Need a CT Scan?



- Not routinely required for diagnosis, but patient did not exhibit classic cholecystitis presentation (epigastric pain w/o Murphy's sign).
- Cost: ~\$1300;¹ Radiation: ~7.7 mSv²
- Able to detect gangrenous or emphysematous cholecystitis better than ultrasound which will not conduct through air.
- Diagnostic accuracy studies compared to ultrasound are conflicting;
 - ❖ Sensitivity range: 52.3%,³ 85%,⁴ 94%⁵
 - ❖ Specificity range: 59%,⁵ 92.3%,³ 100%⁴
 - ❖ CT superior for complicated cholecystitis³

¹<https://www.mdsave.com/procedures/ct-scan-of-abdomen-and-pelvis-with-contrast/d781f5c4/Maryland>

²<https://www.acr.org/-/media/ACR/Files/Radiology-Safety/Radiation-Safety/Dose-Reference-Card.pdf>

³PMID: 32030439

⁴PMID: 29702020

⁵PMID: 22798223

Standard Imaging Workup: MRCP vs ERCP



<https://www.orgastro.com/ercp/>

- ERCP is both diagnostic and therapeutic for choledocholithiasis, but still need cholecystectomy for acute cholecystitis.
- ERCP has ~10% risk of pancreatitis, thus, MRCP preferred for intermediate risk of CBD stone.
- MRCP sensitivity and specificity for biliary obstruction: 95 and 97%¹
- MRCP Cost: \$554²

¹PMID: 14530225

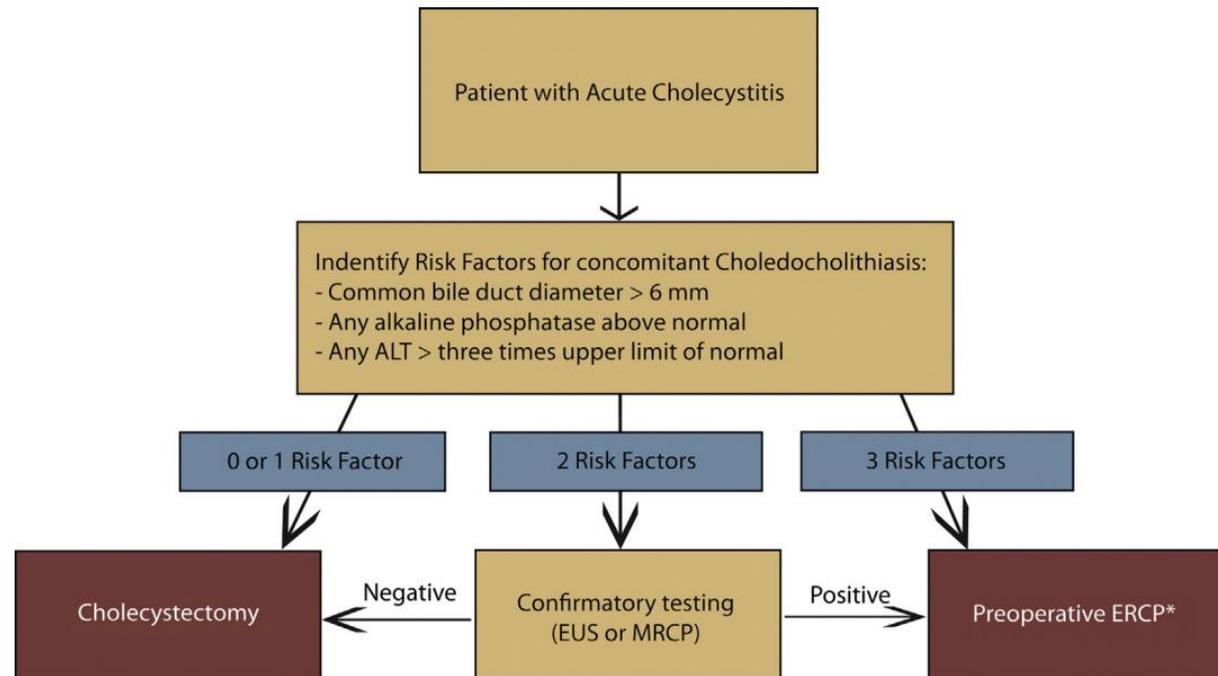
²<https://www.mdsave.com/procedures/mri-abdomen-without-contrast-with-mrcp/d587f9ca>

Did we need a MRCP?

Preoperative predictors of choledocholithiasis in patients presenting with acute calculous cholecystitis (CME)

Phillip R. Chisholm, MD,¹ Arpan H. Patel, MD,¹ Ryan J. Law, DO,¹ Allison R. Schulman, MD, MPH,¹ Arti O. Bedi, MD,¹ Richard S. Kwon, MD, MS,¹ Erik J. Wamsteker, MD,¹ Michelle A. Anderson, MD, MS,¹ Grace H. Elta, MD,¹ Shail M. Govani, MD, MSc,^{1,3,4,*} Anoop Prabhu, MD^{1,2,*}

Ann Arbor, Michigan; San Antonio, Texas, USA



*Confirmatory test (MRCP or EUS) can be considered prior to preoperative ERCP when appropriate

Figure 2. Management algorithm for patients presenting with acute calculous cholecystitis. *ALT*, Serum alanine transaminase.

- Retrospective multivariable analysis of 366 patients with acute cholecystitis in 2019.¹
- 3 Risk factors for choledocholithiasis (CDL)
 - ❖ CBD diameter > 6mm
 - ❖ Elevated alk phos
 - ❖ ALT >3x upper limit of normal
- All 3 risk factors present: 77.8% had CDL
- 0 or 1 risk factors present: 98.6% did not have CDL.
- Our patient had all 3 risk factors: CBD diameter: 7.1mm, elevated alk phos.
 - ❖ Note this algorithm would have exposed the patient to an unnecessary ERCP (cost: ~\$11,000² + complication risks.

¹PMID: 30465770

²<https://www.mdsave.com/procedures/ercp/d785fbc5#:~:text=On%20MDsave%2C%20the%20cost%20of,their%20procedure%20upfront%20through%20MDsave.>

3 Take Aways

1. Imaging workup of nonmalignant biliary disease:

- ❖ RUQ US is first step in diagnosis.
- ❖ HIDA scan is the gold standard if the diagnosis remains uncertain.
- ❖ MRCP or endoscopic ultrasound needed if concern for choledocholithiasis
- ❖ CT helpful for complications: perforation, emphysematous/gangrenous cholecystitis

2. Presence or absence of choledocholithiasis dictates treatment and can be identified by multiple imaging studies at varying levels of diagnostic accuracy, cost, and radiation exposure.

3. Role of clinical predictors: May have high negative predictive value, but poor positive predictive value for choledocholithiasis.