Imaging for Acute Cholecystitis and Choledocholithiasis

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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.


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

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Appropriateness Category</th>
<th>Relative Radiation Level</th>
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</thead>
<tbody>
<tr>
<td>US abdomen</td>
<td>Usually Appropriate</td>
<td></td>
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<tr>
<td>CT abdomen with IV contrast</td>
<td>May Be Appropriate</td>
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<tr>
<td>MRI abdomen without and with IV contrast with MRCP</td>
<td>May Be Appropriate</td>
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<td>Nuclear medicine scan gallbladder</td>
<td>May Be Appropriate</td>
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</table>

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

➢ ?Choledocholithiasis
Not reported on CT read.
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
Numerous stones in GB extending to cystic duct
Mild pericholecystic fluid hyperintensity surrounding fundus
Companion Image MR Pericholecystic Fluid

https://www.semanticscholar.org/paper/Complicated-acute-cholecystitis-includes-Current-in/d6e260a222ce8bc29da28347e1969f61c74a46c8
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

Hepatobiliary Anatomy

https://anatomy-medicine.com/digestive-system/31-the-gallbladder.html
No filling defect of the CBD indicative of choledocholithiasis

CBD maximal dimension 5mm

Filling defect of the CBD indicative of choledocholithiasis

CBD is dilated
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


²https://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 mSv\(^3\)

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\(^2\)https://www.mdsave.com/procedures/hida-scan-hepatobiliary-imaging/d784f4cb/north-Carolina

\(^3\)Radiation 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 mSv\(^2\)

- 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 cholecystitis\(^3\)

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\(^1\)https://www.mdsave.com/procedures/ct-scan-of-abdomen-and-pelvis-with-contrast/d781f5c4/Maryland


\(^3\)PMID: 32030439

\(^4\)PMID: 29702020

\(^5\)PMID: 22798223
Standard Imaging Workup: MRCP vs 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%
- MRCP Cost: $554

PMID: 14530225
1https://www.orgastro.com/ercp/
Did we need a MRCP?

Preoperative predictors of choledocholithiasis in patients presenting with acute calculous cholecystitis

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➢ 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: ~$11,000 2 + complication risks.

1 PMID: 30465770
2 https://www.mdsave.com/procedures/ercp/d785fbc5#:~:text=On%20MDsave%2C%20the%20cost%20of%20their%20procedure%20upfront%20through%20MDsave.

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