Imaging of Gallbladder Disease

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Outline

- Gall stones
- Acute and chronic cholecystitis and variants
- Polyps and polypoidal lesions
- Malignancy
- Gall bladder wall thickening

Gall stones Ultrasonography

- Accuracy 96%
- Echogenic
- Shadow (clean)
- Discrete
- Confluent
- Wall echo shadow
- Intraluminal, dependent and mobile

Gall Stones

- 20 million adults
- 12% of US population
- 80% asymptomatic
- 20% biliary colic
- 700,000 cholecystectomies
- 3000 deaths

Gall stones CT

- Variable
- Isodense: high cholesterol content
- Hyperdense/calcification
- Hypodense, gas
- Lamellation and fissuring

Gall stones MR

- Little or no signal on T2
- Pigment stones: T1 bright, T2 dark
- Cholesterol stones: T1 dark T2 dark

Gall stones

Risk factors:
- Sex, age, obesity, hyperalimentation, ileal disease, ethnicity, oral contraceptive steroids and conjugated estrogens
- Hepatic hypersecretion of biliary cholesterol with altered secretion rates of biliary bile salts or phospholipids
- Cholesterol, bilirubin, calcium salts, protein
- > 75% principally cholesterol (F>M)
- 10% pure cholesterol
- 10-25% pigment
<table>
<thead>
<tr>
<th>Acute cholecystitis</th>
<th>Acute calculous cholecystitis CT</th>
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<tbody>
<tr>
<td>• 3-9% admissions for acute pain</td>
<td>• Less sensitive (75%) for stones</td>
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<tr>
<td>• Clinical diagnosis needs to be confirmed with imaging</td>
<td>• Major criteria: calculi, mural thickening, pericholecystic fluid, subserosal edema</td>
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<tr>
<td>• US fast, accurate, inexpensive, accessible, alternative diagnosis</td>
<td>• Minor criteria: gallbladder distension, sludge</td>
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<tr>
<td>• CT less sensitive for stones, second choice</td>
<td>• Sensitivity 91.7%</td>
</tr>
<tr>
<td>• HIDA more sensitive and specific but takes longer, radiation</td>
<td>• Specificity 99.1%</td>
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<td>• MRCP for CBD stones</td>
<td>• Accuracy 94.3%</td>
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<thead>
<tr>
<th>Acute cholecystitis</th>
<th>Acute cholecystitis MRI/MRCP</th>
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<tbody>
<tr>
<td>• 90-95% secondary to obstructing gall stones</td>
<td>• Equal performance</td>
</tr>
<tr>
<td>• Inflammation, infection and necrosis</td>
<td>• Gall bladder distension, wall thickening with increased T2 SI</td>
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<tr>
<td>• 5% acute acalculous cholecystitis</td>
<td>• Pericholecystic fluid</td>
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<td>• Fluid around liver (C sign)</td>
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<td>• Transient increased enhancement of the adjacent liver parenchyma</td>
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<table>
<thead>
<tr>
<th>Acute cholecystitis: features</th>
<th>Complicated acute cholecystitis</th>
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<tbody>
<tr>
<td>• Cholelithiasis</td>
<td>• Ischemia and necrosis</td>
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<tr>
<td>• Distension: obstructing stone</td>
<td>• Gangrene (NB: pain more diffuse, negative Murphy sign)</td>
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<tr>
<td>• Inflammation</td>
<td>• Perforation</td>
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<tr>
<td>• Wall thickening &gt; 3-4 mm</td>
<td>• Hemorrhage</td>
</tr>
<tr>
<td>• Pericholecystic fluid</td>
<td>• Emphysematous cholecystitis</td>
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<tr>
<td>• Hyperemia GB wall</td>
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<tr>
<td>• Tenderness</td>
<td></td>
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<tr>
<td>• Fat stranding</td>
<td></td>
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<tr>
<td>• Hyperemic liver</td>
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<tr>
<th>Acute calculous cholecystitis Ultrasound</th>
<th>Gangrene</th>
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<tbody>
<tr>
<td>• Sensitivity 80% to 100%</td>
<td>• 20%</td>
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<tr>
<td>• Specificity 60% to 100%</td>
<td>• Asymmetry or discontinuity of wall</td>
</tr>
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<td></td>
<td>• Intraluminal membranes</td>
</tr>
<tr>
<td>• Gallstones</td>
<td>• Intramural/intraluminal gas</td>
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<tr>
<td>• Positive sonographic Murphy sign</td>
<td>• Pericholecystic abscess</td>
</tr>
<tr>
<td>• Gallbladder wall thickening</td>
<td>• Lack of enhancement</td>
</tr>
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<td>• Immediate surgery</td>
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</tbody>
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Bennett GL et al. CT findings in acute gangrenous cholecystitis. AJR 2002; 178:275-281
Empyema
- Gall bladder distended with pus
- Diabetic
- Higher attenuation on CT
- Drainage

Emphysematous cholecystitis
- <1%
- 40% have diabetes
- Men > women
- Gas forming infection
- Increased risk of gangrene and perforation, high mortality
- Dirty versus clean shadow not always helpful

Perforation
- Up to 10%
- Mortality 20%
- Acute leads to peritonitis (10%)
- Subacute leads to contained abscess (60%)
- Chronic leads to fistula (30%)

Porcelain gall bladder
- Diffuse thick calcification
- Rare
- Chronic cholecystitis causes wall calcification
- Reported to be associated with cancer in 12-61%

Gall stone ileus
- Erosion of a stone into the gut with subsequent obstruction
- Stone > 2 cm
- Occurs at duodenum and becomes lodged at sites of narrowing e.g. IC valve,
- Pneumobilia and bowel obstruction with a calculus

Porcelain gall bladder
- Association with gall bladder carcinoma weak
- 25,900 gallbladder specimens at Massachusetts General Hospital
- 150 gallbladder cancer
- 44 calcified gallbladders
- Cancer in 7% “selective mucosal wall” calcification
- None with diffuse intramural calcification
- Risk associated with focal calcification rather than diffuse intramural calcification
  Surgery 2001;129:699-703

Hemorrhagic cholecystitis
- Atherosclerosis predisposes to mucosal ulceration and necrosis and hemorrhage
- Colic, jaundice and melena
- High mortality
- Intraluminal echoes and clots
- High density on CT

Choledocholithiasis
- 10-20% have common duct stones
- Dilated bile ducts
- Sensitivity 75%; US limited for distal CBD
- MRCP/CT
Mirizzi

- Impacted stone in neck or cystic duct
- Obstructs CHD
- Type 1 simple
- Type 2 erosion of wall of CHD fistula
- MRCP may be useful preoperatively to show level of obstruction

Acalculous cholecystitis

- Ultrasound less specific, higher complication rate, mortality up to 60%
- Distension, sludge, wall thickening, hypoechoic regions in wall, pericholecystic fluid, increased echogenicity within the gallbladder from hemorrhage, pus, intraluminal membranes
- Scintigraphy with CCK false positive
- Diagnostic and therapeutic cholecystostomy

Chronic cholecystitis

- Repeated bouts of acute inflammation
- May coexist with acute cholecystitis
- Wall thickening

Pitfalls

- Murphy sign negative: gangrene, opioids, state of consciousness, steroids
- Murphy sign positive: liver, bowel, kidney, other
- Wall thickening from multitude of causes
- Non visualized gall bladder

Xanthogranulomatous cholecystitis

- Chronic inflammation with nodules formed of foamy histiocytes
- Pain, vomiting, leucocytosis and positive Murphy
- Women 60-70's
- More complications (32% abscess, perforation, fistula, local extension)
- Difficult laparoscopic surgery

Acalculous cholecystitis

- Signs of cholecystitis without stones
- Sepsis in ill patients, ventilated, intensive care, diabetes, post surgery and trauma
- Diminished gallbladder emptying
- Decreased blood flow in the cystic artery because of obstruction, hypotension, or embolization
- Bacterial infection
- Ischemic GB, gangrene and perforation

Xanthogranulomatous cholecystitis

- Tender palpable mass
- Marked gallbladder wall thickening with hypoechoic/hypoattenuating nodules
- Gall stones
- Disruption of mucosa
- Pericholecystic fluid
- May mimic carcinoma at imaging
- Extends to liver

Xanthogranulomatous cholecystitis MRI

- High T2 nodules
- Preservation of linear mucosal enhancement
Polypoidal gall bladder lesions
• 3-5 %

Adenomyomatous hyperplasia
• Hyperplastic cholecystosis includes cholesterolosis and adenomyomatosis
• Cholesterolosis
  • deposition of triglycerides and cholesterol esters within the lamina propria
  • characteristic gross appearance of “strawberry gallbladder”

Non neoplastic 95%
• Cholesterol 60%
• Adenomyomatosis 25% (10-20mm)
• Inflammatory 10% (<10mm)
• Heterotopia

Adenomyomatosis
• Proliferation of epithelium growing into thickened muscularis propria to form intramural diverticula which may contain inspissated bile, mucus, stones, sludge and cholesterol
• Localized (fundal mass) most common, segmental, diffuse
• Resulting in luminal narrowing (waist)
• Reverberation (comet tail) characteristic
• Distinguish from air and carcinoma

Cholesterol Polyps
• No malignant potential
• F: M = 2.9: 1
• 40-50 yrs
• Incidental
• <10 mm
• Few associated with cholesterolosis and stones

Adenomyomatosis
• 8.7 % of cholecystectomy specimens
• F> M
• Right upper quadrant pain but over 90% have gall stones
• Diffuse or segmental wall thickening
• Sessile or polypoid mass in fundus
• Anechoic intramural diverticula cystic spaces
• V-shaped reverberation or comet-tail artifact

MR of adenomyomatosis
• Rokitansky-Aschoff sinuses T2 bright
• MRI “string of pearls sign” highly specific (92%)
• Preservation of mucosal enhancement
• Allows differentiation from carcinoma
• CT: intramural diverticula useful also
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<thead>
<tr>
<th>Neoplastic 5%</th>
<th>Gall bladder carcinoma</th>
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<tbody>
<tr>
<td>- Adenomas 4% (5-20 mm)</td>
<td>- Risk factors:</td>
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<tr>
<td>- Solitary associated with gall stones</td>
<td>- Chronic inflammation; 90% have gall stones</td>
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<tr>
<td>- Adenoma to carcinoma progression</td>
<td>- infection (Salmonella typhi)</td>
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<tr>
<td>- Other: leiomyomas, lipomas, carcinoids, neurofibromas, metastasis, carcinoid, lymphoma</td>
<td>- Elderly</td>
</tr>
<tr>
<td></td>
<td>- Women</td>
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<td></td>
<td>- Porcelain gall bladder (20% in older literature )</td>
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<th>Gall bladder carcinoma</th>
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<td>- Uncommon (0.5% autopsy)</td>
<td>- Adenocarcinoma in 90%</td>
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<tr>
<td>- F&gt; M = 2.4:1</td>
<td>- Rarely squamous, small cell</td>
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<tr>
<td>- Asymptomatic and incidental</td>
<td>- Usually fundus or neck</td>
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<tr>
<td>- Sessile or pedunculated</td>
<td>- Diffusely infiltrating mass extending into liver 68%</td>
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<tr>
<td>- &lt; 2 cm</td>
<td>- Polypoid intraluminal mass 25%</td>
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<td>- 10% multiple</td>
<td>- Wall thickening: focal or diffuse</td>
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<td>- 50-65% associated with stones</td>
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<tr>
<td>- Smooth intraluminal polypoidal mass</td>
<td>- MRI shows irregular early and prolonged enhancement unlike chronic cholecystitis</td>
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<td>- Occasionally cauliflower or sessile</td>
<td>- (Benign processes show early enhancement and washout)</td>
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<tr>
<td>- Adjacent normal wall</td>
<td>- &gt; 1 cm wall thickness suggestive</td>
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<td>- MR/CT better for staging</td>
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<th>Gall bladder carcinoma</th>
<th>Gall bladder polyps</th>
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<tr>
<td>- 5th most common GI malignancy but 0.66% of new cancers</td>
<td>- Management based on size, presence of gall stones, PSC and sessile morphology</td>
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<tr>
<td>- Incidental in 1-3% at cholecystectomy</td>
<td>- Surgery if &gt; 10 mm and &gt; 60 years</td>
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<td>- Vague symptoms, pain, weight loss, fever</td>
<td>- (Size cut off ? 6 mm)</td>
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<td>- Presents late with local invasion, biliary dilatation, liver/LN metastasis</td>
<td>- &lt; 10 mm follow with US 6-12 months</td>
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<td>- Poor outcome median survival 3 months</td>
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Gallahan 2010

Gallahan 2010
GB lymphoma

- Primary form extremely rare
- Usually secondary with adjacent disease
- NHL
- Difficult to distinguish from carcinoma
- Adjacent liver mass

Diffuse wall thickening

- Heart failure
- Hepatitis
- Hypoalbuminemia
- Cirrhosis
- Renal failure
- Cholecystitis or adjacent inflammation
- Primary or secondary malignancy
- XGC
- Adenomyomatous hyperplasia
- AIDS

Summary

- Review of imaging features of acute and chronic inflammation
- Review of polypoidal lesions
- Benign more common than malignant

References


Hanbidge AE et al. Imaging evaluation for acute pain in the right upper quadrant. Radiographics 2004; 24:1117–1135


Boscak AR et al. Radiographics 2006;26:941–946