Ultrasound of complicated cholecystitis
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Financial disclosures:
Royalties - Elsevier pub. co.
NIH Grants

Gangrenous cholecystitis
Acute calcific cholecystitis
Emphysematous cholecystitis

Gangrenous Cholecystitis
- Incidence ~ 2-30%
- Men > women (2:1)
- Cholelithiasis ~ 85%
- Perforation ~ 2-10%
- Mortality rate ~ 5-10%

Risk factors
- Immunocompromised state
- Malignancy, steroids
- Ischemia
- Cardiovascular disease
- Diabetes
- Advanced age
- African-American male

Definition
- Transmural necrosis of the gallbladder wall on gross pathological examination
- Occurs in the setting of calculous, acalculous, or emphysematous cholecystitis
Pathogenesis
- Impaction of stone in cystic duct
- Mucus production and distention
- Bile salt concentration → chemical inflammatory reaction
- Ischemia, necrosis, perforation
- 1-7 days after onset of symptoms

Signs and symptoms
- Afebrile (50%)
- Normal WBC count (30%)
- WBC count > 15,000/mL
  - Overlap with non gangrenous cholecystitis
  - ± RUQ pain/tenderness

Merriam, Surgery 1999; 126:680-686
Aydin, J hepatobiliary pancreat Surg 2006; 13:155-159
Teeley, AJR; 2013; 200:363-368

Gangrenous cholecystitis

Sonographic findings
- Absence of a sonographic Murphy’s sign
- Intraluminal membranes
- Wall irregularity, mural perforation, wall thickness
- Pericholecystic fluid collection

Sonographic Murphy’s sign
- Present in 70% of gangrenous cholecystitis cases
- Patchy gangrenous changes
- Preservation of afferent nerves
- Absent in 18% of non gangrenous cholecystitis cases
- Narcotics, large body habitus, obtunded/uncooperative patient

Teeley, AJR 2013; 200:363-368

Intraluminal membranes
- Fibrinous exudate
- Sloughed, necrotic mucosa
- Unusual finding
**Gangrenous cholecystitis**

**Differential diagnosis**
- Inspissated mucous
- Strands randomly oriented
- Multiseptate gallbladder
- Exceedingly rare
- Septae perpendicular to wall

**Inspissated mucous**

**Multiseptate GB**

**Wall irregularity, mural perforation, wall thickness**
- Wall irregularity, mural perforation
- Intramural abscess, necrosis, hemorrhage, ulceration
- Unusual findings
- Wall thickness
- Considerable overlap with nongangrenous cholecystitis

Jeffrey, Radiology 1983; 148:219-221
Teefey, AJR 2013; 200:363-369
Gangrenous cholecystitis

- Intramural abscess

Intramural abscess

Gangrenous cholecystitis

- Intramural ulceration

Intramural ulceration

Gangrenous cholecystitis

- Intramural perforation

Gallbladder perforation

- Fundus

  - Cystic artery branches: end arteries with no collaterals

Fundal perforation

- Pericholecystic fluid collection

  - Simple
    - Anechoic, thin, crescentic
    - Not associated with wall perforation
**Acute cholecystitis**

- Pericholecystic fluid collection
  - Complex
  - Debris, septations
  - Large, round/irregular shape
  - Gallbladder may or may not be identifiable
  - Associated with wall perforation

**Gangrenous cholecystitis**

- Perforation

**Acute Acalculous Cholecystitis**

- Incidence ~ 2-15%
- Men > women (3:1)
- Average age: ≥ 60 years
- Gangrenous changes ~ 40-60%
- Perforation ~ 7-20%
- Mortality rate ~ 30%

**Risk factors**

- Recent surgery, trauma, burns
- Severe illness
- Long ICU stay
- Prolonged hypotension, hypovolemia
- Sepsis
- Prolonged fasting/TPN

Huffman, Clin Gastroenterol and Hep 2010; 8:15-22
Pathogenesis
- Ischemia
  - Hypotension, hypovolemia → decreased perfusion of the GB wall → ischemia/necrosis → bacterial invasion
- Atherosclerosis
  - Elderly males with severe visceral atherosclerosis

Huffman, Clin Gastroenterol and Hep 2010; 8:15-22

- Biliary stasis
  - Precipitated by narcotics, fasting, TPN
  - Functional CD obstruction
    - GB distension → decreased perfusion
      - Bacterial invasion
- Sepsis
  - Bacterial endotoxins → damage GB wall → ischemia/necrosis

Signs and symptoms
- Similar to uncomplicated acute cholecystitis
- Masked by narcotics, postoperative pain, obtunded state

- Abdominal pain (78%)
- RUQ pain (50-56%)
- Fever (37%)
- Leukocytosis (54-70%)
- Abnormal LFTs (80%)

Kalliafas, Am Surg 1998; 64:471-475

Sonographic findings
- GB wall thickening
- Lumen distension
- Pericholecystic fluid
- Sonographic Murphy’s sign
- Sludge

GB wall thickening
- Normal (≤ 3 mm)
- Thick
  - Hypoalbuminemia, heart failure, renal failure, acute hepatitis, chronic liver disease, acute pancreatitis
Acute acalculous cholecystitis

**Lumen distension**
- Absent
- If mechanism ischemia or sepsis
- Present
  - Prolonged fasting, TPN, diabetes, narcotics, bile duct obstruction, vagotomy

**Pericholecystic fluid**
- Absent
- Present
  - Ascites, pancreatitis, perforated peptic ulcer

**Sonographic Murphy’s sign**
- Absent
  - Ischemia/necrosis
  - Narcotics, postop. pain, ↓ level of consciousness
- Present
  - Specific for acute acalculous cholecystitis
Sludge
- Present
- Prolonged fasting, TPN, trauma, post-partum, bone marrow transplantation
- Cause of acute acalculous cholecystitis

Acute acalculous cholecystitis
- Alcoholic pancreatitis, TPN 2 months

55 ICU patients with a low clinical suspicion for acalculous cholecystitis
- GB examined for sonographic signs of acute acalculous cholecystitis
- Wall thickening, wall striations, distension, pericholecystic fluid, sludge, Murphy’s sign

Conclusions
- GB abnormalities are frequently seen on US in ICU patients who have a low suspicion for acute acalculous cholecystitis
- US is of limited value in diagnosing acute acalculous cholecystitis in ICU patients

Boland, AJR 2000; 174:973-977

Reasonable approach
- Clinician: order US when there is a high index of suspicion (risk factors)
- Radiologist: correlate US findings with clinical history
- Consider morphine cholescintigraphy

Emphysematous Cholecystitis
Incidence ~ 1%
Men > women (2-3:1)
Average age: 50-70 years
DM ~ 30-50%
Acalculous: 30-50%
Gangrenous changes - 75%
Perforation - 20%
Mortality - 15-25%

Huffman, Clin Gastroenterol and Hep 2010; 8:15-22
**Pathogenesis**
- Thrombosis or occlusion of cystic artery and its branches
- Ischemic necrosis of GB wall
- Secondary anaerobic infection
  - Cl. welchii, E. coli, Staph., anaerobic Strept.

**Signs and symptoms**
- Severe RUQ pain, sepsis
- Subtle presentation
  - Afebrile (30-50%)
  - Leukocytosis (50%)
  - Absence of focal abdominal tenderness

**Sonographic findings**
- Intramural gas
  - Hyperechoic gallbladder wall
  - Dirty shadowing
  - Ringdown artifact

**Emphysematous cholecystitis**

**Differential diagnosis**
- Adenomyomatosis
- Porcelain gallbladder
Adenomyomatosis

Porcelain GB

- Intraluminal gas
  - Echoic foci with comet tail artifact
  - Changes position if patient turned
  - Rises toward nondependent gallbladder wall

Emphysematous cholecystitis

Differential diagnosis
- Biliary enteric anastomosis or fistula
- Patulous S. of Oddi or sphincterotomy
- Cholesterol crystals

Intramural, intraluminal air
Summary

Gangrenous, acalculous, and emphysematous cholecystitis are increasing in incidence, have a relatively high morbidity and mortality rate, and may have an atypical and often subtle clinical presentation.

Summary

Sonographic findings should be interpreted within the context of the patient's overall clinical status and laboratory tests, given the low specificity and sensitivity of many of the findings.