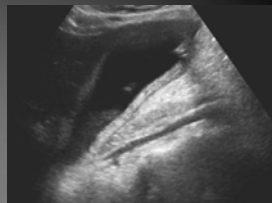


Right upper quadrant pain

Bruce Lehnert MD

Gallbladder

- Acute cholecystitis
 - Occurs in 1/3 of patients with gallstones (F>M).
 - Sonographic findings include:
 - Murphy's sign
 - Gallstones (particularly impacted in the neck or cystic duct)
 - Thickened gallbladder wall (>4mm)
 - Distended gallbladder (>4-5 cm)
 - Pericholecystic fluid
 - Combination of gallstones and sonographic Murphy's sign has highest PPV.



Gallbladder

- Acute cholecystitis
 - CT often initial imaging test in acute right upper quadrant pain in the ED.
 - NPV is approx. 90%
 - Detection of gallstones with CT is less reliable than US
 - 20% not identified
 - Noncalcified stones (cholesterol) may be subtle or non visible, particularly at lower kVp



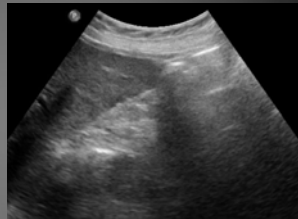
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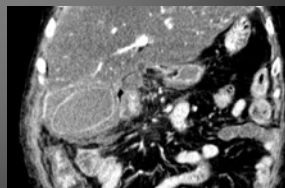
Gallbladder

- Emphysematous cholecystitis
 - Variant of acute cholecystitis due to gas forming organisms
 - C. perfringens
 - E. coli
 - 5 x risk of rupture
 - Risk factors:
 - Male
 - Diabetes
 - US findings:
 - Highly echogenic gas with "dirty shadowing"
 - May be difficult to differentiate from "porcelain" gallbladder or multiple stones



Gallbladder

- Emphysematous cholecystitis
 - CT is most sensitive and specific modality for gas detection in GB wall or lumen
 - Wall thickening
 - Pericholecystic inflammation
 - Pneumoperitoneum (if ruptured)



Gallbladder

- Emphysematous cholecystitis
 - CT is most sensitive and specific modality for gas detection in GB wall or lumen
 - Wall thickening
 - Pericholecystic inflammation
 - Pneumoperitoneum (if ruptured)
 - Higher mortality than typical acute cholecystitis



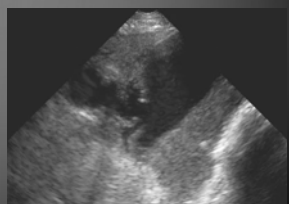
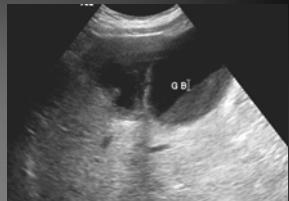
Gallbladder

- Gangrenous cholecystitis
 - Progressive increased intraluminal pressure results in GB wall ischemia and necrosis
 - 26% of acute cholecystitis cases
 - Elderly
 - Diabetes
 - May present with more generalized abdominal pain due to more diffuse peritonitis
 - Sonographic Murphy's negative in 2/3 of cases
 - Imaging findings:
 - Gas in wall or lumen
 - Intraluminal membranes
 - Progresses to perforation in 10%



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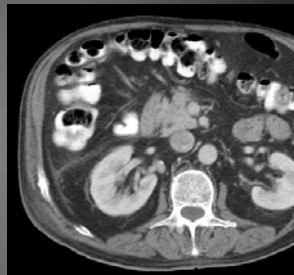
Gallbladder

- Perforated gallbladder
 - Perforation associated with up to 24% mortality
 - Acute (10%)
 - Sub acute (60%)
 - Chronic (30%)



Gallbladder

- Perforated gallbladder
 - CT is not sensitive but is highly specific.
 - Findings parallel those found at ultrasound:
 - Acute:
 - Gas in GB lumen or wall
 - Pneumoperitoneum
 - Peritoneal fluid/peritonitis
 - Intraluminal membranes
 - Irregular or absent GB wall
 - Acute/Subacute:
 - Pericholecystic abscess or biloma
 - Chronic
 - Cholecystoenteric fistula
 - May present with bowel obstruction



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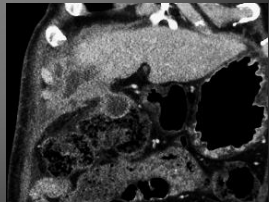
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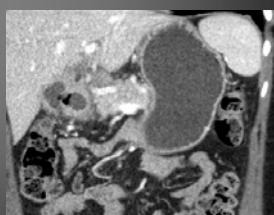
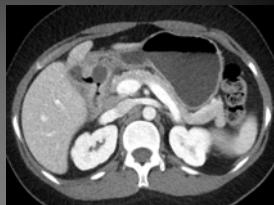
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Gallbladder

- Hemorrhagic cholecystitis
 - Rare complication of acute cholecystitis
 - Trauma
 - Anticoagulation
 - Malignancy
 - Likely due to GB wall inflammation, infarction, necrosis and erosion
 - Patients may present with hematemesis or melena
 - Imaging findings:
 - Hyperattenuating bile
 - Active contrast extravasation
 - Hemoperitoneum if GB perforated



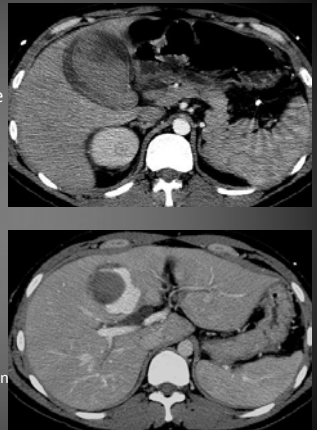
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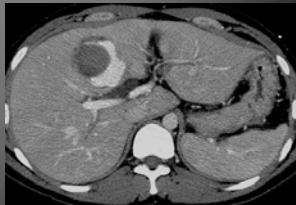
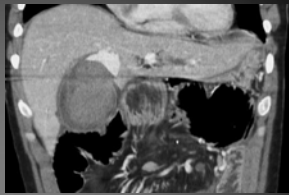
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Gallbladder

- Mirizzi syndrome
 - Extrinsic compression of the common hepatic duct by an impacted cystic duct stone.
 - CHD and cystic duct are adjacent to one another in a common sheath near cystic duct insertion
 - May present with fevers, RUQ pain, and jaundice
 - Acute cholecystitis may be present
 - Findings at CT include
 - Stone in the cystic duct or GB neck
 - Proximal dilation of the common hepatic and intrahepatic ducts
 - Normal common bile duct caliber



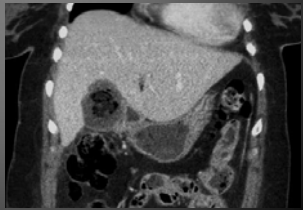
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Gallbladder

- Post cholecystectomy acute complications
 - Bile leak (most common)
 - Cystic duct stump
 - Unrecognized anomalous
 - Acute biliary obstruction
 - Common hepatic duct mistaken for cystic duct and ligated
 - Bile and stone spillage
 - Perforation of the GB is common during laparoscopic removal (35%)
 - Abscess



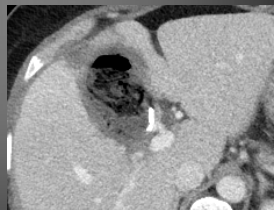
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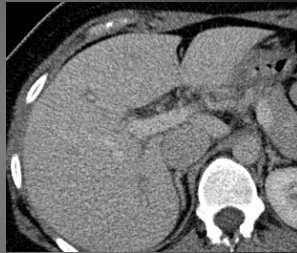
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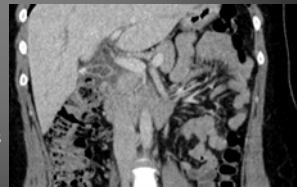
Gallbladder

- Post cholecystectomy subacute complications
 - “Post cholecystectomy syndrome”
 - Group of biliary, extrabiliary, and psychosomatic (50%) post cholecystectomy abdominal symptoms.
 - Subacute/chronic etiologies:
 - Cystic duct remnant stones
 - Bile duct strictures
 - Recurrent CBD stones



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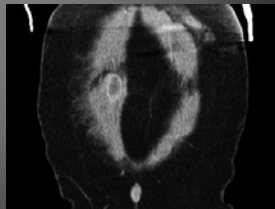
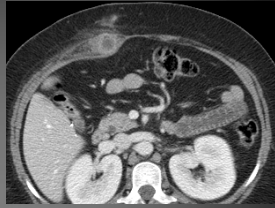
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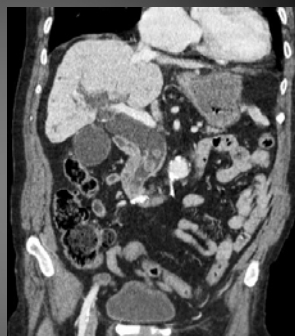
Bile ducts

- Choledocholithiasis
 - Majority pass from GB into CBD rather than arising de novo in the bile ducts
 - Present in 12% at cholecystectomy
 - Often asymptomatic until they result in obstruction
 - Ampulla of Vater
 - Complications
 - Acute cholangitis
 - Gallstone pancreatitis



Bile ducts

- Choledocholithiasis
 - US sensitivity: 70-75%
 - MRCP sensitivity: 95%
 - CT reported sensitivity ranges from 25-90%
 - Approx. 25% of gallstones are isoattenuating to bile or to surrounding tissue (pancreas).
 - “Bull’s eye” sign
 - Dilated bile ducts
 - Size of stone/degree of obstruction
 - Duration of obstruction



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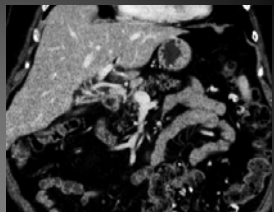
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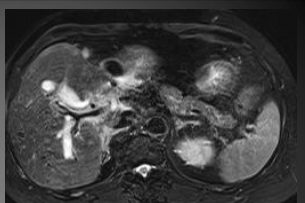
Bile ducts

- Acute cholangitis
 - Bacterial overgrowth in biliary system due to bile stasis/obstruction
 - Chemotherapy
 - AIDS
 - Recurrent pyogenic
 - CT findings:
 - Dilated biliary tree
 - Bile duct thickening and increased enhancement
 - High attenuation bile due to purulent material
 - Strictures in chronic, acute on chronic disease



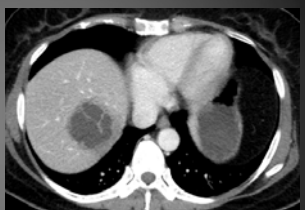
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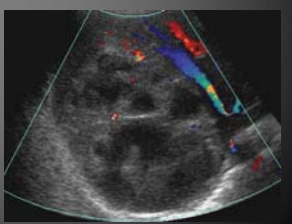
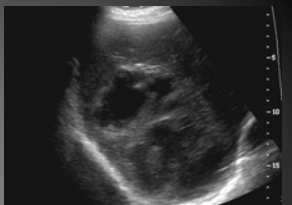
Hepatic infection

- Pyogenic liver abscess
 - Hematologic
 - Portal
 - Diverticulitis
 - Appendicitis
 - IBD
 - Systemic
 - Endocarditis
 - Soft tissue infection
 - Osteomyelitis
 - Direct extension
 - Bacterial cholangitis
 - Iatrogenic
 - Biliary instrumentation
 - Stent placement
 - RFA/TACE
 - Idiopathic (50%)



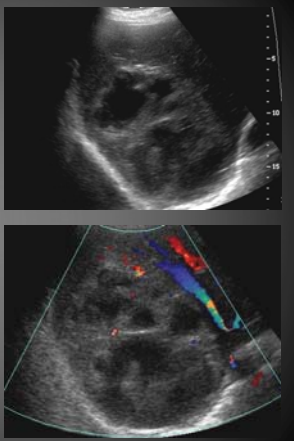
Hepatic infection

- Pyogenic liver abscess
 - Microabscess
 - < 2cm
 - Miliary distribution
 - Hematologic dissemination
 - Spleen frequently also involved
 - Clustered distribution
 - Typically due to enteric disease or direct extension
 - At US
 - Hypoechoic nodules
 - Poorly defined regions of abnormal hepatic echogenicity
 - At CT
 - Hypoattenuating lesions
 - +/- rim enhancement
 - Surrounding edema



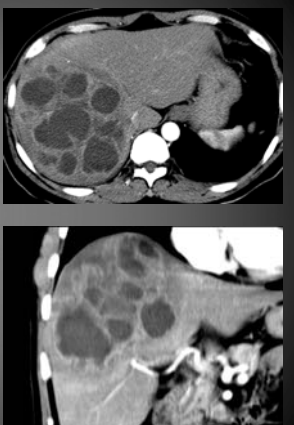
Hepatic infection

- Pyogenic liver abscess
 - Macroabscess
 - > 2cm
 - At US: Variable appearance: requires integration with clinical presentation
 - Cystic mass
 - Variable fluid echogenicity
 - Internal septations- may show vascularity
 - Gas
 - Solid mass



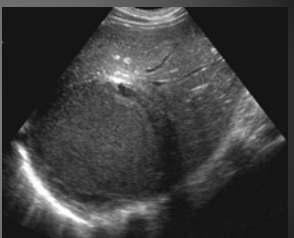
Hepatic infection

- Pyogenic liver abscess
 - Macroabscess
 - At CT
 - Well defined
 - Hypoattenuating
 - Typically complex with multiple enhancing septations
 - » Less commonly unilocular
 - Gas
 - Wedge shaped perfusion anomaly around lesion (arterial phase)



Hepatic infection

- Amebic liver abscess
 - Entamoeba histolytica
 - Approx. 10% world population infected
 - Liver abscess is most common complication
 - Acutely ill at presentation (> pyogenic)
 - Differentiation from pyogenic abscess may be challenging
 - Serum antibodies may be negative in acute phase
 - Aspiration may not allow differentiation



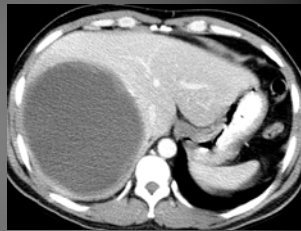
Hepatic infection

- Amebic liver abscess
 - US appearance
 - Hypoechoic lesion
 - Low level internal echoes
 - Well defined
 - Round or oval
 - Often abuts liver capsule
 - Enhanced through transmission



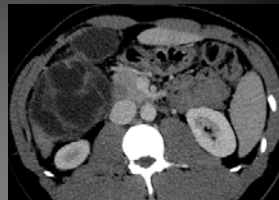
Hepatic infection

- Amebic liver abscess
 - CT appearance
 - Rounded, well defined lesion
 - Often appears unilocular
 - Complex fluid attenuation (10-20HU)
 - Mildly enhancing, thickened wall
 - Thin rim of hepatic parenchyma edema
 - May extend beyond capsule
 - Chest wall
 - Pleura
 - Pericardium (high mortality)



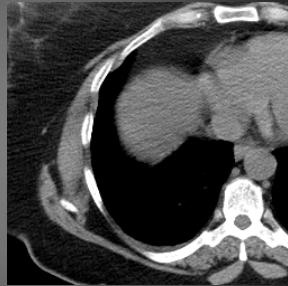
Hepatic infection

- Hydatid cyst
 - *E granulosus* tapeworm infection (most common)
 - Humans infected by ingesting eggs (contaminated food, contact with dogs)
 - Embryos invade intestinal mucosa and travel via portal system to the liver
 - Embryos not destroyed in the liver become hydatid cysts



Hepatic infection

- Hydatid cyst
 - Composed of three layers
 - Pericyst: fibrosed liver
 - Ectocyst: thin a cellular interleaving membrane
 - Endocyst: inner germinal layer
 - As cyst matures, the endocyst invaginates and creates “daughter” cysts.
 - Cyst wall may calcify
 - Does not predict viability



Hepatic infection

- Hydatid cyst
 - CT appearance
 - Well defined wall
 - Hypoattenuating
 - Calcifications: 50%
 - Daughter cysts: 75%
 - Little or no enhancement of the internal septations
 - Dilated intrahepatic bile ducts
 - Mechanical compression
 - Cyst rupture



Hepatic infection

- Hydatid cyst
 - CT appearance
 - Well defined wall
 - Hypoattenuating
 - Calcifications: 50%
 - Daughter cysts: 75%
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 - Mechanical compression
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Hepatic infection

- Hydatid cyst
 - CT appearance
 - Well defined wall
 - Hypoattenuating
 - Calcifications: 50%
 - Daughter cysts: 75%
 - Little or no enhancement of the internal septations
 - Dilated intrahepatic bile ducts (possible jaundice)
 - Mechanical compression
 - Cyst rupture



Hepatic infection

- Hydatid cyst
 - Cyst rupture
 - Some communication of the hydatid cyst with the biliary tree is reported to be common (90%)
 - Rupture of the cyst into the biliary tree is uncommon
 - 5-15%
 - Present with symptoms of cholangitis
 - CT may demonstrate:
 - Cyst wall defect
 - High attenuation material in bile ducts
 - Bile duct thickening and inflammation



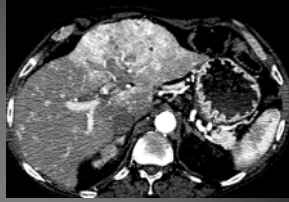
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Hepatic Neoplasm

- Large masses may become symptomatic due to mass effect on or irritation of the liver capsule
- Acute presentation may be related to complication
 - Rupture
 - Hemorrhage
 - Necrosis



Neoplasm

- Large masses may become symptomatic due to mass effect on or irritation of the liver capsule
- Acute presentation may be related to complication
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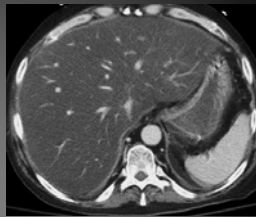
Neoplasm

- Liver lesions prone to hemorrhage
 - HCC
 - Hepatic adenoma
- Less common considerations
 - Focal nodular hyperplasia
 - Hemangiomas
 - Metastases



Hepatitis

- Viral
- Alcoholic
- Non alcoholic steatohepatitis (NASH)



Hepatitis

- Viral
 - Hepatomegaly
 - Reactive gallbladder wall thickening (> than in cholecystitis)
 - Periportal edema
 - Possible reactive porta hepatis lymphadenopathy
 - “Starry sky” on US: increase echogenicity of portal venous walls relative to edematous liver parenchyma



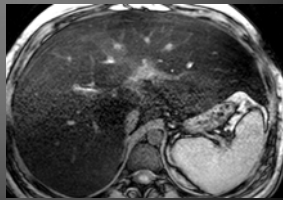
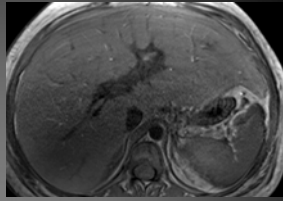
Hepatitis

- Alcoholic
 - Hepatomegaly
 - Reactive gallbladder wall thickening (> than in cholecystitis)
 - Periportal edema
 - Fatty infiltration of the liver
 - No “starry sky”



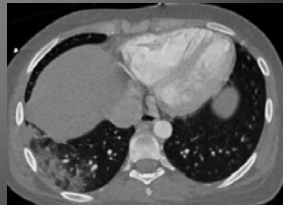
Hepatitis

- Non Alcoholic Steatohepatitis
 - Hepatomegaly
 - Reactive gallbladder wall thickening (> than in cholecystitis)
 - Periportal edema
 - Fatty infiltration of the liver
 - No “starry sky”
 - Indistinguishable from alcoholic hepatitis at imaging



Other causes of RUQ pain

- Pulmonary Embolism
- Pyelonephritis
- Pancreatitis
- Myocardial infarction
- Colitis
- Rectus sheath hematoma
- Pneumonia
- PUD



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Further reading

- Hanbidge AE, Buckler PM, O'Malley ME, Wilson SR. From the RSNA refresher courses: imaging evaluation for acute pain in the right upper quadrant. *Radiographics : a review publication of the Radiological Society of North America, Inc* 2004; 24:1117-1135
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