Yarmouk University

ACUTE CHOLECYSTITIS

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INTRODUCTION

- Gallstones are one of the most common disorders of the GIT, affecting about 10% of people in Western society.
- More than 80% of people with gallstones are asymptomatic.
- Acute cholecystitis is most often caused by gallstones.
- Acute cholecystitis develops in 1-3% of patients with gallstones.
- Helminthic infection (ascariasis) is a major cause of biliary disease in developing countries in Asia, southern Africa, and Latin America.
- Obstruction of the cystic duct causes an inflammatory process to start. This results in acute cholecystitis.
- If the inflammation persists it may cause perforation or gangrene of the gallbladder.
- Diagnosis of acute cholecystitis is made on the basis of clinical features and is supported by results of ultrasound scanning.
- Treatment is predominantly surgical, although the timing of surgery is under debate.

PATHOGENESIS

- Over 90% of cases of acute cholecystitis result from obstruction of the cystic duct by gallstones or by biliary sludge that has become impacted at the neck of the gallbladder.
- Obstruction of the cystic duct causes the intraluminal pressure within the gallbladder to increase and, together with cholesterol supersaturated bile, triggers an acute inflammatory response.
- The trauma caused by the gallstones stimulates the synthesis of prostaglandins I2 and E2, which mediate the inflammatory response.
- Secondary bacterial infection with enteric organisms (most commonly Escherichia coli, Klebsiella, and Streptococcus fecalis) occur in about 20% of cases.
- Biliary sludge is a mixture of particulate matter and bile, and it may stimulate microlithiasis. If the sludge persists—for example, because the patient has already had several pregnancies or is receiving total parenteral nutrition—gallstones can form.
- Most patients with biliary sludge have no symptoms, but the sludge it self can cause acute cholecystitis.

Anatomy of gallbladder and extrahepatic biliary tree

- Bile
  - Helps the body digest fats
  - Made in the liver
  - Stored in the gallbladder until the body needs it
  - Contains:
    - Water
    - Cholesterol
    - Bile pigments
    - Phospholipids
    - Bicarbonate
    - Anions of the bile acids
- Concentrations vary - different kinds of stones may be formed

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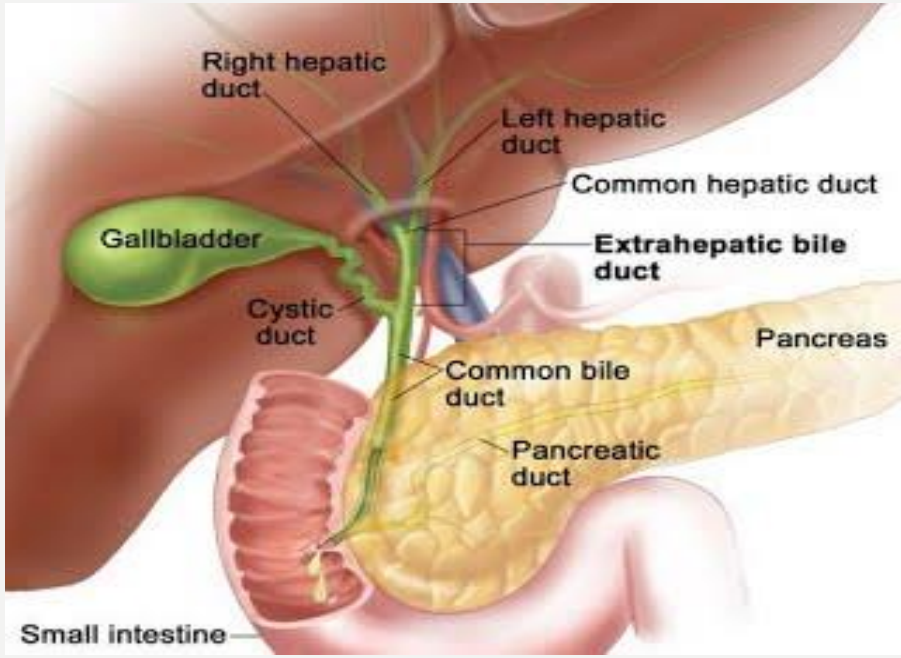
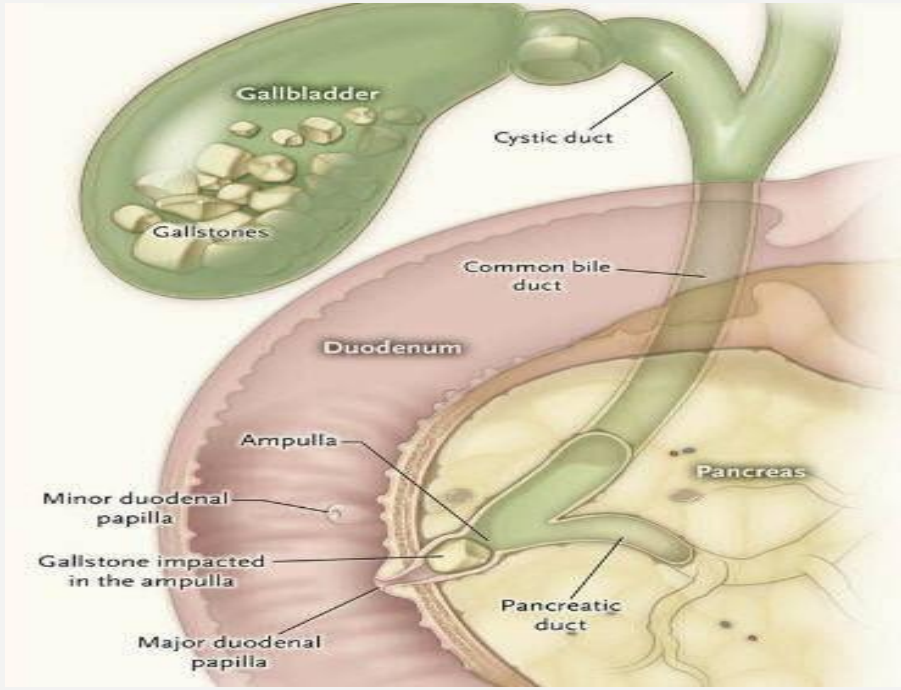
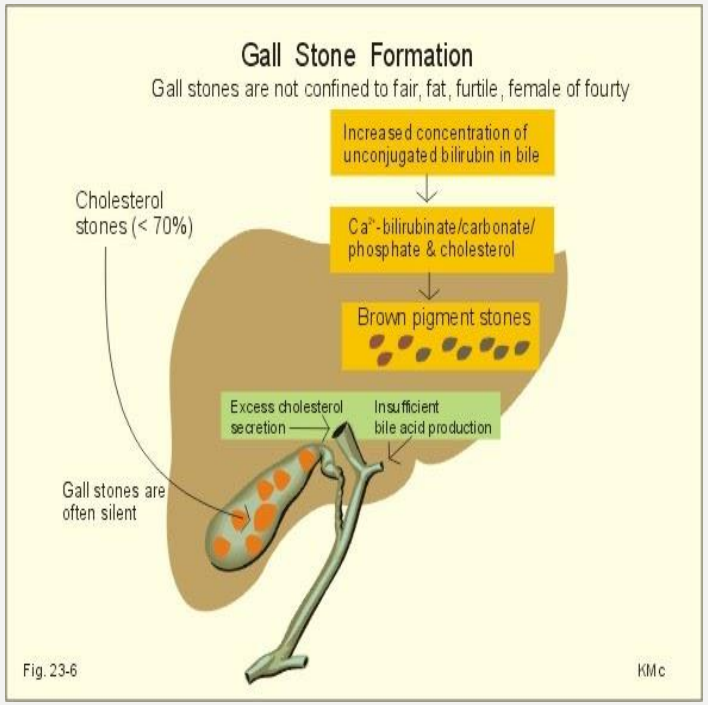
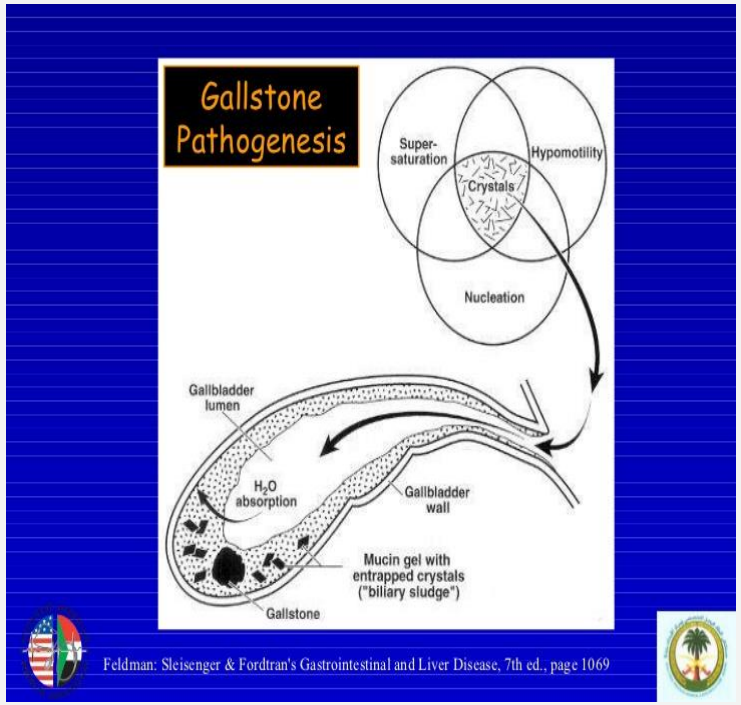
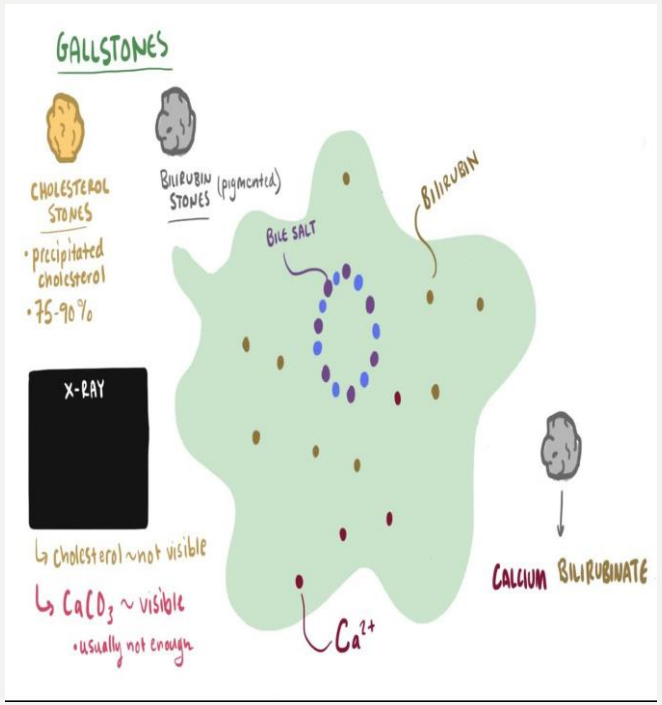


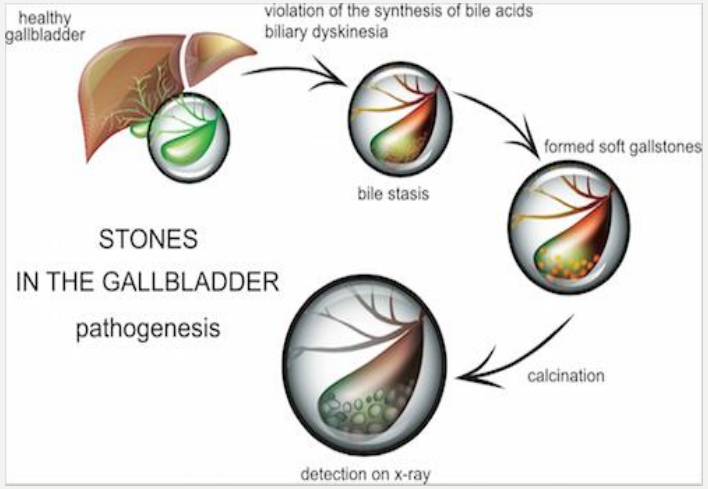


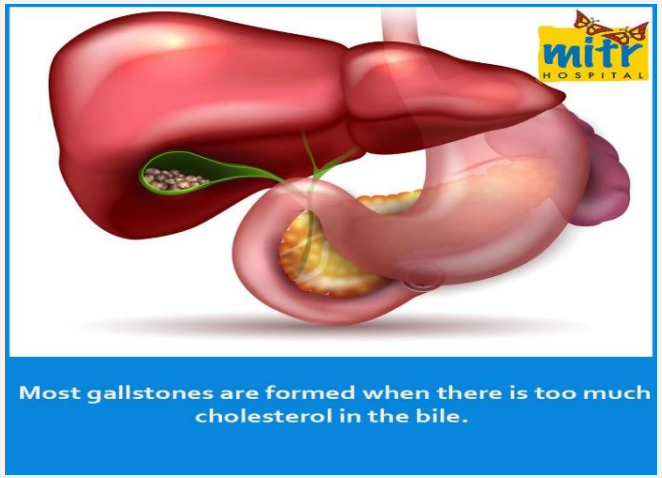
GALLSTONE FORMATION

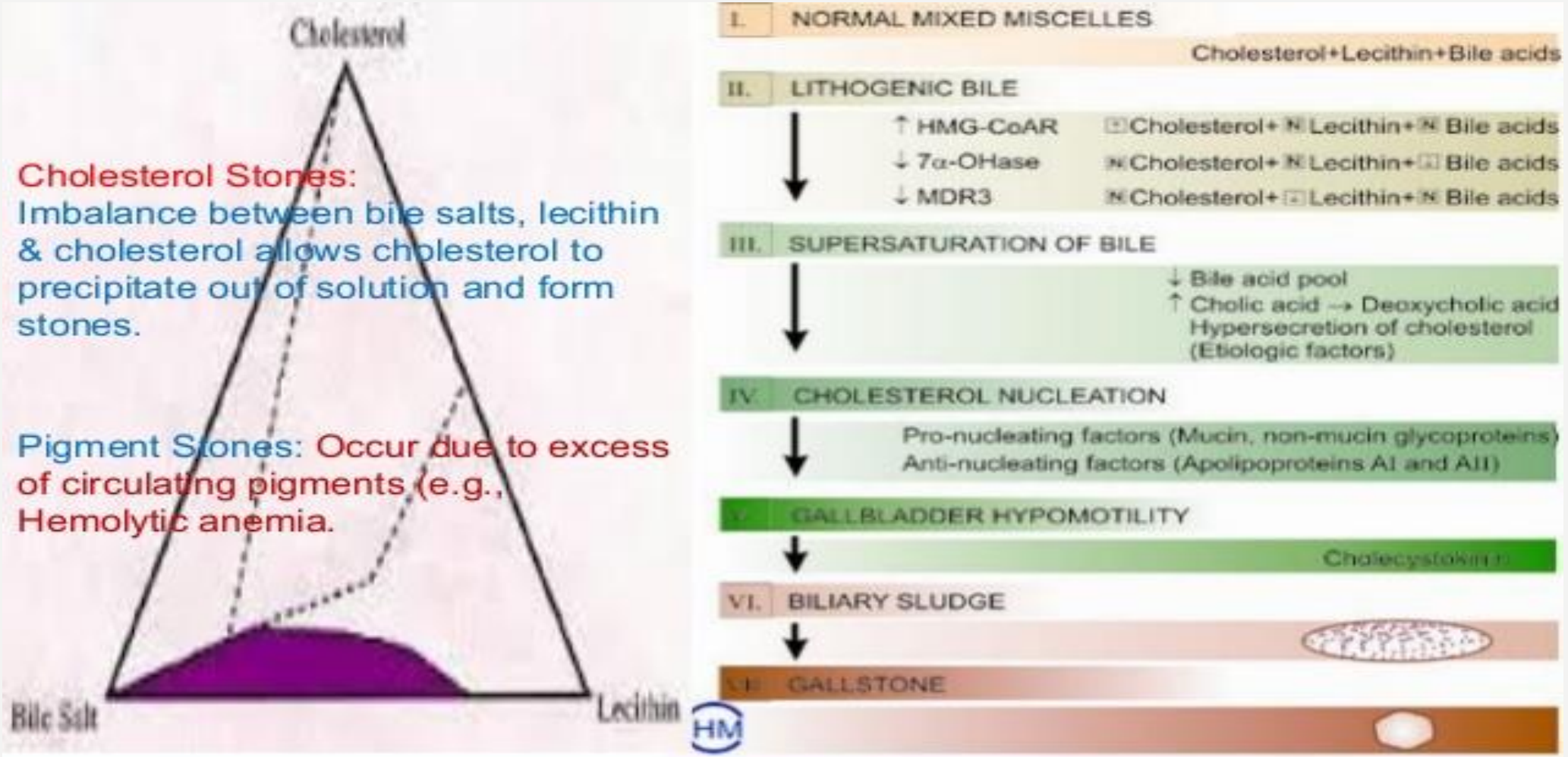




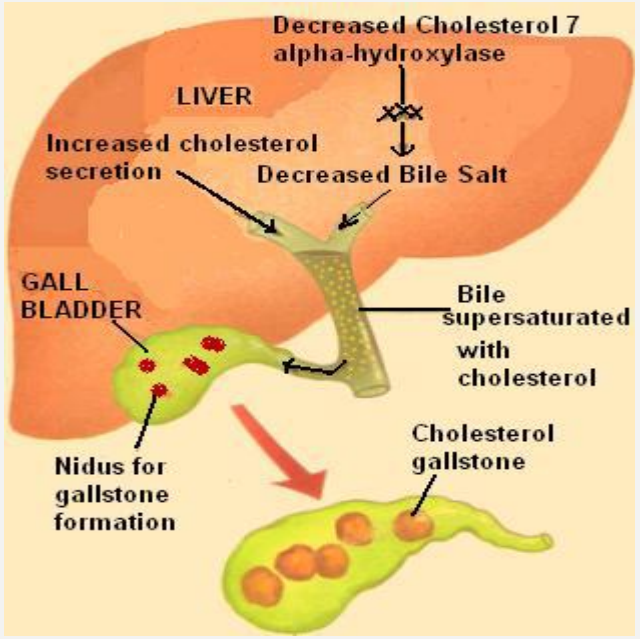


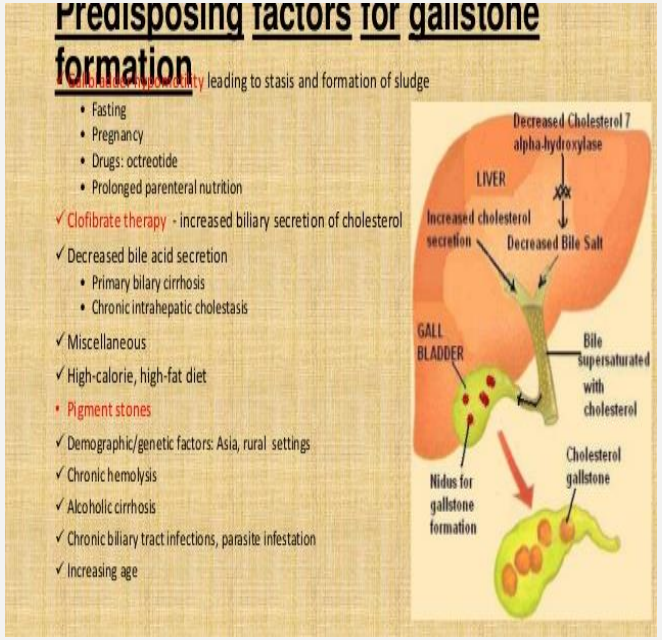






Schematic pathogenesis of gallstone formation. (HMG- CoAR = hydroxy methyl glutaryl-coenzyme A reductase; 7α-OHase = cholesterol 7 α-OHase hydroxylase; MDR3 = multidrug resistance- associated protein 3).





What are gallstones?

- Small, pebble-like substances
- Multiple or solitary
- May occur anywhere within the biliary tree
- Have different appearance - depending on their contents

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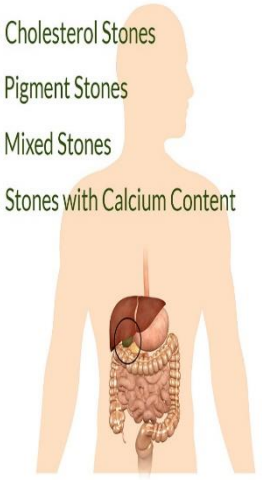
Types of Gallstones

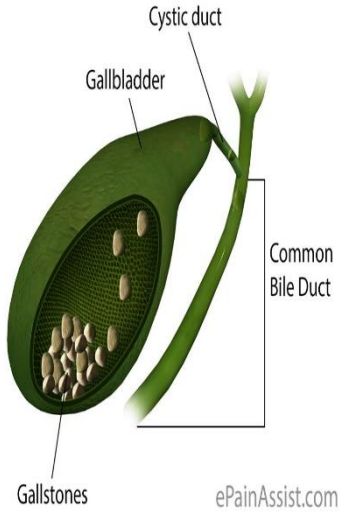
- Mixed (80%)
- Pure cholesterol (10%)
- Pigmented (10%)
  - Black stones (contain Ca bilirubinate, a/w cirrhosis and hemolysis)
  - Brown stones (a/w biliary tract infection)

4 Types of Gallstones

- Cholesterol Stones
- Pigment Stones
- Mixed Stones
- Stones with Calcium Content



Gallstones



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Cholesterol stones

- Large
- Often solitary
- Yellow, white or green
- Made primarily of cholesterol (>70%)
- Risk factors:
  - 4 "F" :
    - Female
    - Forty
    - Fertile
    - Fat
  - Fair (5th "F" - more prevalent in Caucasians)
  - Family history (6th "F")

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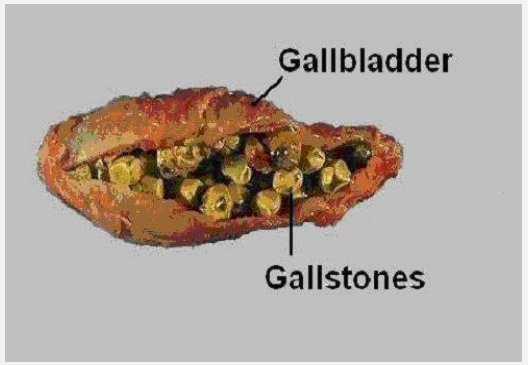

Gallbladder
Gallstones


Codman


Longest stone:
3.2 cm

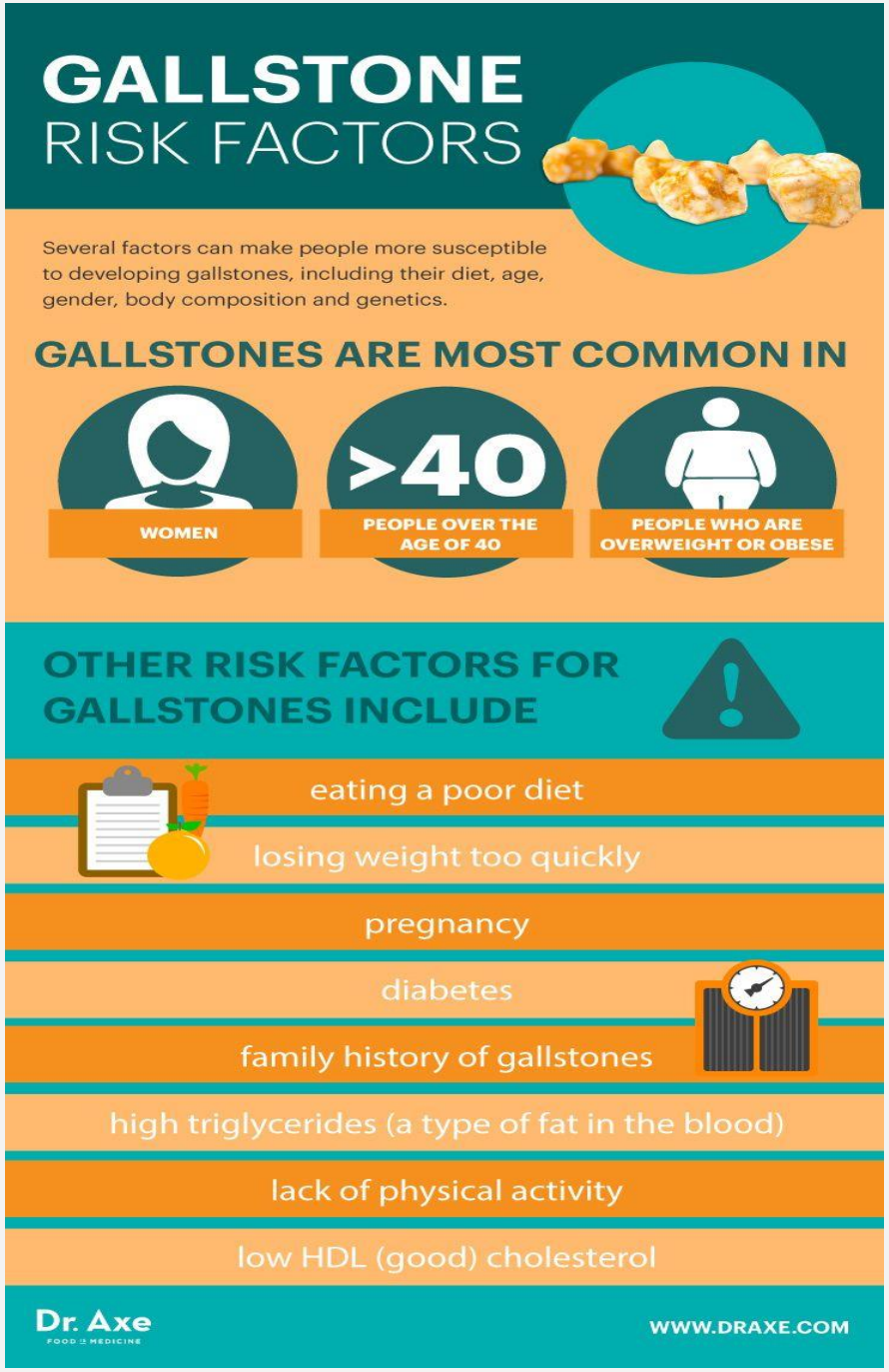
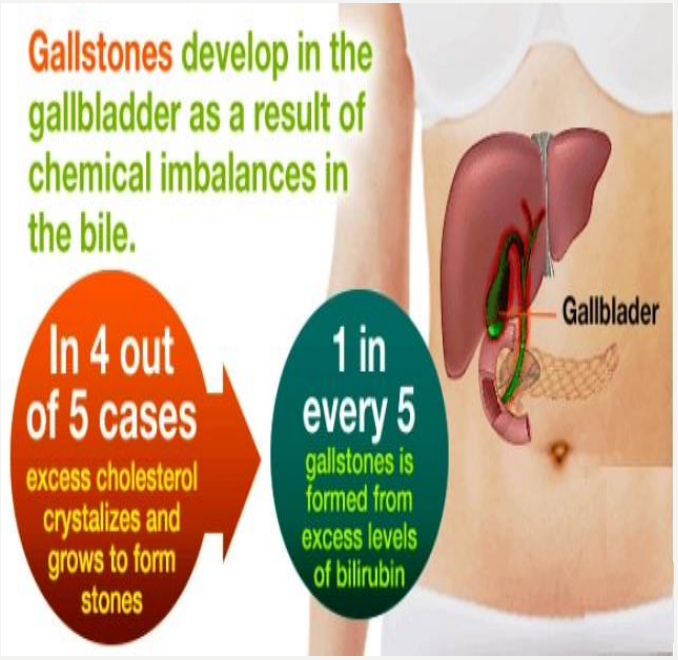


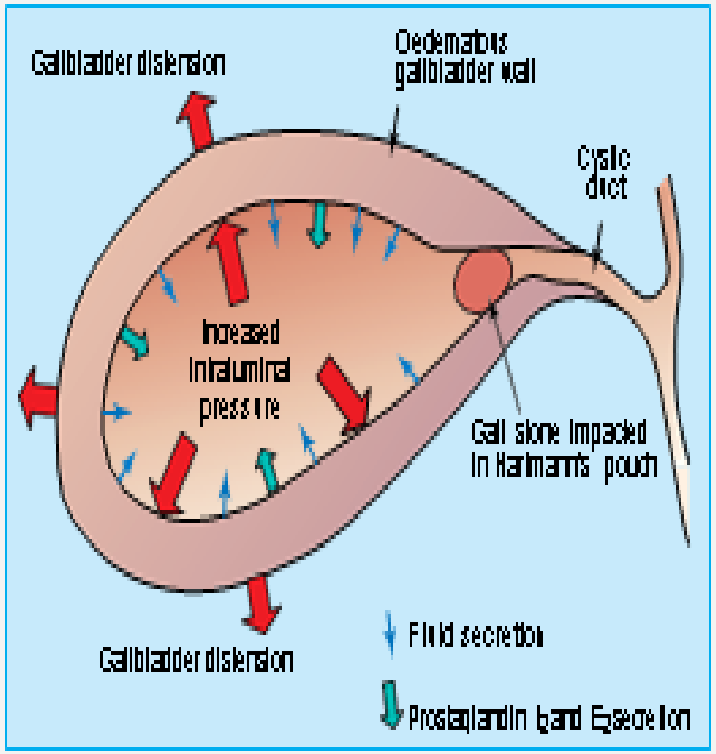
Table 2

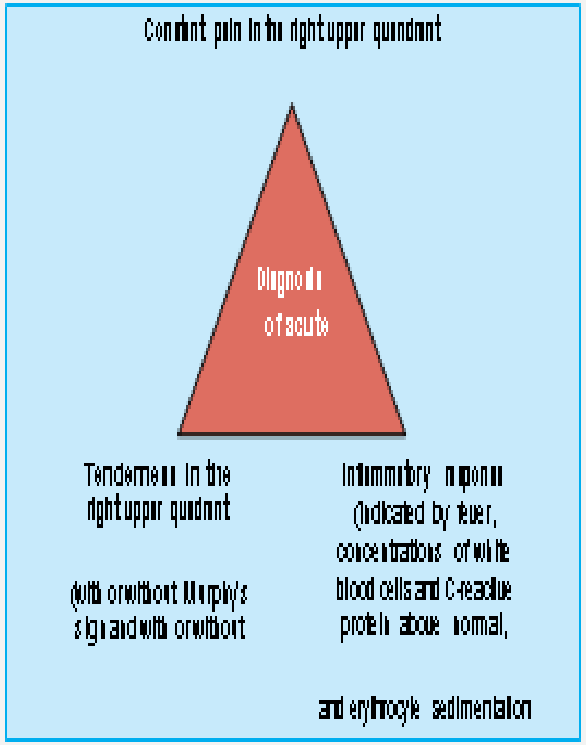
DIETARY IMPACT ON GALLSTONE FORMATION
Increased gallstone risk is associated with:
Diets high in cholesterol
High intake of refined sugar
Iron and vitamin C deficiency
Food allergies to eggs, pork, onions, chicken, and milk
Decreased gallstone risk is associated with:
Vegetarian diets
High-fiber diets
Caffeine intake (coffee)
Weekly consumption of nuts
Vitamin C (observed only in women)
Soy lecithin

Adapted from references 4 and 6.

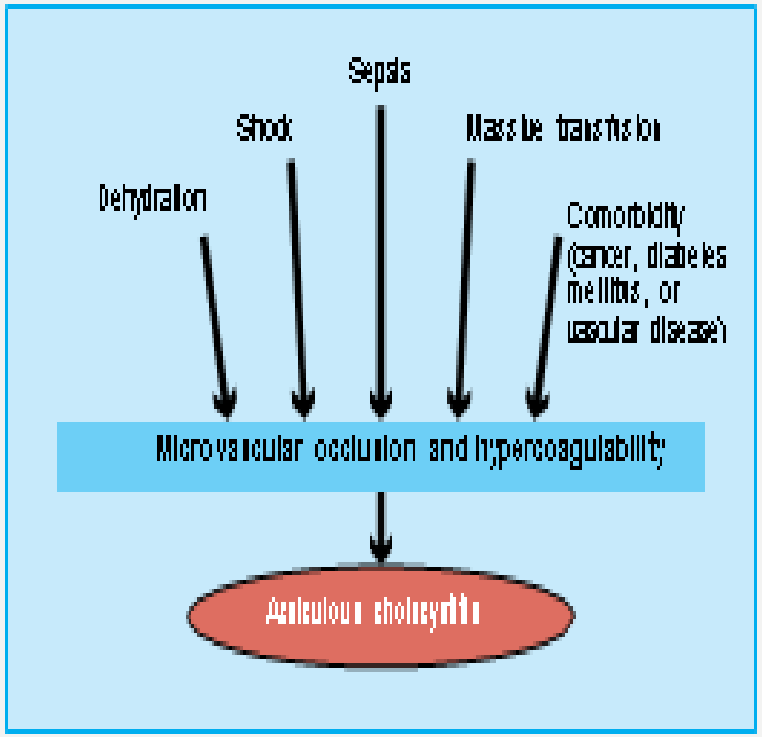


PATHOGENESIS OF ACUTE CHOLECYSTITIS





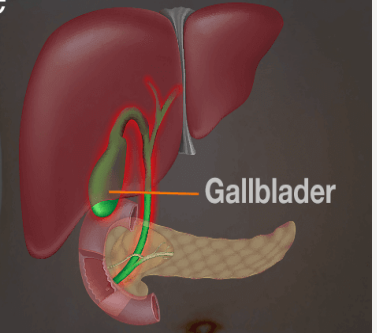
Clinical features of acute cholecystitis: diagnosis is made when features from all three points of diagnostic triangle are present



Pathogenesis and risk factors for acute acalculous cholecystitis

Gallstones

are hard particles that develop in the gallbladder due to **chemical imbalances**.



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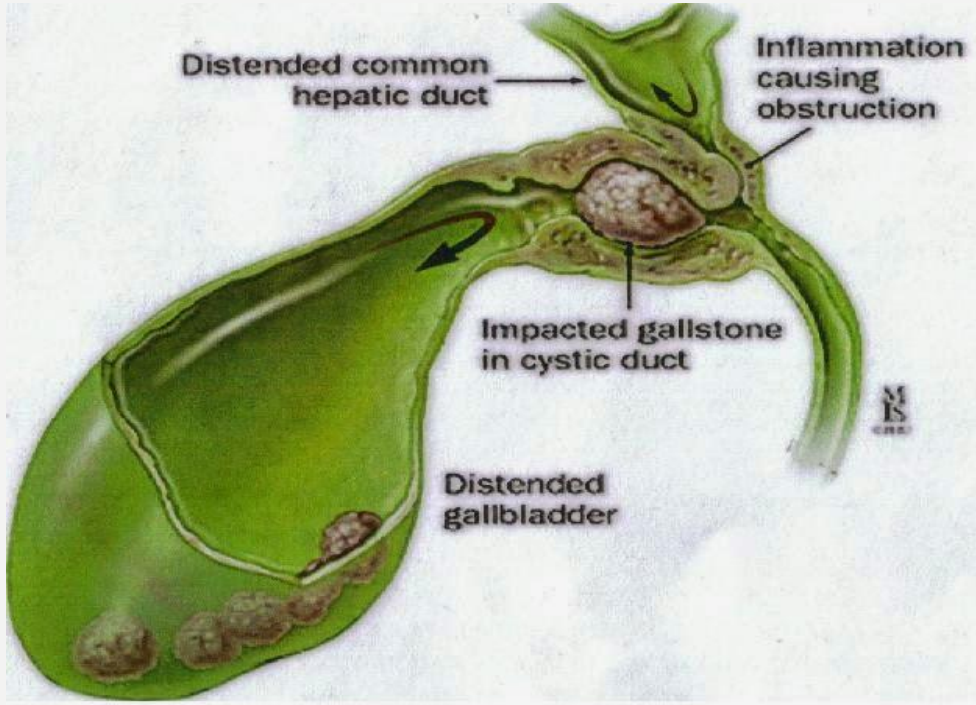
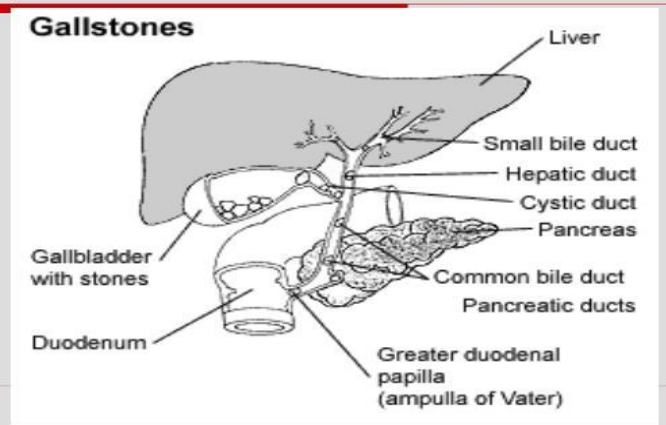


CONCLUSIONS

- Gallbladder stones are not always "innocent"

Common gallstone complications



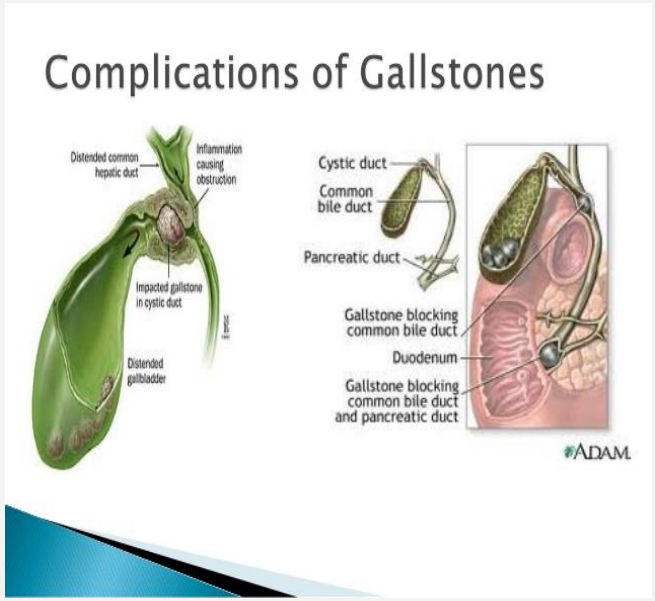
PRESENTATION AND DIAGNOSIS

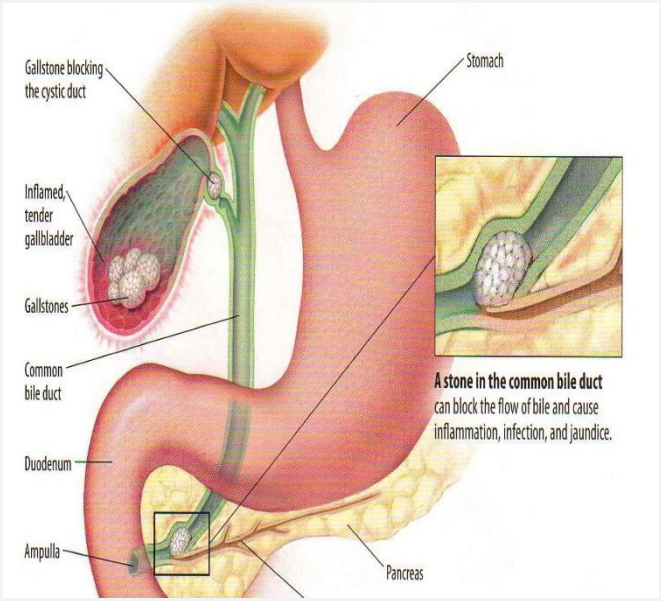
- Acute cholecystitis is diagnosed on the basis of symptoms and signs of inflammation in patients with peritonitis localized to the right upper quadrant.
- Acute cholecystitis should be differentiated from biliary colic by the constant pain in the right upper quadrant and Murphy's sign (in which inspiration is inhibited by pain on palpation).
- Patients with acute cholecystitis may have a history of attacks of biliary colic or they may have been asymptomatic until the presenting episode.
- In patients with superimposed bacterial infection, septicemia develops and is associated with increased morbidity and mortality.
- Patients with severe acute cholecystitis may have mild jaundice (serum concentrations of bilirubin <60 ìmol/l) caused by inflammation and edema around the biliary tract and direct pressure on the biliary tract from the distended gallbladder. Concentrations of bilirubin >60 ìmol/l suggest a diagnosis of choledocholithiasis (a gallstone in the common bile duct) or Mirizzi's syndrome (obstruction by a stone impacted in Hartmann's pouch that compresses the common hepatic duct).

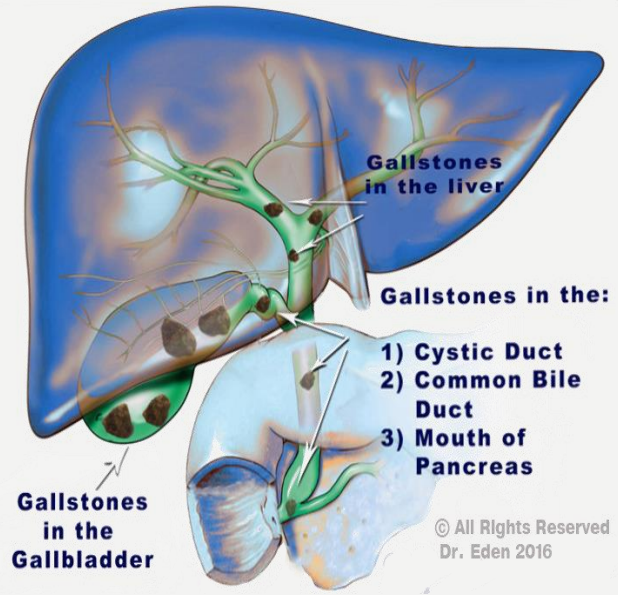
Table 1

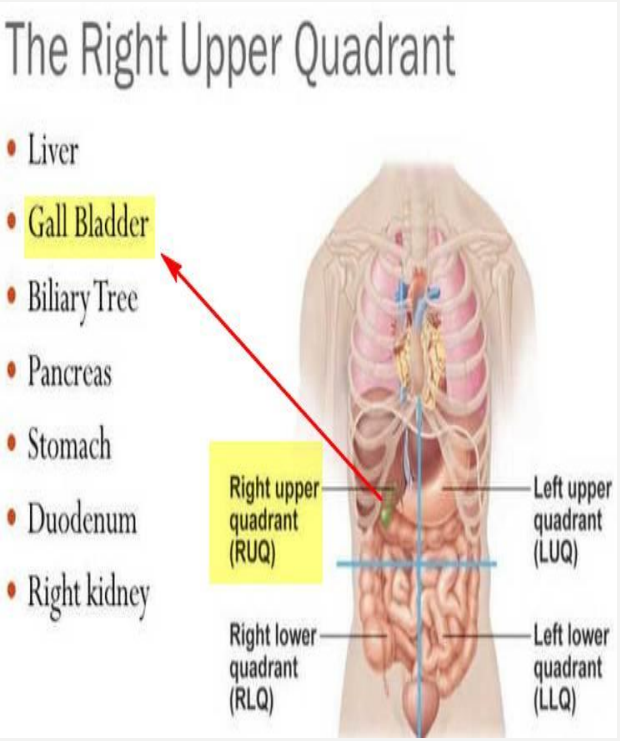
GALLSTONE SYMPTOMS
Intense, sudden pain in the upper right part of the abdomen
Recurrent, painful attacks shortly after a meal, lasting several hours
Pain that worsens with deep breaths, extending to the right shoulder blade
Pain increasing in intensity below the breast bone
Nausea, vomiting, chills, fever, jaundice

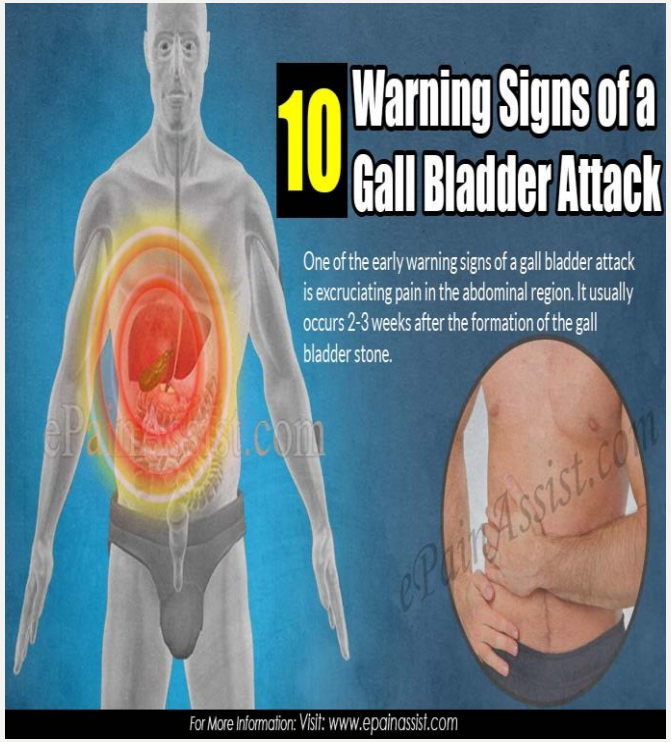
Adapted from references 1, 2, and 4.

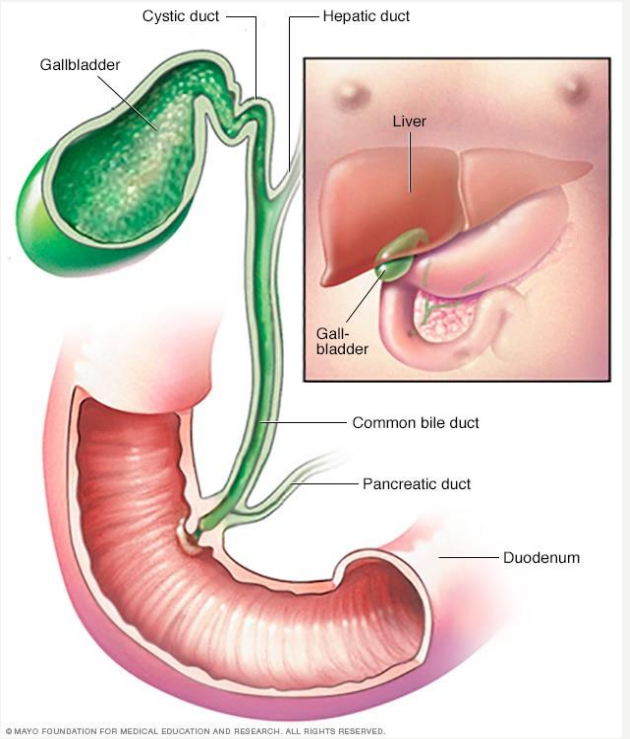







The Right Upper Quadrant
Liver
Gall Bladder
Biliary Tree
Pancreas
Stomach
Duodenum
Right kidney
Right upper quadrant (RUQ)
Left upper quadrant (LUQ)
Right lower quadrant (RLQ)
Left lower quadrant (LLQ)


10 Warning Signs of a Gall Bladder Attack
One of the early warning signs of a gall bladder attack is excruciating pain in the abdominal region. It usually occurs 2-3 weeks after the formation of the gall bladder stone.
For More Information: Visit: www.epainassist.com


Cystic duct
Hepatic duct
Gallbladder
Liver
Gall-bladder
Common bile duct
Pancreatic duct
Duodenum
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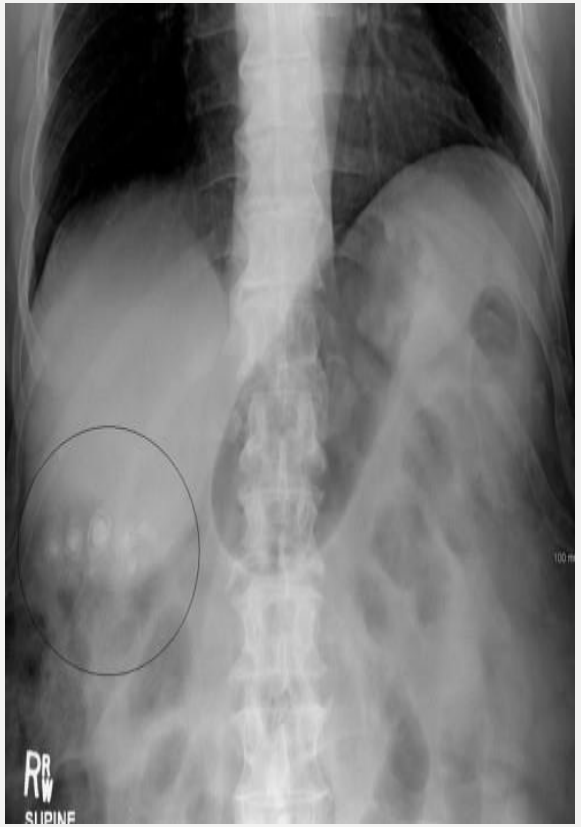
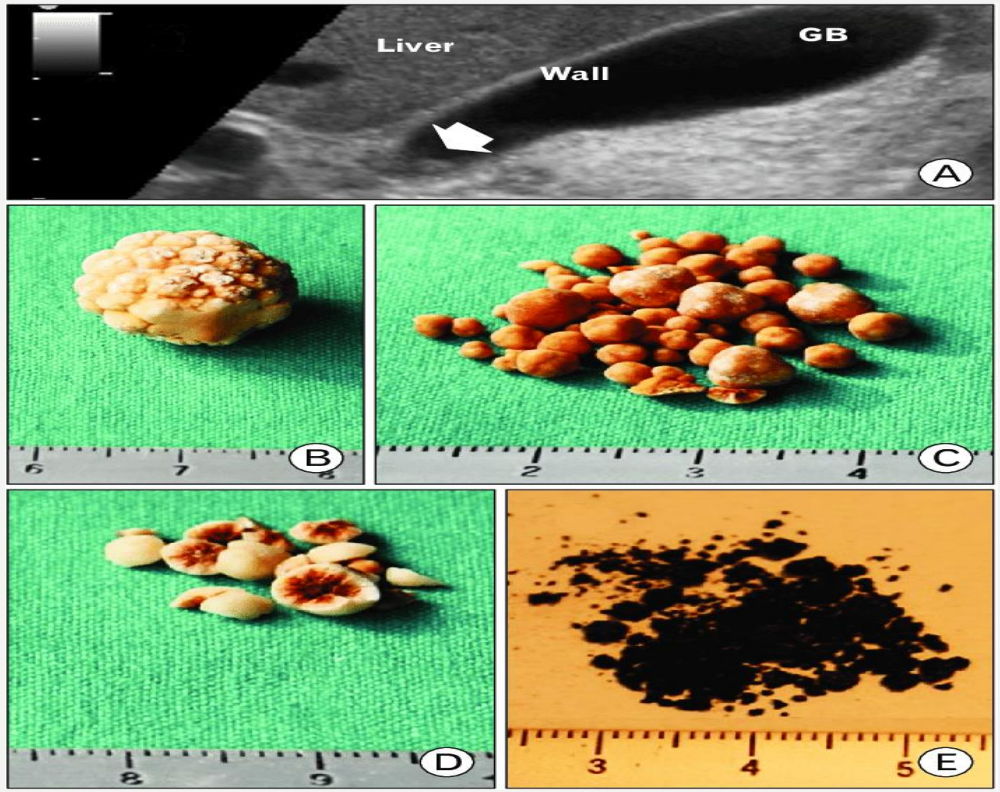
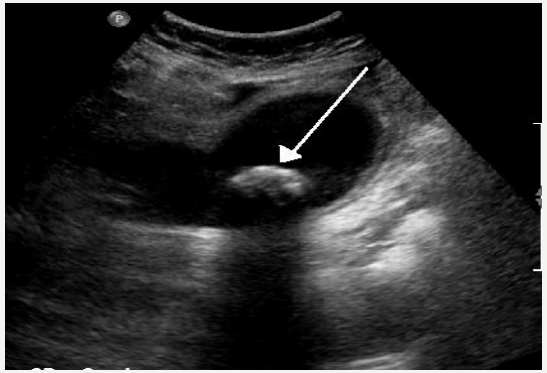
INVESTIGATIONS

- Ultrasound scanning is the investigation of choice in patients suspected of having acute cholecystitis.
- Sonograms typically show pericholecystic fluid (fluid around the gallbladder), distended gallbladder, edematous gallbladder wall, and gall stones, and Murphy's sign can be elicited on ultrasound examination.
- Color flow Doppler ultrasound shows hyperemic, pericholecystic blood flow and acute inflammation.
- Plain abdominal radiographs show radio-opaque gallstones in about 10% of cases of acute cholecystitis and gas within the gallbladder wall in emphysematous cholecystitis.
- Biliary scintigraphy (hydroxyiminodiacetic acid (HIDA) scan) is the gold standard investigation when the diagnosis remains in doubt after ultrasound scanning. The patient is given an intravenous injection of radiolabeled hydroxyiminodiacetic acid and then the abdomen is scanned; in patients with acute cholecystitis, the gallbladder lumen will not takeup any radioactive isotope one to two hours after injection and therefore the gall bladder will not be visible on the scan. Occasionally, an acutely inflamed gallbladder may have delayed filling, leading to a false positive result, but augmentation with morphine reduces this.
- CT Scan
- ERCP
- MRCP

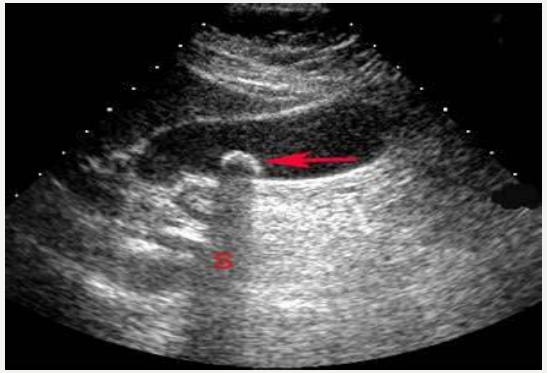

SUPINE

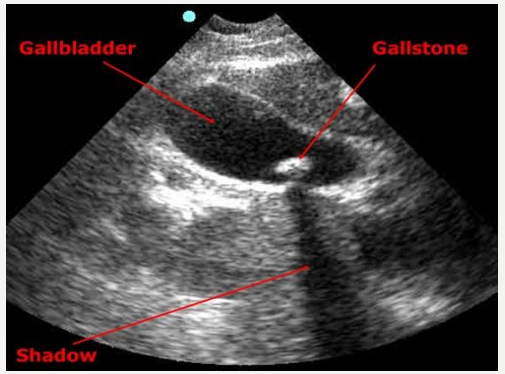

Gallstones shown within the gallbladder cavity
SUPINE

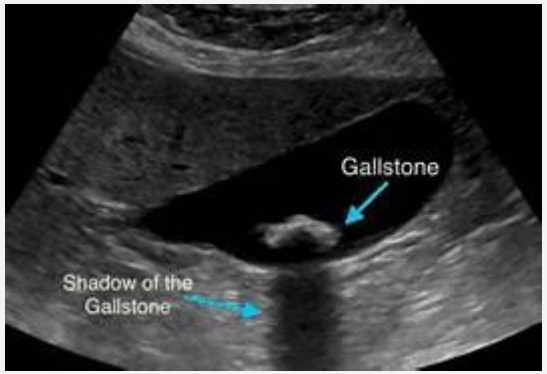


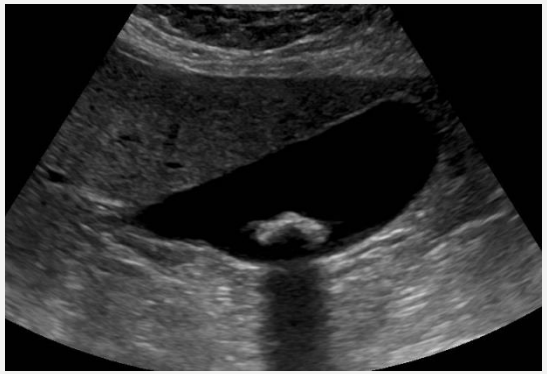


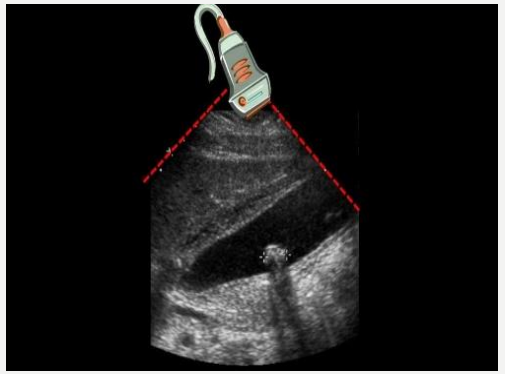
Ultrasound (B mode) findings in acute cholecystitis









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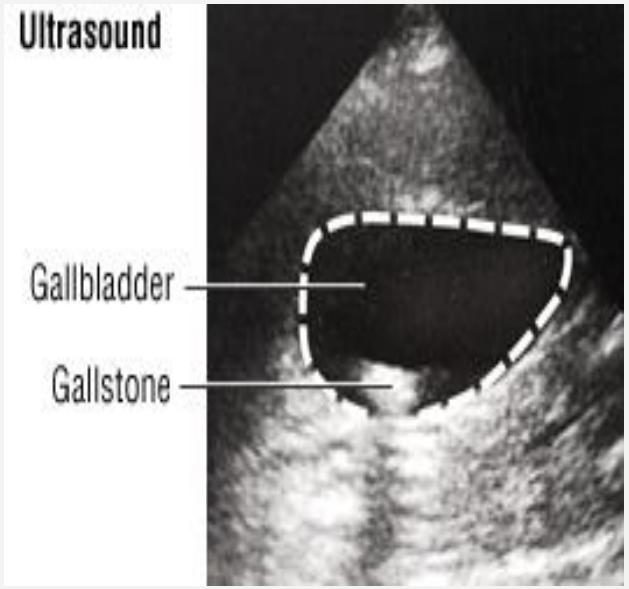
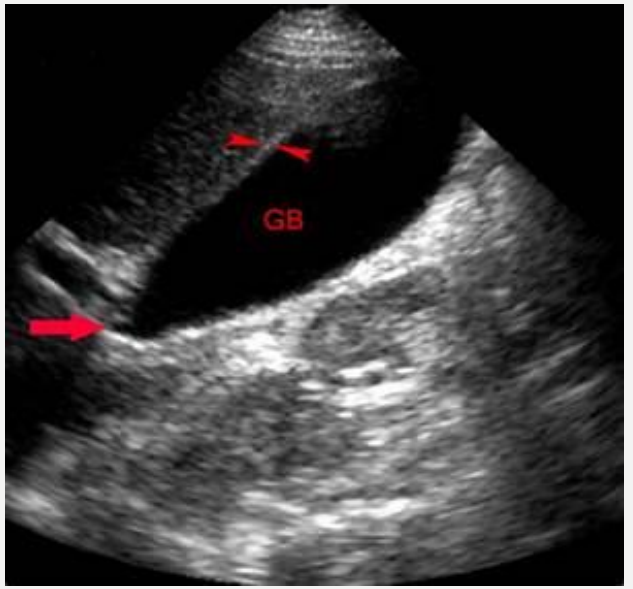

Ultrasound
Gallbladder
Gallstone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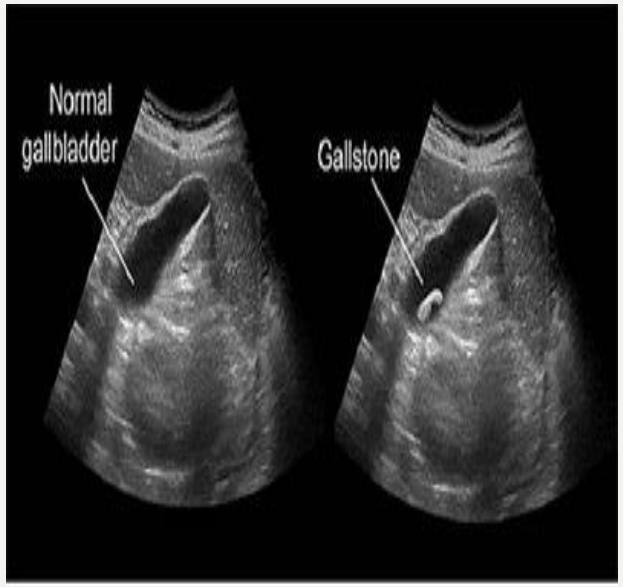
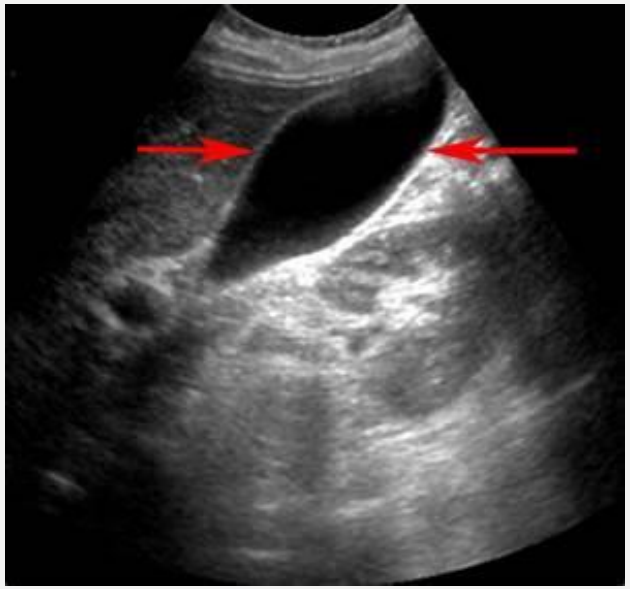
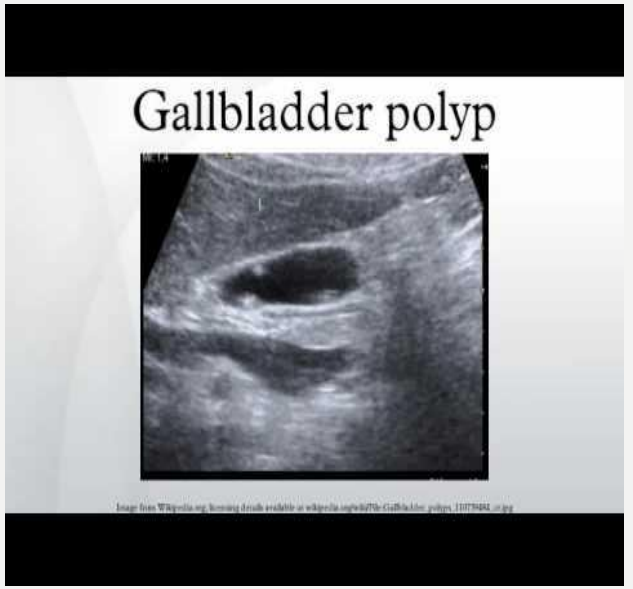
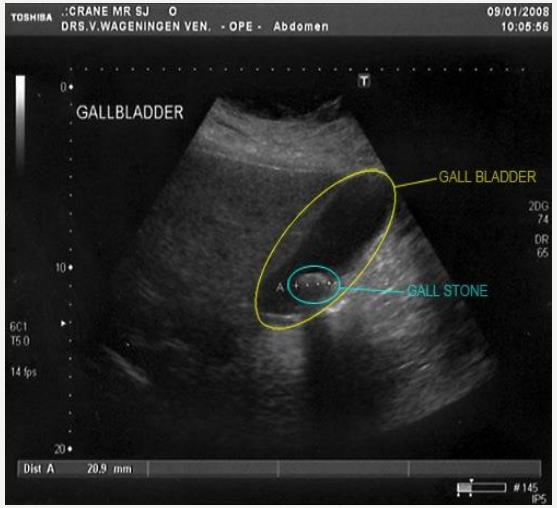

Normal gallbladder
Gallstone




Gallbladder polyp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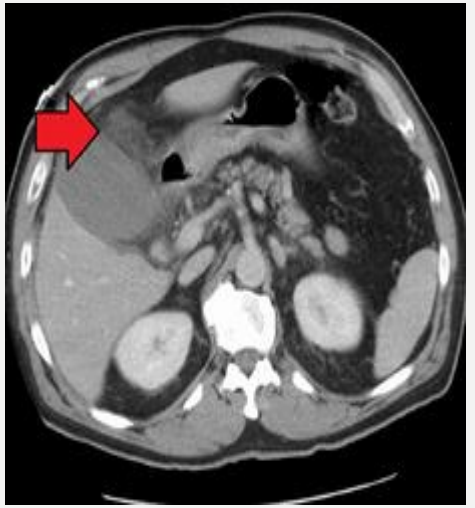
GALLBLADDER
GALL BLADDER
GALL STONE
Dist A 20.9 mm



CHOLESCINTIGRAPHY

- **Cholescintigraphy** or **hepatobiliary scintigraphy** is scintigraphy of the hepatobiliary tract, including the gallbladder and bile ducts. The image produced by this type of medical imaging, called a **cholescintigram**, is also known by other names depending on which radiotracer is used, such as **HIDA scan**, **PIPIDA scan**, **DISIDA scan**, or **BrIDA scan**. Cholescintigraphic scanning is a nuclear medicine procedure to evaluate the health and function of the gallbladder and biliary system. A radioactive tracer is injected through any accessible vein and then allowed to circulate to the liver, where it is excreted into the bile ducts and stored by the gallbladder until released into the duodenum.
- Use of cholescintigraphic scans as a first-line form of imaging varies depending on indication. For example for cholecystitis, cheaper and less invasive ultrasound imaging may be preferred, while for bile reflux cholescintigraphy may be the first choice.
- In the absence of gallbladder disease, the gallbladder is visualized within 1 hour of the injection of the radioactive tracer. If the gallbladder is not visualized within 4 hours after the injection, this indicates either cholecystitis or cystic duct obstruction, such as by cholelithiasis. This investigation is usually conducted after an ultrasonographic examination of the abdominal right upper quadrant for a patient presenting with abdominal pain. If the noninvasive ultrasound examination fails to demonstrate gallstones, or other obstruction to the gallbladder or biliary tree, in an attempt to establish a cause of right upper quadrant pain, a cholescintigraphic scan can be performed as a more sensitive and specific test.
- Cholescintigraphy for acute cholecystitis has sensitivity of 97%, specificity of 94%. The scan is also important to differentiate between neonatal hepatitis and biliary atresia, because an early surgical intervention in form of Kasai portoenterostomy or hepatoportoenterostomy can save the life of the baby as the chance of a successful operation after 3 months seriously decreases.
- Most radiotracers for cholescintigraphy are metal complexes of iminodiacetic acid (IDA) with a radionuclide, usually technetium-99m. This metastable isotope has a half-life of 6 hours, so batches of radiotracer must be prepared as needed using a moly cow. A widely recognized trade name for the preparation kits is TechneScan.

HIDA scan

- A hepatobiliary iminodiacetic acid (HIDA) scan is an imaging procedure used to diagnose problems of the liver, gallbladder and bile ducts.
- For a HIDA scan, also known as cholescintigraphy and hepatobiliary scintigraphy, a radioactive tracer is injected into a vein in the patient arm. The tracer travels through the patient blood stream to the liver, where the bile-producing cells take it up. The tracer then travels with the bile into the patient gallbladder and through the bile ducts to the small intestine. A gamma camera tracks the flow of the tracer from the liver into the gallbladder and small intestine and creates computer images. A HIDA scan is most often done to evaluate the gallbladder. It's also used to look at the bile-excreting function of the liver and to track the flow of bile from the liver into the small intestine. A HIDA scan might help in the diagnosis of several diseases and conditions, such as: cholecystitis, Bile duct obstruction, congenital abnormalities in the bile ducts, such as biliary atresia, postoperative complications, such as bile leaks and fistulas, and assessment of liver transplant. HIDA scan might be used as part of a test to measure the rate at which bile is released from the gallbladder (gallbladder ejection fraction).
- Results of a HIDA scan include:
- **Normal.** The radioactive tracer moved freely with the bile from the liver into the gallbladder and small intestine.
- **Slow movement of radioactive tracer.** Slow movement of the tracer might indicate a blockage or obstruction, or a problem in liver function.
- **No radioactive tracer seen in the gallbladder.** Inability to see the radioactive tracer in the gallbladder might indicate acute cholecystitis.
- **Abnormally low gallbladder ejection fraction.** The amount of tracer leaving the gallbladder is low after the patient have been given a drug to make it empty, which might indicate chronic cholecystitis.
- **Radioactive tracer detected in other areas.** Radioactive tracer found outside of the biliary system might indicate a leak.

CALOT'S TRIANGLE

- The **hepatobiliary triangle** (or **cystohepatic triangle**) is an anatomic space bordered by the cystic duct inferiorly, common hepatic duct medially and the inferior (visceral) surface of the liver superiorly. The cystic artery lies within the cystohepatic triangle, which is used to locate it during a laparoscopic cholecystectomy.
-
- Another name used to refer to this region is **Calot's triangle**, after Jean-François Calot. Calot's original description of the triangle in 1891 included the cystic duct, the common hepatic duct, and the cystic artery (not the inferior border of the liver as is commonly believed). The hepatocystic triangle is the area bound by the cystic duct, common hepatic duct, and the liver margin.
- General surgeons frequently quiz medical students on this term and the name for the lymph node located within the triangle, Mascagni's lymph node or Lund's node, however many often erroneously refer to it as "Calot's node." The latter is frequently enlarged due to inflammation of the gallbladder (e.g. cholecystitis) or the biliary tract (e.g. cholangitis) and may be removed along with the gallbladder during surgical treatment (cholecystectomy).
- Calot's triangle, containing the cystic artery, may also contain an accessory right hepatic artery or anomalous sectoral bile ducts. As a result dissection in the triangle of Calot is ill-advised until the lateral-most structures have been cleared and identification of the cystic duct is definitive. According to SESAP 12 (produced and distributed by the American College of Surgeons) dissection in the triangle of Calot is the most common cause of common bile duct injuries.
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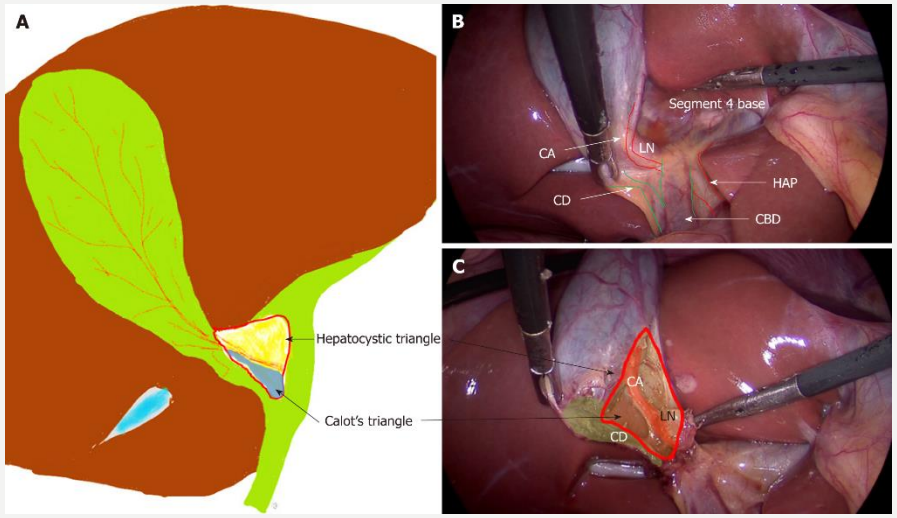
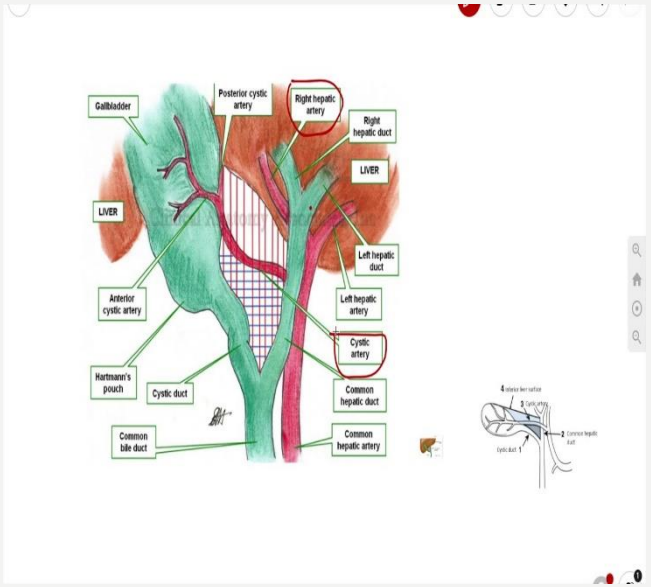
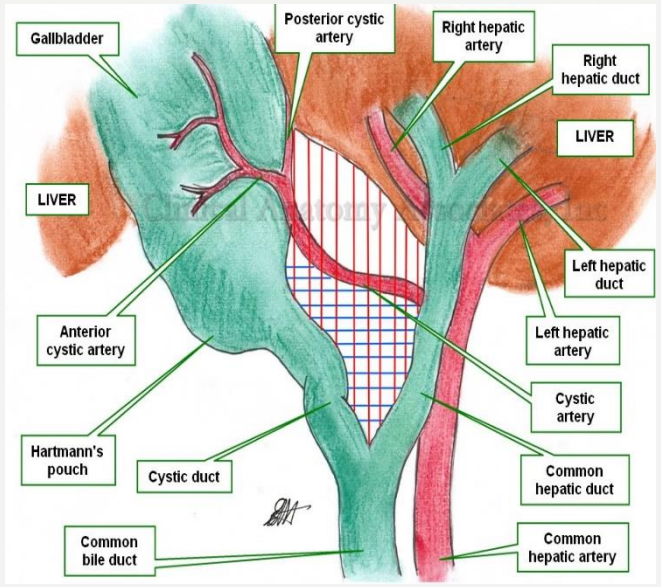
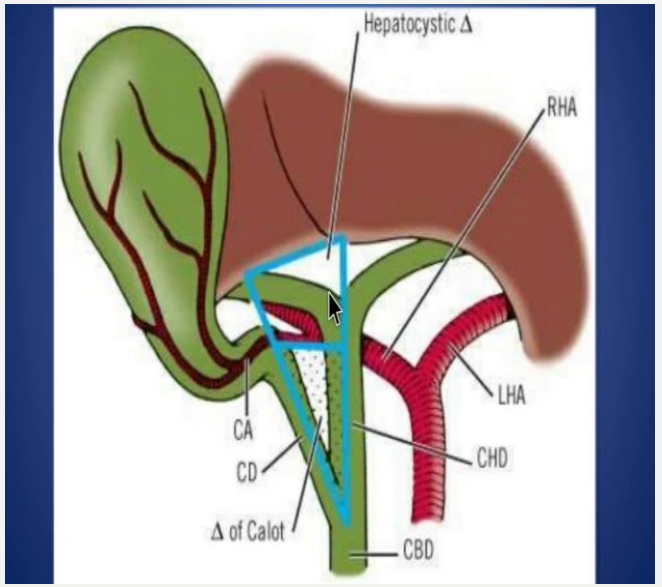
CYSTOHEPATIC TRIANGLE

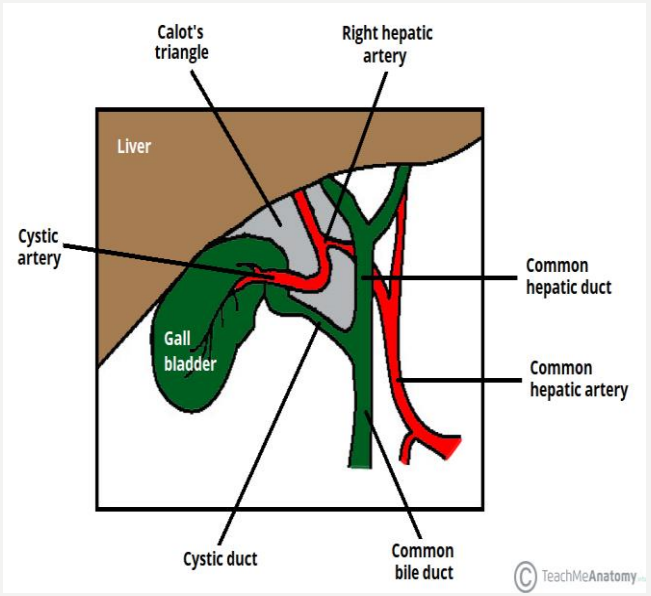
- **Calot triangle** or **cystohepatic triangle** is a small (potential) triangular space at the porta hepatis of surgical importance as it is dissected during cholecystectomy. Its contents, the cystic artery and cystic duct must be identified before ligation and division to avoid intra-operative injury.
- **Boundaries**
- The (isosceles) triangle is positioned so that the apex points towards the liver with the following boundaries:
- **right**: the cystic duct which is often tortuous and has a beaded appearance, passes downward and to the left to join the common duct
- **left**: common hepatic duct
- **superior**: the inferior surface of the liver (in the original description by Calot the superior boundary is the cystic artery)
- **Contents**
- right hepatic artery
- cystic artery
- cystic lymph node (of Lund)
- connective tissue
- lymphatics
- occasionally accessory hepatic ducts and arteries
- **History and etymology**
- This space was first described by the French surgeon, **Jean-François Calot** (1861–1944) [3] in 1891, as part of his PhD thesis; although the triangle as described by Calot differs slightly from the modern description.

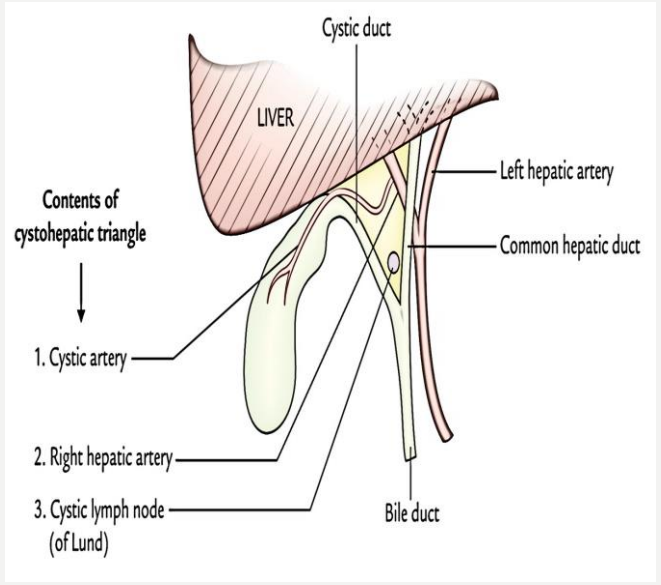


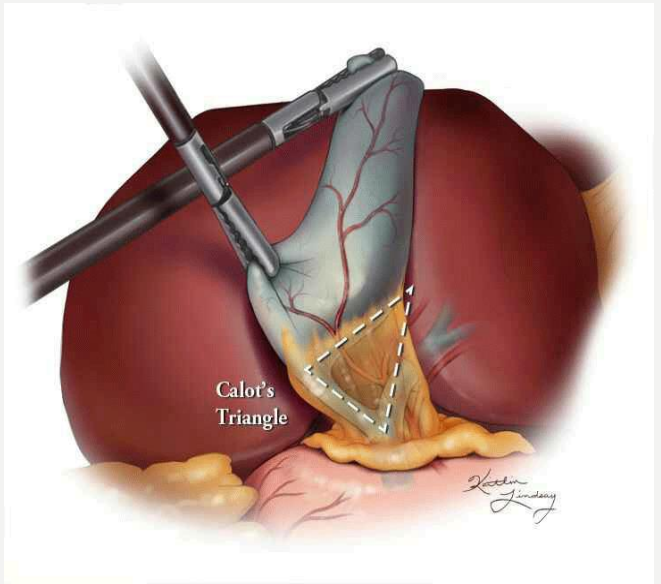

Gallbladder
Posterior cystic artery
Right hepatic artery
Right hepatic duct
LIVER
LIVER
Left hepatic duct
Anterior cystic artery
Left hepatic artery
Cystic artery
Hartmann's pouch
Cystic duct
Common hepatic duct
Common bile duct
Common hepatic artery


Gallbladder
Posterior cystic artery
Right hepatic artery
Right hepatic duct
LIVER
LIVER
Left hepatic duct
Anterior cystic artery
Left hepatic artery
Cystic artery
Hartmann's pouch
Cystic duct
Common hepatic duct
Common bile duct
Common hepatic artery


Hepatocystic Δ
RHA
LHA
CA
CD
CHD
Δ of Calot
CBD


Calot's triangle
Right hepatic artery
Liver
Cystic artery
Common hepatic duct
Gall bladder
Common hepatic artery
Cystic duct
Common bile duct
TeachMeAnatomy


Cystic duct
LIVER
Left hepatic artery
Contents of cystohepatic triangle
Common hepatic duct
1. Cystic artery
2. Right hepatic artery
3. Cystic lymph node (of Lund)
Bile duct

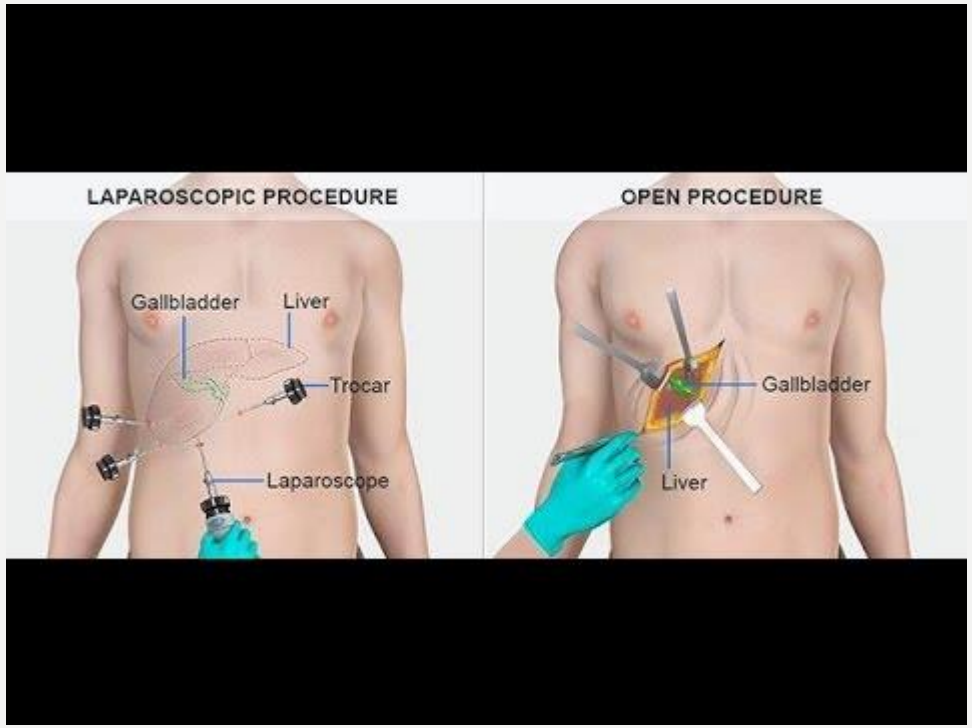

Calot's Triangle

MANAGEMENT: MEDICAL MANAGEMENT

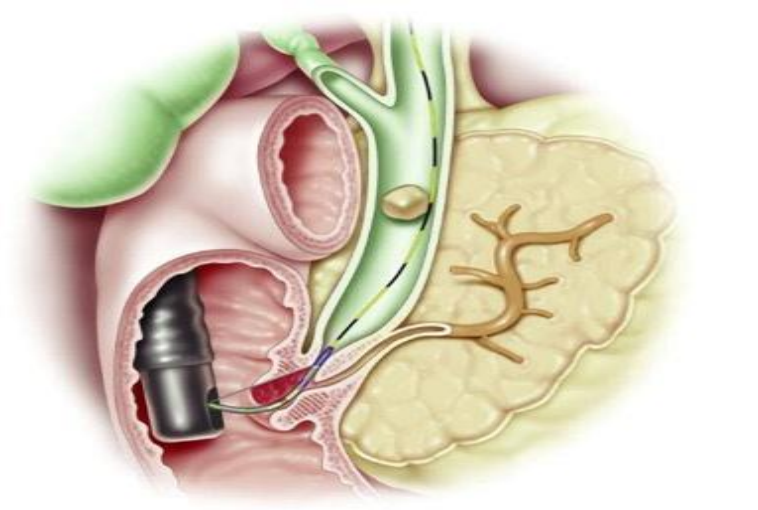
- Most patients with acute cholecystitis respond to conservative, first line management: the gallstone disimpacts and falls back into the gallbladder, which allows the cystic duct to empty. If the gallstone does not disimpact, complications—such as advanced cholecystitis (gangrenous cholecystitis or empyema of the gall bladder) or perforation—may result.
- Immediate measures should be taken to rest the gallbladder; this will subdue the inflammatory process in most patients. Patients should be fasted, rehydrated with intravenous fluids, and given oxygen therapy and adequate analgesia. Indometacin (25 mg three times daily for a week) can reverse the inflammation of the gallbladder and the contractile dysfunction seen in the early stages (first 24 hours) of cholecystitis. The prokinetic action of indometacin will also improve postprandial emptying of the gallbladder in patients with gallbladder disease.
- A single intramuscular dose of diclofenac (75 mg) may substantially decrease the rate of progression to acute cholecystitis in patients with symptomatic gallstones.
- Because of the risk of superimposed infection, intravenous antibiotics should be started empirically if the patient has systemic signs or if no improvement is seen after 12-24 hours. A second generation or newer cephalosporin should be used (for example, cefuroxime 1.5 g every 6-8 hours) with metronidazole (500 mg every 8 hours).
- Nonoperative management—solvent dissolution therapy or extracorporeal shockwave lithotripsy—has been used with variable results to treat chronic cholecystitis in patients unfit for surgery, but it has no place in the management of acute cholecystitis.

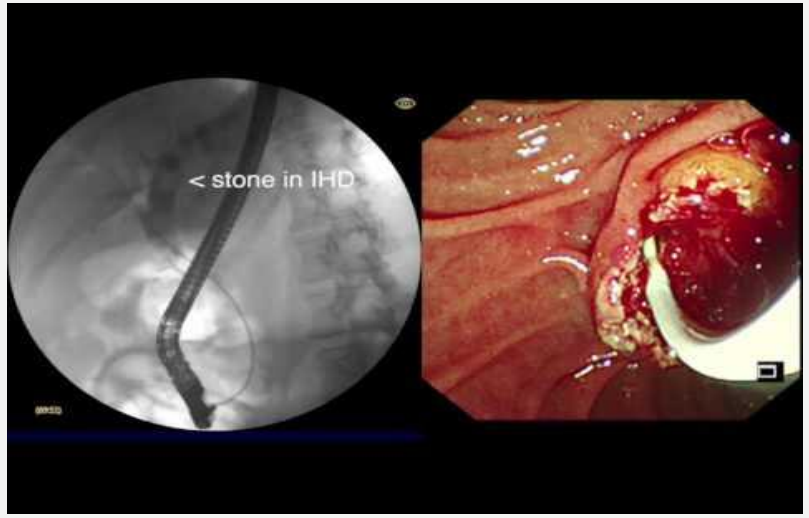
SURGICAL MANAGEMENT

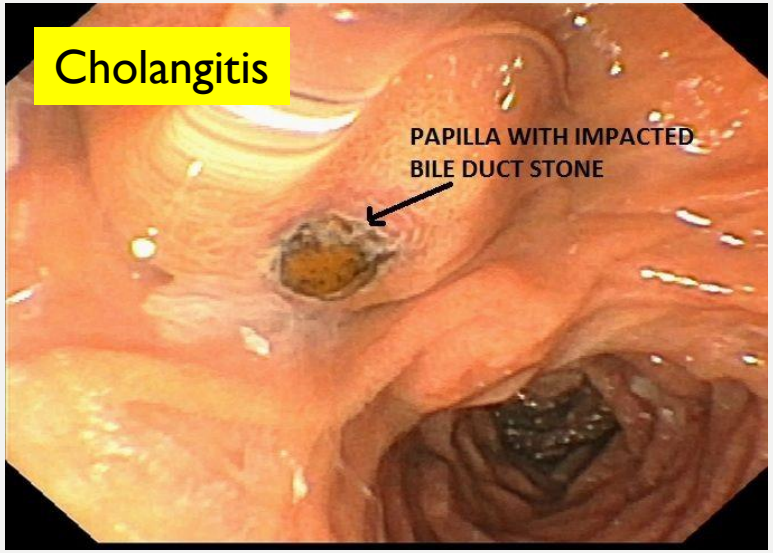
- About 20% of patients with acute cholecystitis need emergency surgery. Such surgery is indicated if the patient's condition deteriorates or when generalized peritonitis or emphysematous cholecystitis is present. These features suggest gangrene or perforation of the gallbladder.

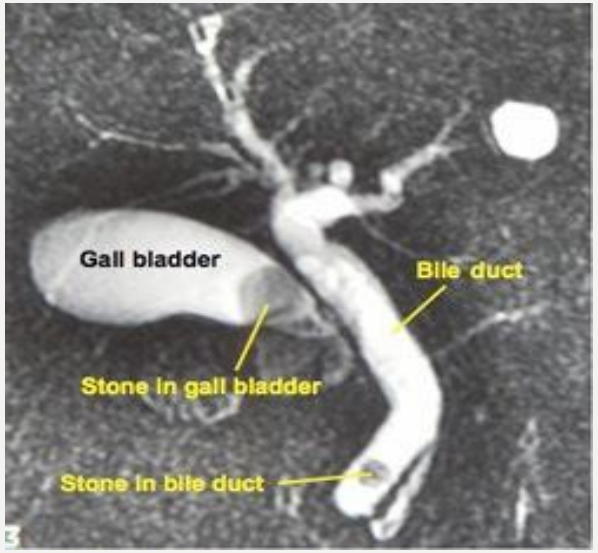


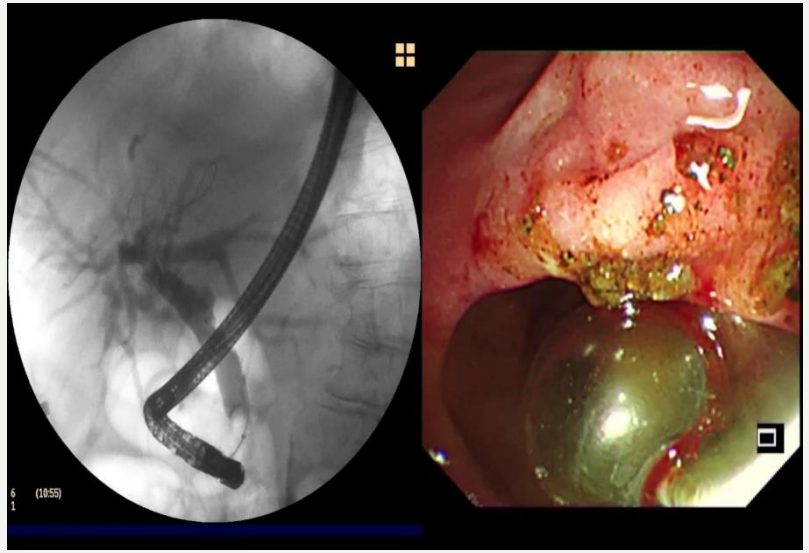
ERCP: SPHINCTEROTOMY





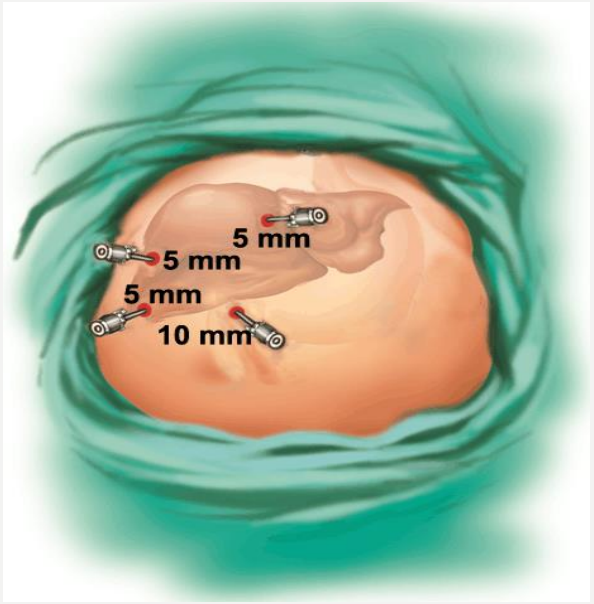






CHOLECYSTECTOMY

- The timing of surgery for the 80% of patients without evidence of gangrene or perforation is under debate. Open cholecystectomy traditionally has been performed 6-12 weeks after the acute episode to allow the inflammatory process to resolve before the procedure (interval surgery).
- Patients with acute cholecystitis who undergo early laparoscopic cholecystectomy (before symptoms have lasted 72-96 hours) have lower complication rates and lower conversion rates than open cholecystectomy and shorter hospital stays than those undergoing interval surgery. Early surgery for acute cholecystitis also has a lower conversion rate than delayed surgery (which is performed during the index admission after conservative management and after symptoms have lasted 3-5 days).
- Early surgery also avoids complications when conservative treatment fails.
- A long time between onset of symptoms and presentation is associated with advanced disease.
- Early laparoscopic surgery is safe and feasible in patients with acute cholecystitis. If early intervention—less than 72 hours after symptoms started—can be achieved, "edema planes" present during this period allow the gall bladder to be dissected laparoscopically.
- Although it is desirable to operate within this time period, it is often difficult to do so in clinical practice. By the time inflammation has been present for more than 72 hours, features of chronic inflammation (such as fibrosis) predominate and make it more difficult to dissect the gall bladder.
- The optimal treatment for patients presenting with acute cholecystitis should be resuscitation followed by laparoscopic cholecystectomy on the next available surgical list. Patients with fever, serum bilirubin >170 ìmol/l, male sex, body temperature >38°C, and advanced cholecystitis are more likely to have complications.



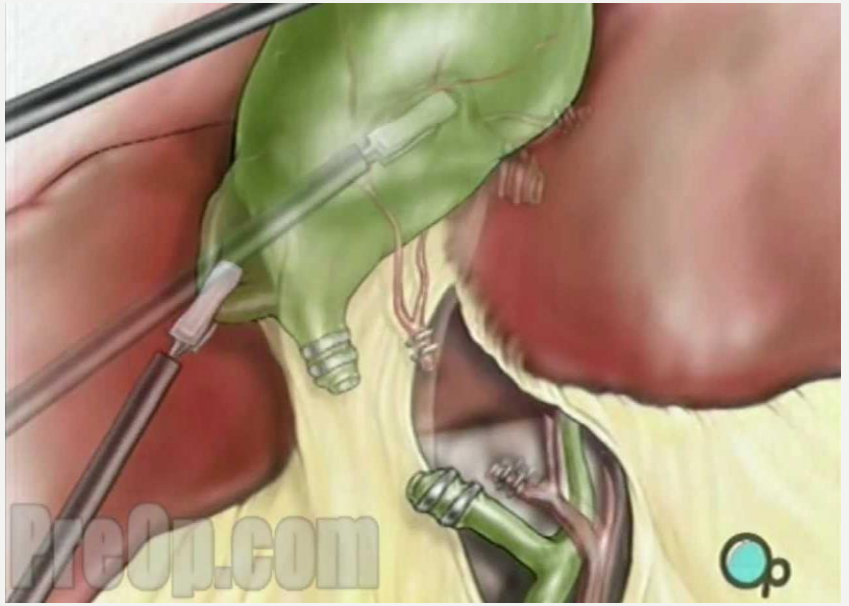
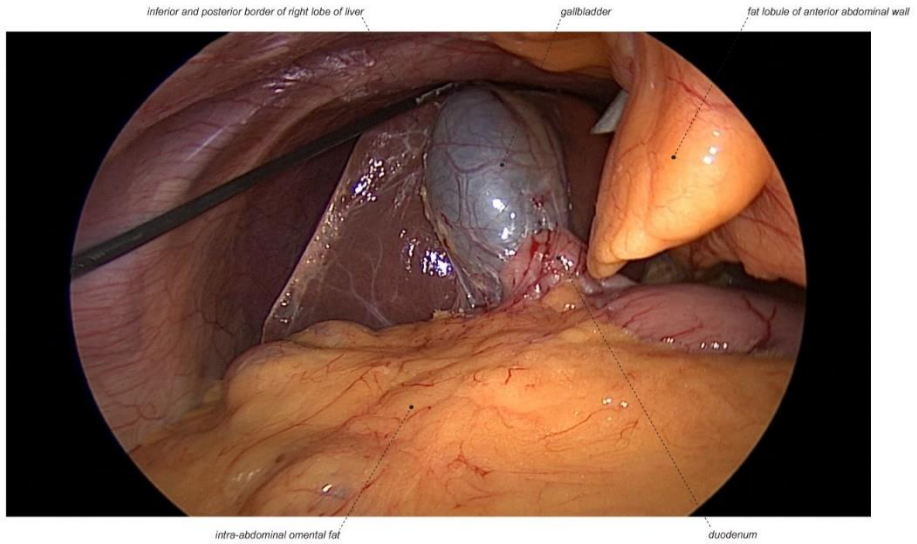
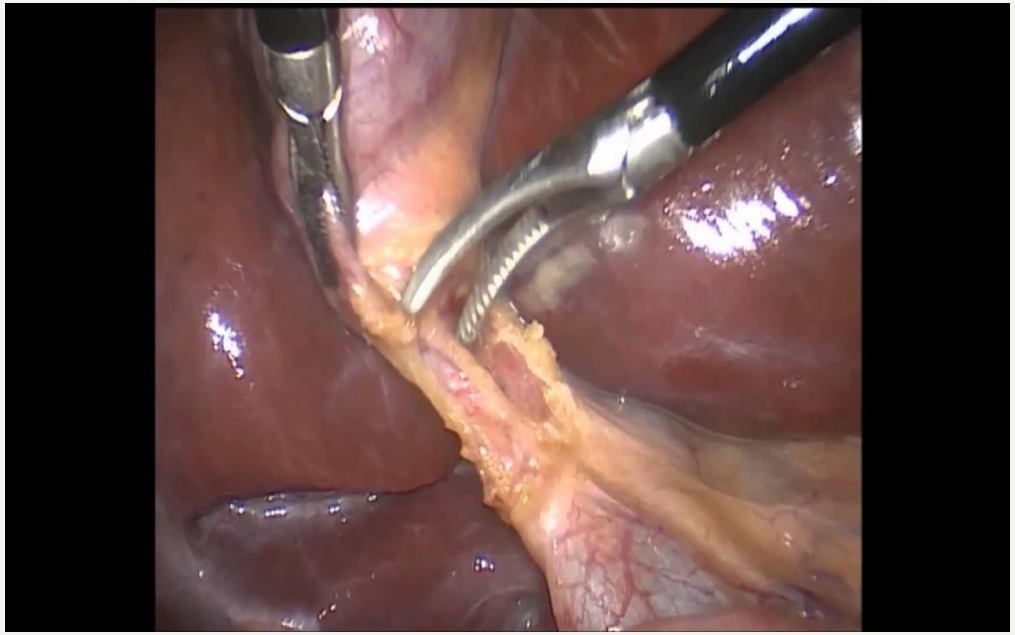
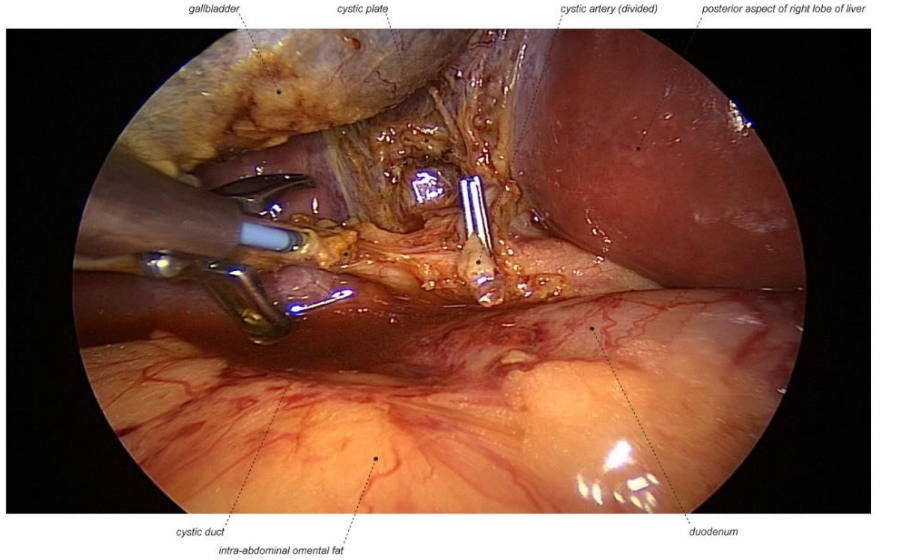
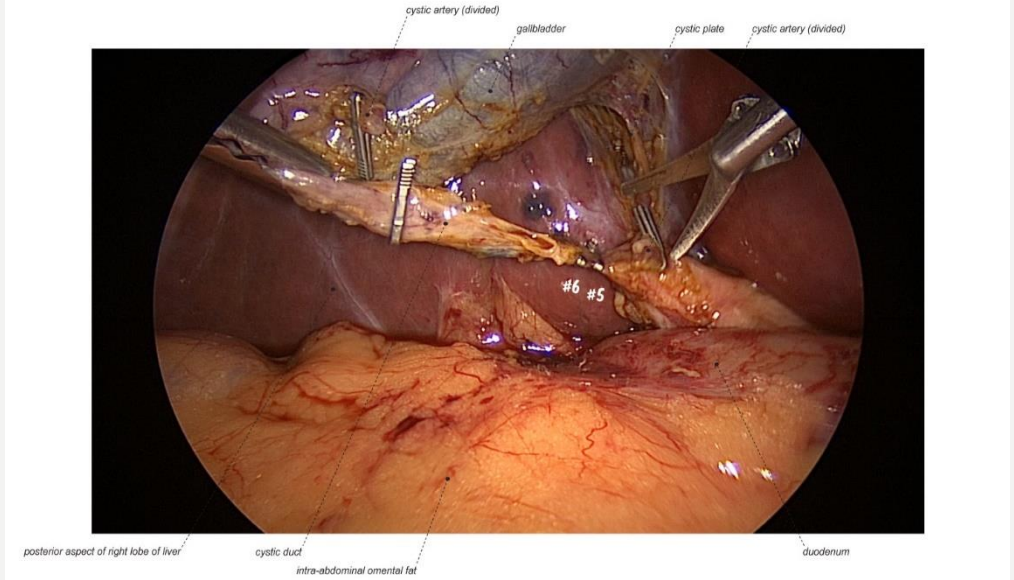


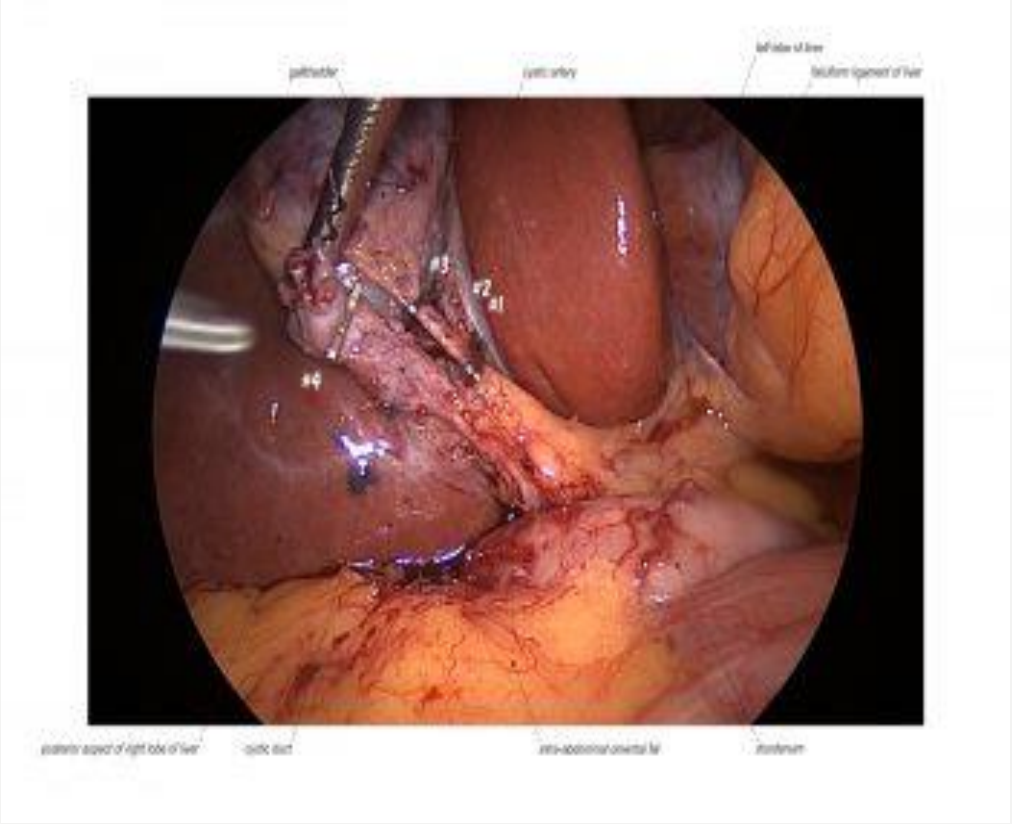
Fig.1: Peroperative photograph showing a giant gallstone


inferior and posterior border of right lobe of liver
gallbladder
fat lobule of anterior abdominal wall
intra-abdominal omental fat
duodenum




gallbladder
cystic plate
cystic artery (divided)
posterior aspect of right lobe of liver
cystic duct
intra-abdominal omental fat
duodenum


cystic artery (divided)
gallbladder
cystic plate
cystic artery (divided)
#6 #5
posterior aspect of right lobe of liver
cystic duct
intra-abdominal omental fat
duodenum


gallbladder
cystic artery
falciform ligament of liver
#3
#2
a1
#4
cystic duct

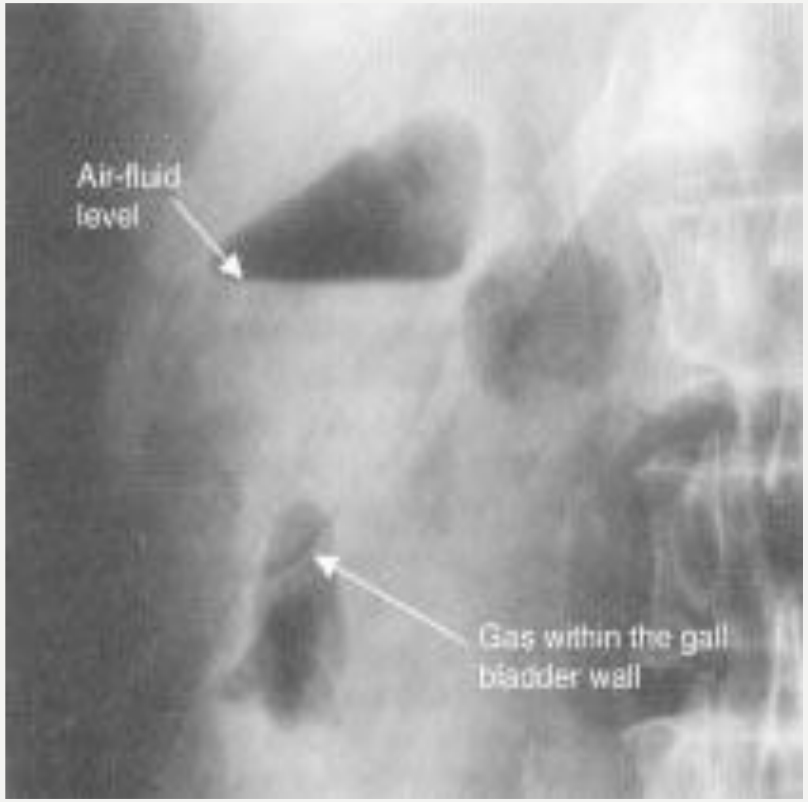
PERCUTANEOUS CHOLECYSTOSTOMY

- It is a minimally invasive procedure that can benefit patients with serious comorbidity who are at high risk from major surgery. It can be performed at the bedside under local anesthetic and is suitable for patients in intensive care units and those with burns. It is the definitive treatment in patients with acalculous cholecystitis, or it may be used as a temporizing measure—to drain infected bile and delay the need for definitive treatment.

- It gives clinical improvement in about 75% of patients. Mortality after this procedure is related to comorbidity (for example, pneumonia or myocardial infarction) or preexisting sepsis. An incomplete or poor response to cholecystostomy within the first 48 hours may indicate causes of sepsis other than cholecystitis, inadequate antibiotic coverage, possible complications (such as dislodgement of the drainage tube), or necrosis of the wall of the gallbladder.

- Patients can undergo cholecystectomy after percutaneous cholecystostomy. In patients unfit to be given a general anesthetic, the drain can be left in place for more than six weeks to allow radiological extraction of calculi at a later date.

EMPHYSEMATOUS CHOLECYSTITIS



Plain abdominal radiograph showing emphysematous cholecystitis: note gas within the gallbladder wall and air fluid level within the gall bladder

SEQUELAE OF ACUTE CHOLECYSTITIS: GANGRENOUS CHOLECYSTITIS

- Gangrenous cholecystitis occurs in 2-30% of cases of acute cholecystitis.
- Men aged over 50 with a history of cardiovascular disease and leukocytosis (>17 000 leucocytes/ml) have the highest risk of gangrene of the gallbladder.
- Gangrene occurs most commonly at the fundus because the vascular supply often becomes compromised.
- Urgent laparoscopic cholecystectomy should be considered in patients at high risk of gangrene, and the surgeon should have a low threshold for conversion to open cholecystectomy during the procedure.

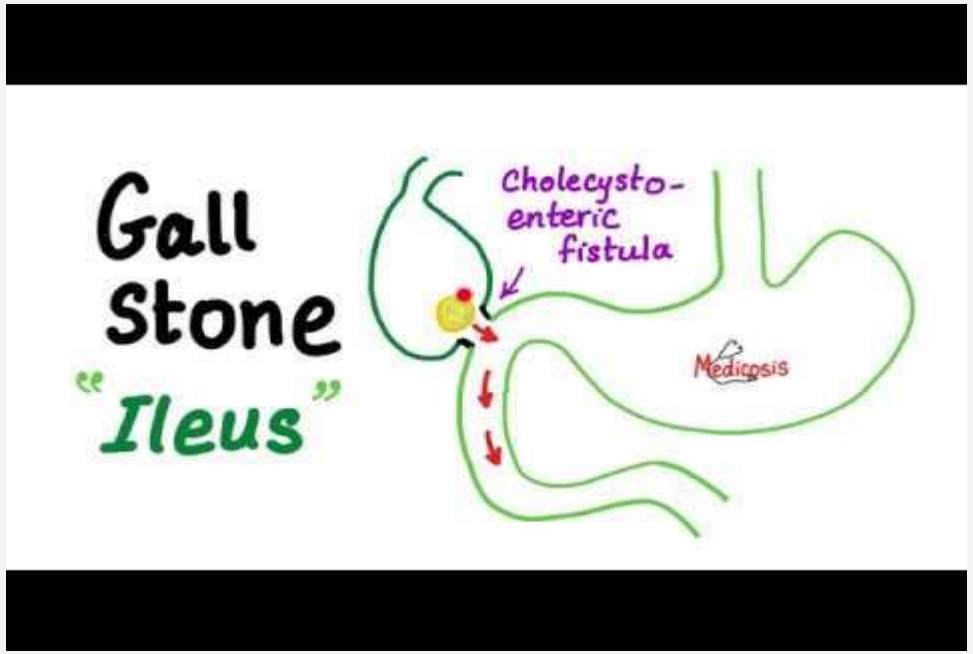
GALLBLADDER PERFORATION

- The gallbladder is perforated in 10% of cases of acute cholecystitis—usually in patients who sought medical attention after a delay or in those who do not respond to conservative management.
- Perforation most commonly occurs at the fundus.

- After the gallbladder has perforated, patients may experience transient relief of their symptoms because the gallbladder decompresses, but peritonitis then develops. Free perforation presents with generalized biliary peritonitis and is associated with a mortality of 30%.
- Localized perforation, with the formation of pericholecystic abscesses, is more common, because the adherent viscera adjacent to the perforation tend to localize spillage of the contents of the gallbladder. A mass may be palpable in patients with localized perforation, and computed tomography is the most useful investigation.

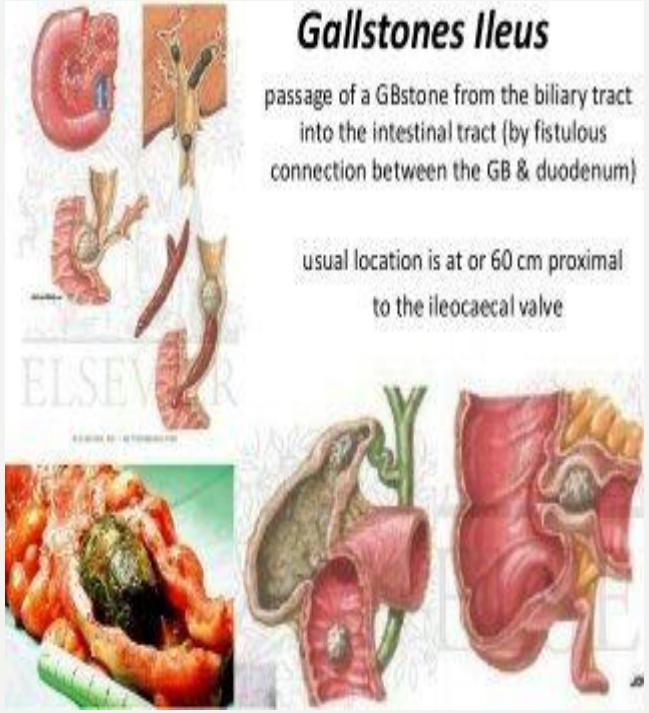
CHOLECYSTOENTERIC FISTULAS

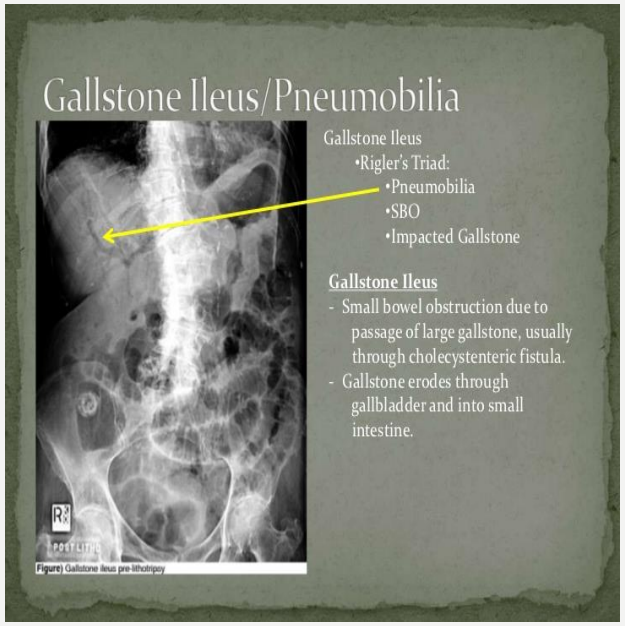
- An acutely inflamed gallbladder may create a cholecystoenteric fistula by adhering to and causing a perforation in other parts of the gastrointestinal tract. The most common sites for fistulas are the duodenum and the hepatic flexure of the colon. Decompression of the gallbladder because of a fistula may cause resolution of the acute cholecystitis. Air in the biliary tree (pneumobilia) can be seen on abdominal radiographs, and imaging enhanced with contrast agents may show fistulas.

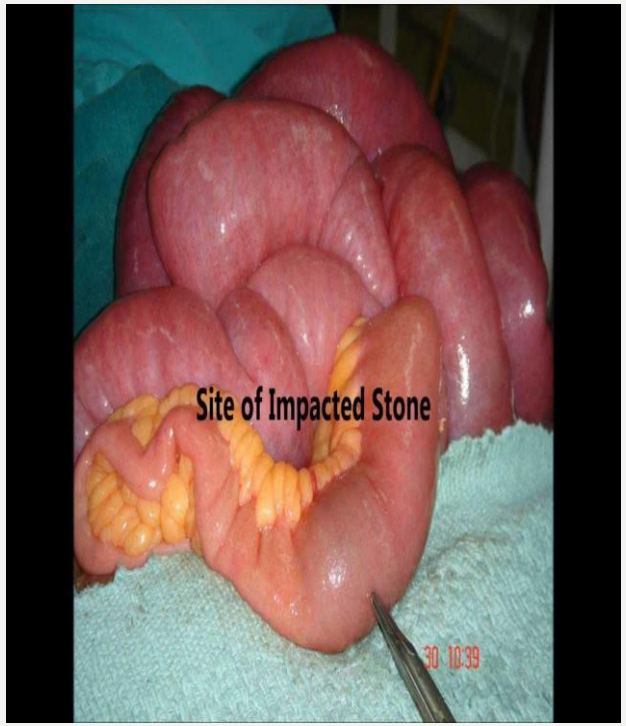


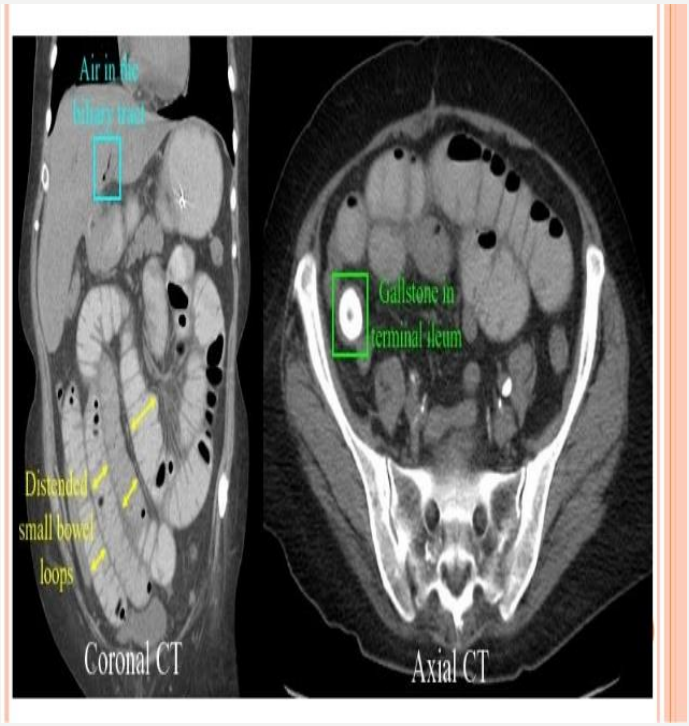
GALLSTONE ILEUS

- Gallstone ileus—obstruction of the small intestine caused by a gallstone passing from the biliary tract into the intestinal tract through a fistula—should be considered in elderly patients with no obvious cause for the intestinal obstruction. Patients may not have a history of cholecystitis.
- Mortality (15-20%) is attributed to delays before surgery is performed or to coexisting medical illnesses. Classic findings on abdominal radiographs include pneumobilia, intestinal obstructions, and gallstones in unusual sites.
- Longitudinal enterotomy




Gallstone Ileus/Pneumobilia
Gallstone Ileus
•Rigler's Triad:
•Pneumobilia
•SBO
•Impacted Gallstone
Gallstone Ileus
- Small bowel obstruction due to passage of large gallstone, usually through cholecystenteric fistula.
- Gallstone erodes through gallbladder and into small intestine.


Site of Impacted Stone

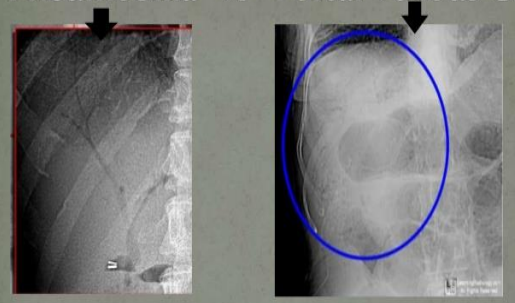

Air in the biliary tract
Gallstone in terminal ileum
Distended small bowel loops
Coronal CT
Axial CT

RIGLER'S TRIAD

A triad of these findings in gall stone ileus:

- Pneumobilia
- Small bowel obstruction
- Gall stone in right iliac fossa

Pneumobilia vs Portal Venous Gas



Portal Venous Gas

- More peripherally located
- Patients are usually ill-appearing
- Etiology: Ischemic Bowel, Necrotic Colorectal CA, NEC, IBD, Appendicitis, Bowel Obstruction, Cholecystitis/Cholangitis, Pancreatitis, Endoscopy

Differential Diagnosis of Pneumobilia

- Recent Instrumentation
  - ERCP
- Incompetent Sphincter of Oddi
  - Sphincterotomy
  - Recent Passage of Gallstone
  - Scarring from Chronic Pancreatitis
- Spontaneous Biliary-Enteric Fistula
  - Gallstone Ileus
  - Peptic Ulcer Disease
  - Neoplasm (Cholangiocarcinoma, Ampullary Carcinoma)
  - Trauma
- Biliary Enteric Surgical Anastomosis
  - Whipple Procedure, etc
- Infection
  - Emphysematous Cholecystitis
  - Liver Abscess

Mesenteric artery Occlusion / Mechanical obstruction.
→ Bowel wall necrosis
→ penetration of gas into vessel wall
→ intrahepatic portal venous gas

Infection of bowel wall
→ Bowel wall necrosis
→ penetration of gas into vessel wall
→ portal venous gas

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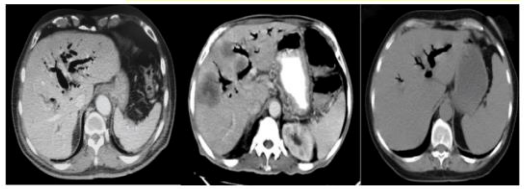
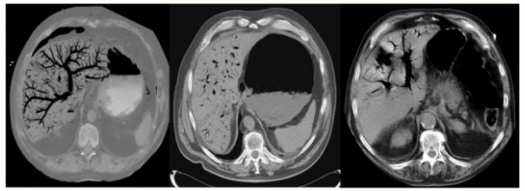
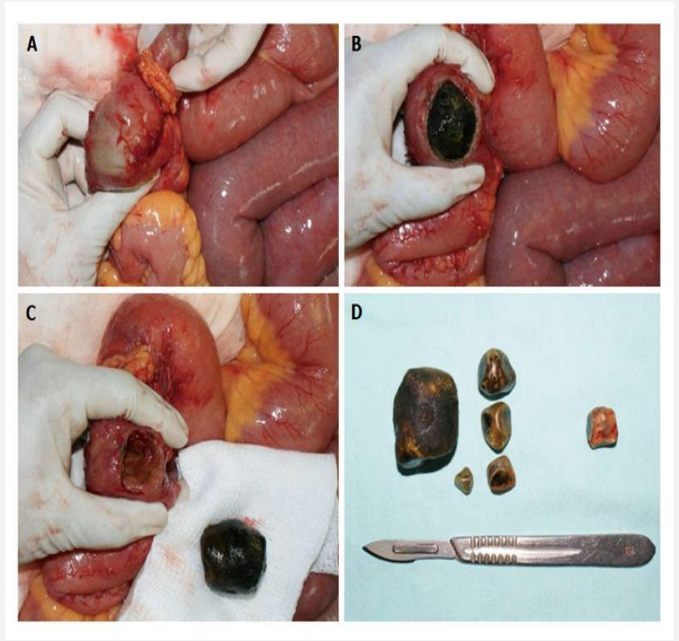
Pneumobilia Mnemonic: CBD - C for Central gas pattern



Portal venous gas Mnemonic: Portal vein - P for Peripheral gas pattern



@jackcfchong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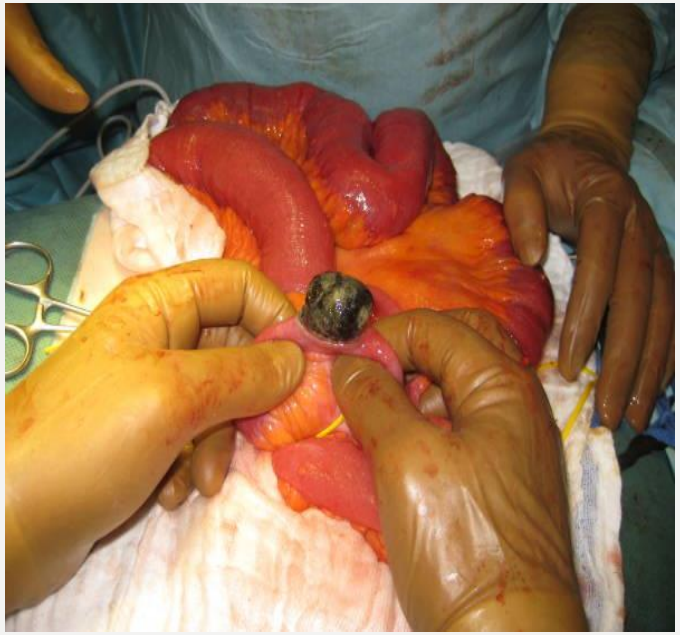
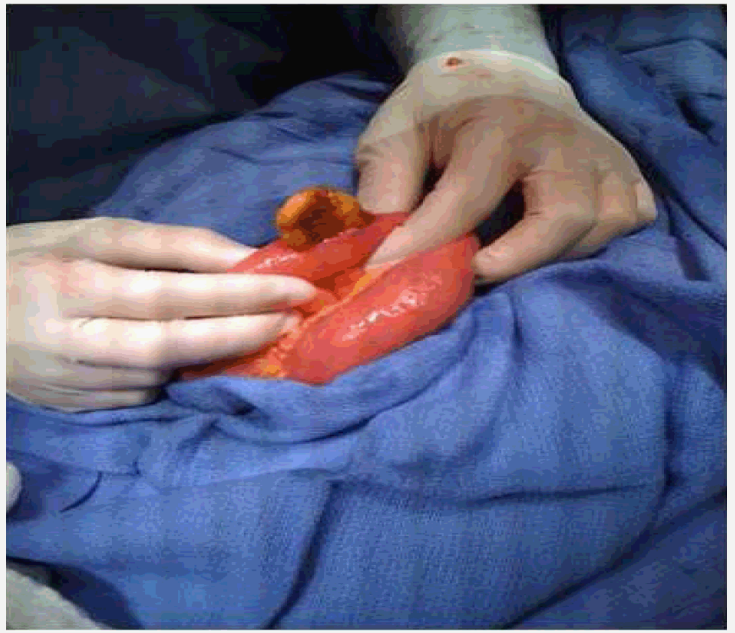
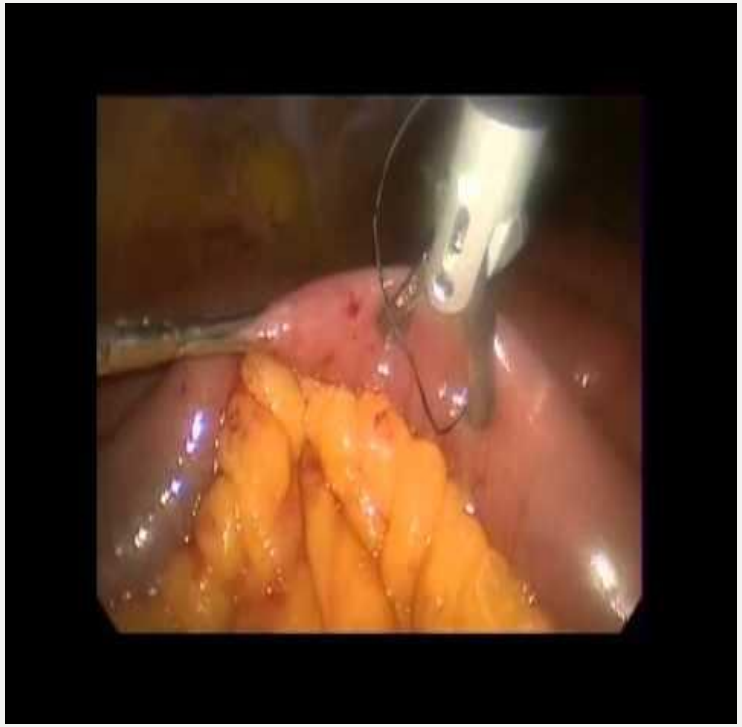
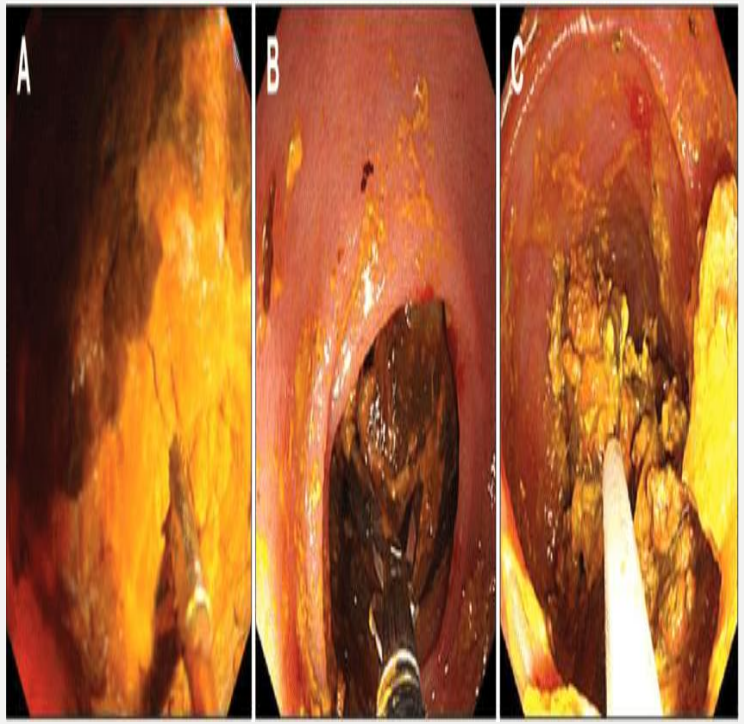




Open enterolithotomy for gallstone ileus



Laparoscopic enterolithotomy for gallstone ileus



Colonoscopic removal of gallstone in the ileocecal valve

MIRIZZI'S SYNDROME

- Is a rare complication in which a gallstone becomes impacted in the cystic duct or neck of the gallbladder causing compression of the common hepatic duct, resulting in obstruction and jaundice. The obstructive jaundice can be caused by direct extrinsic compression by the stone or from fibrosis caused by chronic cholecystitis (inflammation). A cholecystocholedochal fistula can occur.
- **Presentation**: Mirizzi's syndrome has no consistent or unique clinical features that distinguish it from other more common forms of obstructive jaundice. Symptoms of recurrent cholangitis, jaundice, right upper quadrant pain, and elevated bilirubin and alkaline phosphatase may or may not be present. Acute presentations of the syndrome include symptoms consistent with cholecystitis. Surgery is extremely difficult as Calot's triangle is often completely obliterated and the risks of causing injury to the CBD are high.
- **Pathophysiology**: Multiple and large gallstones can become impacted in the Hartmann's pouch of the gallbladder, leading to chronic inflammation—which leads to compression of the common bile duct (CBD), necrosis, fibrosis, and ultimately fistula formation into the adjacent common hepatic duct (CHD) or common bile duct (CBD). As a result, the CHD/CBD becomes obstructed by either scar or stone, resulting in obstructive jaundice. It can be divided into four types.
- **Type I – No fistula present**
- Type IA – Presence of the cystic duct
- Type IB – Obliteration of the cystic duct
- **Types II–IV – Fistula present**
- Type II – Defect smaller than 33% of the CHD diameter
- Type III – Defect 33–66% of the CHD diameter
- Type IV – Defect larger than 66% of the CHD diameter
- **Diagnosis**: Imaging by ultrasonography, MRCP, or CT scan usually make the diagnosis. MRCP can be used to define the lesion anatomically prior to surgery. Occasionally Mirizzi's syndrome is diagnosed or confirmed on ERCP when requested to alleviate obstructive jaundice or cholangitis by means of an endoscopically placed stent, or when USS has been wrongly reported as choledocholithiasis.
- **Treatment**: Simple cholecystectomy is suitable for type I patients. For types II–IV, subtotal cholecystectomy can be performed to avoid damage to the main bile ducts. Cholecystectomy and bilioenteric anastomosis may be required. Roux-en-Y hepaticojejunostomy has shown good outcome in some studies.
- Epidemiology: Mirizzi's syndrome occurs in approximately 0.1% of patients with gallstones. It is found in 0.7 to 2.5 percent of cholecystectomies. It affects males and females equally, but tends to affect older people more often. There is no evidence of race having any bearing on the epidemiology.

ACUTE CHOLECYSTITIS AND PREGNANCY

- Biliary tract disorders are the second most common general surgical condition in pregnancy, with an incidence of symptomatic gallstone disease of <0.1% (acute appendicitis is the most common surgical condition).
- Surgical intervention should be delayed until after delivery unless conservative treatment fails or symptoms recur in the same trimester. When surgery is indicated in pregnancy, laparoscopic cholecystectomy has been shown to be safe.

ACALCULOUS CHOLECYSTITIS

- Acute acalculous cholecystitis is a life threatening condition that occurs in critically ill patients; it accounts for 5-14% of all cases of cholecystitis.
- The diagnosis is often elusive and is associated with considerable mortality (up to 50%).
- Acalculous cholecystitis tends to occur in patients hospitalized for multiple trauma or acute non-biliary illness.

- Risk factors include severe trauma or burns, major surgery (such as cardiopulmonary bypass), long term fasting, total parenteral nutrition, sepsis, diabetes mellitus, atherosclerotic disease, systemic vasculitis, acute renal failure, and AIDS.
- Over 70% of patients have atherosclerotic disease; this might explain the high prevalence of the condition in elderly men.
- Immunocompromised patients can develop primary infections caused by opportunistic organisms that result in primary infective cholecystitis.
- The diagnosis of acute acalculous cholecystitis may be hindered by obtundation of the patient, pre-existing disease, or recent abdominal surgery, and it needs a high index of suspicion.
- Ultrasound scanning is the investigation of choice—it can detect concomitant lesions, it can be performed in intensive care units, and therapeutic interventions (such as percutaneous drainage) can be done simultaneously.
- Percutaneous cholecystostomy is an accepted alternative to cholecystectomy in the treatment of acute acalculous cholecystitis.
- Early cholecystectomy may be appropriate, depending on the patient's clinical condition.

BILIARY DYSKINESIA

- Is a disorder of some component of biliary part of the digestive system in which bile physically cannot move normally in the proper direction through the tubular biliary tract. It most commonly involves abnormal biliary tract peristalsis muscular coordination within the gallbladder in response to dietary stimulation of that organ to squirt the liquid bile through the common bile duct into the duodenum. Ineffective peristaltic contraction of that structure produces postprandial right upper abdominal pain (cholecystodynia) and almost no other problem. When the dyskinesia is localized at the biliary outlet into the duodenum just as increased tonus of that outlet sphincter of Oddi, the backed-up bile can cause pancreatic injury with abdominal pain more toward the upper left side. In general, biliary dyskinesia is the disturbance in the coordination of peristaltic contraction of the biliary ducts, and/or reduction in the speed of emptying of the biliary tree into the duodenum.
- **Mechanism:** Normally, the downstream gallbladder stores and concentrates the bile which originates in liver hepatocyte cells and is released into the microscopic component of the biliary system by the liver. Through aggregating tubules of increasing diameter, the bile leaves the liver and reaches the upstream (proximal) component of the common bile duct. Apparently, the CBD beyond (distal to) the gallbladder tends to normally have a greater tone so that the bile backs up into the gallbladder. When bile enters the duodenum, it aids in digesting the fat within food leaving the stomach. When the bile cannot be properly propelled from the not-mechanically-obstructed gallbladder or cannot flow out of the end of the CBD properly, there is a state of biliary dyskinesia. So, biliary dyskinesia is a dynamically (functional...not fixed mechanical) obstructive, pain-producing disorder. Obstruction by a stone or tumor is a static, mechanical obstruction and tends to produce a more intense pain known as biliary colic. Failure of the biliary sphincter of Oddi can be distinguished from failure of the pancreatic sphincter.
- **Diagnosis:** May or may not be determined by an ultrasound, but most likely the disease and other biliary diseases of the liver, gallbladder, and bile duct are found by what is most commonly referred to as a hepatobiliary or HIDA scan. A radioactive tracer is injected through any accessible vein and then allowed to circulate to the liver and starts accumulating in the gallbladder which can take up to an hour. A standard fatty meal (usually a high fat milk shake) is then given and more imaging is performed for another hour so that the response to the fatty meal by the gallbladder can be shown. The gallbladder should respond and begin emptying into the duodenum, the amount of bile ejected can then be calculated as an ejection fraction (EF). An EF < 35% is considered to be diagnostic of biliary dyskinesia and suitable for cholecystectomy to be considered.

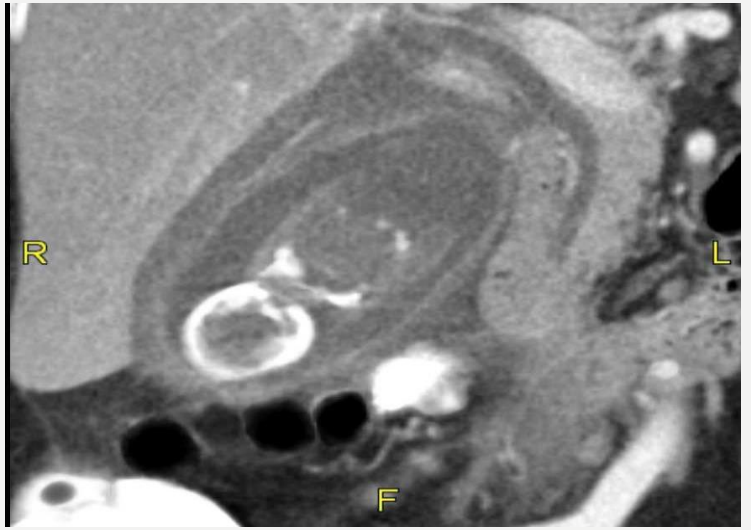
- **Treatment:** Laparoscopic cholecystectomy has been used to treat the condition when due to dyskinesia of the gallbladder. Symptoms may persist after cholecystectomy, and have been linked to the use of proton pump inhibitors.

SUMMARY POINTS

- Acute cholecystitis is most often caused by gallstones
- Patients suspected of having acute cholecystitis should be referred to hospital immediately
- First line treatments include fasting, intravenous fluids, and analgesia
- Surgery (cholecystectomy) within 24-48 hours of admission (early) is preferable to delayed or "interval" surgery
- Percutaneous cholecystostomy is a safe alternative to cholecystectomy for very ill patients or those unfit to undergo surgery
- In 20% of cases, emergency surgery is needed to treat gangrenous cholecystitis or gallbladder perforation

QUESTION

- An "interrupted rim sign" on contrast-enhanced CT or MRI of the gallbladder is most suggestive of which condition?
  - A. Gangrenous cholecystitis.
  - B. Pericholecystic varices in portal hypertension.
  - C. Adenomyomatosis.
  - D. Acalculous cholecystitis.



ANSWER

- An "interrupted rim sign" on contrast-enhanced CT or MRI of the gallbladder is most suggestive of which condition?
  A. Gangrenous cholecystitis.
- Acute gangrenous cholecystitis demonstrates focal mural necrosis visualized as patchy enhancement of the gallbladder mucosa, described as an "interrupted rim sign.“
- Varices would enhance more than the wall but would not appear in a patchy pattern.
- The wall would be thickened and uniformly enhancing in adenomyomatosis.
- Acalculous cholecystitis may progress to a severity sufficient to cause gangrene but is not as likely or common as mural rimming on enhancement in gangrenous cholecystitis.

GANGRENOUS CHOLECYSTITIS (GC)

- GC is a severe form of acute cholecystitis (AC) that carries higher morbidity and mortality than uncomplicated forms of AC.
- GC is present in up to 30% of patients admitted with AC. A preoperative clinical diagnosis of GC is difficult due to a lack of specific findings. The incidence of gangrene in patients with AC increases in older male patients and in patients with a history of cardiovascular disease and leukocytosis greater than 17,000 WBC/mm^3. There is a higher conversion rate from laparoscopic to open cholecystectomy in patients with GC (16%–35%) compared with those with noncomplicated AC. This may lead to an increase in operative time, patient morbidity, and hospital stay, with the subsequent significant increase in overall cost. Early recognition of the gangrenous form of AC may allow emergent surgical treatment to prevent life-threatening complications and in this setting there is a low threshold for conversion from laparoscopic to open cholecystectomy

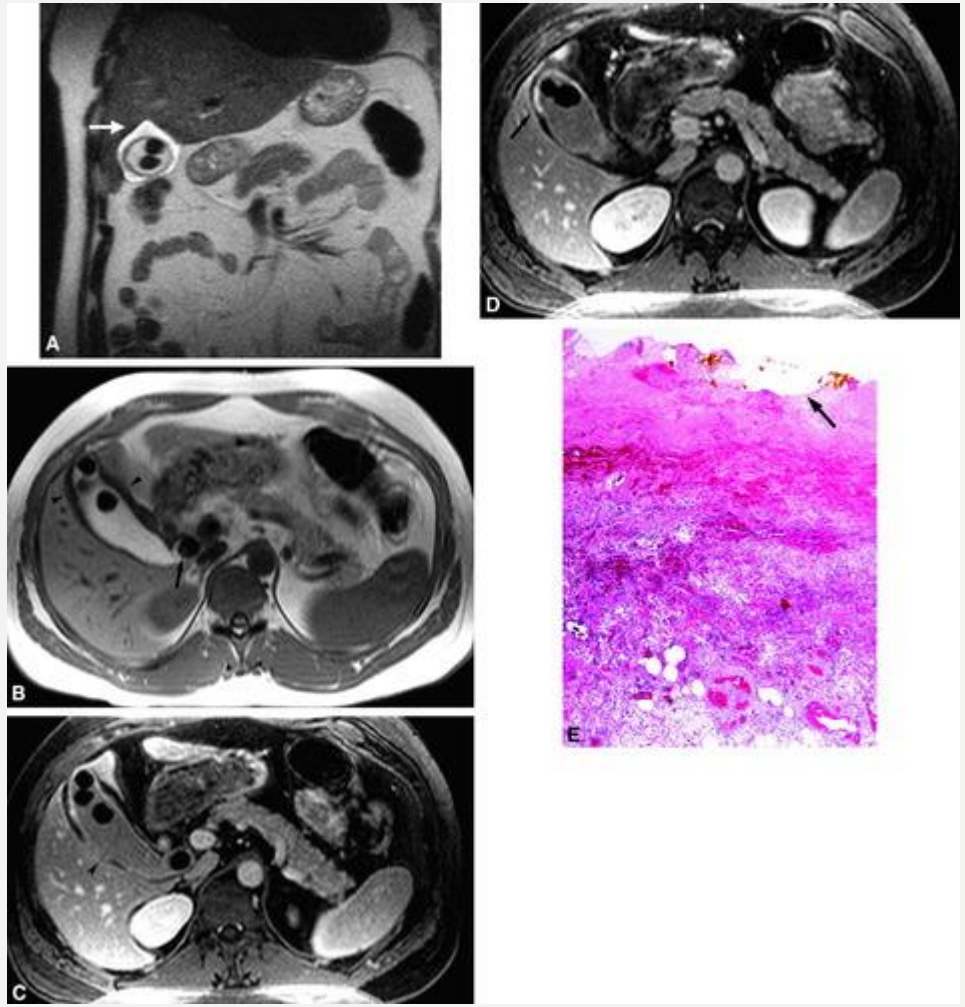
- Clinical and radiological diagnosis of GC is frequently challenging, however early recognition of this form of AC is important to establish since emergent surgery of these patients is the preferred treatment. Radiological imaging findings in GC on ultrasound (US) and Computed Tomography (CT) have been previously described in the literature. The interrupted rim sign: a magnetic resonance imaging (MR) sign indicates gallbladder wall necrosis.

GANGRENOUS CHOLECYSTITIS (GC)

- The sonographic (US) imaging findings in GC include: striated appearance of a thickened gallbladder wall, pericholecystic fluid collections, intraluminal membranes and/or marked irregularities of the gallbladder wall, absence of the sonographic Murphy sign, and diffuse medium-to-coarse intraluminal echoes within the gallbladder that do not show layering or acoustical shadowing. The loss of the mucosal lining/gallbladder wall echo on US has been described as a sign of mucosal/wall necrosis.
- A specificity of 96% for the diagnosis of gangrenous cholecystitis on CT with the presence of air in the gallbladder wall or lumen, irregular or absent gallbladder wall, intraluminal membranes, pericholecystic abscess, and lack of gallbladder wall enhancement.
- A patchy pattern of enhancement of the gallbladder mucosa, the interrupted rim sign, is correlated with foci of gangrene at pathology. Patients presenting with this finding on MR examinations should be strongly considered for urgent surgical therapy.

- Gangrenous cholecystitis (GC) is defined as necrosis and perforation of the gallbladder wall as a result of ischemia following progressive vascular insufficiency.[1,2] GC is a severe complication of cholelithiasis.[3,4] Factors such as male sex, advanced age, delayed surgery, leukocytosis, cardiovascular diseases (CVDs), and diabetes mellitus (DM) increase the likelihood of developing GC.[3,5–8] Compared with uncomplicated acute cholecystitis, GC carries a significantly higher mortality rate, which has been reported to be between 15% and 50%.

- Acute cholecystitis develops in 1% to 2% of patients with asymptomatic cholelithiasis each year.[12] Conservative treatment comprising intravenous fluid resuscitation and antibiotic therapy proves effective in 80% of patients with acute cholecystitis.[13] As one of the severe complications of acute cholecystitis, GC develops in 2% to 20% of the cases with acute cholecystitis.[5,6,14] Epithelial injury by increasing gallbladder wall tension owing to vascular insufficiency arising secondary to persistent obstruction of the cystic duct gives way to the development of GC, which follows a quite rapid course.[5] The phospholipases released from cell membranes of damaged epithelium initiate heavy inflammatory reaction.[1,2,5,15] Inflammation and ischemia of the gallbladder wall show progressive worsening as a result of deteriorating venous insufficiency with age, thereby giving rise to more necrosis and perforation.



A: Coronal HASTE image shows high signal intensity and thickening of the gallbladder wall consistent with edema. A minimal amount of pericholecystic fluid is noted in the gallbladder fossa (arrow).
B: Axial T1-weighted in-phase gradient-echo image shows multiple gallstones and irregular thickening of the gallbladder wall (arrowheads). An impacted gallstone in the neck of the gallbladder is demonstrated (arrow). Note the high signal intensity of the bile within the gallbladder.
C,**D:** Axial T1-weighted three-dimensional fat-saturated gradient–echo images (VIBE) at the level of the neck (C) and fundus (D) of the gallbladder during the venous phase after administration of a single dose (0.1 mL/kg body weight) of gadopentetate dimeglumine (Magnevist®) demonstrate an interrupted rim of mucosal enhancement. Focal areas of enhancement (arrows), consistent with inflammation of the mucosa, were seen along with focal areas that lacked enhancement (arrowheads). Histopathological analysis confirmed extensive necrosis of the gallbladder wall. **E:** Photomicrograph of gallbladder wall. Transmural necrosis with loss of the normal architecture of the gallbladder wall is noted with complete necrosis of the mucosal surface (arrow). Areas of acute and chronic inflammation predominate in the lower portion of the figure.

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