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**"North Ossetian State Medical Academy" of the Ministry of
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Department of surgical diseases No. 2

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ACUTE CHOLECYSTITIS

Textbook for students of 4 courses medical faculty of faculty surgery

Vladikavkaz

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This teaching guide covers main issues about etiology, pathogenesis, clinical features, laboratory and instrumental diagnostics and complications of Acute cholecystitis.

Teaching guide “Acute cholecystitis” is made for “Faculty surgery” discipline in accordance with requirements of FSES HE, and is intended for students from medical universities and faculties, studying for specialty 31.05.01 General medicine.

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INTRODUCTION

One may wonder why gall bladder and pancreas are discussed together!! Yes, biliary tract (gall bladder is an important part of that) ends after joining with pancreatic duct by opening into 2nd part of duodenum.

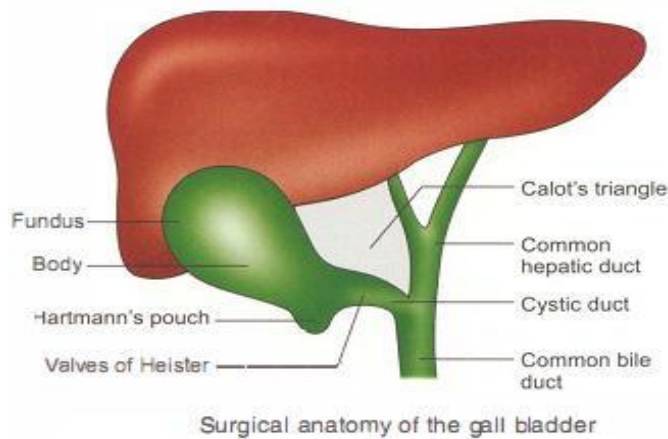
- Gall stones, when they block/pass through ampulla of Vater, produce acute pancreatitis.
- An important surgical condition-surgical jaundice or obstructive jaundice can be discussed better only if you know gall bladder and pancreas.
- Any surgery involving sphincter of Oddi in the form of sphincteroplasty/or removal (as in Whipple's pancreaticoduodenectomy), the gall bladder does not function and hence it needs to be removed.
- Embryologically, liver, biliary tree, ventral pancreas, gall bladder all developed from a diverticulum on the ventral aspect of the foregut of the embryo.
- And gall bladder will be palpable in cases of periampullary/carcinoma head of the pancreas.

SURGICAL ANATOMY OF THE GALL BLADDER AND BILE DUCTS

Gall bladder is a pear or globular shaped organ present in the right hypochondrium on the inferior surface of the liver, situated in the gall bladder fossa. It is about 8-12 cm long.

- Fundus: It is the dilated portion of the gall bladder adherent to undersurface of liver from which it can be separated easily.
- Neck: The narrow angulated distal portion of the neck is called *Hartmann's pouch*-common site where stones occur and tend to stay for a long time (also called infundibulum of gall bladder) (Fig. 1).
- Gall bladder drains into the common bile duct (CBD)

through *cystic duct*, which is 3 cm long. It is lined by cuboidal epithelium. There are prominent mucosal folds within the cystic duct due to the presence of prominent circular muscle fibres underneath. Its lumen is usually 1-3 mm in diameter. Contraction of gall bladder produces a functional valve called *valve of Heister* which prevents the migration of stone into the CBD. The wall of cystic duct is surrounded by a sphincter structure called *sphincter of Lutkens*. A spiral fold keeps cystic duct open for drainage of bile.



(Fig. 1)

Cholecystohepatic triangle or Calot's triangle boundaries

- Lateral: Cystic duct and gall bladder
- Medial: Common hepatic duct
- Above: Inferior surface of right lobe of the liver.

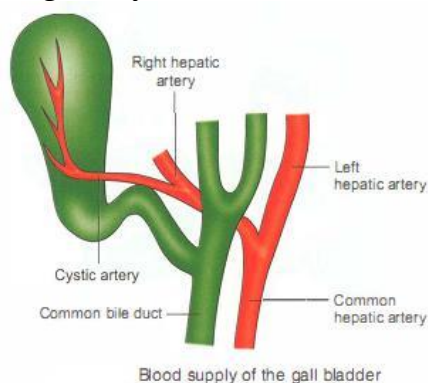
It is an important landmark in the identification of cystic duct, and cystic artery during cholecystostomy so as to avoid damage to extrahepatic biliary tree.

Contents

- Right hepatic artery and its branch, the cystic artery
- Cystic lymph node of Lund.

Blood supply of gall bladder

Cystic artery, a branch of right hepatic artery arises behind the common bile duct. Soon, it branches out over the surface of gall bladder. *Cystic artery is an end artery* (Fig. 2). Multiple small veins from the surface of gall bladder join the liver surface. There is also a cystic vein, from the neck of gall bladder draining into portal vein directly. This explains early spread of gall bladder malignancy to the liver.

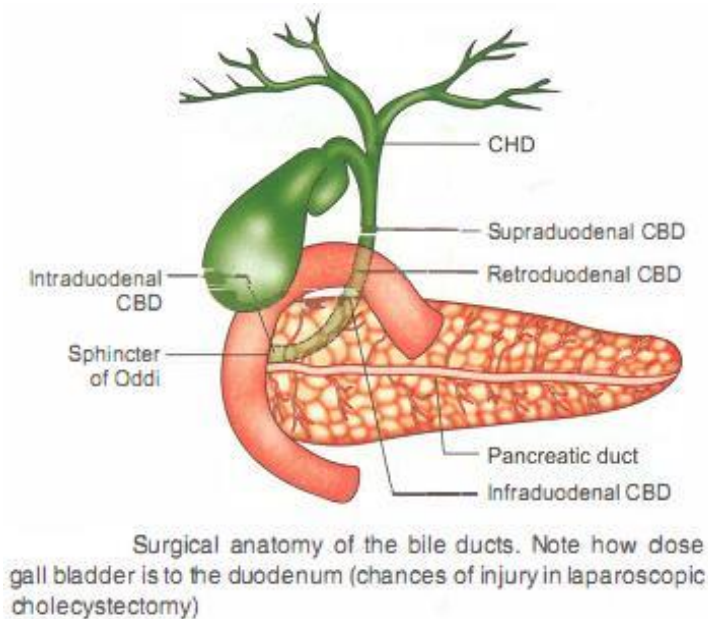


Lymphatics

1. Subserosal and submucosal lymph nodes drain into *cystic lymph node of Lund* and from here they drain into nodes in the hilum of liver and coeliac nodes.
2. Subserosal lymphatic vessels of gall bladder are also connected to subcapsular lymph channels of liver, which accounts for frequent spread of carcinoma gall bladder to the liver.

Anatomy of the bile ducts

- Common hepatic duct (CHD) is formed by the union of right and left hepatic ducts. It is 3 cm long, receives cystic duct and continues as common bile duct (CBD).
- Common bile duct is about 8 cm long. It has four parts: Supraduodenal, retroduodenal, infraduodenal and intraduodenal. Along with pancreatic duct, it forms ampulla of Vater. Controlled by sphincter of Oddi, it ends by an opening into the second part of duodenum (Fig. 3).



(Fig. 3)

PHYSIOLOGY

Functions of the gall bladder

- Reservoir for bile: Bile excreted by the liver is stored in the gall bladder as total of about 500 to 1000 ml per day. At fasting, the tone of sphincter of Oddi is high. Food contents in the duodenum stimulates release of cholecystokinin, which causes gall bladder to contract.
- Concentration: Bile is 98% water. Due to active absorption of water, sodium chloride and bicarbonate, bile gets concentrated 5-10 times.

Thus, a relative increase in bile salts, bile pigments, cholesterol and calcium occurs.

- Mucus secretion: It secretes about 20 ml/mucus per day. Obstruction to the cystic duct causes mucocoele of the gall bladder.

Bile

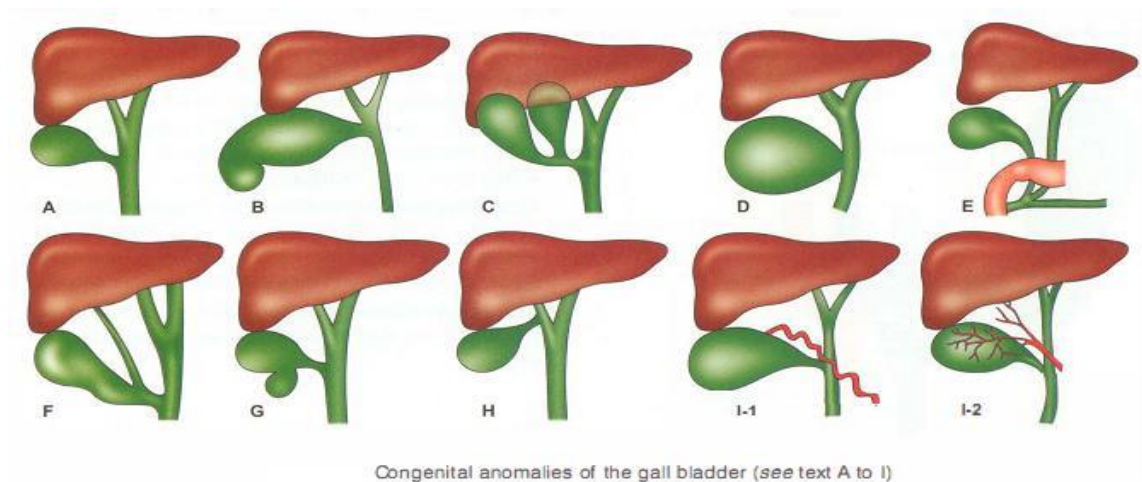
- Secreted from hepatocytes
- pH is more than 7.0
- 500-1000 ml/day, 98% is water
- Concentrated in gall bladder because of absorption of water. Capacity of gall bladder is 40-50 ml.
- Fatty food stimulation releases cholecystokinin, which stimulates gall bladder to contract and at the same time, sphincter of Oddi to relax.
- It also has inorganic ions (more than plasma) and hence, severe electrolyte imbalance is seen in biliary fistula.
- Cholesterol, synthesised in the liver, gives rise to bile acids-choleic and chenodeoxycholic acids. They are meta-bolised in the colon to deoxycholic acid and lithocholic acids.
- Main function of bile acids in the bile is to maintain cholesterol in solution.

CONGENITAL ANOMALIES OF GALL BLADDER

Absence of gall bladder: Very rare; other variations include (Fig. 4):

- A. Floating gall bladder: Results due to long mesentery. It is more vulnerable to torsion-a rare cause of recurrent upper abdominal pain. Such a gall bladder can be easily removed.
- B. Phrygian cap: Cap which was worn by people of Phrygia (ancient Asian country, Mongolia). It is an anomaly connected with the fundus of the gall bladder.
- C. Double gall bladder: The second one is always intrahepatic (rare).
- D. Absence of cystic duct: Cholecystectomy becomes difficult. There are high chances of injury to the common bile duct.
- E. Low insertion of cystic duct: Cystic duct opens into the common bile duct near the ampulla. This anomaly should be kept in mind when operating on cases of obstructive jaundice.
- F. An accessory or aberrant cholecystohepatic duct is present in about 10% of the patients. It may be the cause of significant bile leakage after cholecystectomy. It is the segmental duct that joins biliary system outside the liver instead of within it.
- G. Diverticulum of gall bladder
- H. Cystic duct joining right hepatic duct
- I. Anomalies of blood supply

- Very, very tortuous hepatic artery: Caterpillar turn o Moynihan's hump. It runs in front of the origin of cysti, duct.
- Cystic artery is given anteriorly from right hepatic artery.



(Fig. 4)

GALL STONE DISEASE (CHOLELITHIASIS)

Aetiology

1. Metabolic causes

- Cholesterol is produced from the liver which gives rise to bile acids. Cholesterol is insoluble and it must be transported within the bile salt micelles and phospholipid (lecithin: vesicles. Normal ratio of bile acids: cholesterol is 25:1 (Fig. 25.5).
- This ratio is necessary to maintain the cholesterol in liquid form by forming micelles. When the ratio drops down to 13:1 (which is called critical ratio), cholesterol crystals will nucleate and stones will form.
- Obesity, high calorie diet and medications which increase cholesterol secretion can result in stone formation.

2. Infection

- It is the most common cause responsible for a gall stone in 80% of patients. Sources of infection are tonsils, tooth, bowel, etc.
- Organisms such as *E. coli*, *Proteus*, anaerobic organisms, *Streptococci*, etc. reach the gall bladder wall through the blood stream and form a focus/nidus around which cholesterol and bile salts get precipitated.
- Over a period of many years, this results in a mixed stone. They are usually multiple and occur in infected bile.

3. Bile stasis and decreased bile acid pool

- Pregnancy, oestrogens, following vagotomy and prolonged total parenteral nutrition are associated with bile stasis.
- They are prone to mixed stones as a result of bile stasis

CAUSES OF DECREASED BILE ACID POOL

1. Cirrhosis of liver—pigment stones
2. Gastrectomy
3. Ileal resection
4. Malabsorption
5. Obesity
6. Hypercholesterolaemia

4. Haemolytic anaemia

- Examples: Hereditary spherocytosis, sickle cell anaemia.
- Bilirubin production is increased because of increased break down of RBCs. Since the production is more, they cannot conjugate with glucuronic acid, which is produced at normal levels.
- Such unconjugated bilirubin combines with calcium and is excreted in the biliary tree resulting in calcium bilirubinate stones (pigment stones) not only in the gall bladder but also in the entire ductal system.

5. Saint's triad

Gall stones (can occur along with two other conditions mentioned below)

- Diverticulosis of colon
 - Hiatus hernia
- #### 6. Parasitic infestation
- In Oriental countries, *Clonorchis sinensis* (Chinese liver fluke) infestations can cause stone in the biliary tree.
 - *Ascaris lumbricoides* in the biliary tree may produce stones in our country (India).
- #### 7. Due to abnormal mucus

It is produced in congenital cystic fibrosis. Gall stones occur in these children due to impairment of bile flow.

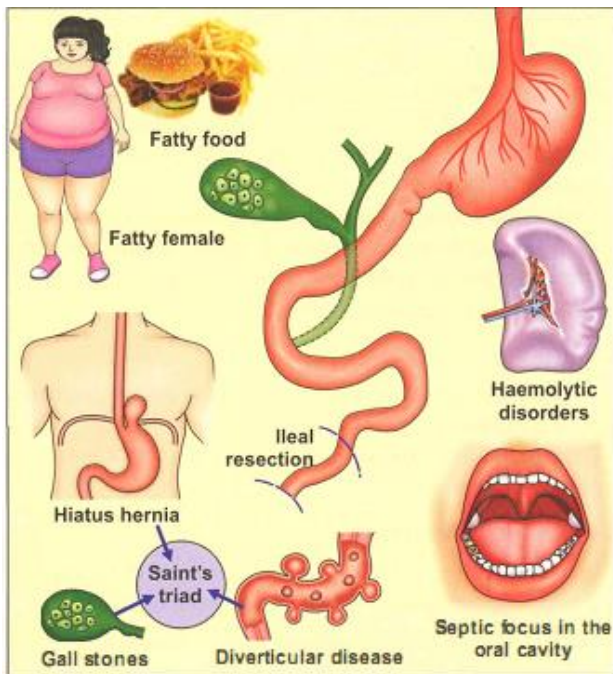
Other diseases associated with gall stone disease:

- Diabetes mellitus
- Type IV hyperlipoproteinaemia
- Cirrhosis of liver
- Fistulae on treatment with total parenteral nutrition
- Gastric surgery

Risk factors for gall stone disease

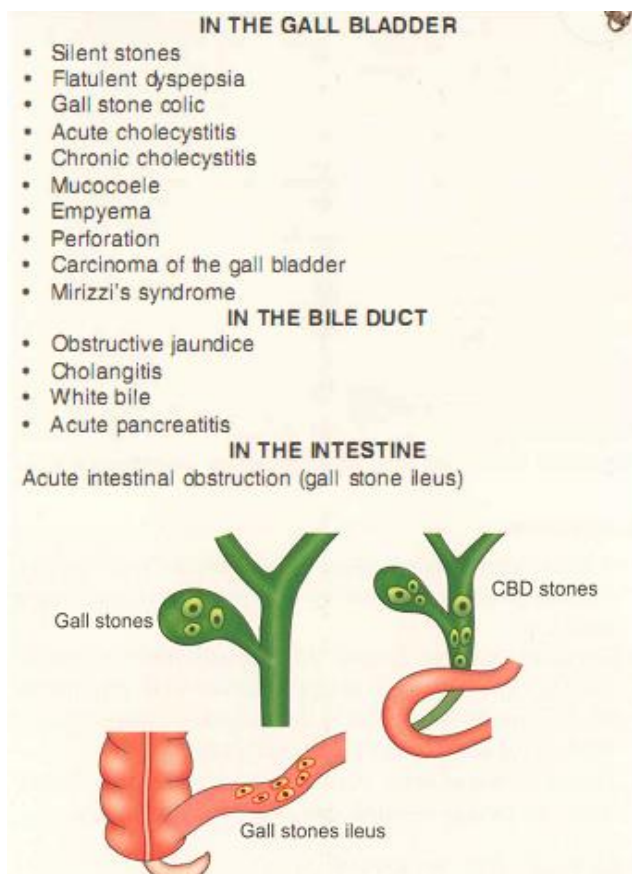
RISK FACTORS

- Female sex
- Obesity
- Maturity onset diabetes
- Age > 40 years



Clinical features (complications of gall stones)

Clinical presentation of these patients vary from dyspepsia to severe forms such as pancreatitis and perforation of the gall bladder. Classified as in the gall bladder in the CBD and in the intestines.

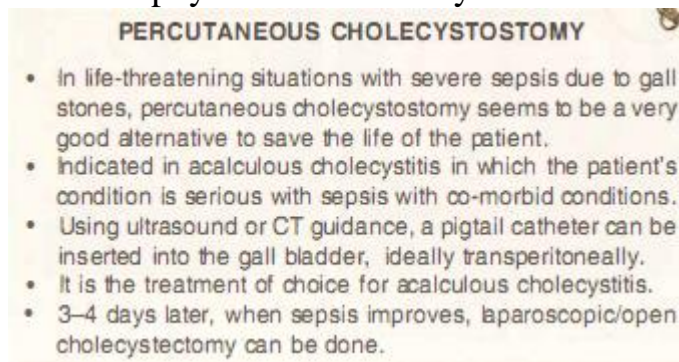


ACUTE CHOLECYSTITIS

Definition: Acute bacterial inflammation of the gall bladder with or without stone.

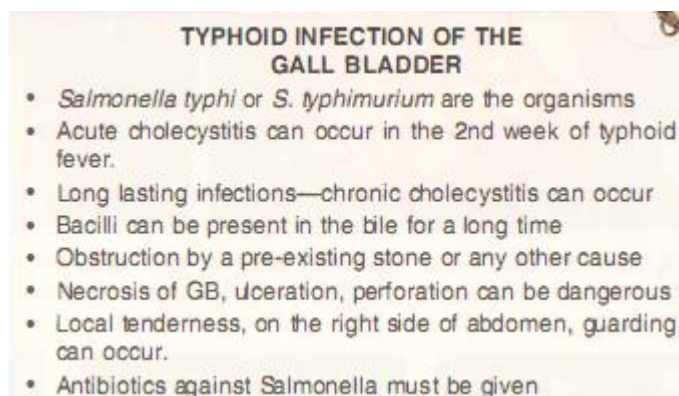
Types

1. Calculous: Obstructive cholecystitis. It is the commonest variety. Calculi cause bile stasis.
2. Acalculous: Nonobstructive cholecystitis. It is not uncommon and is seen in patients who are recovering from major illness.
3. Acute emphysematous cholecystitis.



Bacteriology of acute cholecystitis

1. Majority of the cases of calculous cholecystitis are due to organisms such as *E. coli*, *Streptococci*, *Salmonella*, *Klebsiella*, etc.
2. Typhoid fever can also cause Typhoid Cholecystitis around 2nd week of infection (Key Box 25.6).
3. *Clostridial* infection of the gall bladder produces acute cholecystitis with toxæmia.

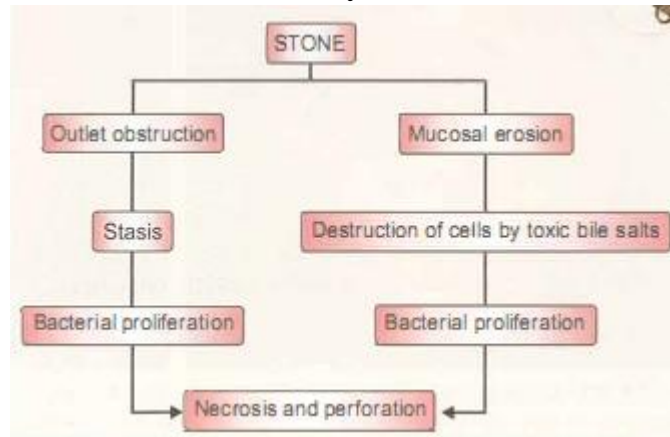


Pathogenesis

- Acute calculous cholecystitis appears to be caused by obstruction to bile flow from gall bladder by stone or oedema formed as a result of local mucosa! erosion and inflammation caused by stone. Once mucosa is eroded, tissue planes are exposed to bile salts. Toxic bile salts destroy

cells by their detergent action leading to necrosis and perforation of gall bladder.

- At the same time, bacterial infection adds to the morbidity of acute cholecystitis. Positive bile cultures are found in 70% of cases of acute calculous cholecystitis.



Pathology

1. Inflammation: Entire gall bladder is inflamed, swollen and is friable. When the inflammatory exudate surrounding the gall bladder collects under the diaphragm, it results in pain radiating to the right shoulder (C3, 4) due to phrenic nerve irritation. It may undergo complete resolution with antibiotic therapy but such recurrent attacks are common at a later date (Fig. 25. I 7).
 2. Perforation: Extensive ulcerations of gall bladder may result in perforation with biliary peritonitis and carries a very high mortality rate. Perforation can occur when the stone is impacted in the Hartmann's pouch.
 3. Obstruction to the neck of gall bladder results in muco-coele or pyocoele (empyema). Empyema of the gall bladder can occur in diabetic patients and is associated with high grade fever, chills, rigors and even septicaemia.
 4. Gangrene of gall bladder can occur if the blood vessels get thrombosed. All these features are more in an obstructive variety.
- If there is clostridial infection as can occur in diabetics because of extensive gas production in biliary tree and associated toxicity, perforation is likely even without a stone.

Clinical features

- A fatty, fertile, female is the typical victim who presents with severe upper abdominal pain. The pain is colicky in nature and more prolonged because of inflammation. Severe nausea and vomiting are present. In the initial phase, there is low grade fever, except in clostridial infection where there is high grade fever.

- You may be surprised to find a young boy, a girl or even a child with gall stones-suspect haemolytic anaemias.

Signs

1. *Murphy's sign*

- Keep the fingers in the right hypochondrium and ask the patient to take a deep inspiration.
 - At the height of inspiration there is a sudden catch in the inspiration.
 - It is due to inflamed gall bladder coming in contact with the abdominal wall under the fingers and producing pain. This is called Murphy's sign positive. It is a diagnostic sign of acute cholecystitis (Fig.5).
2. *Boas' sign*: An area of hyperaesthesia between 9th and 11th ribs posteriorly on the right side is a feature.
 3. Upper abdominal guarding, rigidity.
 4. Vague mass consisting of inflamed gall bladder, omentum, inflammatory exudate can be felt at times. Hence, even if a perforation occurs, generalised peritonitis is uncommon.



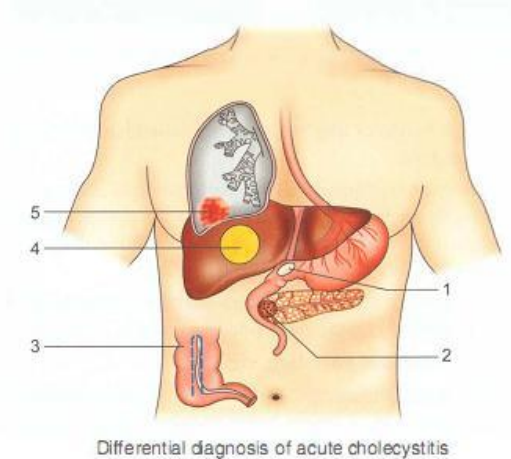
Eliciting Murphy's sign

(Fig.5)

Differential diagnosis (DD) (Fig. 6)

1. Perforated peptic ulcer: Severe sudden pain, severe tenderness in the right hypochondrium, guarding and rigidity caused by perforated peptic ulcer, can mimic acute cholecystitis. Obliteration of liver dullness, coffee ground vomitus, generalised guarding and rigidity clinches the diagnosis of perforated duodenal ulcer.
2. Acute pancreatitis: A severe pain in upper abdomen, tenderness in the right hypochondrium and epigastrium mimic cholecystitis. One should remember that pain of pancreatitis is more severe and classically radiates to back.
3. High retrocaecal appendicitis: Especially when appendix is in the subhepatic position. Once inflammatory fluid spreads in the general peritoneal cavity, there will be more difficulty in diagnosing clinically.

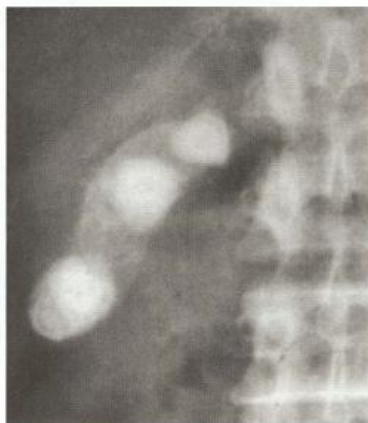
4. Amoebic liver abscess: Can also mimic very closely. It is more common in male alcoholics. Liver is enlarged and one can feel the round lower border of liver very closely. Liver will be extremely tender.
5. Lobar pneumonia (basal): Can cause right hypochondriac guarding and rigidity. It is a referred pain.



(Fig. 6)

Investigations

1. Total WBC count is always raised.
 2. Blood and urine sugar estimation to rule out diabetes mellitus.
 3. Plain X-ray abdomen erect position (Fig. 7)
 - Gall stones can be demonstrated in 10% of the patients as radio-opaque shadows in the right hypochondrium. In lateral view, the stone is seen in front of vertebral bodies.
 - To rule out other causes such as perforated peptic ulcer (air under diaphragm).
 - Rarely, it may show calcified gall bladder (porcelain gall bladder).
- 10% Gall stones are radio-opaque, 90% are radiolucent. Centre of stones may contain radiolucent gas, either triradiate (Mercedes Benz sign) or biradiate.



Plain X-ray abdomen showing radio-opaque shadows

4. Emergency ultrasonography

- To demonstrate stones, which cast posterior acoustic shadow.
- Success rate is > 95%
- It can demonstrate inflamed, thickened organ, in cases of acalculous cholecystitis.
- Demonstration of Murphy's sign, with the help of ultrasonography is possible which adds to the diagnosis.
- Ultrasound can also measure gall bladder function by using ultrasonic dimensions of the gall bladder.
- It can detect gall bladder polyps.

5. CT Scan:

- It is done when ultrasound findings are not clear
- It not only diagnoses gall stones, but also detects other complications such as perforation, stones in the CBD, etc.
- Renal halo sign due to fluid around
- Obliteration of psoas shadow
- Air fluid level in duodenum are the features.

Treatment:

I. Conservative treatment is followed in majority of the cases (60 to 70%)

1. Admission in the hospital
2. Aspiration with Ryle's tube: Aspiration of HCl decreases the stimulus to the secretion of bile. Spasm of gall bladder may come down.
3. Antispasmodics: Injection morphine 8-10 mg IM as analgesic along with injection atropine 0.6 mg to relieve spasm of sphincter of Oddi.
4. Antibiotics: Broad spectrum antibiotics are given against gram +ve, gram -ve and anaerobic organisms. Cefazolin, cefuroxime or amikacin are the drugs of choice. The patient is kept nil orally for 2-3 days and during this time IV fluids are given.

After 2-3 days, pain comes down, signs (tenderness) disappear and abdomen becomes soft. Ryle's tube is removed, clear oral fluid is given for 2-3 days followed by soft diet. After 6 weeks, the patient is advised to undergo elective cholecystectomy. Reason for conservative treatment is in majority of cases, inflammation will settle down.

II. Early cholecystectomy

- Patients in the first group need two admissions, cost is increased and return to work is also delayed. Hence if a surgeon is experienced and the set up is good, one can proceed to early cholecystectomy from 2nd day to 7th day.
- It has been proved that even though gall bladder is inflamed, complications are no way more than elective cholecystectomy in the

hands of experienced surgeon while performing laparoscopic cholecystectomy.

- Thus, if a firm preoperative diagnosis is established and some of the comorbid conditions are corrected (diabetes, hypertension, etc.), surgery can be done safely. This is called early cholecystectomy.

III. Emergency cholecystostomy

About 10% of cases of acute cholecystitis require emergency cholecystostomy.

- In these patients, high grade fever, sepsis, shock, high leukocyte count are the deciding factors.
- Acalculous cholecystitis and perforated gall bladder with peritonitis are definitely strong indications for emergency cholecystectomy.

1. Following is not the feature of acute cholecystitis:

- A. It causes pain in the right hypochondrium
- B. If it perforates, gas under diaphragm is detected by percussion
- C. Shoulder pain can occur
- D. Acalculous cholecystitis is due to hypotension

2. Following is the most important sign of acute cholecystitis:

- A. Pain in the right shoulder
- B. Intercostal oedema and tenderness
- C. Positive Murphy's sign
- D. Hyperaesthesia of the abdominal wall

3. Cystic duct joins supraduodenal CBD in what percentage of the cases?
 - A. 80% B. 90%
 - C. 70% D. 95%
4. Porcelain gall bladder has following features except:
 - A. It is calcification of the gall bladder
 - B. Plain X-ray is not very useful to detect this
 - C. CT scan will detect this
 - D. It may be associated with carcinoma gall bladder
5. Which one of the following is true of choledochal cyst?
 - A. Acquired dilatation
 - B. Not premalignant
 - C. Type I cyst is the most common variety
 - D. Does not cause pancreatitis
6. Which one of the feature is true in gall stone ileus?
 - A. Obstruction is in terminal ileum
 - B. Stone reaches ileum via ampulla of Vater
 - C. Obstruction and features of perforation of gall bladder are found
 - D. Cholecystectomy and extraction of the stones by enterotomy is done
7. Following are true for acalculous cholecystitis except:
 - A. It can be seen in septic shock due to hypotension
 - B. Some features of cholecystoses may also be found
 - C. Salmonella typhi can also give rise to acute acalculous cholecystitis
 - D. Rare to get chronic cholecystitis in Salmonella cholecystitis
8. Following are indications for common bile duct exploration except:
 - A. Palpable stones in the CBD
 - B. Dilated common bile duct
 - C. Jaundice
 - D. Thickened common bile duct
9. Following are risk factors for cholangiocarcinoma except:
 - A. Choledochal cyst
 - B. Caroli's disease
 - C. Primary sclerosing cholangitis
 - D. Biliary stricture
10. Which one of the following is true of carcinoma gall bladder?
 - A. It is common in males
 - B. Disease occurs around 5th decade

- C. Gallstone disease does not predispose to carcinoma gall bladder
- D. Majority are adenocarcinoma

ANSWERS

1-B. 2-D. 3-A. 4-B. 5-C. 6-A. 7-D. 8-D. 9-D. 10-D.

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