Surgery of the biliary tract

Attila SZÍJÁRTÓ M.D.
Anatomy

• The cystic artery which supplies the gallbladder is usually a branch of what artery?
  – The Right Hepatic Artery (90% of the time)
  – Course can vary, usually in triangle of Calot
  – Divides into posterior and anterior branches at neck of gallbladder
Anatomy

• What are the boundaries of the Triangle of Calot?
  – Cystic duct
  – common hepatic duct
  – cystic artery
Anatomy

• What is the name the mucosal folds found in the cystic duct adjacent to the gallbladder neck. Do they have any valvular function?
• The Spiral Valves of Heister, and no they do not have any valvular function.
Problems: surgery & clinical anatomy

Anomalies:

• The classic description applies only in one third of the patients
• G.B: abnormal portions, intrahepatic, rudimentary, or duplicated.
• Bile ducts: duct of Luschka, accessory right hepatic duct.
• Arteries:
  • In 50 % of population
    – Right hepatic artery from SMA (20%)
    – 2 right hepatic arteries (5%)
    – Cystic artery can arise from left hepatic, common hepatic, gastroduodenal, or SMA (10%).
Anatomy

- The arterial supply to the bile ducts is derived from which 2 major arteries and is oriented in what clock positions???
  - Gastroduodenal and Right Hepatic Arteries, in the 3:00 and 9:00 positions (medial and lateral walls)
  - importance: ischemic injury cause stenosis on the bile duct
Ruggero Oddi described the Sphincter of Oddi while he was a student.

Francis Glisson identified the sphincter 2 centuries earlier!

Inflammation of the sphincter of Oddi is called *odditis*.
Physiology

Bile Formation and composition:

• Produced by the liver (500-1000 ml/day).
• Production is stimulated
  – N. vagus
  – food particles in the duodenum
  – secretin
• Composed of water, electrolytes, bile salts, bile pigments, protein, lipids.
• Cholesterol → primary bile acids → (conjugation + Na) → bile salts → small intestine:
  – *80% absorbed in terminal ileum.
  – deconjugated (secondary bile acids) → absorbed in colon
• 95% of the bile acid pools is reabsorbed (enterohepatic circulation)
Indocyanine Green (ICG)

- clinical use for over forty years
- water-soluble, non-toxic and non-allergenic
- tricarbocyanine dye
- intravenous injection
- ICG is not metabolised
- Exclusively eliminated by the liver into the bile
- without enterohepatic re-circulation
- fluorescent and strong infrared absorbing agent with an absorption maximum at 805 nm
- ICG concentration can be quantified photometrically
- non-invasive transcutaneous technique (LiMON® Pulsion Medical Systems, Germany)
**G.B Function:**
- Store and concentrate bile
- Secrete glycoprotein and hydrogen ion
- Contraction
  - stimulated by CCK and vagus nerve
  - inhibited by sympathetic stimulation, VIP, and somatostatin

**Sphincter of Oddi:**
- Regulates bile flow
- Prevents back flow, and diverts bile into G.B.
- Basal resting pressure of 13 mm Hg above duodenal pressure.
- CCK causes relaxation
Which of the following factors are associated with increased risk of gallstone development?

- A. Obesity
- B. Pregnancy
- C. Crohn’s disease
- D. Terminal ileal resection
- E. Gastric surgery
- F. Sickle Cell Disease

- Forty
- Female
- Fat
- Fertile

Over-concentration in the components

Fail in the enterohepatic circulation
Diagnostic studies of the disorders in the biliary system

Blood Tests:
- WBC
- LFT: liver trasnasminase: ASAT/ALAT – „obstruction enzimes” – GGT, ALP BUT: pt with biliary colic blood tests will be typically be normal.

Ultrasonography:
- GOLD STANDARD
- Stones (>90% senzitivity & specificity) -> acoustic shadow, move
- Thickened wall
- Evaluate extra hepatic biliary tree
- Can evaluate tumor invasion and flow in the portal pain.
Diagnostic studies of the disorders in the biliary system

Oral Cholecystography
- Old fashioned, not used

HIDA (99mTc-Technetium-labeled derivatives of dimethyl iminodiacetic acid)
- Radionuclide is injected IV
- Detected in
  - liver within 10 min.
  - GB, ducts, and duodenum are visualized
  - within 60 min.
- Acute cholecystitis → nonvisualized G.B. (95% s&s).
- To evaluate biliary leak
Diagnostic studies of the disorders in the biliary system

MRCP
- used to delineate the anatomy of the bile and pancreatic ducts.

CT:
- The major application is to define the biliary tree and nearby structure.
- Test of choice to evaluate for malignancy.

ERCP:
- Require patient sedation.
- Direct visualization of the ampullary region and direct access to the distal CBD.
- Can be used for therapeutic intervention.
- Used mainly to evaluate complicated duct stones.
- Complications include pancreatitis and cholangitis !!!
Diagnostic studies of the disorders in the biliary system

Percutaneous trashepatic cholangiography and darinage (PTC/PTD):

• Invasive (transhepatic! )

• To evaluate the intrahepatic biliary system
  • when ERCP unsuccessful
  • Hilar stenosis/tumor

• Useful in patient with
  hilar duct strictures and tumors.

• Risk
  • Bleeding
  • Cholangitis
  • Bile leak.
Gallstone disease

Prevalence 11-36%.

Risk factors:
- Obesity
- Pregnancy
- Crohn’s disease.
- Terminal ileum resection.
- Gastric surgery.
- Hereditary spherocytosis, sickle cell disease.
- Female.
- 1st degree relative.
Gallstone disease

Natural History:
• Most pt remain asymptomatic
• 3% become symptomatic per year (biliary colic)
• 3-5% develop complications per year
  • acute cholecystitis
  • choledocholithiasis
  • cholangitis
  • pancreatitis
  • cholecystocholedochal fistula, and cholecystoenteric fistula.
• Prophylactic cholecystectomy may indicated for elderly pts with DM, individual who will be isolated from medical care for extended period of time, and in population with increased risk of cancer.
• Porcelain G.B. is an absolute indication for cholecystectomy.
Gallstones formation:
- Form as a result of settling out of solution.
- Can be classified into:

1- cholesterol stones
   - *80% of gallstones.
     * Secondary to *supersaturation* of bile with cholesterol due to cholesterol hypersecretion.
     *10% -> pure, and present as single large stone with smooth surface.
     *most contain bile pigments and Ca, and are usually multiple, variable size
     *color range from whitish yellow and green to black.
     *most are radiolucent.

2- pigment stones:
   - **black** are usually small, brittle and speculated.
     Formed secondary to *supersaturation* with Ca bilirubinate.
   - **brown** stones are usually less than 1 cm, soft, and mushy. Usually formed secondary to *bacterial infection* due to bile stasis.
Mirizzi’s Syndrome

- Obstruction of the bile ducts by severe pericholecystic inflammation secondary to impaction of a stone in the infundibulum of the GB that mechanically obstructs the bile duct
Symptomatic gallstones
Chronic cholecystitis

• About two thirds of patients with gallstone disease present with chronic cholecystitis.

• Clinical presentation:
  • *The patient suffers discrete attacks of pain
  • *RUQ tenderness.
  • *Atypical presentation.

• Hydrops: due to an impacted stone in the cystic duct.

• Diagnosis: clinical presentation + US

• Management: dietary modification and elective cholecystectomy.
Symptomatic gallstones
Acute cholecystitis

• **Causes:**
  1. stones 90-95%
  2. acalculous (ICU, sepsis!)
  3. tumor

• **Clinical manifestation:**
  * 80% give a history compatible with chronic cholecystitis.
  * RUQ or epigastric pain that may radiate to the right upper part of the back or the interscapular area.
  * fever, complains of anorexia, nausea, and vomiting.
  * RUQ tenderness and *Murphy's sign*: An inspiratory halt upon deep palpation of the R subcostal area, characteristic of acute cholecystitis

• **Diagnosis:**
  * **WBC: 12-15, LFT**
  * **US & HIDA & CT**
Symptomatic gallstones
Acute cholecystitis

➢ **Treatment:**
  * intravenous fluids
  * antibiotics (Gram negative and anaerobes)
  * analgesia

* Cholecystectomy; early vs delayed (a’froide)
* unfit for surgery
  - a percutaneous cholecystostomy or an open cholecystostomy under local analgesia can be performed.
Choledocholithiasis

• Common bile duct stones
  • primary or secondary.

• Clinical manifestation:
  • May be silent or
  • can present with
    • biliary colic,
    • cholangitis,
    • gallstone pancreatitis, or
    • obstructive jaundice.

• Diagnosis: US, MRC, ERCP

• Treatment:
  • *ERCP followed by LC
  • * LC and intraoperative cholangiogram and laparoscopic CBD expl.
  • *Open CBD ex and T-tube placement
Choledocholithiasis

- Common bile duct stones
  - primary or secondary.
- Clinical manifestation:
  - May be silent or
  - can present with
    - biliary colic,
    - cholangitis,
    - gallstone pancreatitis, or
    - obstructive jaundice.
- Diagnosis: US, MRC, ERCP
- Treatment:
  - *ERCP followed by LC
  - * LC and intraoperative cholangiogram and laparoscopic CBD expl.
  - *Open CBD ex and T-tube placement
Cholangitis

Is an ascending bacterial infection in association with partial or complete obstruction of the bile ducts. (*E. coli, Klebsiella pneumoniae, Str. faecalis, and Bacteroides fragilis*)

**Clinical presentation:**
- Charcot's triad: (jaundice, fever, abdominal pain)
- Reynolds pentad: Charcot's triad + shock and an altered mental status.

**Diagnosis:**
- Leukocytosis, hyperbilirubinemia, and elevation of alkaline phosphatase and transaminases.
- US
- ERCP, PTC
- CT, MRI

**Treatment:**
- Intravenous antibiotics and fluid resuscitation
  - *the obstructed bile duct must be drained as soon as the patient has been stabilized* !!!
Surgical Treatment

Is prophylactic cholecystectomy routinely indicated in patients with asymptomatic gallstones?

• NO
• Advisable for
  – elderly diabetics,
  – pts isolated from medical care,
  – pts w increased risk of GB CA
• Porcelain GB is indication for cholecystectomy

A 45 yo WF presents to the Emergency Dept. with biliary colic for the second time in 2 weeks, repeat RUQ pain, US shows no stones but sludge in the GB. Is cholecystectomy indicated in this pt?

• Yes!
• 2 or more occasions of pain/sludge
• Cholesterolosis/adenomyomatosis/granulo-matous polyps indication if causing sx’s
Emphysematous Gallbladder

• Gas in GB lumen/wall of GB

• Cause:
  – Persistent obstruction > secondary bacterial inflammation with gas forming organisms involved

• Gas in the track without infection:
  – GB can perforate,
  – form cholecystoenteric fistula, lead to gallstone ileus, cause intrahepatic abscess, peritonitis, etc.
Biliary disease Surgery

Laparoscopic cholecystectomy  Open cholecystectomy
History

* Carl Langenbuch performed the first Cholecystectomy in 1882 in Berlin on a 43 yrs old male patient

* Morning following the operation the patient was smoking cigar and professing hunger. Discharged 7 weeks after the operation
Laparoscopic cholecystectomy

• Patients prepared and draped in a similar fashion to open cholecystectomy

• Conversion rate 5% for elective cholecystectomy and upto 30% of cholecystectomies for acute cholecystitis

• Insert foley if needed

• Insert OG Tube
Laparoscopic cholecystectomy

- Patients prepared and draped in a similar fashion to open cholecystectomy
- Conversion rate 5% for elective cholecystectomy and up to 30% of cholecystectomies for acute cholecystitis

**Indications**
- Symptomatic cholelithiasis
- Prophylactic cholecystectomy for patients who undergo transplantation
- Calcified gall bladder
- Trauma
- Biliary dyskinesia
- Symptomatic gall bladder polyps

**Contraindications**
- Relative
  - Bowel Obstruction
  - Disorders of coagulation
  - Liver Cirrhosis
- Absolute
  - Patients who can’t tolerate GA
Complications

- Mortality less than 0.1%
- Major bile duct injury – 0.3% - 0.6%
- Major vascular injuries
- Spillage of stones – 10%
- Intraabdominal abscess, subcutaneous abscess, discharge of retained stones through the abdominal wall or through the lung and trachea
Gallbladder Cancer

- Patients with gallbladder cancer be recognized before laparoscopic cholecystectomy for the risk of port site seeding and bile spillage with its potential for subsequent carcinomatosis
- 50% of patients have found to have unresectable disease at the time of diagnostic laparoscopy
- Patients with unresectable disease have a median survival of only 6 months
Cholecystectomy with or without Partial Hepatectomy

- 5 year survival of patients undergoing resection with curative intent is 17%

- Resection is possible only in 25% of patients at presentation

- Results of treatment and the scope of the operation are related to the depth of tumor penetration

- For tumors limited to the muscular layer of the gallbladder (T1) – Simple cholecystectomy is adequate

- Extent of resection for T2 and greater tumors is controversial – recommendations range from simple cholecystectomy to radical excision including hepatectomy
Gallbladder cancer

- **T2 Lesions** – Tumor invades the perimuscular connective tissue; no extension beyond the serosa or into the liver
  - Radical cholecystectomy (wedge resection of hepatic bed) or a segment of 4b and 5 resection with lymphadenectomy

- **T3 Lesions** – Tumor perforates the serosa or directly invades the liver or one other adjacent organ or structure
  - Segment 4b and 5 resection or extended Right hepatectomy

- **T4 Lesions** – Tumor invades main portal vein or hepatic artery or invades multiple extrahepatic organs
  - More radical excision of liver such as extended Right hepatectomy
Classification of Cholangiocarcinomas

- Intrahepatic
- Peri-hilar (Klatskin) – most common 70% of cases
- Distal
Bismuth-Corlette classification

I.

II.

IV.

Bismuth H, Corlette MB:
Intrahepatic cholangioenteric anastomosis in carcinoma of the hilus of the liver.
Surgical treatment of Cholangiocarcinoma

- Surgical exploration is often the only means of assessing the resectability.

- Staging laparoscopy will help to detect peritoneal metastases or additional intrahepatic disease through the use of laparoscopic ultrasound.

- Less sensitive in detecting nodal metastases or locally invasive tumors.

- Hilar cholangiocarcinomas are considered unresectable.
  - Local factors – Invasion in the main portal vein or both the right and left portal vein, hepatic arteries and tumor extension into the biliary radicals of both right and left hepatic lobes.
  - Metastatic spread.

- Complete resection is needed for cholangiocarcinoma which requires biliary and hepatic resection and often major vascular reconstruction.

- 5 year survival rate after resection – 10% to 30%.
- Resection improves survival and quality of life.