Biliary System: Anatomy and Physiology Review

Katherine Mansfield RN, CGN, MN
Clinical Nurse Educator
St Michaels Hospital
• Objectives

• To review the anatomy and physiology of the Biliary System

• To consider the main functions of the Biliary System and its impact on clinical outcomes

• To highlight some of the main pathological conditions which affect the Biliary System
Anatomy of Biliary System

Gallbladder  Hepatic, Cystic and Common Bile Duct

- Holds 50ml of bile
- The Cystic Duct joins the Hepatic Duct to become the Common Bile Duct
- Common bile duct joins with the Pancreatic Duct
- exits into the duodenum via the Ampulla of Vater
• Functions of Biliary System
• Sphincter Of Oddi

- Complex group of smooth muscles
- Regulates the flow of bile (gallbladder not an essential organ)
- Inhibits the flow of bile into the pancreatic duct
- Prevents the reflux of intestinal contents into the ducts
Functions of The Biliary System

The biliary system's main function includes the following:
- to drain waste products from the liver into the duodenum
- to help in digestion with the controlled release of bile
- to collect, concentrate and store bile
- to release it into the duodenum when it is needed for digestion
Bile is an alkaline greenish-yellow fluid that is secreted by the liver cells to:

- carry away waste
- break down fats during digestion (Bile Salt)

Bile, which is excreted from the body in the form...
- Its major components are water (97%)
- Hepatic bile, bile salts, fatty acids, lipids (cholesterol), lecithin, inorganic electrolytes & conjugated bilirubin
- Bile flows from the liver via the cystic duct for storage in the gall bladder
The Biliary System: Bile Functions

**Functions of bile**

- Bile salts emulsify triglycerides and phospholipids in our food. This makes it easier for the pancreatic enzymes to break them down.
- Aids fat absorption
- The bile salts and IgA antibodies inhibit bacterial growth in the small intestine.
- Neutralises gastric acid in the small intestine
- Aids excretion of bilirubin (from recycled red blood cells)

**4 Major Functions of Bile**

- Fatty Acid Metabolism
- The Excretion of Waste Products
- Kill off Bad Microbes
- Blood Sugar Metabolism
• Cholelithiasis

- Presence of stones or calculi in gallbladder

- 5th leading cause of hospitalization among adults

- 90% of all disease of biliary system

- 2 types of stones
Cholelithiasis: Cholesterol Stones

- hardened cholesterol
- yellow green in color
- contain calcium, salt and protein and bile
- 80% of all gallstones, yellow green in color
Cholesterol Stones : Etiology

- diets
- Age,
- Pregnancy
- birth control
- estrogen therapy
- ileal disease
- hyperlipidemia
- Obesity
- Drugs
- spinal cord injury,
- diabetes
Pigment Stones: Risk Factors

- increasing age
- chronic hemolysis
- alcoholism or alcoholic cirrhosis
- Biliary infection
- TPN
- Vagotomy
- Periampullary diverticula
- Gall Bladder Stasis

Black Pigment stones contain bilirubin polymers & inorganic calcium salts
- Stones may be passed, but those that get stuck become a problem
- Lodge in neck, cystic duct or common bile duct obstruct passage
- May move around and may be passed without causing distress

Stones that move to the neck:
- obstruct flow of bile
- cause mucosal damage and infection
Symptoms:
- Biliary colic pain
- 3+hrs post eating big meal
- radiates to shoulder & back
- N&V
- Dyspepsia
- fever, chills

Complications:
- Cholecystitis,
- cholangitis
- abscess or fistula
- perforation
- gangrene
- hepatic damage
- gallbladder CA

Cholelithiasis
Diagnosis: US*, CT, MRI, Blood Work, ERCP

Treatment: Diet, pain control
- surgery (cholecystectomy)
- New drug therapy to dissolve stones Ursodiol, (Actigall) & chenodiol (Chenix)
- Infusion of methyl tertbutyl ether into gallbladder to dissolve stones
- Biliary lithotripsy (acoustic shock waves)
- No medical treatment for **pigment stones**
- Surgery only option for **pigment stones**
Endoscopic Treatment

CBD Stone Extraction with Basket

A retrieval basket is designed to accommodate a wide range of stone sizes. The basket is advanced into the common bile duct and opened above the stone. The stone is captured within the basket and pulled out of the bile duct and into the duodenum where it is released.

Balloon Extraction of CBD Stone

An extraction balloon can be used for common bile duct stones <1 cm in diameter. The balloon is advanced into the bile duct above the stone and then inflated. The balloon and stone are then pulled through the ampulla.
Mechanical Lithotripsy

For large stones a mechanical lithotripsy device is used to crush and extract stones.
- Presence of gallstones in common bile duct or hepatic duct
- Most often are pigment stones
- Pigment stones develop right in the common bile duct (primary)
- Cholesterol stones are made in gallbladder and lodge in the duct “secondary stones”
- Cause problems by obstructing flow of bile into duodenum
• Symptoms

- biliary colic
- epigastric RUQ pain
- obstructive jaundice
- pruritus cholangitis
- fever, chills
- jaundice “Charcot triad”
- acute gallstone pancreatitis
- severe back pain
Diagnostics

- Lab liver function tests
- US Imaging
- Oral cholecystography,
- ERCP,
- Percutaneous transhepatic cholangiography (PTC),
- EUS,
- Magnetic resonance cholangiography (MRC)
**Choledocholithiasis: Treatment**

- NPO and IV therapy
- Pain management
- NG tube
- Antibiotics if sepsis or cholangitis
- ERCP → sphincterotomy (cut muscle fiber of Sphincter of Oddi)
- Lithotripsy before removal
- Surgery → choledochotomy → common
Choledocholithiasis: Complications

Complications: Cholangitis, cirrhosis with hepatic failure, portal hypertension, hepatic abscess formation or gallstone pancreatitis

CBD Stones

- Present in 10-20% of patients with symptomatic gallstones
- Most commonly results from passage of gallstones through the cystic duct

Complications
- Biliary obstruction
- Cholangitis
- Pancreatitis
- Biliary cirrhosis
Rare bacterial infection of the bile duct that is often associated with:

- Choledocholithiasis

- Obstruction of bile duct from strictures, cysts, fistulas, neoplasms or parasites
### Complications and Symptoms

<table>
<thead>
<tr>
<th>Complications</th>
<th>Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inflammation causes fibrosis and stenosis of common bile duct (CBD), liver abscess</td>
<td>Fever chills, dark urine, abdo pain, profound toxic sepsis with shock</td>
</tr>
</tbody>
</table>
Complications

- **Complications: Symptoms**: 85% caused by impacted stones in CBD causing bile stasis
- Bacteria present in 40% (E. Coli, klebsiella, pseudomonas, enterococci, proteus, bacteroides fragilis, or clostridium perfringens) can infect liver-cause abscess
- Cholangitis: Treatment:
  - IV antibiotics
  - Endoscopic T-Tube insertion (decompress biliary duct)
  - basket/balloon, lithotripsy
Primary Sclerosing Cholangitis

- **Diagnosis**: ERCP, PTC, US, liver biopsy, dilatation, biliary stent
- **Treatment**: Pruritis (meds) bile salt binding agents – Cholestyramine (Questran), ERCP dilatation of strictures, liver transplant → 3rd most common reason for transplant,
- **Complications**: Progression to cirrhosis and portal hypertension is expected → death from liver failure, CA, median survival rate from onset of symptoms 12 years
Mirizzi’s syndrome

Mirizzi’s syndrome is the result of a gallstone obstructing the cystic duct and resulting in inflammation and compression of the common bile duct (Figure 25). The symptoms and signs involve jaundice and pain. The diagnosis and treatment involve ERCP.
Primary Sclerosing Cholangitis (PSC)

PSC = Rare inflammation resulting in multiple strictures of the bile ducts → causing chronic cholestatic liver disease

50 – 75% many have UC, associated with Crohn’s, ♂ 2X> ♀

Symptoms: Progressive fatigue, jaundice, pruritis, abdo pain, ALP (serum alkaline phosphatase)
• Cholecystitis

• Acute or chronic inflammation that causes distention of gallbladder
• In pediatrics is chronic and associated with gallstones
• Can occur without evidence of gallstones. This more common in children.
• Associated with: post op states, traumas and burns
• **Symptoms**: Fever, pain and jaundice
• Cholecystitis
-90% have gallstone impacted in cystic duct

-Obstructed gallbladder wall becomes inflamed, edematous and ischemic

-Leads to 2nd bacterial infection

Risk factors:
Age, ethnic, obesity, sedentary, pregnancy, hemolytic anemias, IDDM
• Symptoms:
  - RUQ pain
  - N&V, anorexia
  - Fever
  - headache
  - Leukocytosis
  - Tachycardia
  - Tachypnea
  - rebound tenderness, intolerance to fatty foods and heavy meals
Complications:
- Cholangitis
- Perforation
- Sepsis
- Cholecystenteric fistula

Diagnosis: Blood test, US, radioisotope imaging
Acute Calculous Cholecystitis

Treatment: Antibiotic therapy, NGT, IV, analgesia, surgery (cholecystectomy or choicystostomy), ERCP with NBC (nasobiliary catheter) or stent.
• Benign/Malignant Tumours: Symptoms:

Vague abdo symptoms
N&V
Weight loss
Anorexia
Fat intolerance
Jaundice
RUQ pain
If RUQ mass is palpable almost always incurable - cholecystograms - cholangiograms, - PTC - EUS - MRI - ERCP - rarely diagnosed pre-operatively

- Diagnostic and therapeutic
- Best suited for lesions proximal to the bifurcation of hepatic duct
- Invasive
- Complications similar to ERCP
Treatment

Relieve symptoms and prolong quality and length of life with:

- stents
- antiemetic's
- vitamin and mineral replacements
- frequent small meals
- pain meds before eating
- tube feeding
Bile Duct Cancer

- Associated with UC, Crohn’s and PSC or congenital dilatation of the bile ducts
- **Symptoms**: Painless obstructive jaundice then pruritis, N&V, wt loss, pain in RUQ, ↑ ALP
- Benign tumor rare. Found incidentally, usu metastatic
- **Diagnosis**: US, CT, PTC, ERCP
- **Treatment**: surgery (pancreaticoduodenectomy), palliative, survive < 1yr
Bile Duct Cancer

Bile Duct Cancer (Cholangiocarcinoma)
Stent Insertion for Biliary stricture

Plastic or metal biliary stents are inserted into the common bile duct to allow and provide bile duct patency in a stricture caused by malignancy and inflammation from gallstones.
Questions?
Congenital Abnormalities (Gallbladder)

In gallbladder or the ducts

Gallbladder:
- Agenesis = absence of gallbladder
- Anomalies of location — Ectopic gallbladder — need cholecystectomy
- Anomalies of form — more than 1 cystic structure found
- Anomalies of fixation — floating gallbladder (may twist therefore vascular occlusion, ischemic necrosis or perforation — need surgery (cholecystectomy)
Congenital Abnormalities (Bile Duct)

Bile duct:

- Anomalies of extrahepatic duct configurations (atresia, accessory ducts, abn lengths of ducts, junction of ducts of cystic and hepatic). In kids with atresia, get liver transplant.

- Cystic anomalies of CBD → choledochal cyst → dilatation of CBD → treat with Roux-en-Y choledochocystojejunostomy with cholecystectomy.

- Cystic dilatation of intrahepatic ducts or “Caroli’s disease”, rare in young adults, leads to bile stasis, cholangitis, stone formation in liver or abscess formation.

- Anomalies impair the fbw of bile → cholestasis which leads to sludging in GB of – mucous gel