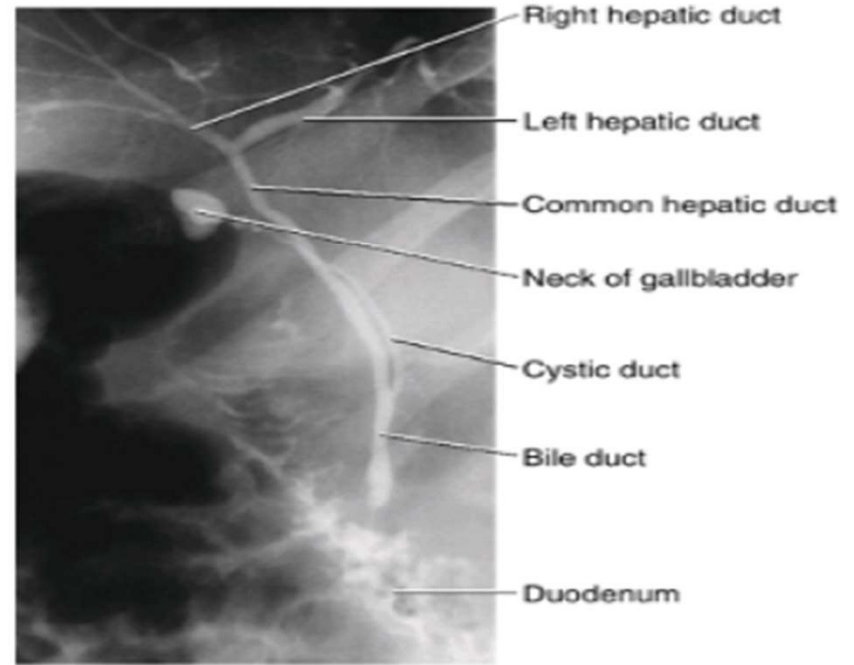


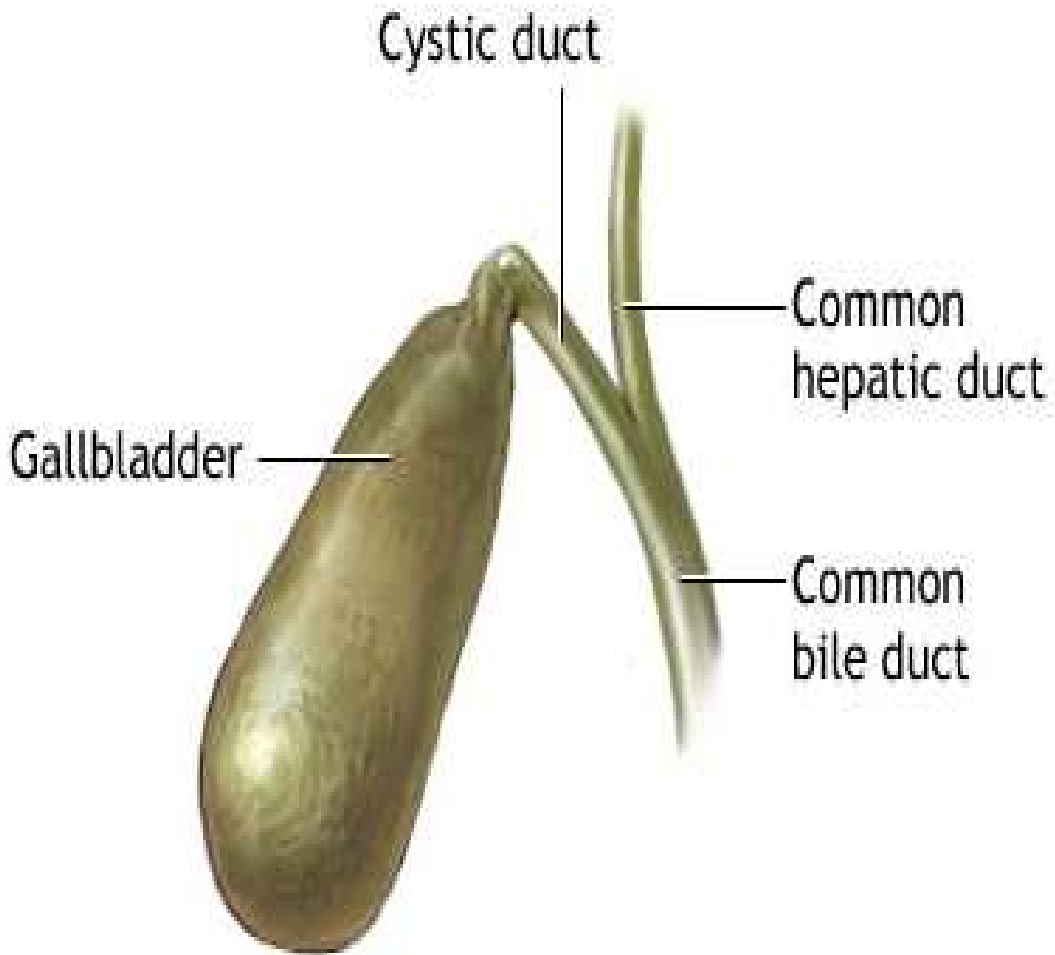
B Sagittal section



C Anterior view

BILE PHYSIOLOGY

D. HAMMOUDI, MD



Sac to hold bile

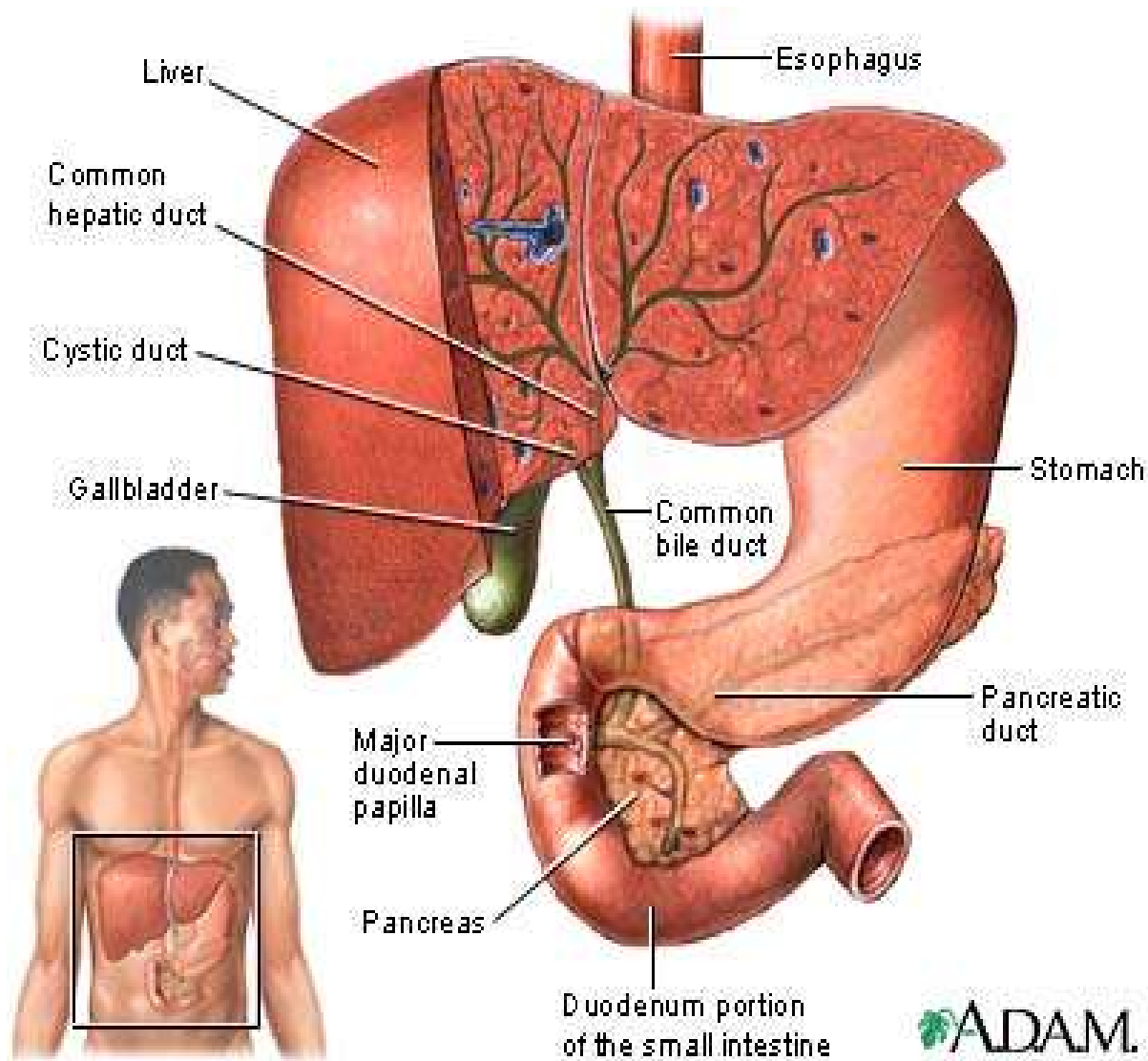
Three layers:

- *Serous - outer*
- *Fibrous/muscular*
- *Mucousal - inner*

Has three parts:

- *Fundus*
- *Body*
- *Neck*





Located in right hypochondriac region.

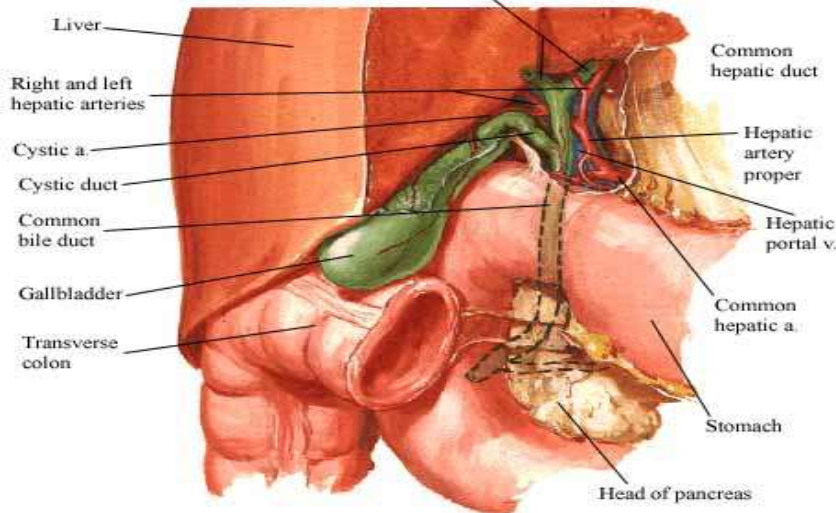
It is a pear-shaped sac from 7-10cm long and 3cm broad at its widest point. Can hold 30-50 ml of bile.

Divided into four anatomic portions:

- *the fundus,*
- *the corpus or body,*
- *infundibulum,*
- *the neck.*

Gallbladder and Extrahepatic Bile Ducts

Right and left hepatic ducts



-Note the **right** and **left hepatic ducts** coming together as the **common hepatic duct**, joining the **cystic duct** to form the **common bile duct**. This descends to the 2nd part of the duodenum, is joined by the **pancreatic duct**, and empties its contents into the duodenal lumen via the **major duodenal papilla**.

-Note the extensive folds of mucosa extending into the lumen, consisting of **tall, simple columnar epithelium**.

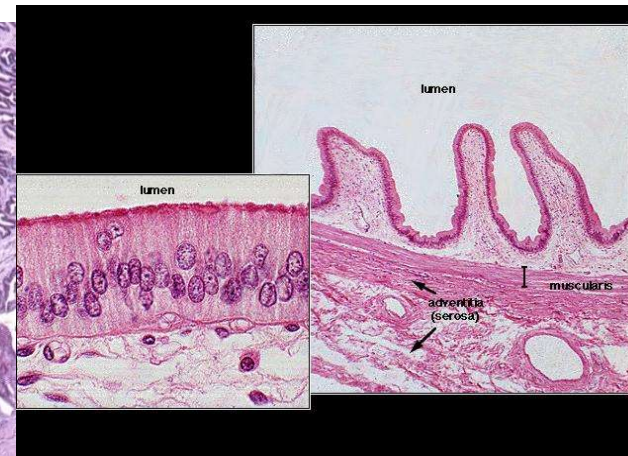
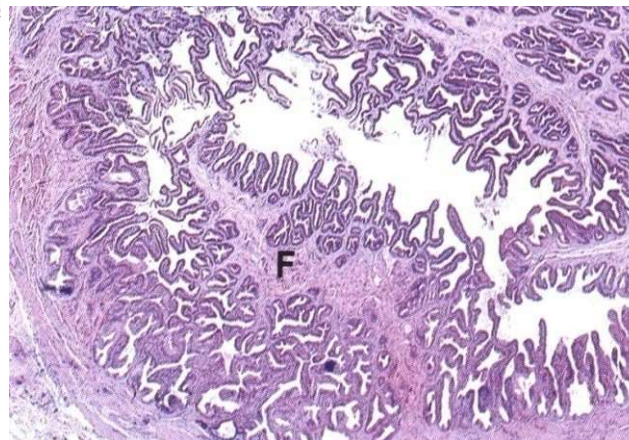
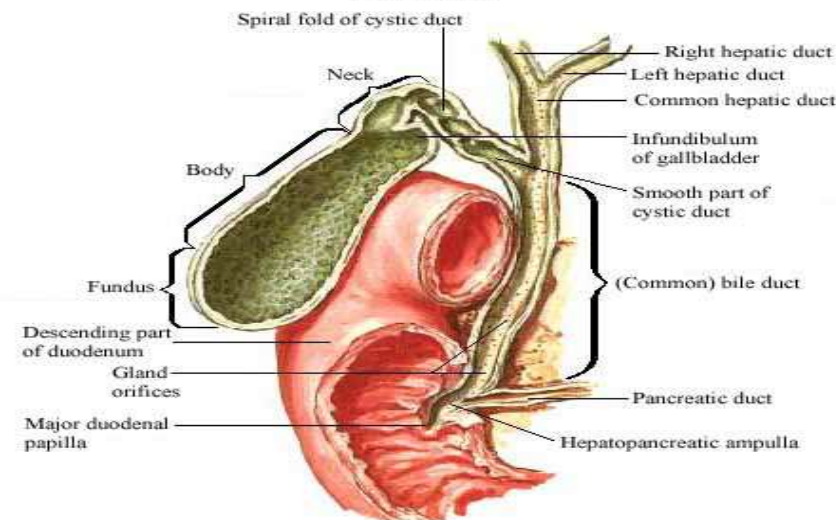
-The underlying connective tissue is comprised of lamina propria, with no distinctly defined submucosa.

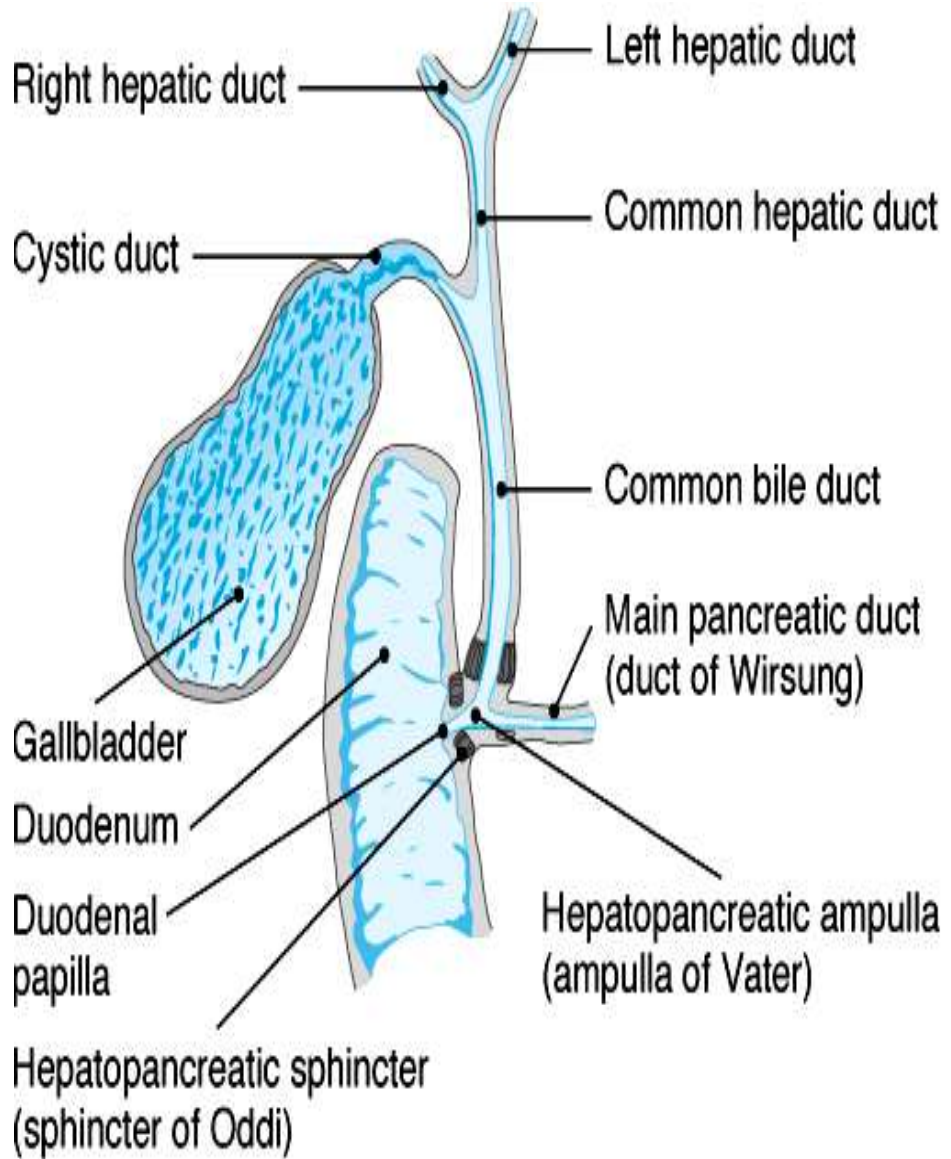
-There are scattered bundles of smooth muscle in the muscularis.

-The adventitia has rather dense connective tissue connecting the gallbladder to the liver.

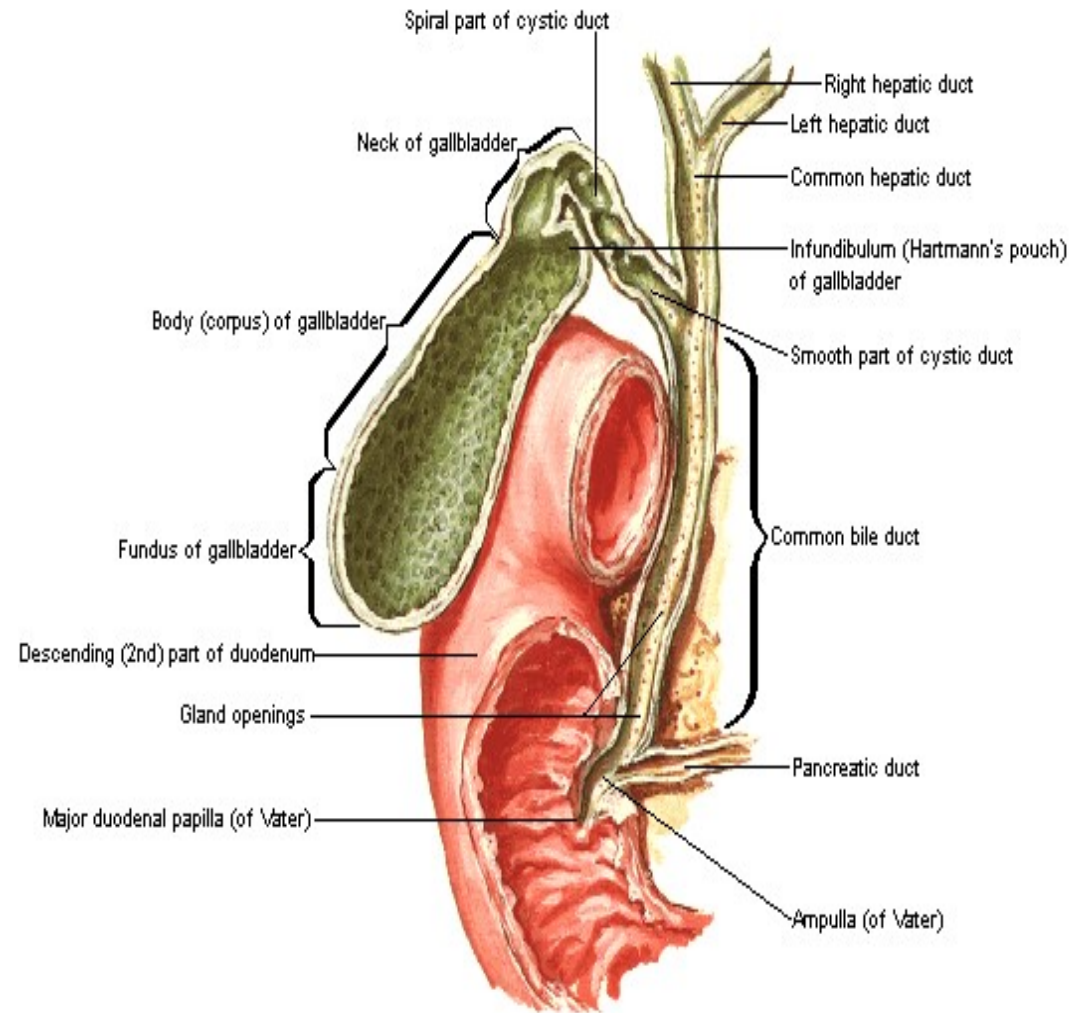
Gallbladder and Extrahepatic Bile Ducts

Sectioned





Gallbladder and Extrahepatic Bile Ducts Sectioned



- Its job is to store and release bile, a fluid made by the liver.
- Bile helps break down fats in the food you eat.
- **Release of bile**
 - The coordinated release of bile requires simultaneous contraction of the gallbladder and relaxation of the sphincter of Oddi.
 - This process is predominantly under humoral control (via cholecystinin [CCK]), but vagal and splanchnic nerves also play a role

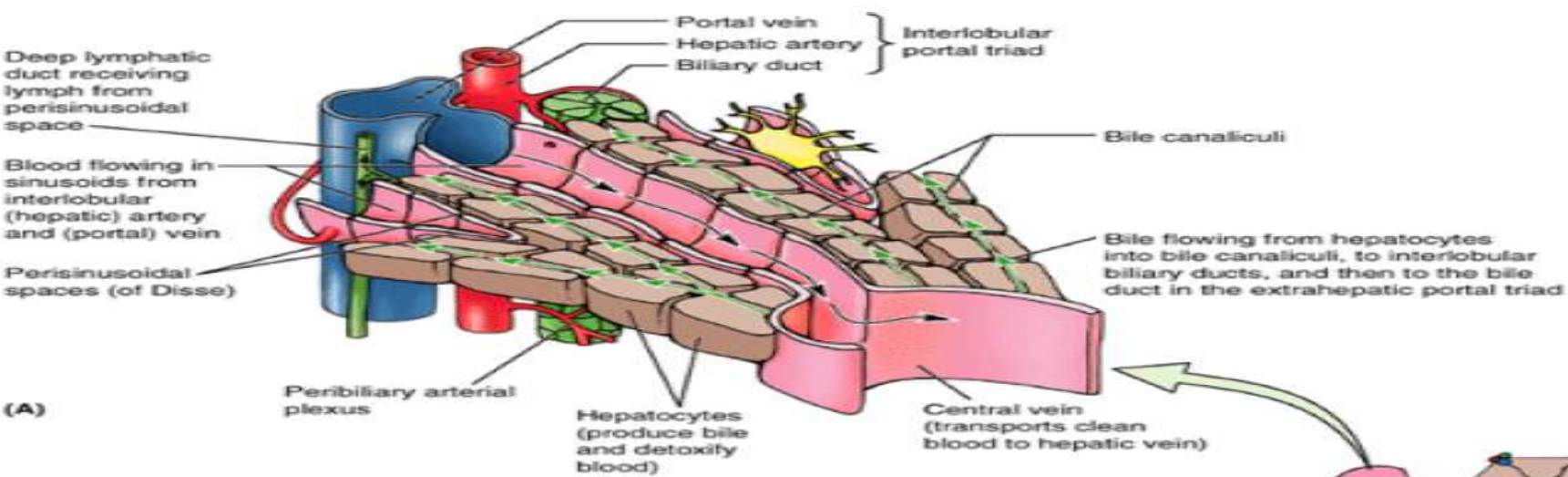
Bile is a physiological aqueous solution produced and secreted by the liver.

It consists mainly of

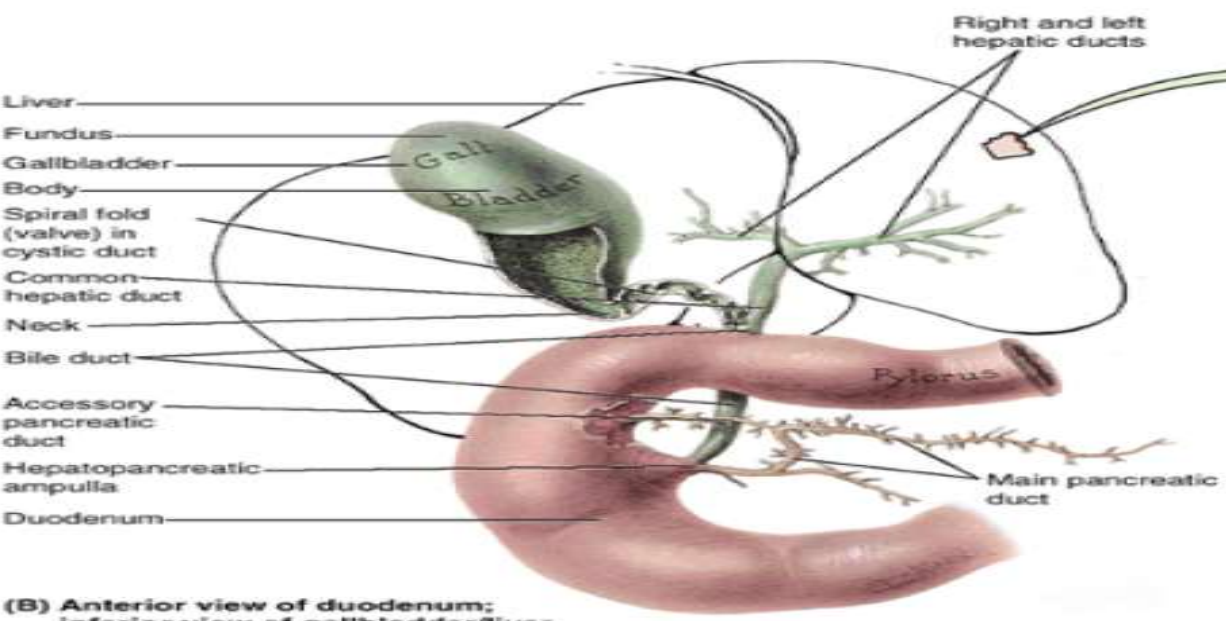
- **bile salts**
- **phospholipids**
- **cholesterol**
- **conjugated bilirubin,**
- **electrolytes**
- **water**

The hormone secretin also plays an important role in the flow of bile into the small intestine.

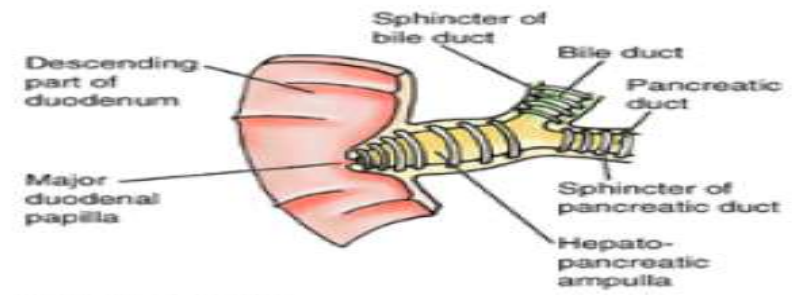
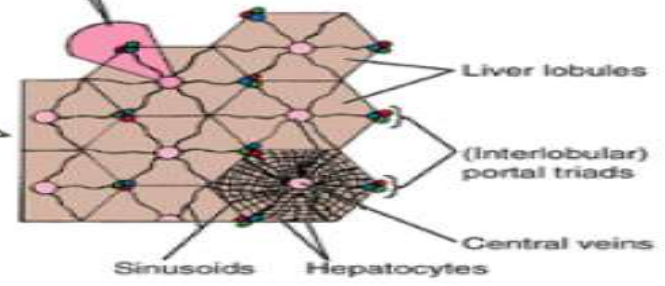
By stimulating biliary and pancreatic ductular cells to secrete bicarbonate and water in response to the presence of acid in the duodenum, **secretin effectively expands the volume of bile entering the duodenum.**



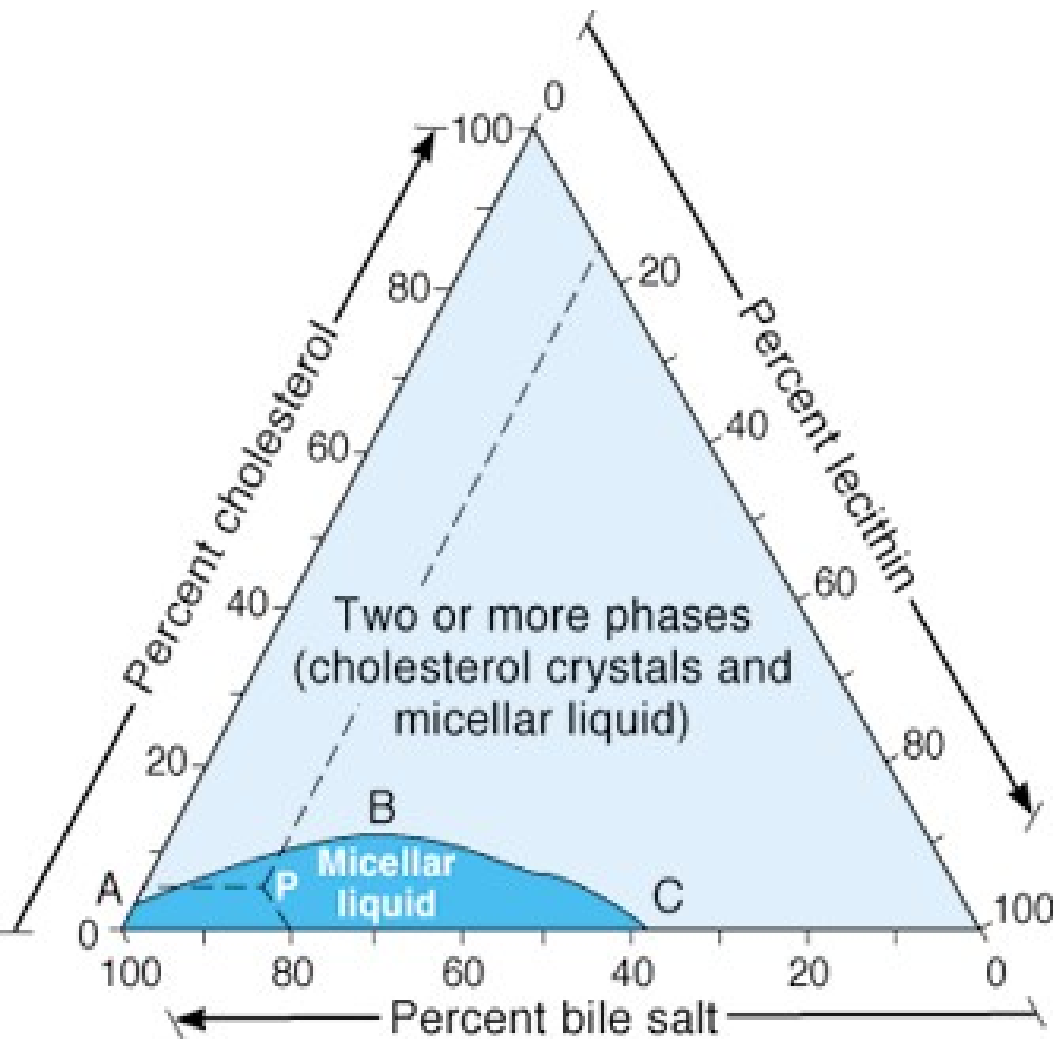
(A)



(B) Anterior view of duodenum; inferior view of gallbladder/liver



(C) Anterior view



Cholesterol solubility in bile as a function of the proportions of lecithin, bile salts, and cholesterol.

In bile that has a composition described by any point below line ABC (eg, point P), cholesterol is solely in micellar solution; points above line ABC describe bile in which there are cholesterol crystals as well. (Reproduced, with permission, from Small DM: Gallstones. N Engl J Med 1968;279:588.)

Bile Secretion

- Necessary for **digestion and absorption of lipids** in small intestine
- Mixture of bile salts, bile pigments, and cholesterol
- Bile salts emulsify lipids to prepare them for digestion
- Solubilize products of lipid digestion in packets called **micelles**
- Bile is produced by **hepatocytes** and it is then **modified by the cholangiocytes lining the bile ducts**.
- After lipids absorbed, bile salts are recirculated to liver via **enterohepatic circulation**
 - Absorption of bile salts from ileum into portal circulation
 - Delivery back to liver

The main functions of bile are 2-fold:

1.To facilitate lipid absorption and digestion

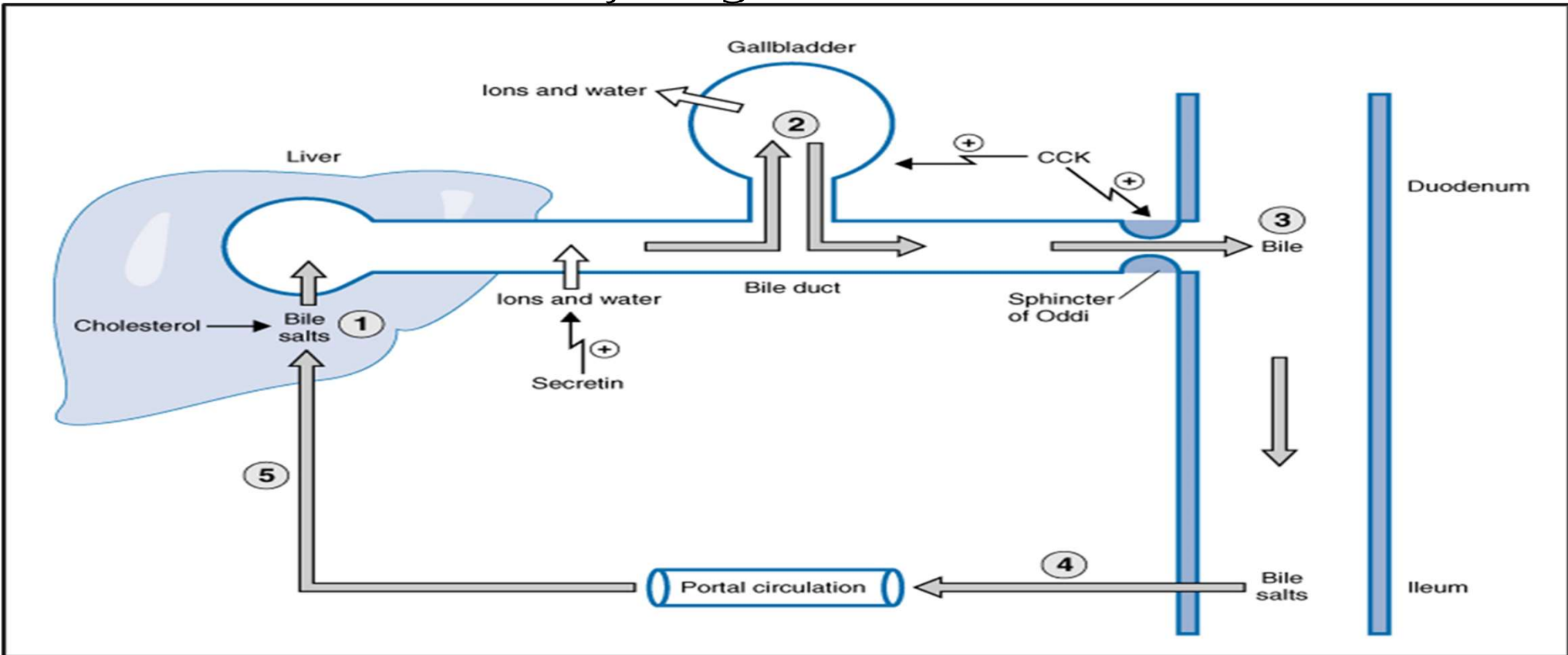
2.To eliminate waste products from the body

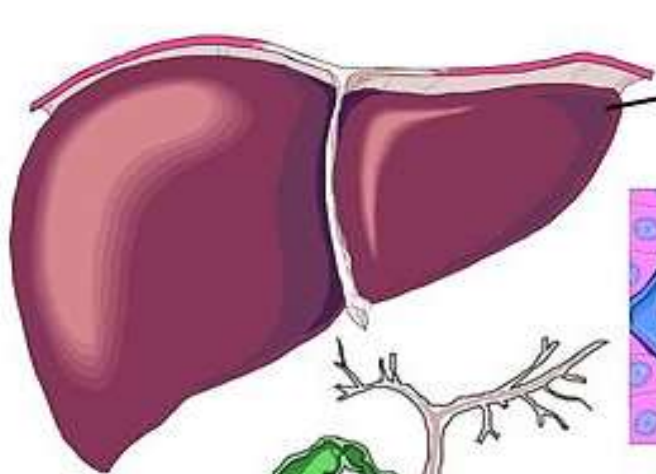
3.Cholesterol is eliminated through its conversion into bile acids, allowing the body to maintain cholesterol homeostasis.

4.Bile acid sequestrants, medications intended to lower cholesterol, function by binding bile acids in the small intestine, and increasing their excretion in the stool.

5.Bilirubin is also eliminated through its secretion into bile, where it eventually forms the dark pigment of feces

Bile Secretion and Recycling





Liver



Microscopy of liver tissue

Hepatocyte

Branch of hepatic vein

Sinusoid

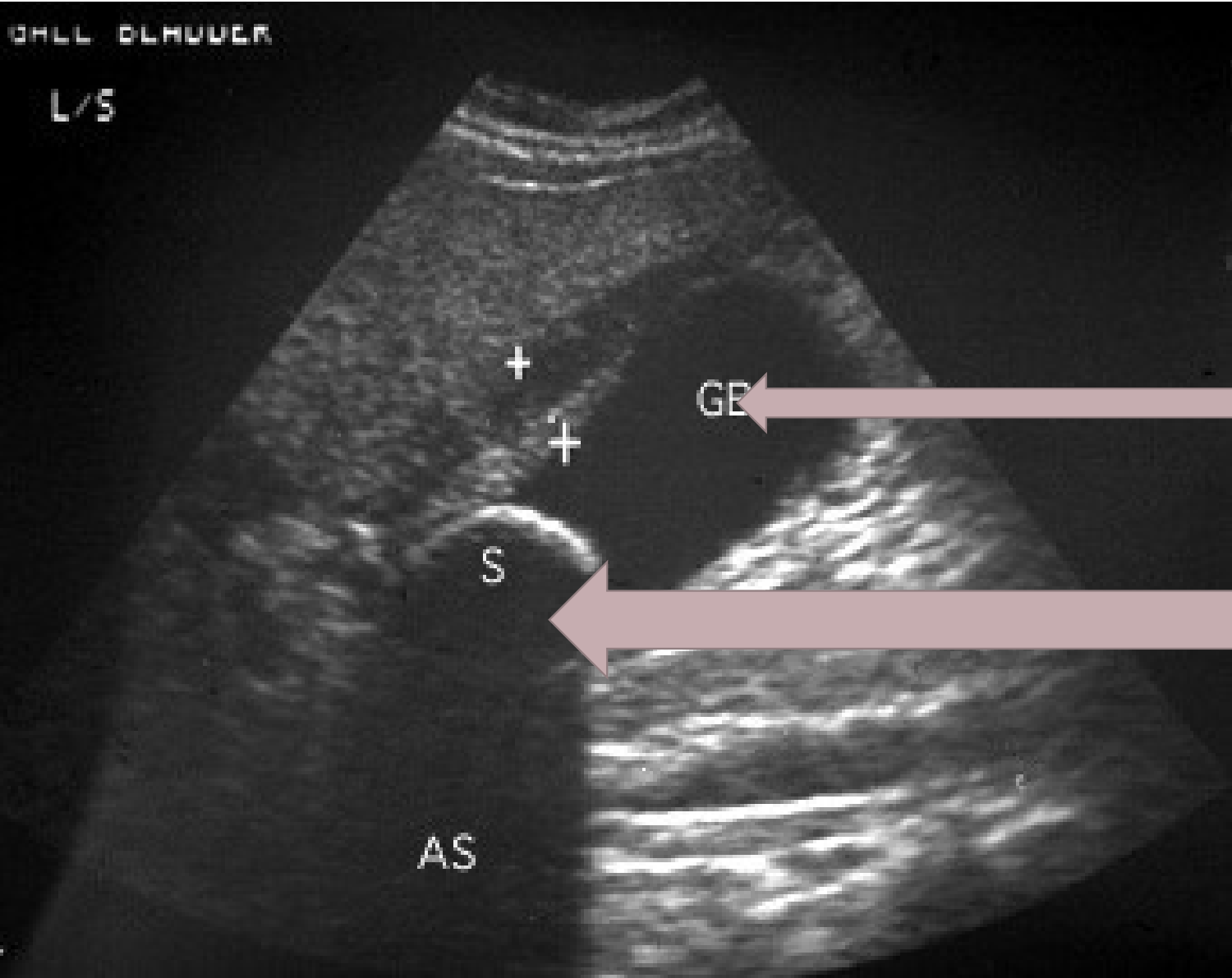
Gall Bladder

Common Bile Duct

Pancreas

Sphincter of Oddi

Duodenum



GE

Gallbladder

S

Stone
[lithiasis]

AS

Types of Gallstones.

| Type | Frequency | Chemical Composition | Gross Appearance |
|------------------|-----------|--|---|
| Mixed | 80% | Cholesterol, calcium carbonate, calcium bilirubinate | Multiple, small, faceted; variable in size and shape; smooth surface, yellow; laminated on cut section. |
| Pure cholesterol | 5% | Cholesterol | Solitary, large, oval, white; rough surface; cut section: radiating crystalline structure |
| Combined | 10% | Pure cholesterol center, mixed shell | Solitary or 2 stones; oval or barrel-shaped, yellow, smooth surface |
| Pigment | Rare | Calcium bilirubinate | Multiple, very small, faceted, black |
| Calcium | Very rare | Calcium carbonate | Multiple, amorphous; small grains, rarely large |



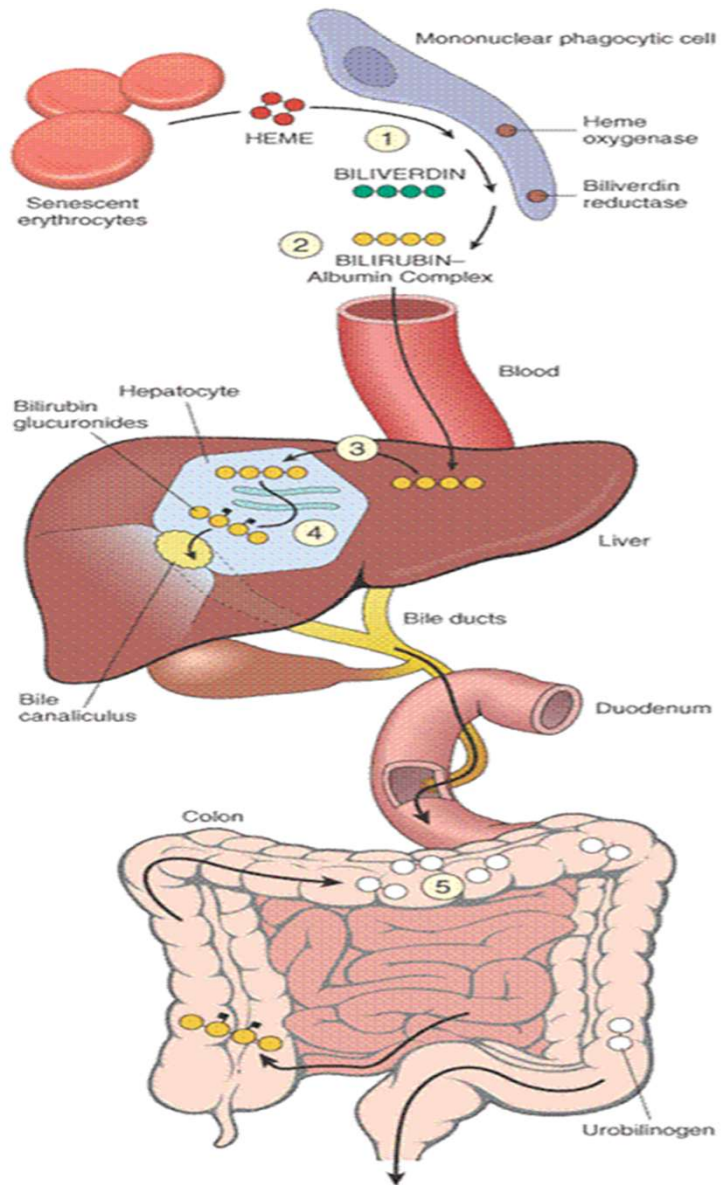
Cholesterol stones

- 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")





CM 1 2 3 4

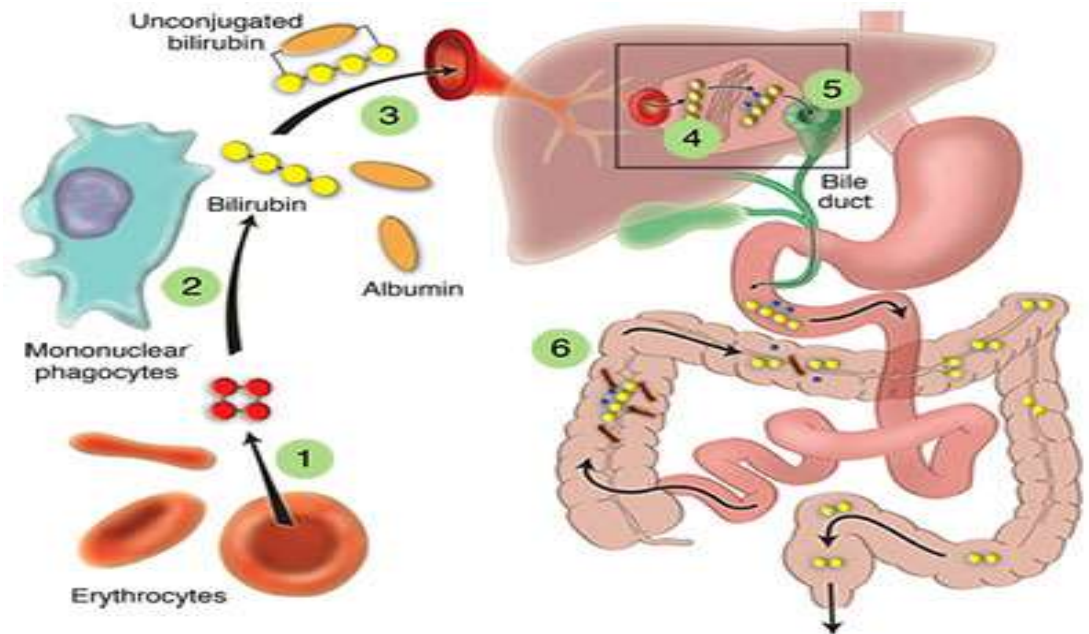


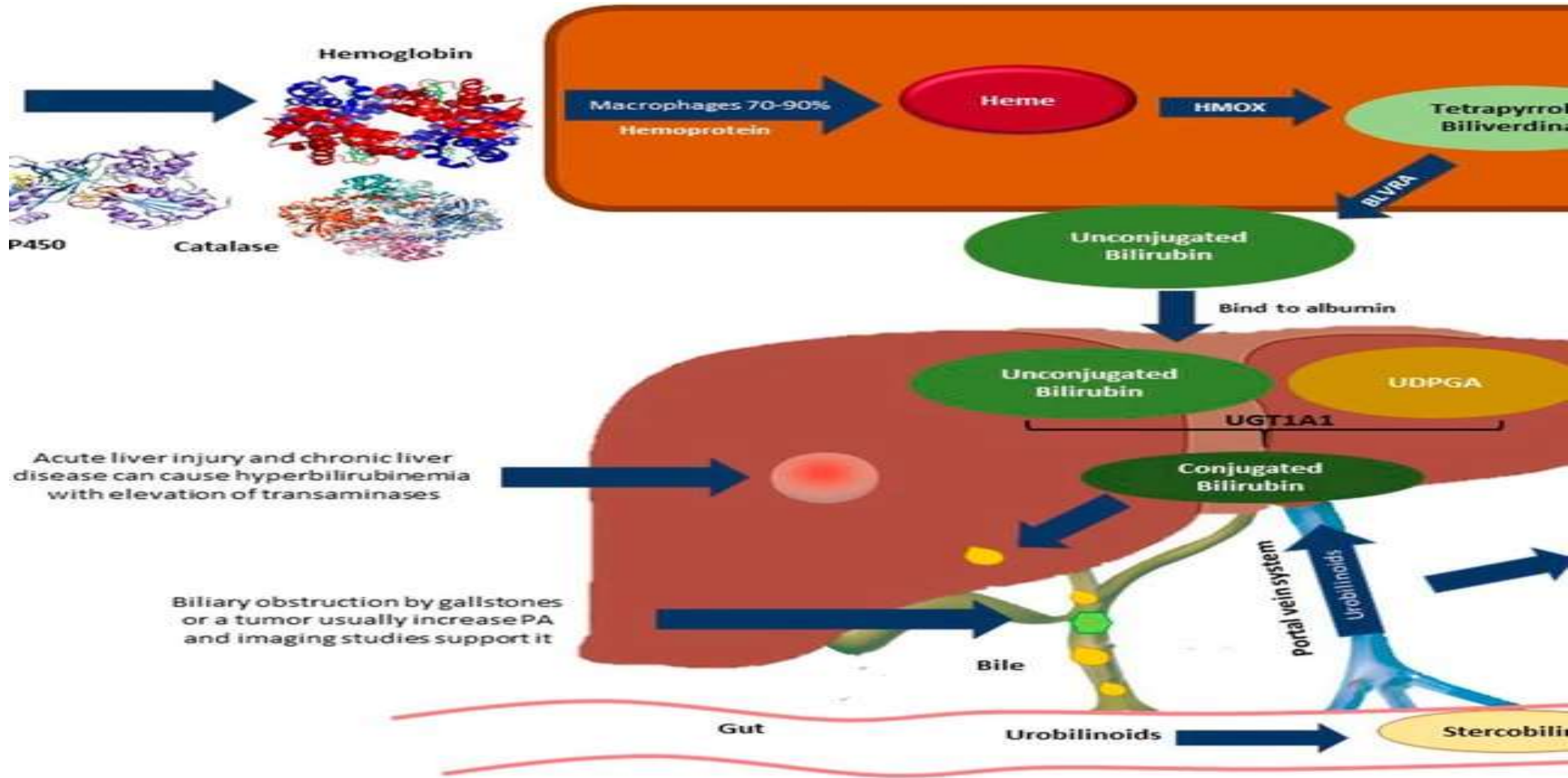
Bilirubin: (0.3-1.2 mg/dl)

UN-conjugated (IN-direct)

Conjugated (direct)

- Bilirubin, the major pigment of bile, is an end product of heme catabolism that travels to the liver bound to albumin.
- The water-soluble conjugated bilirubin is then secreted into bile, providing its characteristic yellow color





Gastrointestinal/Hepatobiliary

Liver: Site of bile formation, reuptake of bile acids, and reuptake of urobilinogen

Bile ducts: Modify and transport bile, secrete ions and water into bile

Gallbladder: Stores and concentrates bile

Small intestine:

- Bacteria form secondary bile acids via dehydroxylation of primary bile acids
- Bilirubin glucuronide is converted back to bilirubin
- Bacteria convert bilirubin to urobilinogen

Duodenum: Site of lipid digestion and absorption facilitated by bile

Ileum: Site of reabsorption of bile salts

Portal circulation: Transports reabsorbed bile salts back to the liver

Rectum: Urobilin and stercobilin (compounds oxidized from urobilinogen) are responsible for dark fecal pigment.

- **By FAR, the most common cause of jaundice is choledocholithiasis**

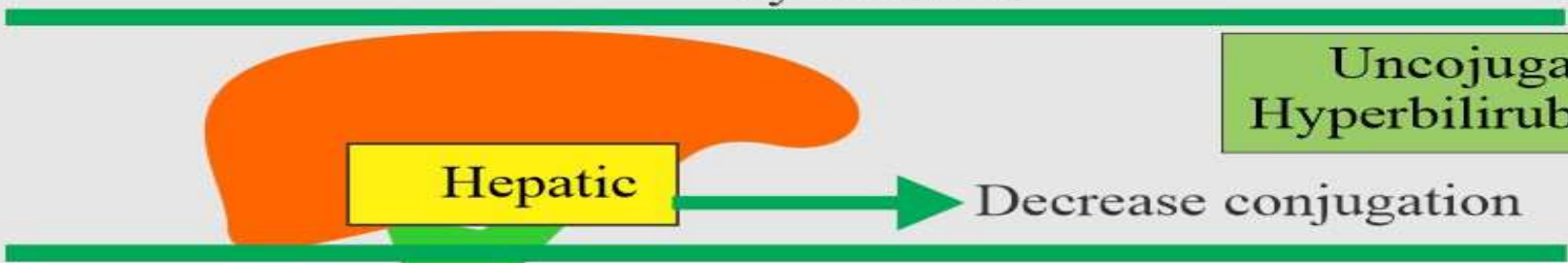


Jaundice classification

Prehepatic

- Overproduction
- Impaired uptake by the liver

Unconjugated Hyperbilirubinemia



Hepatic

Decrease conjugation

Unconjugated Hyperbilirubinemia

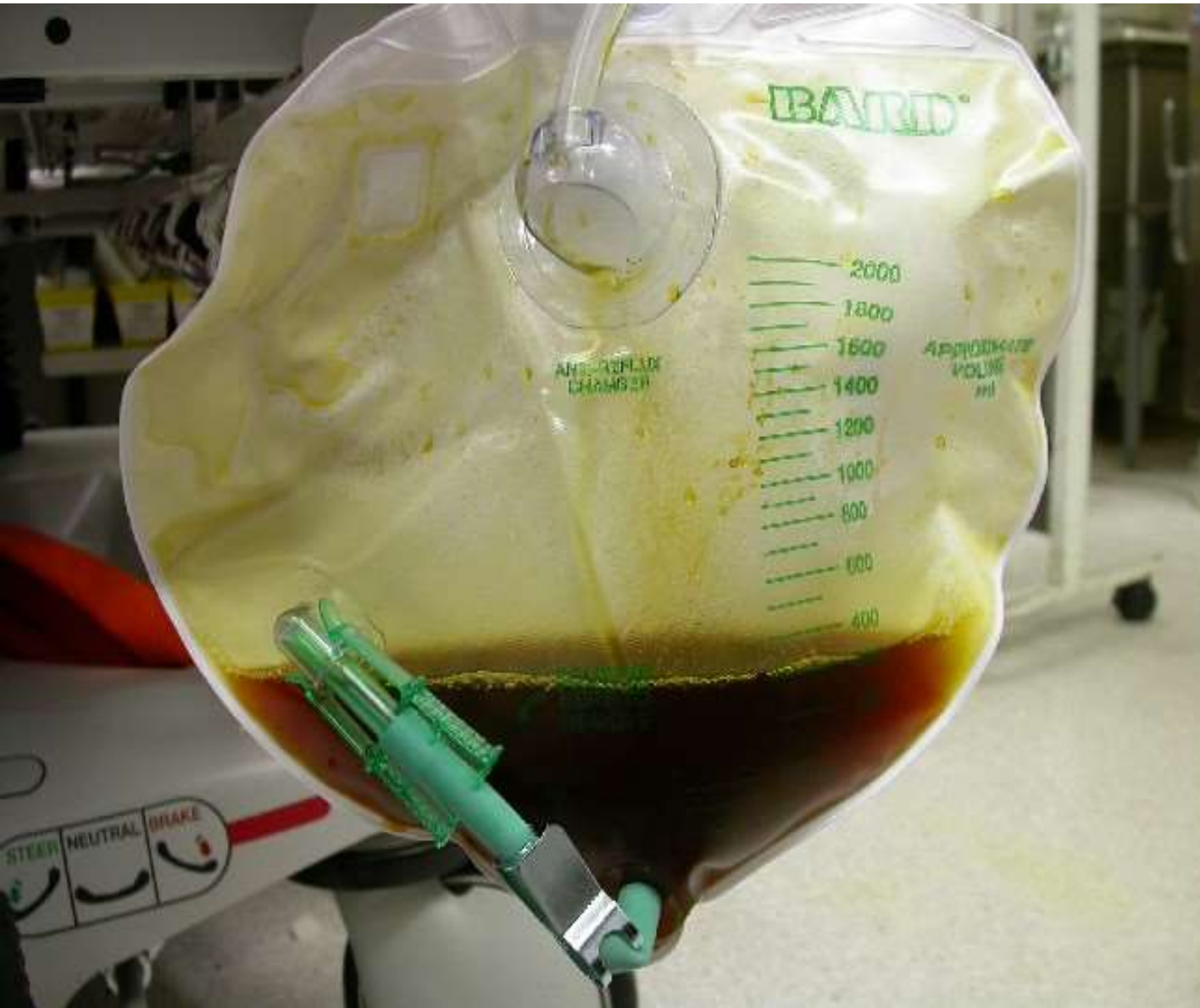
Posthepatic

Decreased excretion
(Intra or extrahepatic obstruction)

Gall bladder

Pancreas

Conjugated Hyperbilirubinemia



Bilirubine in the urine



**Before
phototherapy**



**After
phototherapy**

