

Pathophysiology I

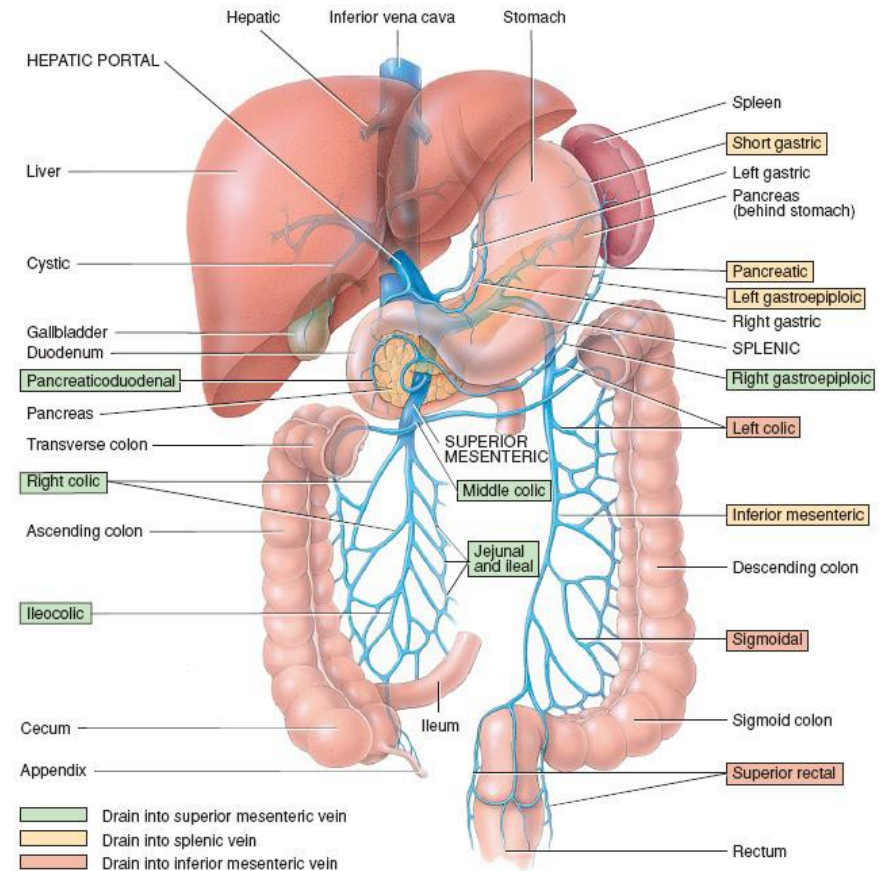
Liver and Biliary Disease

The Liver

- The liver is located in the right upper portion of the abdominal cavity just beneath the right side of the rib cage. The liver has many functions that are vital to life. Briefly, some of the important functions of the human liver are:
 - Detoxification of blood
 - Production of important clotting factors, albumin, and many other important proteins
 - Metabolizing (processing) medications and nutrients
 - Processing of waste products of hemoglobin and other cells
 - Storing of vitamins, fat, cholesterol, and bile
 - Production of glucose (gluconeogenesis or glucose synthesis/release during starvation)

The Liver and Circulation

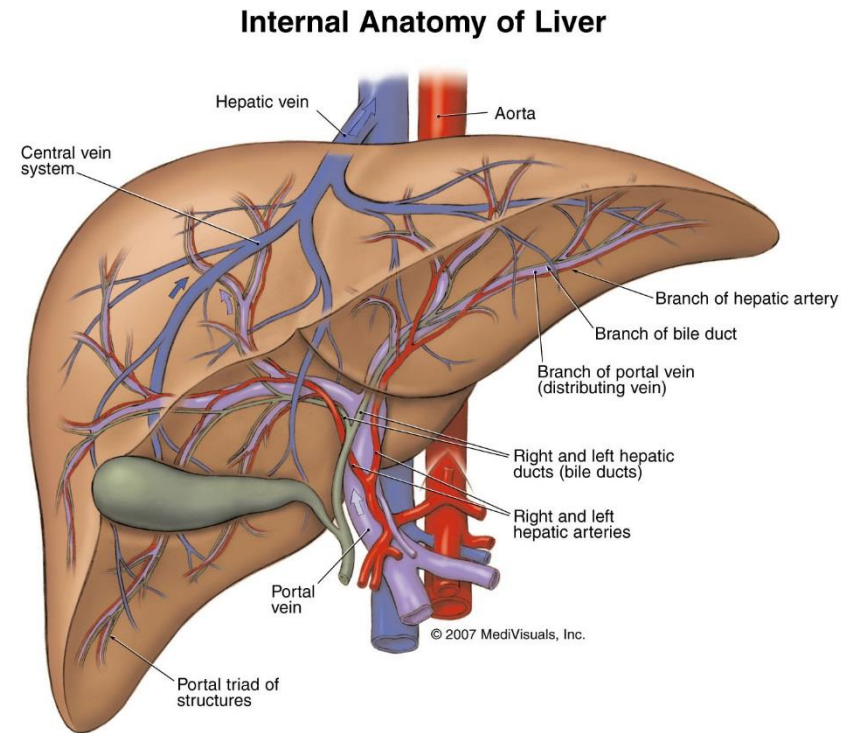
- The liver has a quadruple circulation system.
 - 1) The portal vein circulation drains all blood coming from the stomach and intestines into the liver where the nutrients that have been absorbed are processed and broken down into basic chemicals that the body can use, like glucose.



(a) Anterior view of veins draining into hepatic portal vein

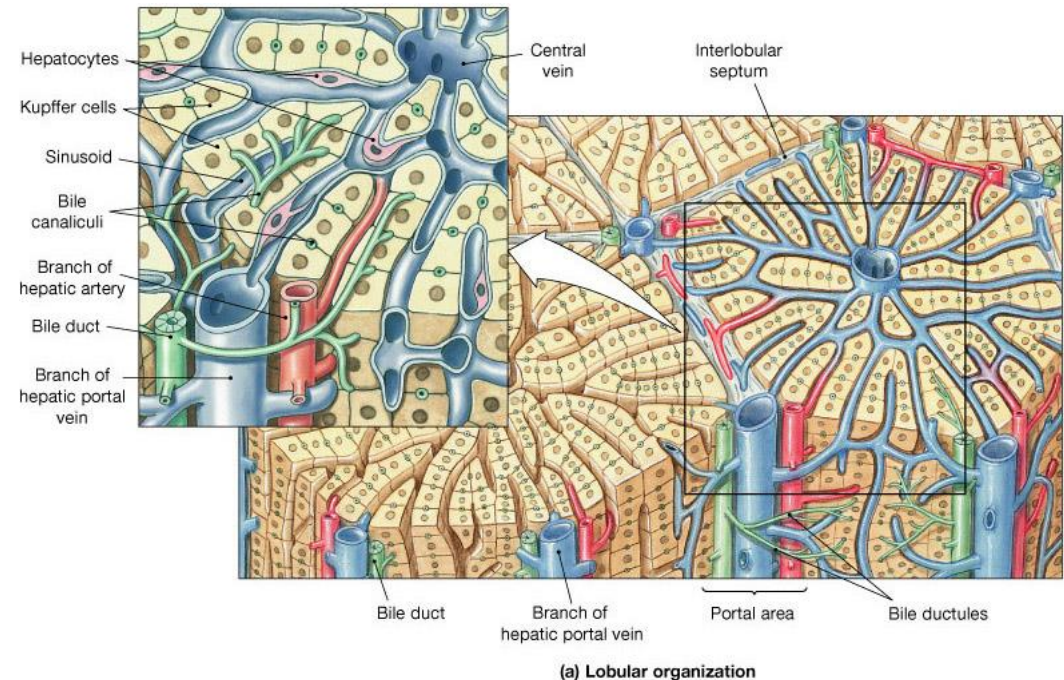
The Liver and Circulation

- The liver has a quadruple circulation system.
 - 2) The arterial circulation brings oxygenated blood to the liver
 - 3) The hepatic vein circulation takes all the deoxygenated blood and nutrients away

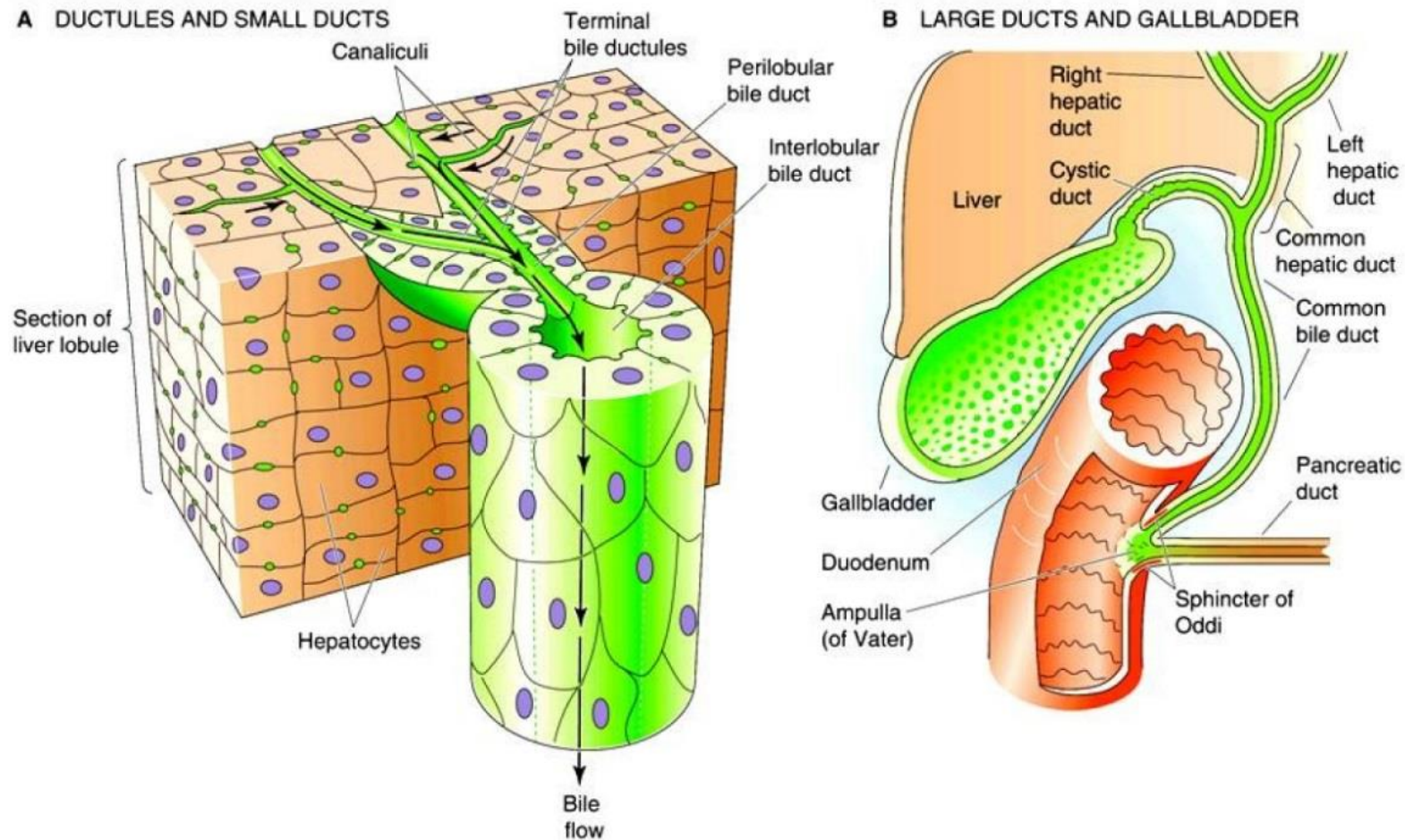


The Liver and Circulation

- The liver has a quadruple circulation system.
 - 4) The bile duct circulation is an elaborate circulatory system of bile ducts throughout the liver serving all cells with bile eventually draining back into the intestines



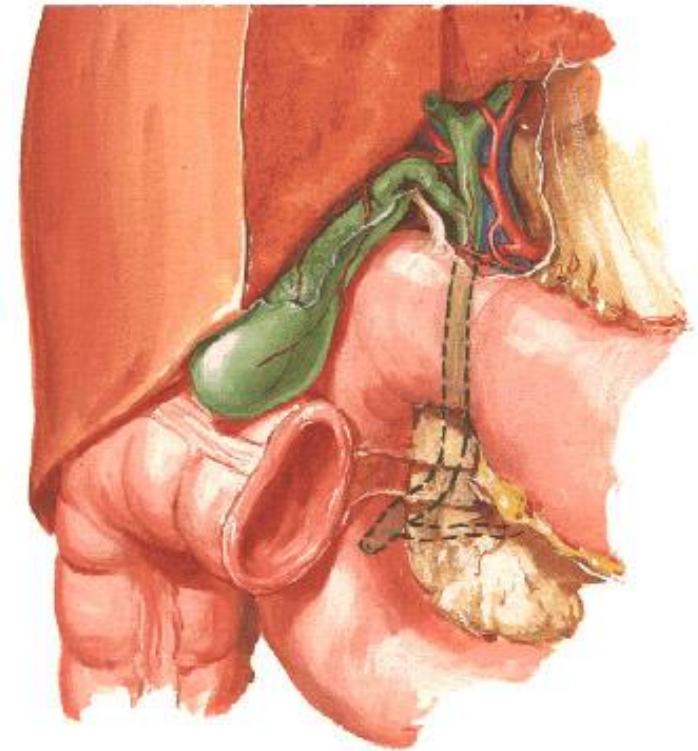
Bile is secreted by the liver, stored in the gall bladder and ejected into the small intestine



Gallbladder Anatomy

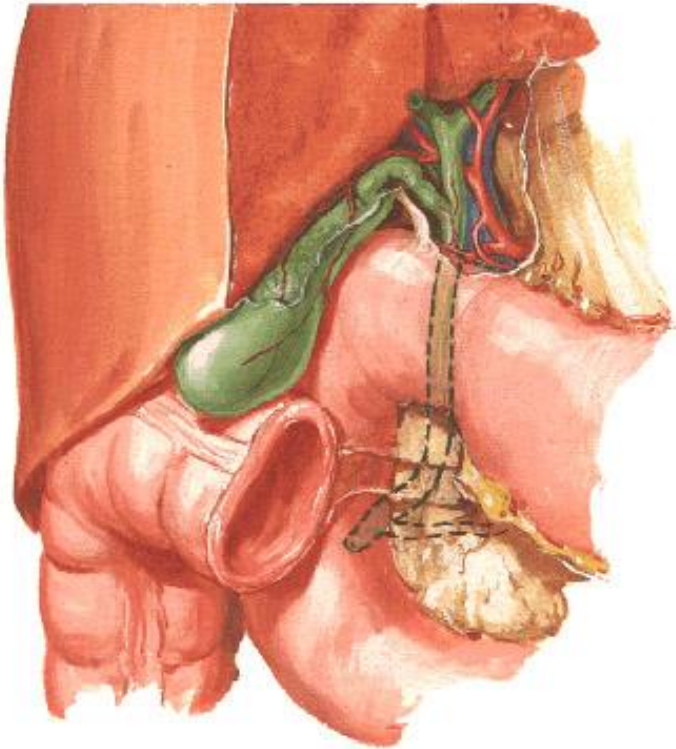
- The gallbladder is on the undersurface of the liver and is a storage organ for bile.
- Half of the bile secreted by the liver is diverted to the cystic duct and on into the gallbladder.
- The remainder enters the common bile duct directly.

Gallbladder and Extrahepatic Bile Ducts



Gallbladder Anatomy

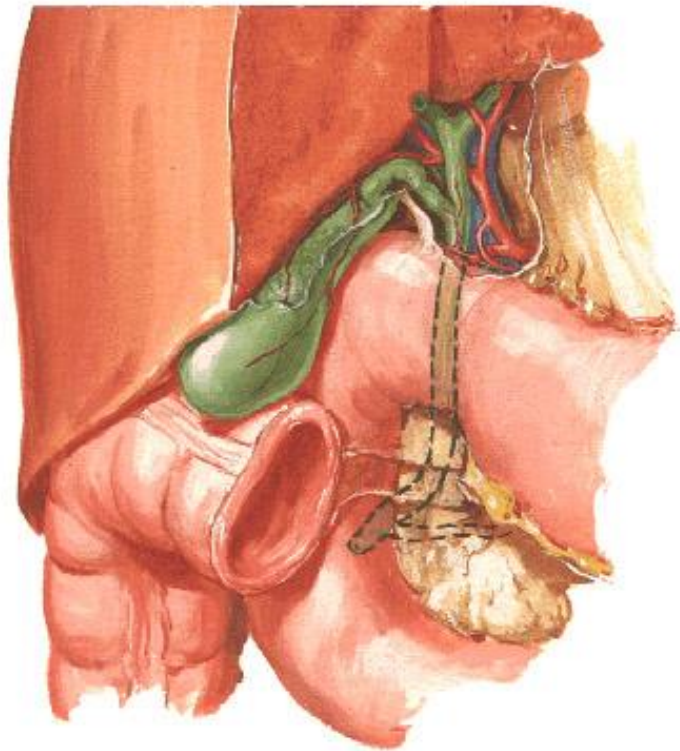
Gallbladder and Extrahepatic Bile Ducts



- The Liver (hepat/o), Gallbladder (chol/e – can also indicate bile), and pancreas (pancreat/o) are all accessory organs of the digestive system
- Bile is secreted from the gallbladder, through the bile duct (cholangi/o), joining with the common bile duct (choledoch/o) into the duodenum
- Pancreatic digestive enzymes are secreted into the duodenum

Gallbladder Anatomy and Pathology

Gallbladder and Extrahepatic Bile Ducts



- Gallstones can form in the gallbladder (cholelithiasis), this can lead to cholecystitis
 - If they get ejected from the gallbladder and lodge in the common bile duct the condition would be called choledocholithiasis
 - If they prevent pancreatic enzymes from entering the duodenum, these can backflow and start digesting the pancreas, causing pancreatitis

Liver Disease and Blood Tests

Liver Function Tests

- ALT and AST, liver enzymes
- The aminotransferases catalyze chemical reactions in which an amino group from one amino acid is transferred from a donor molecule to a recipient molecule, hence, the names "aminotransferases." They are also referred to under different names. The enzyme aspartate aminotransferase (AST) is also known as serum glutamic oxaloacetic transaminase (SGOT). Alanine aminotransferase (ALT) is also known as serum glutamic pyruvic transaminase (SGPT).
- To put matters briefly, AST = SGOT and ALT = SGPT
- Both of these are enzymes in the liver that are released when liver cells are damaged
- Both will be high with alcoholic liver disease, cirrhosis
- Both will be very high with viral hepatitis, esp. HVA (sometimes in the thousands of units/liter range)
 - The normal range of values for AST is about 5 to 40 units per liter of serum.
 - The normal range of values for ALT is about 7 to 56 units per liter of serum

Liver Disease and Blood Tests

Liver Function Tests

- Alkaline Phosphatase
 - The liver synthesizes the highest amounts of this enzyme so high levels in the blood may suggest liver injury among other causes. Normal levels of ALP are about 45 to 115 U/L.
 - Will be high with obstructed biliary duct
 - *Also with bone healing/growth, Paget's disease*

Liver Disease and Blood Tests

Liver Function Tests

- Albumin
 - Low with chronic liver disease
- Ammonia
 - Checked in hospital, will be high with 80% liver destroyed
- Bilirubin
 - Check both conjugated and unconjugated
- PT (Prothrombin time)
 - Measure blood's ability for normal clotting and prevention of bleeding and bruising
 - Tells that liver is not working well

Hematopoietic and Lymphoid System

Contributing Factors – RBCs Lifespan

- RBCs live in circulation for 120 days, after which they are removed by the spleen and their components are recycled.
 - Heme is converted to bilirubin which is used to form bile
 - Bilirubin can be checked clinically
 - Clinically, it is referred to as conjugated and unconjugated
 - Unconjugated = indirect
 - Hemolytic anemia results in high indirect bilirubin
 - Reticulocyte count will be high
 - Hepatocellular problems results in high mixed bilirubin
 - Conjugated = direct
 - (Post hepatic) Obstructive liver problems results in high direct bilirubin
 - White stool will be present

Liver Diseases

- Hepatitis is inflammation of the liver and can be caused by viruses, as well as drugs, alcohol, and immune mechanisms.
- Hepatitis viruses invade the liver cells, damaging them and disrupting their normal function. Changes to the liver include:
 - Reversible changes
 - Irreversible liver changes with cell death
 - Inflammatory infiltrates – macrophages invade
 - Regeneration of hepatocyte – Liver cells can regenerate

Liver Diseases

- Viral hepatitis includes Hepatitis A, B, C, D, E
- Table 11-2 gives features of hepatitis
- HAV is transmitted through the fecal-oral route, usually affects children in undeveloped countries or travels to southern countries. Usually does not become chronic.
- HBV is transmitted through blood or sexual contact. Patients will be possible jaundiced, and will have high ALT, AST. Can become chronic.
- HCA is transmitted through blood or sexual contact. Clinical presentation is the same as HBV. Fig 11-6 outlines.

Jaundice

- A symptom, not a disease. Characterized by yellow discoloration of the skin and mucosa caused by hyperbilirubinemia.
- Bilirubin binds to connective tissue and stains it yellow. Best seen in the sclera.
- Bilirubin also causes itching.
- Certain types of jaundice cause the urine to become brown and foamy.
- Normal is 1.2 mg/dL
- Jaundice becomes apparent when bilirubin exceeds 3 mg/dL
- Classified as:
 - Prehepatic or hemolytic
 - Hepatic
 - Posthepatic (obstructive)
- Classification based on if the bilirubin is conjugated (combined with glucuronic acid) in the liver.

Jaundice Syndromes

- Prehepatic involves hemolysis of RBCs as seen in sickle cell anemia or SLE
 - Unconjugated (indirect) bilirubin is high
- Hepatic involves liver damage from hepatitis, alcohol, etc.
 - Mixed (conjugated and unconjugated)
- Posthepatic involves obstruction of bile, usually from gallstones in the common bile duct or other ducts. Can involve tumors of bile duct, pancreas, duodenum.
 - Conjugated bilirubin is high, patients have white stool.

Cirrhosis

- Cirrhosis is a chronic liver disease characterized by a loss of normal liver structure and function, it is synonym with end stage liver disease.
- Causes include:
 - Alcoholism
 - Hepatitis (B, C, and D)
 - Others listed in box 11-1