

Liver

Gross Anatomy

Four lobes (big right, smaller left, caudate & quadrate) each divided into several smaller lobules

Right & Left hepatic ducts deliver bile to common hepatic duct.

Cystic duct delivers bile to the gallbladder for storage & concentration, then carries bile from gallbladder to common bile duct.

Common bile duct - passes into duodenum, via hepatopancreatic ampulla & sphincter of Oddi, to deliver the bile

Gallbladder

Function-store and concentrate bile until it is needed and is released into the small intestine by way of the Sphincter of Oddi

Liver Histology

- **Hepatocytes** produce and secrete bile, detoxify, & balance nutrients
- **Kupffer cells** - act as phagocytes engulfing foreign bacteria

Blood supply

- **Hepatic artery**-oxygenated blood
- **Hepatic portal vein**-deoxygenated blood rich with newly absorbed nutrients from GI tract & spleen enters the liver on the inferior aspect next to the hepatic artery
- **Hepatic vein**-exits the liver on the superior aspect rejoining the inferior vena cava

Blood flow in the liver

Both oxygenated and deoxygenated blood enter the liver and form a common capillary bed called the sinusoids of the liver and passing by the hepatocytes

Blood flows from the sinusoids to the central vein to the hepatic vein and finally rejoins the inferior vena cava

Functions of the Liver:

1. Metabolism of carbohydrate, lipids, and proteins to maintains normal glucose level in the blood

Metabolic processes

Glucogenesis - glucose from a carbohydrate source is turned into glycogen and stored

Glycogenolysis - glycogen turned back into glucose for cellular use

Gluconeogenesis - lipids or proteins converted into glucose

Glycogenesis – building glycogen from glucose for storage

Lipogenesis – building lipids for long-term energy storage

Protein Metabolism

The byproduct of the conversion of amino acids into glucose is ammonia (NH₃). This is a toxin, which is then converted into urea which is less toxic and is removed from the body by the kidneys or in the feces. This process is normal as long it is kept to a minimum and protein is not being used as the main source of energy for the body. However if there is an abnormal amount of protein catabolism, the ammonia build up can damage the liver and cross the blood - brain barrier leading to coma.

The production of Plasma Proteins

Albumin- Lifespan @ 14 days

Transport proteins – eg; hemoglobin

Clotting Factor-with the aid of Vitamin K; Lifespan 24-36 Hours

Lipoprotein- used to make the cell membrane

Lipid Metabolism

The by-products of the conversion of lipids into glucose are ketone bodies. Lipids are used for stored energy and are used to produce cholesterol, from which steroid hormones are produced.

2. Production of Bile

Substance used in the emulsification of large fat molecules into smaller particles to aid in the digestion of lipids

Produced by the Hepatocytes

Contains: Water, Na⁺, Ca, K, Cl⁻, HCO₃⁻, Fatty Acids, Cholesterol, bilirubin, and bile salts

Stored & concentrated in the gallbladder

3. Conjugation of Bilirubin

In the spleen old RBC are broke into three parts the **Globin** (protein), the **Ferritin** (iron) and **Heme** (pigment)

The globin and the ferritin are recycled.

The heme, however, is transported to the liver where it under goes various changes. First it is unconjugated **bilirubin (lipid based and water insoluble)** and then it is converted to conjugated **bilirubin (protein based and water-soluble)** by the hepatocytes this allows the bilirubin to move in a water solution. The bilirubin is then secreted into the bile and move to the small intestine. Bacteria in the small intestine convert bilirubin to **urobilinogen** this substance can either be removed in the feces or reabsorbed and secreted by the kidney in the urine

If unconjugated bilirubin is released into the blood stream in high levels it can damage cell by diffusing into the cell through the lipid based membrane. → jaundice → kernicterus

4. Detoxifies the blood of heavy metals, drugs such as barbiturates and amphetamines, also breaks down hormones

5. Storage of vitamins (A, B-12, D, E, and K), and minerals such as iron and copper

6. Phagocytosis of worn out white and red blood cells & some bacteria

Features of Liver Disorders

ASCITES

Abnormal accumulation of fluid (over 500ml) in the abdominal region

Fluid contains proteins and electrolytes

Fluid leaks from veins and lymphatic vessel in the abdominal cavity caused by the increased pressure in the hepatic portal system & decreased oncotic pressure R/T decreased serum proteins

Decrease of fluid in the blood as it leaks into abdomen causes a decrease in blood volume and finally leads to a decrease in urine output

Causes:

- Increased portal hypertension
- Impairment of the kidneys causes an increase of H₂O and Na⁺ in the blood
- Reduction of plasma proteins production causing a decrease in the osmotic pressure in the blood
- Increase of aldosterone due to the fact that the damaged liver can not metabolize and degrade the hormone causes an increase of H₂O and Na⁺ in the blood

ESOPHAGEAL VARICES*

Enlarging of the veins in the esophagus due to an increase of blood flow to the area (collateral circulation). The increased blood flow is due to diminished blood flow in the hepatic portal system (Increased portal hypertension)

Varices may rupture → hemorrhage; can also manifest in slow chronic bleeding.

* Varices may also be found in other areas of the GI tract such as the colon and stomach

JAUNDICE

The yellow or greenish-yellow coloration of the skin caused by the build up bilirubin in the blood

- **Hemolytic Jaundice** - Increase in the destruction of the RBC. Bilirubin can not be excreted fast enough by the normal liver. This would be an increase in unconjugated bilirubin. Example Sickle cell anemia
- **Hepatocellular Jaundice** - Diseased liver is unable to clear the bilirubin from the blood. This would be an increase in both unconjugated bilirubin and conjugated bilirubin
- **Obstructive Jaundice** - Obstruction of the bile duct causes the bile to back up into the liver. The bile maybe reabsorbed into blood to be excreted by the kidney. This would be an increase in conjugated bilirubin

DISORDERS OF THE LIVER

Hepatitis A infectious hepatitis

Oral - fecal route of transmission, ingestion of contaminated food / water.

Incubation: 1-7 wk., average 4 wk., duration 4-8 wk. mild flu-like upper respiratory infection, fever low grade, anorexia, jaundice

Hepatitis B Serum. Transmitted through body fluids

Longer incubation period 2-5 months, insidious and variable

Symptoms include anorexia, abdominal pain, generalized aching, malaise, weakness, possible jaundice, and enlarged and tender liver.

Hepatitis C or Non A or B:

Blood borne carrier possible.

Causes:

Major cause: Blood transfusion. Related viral hepatitis, no jaundice, Similar to hepatitis B may become chronic.

Cirrhosis:

Enlarged liver, loaded with fat; firm and sharp edge on palpation, may become nodular and healthy tissue is replaced with scar tissue.

Laennec's Cirrhosis = Alcoholic Cirrhosis - most frequent associated with alcohol abuse or poor nutrition

Biliary- Rare insidious onset and protracted course (30 yrs. or more) associated with chronic biliary obstruction and infection

Hepatic Coma

Accumulation of ammonia, a by-product of protein metabolism, the ammonia is released into the blood stream in its raw form instead of in the form of urea. The ammonia then enters the CNS causing coma and then death. Clients with liver disorder must be careful of the amounts of protein in the diet. In the early stages of the problem the protein is needed to heal the liver, in the end stages it is reduced to prevent coma