LIVER

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FUNCTIONAL ANATOMY OF LIVER

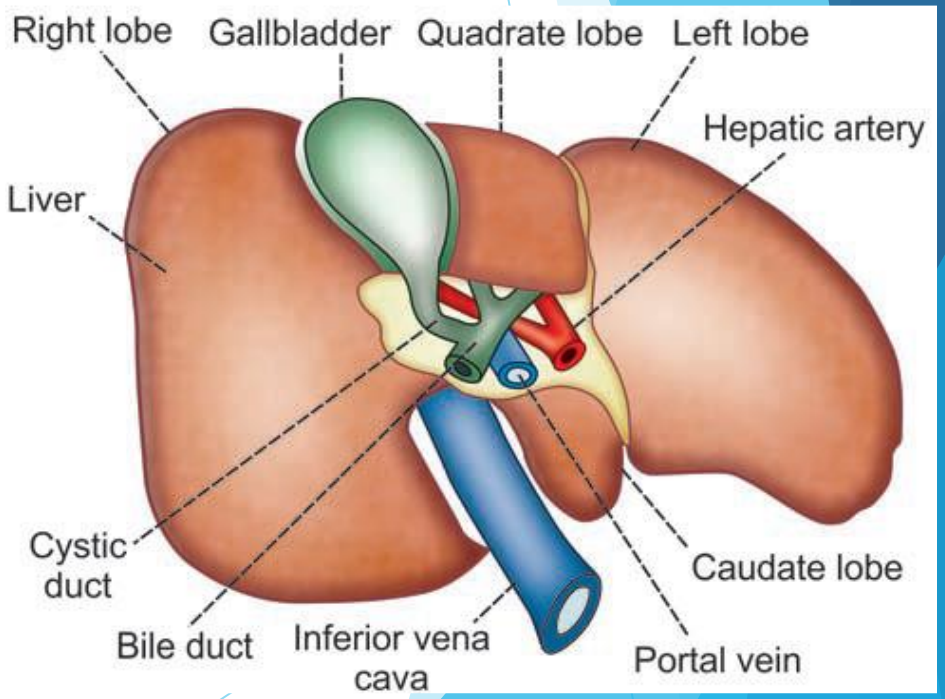
- Liver is a dual organ having both secretory and excretory functions.
- It is the largest gland in the body, weighing about 1.5 kg in man.
- It is located in the upper and right side of the abdominal cavity, immediately beneath diaphragm.

Hepatic Lobes

- Liver is made up of many lobes called hepatic lobes.
- Each lobe consists of many lobules called hepatic lobules.

Hepatic Lobules

- Hepatic lobule is the structural and functional unit of liver.
- There are about 50,000 to 100,000 lobules in the liver.
- The lobule is a **honeycomb-like structure** and it is made up of liver cells called hepatocytes.



Hepatocytes and Hepatic Plates

- Hepatocytes are arranged in columns, which form the hepatic plates.
- Each plate is made up of two columns of cells.
- In between the two columns of each plate lies a bile canaliculus.
- In between the neighboring plates, a blood space called **sinusoid** is present.
- Sinusoid is lined by the endothelial cells.
- In between the endothelial cells some special macrophages called **Kupffer cells** are present.

Portal Triads

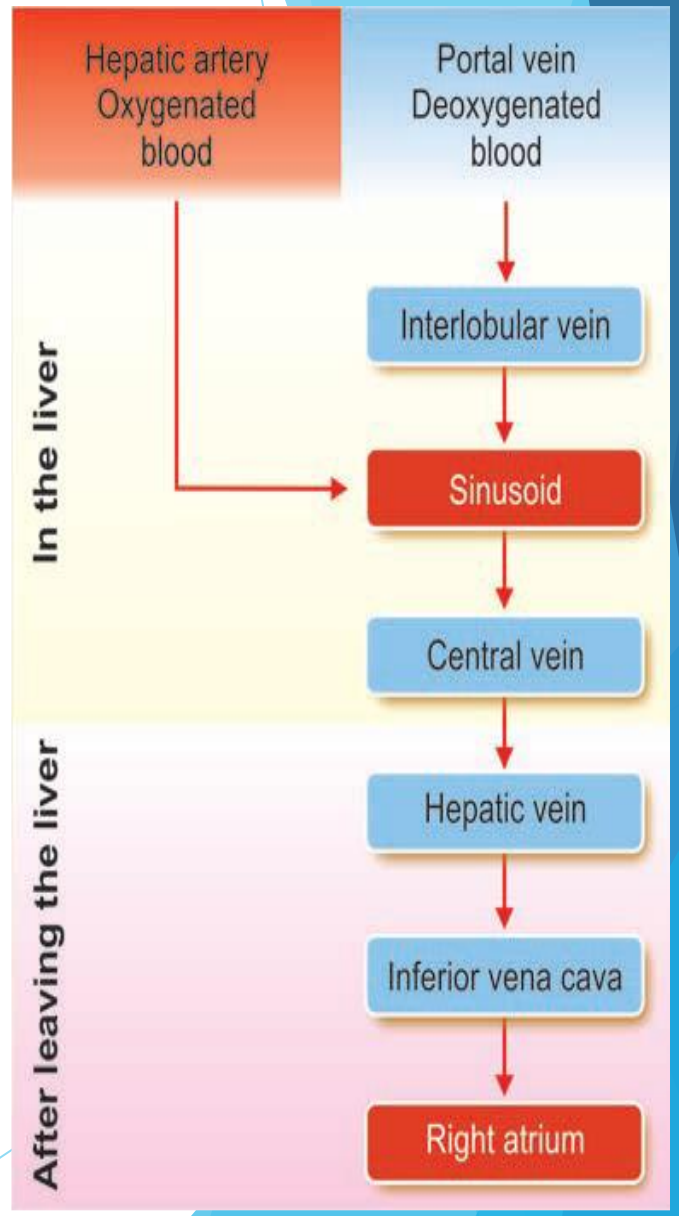
- Each lobule is surrounded by many portal triads.
- Each portal triad consists of three vessels:
  1. A branch of hepatic artery
  2. A branch of portal vein
  3. A tributary of bile duct.

BLOOD SUPPLY TO LIVER

- Liver receives maximum blood supply of about 1,500 mL/minute.
- It receives blood from two sources, namely the hepatic artery and portal vein.

HEPATIC ARTERY

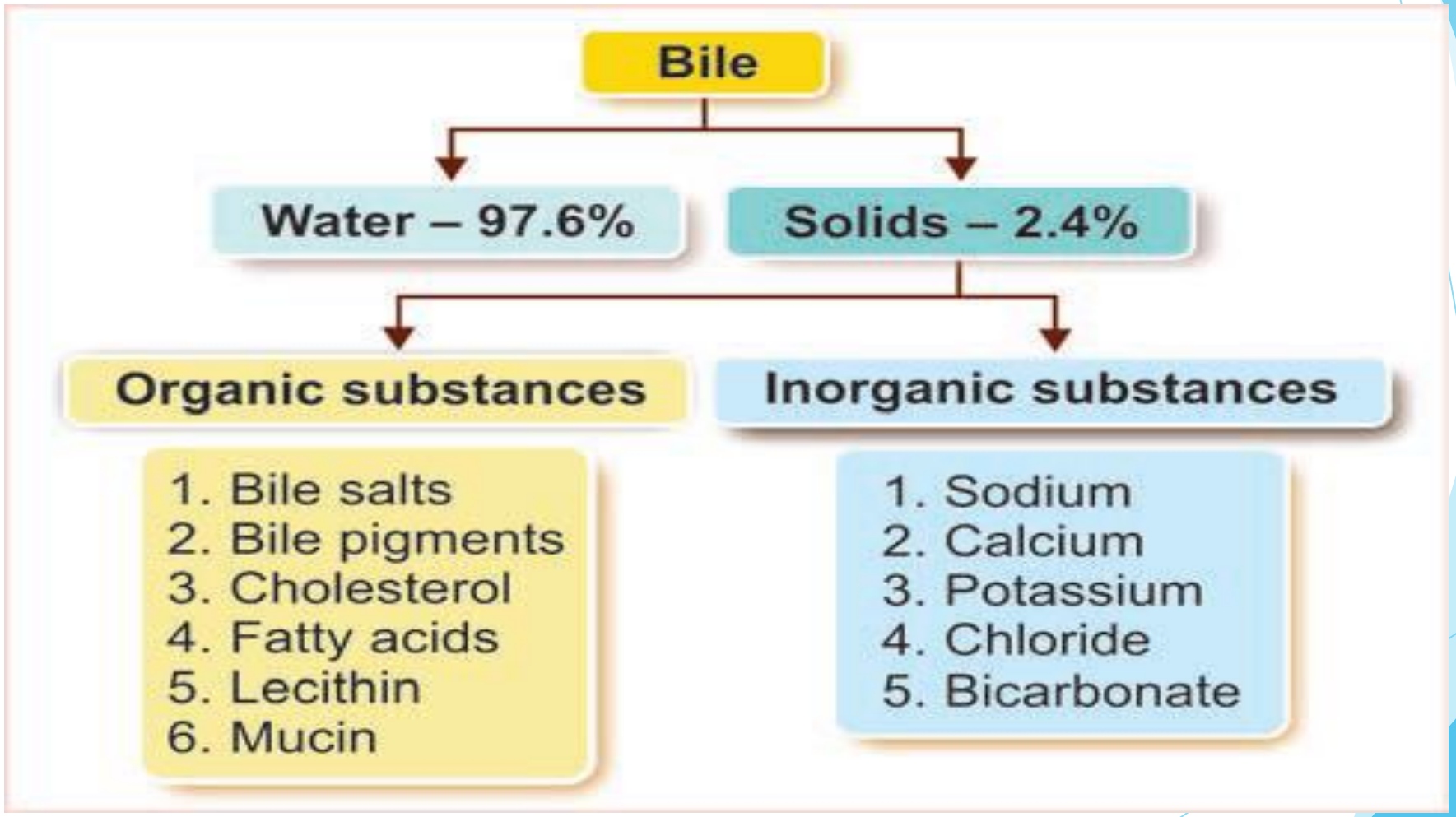
- Hepatic artery arises directly from aorta and supplies **oxygenated blood** to liver.
- After entering the liver, the hepatic artery divides into many branches.
- Each branch enters a portal triad.



PROPERTIES OF BILE

- **Volume** : 800 to 1,200 mL/day
- **Reaction** : Alkaline
- **pH** : 8 to 8.6
- **Specific gravity** : 1.010 to 1.011
- **Color** : Golden yellow or green.

COMPOSITION OF BILE



FUNCTIONS OF BILE SALTS

- Bile salts are required for **digestion and absorption of fats in the intestine.**
- The functions of bile salts are:

1) Emulsification of Fats

- Emulsification is the process by which the **fat globules** are broken down into minute droplets and made in the form of a **milky fluid** called **emulsion** in small intestine, by the action of bile salts.

2) Absorption of Fats

- Bile salts help in the absorption of digested fats from intestine into blood.
- Bile salts combine with fats and make complexes of fats called **micelles.**
- The fats in the form of micelles can be **absorbed easily**.

3) *Choleretic Action*

- Bile salts **stimulate the secretion** of bile from liver.
- This action is called choleretic action.

4) *Cholagogue Action*

- Cholagogue is an agent which causes **contraction** of **gallbladder** and release of bile into the intestine.
- Bile salts act as cholagogues indirectly by stimulating the secretion of hormone cholecystokinin.
- This hormone causes contraction of gallbladder, resulting in release of bile.

5) *Laxative Action*

- Laxative is an agent which induces defecation.
- Bile salts act as laxatives by stimulating peristaltic movements of the intestine.

6) *Prevention of Gallstone Formation*

- Bile salts prevent the formation of gallstone by keeping the cholesterol and lecithin in solution.
- In the absence of bile salts, cholesterol precipitates along with lecithin and forms gallstone.

BILE PIGMENTS

- Bile pigments are the excretory products in bile.
- **Bilirubin** and **biliverdin** are the two bile pigments and bilirubin is the major bile pigment in human beings.

FUNCTIONS OF BILE

- Most of the functions of bile are due to the **bile salts**.

1. DIGESTIVE FUNCTION

- Refer functions of bile salts.

2. ABSORPTIVE FUNCTIONS

- Refer functions of bile salts.

3. EXCRETORY FUNCTIONS

- Bile pigments are the major excretory products of the bile. Other substances excreted in bile are:

  i. Heavy metals like copper and iron

  ii. Some bacteria like typhoid bacteria

  iii. Some toxins

  iv. Cholesterol

  v. Lecithin

  vi. Alkaline phosphatase.

4. LAXATIVE ACTION

- Bile salts act as laxatives.

5. ANTISEPTIC ACTION

- Bile inhibits the growth of certain bacteria in the lumen of intestine by its **natural detergent action.**

6. CHOLERETIC ACTION

- Bile salts have the choleretic action.

7. MAINTENANCE OF pH IN GASTROINTESTINAL TRACT

- As bile is highly alkaline, it neutralizes the acid chyme which enters the intestine from stomach.
- Thus, an optimum pH is maintained for the action of digestive enzymes.

8. PREVENTION OF GALLSTONE FORMATION

- Refer function of bile salts.

9. LUBRICATION FUNCTION

- The mucin in bile acts as a lubricant for the chyme in intestine.

10. CHOLAGOGUE ACTION

- Bile salts act as cholagogues.

FUNCTIONS OF LIVER

- Liver is the largest gland and one of the vital organs of the body.
- It performs many vital metabolic and homeostatic functions.

1. METABOLIC FUNCTION

- Liver is the organ where maximum metabolic reactions such as metabolism of carbohydrates, proteins, fats, vitamins and many hormones are carried out.

2. STORAGE FUNCTION

- Many substances like glycogen, amino acids, iron, folic acid and vitamins A, B12 and D are stored in liver.

3. SYNTHETIC FUNCTION

- Liver produces glucose by gluconeogenesis.
- It synthesizes all the plasma proteins and other proteins (except immunoglobulins) such as clotting factors, complement factors and hormone binding proteins.
- It also synthesizes steroids, somatomedin and heparin.

4. SECRETION OF BILE

- Liver secretes bile which contains bile salts, bile pigments, cholesterol, fatty acids and lecithin.
- The functions of bile are mainly due to bile salts.
- Bile salts are required for digestion and absorption of fats in the intestine.
- Bile helps to carry away waste products and breakdown fats, which are excreted through feces or urine.

5. EXCRETORY FUNCTION

- Liver excretes cholesterol, bile pigments, heavy metals (like lead, arsenic and bismuth), toxins, bacteria and virus (like that of yellow fever) through bile.

6. HEAT PRODUCTION

- Enormous amount of heat is produced in the liver because of metabolic reactions.
- Liver is the organ where maximum heat is produced.

7. HEMOPOIETIC FUNCTION

- In fetus (hepatic stage), liver produces the blood cells.
- It stores vitamin B12 necessary for erythropoiesis and iron necessary for synthesis of hemoglobin.
- Liver produces thrombopoietin that promotes production of thrombocytes.

8. HEMOLYTIC FUNCTION

- The senile RBCs after a lifespan of 120 days are destroyed by reticuloendothelial cells (Kupffer cells) of liver.

9. INACTIVATION OF HORMONES AND DRUGS

- Liver catabolizes the hormones such as growth hormone, parathormone, cortisol, insulin, glucagon and estrogen.
- It also inactivates the drugs, particularly the fatsoluble drugs.
- The fat soluble drugs are converted into water soluble substances, which are excreted through bile or urine.

THANK YOU