Anatomy

Faculty of Medicine - JU2017

Number >>	10
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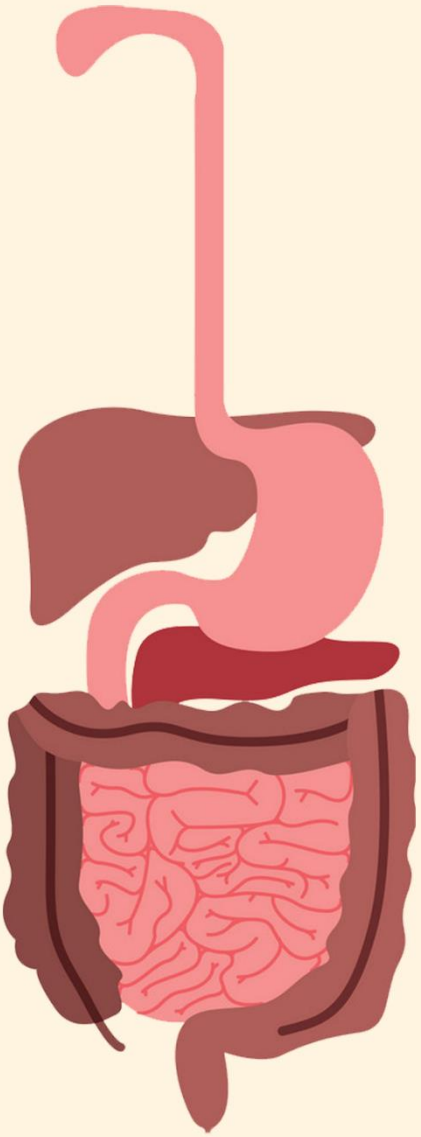
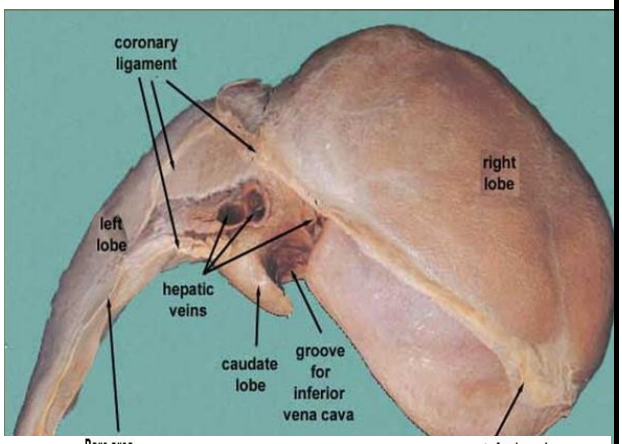
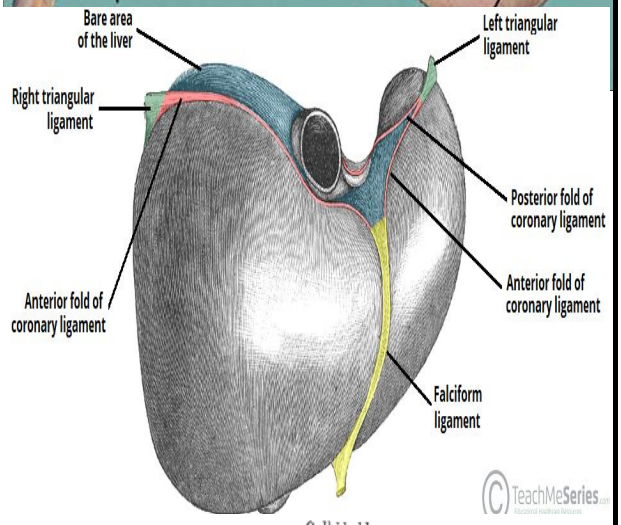
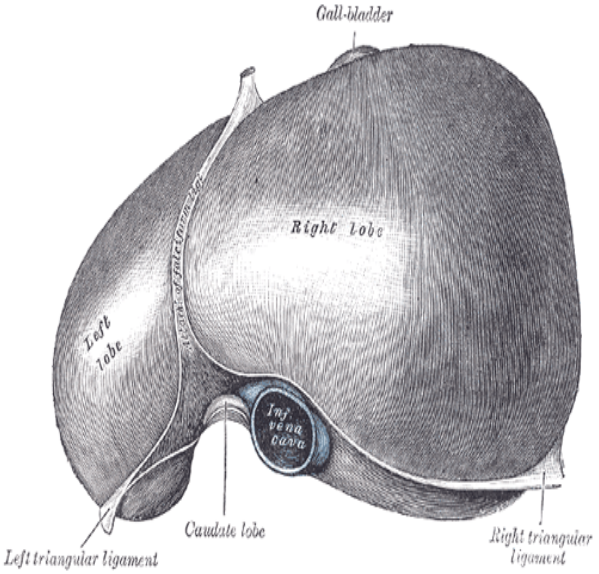


2nd system - GI

The Liver continued







<u>The superior surface of the liver</u>

You can see

* The *right* and *left lobes*.

* Cut edge of the *Falciform ligament.*

* *The coronary ligament*, continues on both sides as:

* *The left triangular ligament*

* *The right triangular ligament*

* Between the edges of the coronary ligament is the *Bare area of the liver* (where there is no peritoneum covering the liver).

* *Groove for the inferior vena cava* and the 3 *hepatic veins* that drain in it.

* Cut edge of the *Falciform ligament*.

* Caudate lobe of the liver more or less wrapping around the groove of the inferior vena cava

* Fundus of gall bladder

* Ligamentum teres

→ *Relations of the superior surface*

• Diaphragm (the diaphragm is above the liver and is related to the anterior, superior and posterior surfaces of the liver but the visceral surface of the liver doesn't have relations with the diaphragm).

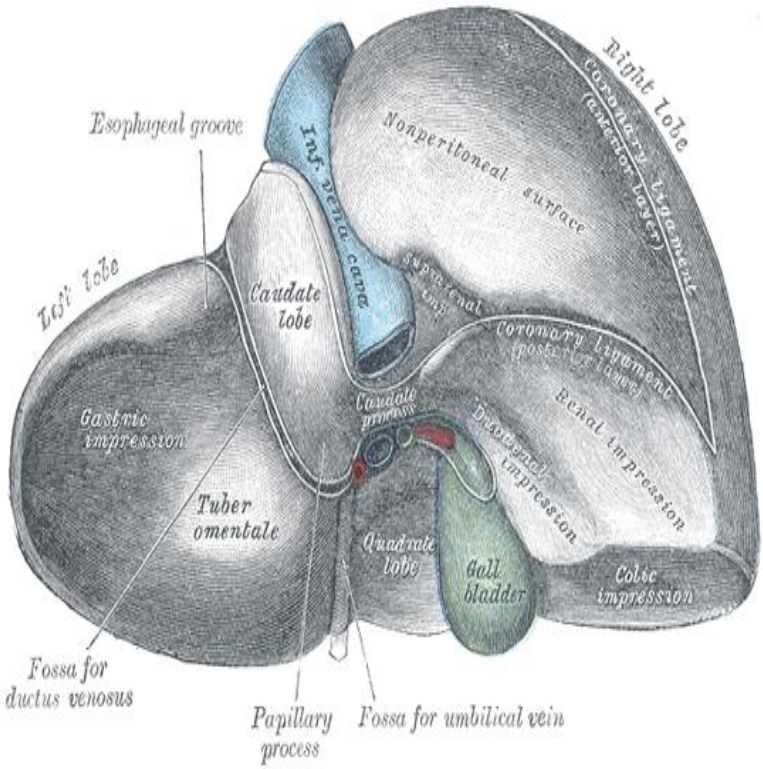
The diaphragm separates the Pleura & lung and the Pericardium & heart from the liver.

→ *Relations of the liver anteriorly*

- Diaphragm
- Rt & Lt pleura and lung (separated from the liver by the diaphragm)
- Costal cartilage
- Xiphoid process
- Anterior abdominal wall

→ *Relations of the liver posteriorly*

- Diaphragm
- Rt. Kidney
- Supra renal gland
- Transverse colon (hepatic flexure)
- Duodenum
- Gall bladder
- I.V.C
- Esophagus
- Fundus of stomach



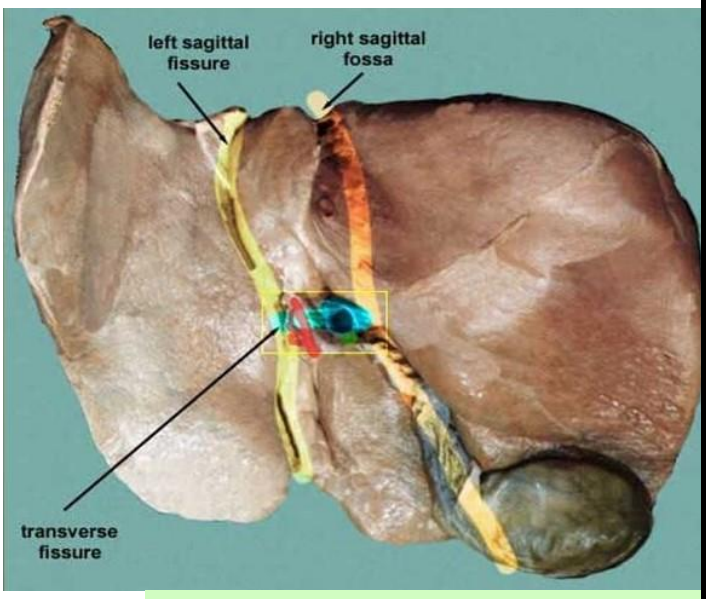
(pay attention to the impressions in the picture they are important)

→ *lobes of the liver*

- Right Lobe
- Left lobe
- Quadrate lobe
- Caudate lobe

(the quadrate and caudate lobes are similar physiologically and functionally to the left lobe)

Separation of the four lobes of the liver:

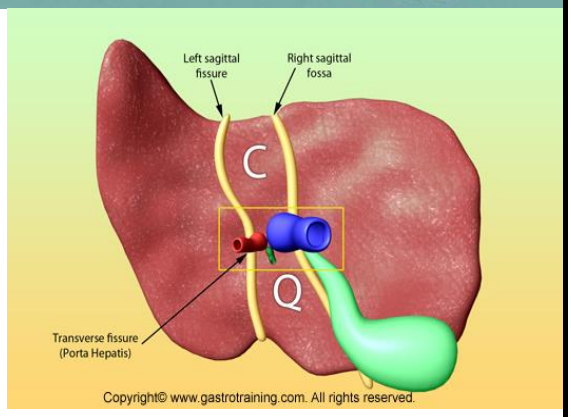


• Right sagittal fossa – a vertical line between the impression for inferior vena cava and gall bladder

• left sagittal fissure - contains the Ligamentum Venosum and round ligament of liver (ligamentum teres)

• Transverse fissure (also porta hepatis) - bile ducts, portal vein, hepatic arteries

They create an **H** shape that divides the liver to 4 lobes



-the right and left lobes, the caudate lobe is next to the impression of IVC and the quadrate is next to the gallbladder.

(The *porta hepatis* contains the portal vein, hepatic artery, common bile duct, lymph nodes and sympathetic and parasympathetic fibers.

It is below the caudate lobe and above the quadrate lobe).

NOTE : celiac trunk comes from the anterior wall of abdominal aorta and gives :

1.splenic artery (Moving on the upper border of the pancreas towards the spleen)

2.left gastric artery → stomach and lower third of esophagus .

3.right +left hepatic arteries → porta hepatis .

Right Lobe

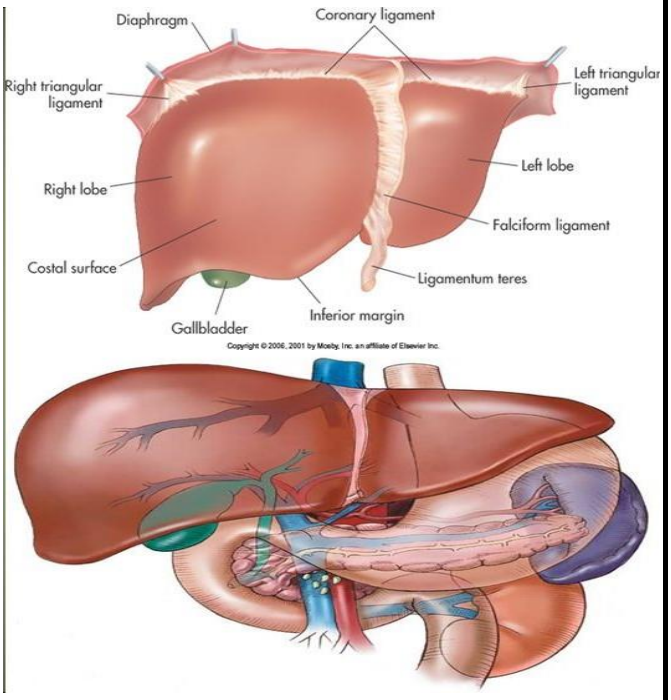
-Largest lobe

- Occupies the right hypochondrium

- it receives the right hepatic artery and the right hepatic vein comes out of it

- Divided into anterior and posterior sections by the right hepatic vein

- Riedel's Lobe an extension of the right lobe as far posteriorly as the iliac crest found in some people



The veins and arteries of the liver are very important in liver transplantation, during the operation the doctors will try to take a part of the liver that has an artery, vein and innervation to transplant so it can survive.

Left Lobe

– Varies in size

– Lies in the epigastric and left hypochondriac regions

– Divided into lateral and medial segments by the left hepatic vein

(we have 4 lobes and 3 hepatic veins; the right and left hepatic veins and the central hepatic vein which drains the caudate and quadrate lobe)

Right and left lobes are separated by

• Falciform ligament

• Ligamentum Venosum

• Ligamentum teres

Caudate lobe

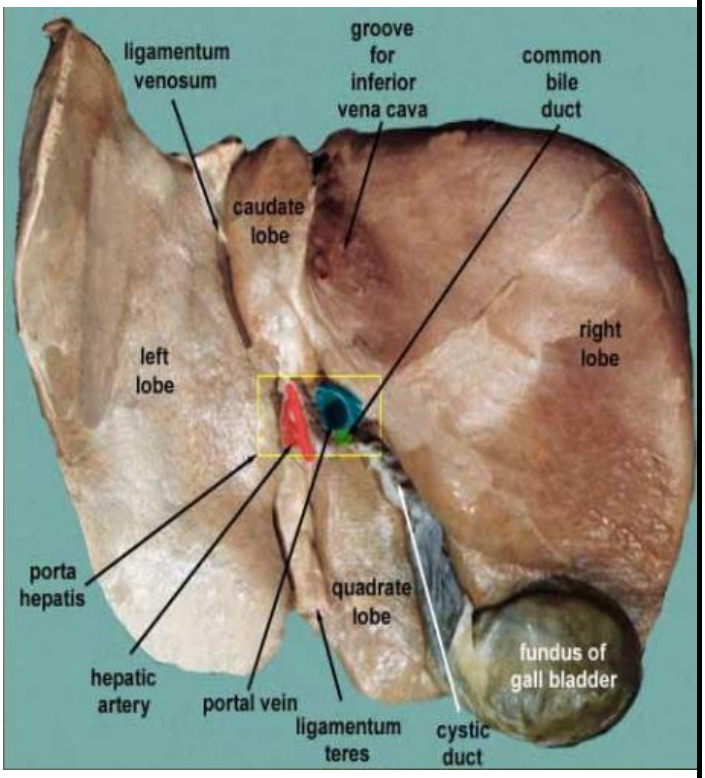
present in the posterior surface from the Rt. Lobe (*from slide*)

has 2 processes

1- caudate process

2- papillary process

(The caudate section of the liver is connected to the right lobe by a narrow bridge called the caudate process. This lies behind the porta hepatis, a deep crease in the liver. Below this is a small round appendage called the papillary process. This occasionally completely covers the inferior vena cava, bridging from the caudate lobe to the right liver lobe), ***from the web****.*



Relations of caudate lobe

- Inferiorly → the porta hepatis

- to the right → the fossa for the inferior vena cava

- to the left → the fossa for the ligamentum venosum

Quadrate lobe

Present on the inferior surface from the Rt. Lobe (*from slide*)

Relations of caudate lobe

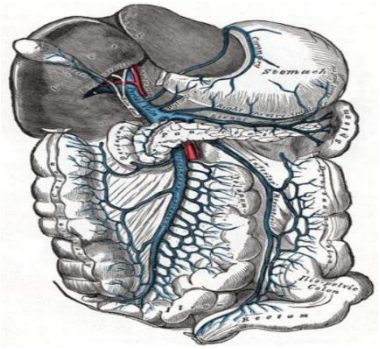
- Anteriorly → anterior margin of the liver

- Superiorly → porta hepatis

- to the right → fossa for the gallbladder

- to the left → fossa for ligamentum teres

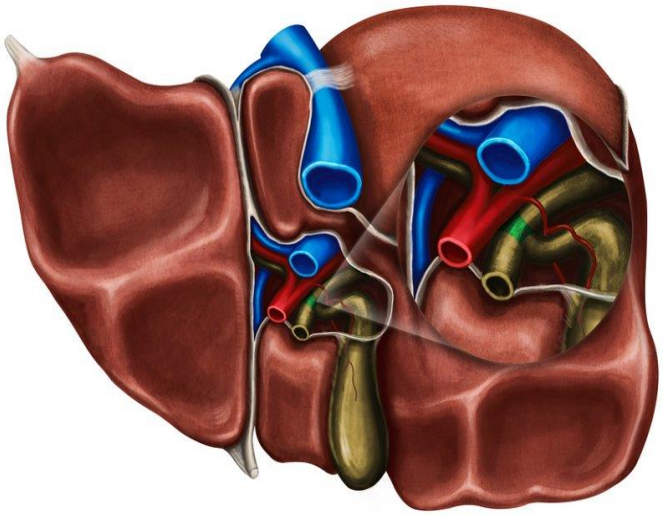
→ *Porta hepatis*



-It is the hilum *(a depression or fissure where structures such as blood vessels and nerves enter an organ)* of the liver.

-It is found on the posteroinferior surface and lies between the caudate and quadrate lobes.

-Lesser omentum attaches to its margin (it is not covered by peritoneum, it is surrounded by it).



The hepatic artery and portal vein enter the liver from the porta hepatis, and the common bile duct exits through it (the contents of the free edge of the lesser omentum)

<u>Contents</u>

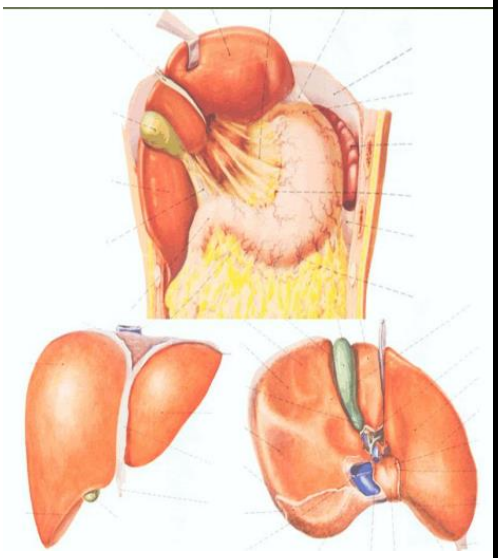
- Gallbladder (anteriorly) → the cystic duct joins the hepatic duct to form the common bile duct

- Hepatic artery + nerve (sympathetic and parasympathetic from the celiac plexus) + hepatic lymph nodes (middle)

The hepatic artery divides into right and left hepatic arteries, the right branch gives the *cystic artery* which supplies the gallbladder.

- Portal vein (posteriorly) → in the liver it divides into the right and left hepatic veins.

→ *Peritoneum of the liver*



• The liver is covered by peritoneum (intraperitoneal organ) except at bare area.

• Inferior surface covered with peritoneum of greater sac except porta hepatis, Gallbladder & Ligamentum teres fissure.

• Right Lateral surface covered by peritoneum, related to diaphragm which separates it from right pleura, lung and the right ribs (6-11).

The lesser omentum connects between the porta hepatis and the lesser curvature of the stomach and reaches the diaphragm and first part of the duodenum.

→ *The ligaments of the liver* (everything was discussed before so this isn't new)

1- The Falciform ligament of liver

2- The Ligamentum teres hepatis

3- The coronary ligament

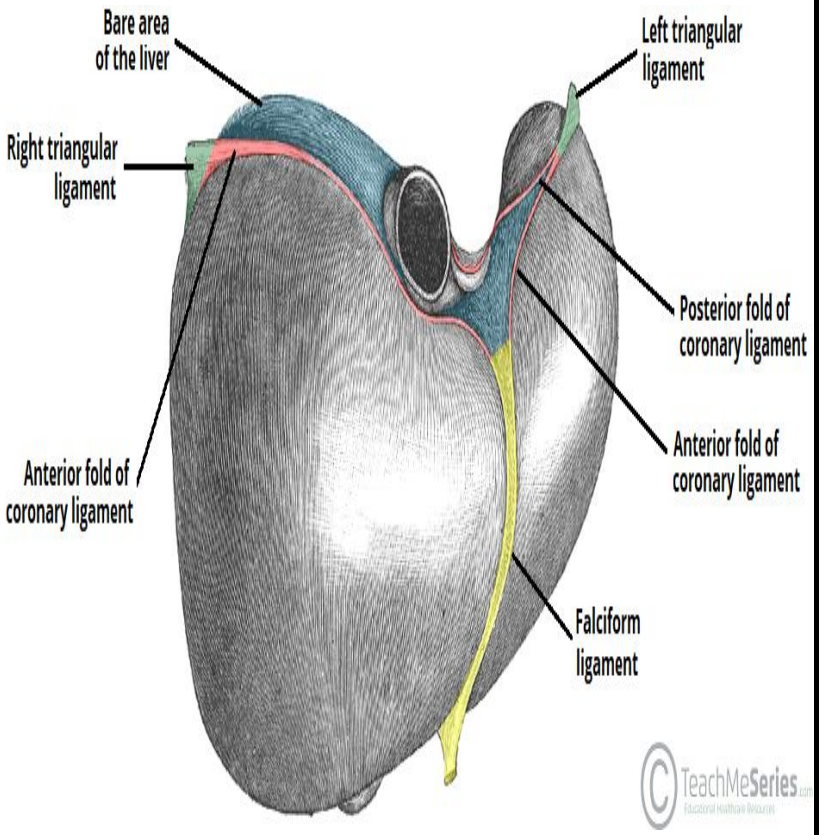
4- The right triangular ligament

5- The left triangular ligament

6- The Hepatogastric ligament

7- The hepatoduodenal ligament

8- The Ligamentum Venosum (in embryo it was *ductus venosum* but was obliterated)



• Falciform ligament of liver

– Consists of double peritoneal layer – Sickle shaped – Extends from anterior abdominal wall (umbilicus) to liver – Free border of the ligament contains Ligamentum teres (obliterated umbilical vein)

• Coronary ligament

the area between upper and lower layers\lips of the coronary ligament is the bare area of liver which contracts with the diaphragm

• Left and right triangular ligaments

formed by left and right extremity of coronary ligament

Note: how to differentiate between the surfaces of liver that are and aren't covered by peritoneum?

The surface covered by peritoneum would be glistening (shinning) and smooth.

• Hepatogastric ligament and Hepatoduodenal ligament

(lesser omentum)

The hepatoduodenal ligament has the free edge of lesser omentum which contains the hepatic artery, portal vein and common bile duct.

***note:* in sheet 6 I wrote that in the free edge of the lesser omentum the hepatic artery is lateral of the common bile duct, to be more specific it is to the left of it and both are anterior to the portal vein**

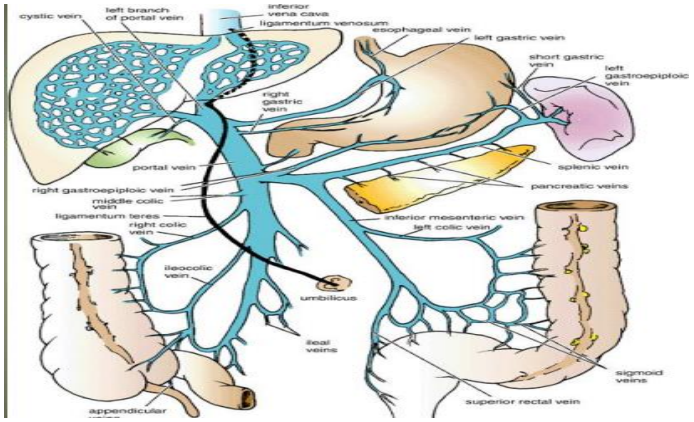
The Ligamentum Venosum

(dashed black line in the picture)

Fibrous band that is the remains of the *ductus venosus* (in the embryo connects between the left portal vein and IVC).

Is attached to the left branch of the portal vein and ascends in a fissure on the visceral surface of the liver to be attached above to the inferior vena cava.

Notice the black line between the umbilicus and the left portal vein, this is the umbilical vein that is obliterated and becomes ligamentum teres.

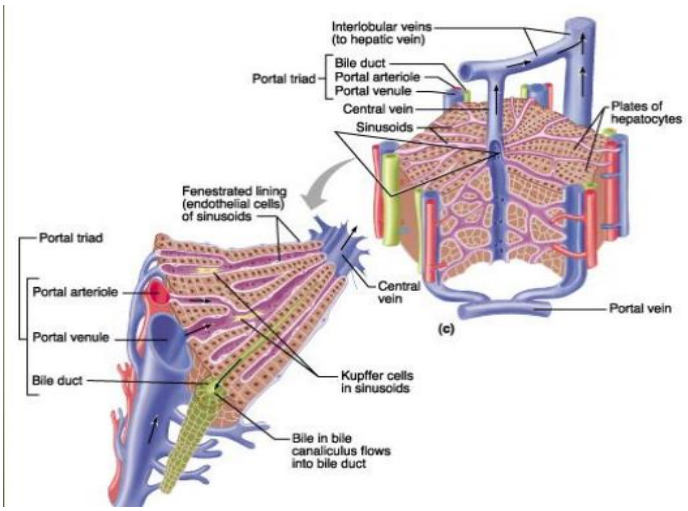


→ *Histology of the Liver*

The liver is the largest gland in the body, and glands are usually covered by connective tissue capsules, the capsule that covers the liver is called **Glisson's capsule**.

This capsule sends fibrous tissue septa that divide the liver into lobes and lobules.

The lobules are hexagonal in shape, consist of:



Hepatocytes that radiate outward from a *Central vein*.

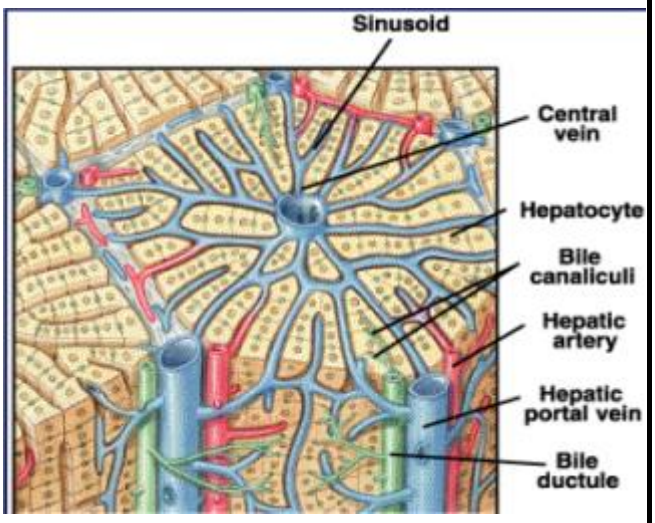
The venous drainage of hepatocytes is via the central vein → interlobular veins → hepatic veins → IVC

At each of the six corners or angles of a lobule is a portal triad which consists of:

-Proper hepatic artery: an arteriole branch of the hepatic artery that supplies oxygen (Portal arteriole)

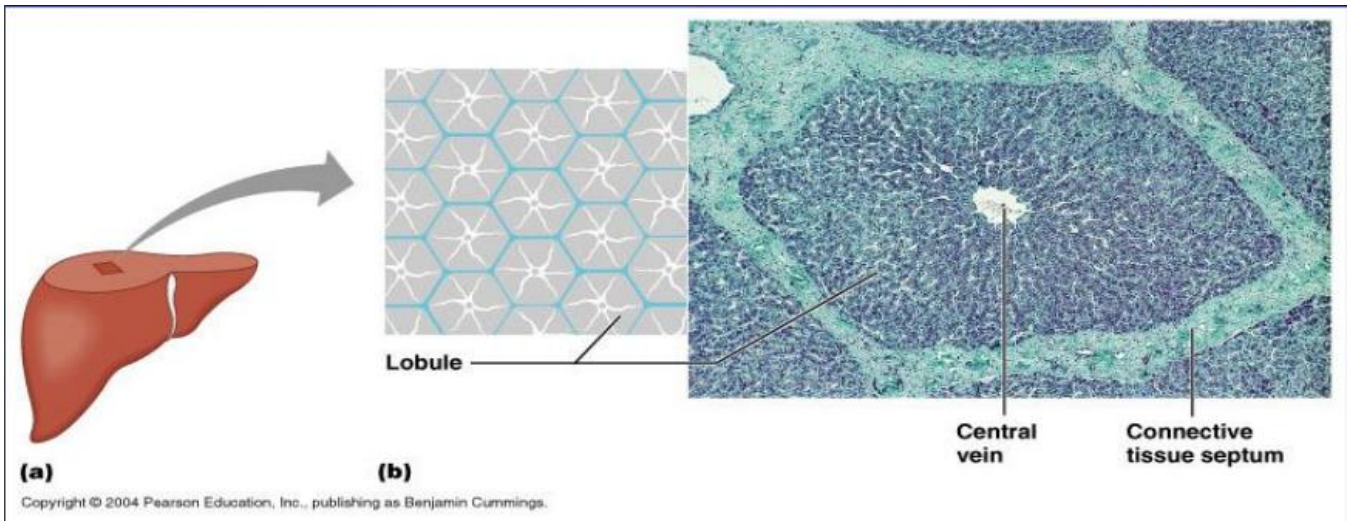
-Hepatic portal vein: a venule branch of the portal vein, with blood rich in nutrients but low in oxygen (Portal venule)

-Bile duct (collects bile produced in hepatocytes)

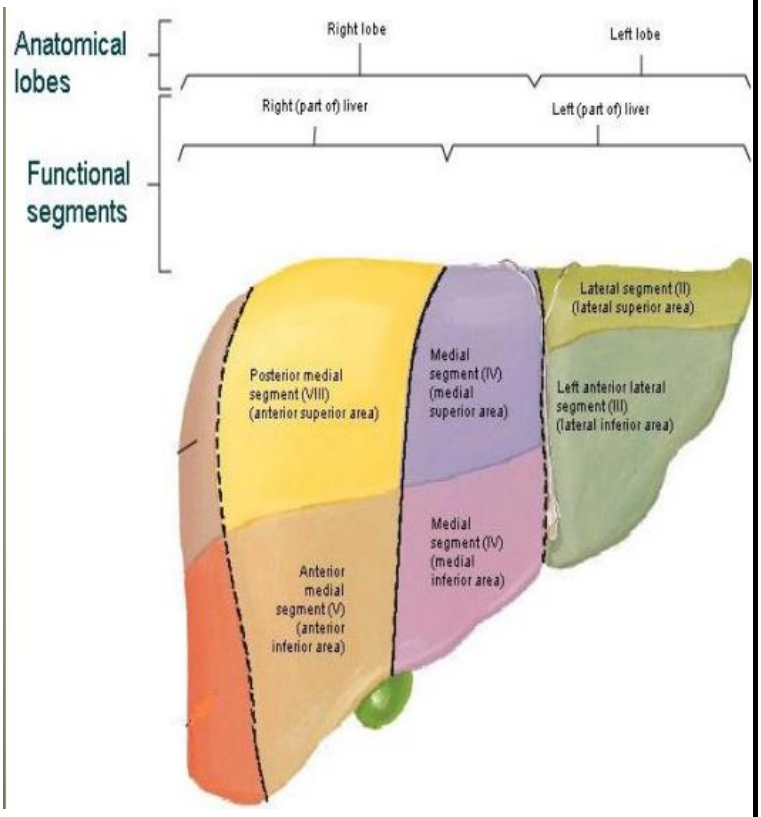


Between the hepatocytes are the *liver sinusoids* (contains oxygenated blood from hepatic artery and portal blood which contains absorbed nutrients, the blood in them is 20-25% from hepatic artery and 75-80% portal blood), the sinusoids are where the two blood supplies of the liver (hepatic artery, portal blood) mix.

The hepatocytes absorb the oxygen and nutrients from the sinusoids and perform their function and the waste products go to the central vein.



→ *Segmental anatomy of the liver*



• Right and left lobes anatomically have no morphological significance. - Separated by ligaments (Falciform, ligamentum Venosum & Ligamentum teres).

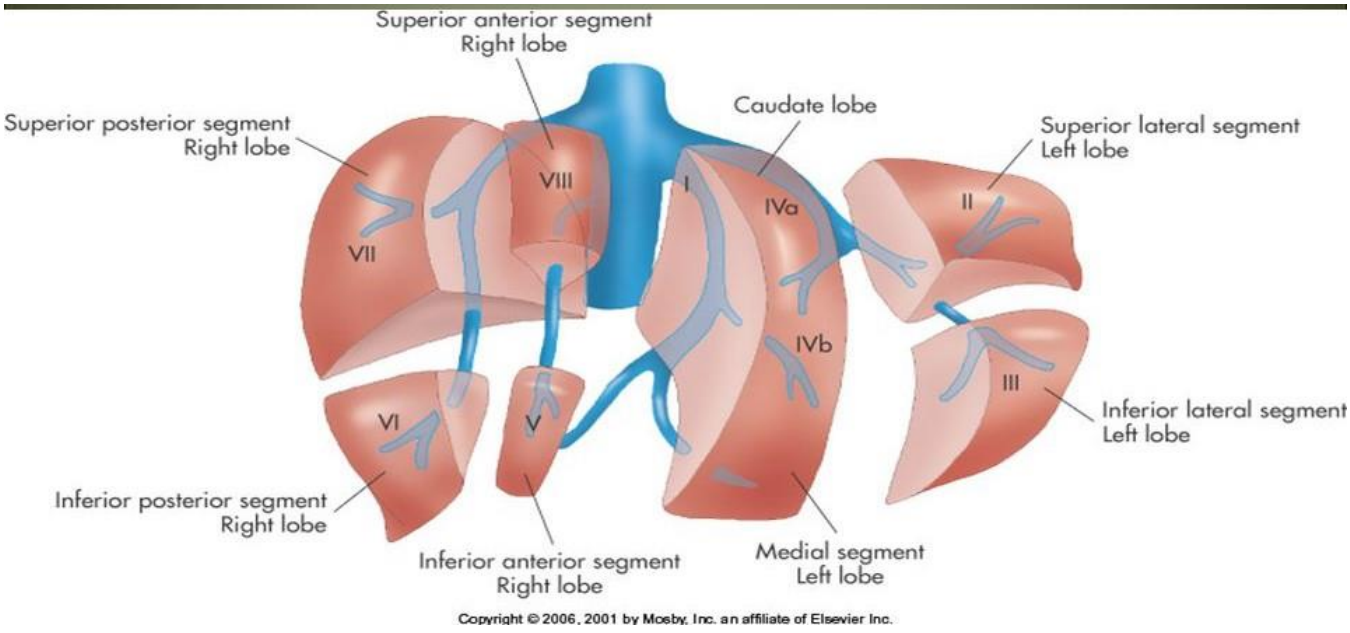
• True morphological and physiological division by a line extend from fossa of gallbladder to fossa of IVC, each side has its own arterial blood supply, venous drainage and biliary drainage.

• No anastomosis between divisions.

• 3 major hepatic veins (Right, left and central veins).

• 8 segments based on hepatic and portal venous segments.

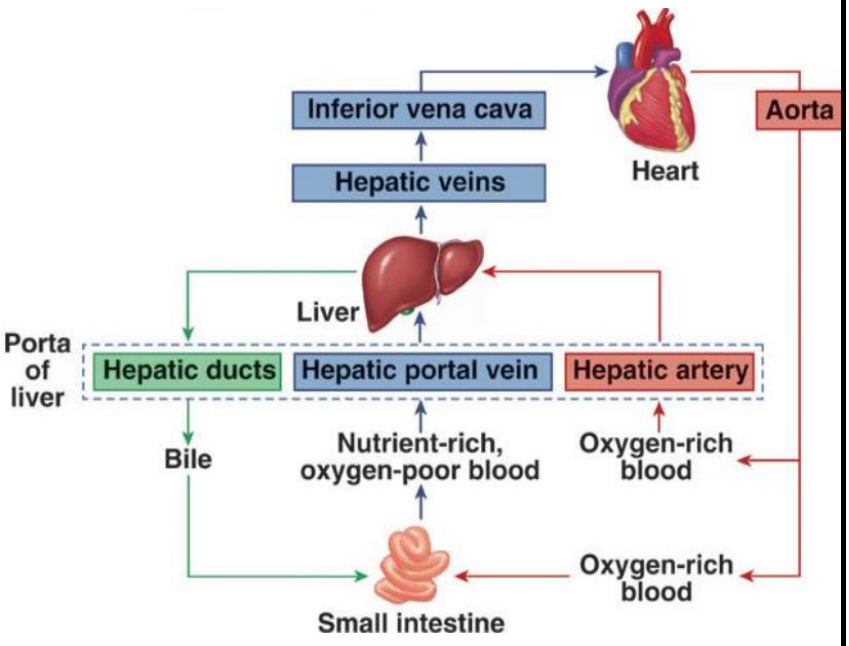
(the doctor mentioned the names of the segments, they are in the picture)



This segmentation is very important in liver transplantation, in the past we used to transplant large parts of the liver but now we only transplant segments of the liver as each segment has its own blood supply and lymph drainage.

→ *Blood supply of the liver*

As we know hepatic duct exists from the liver and joins cystic duct to form common bile duct that opens in the 2nd part of duodenum.

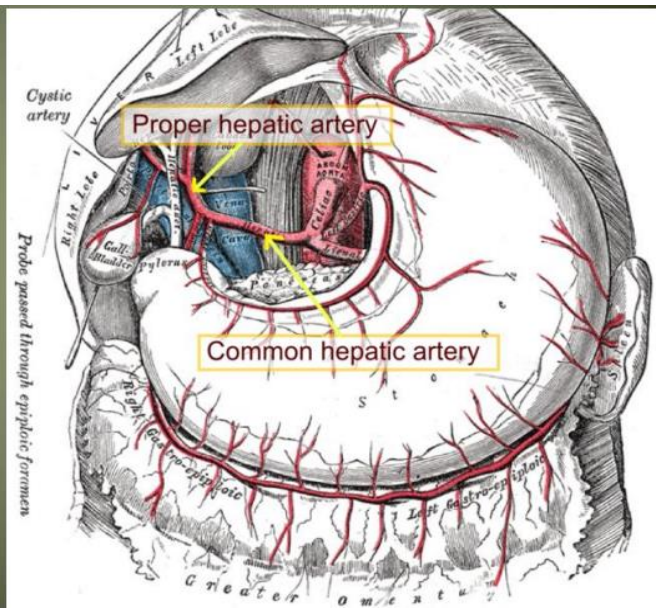


The hepatic artery enters the liver through porta hepatis carrying oxygenated blood and it is a branch of the celiac artery.

The portal vein forms behind the neck of pancreas from the joining of splenic vein and superior mesenteric vein, enters the liver through porta hepatis carrying nutrient rich but oxygen poor blood.

3 hepatic veins (right, left and central) exit from the liver and drain into IVC which drains into the right atrium of the heart.

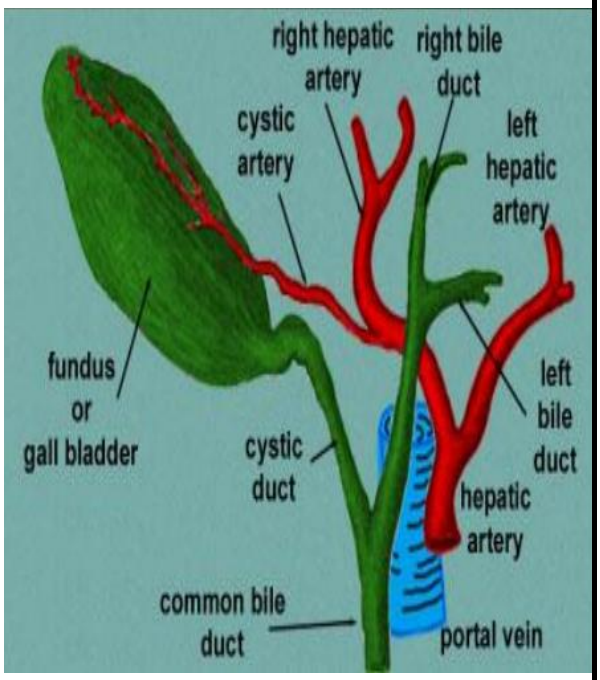
- Proper hepatic artery → The right and left hepatic arteries enter the porta hepatis.
- The right hepatic artery usually gives off the cystic artery, which runs to the neck of the gallbladder.

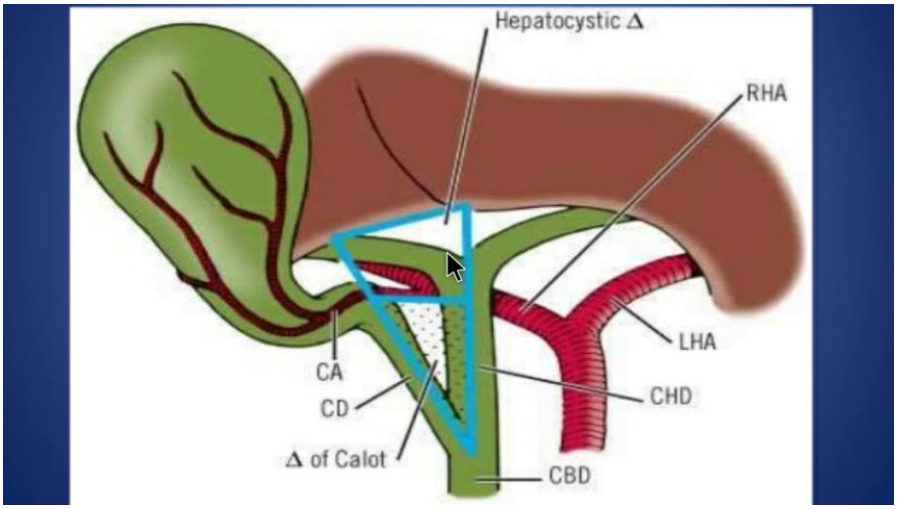


As mentioned before the hepatic artery branches in the porta hepatis to right and left hepatic arteries and the cystic artery branches from the right artery.

Similarly, there is the right and left branches of portal vein and the cystic vein drains into the right branch.

Notice how a triangle is formed between the cystic duct and the common hepatic duct and the cystic vessels from above, this triangle is called **Calot's triangle**, it has clinical importance in cholecystectomy.



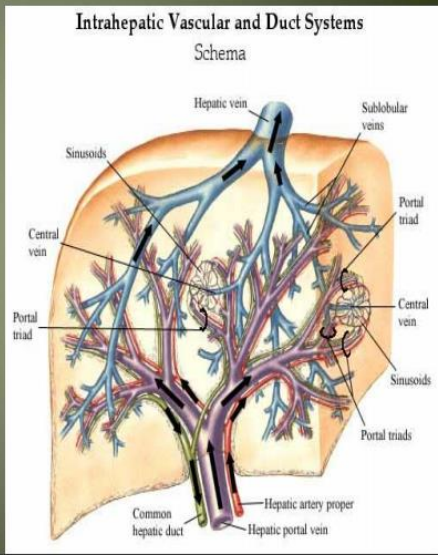


In cholecystectomy, we perform 2 ligations of the cystic vessels before cutting them to prevent bleeding, we also perform 2 ligations of the cystic duct and cut it then we remove the gallbladder.

- In 80% of people the cystic vessels are posterior to the common hepatic duct and rarely (20%) they are anterior to the duct.

Vein drainage of the liver

- The portal vein divides into right and left terminal branches that enter the porta hepatis behind the arteries.
- The hepatic veins (three or more) emerge from the posterior surface of the liver and drain into the inferior vena cava.



→ *Lymphatic drainage of the liver*

• Liver produce large amount of lymph (~ one third – one half of total body lymph)

• Lymph from the right and left lobes leaves the liver and enters *hepatic lymph nodes* in porta hepatis and continues to *celiac nodes*.

• A few vessels pass from the bare area of the liver through the diaphragm to the right thoracic lymph nodes.

→ *Nerve supply*

• Sympathetic → hepatic plexus >>> <u>celiac plexus</u> >>> thoracic ganglion chain T1- T12

• Parasympathetic → vagus nerve (anterior part)

• Sympathetic and parasympathetic nerves form the celiac plexus.

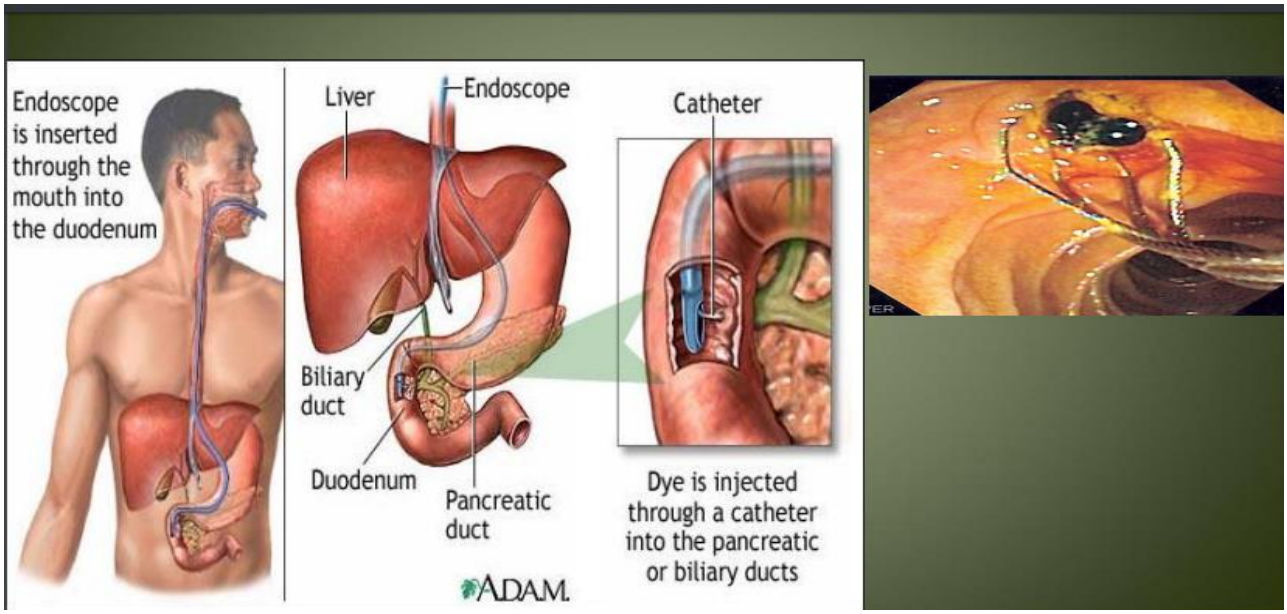
• The anterior vagal trunk gives rise to a large hepatic branch, which passes directly to the liver.

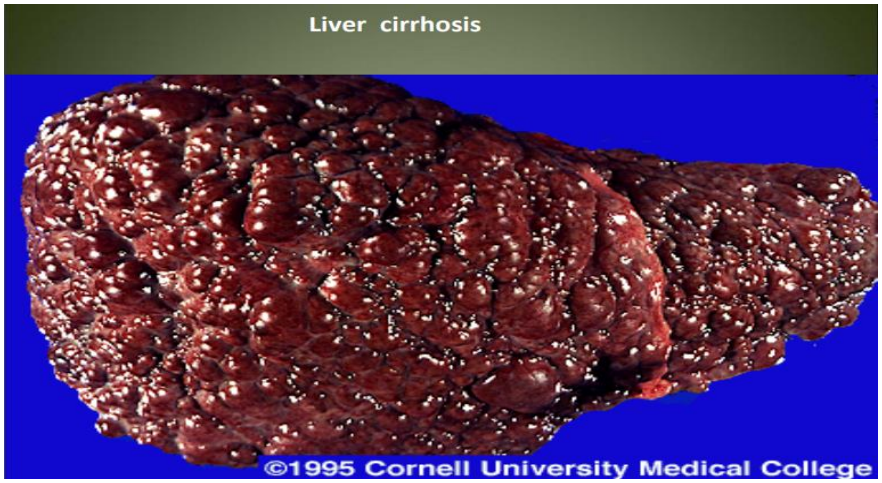
→ *Endoscopic retrograde cholangiopancreatography (ERCP)*

• It is a technique that combines the use of endoscopy and fluoroscopy to diagnose and treat certain problems of the biliary or pancreatic ductal systems. Through the endoscope, the physician can see the inside of the stomach and duodenum and inject dyes into the ducts in the biliary tree and pancreas so they can be seen on X-rays.

• ERCP is used primarily to diagnose and treat conditions of the bile ducts, including gallstones, inflammatory strictures (scars), leaks (from trauma and surgery), and cancer.

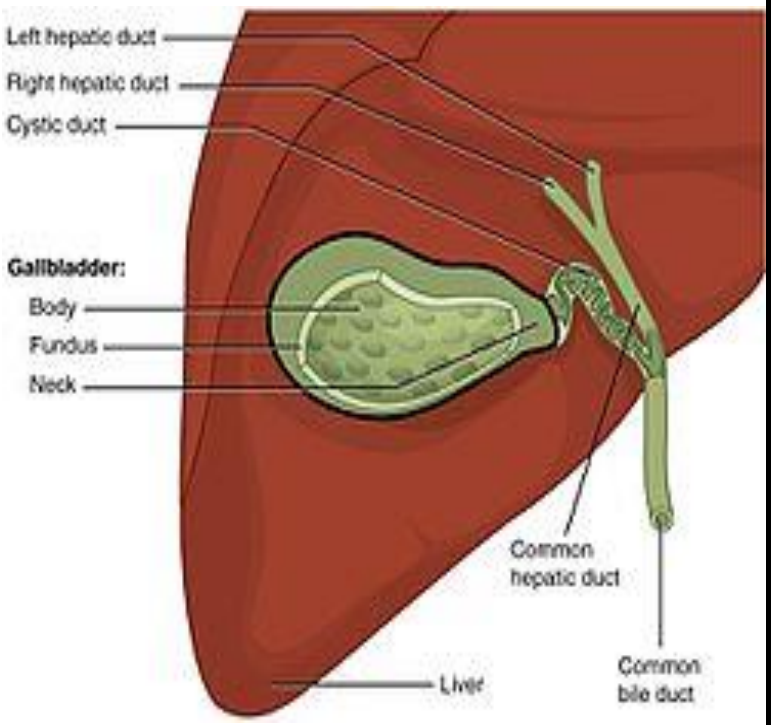
• After we reach the second part of duodenum by the endoscopy , we enter the pancreatic duct or the bile duct retrogradely .





Gallbladder

→ *Structure of the gallbladder*



<u>Fundus</u>

Anterior: anterior abdominal wall

Posteroinferior: transverse colon

<u>Body</u>

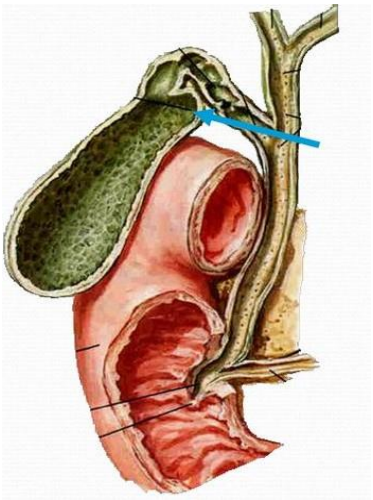
superior: liver

posteroinferior: Transverse colon, End of 1st part of duodenum, beginning of 2nd part of duodenum

<u>Neck</u>

- Forms the cystic duct which is 4cm in length

<u>Hartmann's Pouch</u>



1. Lies between body and neck of gallbladder
2. A normal variation
3. May obscure cystic duct
4. If very large, may see cystic duct arising from pouch

Hartman's pouch is the dilated posteromedial wall of the neck directed downwards and backwards, usually filled with bile secretion but there may be stasis of the secretion which could lead to the formation of stones (usually single stones the size of the pouch).

What is the importance of the Gallbladder?

-concentration of bile (becomes 20 times more concentrated) by absorption of water.

How does bile (which is originally produced in the liver) reach and enter the gallbladder?

-the bile moves through the common bile duct but encounters a closed sphincter of Oddi, so it moves to the gallbladder where it is concentrated.

The gallbladder secretes the bile by the contraction of its wall and the relaxation of the sphincter of Oddi, induced by hormonal stimulation via cholecystokinin which is synthesized sand secreted by endocrine cells in the duodenum.

Because the bile is concentrated in the gallbladder, it only requires a small amount of it to perform its function (digestion of fat and lipids) unlike the diluted bile from the liver which require 20 times more amount to perform the same function.

Patients who undergo cholecystectomy rely on diluted bile from the liver, that is why they have incomplete digestion of fat and lipids which causes diarrhea.

→ *Anatomical position of Gallbladder*

- Epigastric and right hypochondriac region

- At the tip of the 9th right costal cartilage (especially the fundus)

- Green muscular organ

- Pear-shaped, hollow structure

- On inferior surface of liver

- Between quadrate and right lobes

- Sometimes it is completely covered by peritoneum and has a short mesentery.

(and sometimes the peritoneum covers the front and both sides of it , fixing it to the liver)

- Capacity 40- 60 cc

- Body and neck Directed toward porta hepatis

→ *Histology of gallbladder*

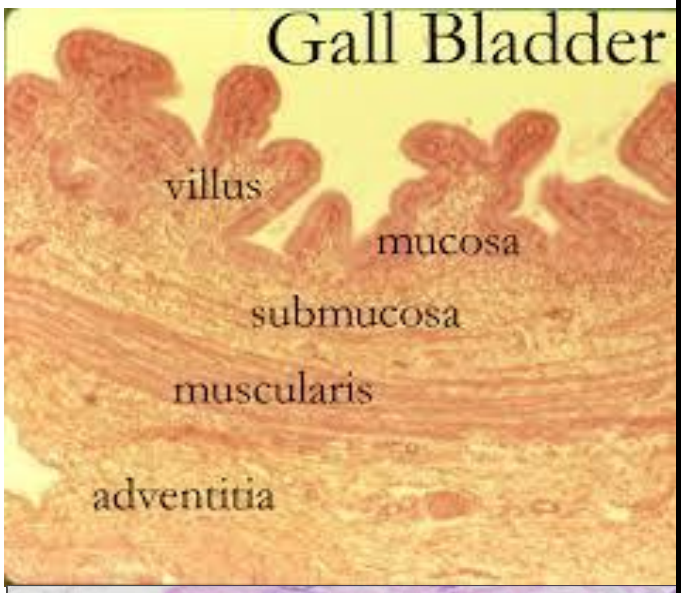
The wall of gallbladder has 4 layers:

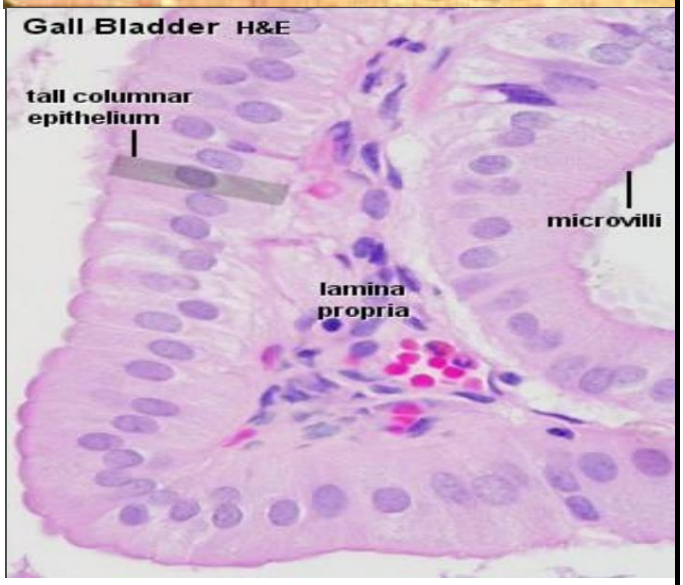
-mucosa

-submucosa

-muscularis

-adventitia or serosa





The lining epithelium is simple columnar epithelium without goblet cells.

The mucosa in the gallbladder is characterized by abundant *foldings* and microvilli.

The submucosa is sometimes absent.

The muscularis is externa *irregular* (unlike other organs which an external longitudinal and inner circular).

→ *Blood supply of gallbladder*

- Cystic artery (branch of right hepatic artery)

- Cystic vein (end in right branch of portal vein)

- Small branches (arteries and veins run between liver and gall bladder directly)

→ *Lymphatic drainage of gallbladder*

cystic lymph nodes at the junction of cystic & common hepatic ducts→ Hepatic lymph nodes → celiac lymph nodes

→ *Nerve supply*

• Sympathetic and parasympathetic from celiac plexus

• Parasympathetic ---- vagus nerve

• Hormonal stimulation (cholecystokinin from duodenum)

The cystic duct joins the common the hepatic duct to form the *common bile duct*.

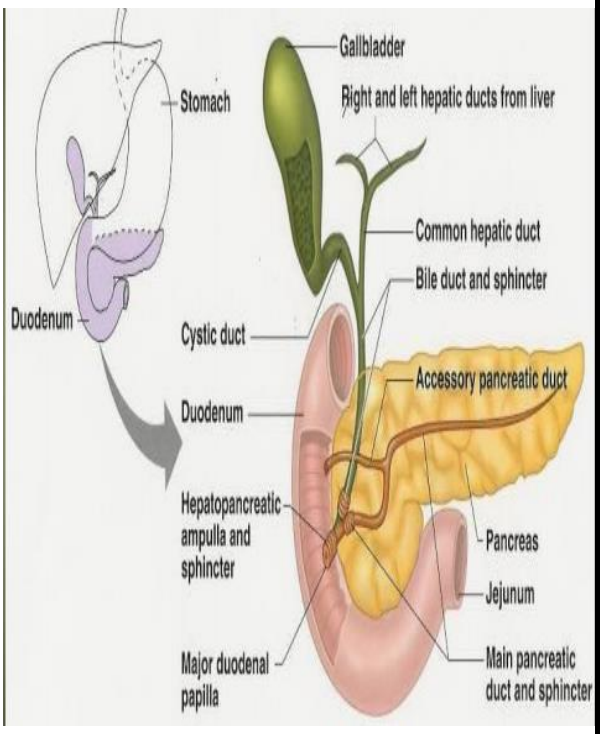
(right hepatic duct + left hepatic duct → Common hepatic duct + Cystic duct → Common bile duct)

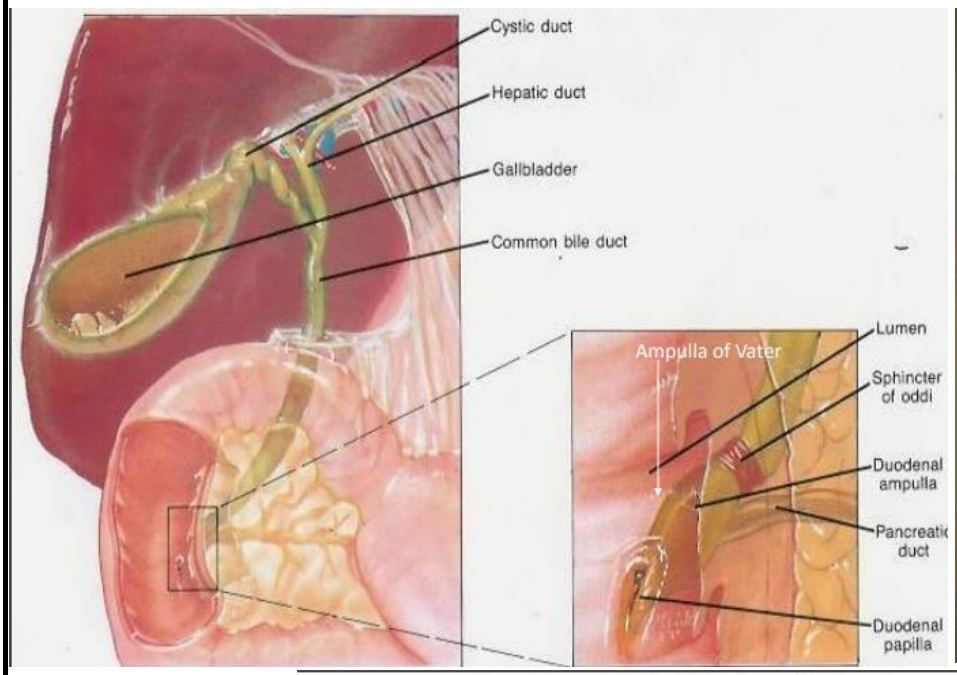
The common bile duct is 3 inch long, descends in the free edge of lesser omentum and is divided to 3 parts:

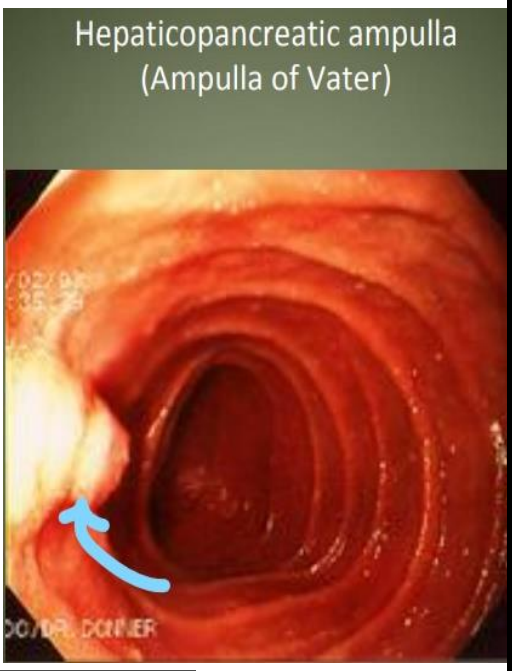
-supraduodenal

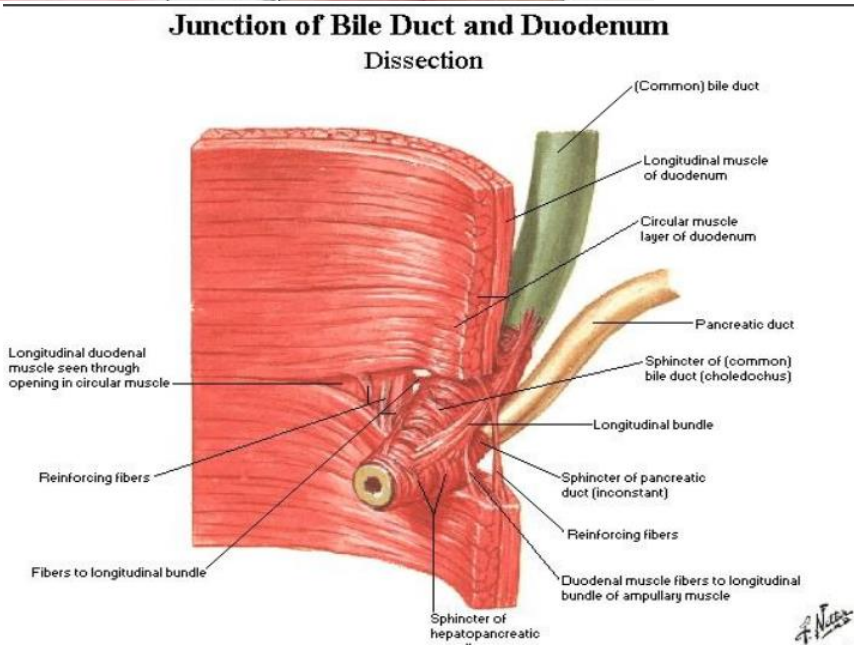
-retroduodenal

-retropancreatic









→ Blood supply of common bile duct

Small arteries supply the common bile duct

a. Arise from cystic artery

b. Posterior branch of superior pancreaticoduodenal artery

What is bile?

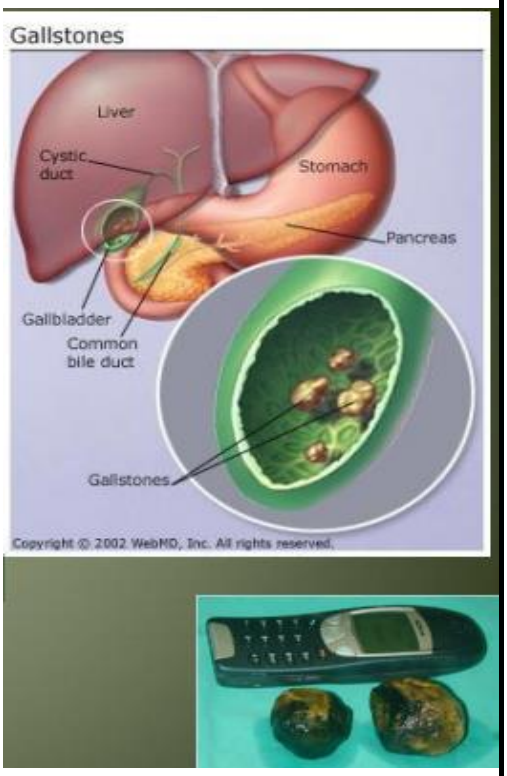
• Bile is composed of water, ions, bile acids, organic molecules (including cholesterol, phospholipids, bilirubin)

• Gallstones are mostly cholesterol

• Acids and salts emulsify fats for absorption across wall of small intestines into lacteal lymph capillaries

• Contains waste products from RBC breakdown and other metabolic processing (color of feces from bilirubin in bile)

• Ions buffer chyme from stomach



Cholelithiasis

• Gallbladder shows likely sites of stone formation/deposition

• Stones in common bile duct cause obstructive jaundice & pancreatitis

Gallbladder Diseases

1- Cholelithiasis (stones in GB) & Cholecystitis (inflammation of GB)

2- Obstructive jaundice: liver patterns

3- Gangrene of gall bladder rare (why is rare? Because the GB has 2 blood supplies)

4- Congenital defects