



# GI ANATOMY

# ??



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# Liver

- The liver is the largest gland in the body and has a wide variety of **Functions.**

- **Weight: 1/50 of body weight in adult & 1/20 of body weight in infant.** If you have a normal adult & his weight estimated to be 50 kg, you can estimate his normal liver mass by 1 kg. While if you have a normal infant with 20 kg weight, you can estimate his liver mass with 1 kg, also! Because in the infant the activity of the liver is higher. (50 kg vs. 20 kg), (1 kg vs. 1 kg).

- **It is exocrine(bile) & endocrine organ(Albumen , prothrombin & fibrinogen).** It's mixed gland. It's endocrine; where it's ductless. It's exocrine; where you find a duct.

Right hepatic duct + left hepatic duct= common hepatic duct.

Common hepatic duct + cystic duct= common bile duct.

**-Function of the liver:**

- **Secretion of bile & bile salt.**
- **Metabolism of carbohydrate, fat and protein.**
- **Formation of heparin & anticoagulant substances.**
- **Detoxication.**
- **Storage of glycogen and vitamins.**
- **Activation of vita. D.**

-the liver is the most important organ in the GI tract. Although, 1/8 of the liver is sufficient to act its function. The problem in this regard is the total spread of a disease in the liver structure.

-bile and bile salts are very important for digestion of fat, especially.

-the liver synthesizes heparin normally. It is an anti-coagulant substance. Heparin is the first pharmaceutical agent for a patient with a stroke. Also there is a synthesized coagulant substance; such a Fibrinogen. So, as well as the liver contributes to the coagulation processes.

- Detoxication: -why the doctor mentioned the morphine here? -Because its toxicity. The liver and the kidney are the places where the entities, such as drugs, may be detoxicated. When your patient has a tumor and you decide to get his pain away, then you determine the morphine as a drug. When your patient has a liver dysfunction, the morphine decision is wrong. Because its toxicity to the liver.

-How to describe the location of the liver? Primarily.

Its right lobe extends along the right hypochondriac region. Its left lobe located in the epigastric region, and extends to the left hypochondriac region.

\*Its general surface anatomy vs. its surfaces!

A) the liver has 5 surfaces:

• **Postero - inferior surface= visceral surface;** related to the visceral impression. Where

The liver directed toward the abdominal viscera.

• **Superior surface = Diaphragmatic surface**

• **Anterior surface**

• **Posterior surface**

• **Right surface**

B) its surface anatomy:

-it extends upwards... its upper border reaches the right fifth (5<sup>th</sup>) rib & the right fifth (5<sup>th</sup>) intercostal space.

-its right lobe pushes the diaphragm upwards; that's why the right cupola of the diaphragm (dome) is higher than the left cupola of the diaphragm.

-the diaphragm covers a part of the anterior surface, a part of the posterior surface, superior surface and the right surface. So the diaphragm is related to the all liver's surfaces except the visceral surface.

**-The greater part of the liver is situated under cover of the right costal margin.**

**- Diaphragm separates it from the pleura, lungs, pericardium, and heart.**

-its lower border reaches the right ninth (9<sup>th</sup>) rib. When you ask your patient to take a deep inspiration while your index can palpate the sharp edge of the inferior border of the liver below the right ninth (9<sup>th</sup>) rib. Especially, in the hepatomegaly patients, the inferior border is easily palpable.

**\*Ant. View of the liver & Relations of the liver anteriorly**

**A- Ant. View of the liver:**

• **Right lobe**

• **Cut edge of the falciform ligament:** \*it separates the right lobe from the left lobe.

\* it attracts the liver to the anterior abdominal wall & the diaphragm.

• **Left lobe**

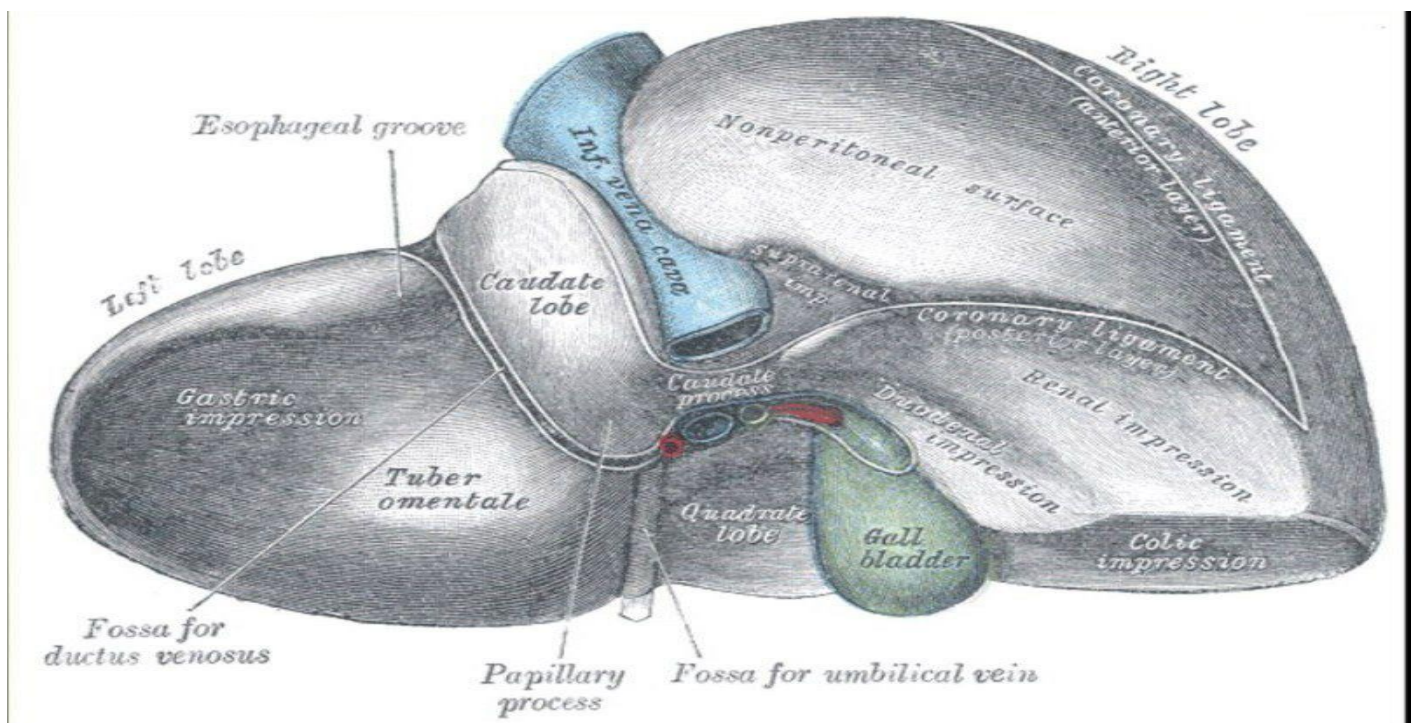
• **Diverging cut edges of the superior part of the coronary ligament**

• **Fundus of the gall bladder**

## B- Relations of the liver anteriorly:

- Diaphragm
- Rt & Lt pleura and lung
- Costal cartilage
- Xiphoid process
- Ant. abdominal wall

\* **Posterior relations of the liver:** is a small surface and it continues as a visceral surface of the liver. " THEY ARE A PART FROM EACH OTHER!"



- Diaphragm
- I.V.C
- Supra renal gland
- Rt. Kidney
- T.colon (**hepatic flexure**); includes the right hepatic flexure.
- Duodenum
- Gall bladder
- Esophagus
- Fundus of stomach

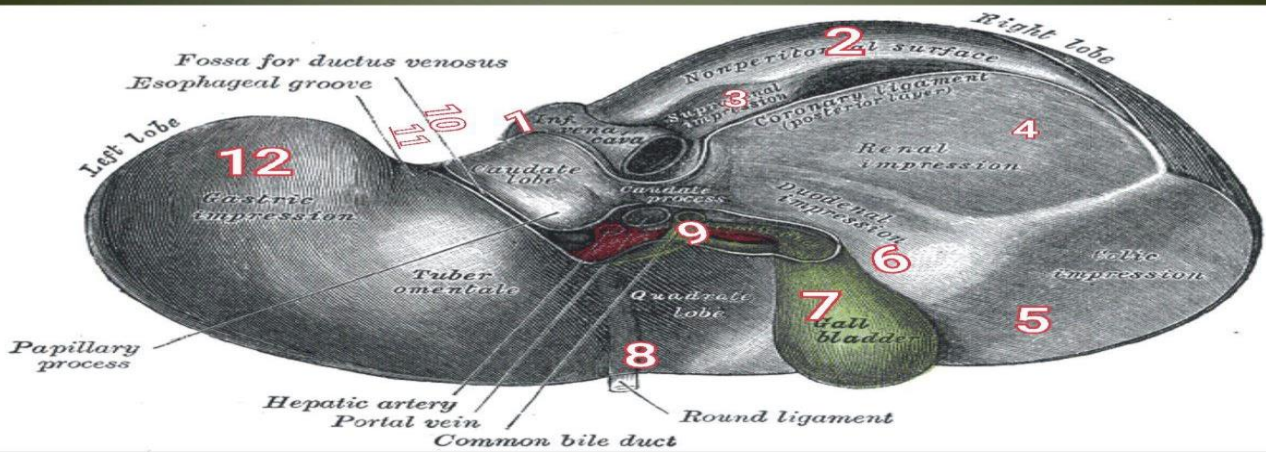
-tuber omentale: visceral omentum surrounds the porta hepatis.



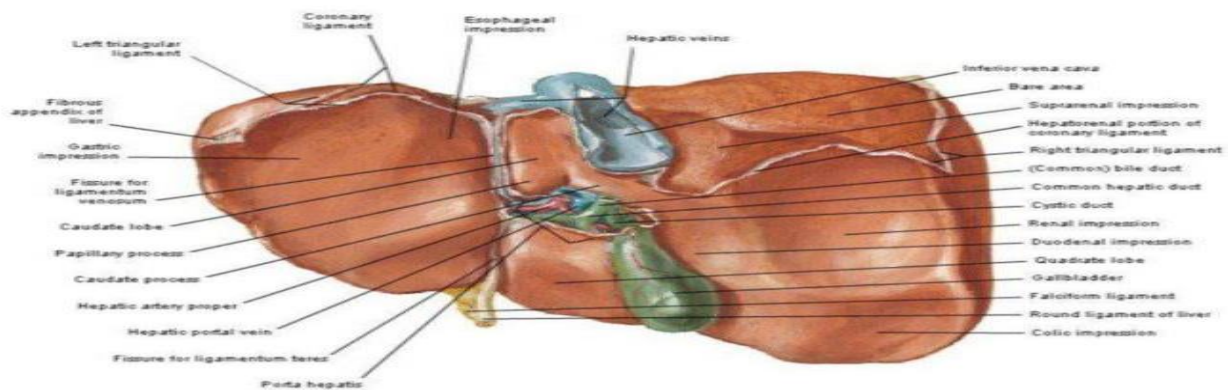


**\*Postero- inferior surface= visceral surface**

## Postero-inferior surface of the liver



### Surfaces and Bed of Liver Visceral Surface



**A- General view:** -it covered by the visceral peritoneum except the bare area.

-it's related to the visceral impression. Where the liver directed toward the abdominal viscera.

**B- relations:** (we connect the right impressions with the right relations & vice versa!)

**1• I.V.C**

**2•Bare area.**

**3• Rt. Suprarenal gland**

**4• The right kidney**

**5• The right colic flexure**

**6• The duodenum**

**7• The gallbladder.**

**8• Lig. Teres or the round ligament of**

**9• Porta hepatis (bile duct, H. A, Portal.V); centrally. Surrounded by the edge of the lesser Omentum.**

**10• Fissure for lig. Venosum & lesser omentum**

**11• The esophagus**

**12• The stomach**

**...• Tubular omentum:** embryonic structure, indicates to the formation of the lesser omentum.

## Sup. Surface of the liver & its relations:

A) Sup. Surface of the liver:

- Right & left lobes
- Cut edge of the Falciform ligament
- The cut edges of the superior and inferior parts of the coronary ligament
- The left triangular ligament
- The right triangular ligament
- Bare area of the liver (where there is no peritoneum covering the liver)

It is dull not shiny. Formed by the ant. & pos. lips of the coronary ligament and connects laterally to form left & right triangular ligaments.

- Groove for the inferior vena cava and the hepatic veins
- Caudate lobe of the liver more or less wrapping around the groove of the I.V.C
- Fundus of gall bladder
- Lig.teres

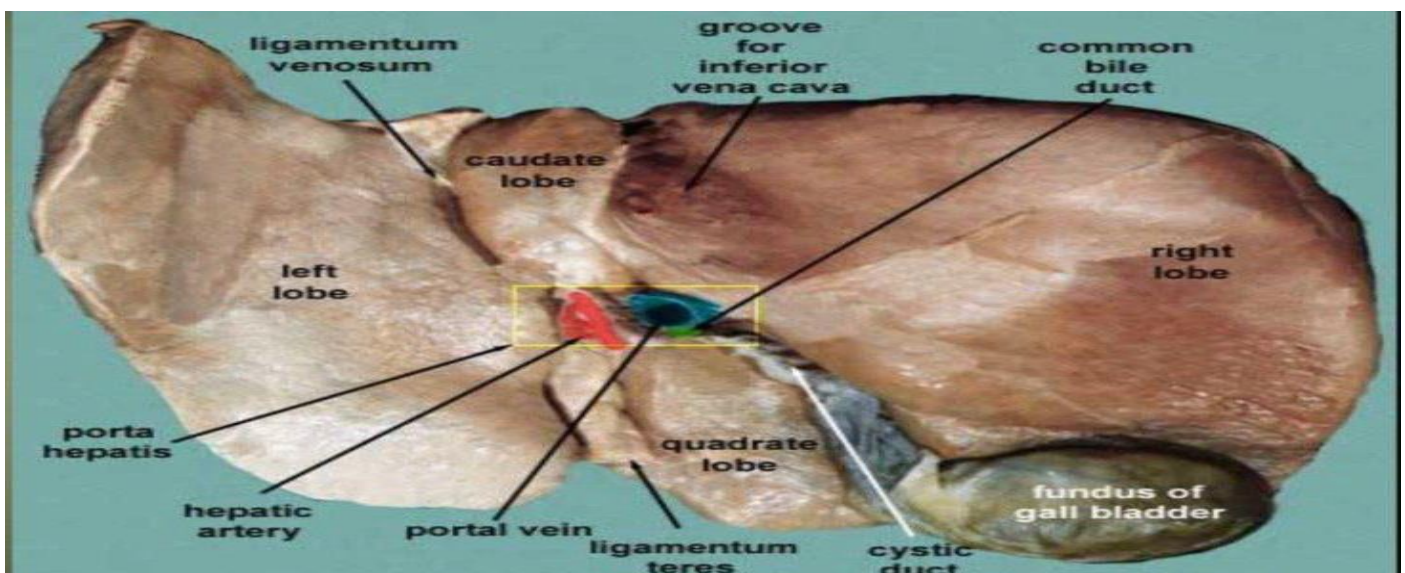
Regarding the last 2 points: "If you put the liver in the anatomical position the liver lies Superior to the gallbladder & the ligamentum teres"!

B) Relations of Sup. surface of liver:

- Diaphragm
- Pleura & lung
- Pericardium & heart

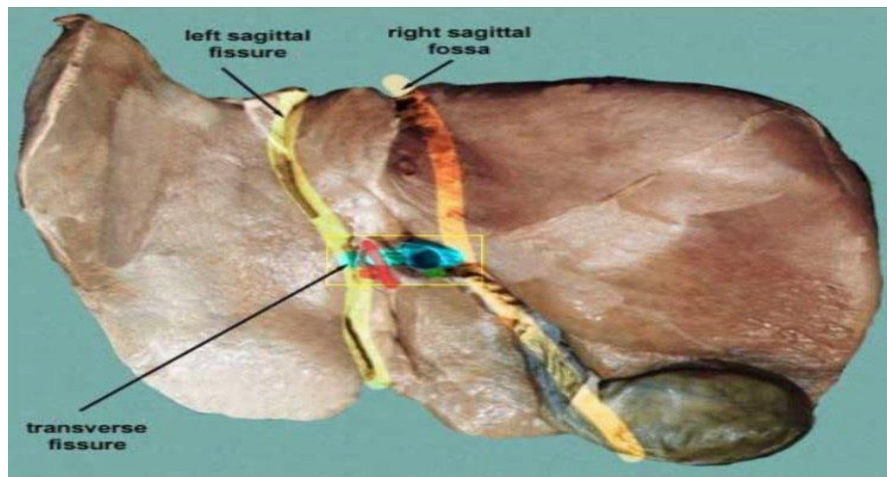
### \*Lobes of the liver:

- Rt. Lobe • Lt .lobe • Quadrate lobe • Caudate lobe



### \*Separation of the four lobes of the liver:

The separation between the the 4 lobes of the liver made by 2 vertical lines and 2 horizontal lines (H-shape). The right line made by the I.V.C. impression and the gallbladder is the inferior part of the line. The left line made by the ligamentum venosum and the round ligament of the liver (ligamentum Teres) is the inferior part of the line. The 2 horizontal lines made by the porta hepatis (above & below); so we recognize the the caudate & quadrate lobes.



- Right sagittal fossa -groove for inferior vena cava and gall bladder
- left sagittal fissure -contains the Ligamentum Venosum and round ligament of liver
- Transverse fissure (also porta hepatis) -bile ducts, portal vein, hepatic arteries

### **-Rt. Lobe**

- Largest lobe
- Occupies the right hypochondrium
- Divided into anterior and posterior sections by the right hepatic vein
- Reidel's Lobe extend as far caudally as the iliac crest; (RIGHT-inferior angle of the liver)

### **-Left Lobe**

- Varied in size
- Lies in the epigastric and left hypochondriac regions
- Divided into lateral and medial segments by the left hepatic vein

#### **-Lobes of the liver.....cont**

#### **Rt. & Lt lobe separated by**

- Falciform ligament
- Ligamentum Venosum: obliterated ductus venosum from the embryo
- Ligamentum teres: obliterated umbilical vein from the embryo

### **-Caudate Lobe**

- present in the posterior surface from the Rt. Lobe
- Two processes: located above the porta hepatis as the extensions of the caudate lobe.

1- caudate process

2- papillary process

#### **Relations of caudate lobe**

- Inf. to the porta hepatis
- The right to the fossa for the inferior vena cava
- The left to the fossa for the lig. venosum.

## **-Quadrate lobe**

Present on the inferior surface from the Rt. Lobe

Relations:

- Ant. anterior margin of the right lobe of the liver
- Sup. porta hepatis
- Rt. fossa for the gallbladder
- Lt. by the fossa for lig.teres

\*\*THE CAUDATE & QUADRATE LOBES:

-Anatomically: they follow the right lobe of the liver

-Physiologically/ functionally: they follow the left lobe of the liver.

\*\* The GALLBLADDER: anatomically & physiologically: related to the right lobe of the liver

## **\*Peritoneum of the liver**

- The liver is covered by peritoneum (interperitoneal organ) except at bare area (it is origin from septum transversum, which separates heart from the developing liver )
- Inferior surface covered with peritoneum of greater sac except porta hepatis, G.B & Lig.teres fissure
- Rt. Lateral surface covered by peritoneum, related to diaphragm which separate it from Rt. Pleura, lung and the Rt Ribs (6-11)

-the anterior surface of the liver usually covered by peritoneum. While other part of the gallbladder impressed in the liver. This impression has an advantage; while the cystic blood supply cut, the direct blood supply from the liver to the gallbladder occurs. That is why the gallbladder is not attacked by the gangrene

## **-The ligaments of the liver**

- 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

(6+7= lesser omentum)

- Falciform ligament of liver
  - Consists of double peritoneal layer
  - Sickle shape
  - 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 layer of the coronary ligament is the bare area of liver which contract with the diaphragm;

- Left and right triangular ligaments formed by left and right extremities of coronary ligament. "Extremity" === "lip".

- **The Ligamentum Venosum**

- Fibrous band that is the remains of the ductus venosus

- 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

In summary: In the embryo: umbilicus umbilical vein → liver ductus venosum (v.) → I.V.C.

In the adult: - umbilicus falciform ligament → liver.

- Ligamentum venosum above to I.V.C.

- \*Porta hepatis:**

- It is the hilum of the liver

- It is found on the postero-inferior surface

- lies between the caudate and quadrate lobes

- Lesser omentum attach to its margin Contents

- Gallbladder → ant.

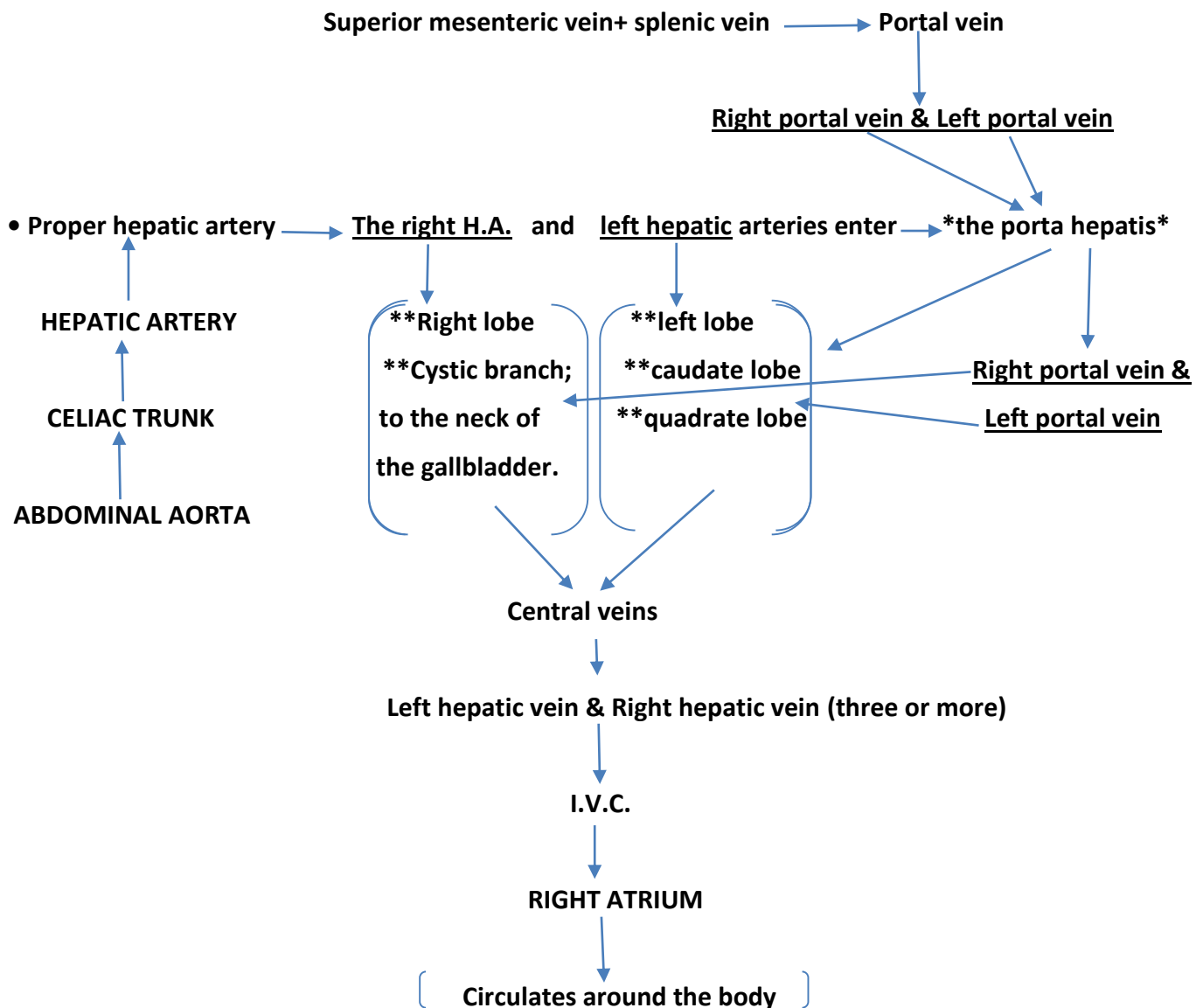
- Hepatic. Art + nerve+ lymphatic node → middle.

- Portal vein → post.

- its contents: portal vein, hepatic artery and common hepatic duct.

- it also contains nerves, lymphatic vessels & lymph nodes and fat.

## \*Blood supply of the liver... The blood movement through the liver:



### -Blood Circulation through the Liver

- The blood vessels conveying blood to the liver are the hepatic artery (20-25%) and portal vein (75-80%).
- The hepatic artery brings oxygenated blood to the liver, and the portal vein brings venous blood rich in the products of digestion (nutrients & absorptive materials), which have been absorbed from the gastrointestinal tract.
- The arterial and venous blood is conducted to the central vein of each liver lobule by the liver sinusoids, this point will be discussed in histology, specifically.
- The central veins drain into the right and left hepatic veins, and these leave the posterior surface of the liver and open directly into the inferior vena cava

### -Vein drainage of the liver

- **The portal vein** (WHICH CARRIES BLOOD FROM THE GI TRACT, GALLBLADDER, PANCREAS, SPLEEN; THAT IS WHY IT CALLED PORTAL) **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 leave the liver and enters several lymph nod. in porta hepatis → efferent vessels pass to celiac nodes
- A few vessels pass from the bare area of the liver through the diaphragm to the posterior Mediastinal lymph nodes.

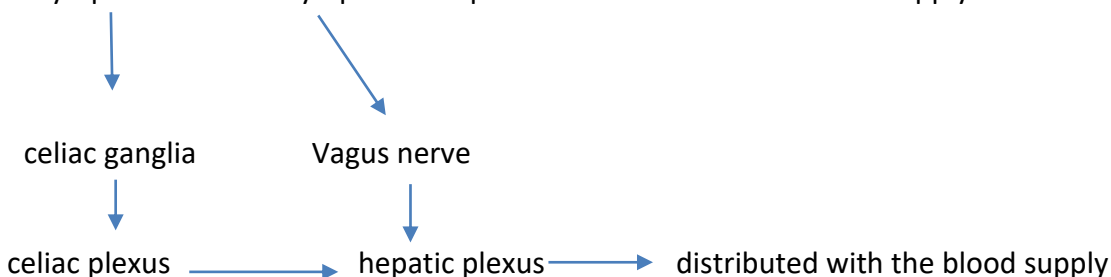
### -Nerve supply

- **Sympathetic** → **hepatic plexus** → **celiac plexuses** → **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

### In summary:

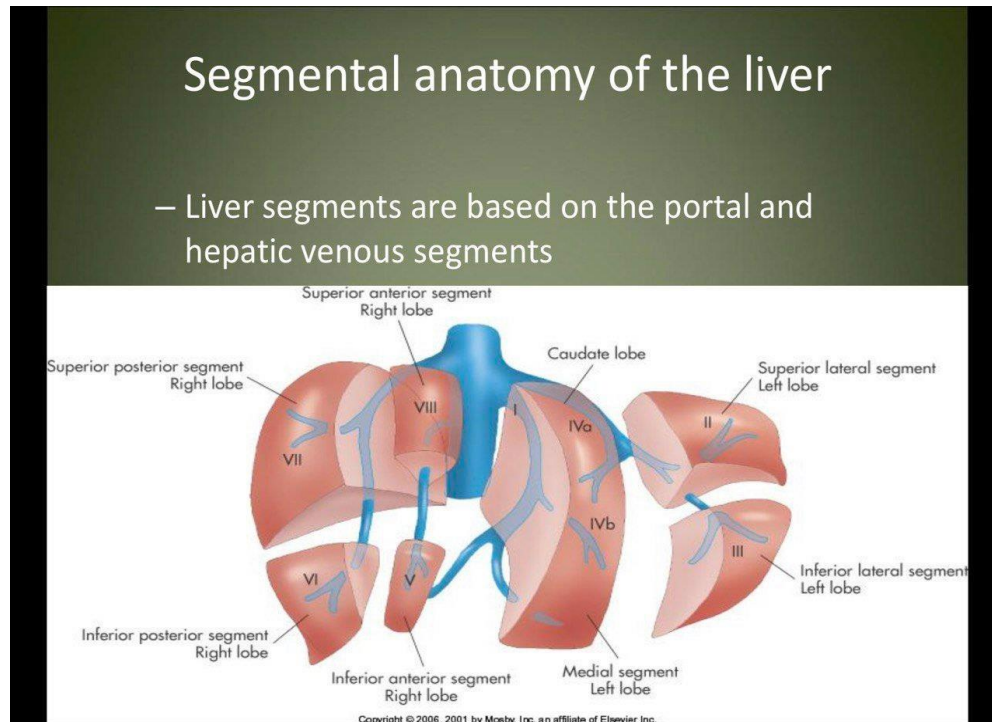
-Hepatic lymph nodes+ cystic lymph nodes = celiac lymph nodes → cisterna chyli → thoracic duct  
↓  
Left subclavian v.

- Sympathetic + Parasympathetic= plexuses distributed with blood supply of the celiac trunk



## -Liver transplantation:

- In the ancient form, it has depended on the segmentation of the liver for the 4 lobes.
- in the modern form, it depends on the segmentation of the liver for the 8 lobes.
- the most modern form depends on the hepatocytes' principle in a liver transplant.



-The toleration is necessarily the aim; so the transplantation depends on many tests.

## -Segmental anatomy of the liver:

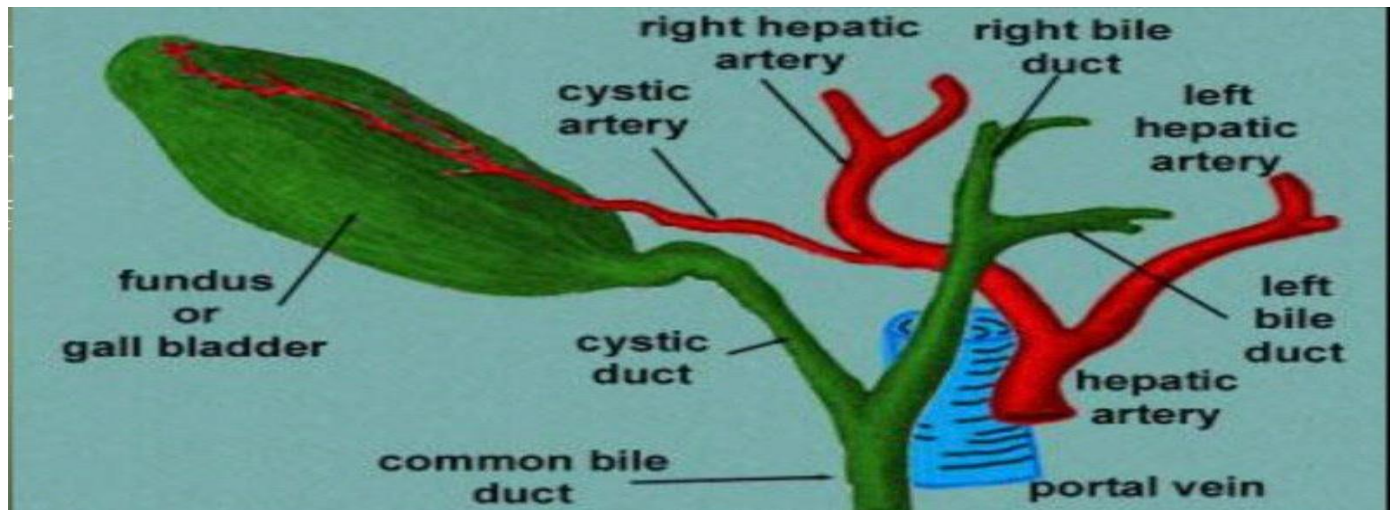
- Rt .& Lt. lobes anatomically no morphological significance. Separation by ligaments (Falciform, lig. Venosum & Lig.teres)
- True morphological and physiological division by a line extend from fossa of GD to fossa of I.V.C each has its own arterial blood supply, venous drainage and biliary drainage
- No anastomosis between divisions
- 3 major hepatic veins 2 Rt, Lt & central
- 8 segments based on hepatic and portal venous segments



When inflammation attacks the common bile duct or stones obstruct the passage of bile... you have to understand the anatomy of the Callot's triangle for a well-rounded understanding in –a cholecystectomy as an ancient procedure –ERCP as a modern medical intervention .

### **-Callot's triangle:**

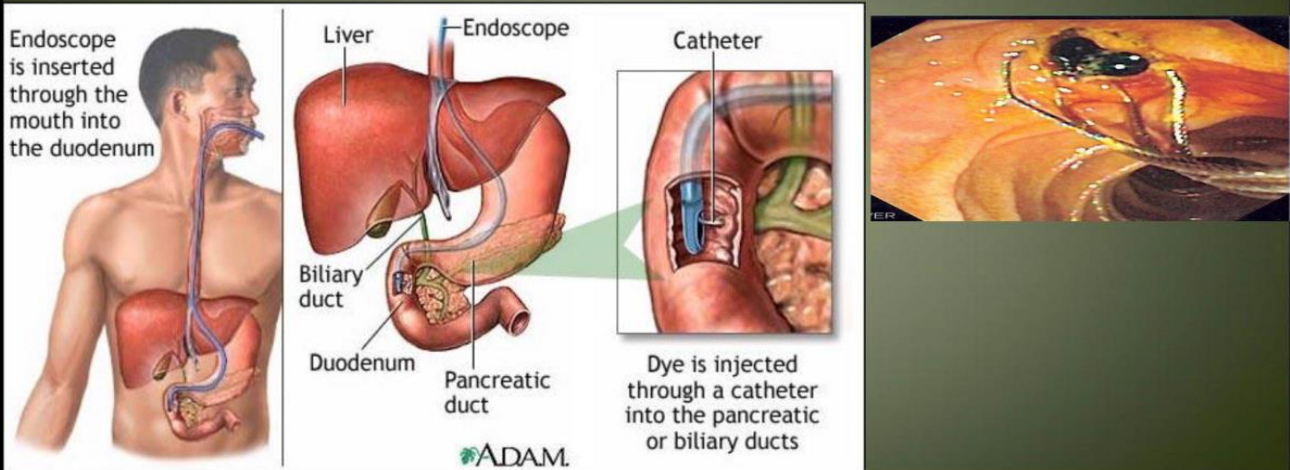
- Margins: cystic duct(right), common hepatic duct(left) and cystic vessels(superior).
  - Important surgically in cholecystectomy: cutting and ligation (to prevent bleeding) of blood vessels and the cystic duct ☑ now the gallbladder is free and can be removed
- ⇒ Need to take the location of the cystic vessels into consideration: in 80% of cases, the blood vessels are located posteriorly to the common hepatic duct but in 20% of the cases ☑ anteriorly to the duct (2020)



### **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. The catheter inserted retrogradely into the pancreatic or biliary ducts.
- 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.

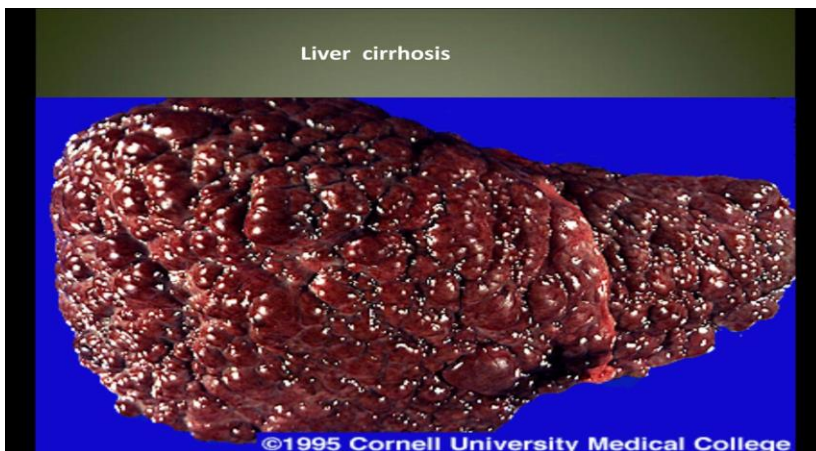
# ERCP



-From the 1<sup>st</sup> page: " -the liver is the most important organ in the GI tract. Although, 1/8 of the liver is sufficient to act its function. The problem in this regard is the total spread of a disease in the liver structure."

-as you see in the picture, the liver cirrhosis is not restricted to a specific area in the liver. rather it spread all over the liver. The most common cause of liver cirrhosis is alcohol abuse.

- in Egypt this equation is common → bilharzia= liver fibrosis+ hepato-spleno-  
-megaly.



Alhamdulillah

الْحَمْدُ لِلَّهِ

-The correction:

In summary.. p.11

The thoracic duct drains into the left subclavian vein. This is the right!.

A short animated video:

Watch "Normal Lymphatic Anatomy and Flow" on YouTube: <https://youtu.be/aHXHyAzwOOc>

**-LAB 4: "The thoracic duct ascends upwards at the left side and ends at the junction of left subclavian and left internal jugular veins (beginning of the left brachiocephalic vein)."**