



Anatomy

● Sheet

○ Slide

number

9

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-Please refer to the slides for pictures only .

The liver:

-The liver is the largest gland in the body, It weighs 1/50 of the body weight in adults & 1/20 of the body weight in infants **that insures that the function of the liver is more than that in infant.**

- The liver is considered as **endocrine and exocrine** gland (mixed gland) :

*Endocrine gland; as it secretes hormones such as" albumin ,globulin, fibrinogen and prothrombin"

*Exocrine : secretes "bile and bile salts" which play a role in fat digestion.

-Location :

The liver lies in the right hypochondriac region and extend to the epigastric and it may reach the left hypochondriac region

NOTE: The liver receives portal vein and hepatic artery-

-The hepatic artery carries oxygenated blood to the hepatocytes.

-the portal vein carries nutritive materials “absorptive” to the liver.

- The blood supply to the liver is through portal vein and hepatic artery , while venous drainage is through hepatic vein which ends in the inferior vena cava .

functions of the liver:

- 1- Secretion of bile & bile salt.
- 2- Metabolism of carbohydrate, fat and protein.
- 3- Formation of heparin (**anticoagulant substance**).
- 4-Detoxification.
- 5- Storage of glycogen and vitamins.
- 6-Activation of vitamin D.
- 7-The secretion of bile and bile salts is through the common bile duct that reach the second part of duodenum to continue the digestion of fats.
- 8- The metabolism of carbs , proteins ,fats.

9-secretion of **coagulation** factors.

10-torage of glycogen and vitamins “ vitamin D.

-the surface anatomy of the liver:

We have five surfaces of the liver

-anterior

-posterior

-Right

-superior

--**The visceral surface** is the inferior surface which also called postero-inferior surface and is the **surface of impressions** because many organs lies on it .

NOTE: right copula of the diaphragm covers all the liver's surfaces except the visceral surface.

- Diaphragm separates liver from the

1-Right lung and pleura

2- pericardium and heart

Two borders

Upper: it reaches the fifth rib ,so the liver pushes the right copula of the diaphragm upward till it reaches again the fifth intercostal space.

Lower: We have also inferior “ sharp border “ which reaches the right ninth costal cartilage .You can palpate the inferior border by telling your patient to take a deep inspiration ,so the liver descends downward and by your index you can palpate it.

Clinical point : when we take a biopsy from the patient we insert the needle at the level of right 9th intercostal space to avoid injuring the lung since its lower boarder ends at 8th costal cartilage. So, The layers which can be penetrated are peritoneum>pleura>diaphragm then to the liver . (don't take it from above because you will damage the lung .

- Two lobes:-

-The liver **anatomically** has a right lobe and a left lobe but **physiologically** it has FOUR lobes :

-A left lobe

- A right lobe

- A caudate lobe

-A quadrate lobe

the liver has right and left lobe,Between them the falciform ligament is found(which is two layers of peritoneum attached the anterior abdominal wall and the diaphragm upward),and at the end of that ligament there is ligamentum teres.

NOTE :ligamentum teres is an obliterated umbilical vein in embryo.

1- Right lobe:-

-Largest lobe

-Occupies the right hypochondrium

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

-NOTE:- Reidel's Lobe is the extension of right lobe into the iliac crest (rare condition)

2- Left lobe :-

-Varied in size

– Lies in the epigastric and left hypochondriac regions

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

-Why we have these four lobes physiologically?

Because, the caudate and quadrate follow the right lobe anatomically, But **physiologically they follow the left lobe.**

HOW?

1-The hepatic artery that comes from celiac trunk gives right and left branches in the " porta hepatis".The left one goes to the left lobe and to the caudate and quadrate ,while the right one goes to the right lobe of the liver.

2-the lymphatic drainage through hepatic veins which are three:

One from the right lobe, One from the left lobe and a central one from the caudate and quadrate lobes

3-For bile secretion :-Left lobe,along with the caudate and quadrate lobes, gives the left hepatic duct While The right lobe gives right hepatic duct

***Relation of the liver:-**

1-The Organs that make impressions on it are:(postero-inferior relation)

- 1) I.V.C
- 2)the esophagus
- 3)the stomach
- 4)the duodenum
- 5)the right colic flexure(transverse colon)
- 6)the right kidney
- 7)Right Suprarenal gland

8)the gallbladder

9)Tubular omentum.

10)Ligamentum teres.

11)Fissure for ligamentum venosum(ductus venosum in embryo) and lesser omentum.

12) porta hepatis.

NOTE: as we said before the gallbladder may be covered completely by peritoneum and sometimes imbedded in the liver where it takes its whole blood supply from the liver.

2- Superior relation :-

- Diaphragm
- Pleura & lung
- Pericardium & heart

3-Anterior relation:-

- **Diaphragm**
- **Right & Left pleura and lung**
 - Righr ninth Costal cartilage**(Gallbladder is also related to the right 9th costal cartilage).
- **Xiphoid process**
- **Anterior abdominal wall**

4- posterior relation :-

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

-As mentioned before the diaphragm covers all the liver's surfaces except the

visceral surface (dome- like structure around the liver).

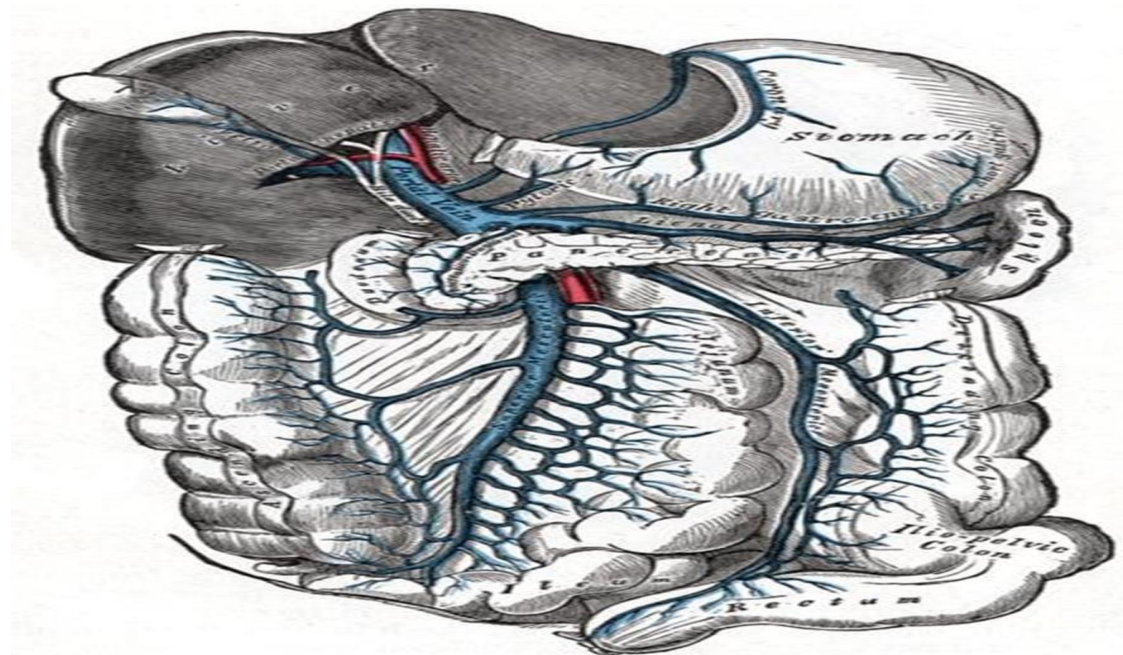
-the superior surface of the liver:

- It contains groove for inferior vena cava.

-Coronary ligaments that have two lips between them we have the **bare area** of the liver, So the liver it's completely covered by peritoneum except for this bare area.

-The coronary ligaments at the end forms the triangular ligaments ,so we have right and left triangular ligaments.

Porta hepatis:



-It is the hilum of the liver.

-It is found on the postero-inferior surface - lies between the caudate and - quadrate lobes with the **Lesser omentum attached to its margin.**

- **It is not covered by peritoneum. So both bare area and porta hepatis are not covered with peritoneum.**

Contents:

1) Common bile duct (anteriorly).

- Cystic duct of gallbladder and hepatic duct of the liver join together in the porta hepatis to form common bile duct.

2) Hepatic artery, Nerves, lymph vessels and lymph nodes.(middle in position).

3) Portal vein divides into left and right(posteriorly).

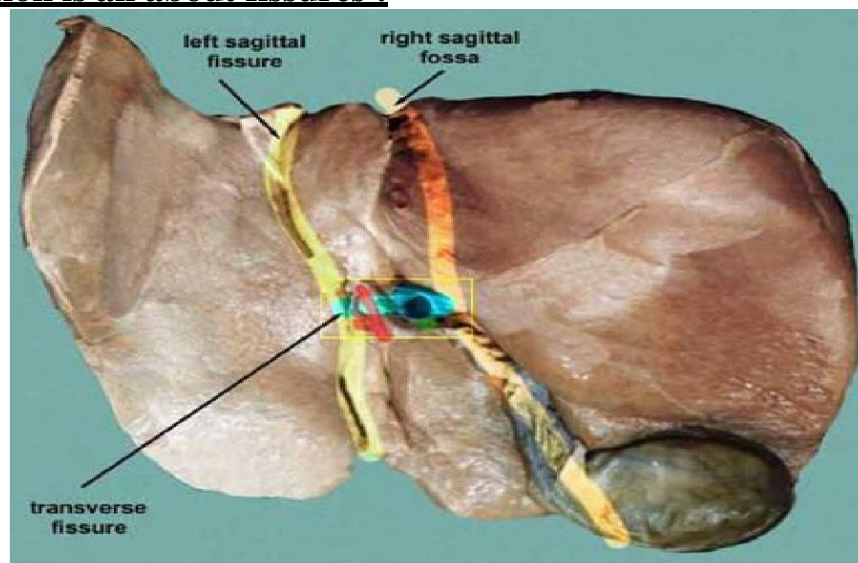
VERY IMPORTANT NOTES:-

1- These contents found in the free edge of the lesser omentum, then they directed towards the porta hepatis.

2- Common bile duct leaves the liver through porta hepatis, while hepatic artery and portal vein go through porta hepatis into the liver.

Separation of the four lobes of the liver:

The separation is all about fissures :



1-We have fissure for inferior vena cava

2-Fissure for gallbladder and cystic duct

3-Fissure for(ligamentum venosum) it is a ductus venosum in the embryo and then it obliterated and converted to ligamentum venosum and it continues to reach the edge of quadrate lobe.

****Relation of caudate and quadrate lobes in addition to important notes:**

***Caudate lobe:-**

Inferior: the porta hepatis / **left:** the fossa for the ligmentum venosum/ **right:** the fossa for the inferior vena cava.

-location:- present in the posterior surface from the Rt. Lobe, between I.V.C and lig.venosum

*** Quadrate lobe :-**

- Anterior :anterior margin of the liver / Superior: porta hepatis / Right :fossa for the gallbladder / Left: by the fossa for lig.teres.

-location:- Present on the inferior surface from the Rt. Lobe , close to the gallbladder, between cystic duct and ligamentum teres.

Note:the caudate and quadrate follow the left lobe physiologically "functionally",they are supplied by the left branch of hepatic artery and they give bile to the bile duct which gives left hepatic duct.

Note :the lesser omentum is two layers of peritoneum extending from the lesser curvature of the stomach to the porta hepatis and from fissure of ligamentum venosum till the diaphragm.

-Peritoneum of the liver :-

NOTE:- we talked about this topic in the peritoneum lecture .

1-The liver is covered by peritoneum (intraperitoneal

organ)except at :-

a- porta hepatis

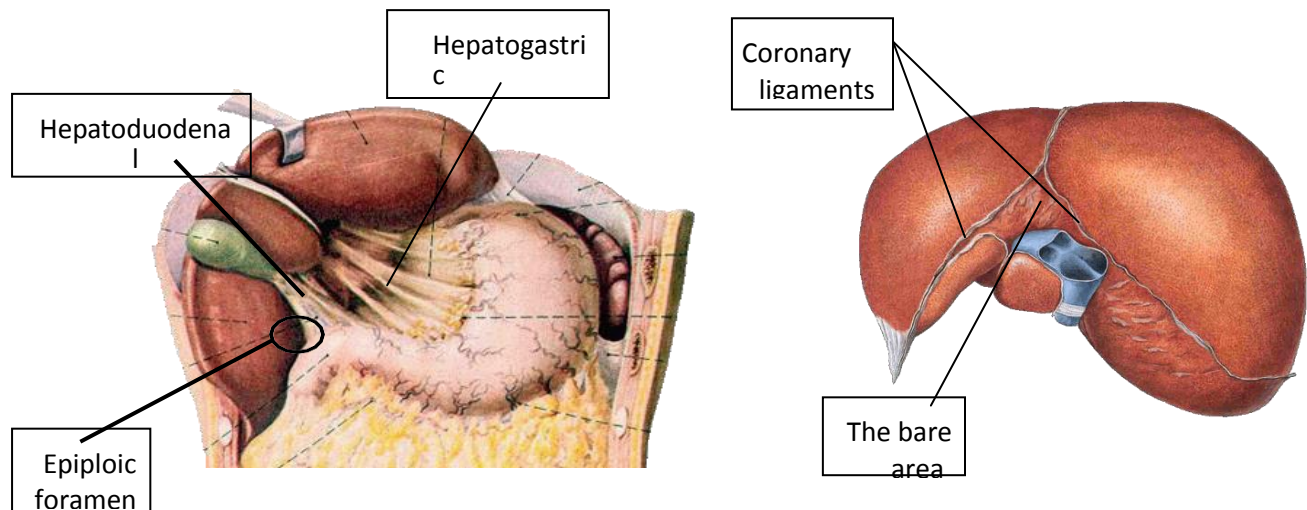
b- bare area of the liver

2- Inferior surface covered with peritoneum of greater sac except porta hepatis, Gallbladder & Lig.teres fissure

4-Rightt. Lateral surface covered by peritoneum, related to diaphragm which separate it from Rt. Pleura , lung and the Rt Ribs (6-11).

-Porta hepatis, bare area , gallbladder and ligamentum teres fissure are not covered by peritoneum .

ligaments of liver:-



1-Falciform ligament:

- Sickle-shaped
- Two layers of peritoneum
- Attached to the anterior abdominal wall , the liver and the diaphragm and separates the left and right lobes of the liver.

2-Ligamentum

teres:

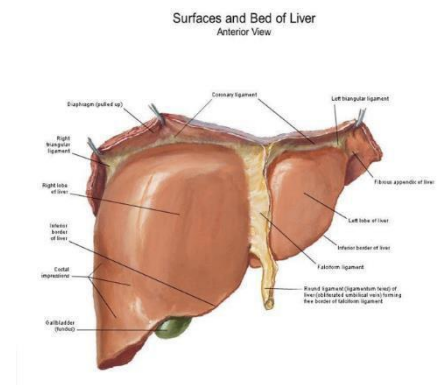
- Obliterated umbilical vein. (in embryo it connects the umbilicus with the left portal vein).

3-Coronary ligament : -the area between upper and lower layers of the coronary ligament is the **bare area** of liver which contracts with the diaphragm.

- At each Side of it to the right and left it makes **right and left triangular ligament.**

4--Left and right triangular ligaments:

- formed by left and right extremity of coronary ligament/



5-Ligamentum venosum (ductus venosum):

- Fibrous band that is the obliteration of ductus venosum, which connects the inf. Vena cava with portal vein in embryo.

- 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 inf. Vena cava.(between left branch of portal vein and inf.vena cava)
- Found between left lobe and caudate lobe.

- 6- Hepatogastric ligament

7- Hepatoduodenal ligament

NOTE: Hepatogastric and hepatoduodenal are coming from the lesser omentum.

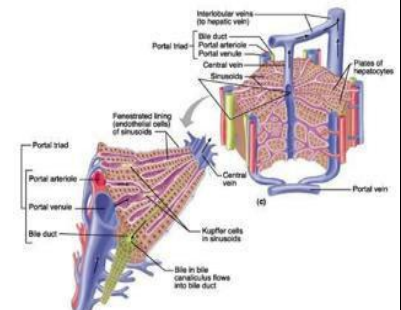
Histology of the liver:

-It is hexagonal lobules and in the center we have central vein and the hepatocytes lying radially to the central vein and between the hepatocytes there are blood **sinusoids** containing mixed blood from hepatic artery and from the portal vein.

-**Portal triad** lies in the edges of the hexagonal lobule contain a branch of the portal vein and branches from the hepatic artery and bile duct.

-The capsule that covers the liver "**Glisson's capsule**" converts the liver into hexagonal lobule(The Liver is surrounded by a thin capsule at porta hepatis that sends septa into liver ,subdividing the parenchyma into lobules) .

-All the central veins at the end drain in three hepatic veins,which end in the inferior vena cava.



Segmental anatomy of the liver:

-The liver divided into eight segments with each segment having its own blood supply , venous drainage & lymphatic drainage and these segments are important in **liver transplantation**.

-No anastomosis between these divisions.

-the right and left anatomical lobes are separated by :the

falciform ligament, ligamentum teres and ligamentum venosum with no morphological significance.

-Liver segments are based on the portal and hepatic venous segments

-Blood supply of the liver:- 1- hepatic artery 2- portal vein

Blood Circulation through the Liver:

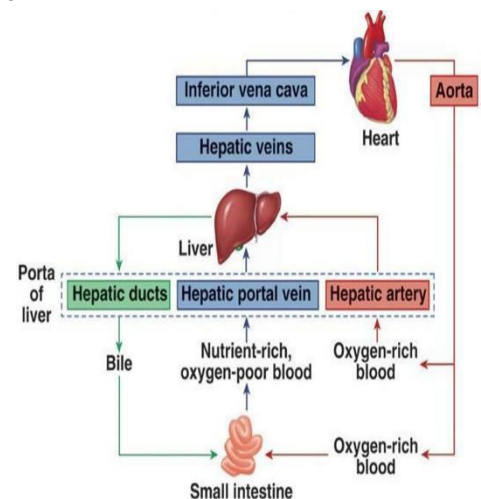
The blood vessels conveying blood to the liver are the **hepatic artery (30%)** and **portal vein (70%)**

The Hepatic artery gives oxygenated blood to the hepatocytes and, there's also the portal vein which carries the absorptive materials, Arterial 20-25% and the rest comes through portal vein 70-75%.

-The right hepatic artery usually gives off the cystic artery, which runs to the neck of the gallbladder

-Proper hepatic artery gives the right and left hepatic arteries that enter the porta hepatis.

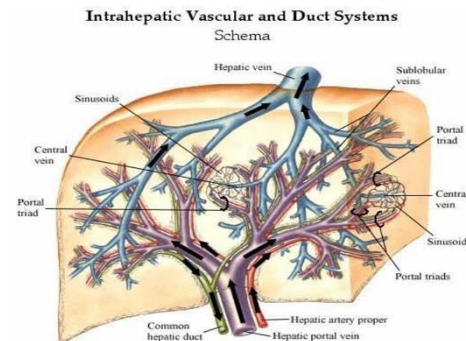
-Formation of bile and bile salts by hepatic duct that meet the cystic duct to form the common bile duct which opens in the second part of the duodenum.



Veinous drainage of the liver:- hepatic vein which drains to I,V,C.

-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.



-portosystemic anastomosis:- is a specific type of anastomosis that occurs between the **veins of portal circulation** and those of **systemic circulation**.

- So when a damage occurs in the liver due to liver cirrhosis or any other disease an obstruction in the portal vein happens , as a result of that the blood can't move to the liver ,instead it moves in backward direction to the areas where the anastomosis found .After that the blood shunts it's movement to the systemic circulation.

- Sometimes the anastomosis become **congested** and form venous dilatations. Such dilatation can lead to 3 **clinical condition:-**

1-esophageal varices.

2-rectal varices

3- caput medusa (in the Paraumbilical region).

- What is the portal and systemic circulations for these 3 regions ?

1- Esophagus : the portal circulation is through Esophageal branch of left gastric vein , while systemic circulation through Esophageal branches of Azygos vein.

2- Rectal: portal circulation >>Superior rectal vein , while systemic circulation >>Middle rectal veins and inferior rectal veins.

3-Paraumbilical : portal circulation >>Paraumbilical veins , while systemic circulation >>Superficial epigastric vein

NOTE:- Portal systemic anastomosis topic will be covered next lecture in details.

Lymphatic drainage of the liver:

Liver produces large amount of lymph~ one third – one half of total body lymph.

Lymph leaves the liver and enters several lymph nodes in porta hepatis, then 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 .

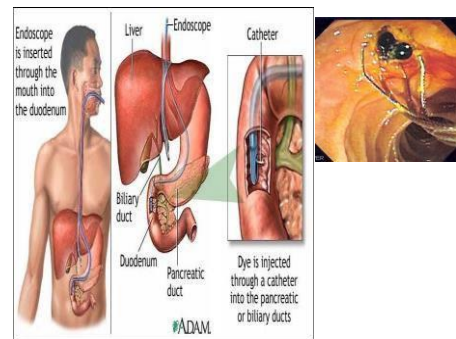
Endoscopic Retrograde Cholangiopancreatography

ERCP(:

You insert the endoscope into the oral cavity until we reach second part of duodenum on the sphincter of oddi and we cut the sphincter to enter retrograde into bile duct or into pancreatic duct.

-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-ray.

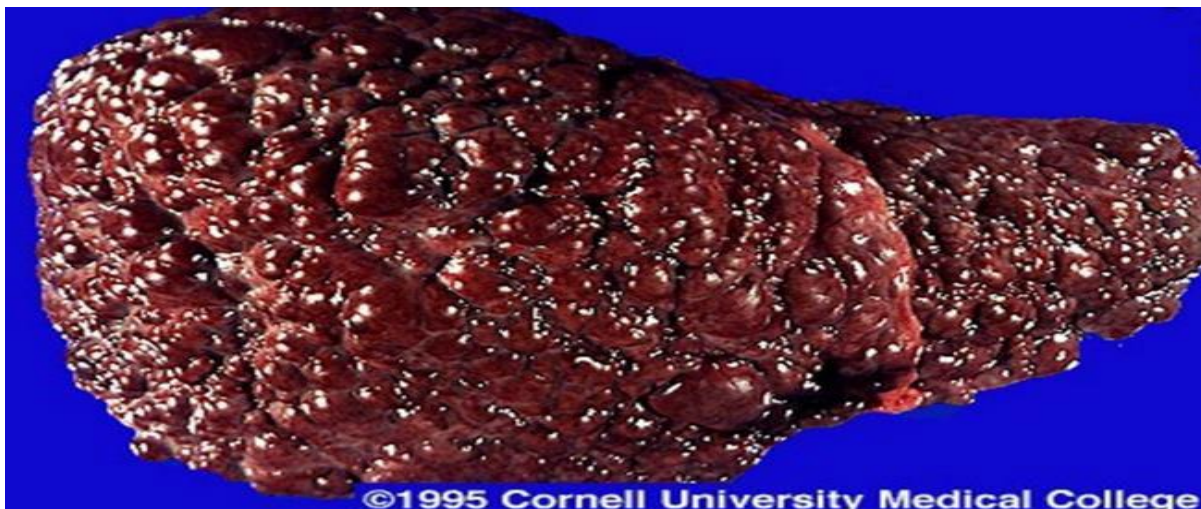
ERCP is used primarily to diagnose and treat conditions of the bile ducts, including gallstones, inflammatory strictures (scars), leaks (from trauma and surgery), and cancer.



Liver cirrhosis

-The most important reason is alcoholism.

The problem with the liver that the disease spreads very rapidly before being discovered.



➤ The Gallbladder

- The gallbladder has a body, a fundus (a rounded end), a neck, Hartmann's pouch before the neck and a cystic duct that meets the common hepatic duct to form the common bile duct.
- Hartmann's pouch is a pouch which can be obstructed by single stone due to some pathological condition.

The gallbladder is capable of concentrating the bile up to 40-60 times but the concentration is about 20 times by absorption of water.

- Lies in the epigastric and right hypochondriac regions.

The sphincter of oddi is a thickening of smooth muscles.

Its mechanism of function: The sphincter of oddi is always closed, so that all secretions of the liver return back to the gallbladder where they get concentrated by absorption of water.

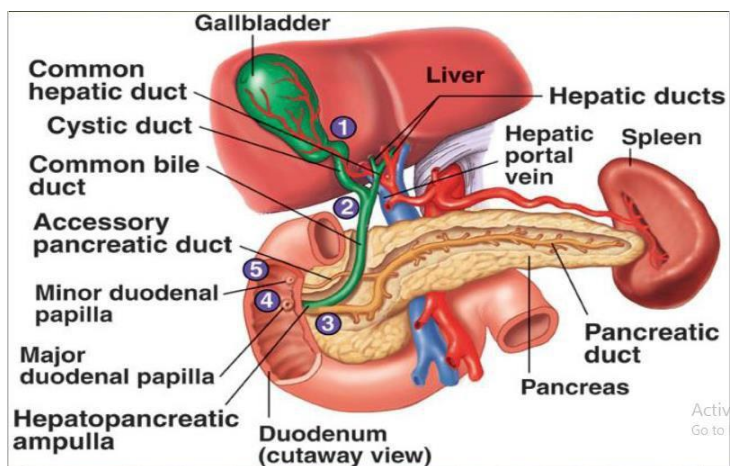
The gallbladder is the storage site for bile, the bile gets concentrated inside the gallbladder. So instead of secreting 20 L of diluted bile through the hepatic duct after a fat-rich meal, the gallbladder secretes 1-2 mL of concentrated bile.

This sphincter relaxes when it receives stimulation, whether this stimulation is neural (parasympathetic) or hormonal, and then the wall of the gallbladder contracts releasing the concentrated bile.

Relations of the gallbladder

Anteriorly:

The anterior abdominal wall and the inferior surface of the liver (It's embedded in the right lobe of the liver and adherent to the quadrate lobe of the liver).



Posteriorly:

The transverse colon and the 1st and 2nd part of the duodenum.

Cholecystectomy

Cholecystectomy means the surgical removal of the gallbladder and it's done by doing two ligations and cutting the cystic artery and doing the same thing to the vein and the cystic duct then removing the gallbladder, the patient will then be completely dependent on the diluted bile secreted directly by the liver into the duodenum. So when this patient eats a meal, even if it has a minimal amount of fat he/she will suffer from many complications such as diarrhea.

Acute Cholecystitis

It's the inflammation of the gallbladder.

This acute inflammation might become chronic and raises the risk of forming a stone in the gallbladder (due to the stasis and concentration of the secretions), a stone in the gallbladder is called Cholelithiasis.

Hartman's pouch is a pouch that precedes the neck and its common site for single-stone formation.

Any stone that forms in the gallbladder must be surgically removed (cholecystectomy) because this stone may be a cause of cancer.

Histology of the gallbladder

We notice:

- Type of epithelium: simple columnar without goblet cells
- Folding mucosa forming Honey-comb appearance



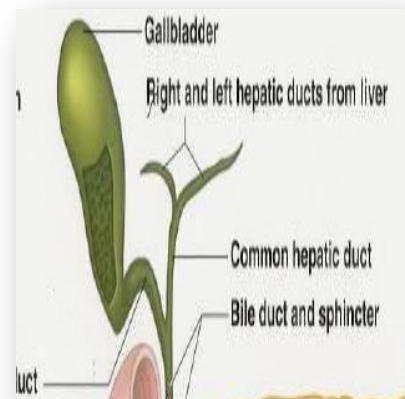
Cystic duct

The cystic duct is 4 cm long and connects the neck of the gallbladder to the common hepatic duct to form the common bile duct (it's ligated in cholecystectomy as previously mentioned).

The common bile duct

It's 10 cm long and it's divided into 3 parts :

- 1) Supraduodenal part: Above the duodenum.
- 2) Retroduodenal part: behind the 1st part of



duodenum.

3) Retropancreatic part: behind and through the head of pancreas.

The common bile duct opens into the 2nd part of the duodenum .It has an important relation to the 1st part of the duodenum as it passes posterior to it along with the portal vein and the gastroduodenal artery.

Arterial supply of the gallbladder

The cystic artery, a branch of the right hepatic artery, supplies the gallbladder

Venous drainage

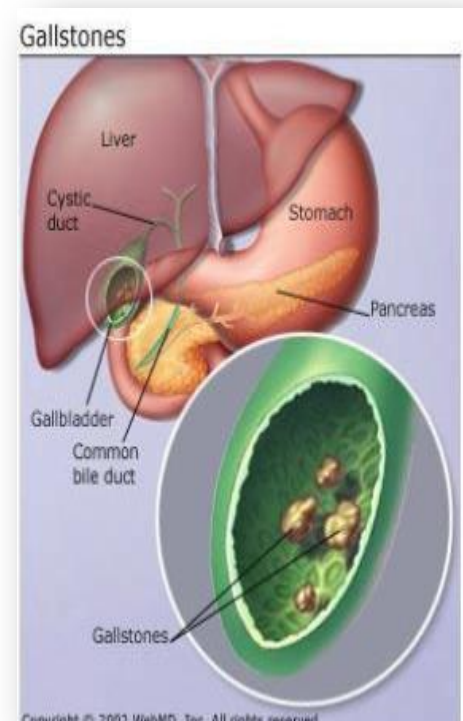
Opposite to the arterial supply, the cystic vein directly drains into the right branch portal vein.

Lymphatic drainage

Drainage Into the celiac lymph nodes.

Nerve supply

- Parasympathetic by the vagus nerve
- Sympathetic by the splanchnic nerve
- hormonal by CCK (cholecystokinin) that induces contraction of the wall of the gallbladder.



The bile:

Bile composed of water, ions, bile acids, organic molecules (including cholesterol, phospholipids, and bilirubin) and it may lead to stone formation (cholecystitis) and stones have many types depending on the type of material.

Note: Gangrene doesn't happen to the gallbladder as it receives its blood supply directly from the liver while Gangrene might happen to the appendix.

_ PLEASE refer to the slides for pictures only

THE ENG

و إذا كانت النفوس كباراً -- تعبت في مُرادِها الأجسامُ

المتنبي

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