



THE



SYSTEM

Anatomy

Sheet

Slide

Handout

Number: **7**

Subject: **Liver, Gallbladder, pancreas & spl**

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Price:

Hello, We did our best to make this sheet as understandable as possible using multiple sources(slides,book and record).As you all saw, the lecture a heavy-duty . Please refer to the slides to see the figures clearly and forgive us for any mistakes.Good luck.

The liver:

-The liver is the largest gland in the body,it weighs 1/5 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:

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

*Exocrine : secretes "bile and bile salts"

-Location :

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

functions of the liver:

1- Secretion of bile & bile salt.

2- Metabolism of carbohydrate, fat and protein.

3- Formation of heparin & anticoagulant substances.

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 heparin “anticoagulant factor” and coagulation factors*

10-storage of glycogen and vitamins “ vitamin D.

-the surface anatomy of the liver:

We have five surfaces of the liver

-anterior

-posterior

-Right

-visceral

-superior

Superiorly:” diaphragm”, right pleura and lung , centrally above the upper border of the liver we have the pericardium of the heart.

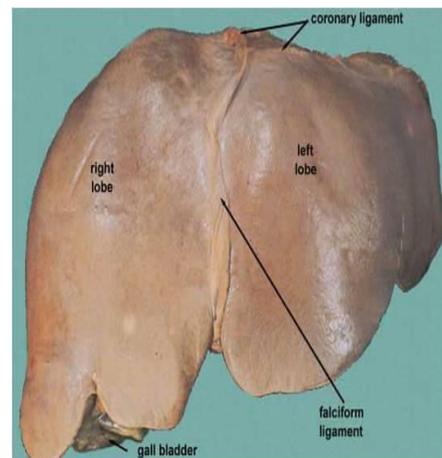
Other borders it reach the fifth intercostal space ,so the liver pushes the right copula of the diaphragm upward till it reaches again the fifth intercostal space.

We have also inferior “ sharp border “ , 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.

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

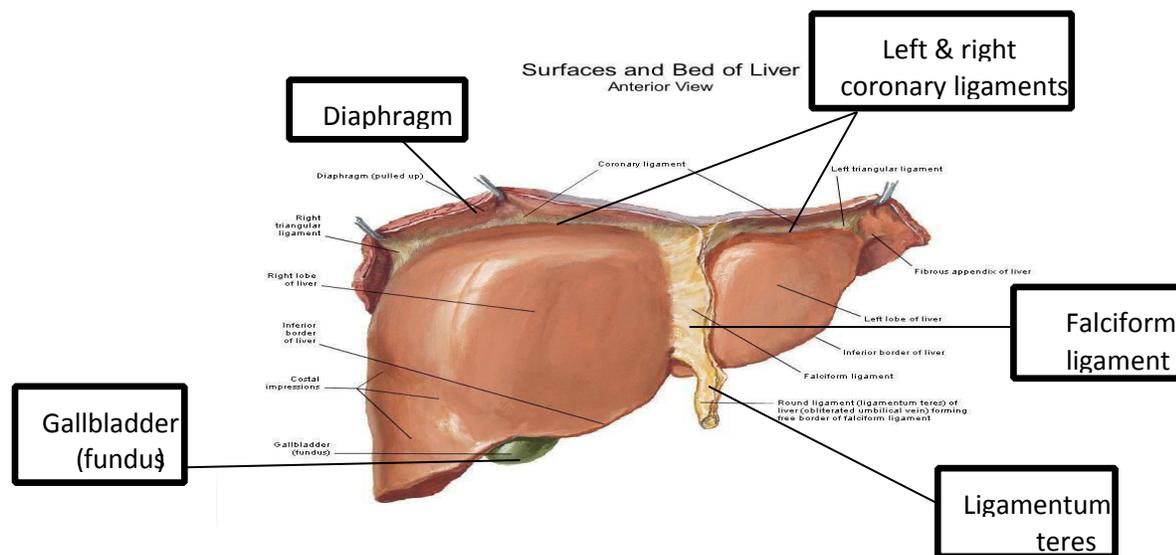
NOTE :ligamentum teres is an obliterated umbilical vein in embryo.

-The visceral surface is the inferior posterior surface and is the surface of impressions of the



viscera, and is directed to the abdominal cavity.

-The Organs that make impressions on it are:



- 1) I.V.C
- 2) the esophagus
- 3) the stomach
- 4) the duodenum
- 5) the right colic flexure
- 6) the right kidney
- 7) Rt. Suprarenal gland
- 8) the gallbladder

Note: the porta hepatis conducts the bile duct, the hepatic artery and the hepatic vein.

- 9) Tubular omentum.
- 10) Ligamentum teres.
- 11) Fissure for ligamentum venosum (ductus venosum in embryo) and lesser omentum.

On the right lobe:

- renal impression of the right kidney
- Suprarenal impression
- duodenal impression
- The neck of gallbladder
- Right colic flexure
- Transverse colon

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.

-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

-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?

-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.

-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

- 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

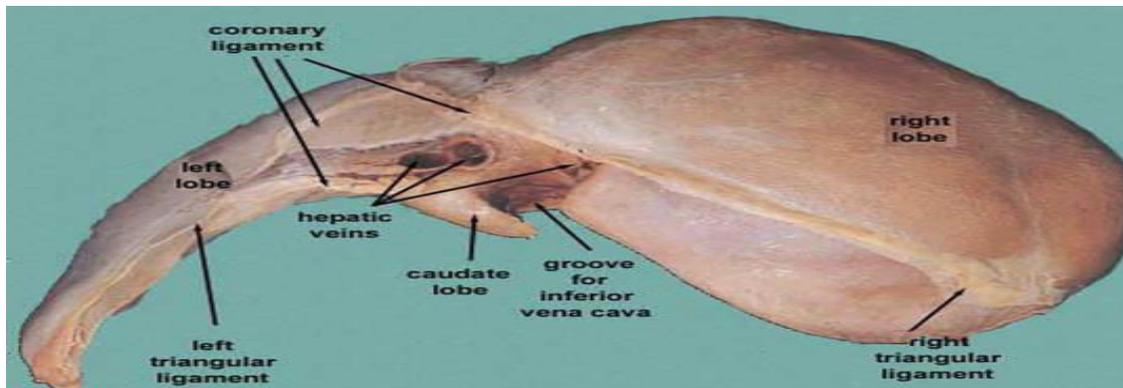
-the superior surface of the liver:

- 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 form the triangular ligaments ,so we have right and left triangular ligaments.

Relations of the superior surface:



-Superiorly :The diaphragm which separates the right pleura and Lungs from the liver and the pericardium of the heart centrally.

-Anteriorly:

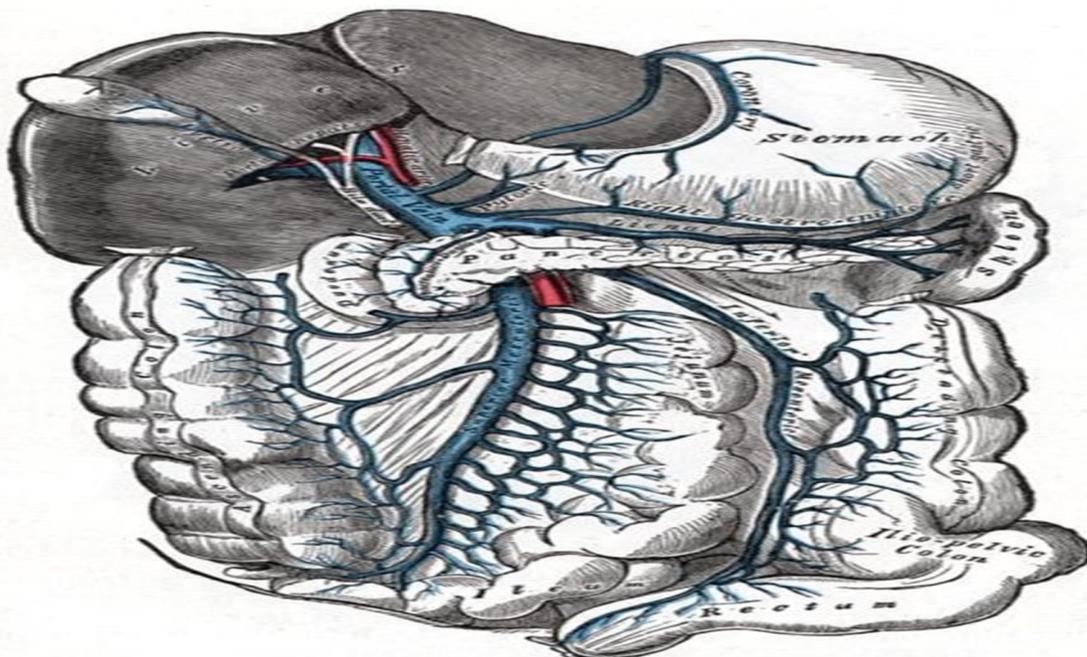
Diaphragm • Right and left pleura and lung • Costal cartilage • Xiphoid process • •
Ant. abdominal wall

Posterior relation of the liver:

(Which is related to the visceral surface of the liver):

- Diaphragm.
- Right kidney.
- Supra-renal gland.
- Transverse colon(the hepatic flexure to be specific).
- Duodenum.
- Gall bladder.
- Inferior vena cava.
- Esophagus.
- Fundus of the stomach.

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.

Contents:

1) Nerves ,lymph vessels and lymph nodes.

2)Hepatic artery which divides Into right and left.

3)Portal vein divides into left and right.

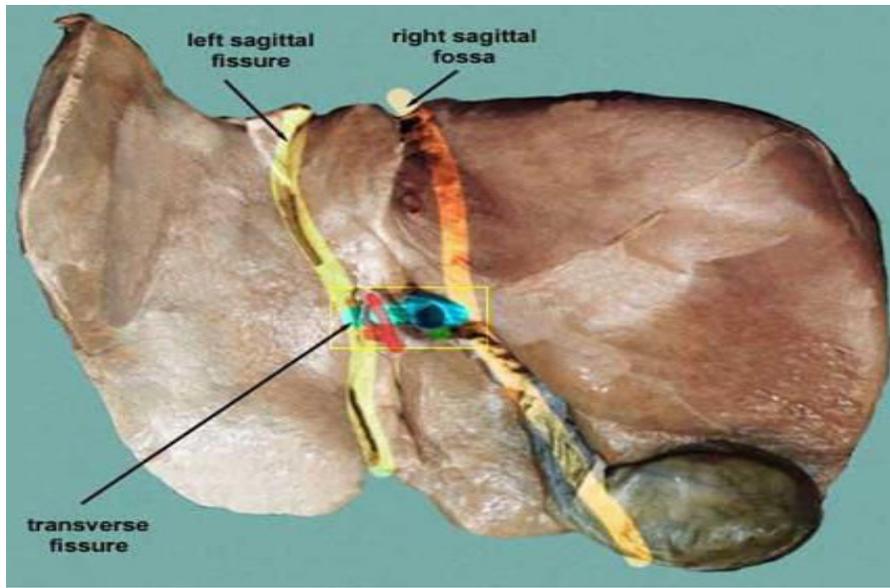
4)Common bile duct which opens in the second part of the duodenum.

Nerves ,lymph vessels and lymph nodes

-Anteriorly to the porta hepatis is the cystic duct that comes from the gallbladder, the free edge of the lesser omentum which contains the portal vein and hepatic artery & the common bile duct. all these structures are going to the porta hepatis.

Separation of the four lobes of the liver:

The separation is all about fissures :



- We have fissure for inferior vena cava

-Fissure for gallbladder and cystic duct

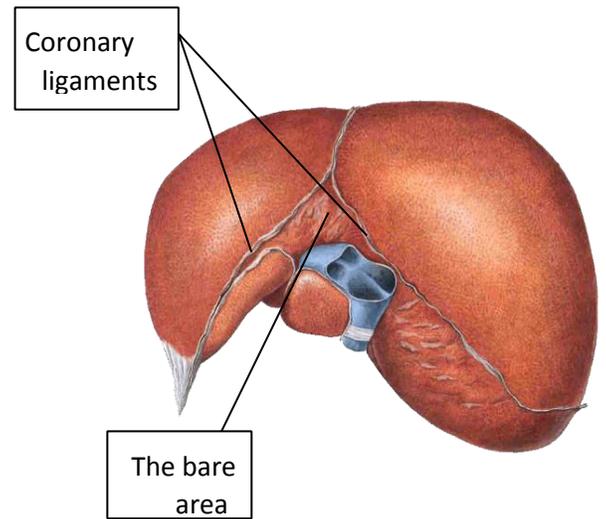
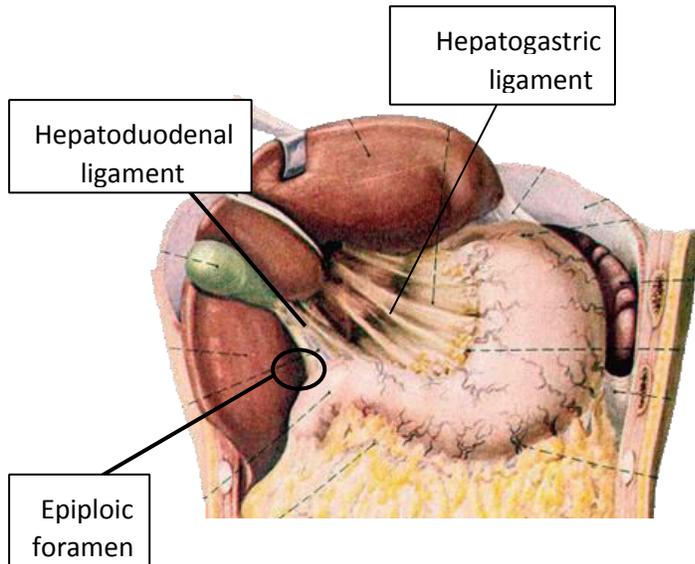
-Fissure for **ligamentum venosum**"it is a ductus venosum in the embryo and then it obliterated and converted to ligamentum venosum and it continues to reach the edge of quadrate lobe.

NOTE:Caudate lobe lies to the left of inferior vena cava , to right of ligamentum venosum and above the porta hepatis ,the **quadrate** lies to the left side of cystic duct and gallbladder ,below porta hepatis and to the right of left lobe.

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.

ligaments of liver:-



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.

-Ligamentum teres:

obliterated umbilical vein

Coronary ligament : two lips between them the bare area and in each Side of it to the right and left it makes right and left triangular ligament

-Ligamentum venosum (ductus venosum):

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

-Coronary ligament:

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

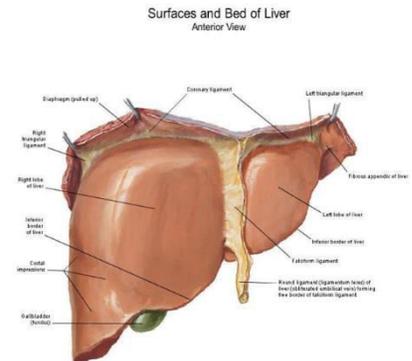
-Left and right triangular ligaments:

- formed by left and right extremity of coronary ligament/

- Hepatogastric ligament

-Hepatoduodenal ligament

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



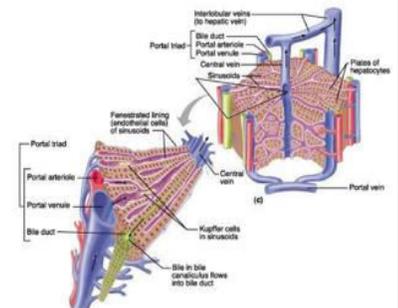
Histology of the liver:

-It is hexagonal lobule 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 portahepatis that send 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.

-True morphological and physiological division by a line extending from fossa of Gallbladder to fossa of I.V.C.

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

-Blood supply of the liver

Blood Circulation through the Liver:

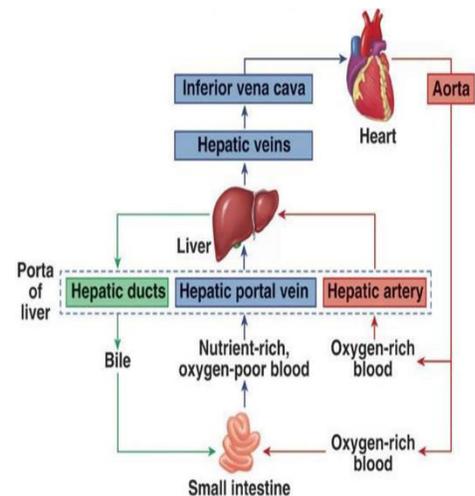
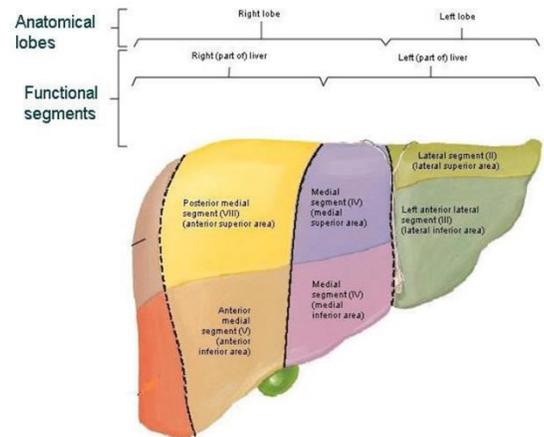
The blood vessels conveying blood to the liver are the hepatic artery (30%) and portal vein (70

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.

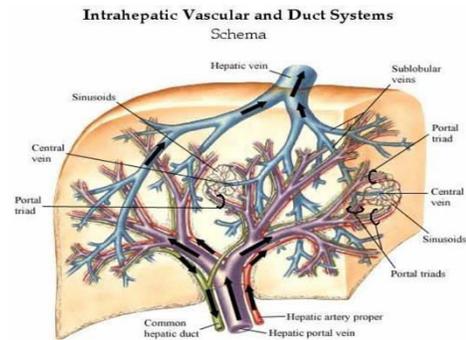
-Formation of bile and bile salts by **hepatic duct** that meet the **cystic duct** to form the **common bile duct** which opens in the second part of the duodenum.



Veinous drainage of the liver

-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 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, 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 .

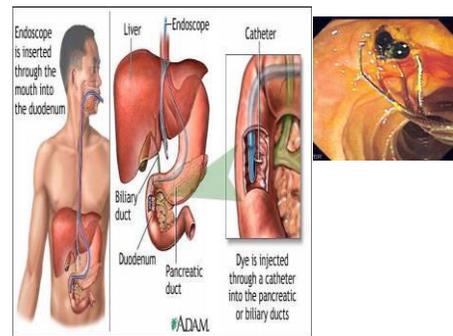
Endoscopic Retrograde Cholangiopancreatography

(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.

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.

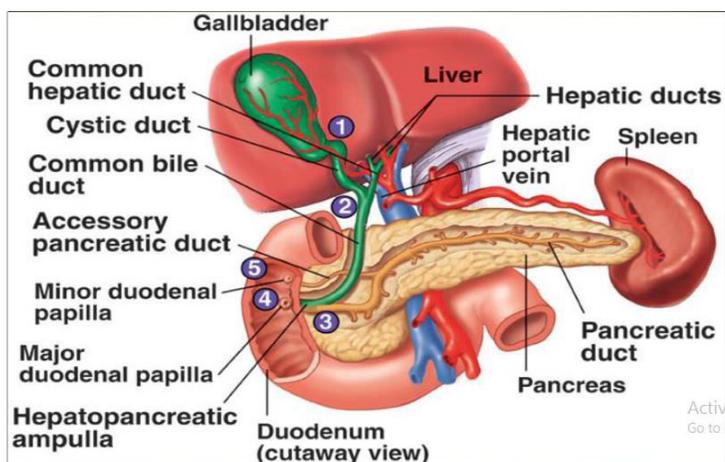
The gallbladder is the storage site for bile, the bile gets concentrated inside the gallbladder. So instead of secreting 20 L of diluted bile through the hepatic duct after a fat-rich meal, the gallbladder secretes 1-2 mL of concentrated bile.

This sphincter relaxes when it receives stimulation, whether this stimulation is neural 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



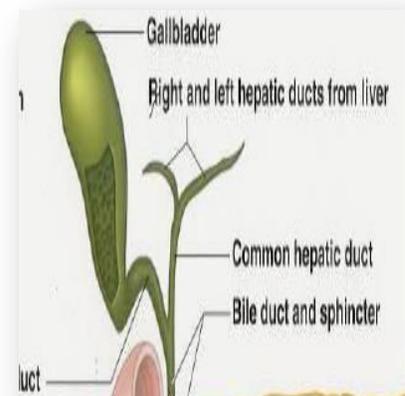
Cystic duct

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.

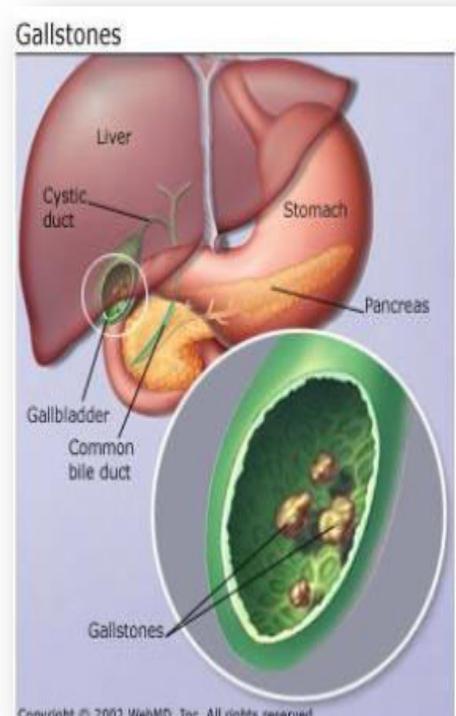
Lymphatic drainage

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.

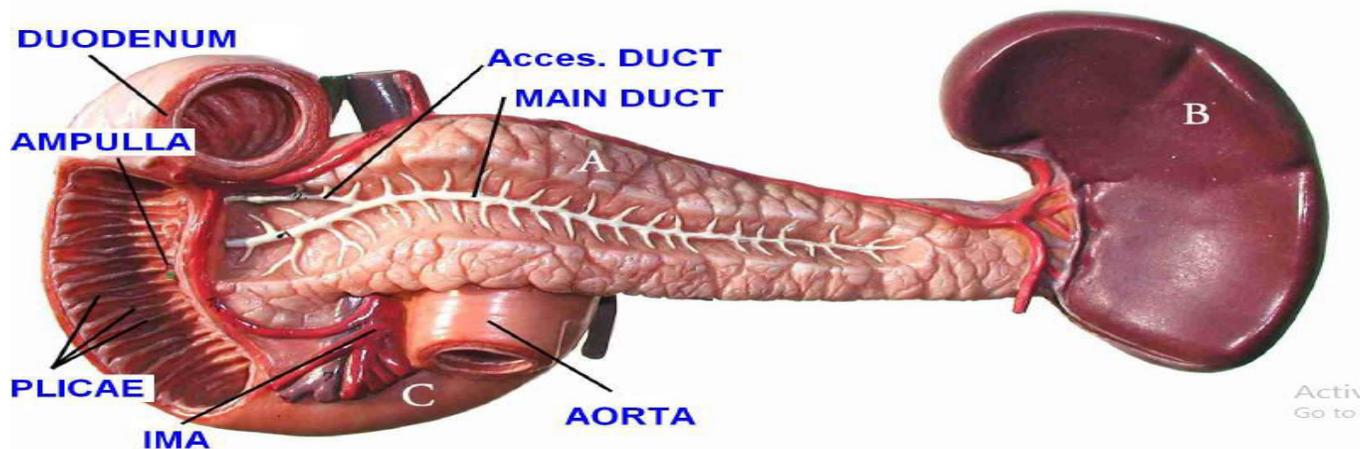
The bile:



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.

➤ The pancreas



Parts of the pancreas

1) The head:

-it's disc-shaped.

- A part of the head extends to the left behind the superior mesenteric vessels and is called the uncinata process.

2) The neck:

The portal vein is formed behind the neck by the superior mesenteric and the splenic veins.

3) The body:

The head is present in the concavity of the duodenum .The main pancreatic and the main bile duct originates from this part.

4) The tail: Passes forward in the splenicorenal ligament and comes in contact with the hilum of the spleen , this ligament must be protected during splenectomy as injury may cause a leakage of the pancreatic secretions causing peritonitis.

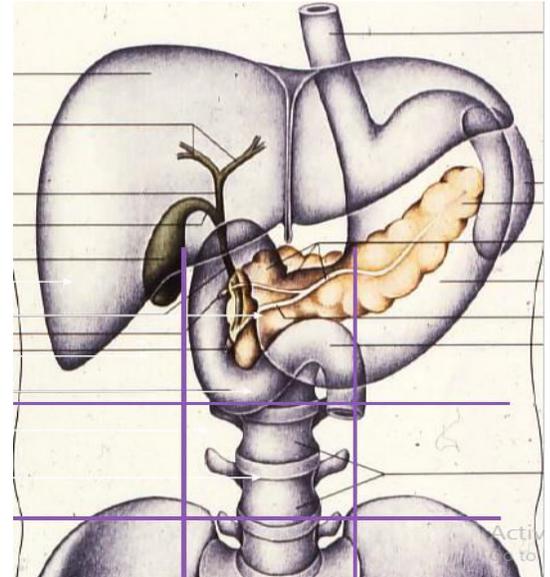
The pancreas has 3 surfaces and three borders:

- The splenic artery (tortuous) runs along the superior border
- The anterior border is attached to the mesocolon of the transverse colon (two layers of peritoneum)

The anterior surface is covered by peritoneum of the lesser sac.

-The posterior surface is devoid of peritoneum and is in contact with the aorta, the splenic vein and the left kidney.

-The inferior surface is narrow between the anterior and posterior surfaces.



Relations:

It's a retroperitoneal structure, found in the posterior abdominal wall in the epigastric and left hypochondrial region.

Anteriorly :

The transverse colon, mesocolon, the lesser sac and the stomach (remember: It's a part of the stomach bed).

Posteriorly:

- the bile duct, the portal and splenic veins, the inferior vena cava, the aorta, the origin of the superior mesenteric artery, the left psoas muscle, the left suprarenal gland, the left kidney, and the hilum of the spleen.

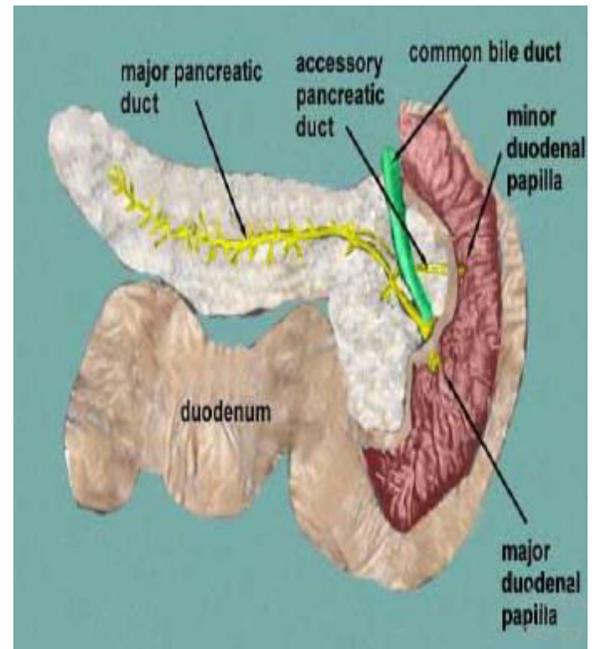
-It's a mixed gland that has an endocrine portion (the islets of Langerhans that secretes insulin and glucagon) and an exocrine portion (secretes pancreatic juice).

Note: the superior mesenteric artery is anterior to the uncinata process while the origin of the mesenteric artery is behind the body

The pancreatic ducts:

The main pancreatic duct opens into the major duodenal papilla.

The accessory pancreatic duct opens into the minor duodenal papilla. (One inch above the main duct).



Histology of the pancreas

A section in the pancreas showing the endocrine part (islets of Langerhans) and the exocrine portion (the pancreatic acini).

Arterial supply of the pancreas

The splenic and the superior pancreaticoduodenal (from the celiac trunk) and inferior pancreaticoduodenal (from the superior mesenteric) arteries supply the pancreas.

As we see, the superior mesenteric and the celiac trunk supply the pancreas, so it follows the foregut and the midgut.

Venous drainage

The corresponding veins (the superior and inferior pancreaticoduodenal veins) drain into the portal system.

Lymphatic drainage

Pancreaticoduodenal lymph nodes drain into the superior mesenteric and the celiac lymph nodes.

Nerve supply

Parasympathetic from the vagus nerve.

Sympathetic by the splanchnic nerve into the celiac plexus.

Clinical notes

-Pancreatic anomalies will be discussed in embryology.

-Cancer of the head of the pancreas causes obstructive jaundice while cancer of the body creates a pressure on the inferior vena cava and the portal vein.

Acute pancreatitis: inflammation of the pancreas and the common cause is alcoholism.

➤ The spleen

-The required material is what was discussed in the lab sessions.

The pancreas has:

1) 2 ends

An upper end and a lower end (located on the midaxillary line).

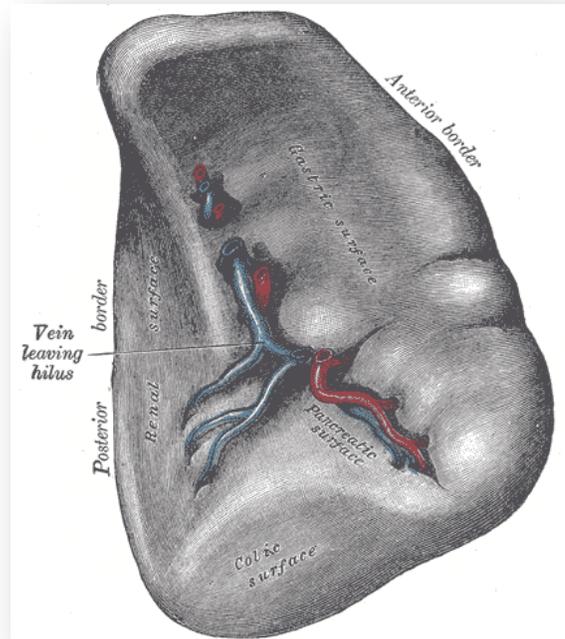
2) 2 borders

An Upper border and a lower border.

3) 2 surfaces

Visceral surface: related to the stomach (that forms the gastric impression), the left kidney (renal impression), the tail of the pancreas and the right colic flexure.

And a costal surface :related to the 9th, 10th and 11th costal cartilage on the left side and its axon is parallel to the 10th left rib. A trauma to this area will lead to a ruptured spleen.



The splenicorenal (leinorenal) ligament carries the splenic vessels and the tail of the pancreas.

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