



GI ANATOMY

2



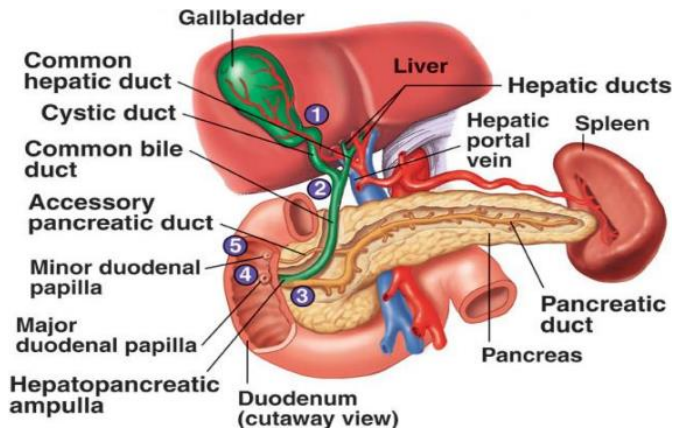
WRITER:
Renad Saleh

CORRECTOR:
Osama Younis

DOCTOR:
Dr. Mohtaseb

اللَّهُمَّ لَا سَهْلًا إِلَّا مَا جَعَلْتَهُ سَهْلًا وَأَنْتَ تَجْعَلُ الْحَزْنَ إِذَا شِئْتَ سَهْلًا

★ Information that Dr. Mohtaseb repeated many times or focused on will have a star next to it. Any extra info from me will be in blue. I included images from outside the slides that are clearer. Happy reading!



Gallbladder

The doctor started off with some general things to know about the gallbladder.

Firstly, it is made up of a few parts: fundus, body, neck (which gives the cystic duct), and a downward bulge called Hartman's pouch. Secretions of

the gallbladder can accumulate in this bulge and get stuck (stasis), which will then accumulate and lead to the formation of a single stone. (We talk about gallstones later on.)

★ The right and left hepatic ducts (carrying bile) meet to form the **common hepatic duct**, which then meets the **cystic duct** to form the **common bile duct (CBD)**. The common bile duct then opens into the second part of the duodenum at the major duodenal papilla (containing the sphincter of oddi), along with the pancreatic duct.

Secondly, we need to know that the sphincter of oddi is almost always contracted. When the **dilute** bile produced in the liver travels along the duct, it goes to the gallbladder, where absorption of water and **concentration** of bile occurs. (1 ml of bile from the gallbladder is equivalent to 20 ml from the liver!) The bile is stored there until you eat a meal high in fat. The gallbladder contracts and sphincter relaxes ⇒ bile into duodenum.

In the case where a patient has undergone cholecystectomy (removal of the gallbladder), they will experience diarrhea and steatorrhea. Why? Because the bile will be dilute as its secreted straight from the liver (no gallbladder to concentrate the bile anymore), so they'll have inefficient digestion of fats.

Anatomical position of GB

Located in the Epigastric - Right hypochondrium region at the tip of the 9th right costal cartilage.

It is a green muscular organ on the inferior surface of liver

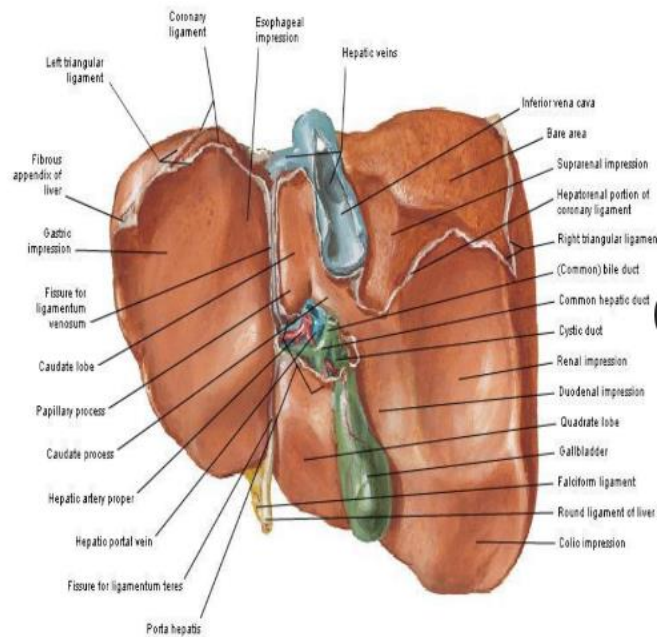
Pear-shaped, hollow structure

Between quadrate and right lobes

Has a short mesentery

Capacity 40- 60 cc

Body and neck are directed toward porta hepatis.



Its anterior surface is covered in peritoneum/serosa. The rest is embedded in the liver. (★This provides it with direct blood supply, other than the cystic artery, so complete cut of blood supply and gangrene happening in the GB is very rare.)

Structure of GB

⇒ Fundus

Anterior: ant. abdominal wall

Posterior and inferior: transverse colon

⇒ Body

Superior: liver

Posterior and Inferior:

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

⇒ Neck

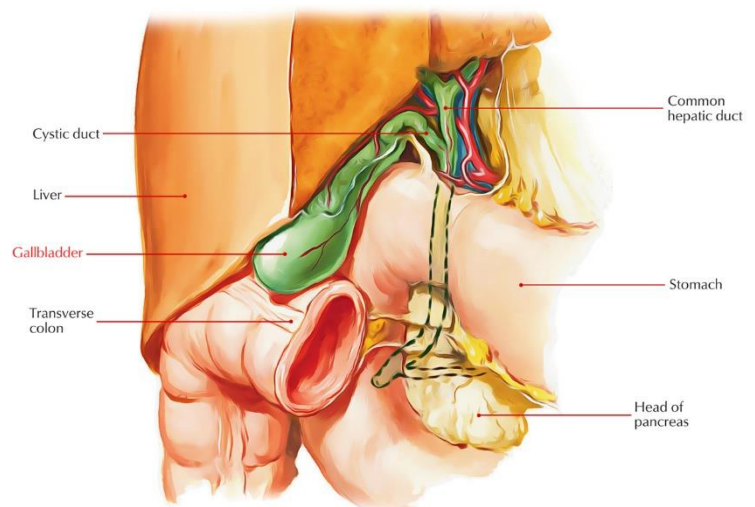
Forms the cystic duct (4cm long)

⇒ Hartmann's Pouch

Lies between body and neck of gallbladder

A normal variation (not a congenital abnormality)

May obscure cystic duct



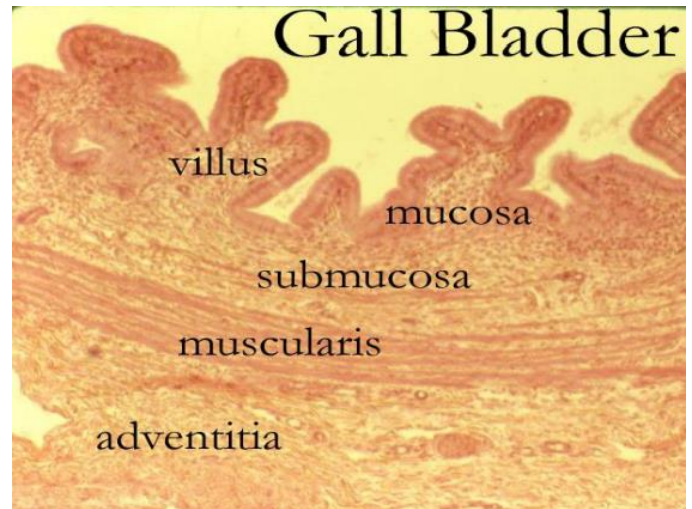
If very large, may see cystic duct arising from pouch

★ If a stone occurs in Hartmann's pouch, it can enter the CBD and obstruct it, leading to jaundice (yellow appearance).

Histology of the GB

Its layers are similar to the rest of the GI:

⇒ Mucosa: the lining epithelium is **simple columnar without goblet cells**. There is abundant folding, giving it a honeycomb appearance. Some gallbladder cells can secrete mucus.



⇒ Submucosa: **not well defined** as in the GI tract

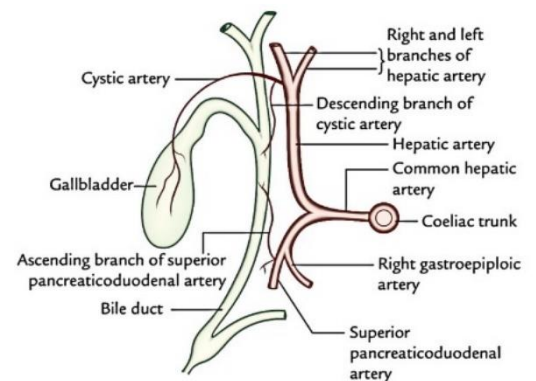
⇒ Muscularis: muscle fibers run **in different directions** (not just the inner circular and outer longitudinal layers.)

⇒ Serosa (on its anterior surface) or adventitia (connective tissue covering the rest.)

Cystic duct

It's a 4 cm long continuation of the GB neck.

It joins common hepatic duct to form the CBD. The CBD is 10 cm long and has 3 parts: a supraduodenal, retro duodenal, and retro pancreatic part. (Explained later.)



Blood Supply of the Gallbladder

Celiac trunk ⇒ Common hepatic artery ⇒ Right hepatic artery ⇒ Cystic artery

★ The cystic vein ends in the right branch of the portal vein. Small branches (arteries and veins) run between liver and gall bladder.

Lymphatic drainage of GB

It drains to the cystic node at neck of GB (actually a hepatic node, in lesser omentum,) which lies at junction of cystic & common hepatic ducts.

Terminates at celiac nodes around celiac ganglia. Other lymph vessels also drain into hepatic nodes.

Nerve supply of GB

Sympathetic (from celiac ganglia) and parasympathetic (from Vagus nerve)
⇒ celiac plexus

The hormone cholecystokinin from the duodenum stimulates the gallbladder.

Common bile duct

Extra hepatic biliary system:

★ Rt. hepatic duct + Lt hepatic duct ⇒ Common hepatic duct + Cystic duct
⇒ Common bile duct

4 cm of it descends in free edge of lesser omentum.

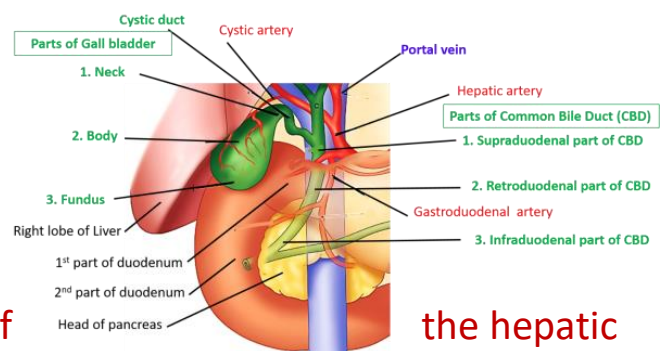
Bile duct's parts and relations

3 in. long (Dr said 10 cm)

⇒ 1st part (**supraduodenal**) is located in right free margin of lesser omentum, in front of the opening into the lesser sac (Epiploic opening). It is to the right of artery and portal vein.

⇒ 2nd part (**retroduodenal**) is behind the 1st part of the duodenum, to the right of the gastroduodenal artery

⇒ 3rd part (**retropancreatic**) is on the posterior surface of the **head** of the pancreas, and is in contact with main pancreatic duct. Related with IVC, gastroduodenal artery, and portal vein. It ends halfway through the second part of duodenum **medially** at the ampulla of Vater.



the hepatic

Blood supply of CBD

Small arteries supplying CBD arise from cystic artery and posterior branch of superior pancreaticoduodenal artery. (celiac trunk ⇒ hepatic artery ⇒ gastroduodenal artery ⇒ superior pancreaticoduodenal)

What is bile?

Bile 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.

(The Dr skipped over all of this:)

Gallbladder Diseases

- ⇒ Cholelithiasis (Stone(s)) in GB & Cholecystitis (inflammation of GB)
- ⇒ Obstructive jaundice: liver patterns. Jaundice occurs especially when the CBD is closed.
- ⇒ ★ Gangrene of gall bladder rare (has blood supply from both the cystic artery and directly from liver, as the GB is embedded in it)
- ⇒ Congenital defects

Cholelithiasis

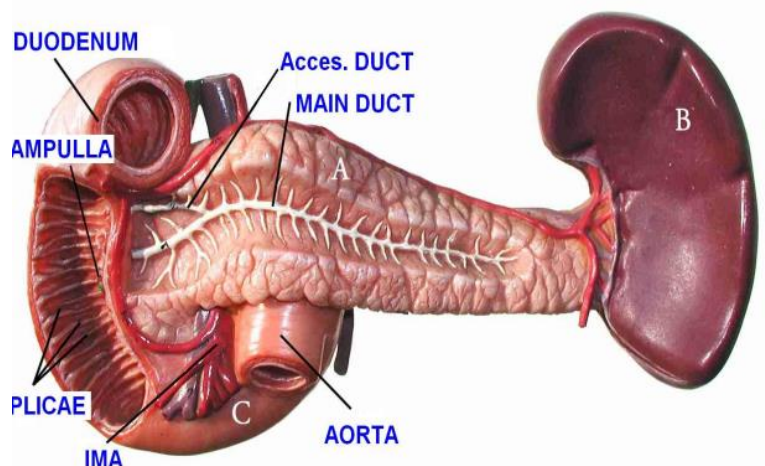
GB shows likely sites of stone formation/deposition. Gangrene of gallbladder is rare. A stone in C.B.D will obstruct it ⇒ jaundice & pancreatitis

Pancreas

Once again, some general notes Dr. Mohtaseb mentioned:

The pancreas, like the liver, is a mixed exocrine and endocrine gland. The exocrine portion is composed of pancreatic acini that secrete enzymes into the pancreatic duct and accessory pancreatic duct, which open into the 2nd part of the duodenum. The endocrine portion is made of islets containing 4 types of cells: alpha, beta, gamma, and delta cells.

The pancreas has a tail, body, neck, and head (with the uncinete process to the left of head, behind the sup. Mesenteric vessels. ★)



It extends from the hilum of the spleen on the left, to the concavity of the duodenum. (Remember, the duodenum is concave backwards and to the left, surrounding the pancreas's head.)

Anatomical position

Extends from the epigastric to upper left hypochondrium regions.

It is retroperitoneal, lying on the posterior abdominal wall.

★ Relations of the pancreas

⇒ The splenic artery runs along its upper border.

⇒ Anterior

Transverse colon, transverse mesocolon (holds onto anterior border of pancreas), lesser sac and stomach

⇒ Posterior

Bile duct (behind head of pancreas, then pierces it)

Portal vein (behind head)

Splenic vein, IVC, Aorta, Left Psoas muscle (behind body)

Origin of Sup mesenteric artery

Left Suprarenal gland and left kidney

Hilum of the spleen (★ The pancreas's tail makes an impression on it)

Posterior view of duodenum/pancreas

The celiac trunk and splenic artery are found along its upper border.

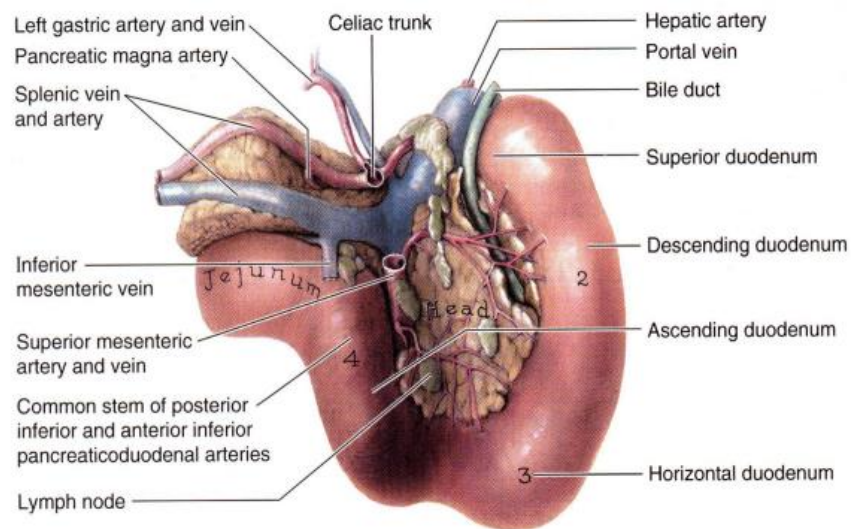
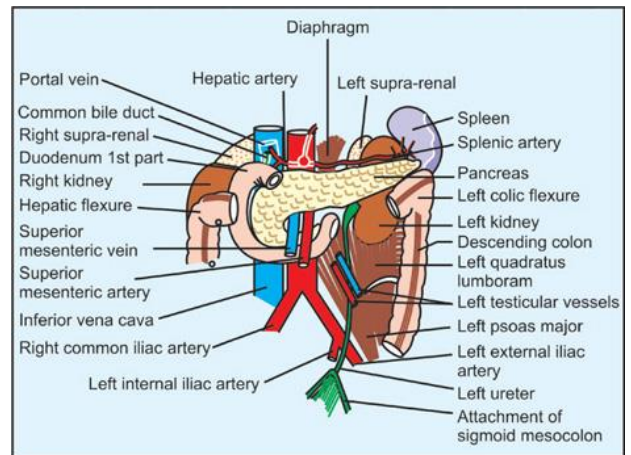
The bile duct is initially posterior to the head, then pierces the head to reach the medial side of the 2nd part of the duodenum.

The splenic vein combines with the sup mesenteric vein to form the portal vein behind the neck of the pancreas. The inf. Mesenteric vein drains into the splenic vein.

The inf. Mesenteric vein drains into the splenic vein.

Histology of pancreas

The exocrine part (acini) produces pancreatic juice. The endocrine part produces insulin, glucagon, and somatostatin (to keep blood glucose levels between 70-11 mg/dL.)



Parts of the pancreas:

Head, neck, body, and tail.

The head

It is disc shaped and lies within the concavity of the duodenum (duodenum surrounds it.) A part of the head extends to the **left, behind the superior mesenteric vessels** and is called the **Uncinate process**.

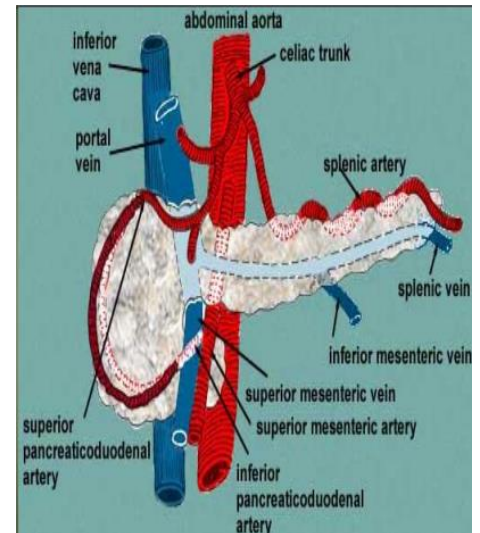
The neck

It is the constricted portion of the pancreas which connects the head to the body. It lies in front of the beginning of the portal vein ★ where the sup mesenteric and splenic veins meet ⇨ portal.

The body

It runs upward and to the left across the midline and is somewhat triangular in cross section.

If we take a section of the body, we will observe 3 borders (anterior, superior, and inferior) and 3 surfaces (anterior, posterior, and inferior.)



The anterior surface

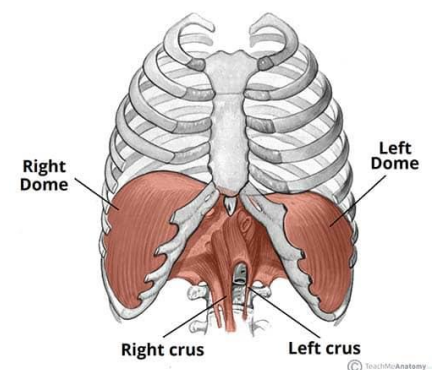
⇨ Covered by the peritoneum of the post. wall of the lesser sac

⇨ Tuber omental: upward projection where the ant. surface of pancreas joins the neck, to left of the sup mesenteric vessels.

The posterior surface

⇨ is devoid of peritoneum (it is retroperitoneal)

⇨ is in contact with the aorta, the splenic vein, the left kidney and its vessels, the left suprarenal gland, the origin of the superior mesenteric artery, and the origin of the left crus of the diaphragm.



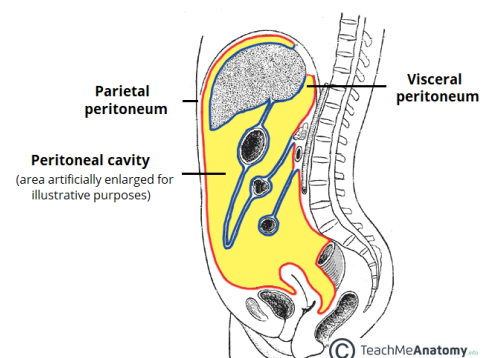
The inferior surface

⇨ Narrow on the right but broader on the left

⇨ Covered by **peritoneum of greater omentum**

⇨ lies upon the duodenojejunal flexure and some coils of the jejunum

⇨ its left extremity rests on the left colic flexure



The superior border

- ⇒ Blunt and flat to the right
- ⇒ Narrow and sharp to the left near the tail
- ⇒ It commences on the right in the omental tuberosity (tuber omental, so it reaches the neck)
- ⇒ In relation with the celiac artery and its branches, including the hepatic artery and the **splenic** artery, ★ which runs toward the left in a groove along this border in a **tortuous** course.

The anterior border

- ⇒ separates the anterior surface from the inferior surface
- ⇒ along this border the two layers of the transverse mesocolon diverge from one another; one passing **upward** over the **anterior** surface, the other **backward** over the **inferior** surface.

The inferior border

- ⇒ separates the posterior from the inferior surface
- ⇒ the superior mesenteric vessels emerge under its right extremity, then pass over the uncinata process.

The Tail

Passes forward in the splenicorenal/lienorenal ligament (along with the splenic vessels) and comes in contact with the hilum of the spleen.

The spleen is a lymphatic organ, but it is also a **reservoir (full) of blood**. If we have ★ **left side trauma** (specifically fracturing of the 9th, 10th, or 11th ribs) ⇒ rupture of spleen ⇒ bleeding. This rupture cannot be stitched, so we perform a splenectomy instead. The lienorenal ligament is opened, and the splenic vessels are ligated and cut. Like we said, the tail of the pancreas passes through this ligament and is in contact with the spleen. During a splenectomy, we must be careful not to injure the tail of the pancreas, otherwise pancreatic secretions (digestive enzymes) go into the abdominal cavity and cause peritonitis!

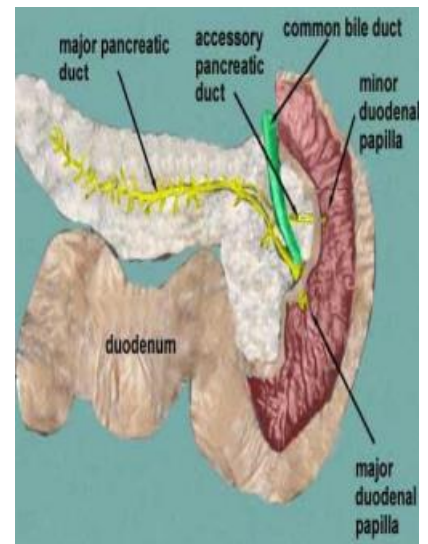
Pancreatic ducts

The main duct:

- ⇒ begins in the tail, runs the length of the gland, and receives numerous tributaries on the way.

**ALMOST
THERE!**

⇒ opens into the **second** part of the duodenum at its middle, with the bile duct, on the major duodenal papilla. This point marks the halfway point of the duodenum. Before it, structures of the GI tract originate from the foregut (embryo) and its blood is supplied by the celiac trunk. After it, until the distal 1/3 of the transverse colon, structures of the tract originate from the midgut are supplied by the sup mesenteric artery. (from the midterm material.)



Accessory duct:

⇒ When present, it drains the upper part of the head of pancreas.

⇒ It then opens into the 2nd part of duodenum a short distance above the main duct on the minor duodenal papilla .

⇒ The accessory duct frequently communicates with the main duct.

Blood Supply of pancreas

Arteries:

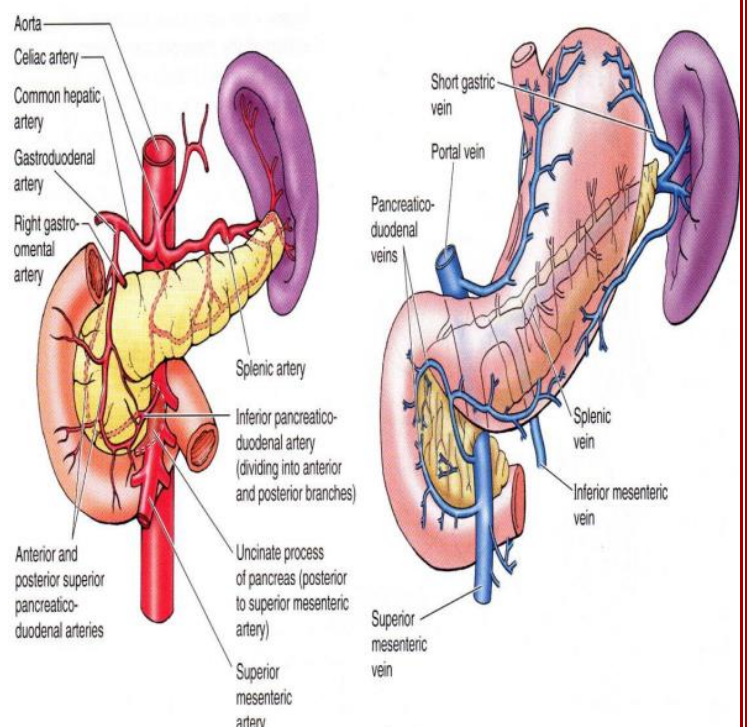
⇒ The **splenic artery**, which **gives anterior and posterior pancreatic** branches, and 5-6 splenic branches in the hilum.

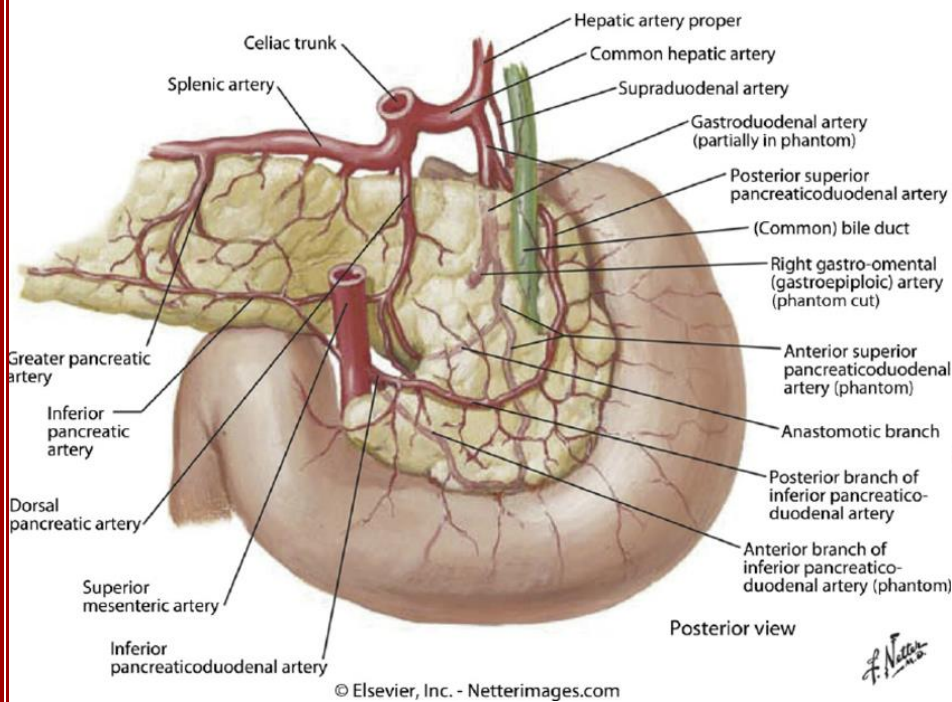
⇒ The **superior pancreaticoduodenal artery**, from the hepatic artery, from the celiac trunk.

⇒ **Inferior pancreaticoduodenal artery**, from the sup mesenteric artery.

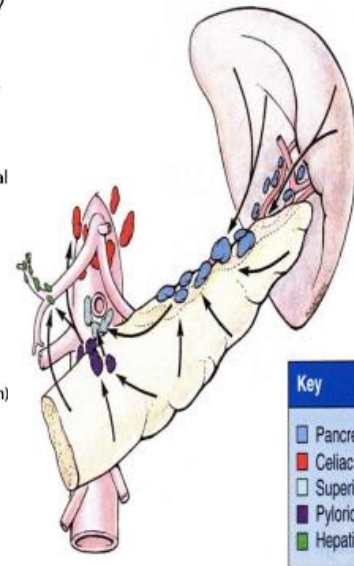
Veins:

⇒ The corresponding veins **drain** into the **portal** system. So opposite to the splenic artery, we have the **splenic vein**, which receives tributaries from the short gastric and left gastroepiploic veins. The splenic vein meets the sup mesenteric behind the neck of the pancreas to form the portal vein. (The Dr. repeated this point a lot, sorry for the repetition.) We also have the **pancreaticoduodenal veins draining into the sup mesenteric vein**. (See image.)





Pancreaticoduodenal artery and its branches:



Lymphatic drainage of pancreas

Lymph nodes are situated along the arteries that supply the gland, including pancreaticosplenic, gastric, and hepatic nodes. The efferent vessels ultimately drain into the celiac and superior mesenteric lymph nodes, eventually reaching the cisterna chyli (sac of lymph at the lower end of the thoracic duct) and the thoracic duct, to drain into the left subclavian vein.

Nerve supply

⇒ Sympathetic (from celiac ganglia) and parasympathetic (from vagus nerve) chain. They form a plexus whose fibers distribute via blood supply.

Congenital defects of pancreas

⇒ Annular Pancreas (rare): occurs when the pancreas encircles duodenum (2nd part), instead of the pancreas being surrounded by the duodenum as normal. This **obstructs** the duodenum.

⇒ Ectopic Pancreas (very common)= Outside the gastrointestinal tract. This is the occurrence of pancreatic tissue outside the pancreas's normal site.

Clinical notes

⇒ Cancer of the head of pancreas ⇒ Obstruction and jaundice. A tumor in the head will **close the CBD**, which pierces the head from behind.

⇒ Cancer body of pancreas ⇒ pressure on the I.V.C & portal vein (which are behind the body)

⇒ Acute pancreatitis ⇒ inflammation of pancreas, due to stasis of secretions of the pancreatic duct.

Spleen

A few notes about the spleen before we continue:

It has 2 surfaces (visceral and diaphragmatic/costal), 2 ends (upper/medial and lower/lateral), and 2 borders (upper/anterior and lower/posterior.)

Location and Description

It is reddish & oval shaped, is the largest single mass of **lymphoid** tissue in the body, and has a notched anterior border.

Location:

⇒ In the left hypochondrium, just beneath the left half of the diaphragm

⇒ Under the **9th, 10th, and 11th left ribs**, with its long axis parallel to the 10th rib

⇒ Medial end is 4 cm away from mid line post

⇒ Lateral end is in left mid axillary line

★ As mentioned before, left side trauma (e.g. during a car accident) can cause a ruptured spleen, which is a surgical emergency requiring a splenectomy. Otherwise, hemorrhage leading to death may occur.

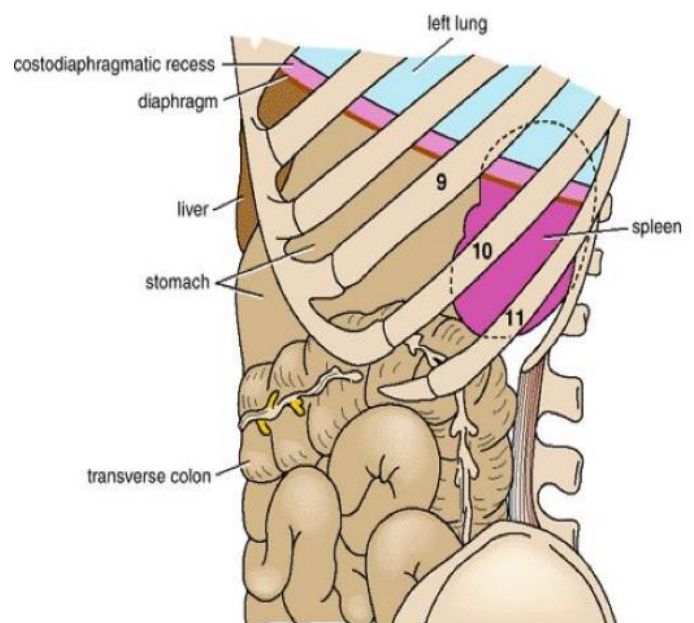
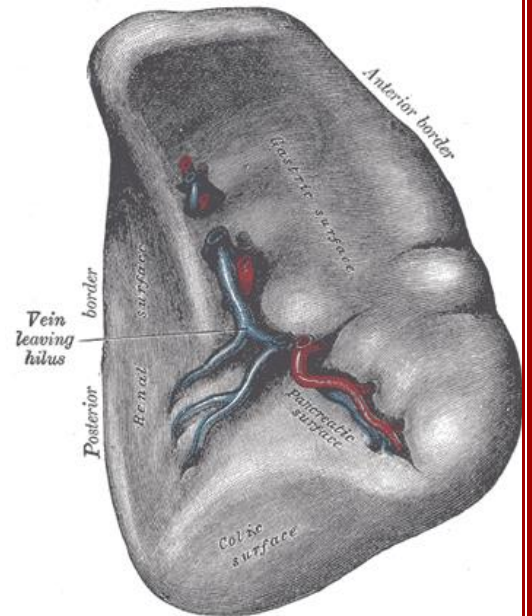
Peritoneum

The spleen is completely covered with peritoneum ⇒ intraperitoneal organ, except the hilum ⇒ has a slit-like opening enclosed by the lesser omentum.

Two ligaments

⇒ The gastrosplenic omentum (ligament) between the spleen & the greater curvature of the stomach (carrying the short gastric and left gastroepiploic vessels)

⇒ The splenicorenal ligament between hilum of spleen & left kidney (carrying the splenic vessels and the tail of the pancreas).

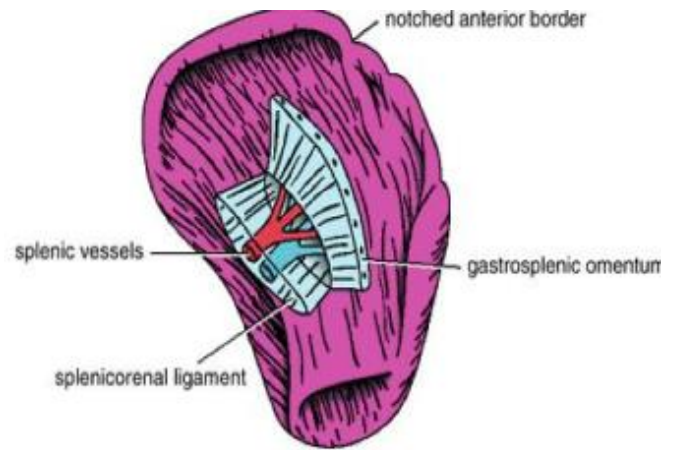


Size: 1 inch thick, 3 inches broad (width,) 5 inches long (odd numbers)

Weight: 7 ounces

Shape: is variable, but has: 2 ends, 2 borders, and 2 surfaces

Notched on upper surface, due to lobulation in embryo.



Surfaces of spleen

It has 2 surfaces: A diaphragmatic/costal surface and a visceral surface.

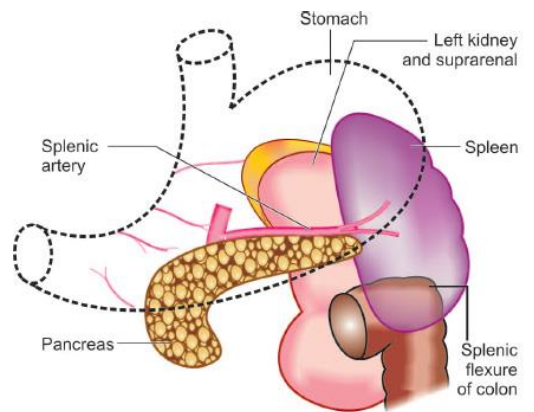
Diaphragmatic surface

It has posterolateral relations (is directed posteriorly and laterally.) It is convex and smooth. The diaphragm separates it from the **left pleura, lung, and ribs 9, 10, and 11.**

Visceral surface

It has Anteromedial relations (it is directed anteriorly and medially.)

It is divided by a ridge into an anterior or **gastric portion**, and a posterior or **renal portion**. Its lower extremity has a **colic surface** and a **pancreatic surface**.



The splenic vessels enter through the hilum on this surface. Multiple organs rest on the visceral surface of the spleen and make impressions, including:

⇒ the greater curvature of the stomach (above hilum)

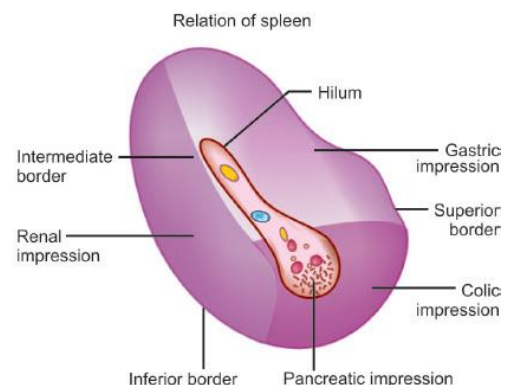
⇒ the left kidney (below hilum)

⇒ the left colic flexure/splenic flexure (at the inferior angle)

⇒ the tail of the pancreas (below hilum, very close to it)

Gastric surface: Extends forward, upward, and medialward; it is broad, concave, and related to stomach.

Renal surface: Directed medialward and downward; it is somewhat flattened and related to left kidney.



The doctor didn't say a lot of additional notes after this point.

The lower extremity or colic surface: is flat and triangular in shape; it rests upon the left flexure of the colon and the phrenicocolic ligament, and is generally in contact with the tail of the pancreas (pancreatic surface.)

Hilum of spleen contains the splenic **artery anteriorly**, the splenic **vein posteriorly**, and tail of pancreas (which was in the splenicorenal/lienorenal ligament.)

Borders of spleen

The superior border is free, sharp, thin, and often notched (sup.notch), especially below. It separates the diaphragmatic surface from the gastric surface.

The inferior border is more **rounded** and blunter. It separates the renal from the diaphragmatic surface, and corresponds to the lower border of the eleventh rib. It lies between the diaphragm and left kidney.

The intermediate margin is the ridge which separates the renal and gastric surfaces (red.) The internal border separates the diaphragmatic from the colic surface (blue.)

2 Ends

⇒ Medial end is directed superiorly and back, 4 cm away from midline/mid sagittal line posteriorly.

⇒ Lateral end is along left mid axillary line.

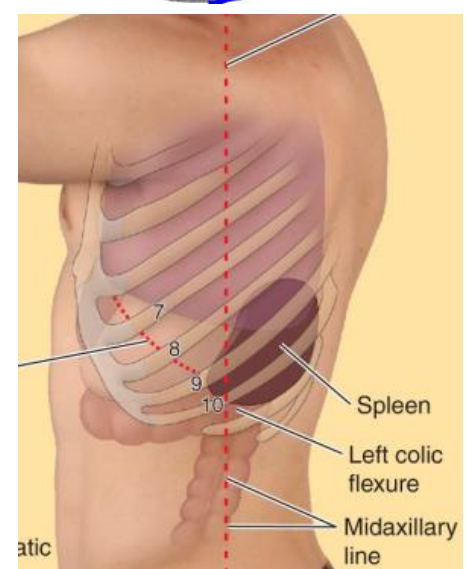
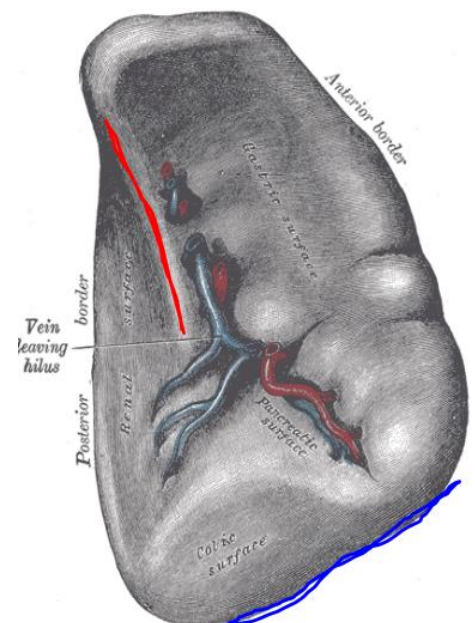
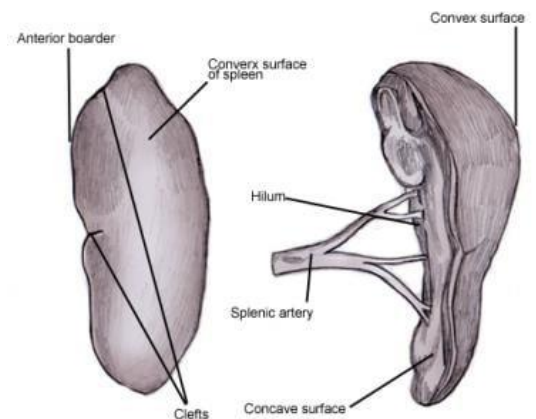
Blood supply

⇒ The **splenic artery** is the largest branch of the celiac artery.

⇒ has a tortuous course

⇒ runs along the upper border of the pancreas

⇒ divides into about six branches, which enter the spleen at the hilum



Veins

The **splenic vein** leaves the hilum and runs behind the tail and the body of the pancreas. Behind the neck of the pancreas, the splenic vein joins the superior mesenteric vein to form the **portal vein**.

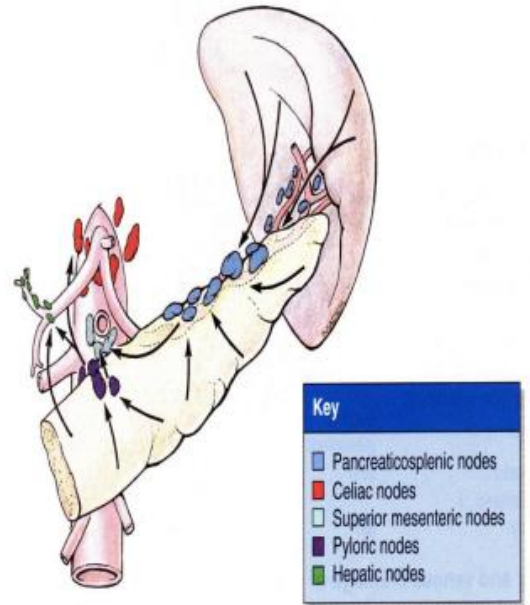
Lymphatic Drainage of spleen

The lymph vessels emerge from the hilum and pass through a few lymph nodes along the course of the splenic artery (e.g.

★ **pancreaticosplenic nodes**) and then drain into the ★ **celiac nodes**.

Nerve Supply of spleen

The sympathetic and parasympathetic **nerves** accompany the splenic artery and are derived from the **celiac plexus**.



V1