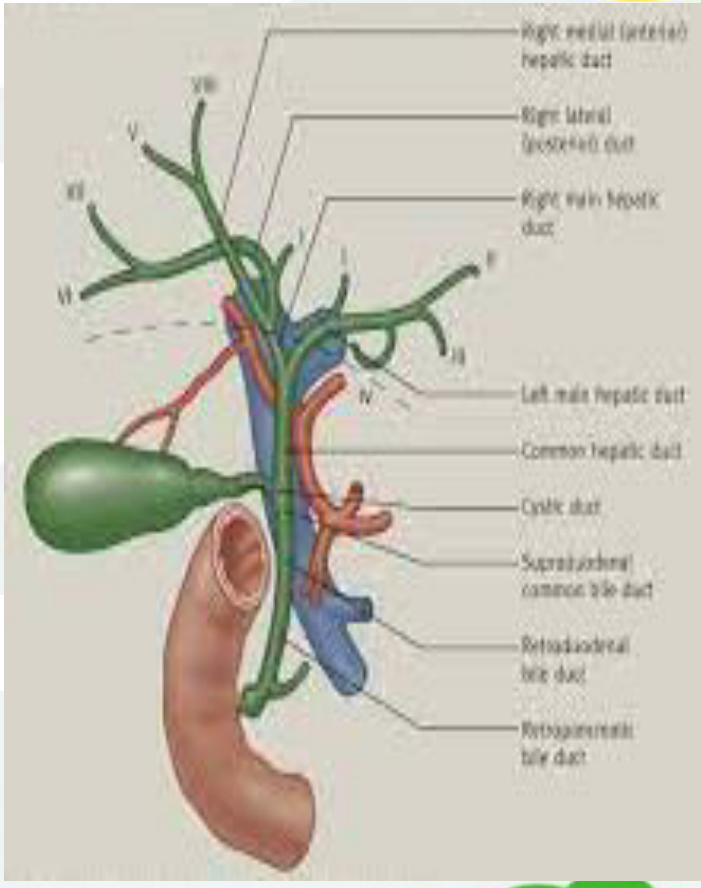
Anatomy of hepato biliary system

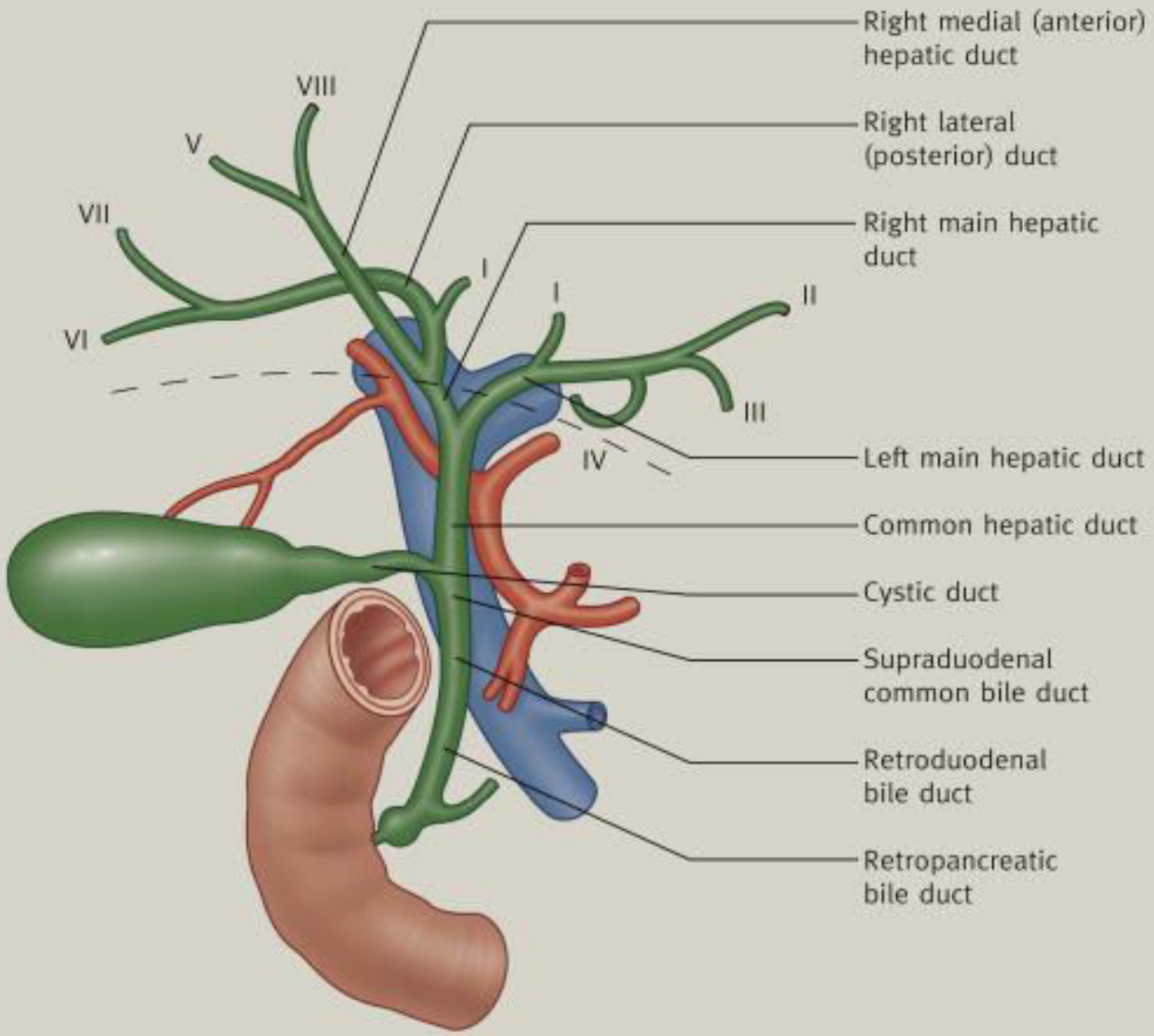
Guest lecture at CME
Department of General Surgery



Prof.Dr.N.Shakuntala
M.B.,B.S.,D.P.M.,M.S

P.E.S Institute of Medical Sciences and Research,
Kuppam,
AndhraPradesh.

Schematic illustration of intrahepatic and extrahepatic biliary tract



The level of the porta hepatis is indicated by the dashed line.

The biliary system

- **Intrahepatic:**
- Bile canaliculi
- Bile ductules(canals of Hering)
- Interlobular bile ducts
- Right and left lobar ducts
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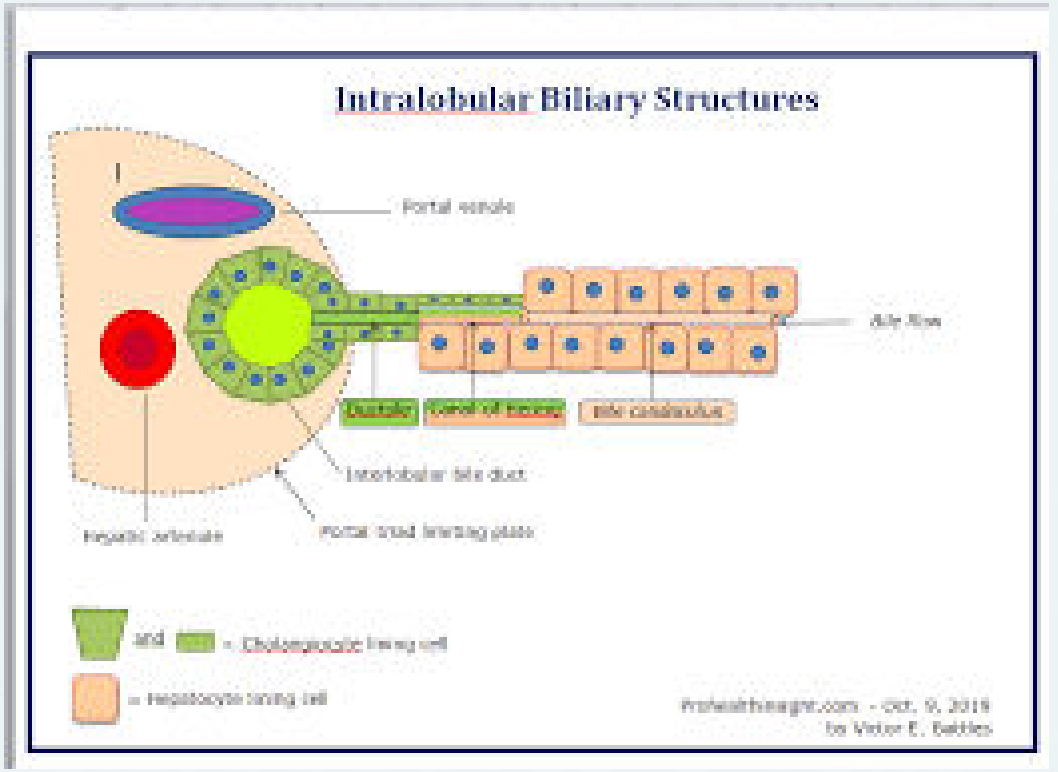
- **Extrahepatic:**
- Common hepatic duct
- Cystic duct
- Gall bladder
- Common bile duct

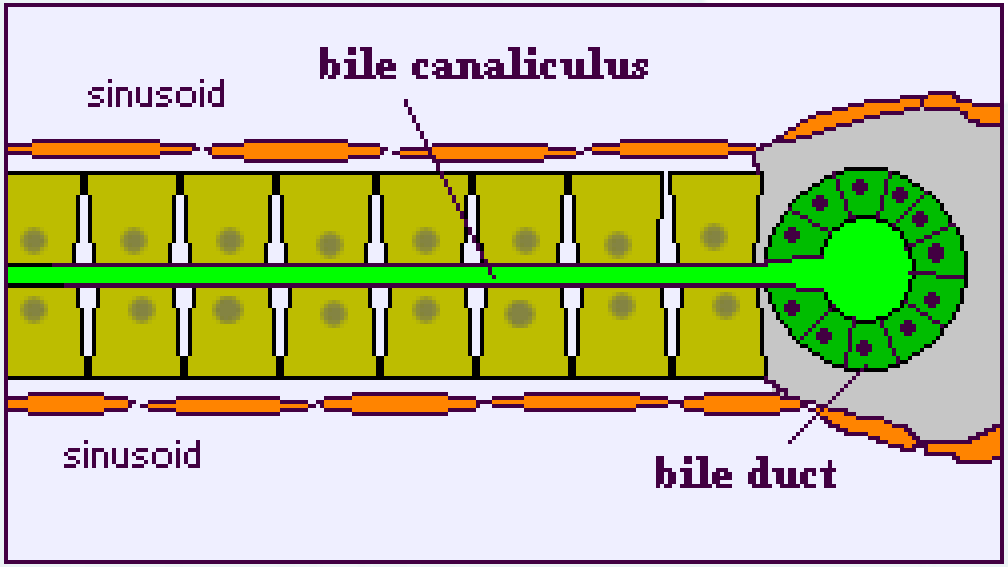
Intrahepatic biliary system

- Starts as **canaliculi.**
- Hepatocytes have a diameter of 20-30 micrometers.
- The life span is about five months.
- Liver cells lie in plates
- Between the adjacent cells are the **bile canaliculi.**



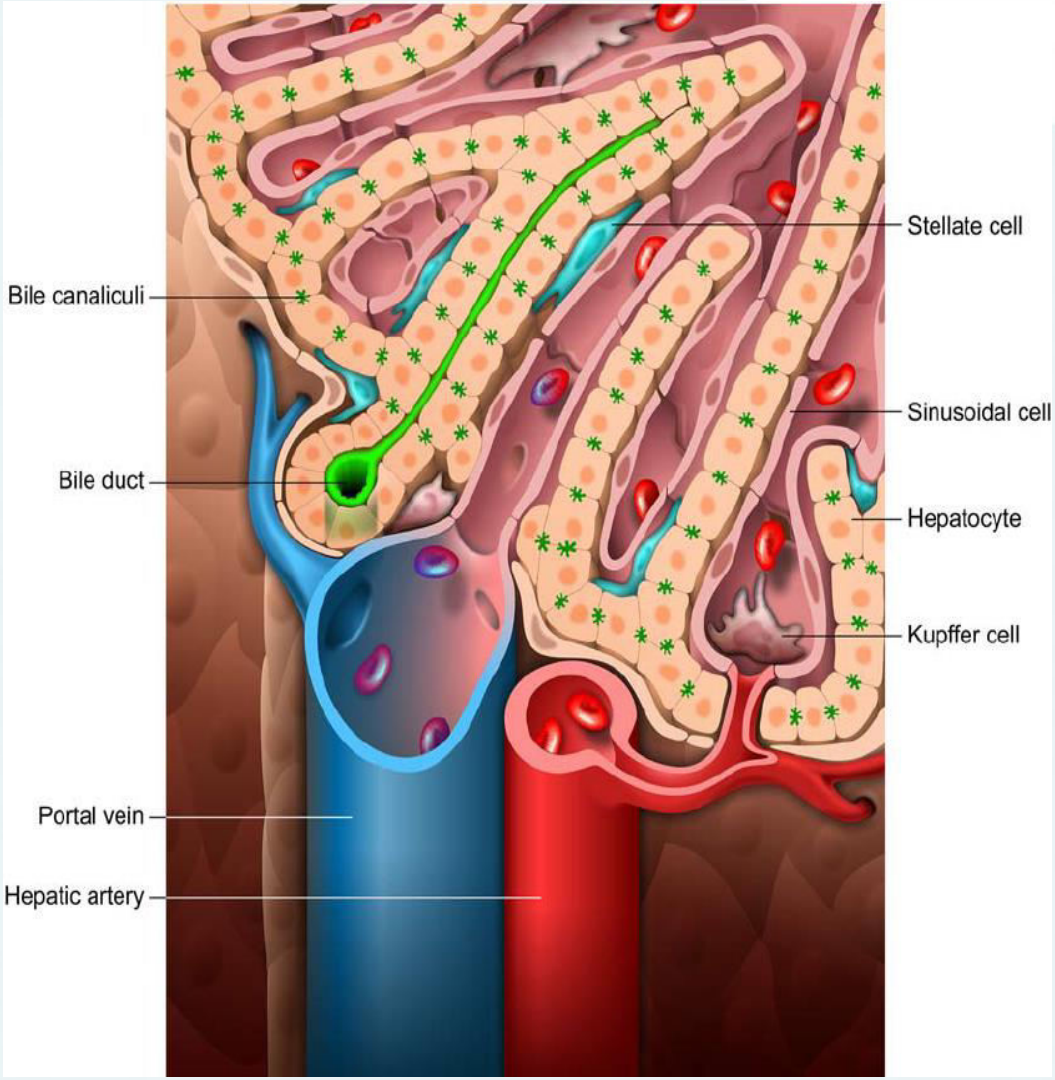
Bile canaliculus

- Bile capillary is a **tubular space between adjacent hepatocytes.**
- They are like grooves between the faces of adjacent hepatocytes.
- A few short microvilli from the hepatocytes extend into it.
- On either side of the canaliculus the cells are held by gap junctions and desmosomes.



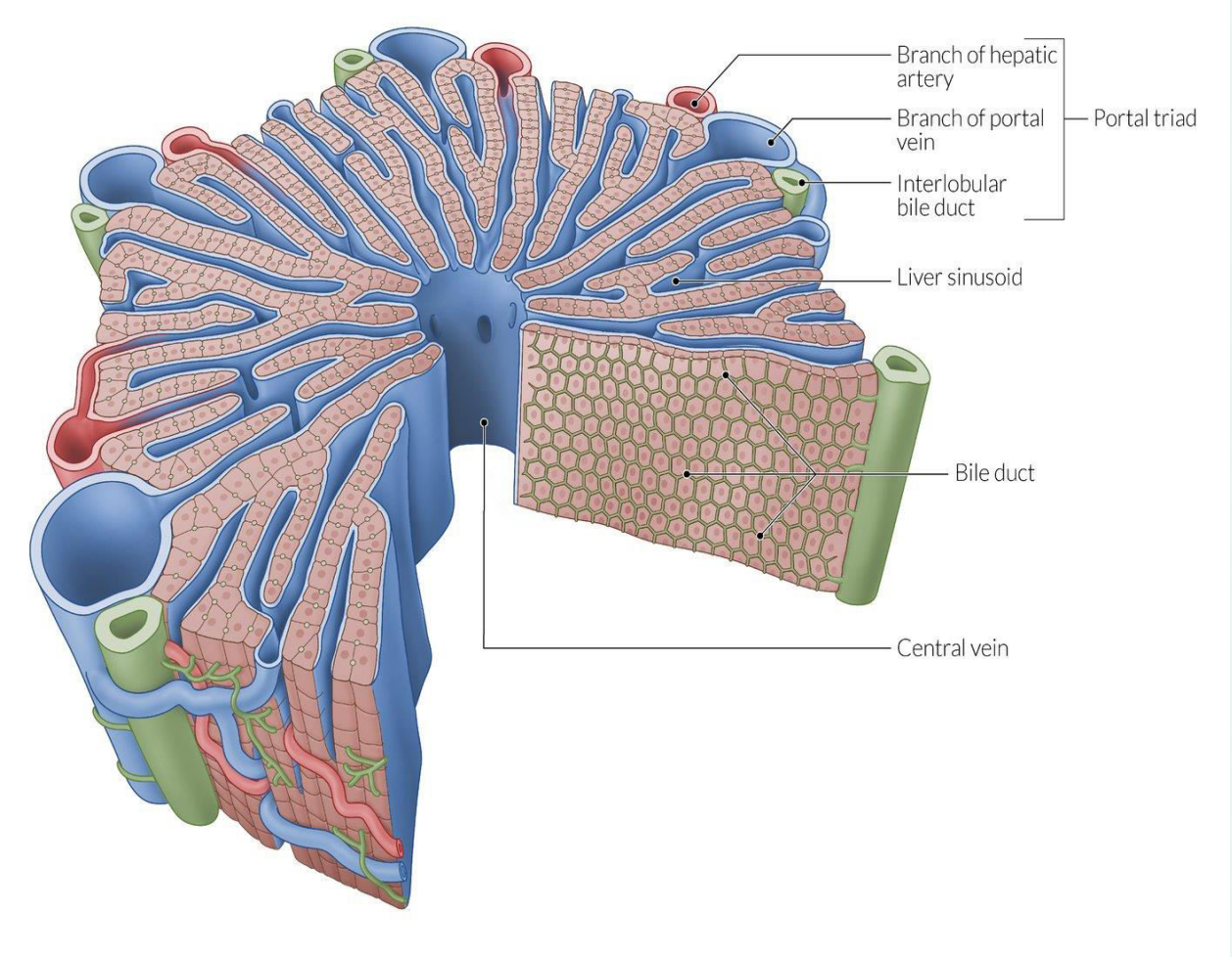
Bile ductules

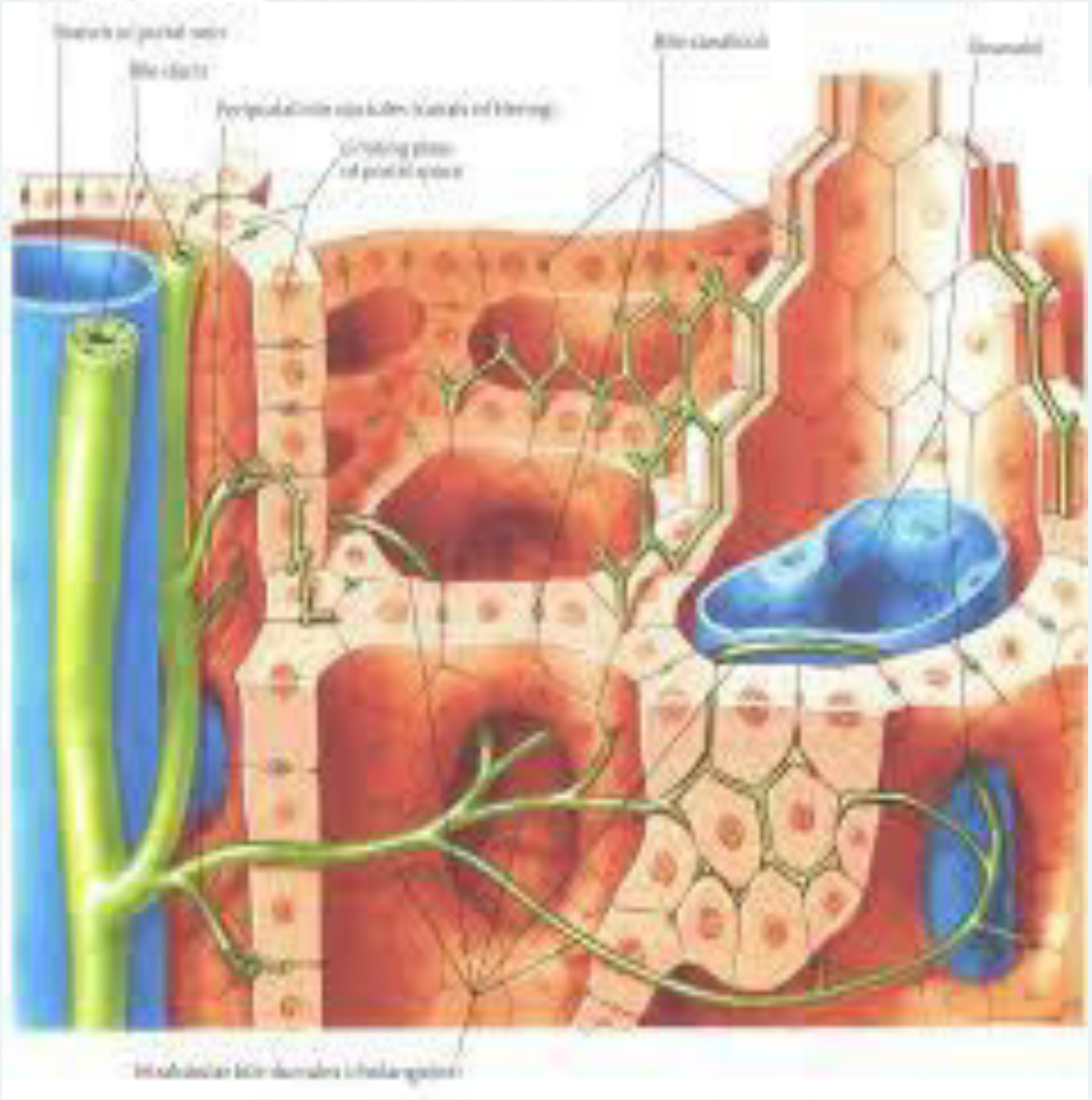
- Bile is secreted into the canaliculi.
- Carried from the centre to the periphery of the lobule.
- Flows in a direction opposite the flow of blood.
- They continue as **ductules of Hering.**

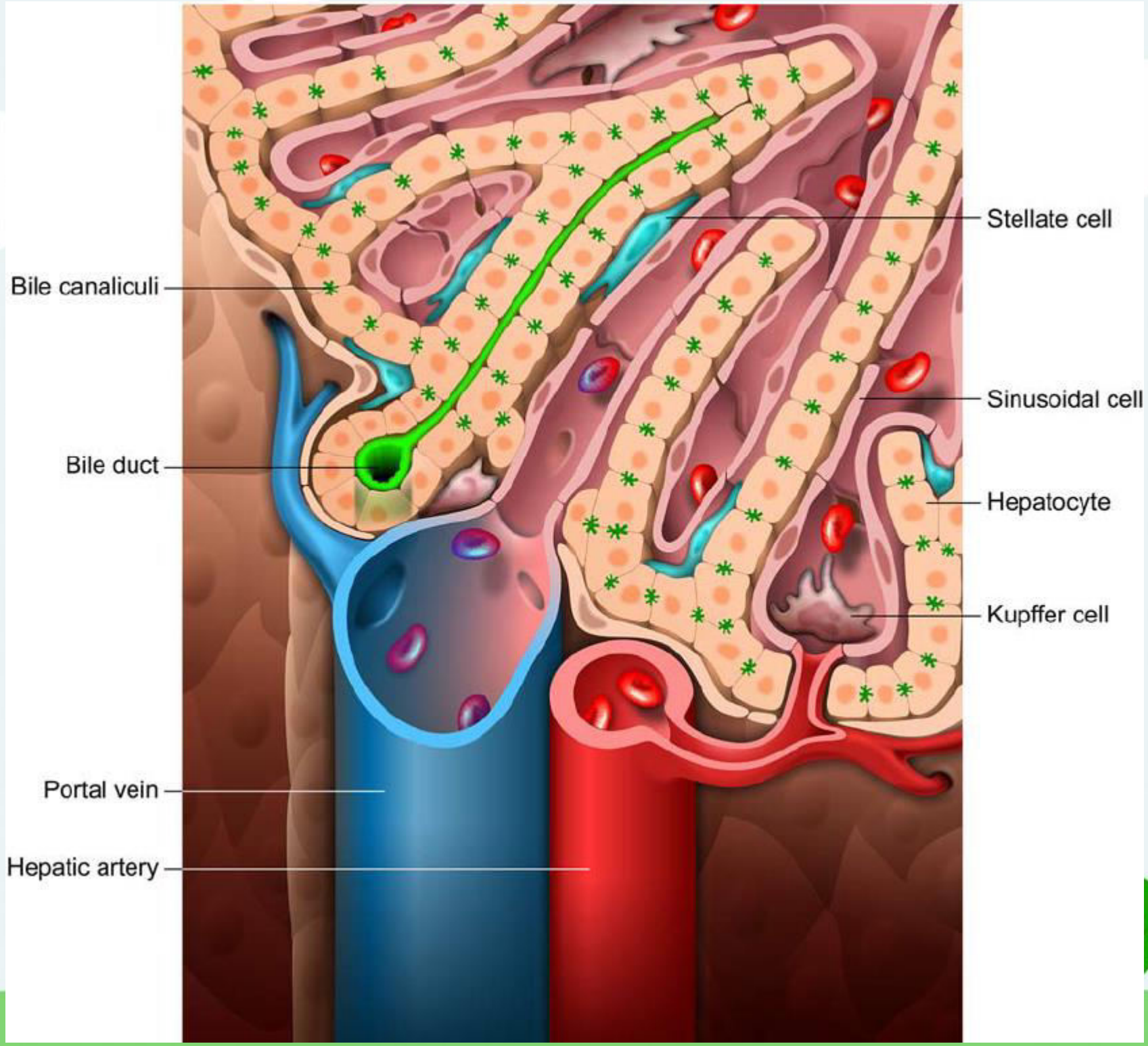


Interlobular bile ducts.

- The ductules join the **interlobular bile ducts**
- Which are present in the **portal triads.**

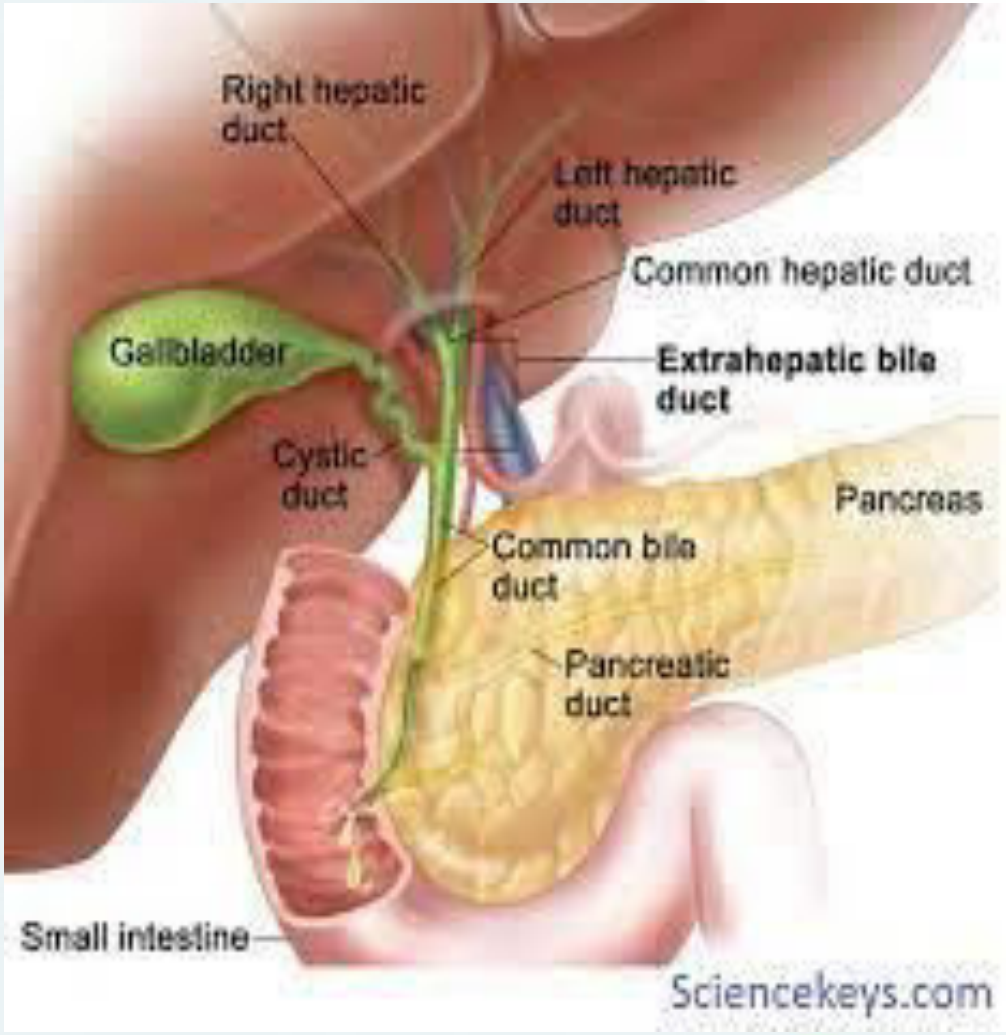





Stellate cell
Bile canaliculi
Sinusoidal cell
Bile duct
Hepatocyte
Kupffer cell
Portal vein
Hepatic artery

Hepatic ducts

- The interlobular ducts join to form **right and left lobar ducts.**
- They join at the hilum to form the extrahepatic common hepatic duct.



Right biliary tree

- Originates in the four areas of the right lobe.
- The branches are named by their locations: **anterosuperior, anteroinferior, posterosuperior and posteroinferior.**
- These join to form the **anterior and posterior segments**
- **Right hepatic duct** is formed by union of anterior and posterior segment ducts at the porta hepatis.
- The average length of the duct is 0.9 cm.
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Left biliary tree

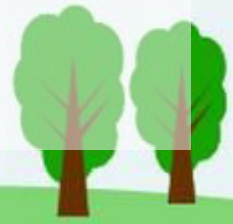
- Formed by the confluence of the ducts of the **medial and lateral segments.**
- **The tributaries of the right and left hepatic drain the caudate lobe.**
- **A separate duct serves the caudate process, draining into the right hepatic duct.**

Remember

- The right hepatic duct drains segments V,VI,VII & VIII of liver
- The left hepatic duct drains segments II, III, and IV.
- The caudate lobe I, drains to both right and left ducts.

Pathway of bile

- Bile produced by hepatocytes drains into **hepatic canaliculi.**
- To the **bile ductules**
- The terminal **bile ducts** in portal triads
- To the **right and left hepatic ducts**.
- It moves to the **common hepatic duct.**
- Then to the **gall bladder** through the cystic duct.
- Drains into the **common bile duct**
- Drains finally into the duodenum.

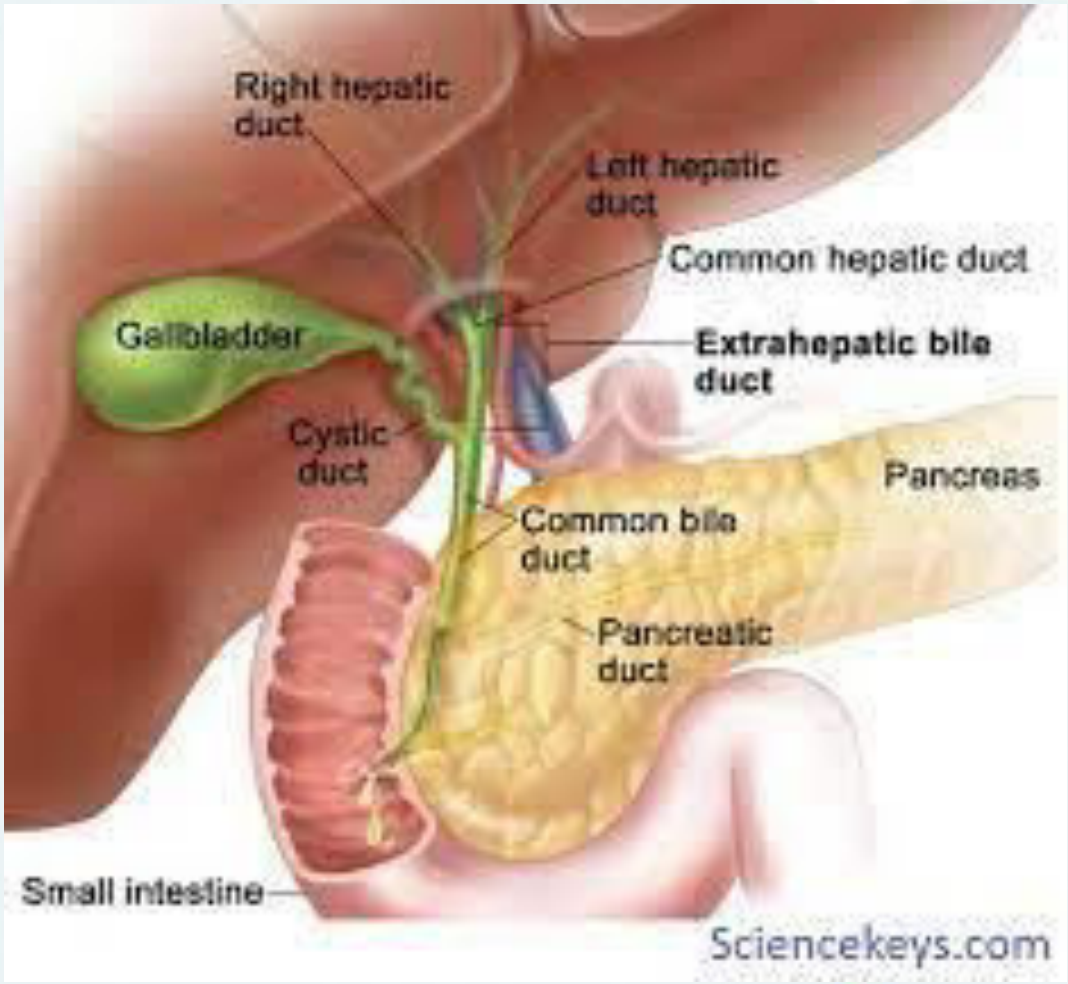


Extrahepatic biliary tree

- The extrahepatic triad consists of the **hepatic artery,hepatic portal vein,and hepatic duct.**
- **The extrahepatic pathway of bile is the common hepatic duct, gall bladder, cystic duct and common bile duct.**

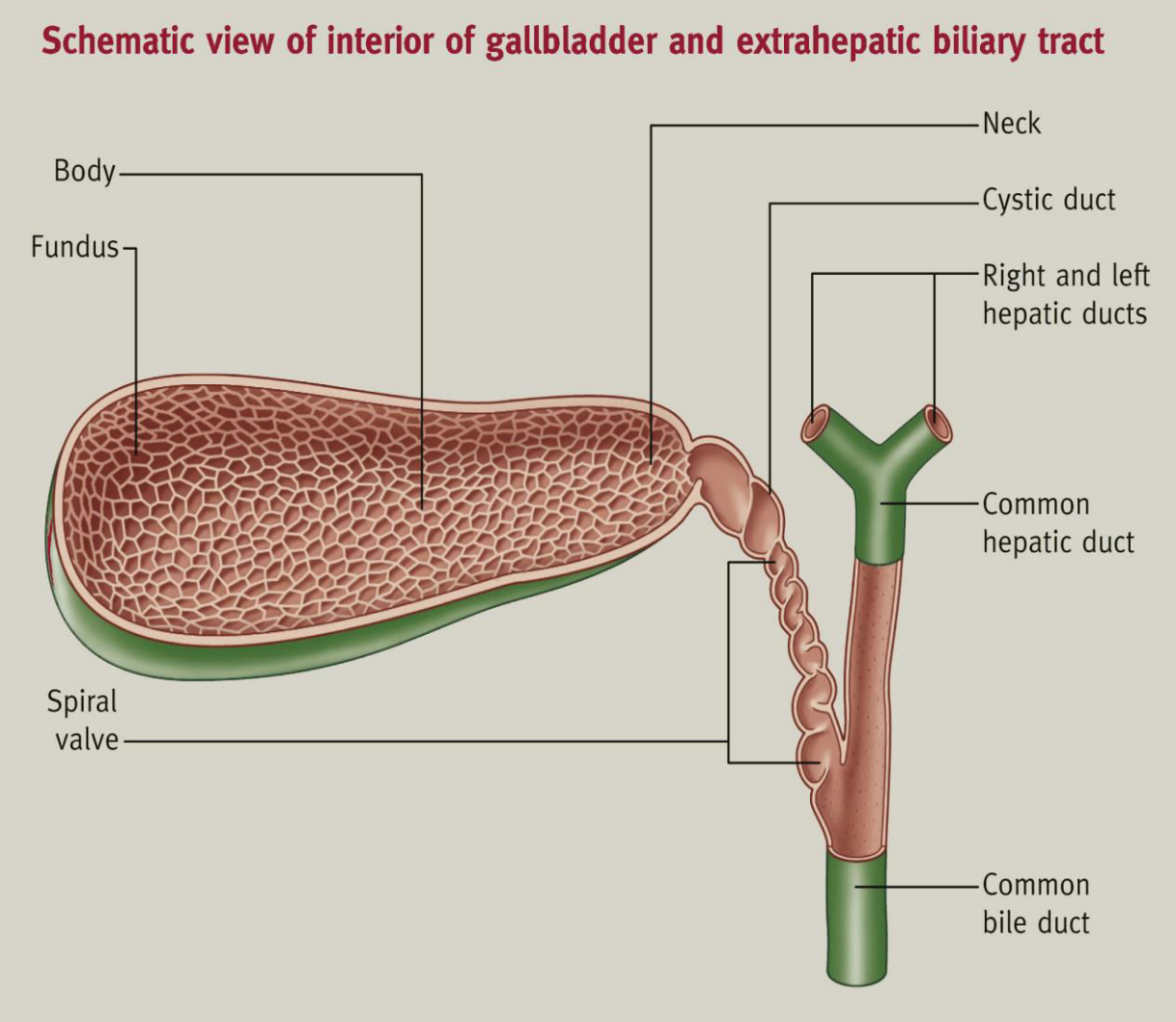
Common Hepatic duct

- Union of right and left hepatic ducts in the porta at the transverse fissure of liver.
- The lower end of the porta is at its junction with the cystic duct.
- The distance between the two points is 1.0cm to 7.5 cm.
- Diameter is 0.4 cm

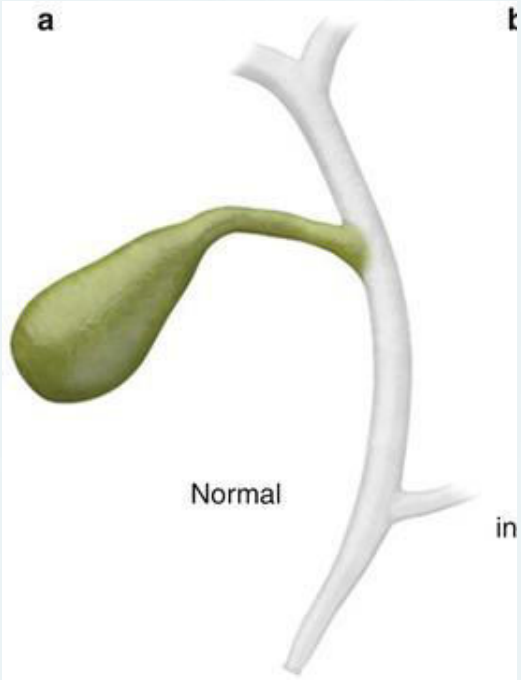


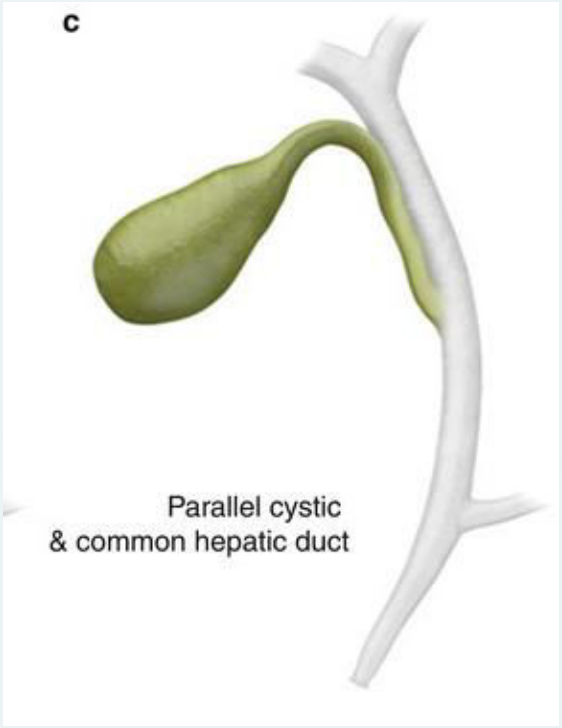
Cystic duct

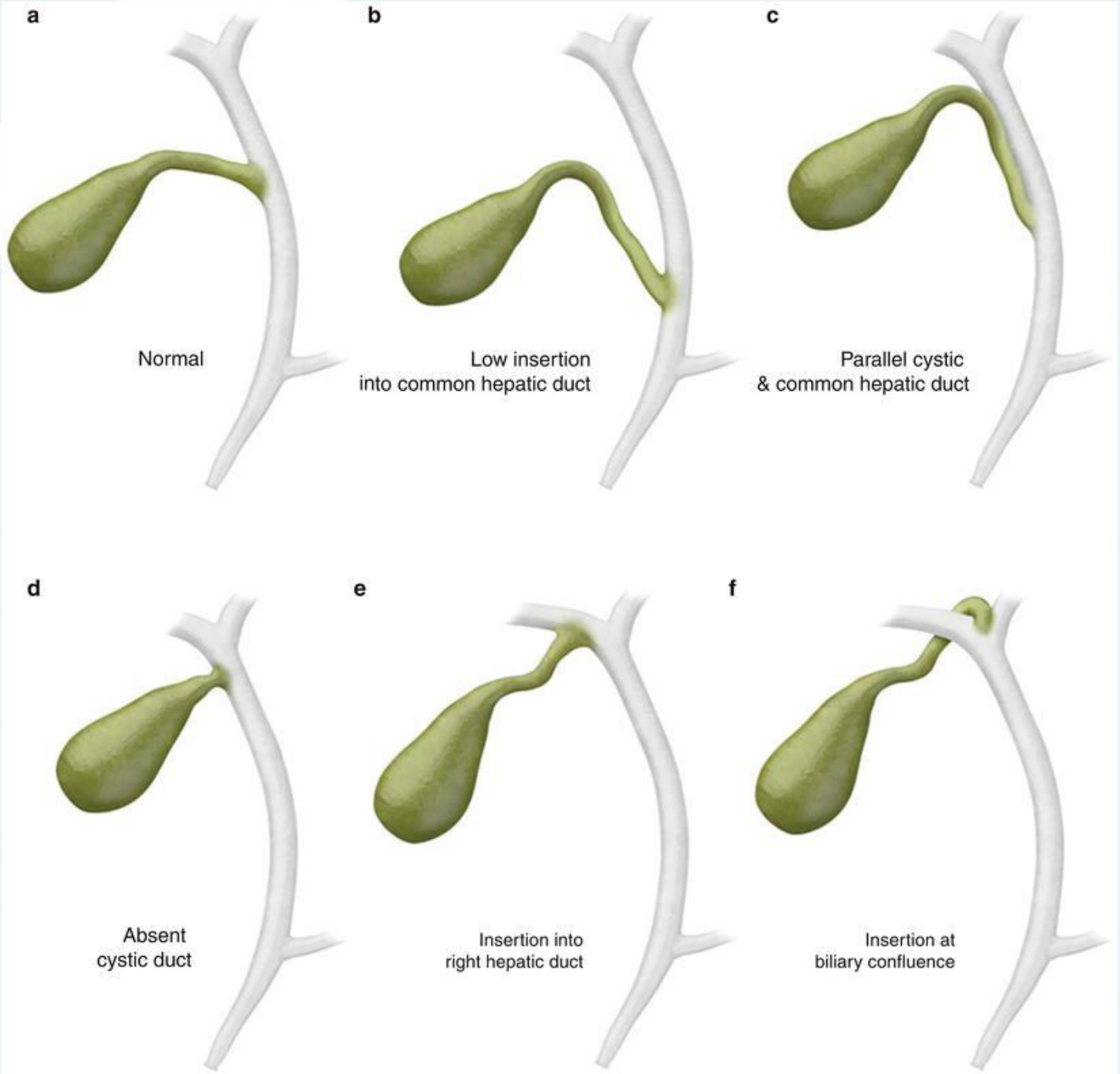
- Contains 5-12 crescent shaped folds of mucosa
- These are the **spiral valves of Heister.**



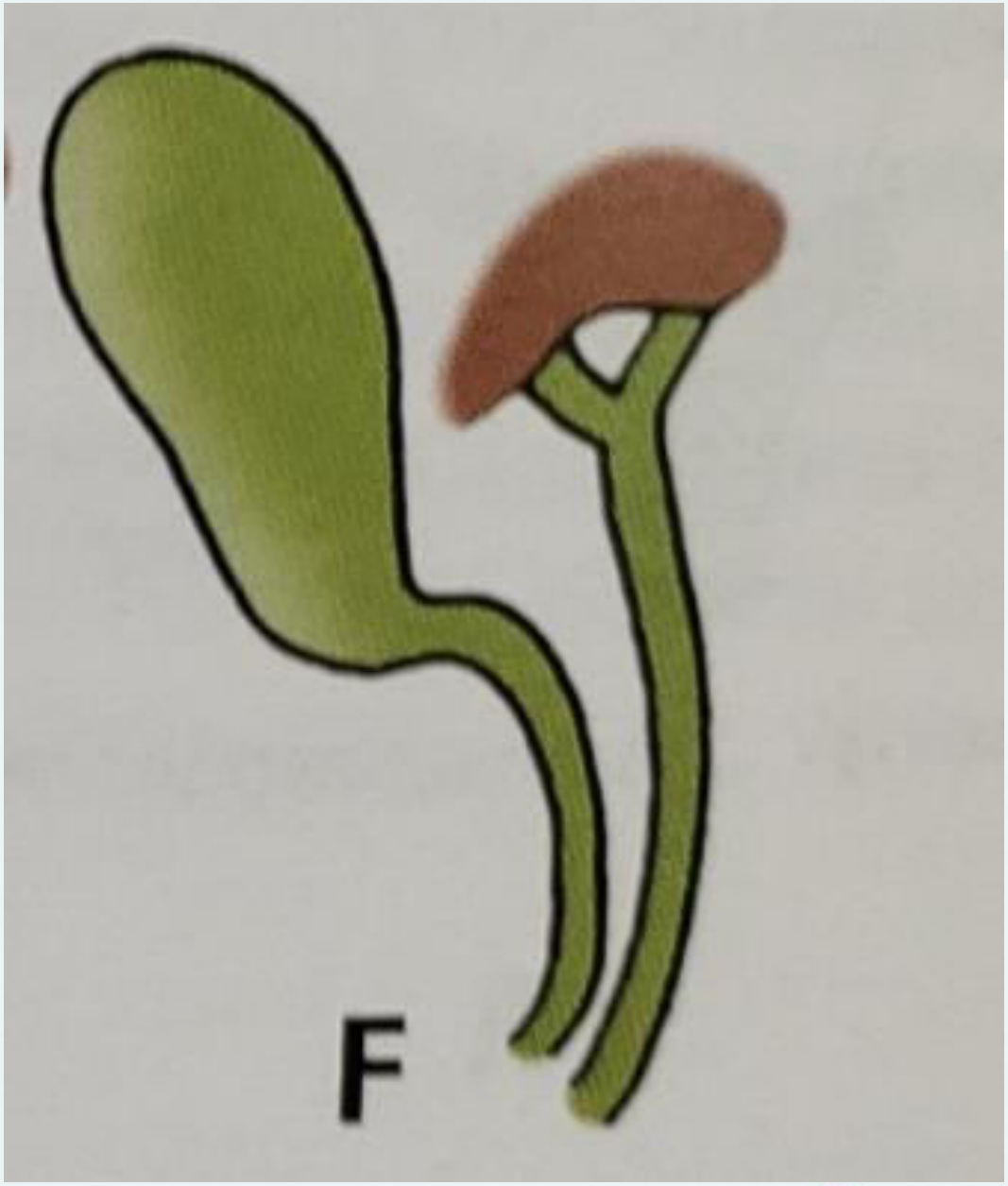
- Cystic duct joins the hepatic duct at an angle of about 40º(75%)
- **Variations:** it may pass parallel to hepatic duct and may enter the duodenum separately-absence of common bile duct.

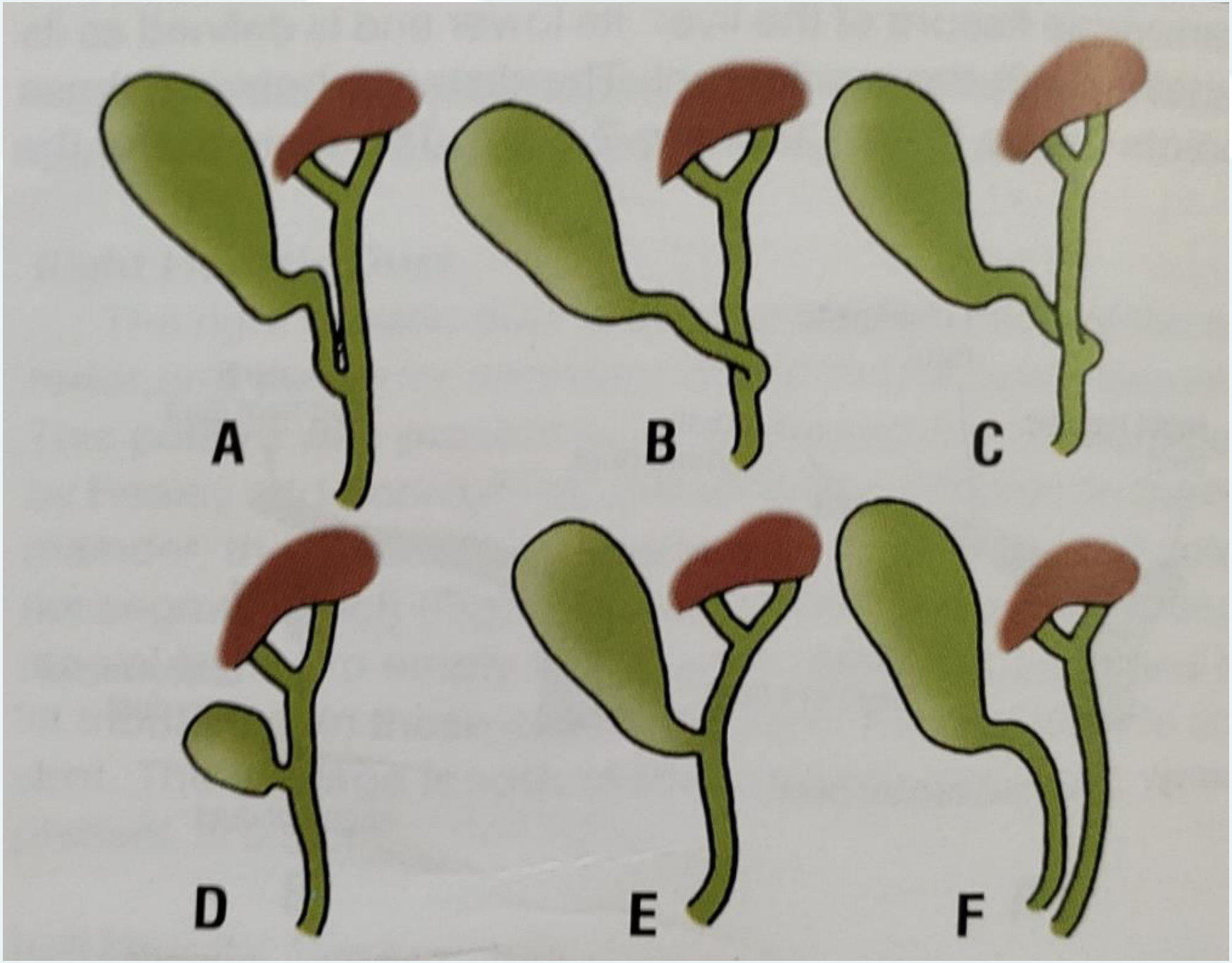




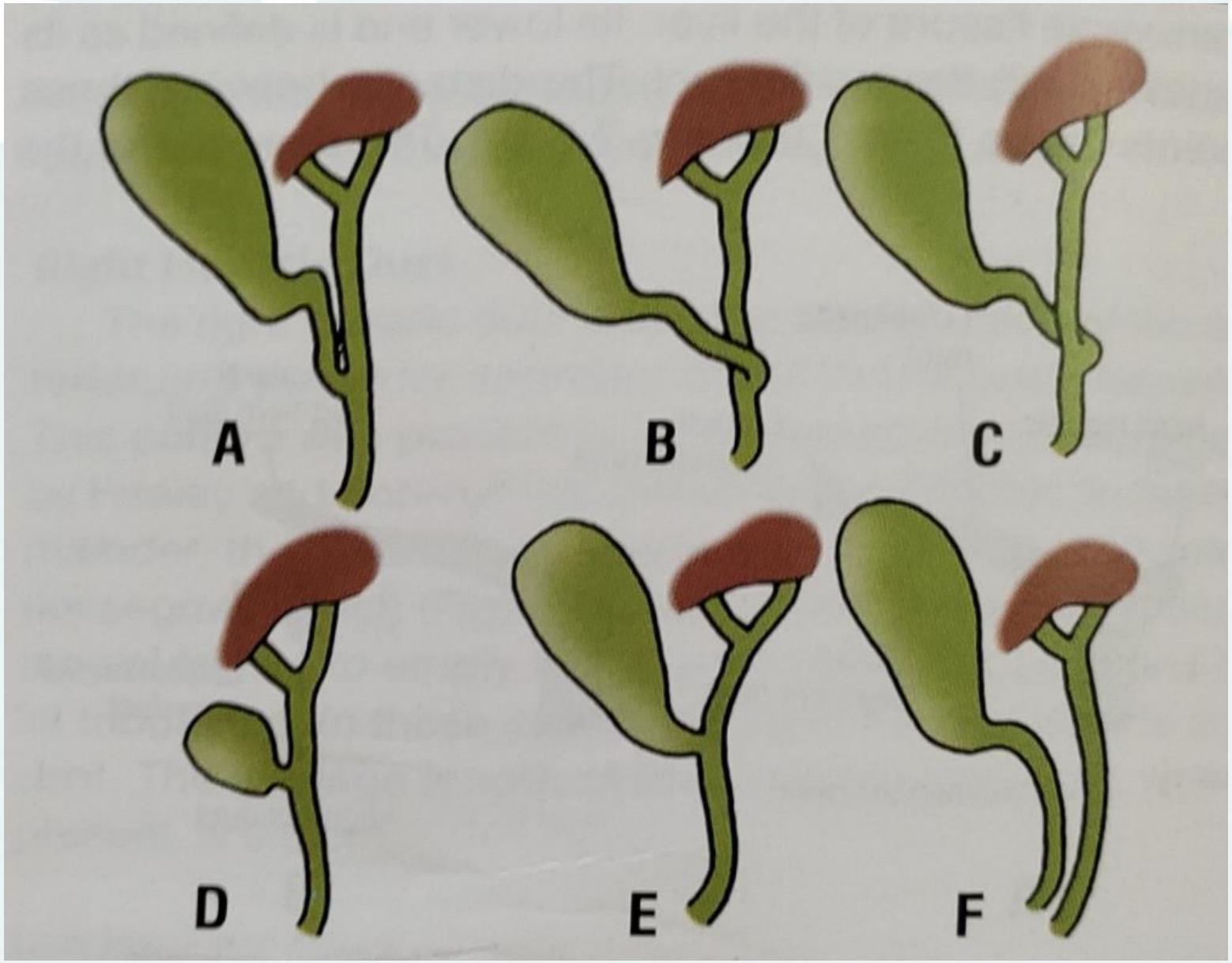

a
Normal
b
Low insertion
into common hepatic duct
c
Parallel cystic
& common hepatic duct
d
Absent
cystic duct
e
Insertion into
right hepatic duct
f
Insertion at
biliary confluence

- In the parallel type the long cystic duct may be left in place by the surgeon ligating the cystic duct.
- This causes **cystic duct remnant syndrome.**




A
B
C
D
E
F

- A sessile gall bladder has no cystic duct.

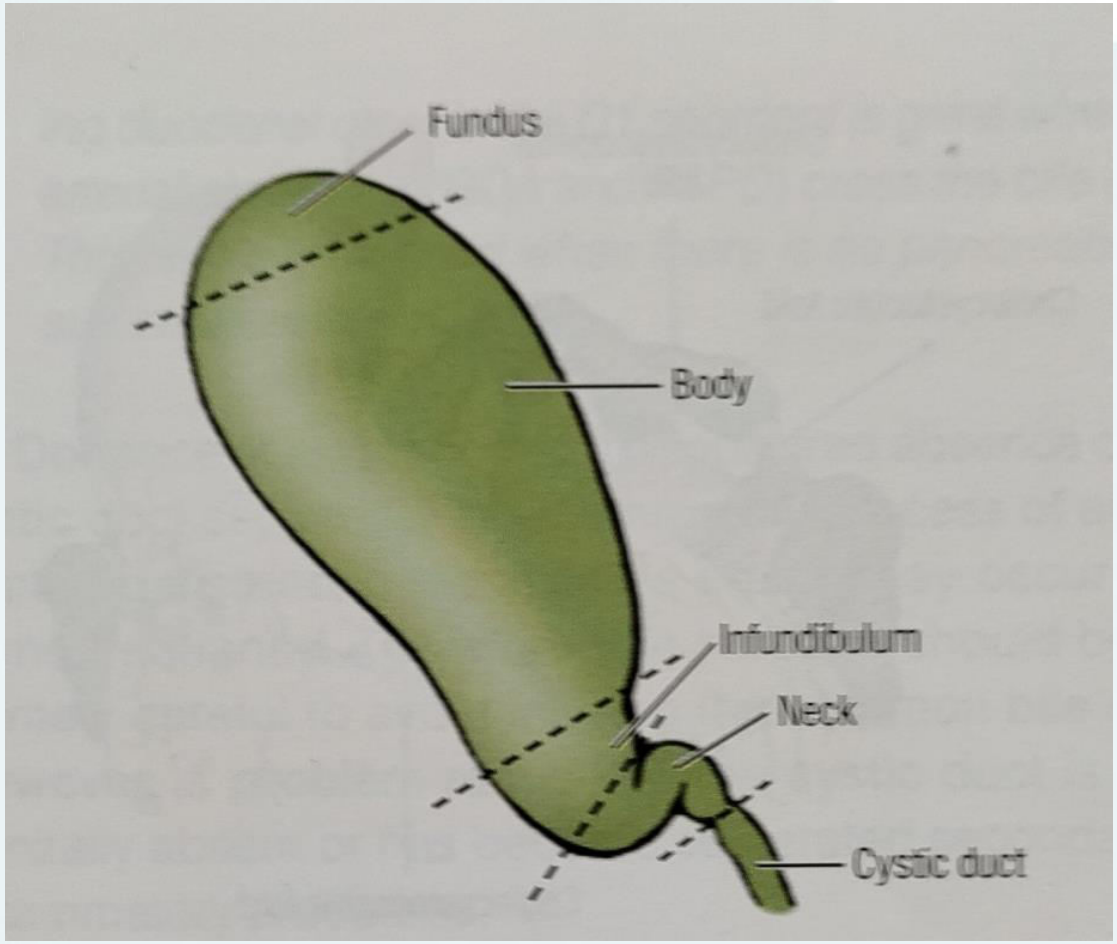


“White bile”

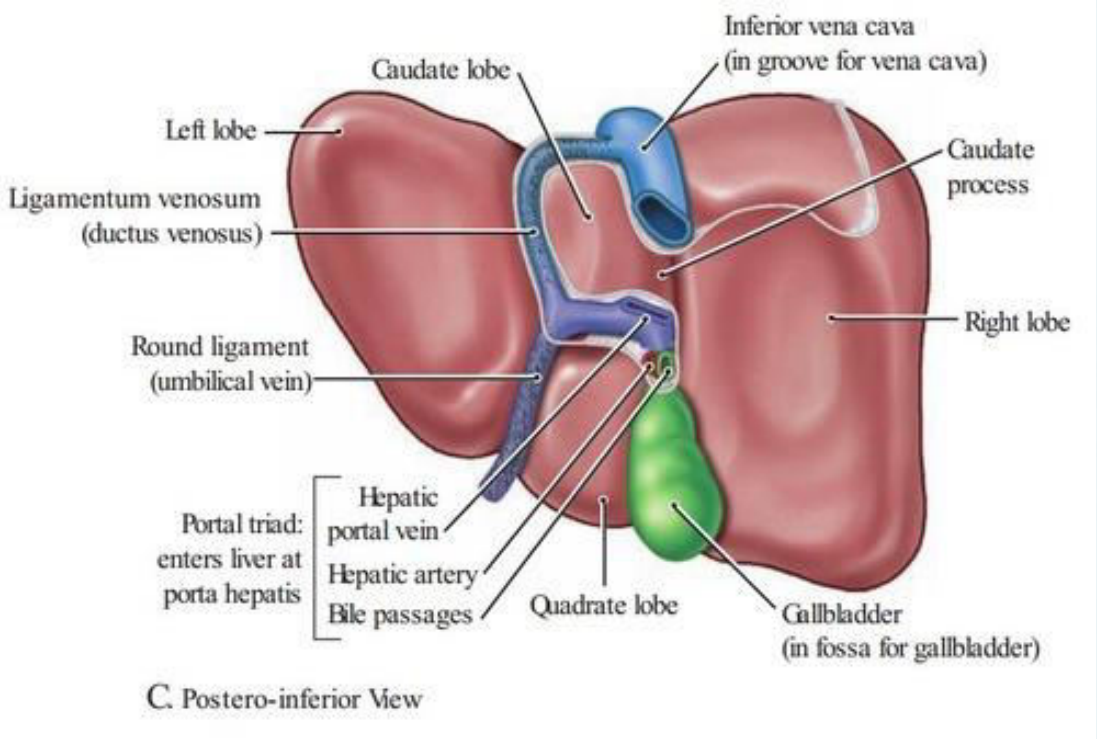
- The pressure of secretion of mucous glands in the cystic duct is higher than the secretion pressure of bile.
- **Prolonged obstruction of extrahepatic biliary tree proximal to cystic duct results in “white bile”** composed of mucous only.

Gall bladder

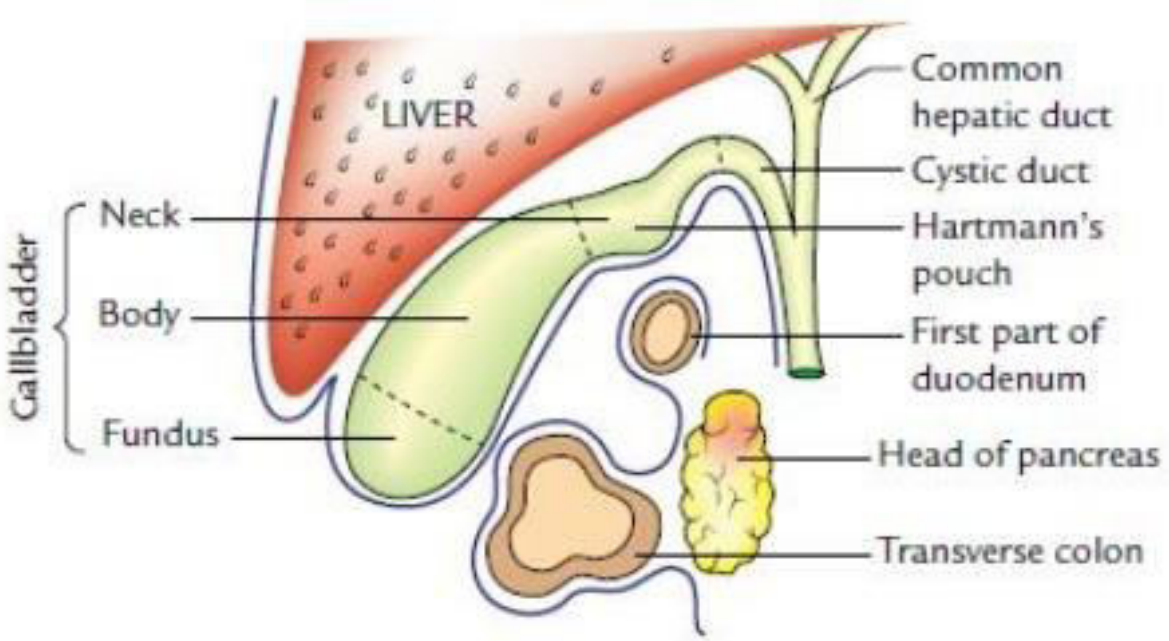
- It is 7-10 cm long.
- Capacity of 30-50ml
- Located on visceral surface of liver
- In a shallow fossa at the junction of the quadrate lobe(segment IV) and the right lobe of liver
- This is along the line of Rex.



- **Line of Rex** is the line of interlobar fissure or median fissure
- It extends from the gall bladder fossa below to the inferior vena cava above.



- Gall bladder is separated from the liver by Glisson's capsule
- Anteriorly covered by peritoneum which is continuous with that of liver.

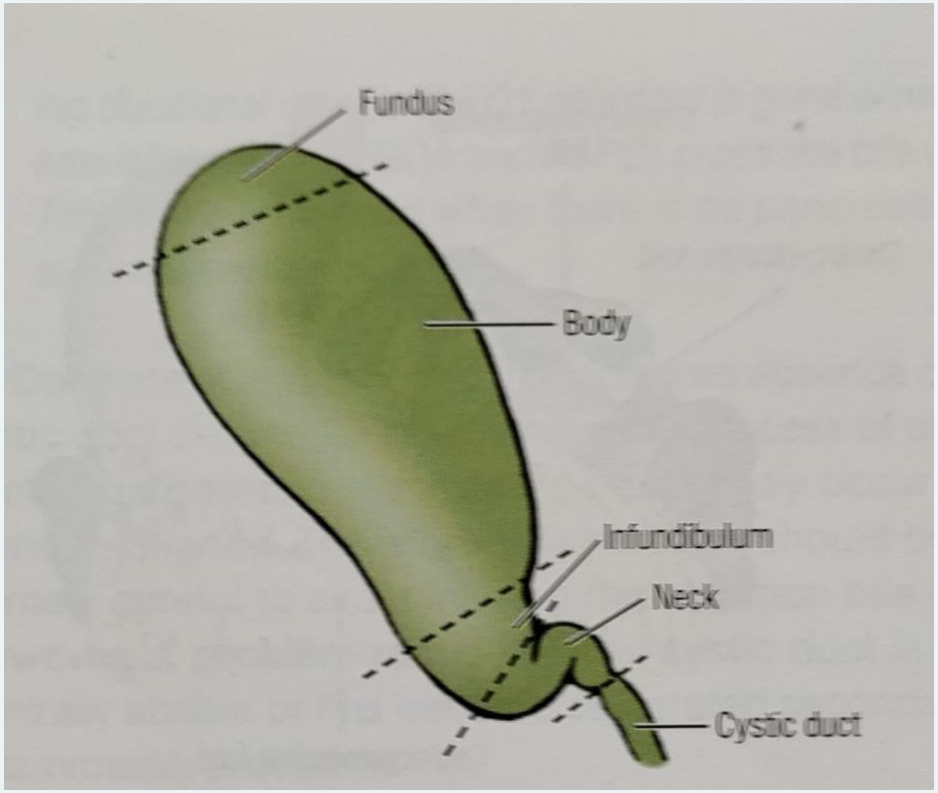


Peritoneal covering of gallbladder

Covered by peritoneum except for the surface resting on liver.

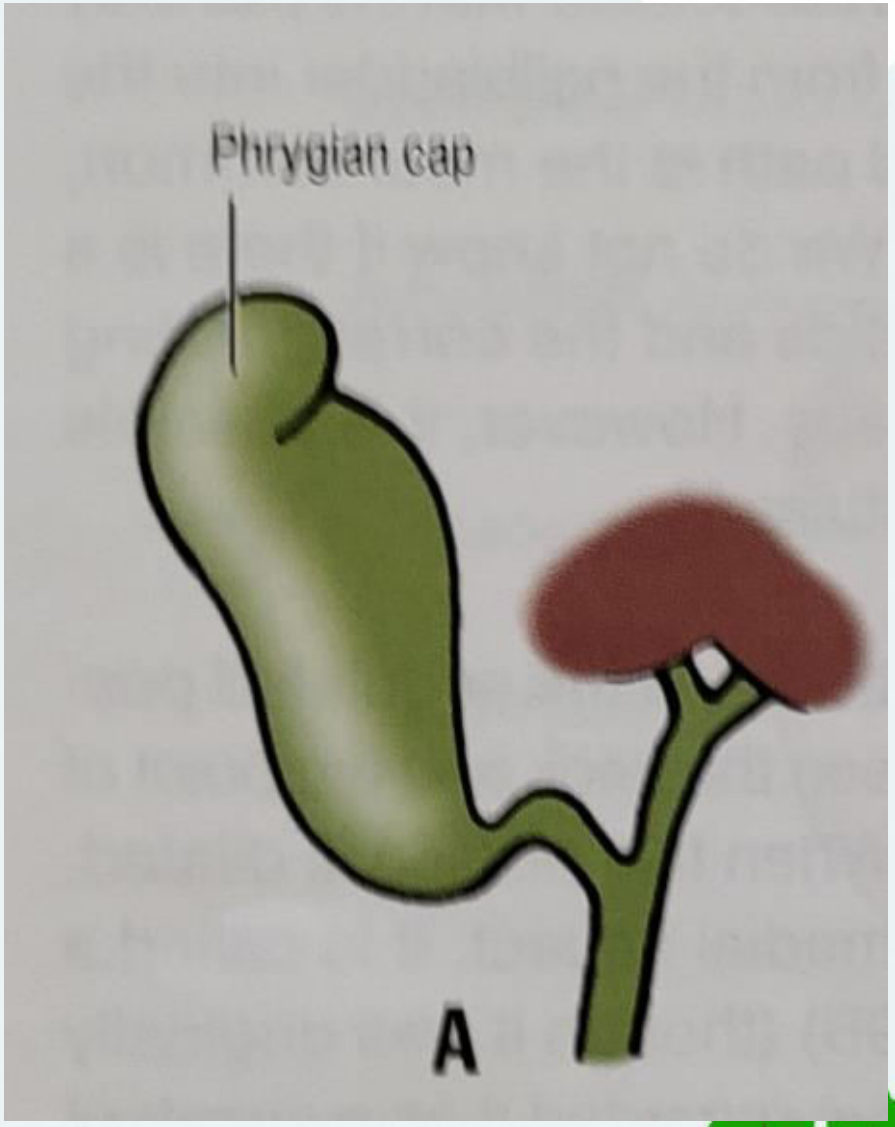
Parts of gall bladder

- **Fundus** is usually located at the angle of the 9 costal cartilage with the right border of the rectus sheath.
- To the left of hepatic flexure of colon.
- Completely covered by peritoneum.
- It projects beyond the lower border of liver.



“Phrygian cap”

- **A partial folding of the fundus** may result in such a deformity
- It is a greek term used for the liberty cap a symbol of the French Revolution.
- 2-6% of cases only.
- Due to defective musculature of the fundus.
- Risk for lithiasis is higher.



Body of fundus

- Occupies the gall bladder fossa of the liver.
- It is related to first and second portions of duodenum and transverse colon.
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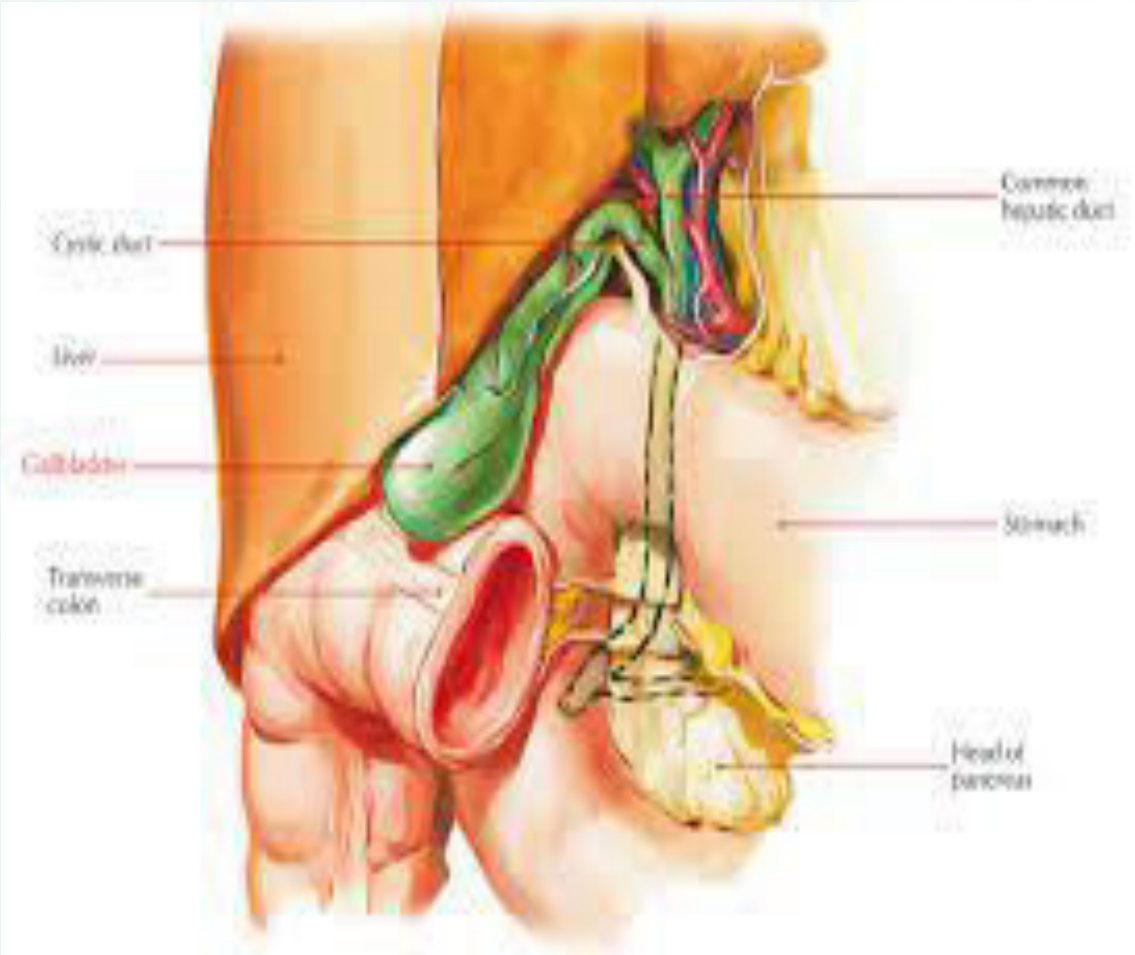
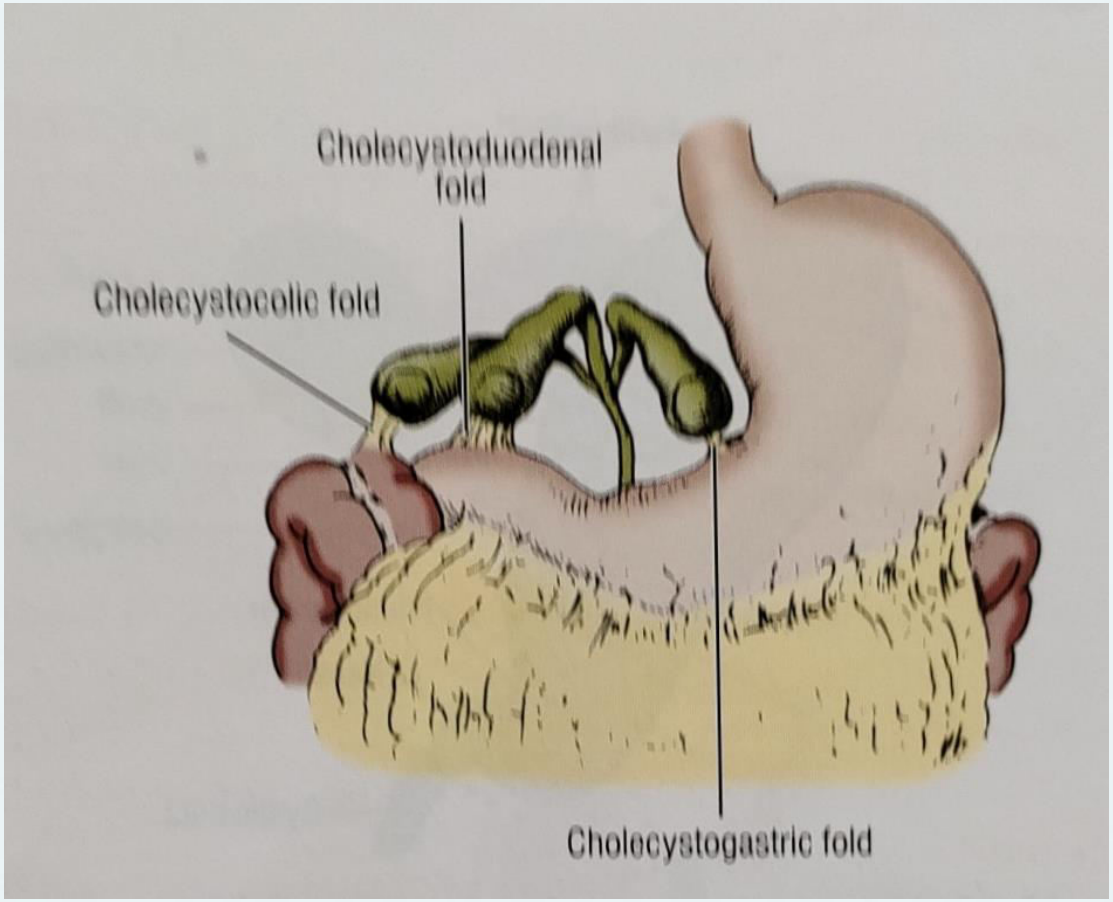
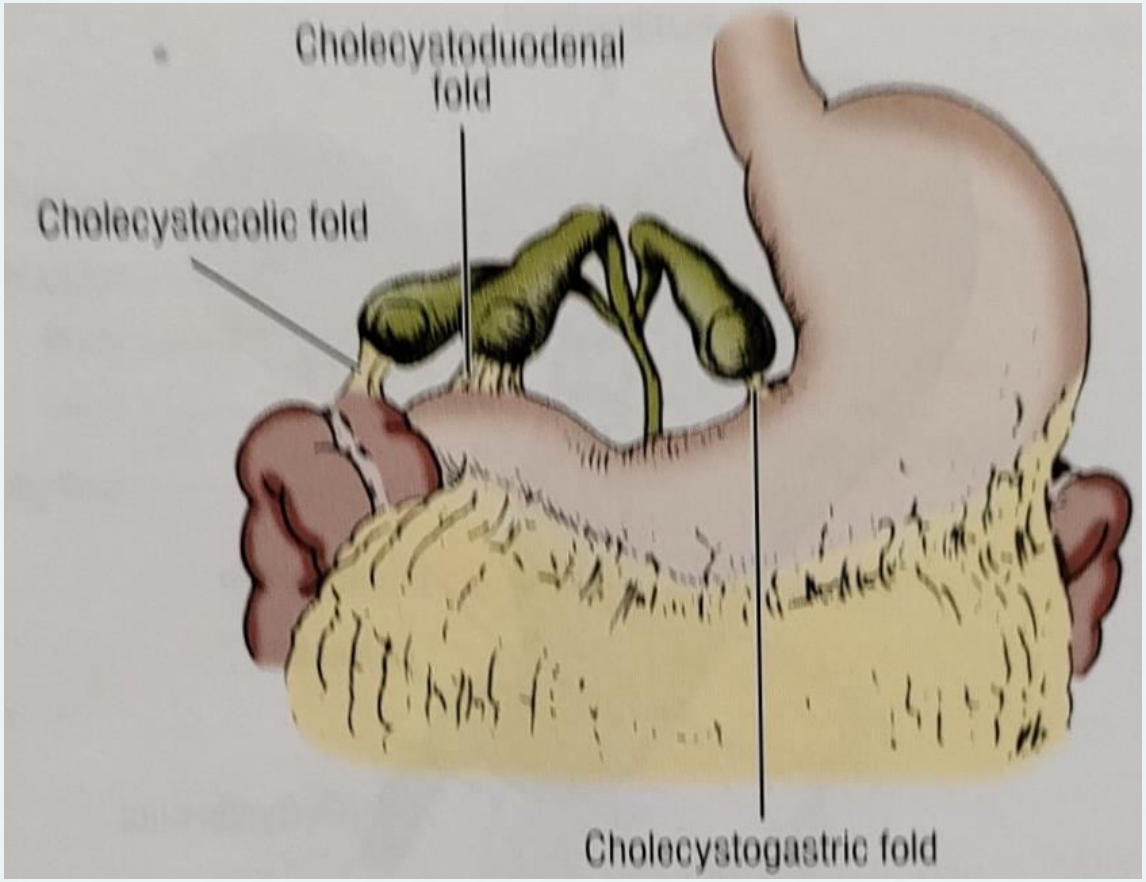


Wandering gall bladder

- Rarely is a mesentery present when it is completely covered by peritoneum.
- It causes acute torsion of gall bladder.
- Peritoneal folds may extend to the duodenum, colon,or stomach.

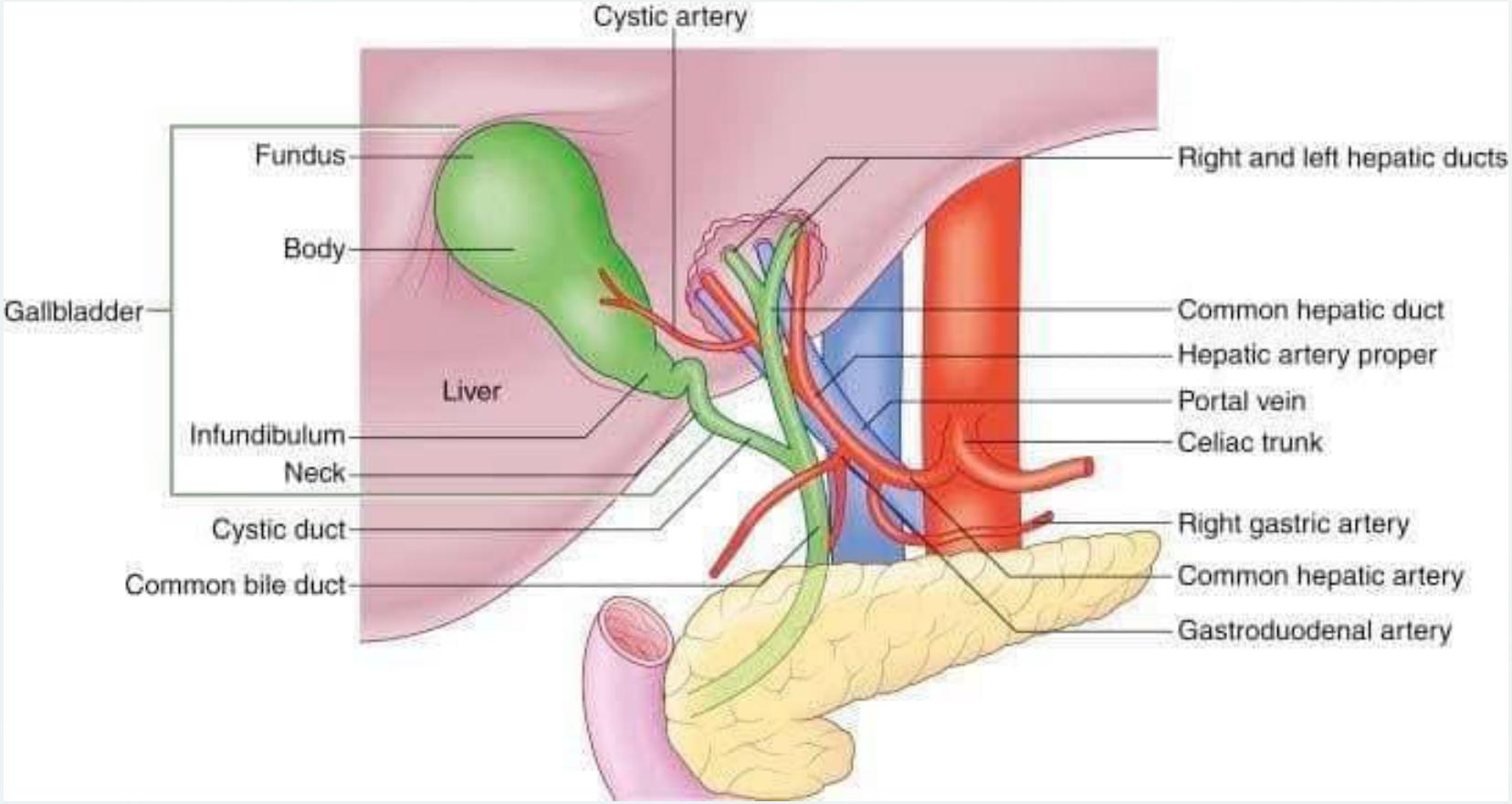


- The peritoneal folds may form a pathway for gall stones ulcerating the gall bladder into the intestinal tract.
- Duodenal path is the most common.
- Gastric path is rarest.



Infundibulum

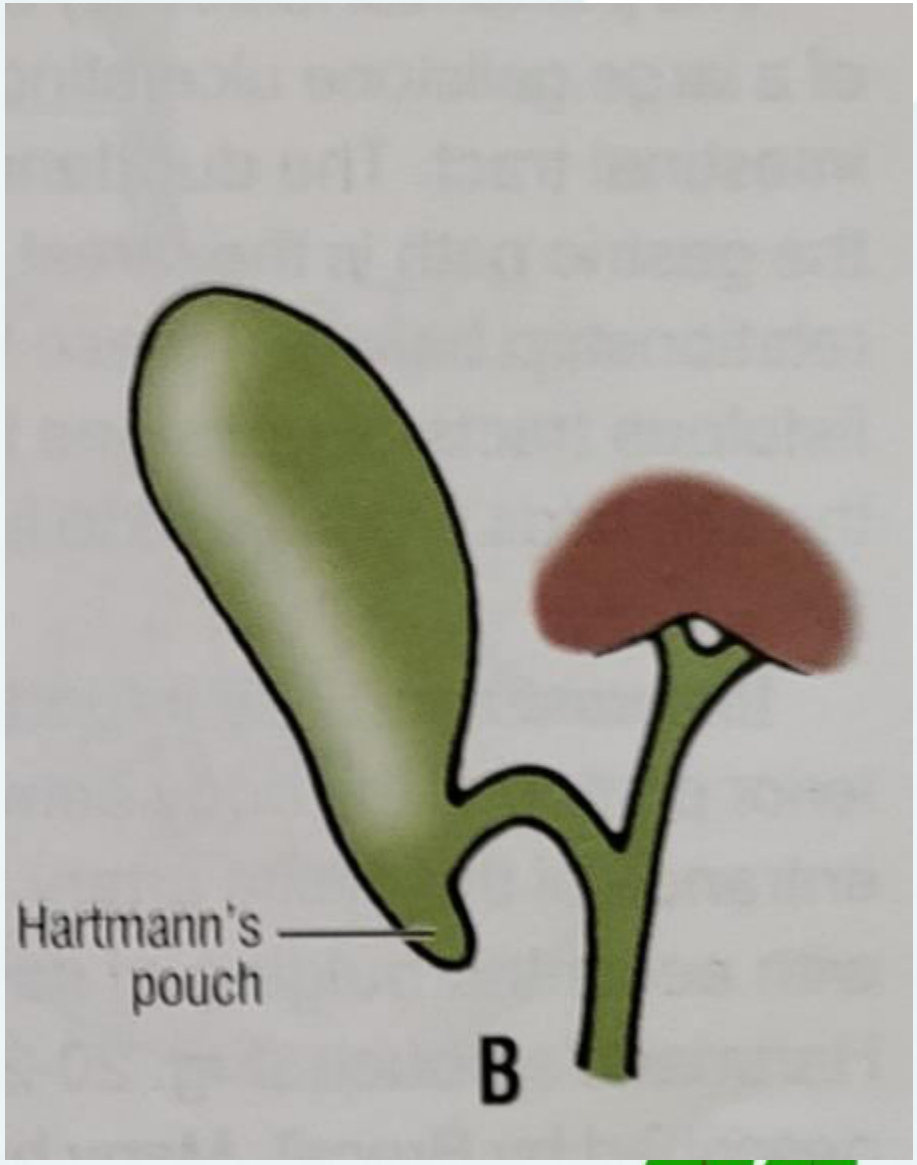
- It is the angulated posterior portion of the body **between the neck and the point of entrance of the cystic artery.**



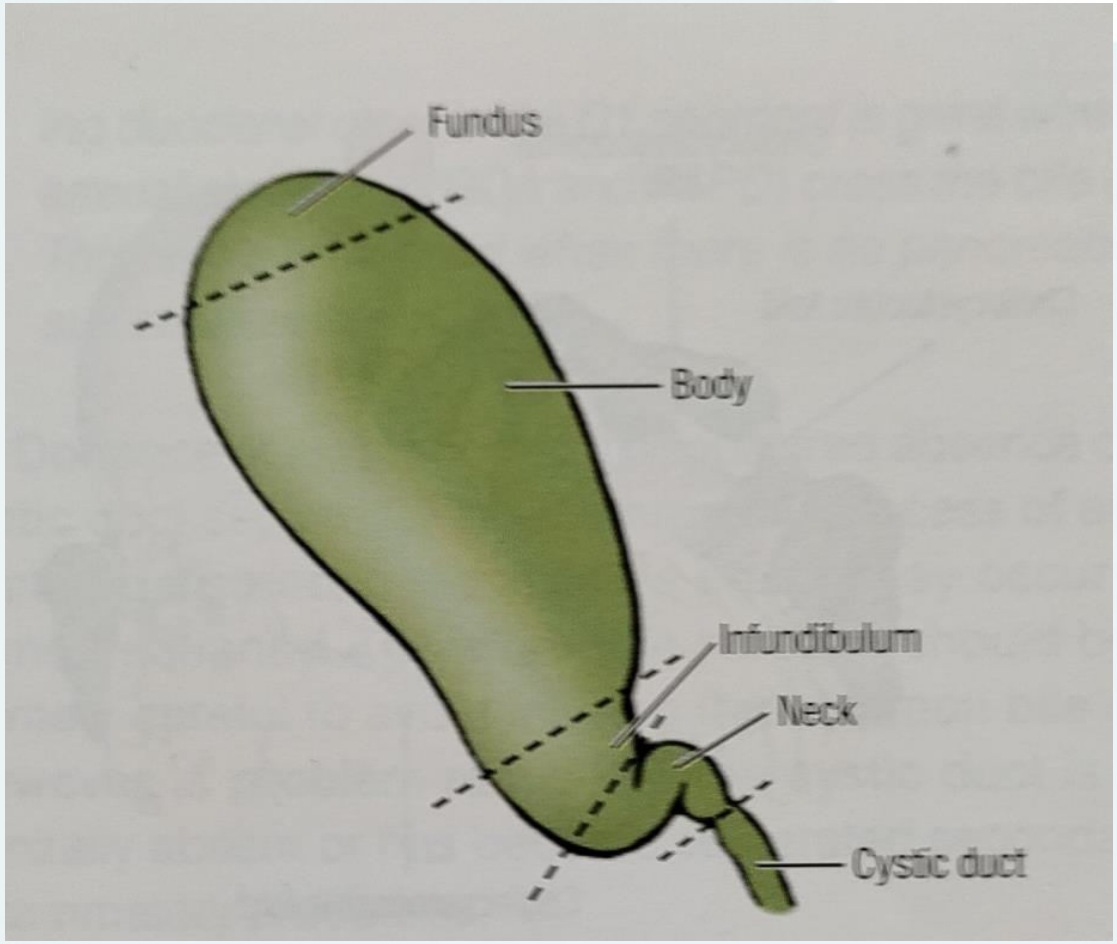
An eccentric bulging of its medial aspect when the portion is dilated is called **Hartmann's pouch.**

Associated with chronic or acute inflammation due to lithiasis

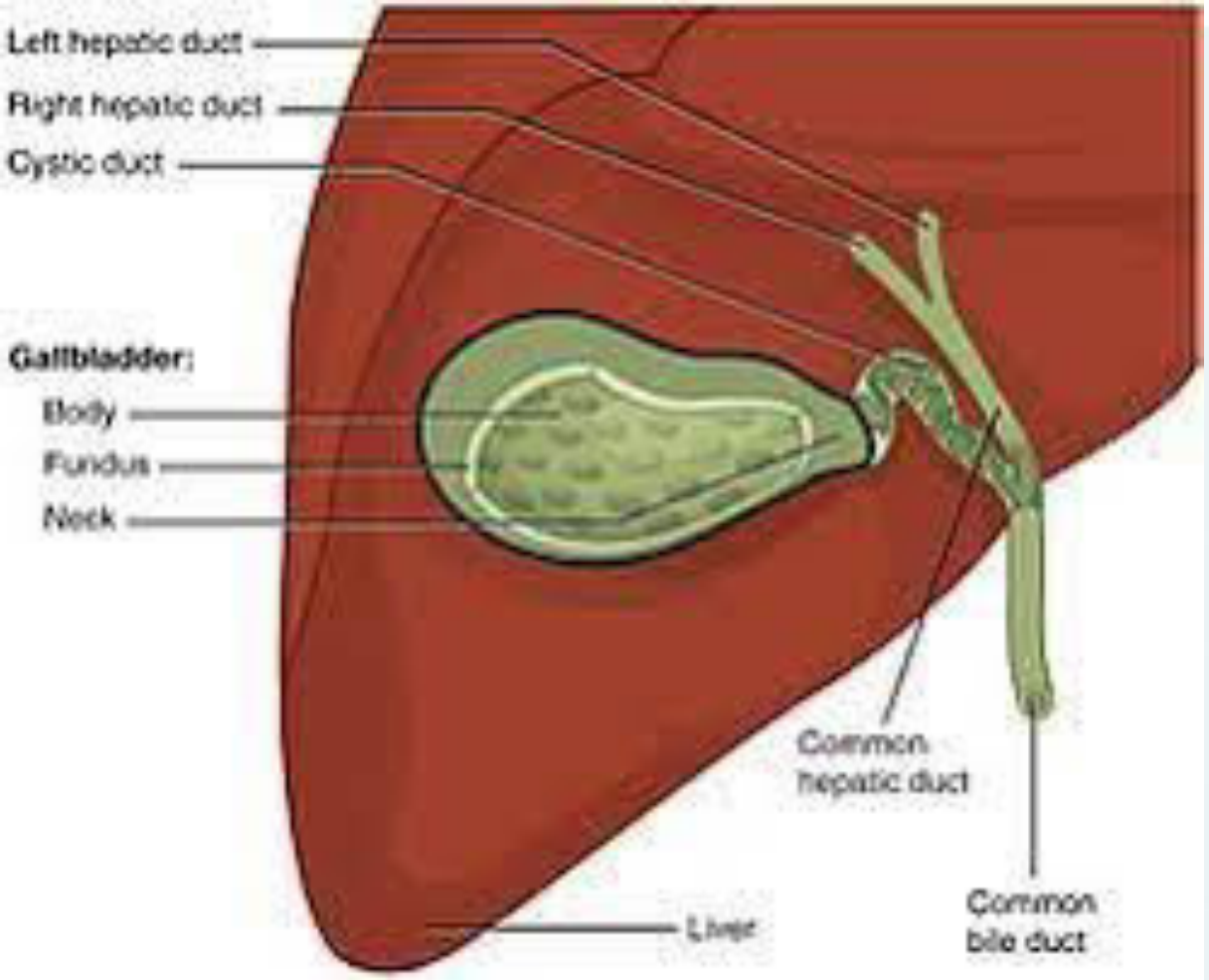
Accompanies a stone impacted in the infundibulum.



- **The neck** curves up and forward and then back and downward
- It forms a **S shape** to become the cystic duct.
- The cystic artery is found in this region
- In the loose connective tissue that attaches the neck of gall bladder to the liver.
- It lies in the free border of hepatoduodenal ligament.



- The mucosa lining the neck is a spiral ridge.
- When neck is distended it forms a spiral groove on the surface.



- The **constriction** at the junction of the neck and cystic duct
- And the ridges of **valve of Heister** in the cystic duct
- **Interfere with passage of an instrument**
- **May stop the passage of gall stones.**

Common Bile Duct

- Ductus Choledochus
- Begins at the union of the cystic and common hepatic ducts
- Ends at the papilla of Vater in the second part of the duodenum.
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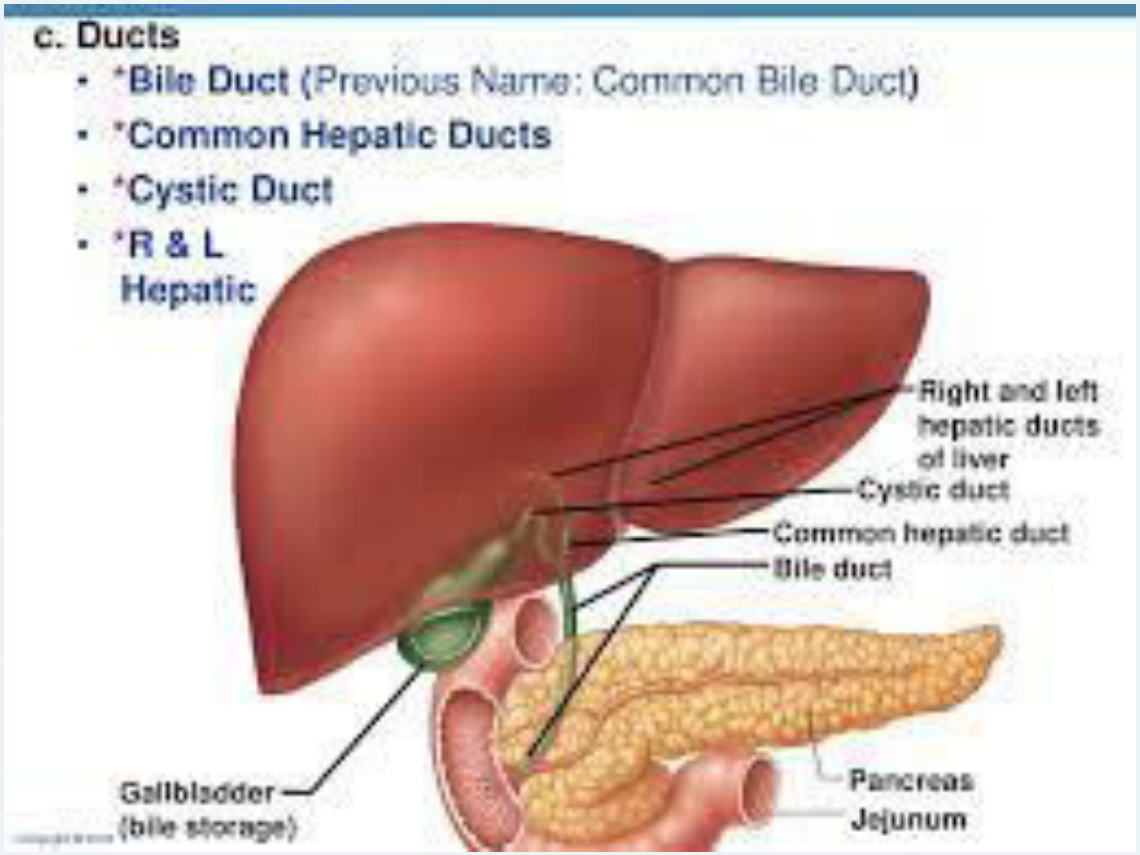
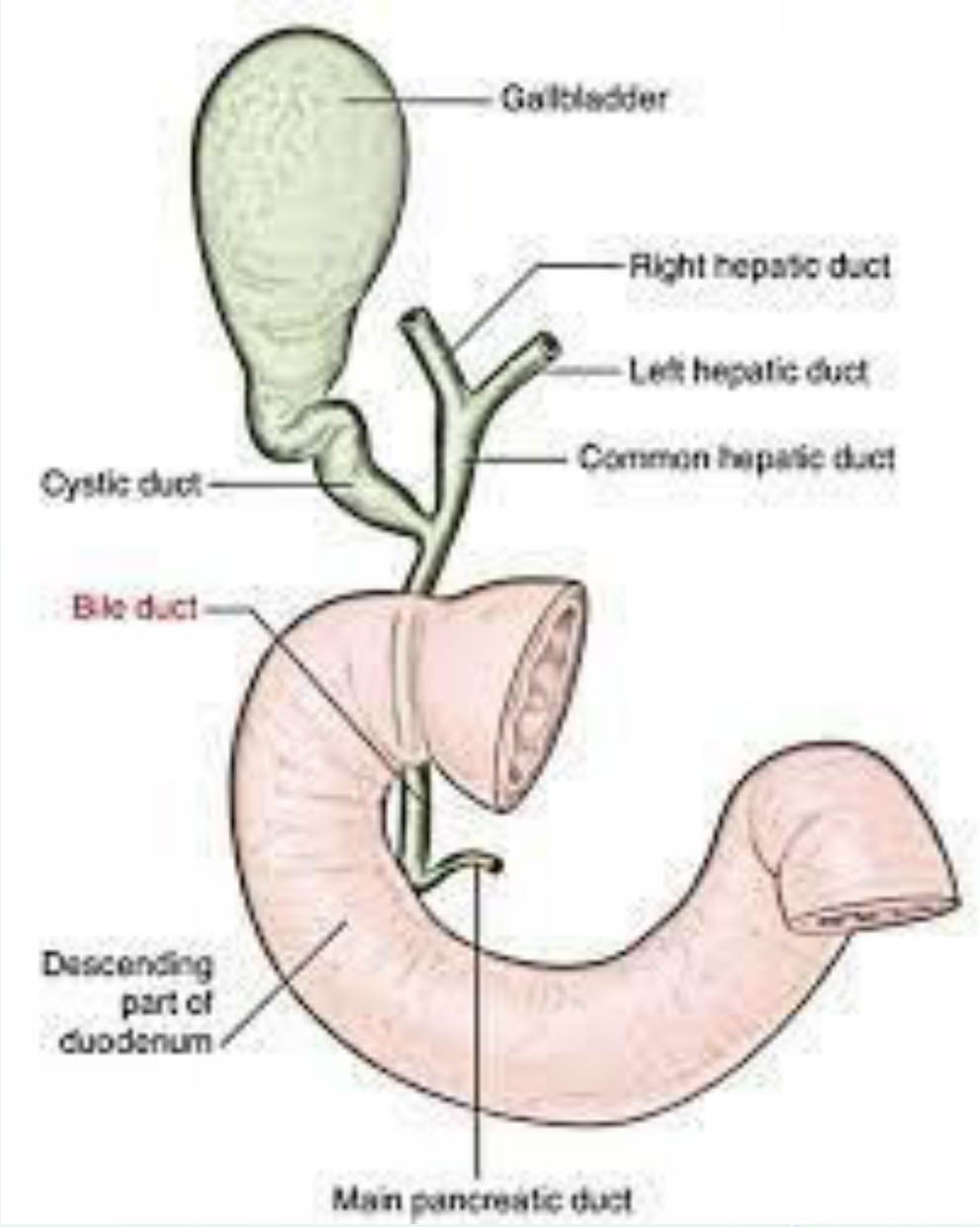
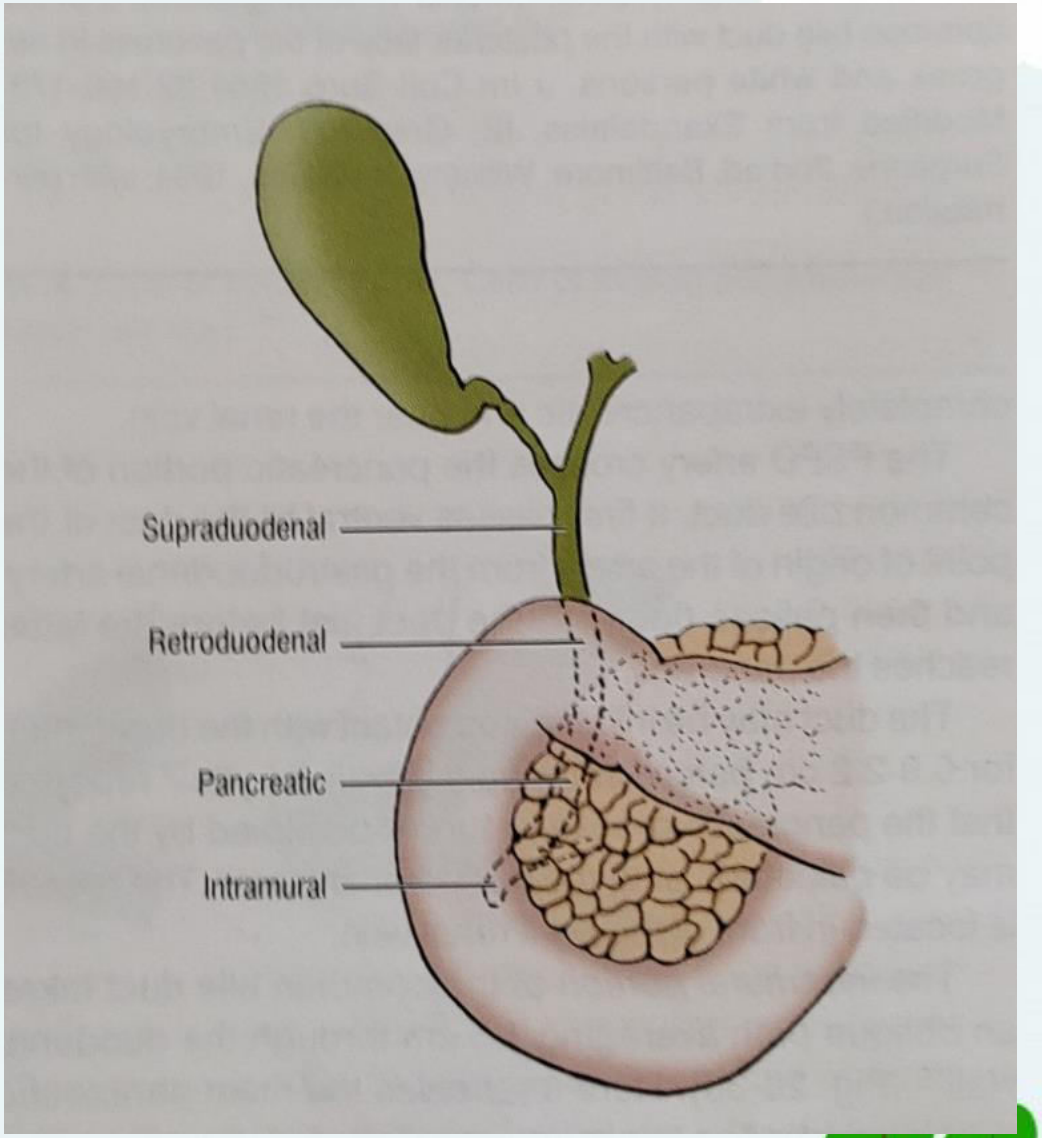


- Length: 5 to 15 cm
- Diameter is 6mm
- Sometimes it runs parallel to cystic duct for 17 mm before they unite.



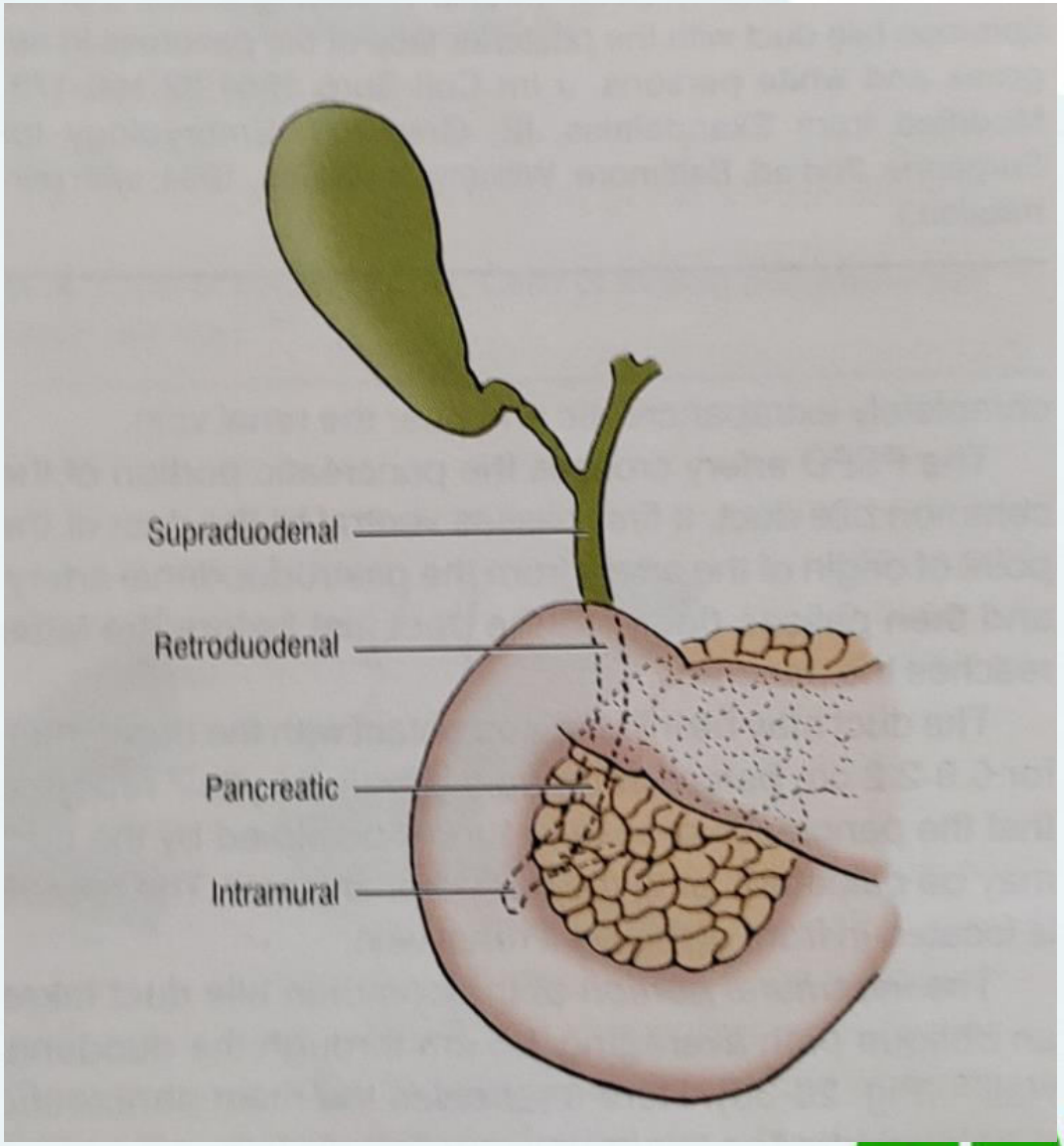
Four segments

- It is divided into four segments.
- Supraduodenal
- Retroduodenal
- Pancreatic
- Intramural.



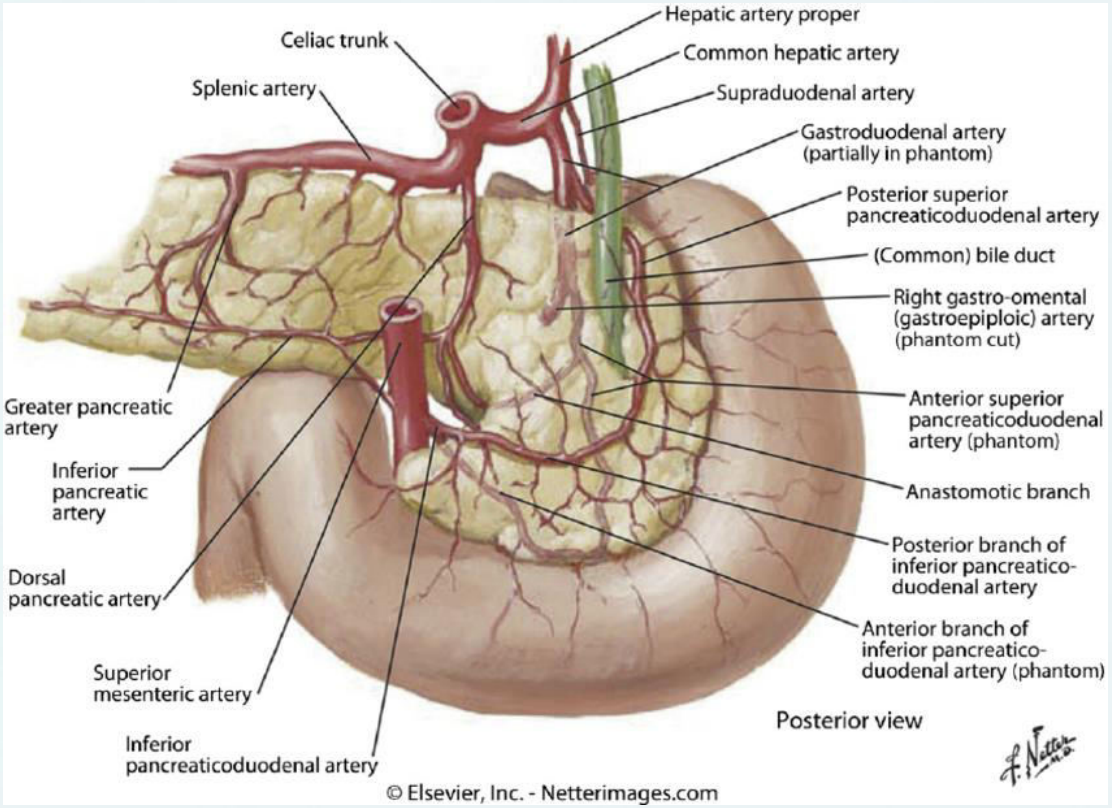
Supraduodenal part

- 2-5cm in length
- Lies between the layers of the hepatoduodenal ligament
- In front of epiploic foramen of Winslow
- To the right or left of hepatic artery.
- Anterior to portal vein

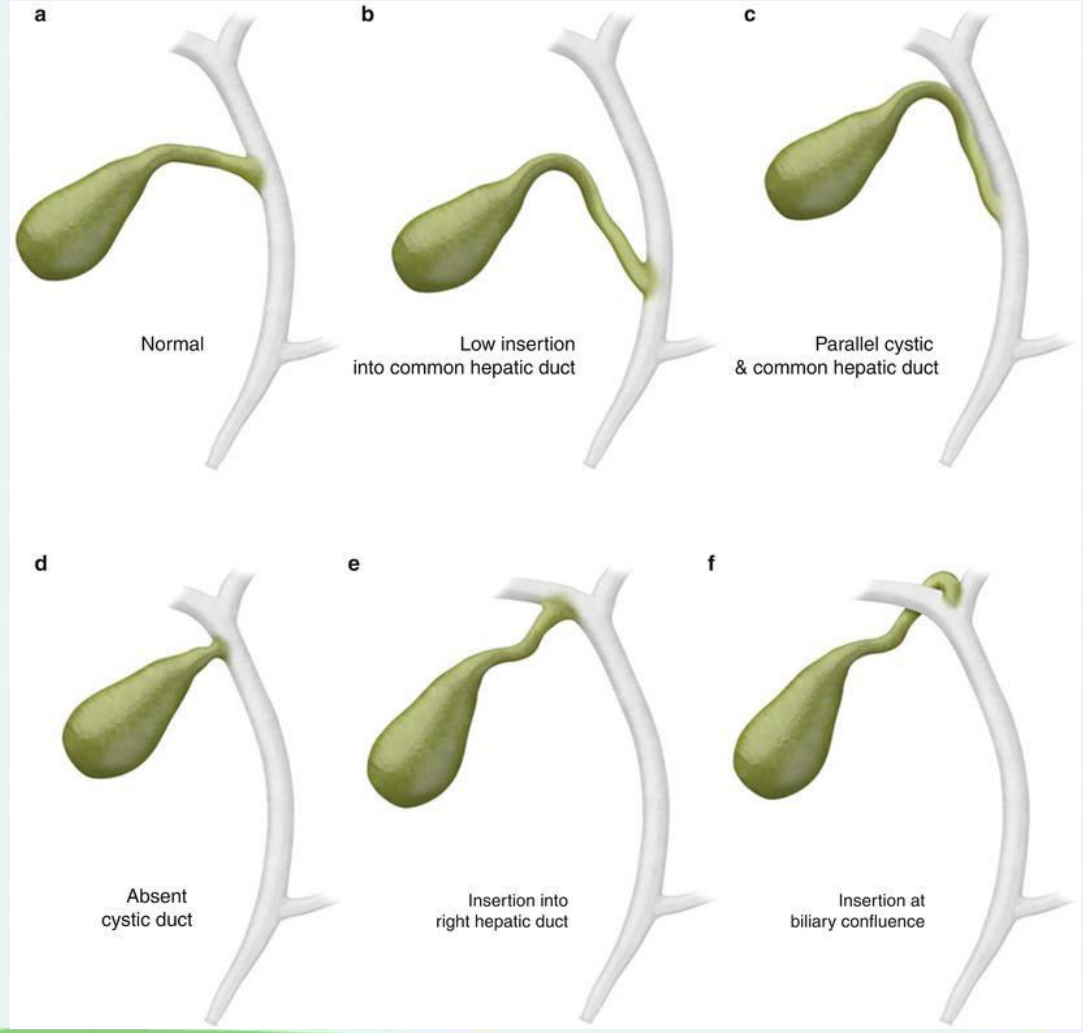


Injury to PSPD artery.

- Distal part of supraduodenal portion is related to posterior superior pancreaticoduodenal(PSPD) artery.
- The artery is present behind duodenum
- **It crosses the duct first anteriorly then posteriorly.**
- Not to confuse with supraduodenal artery.

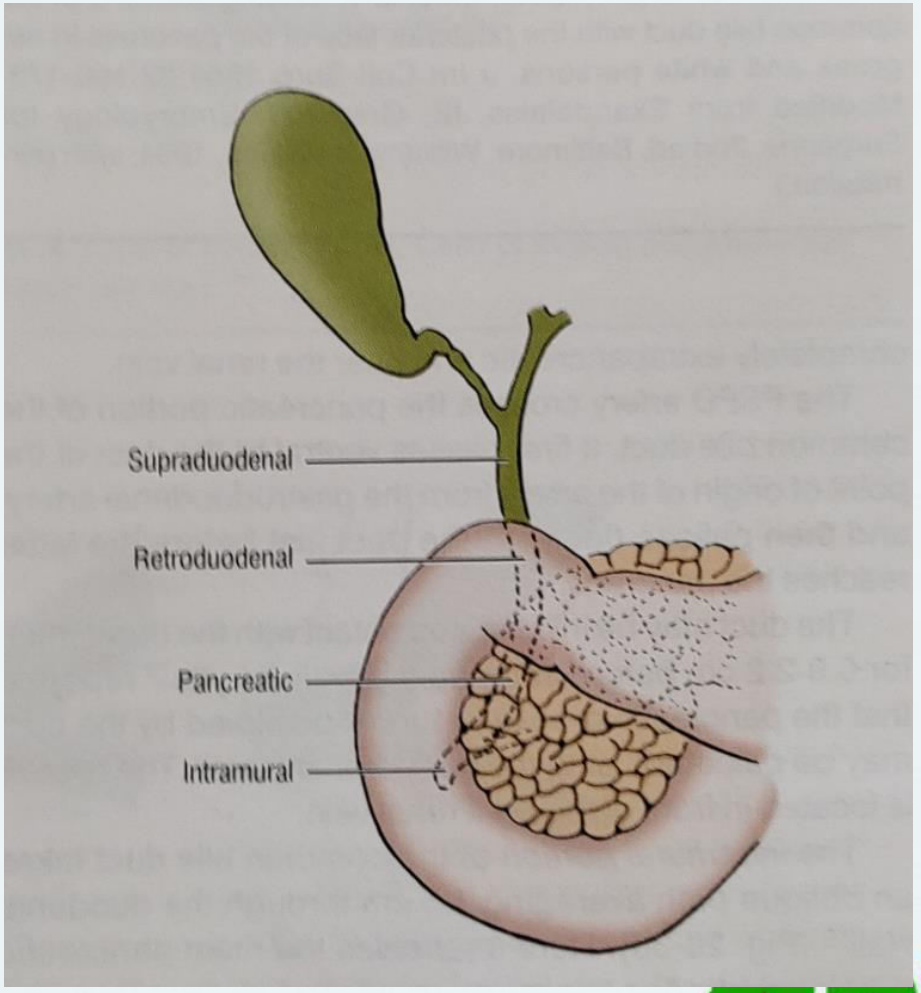


- The supraduodenal segment is short or even absent if the cystic duct joins at a lower level.

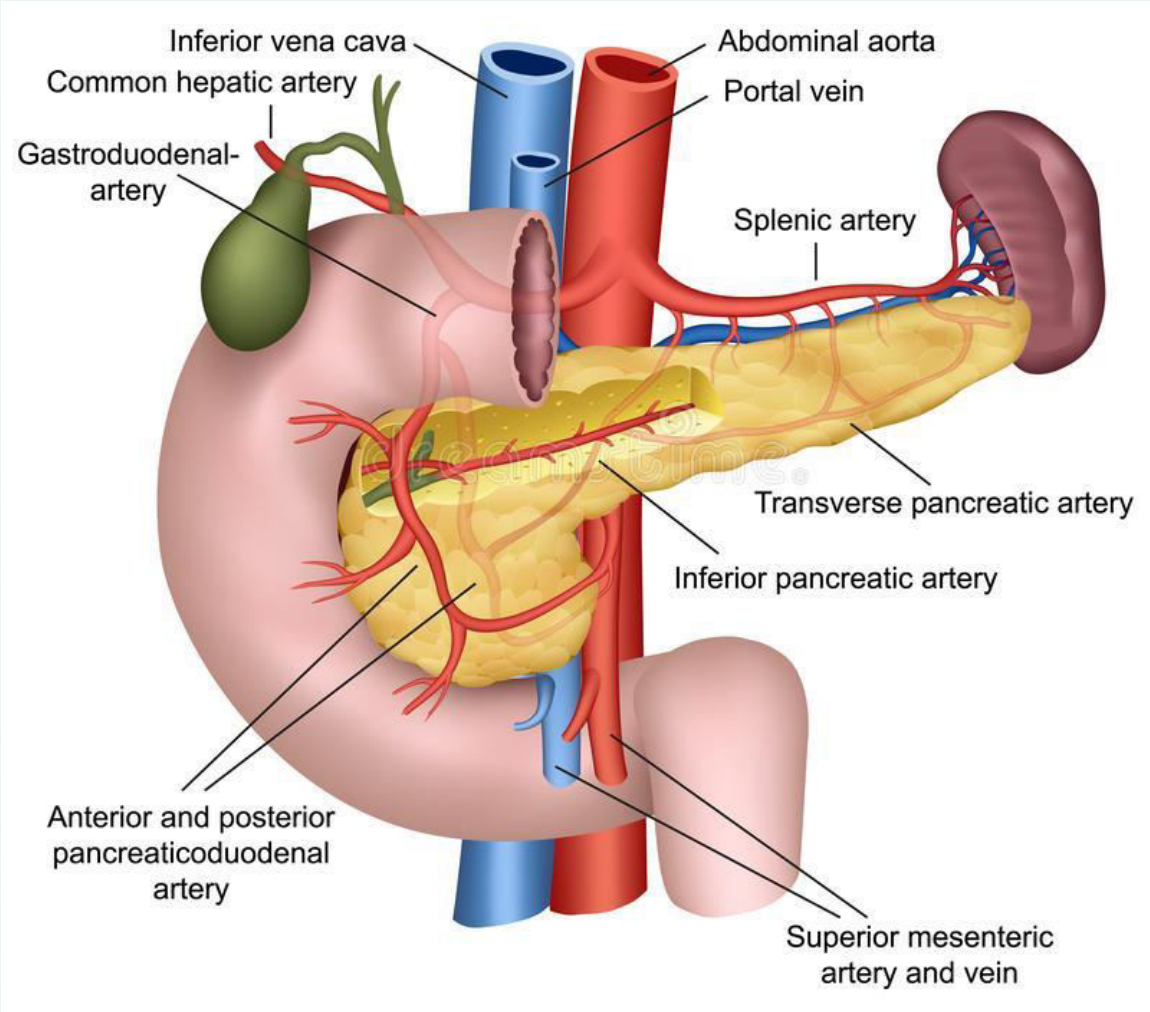


Retroduodenal segment

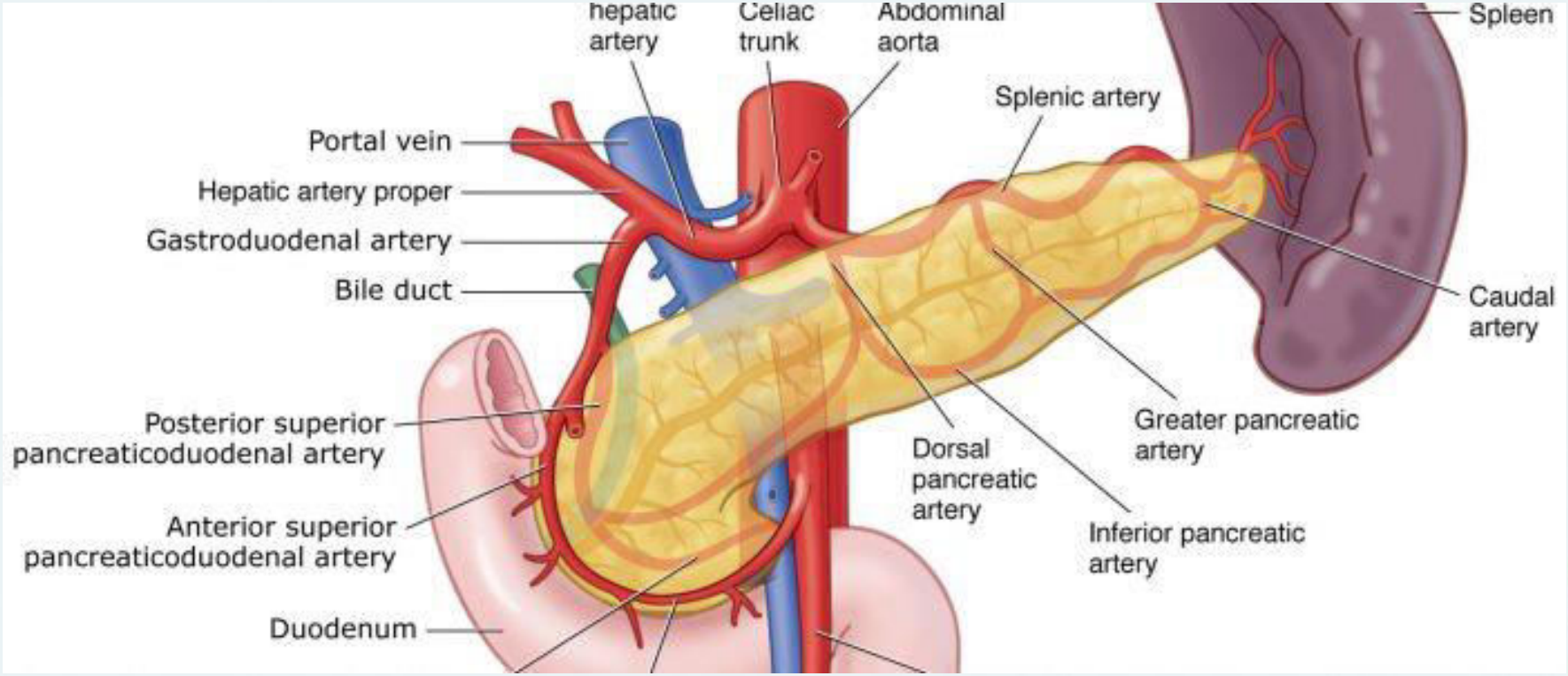
- Between the superior margin of the first portion of the duodenum and the superior margin of the head of pancreas.
- It is 1-3.5 cm long.
- The duct may be free or partially fixed to the duodenum.



- Retroduodenal part lies in front of portal vein.
- Gastroduodenal artery lies to the left of the duct.



- **Gastroduodenal artery** lies to the left
- **PSPD artery** lies anterior to common bile duct.
- **Middle colic artery** lies anterior to common bile duct.



- Intramural portion takes an oblique path
- 1.5 cm through the duodenal wall
- Receives the main pancreatic duct inferiorly
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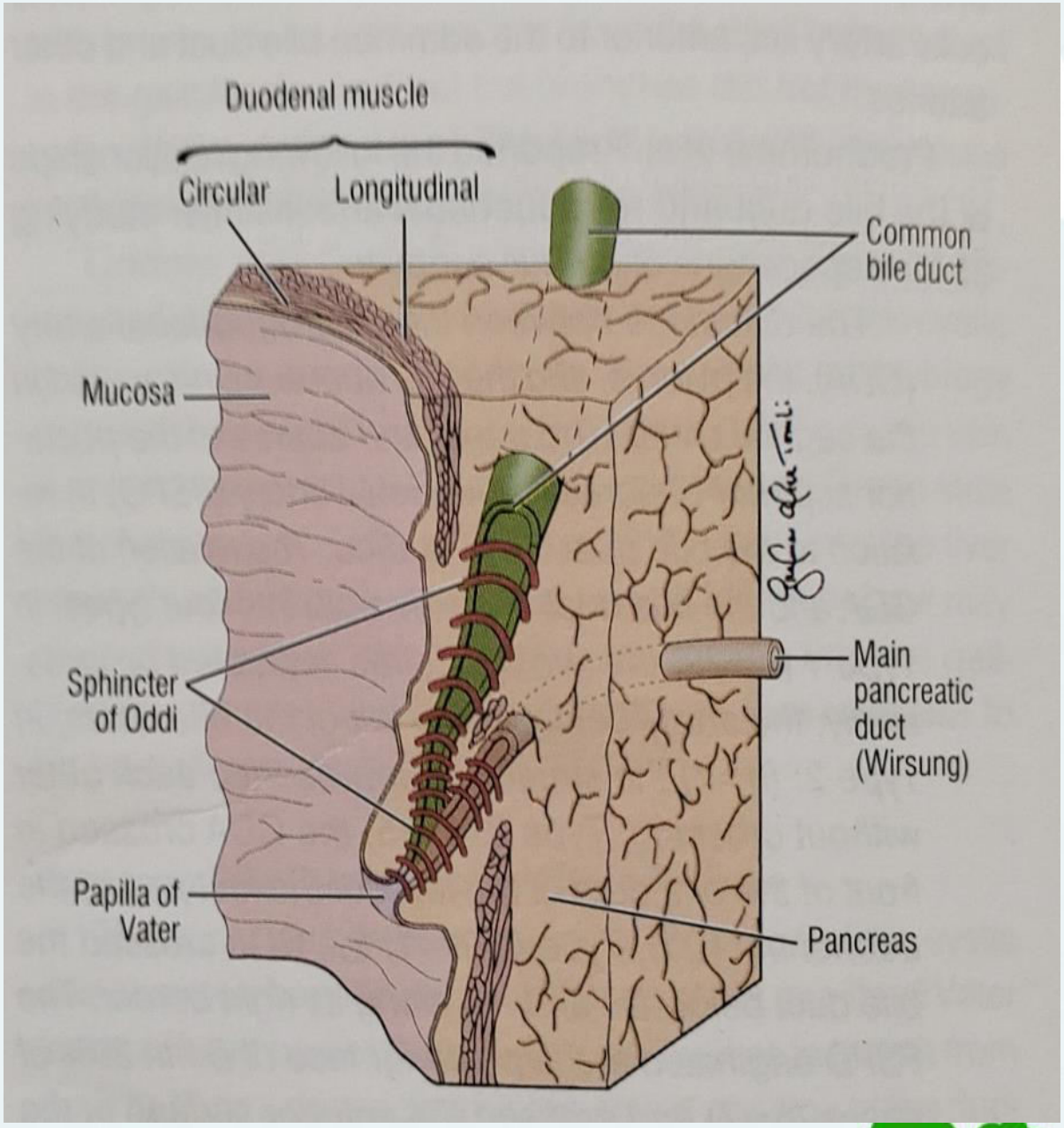
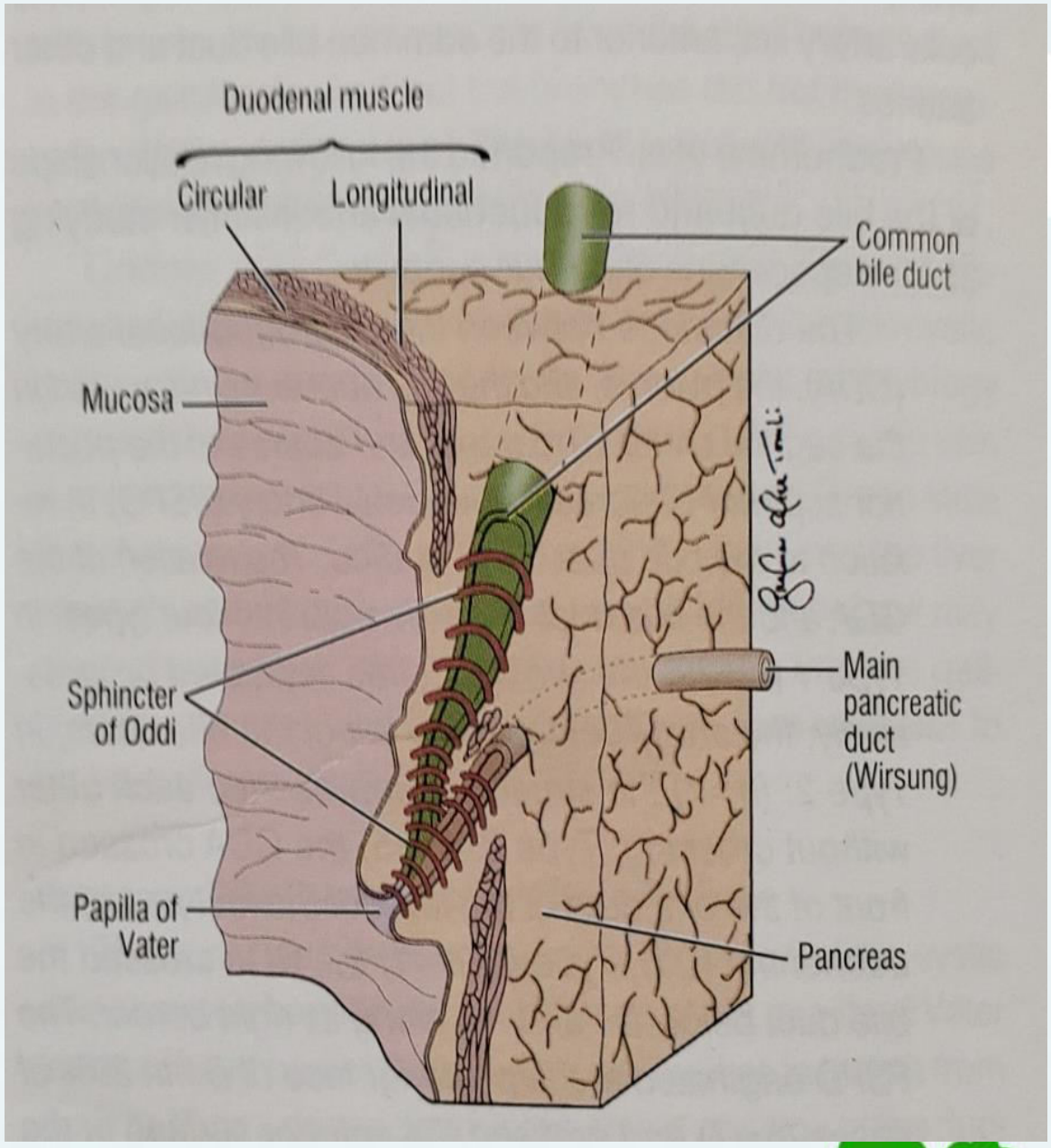
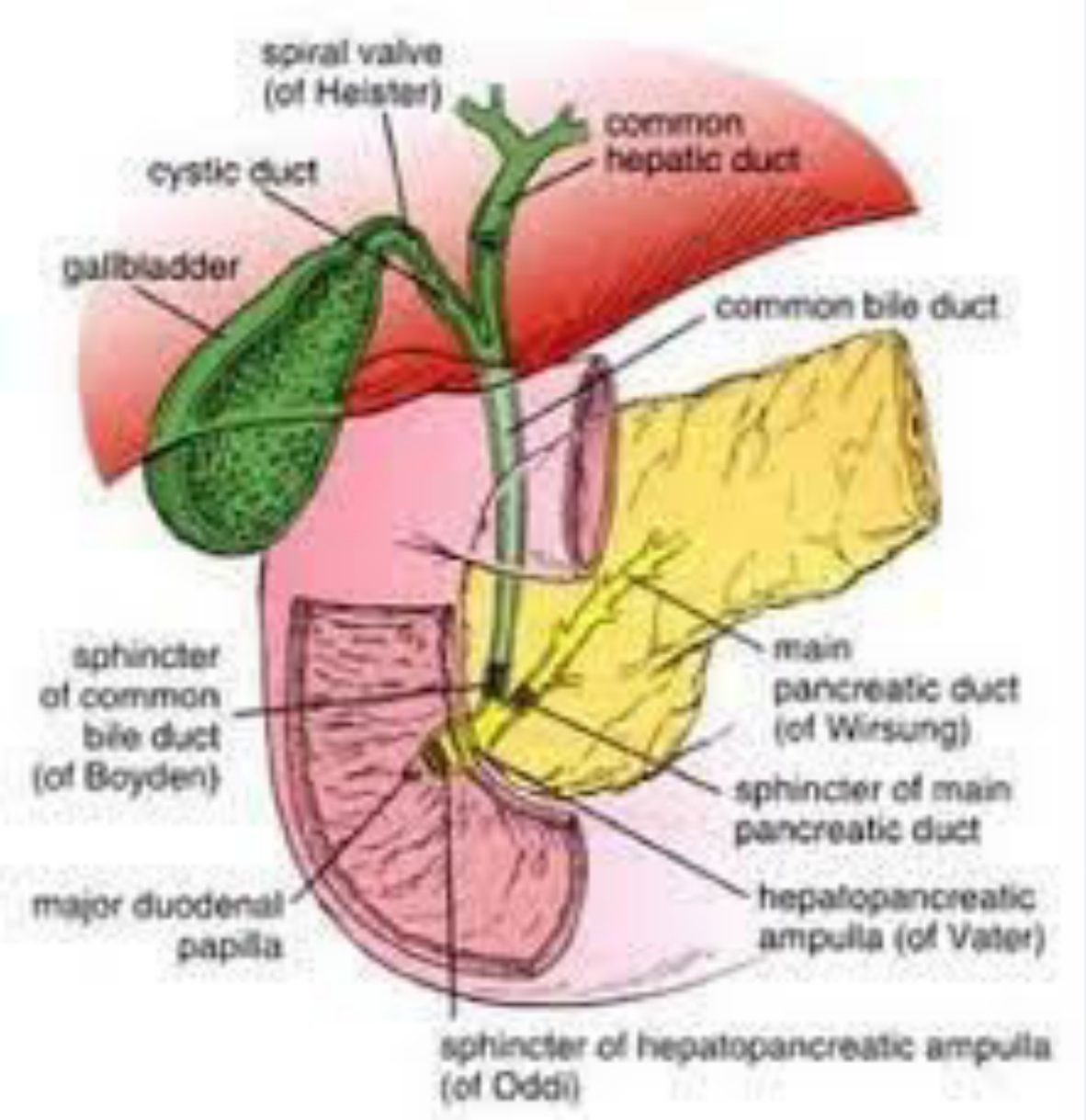
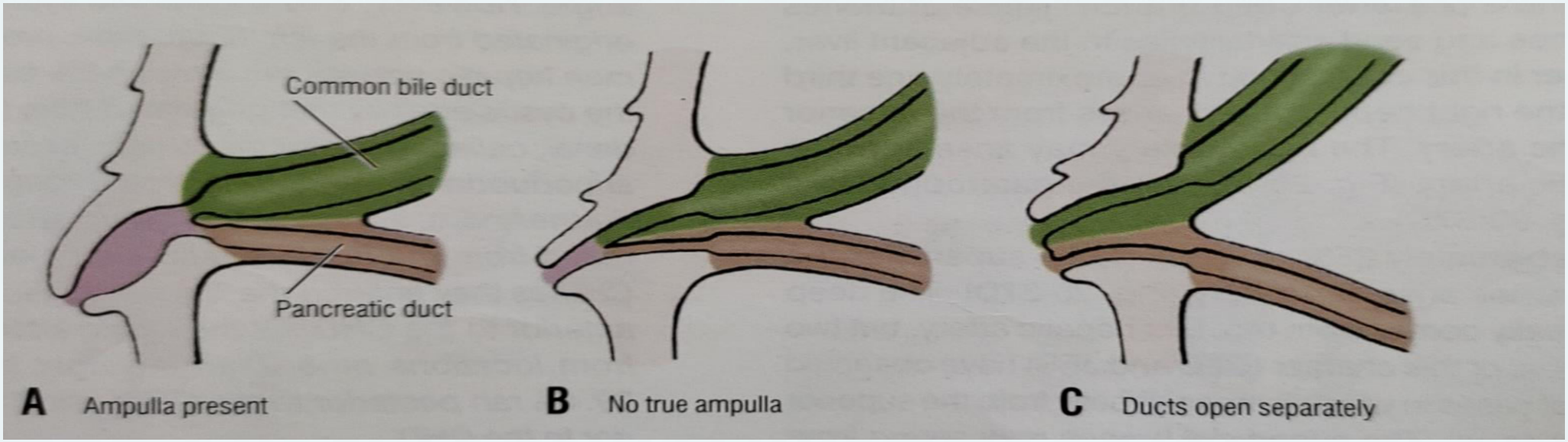


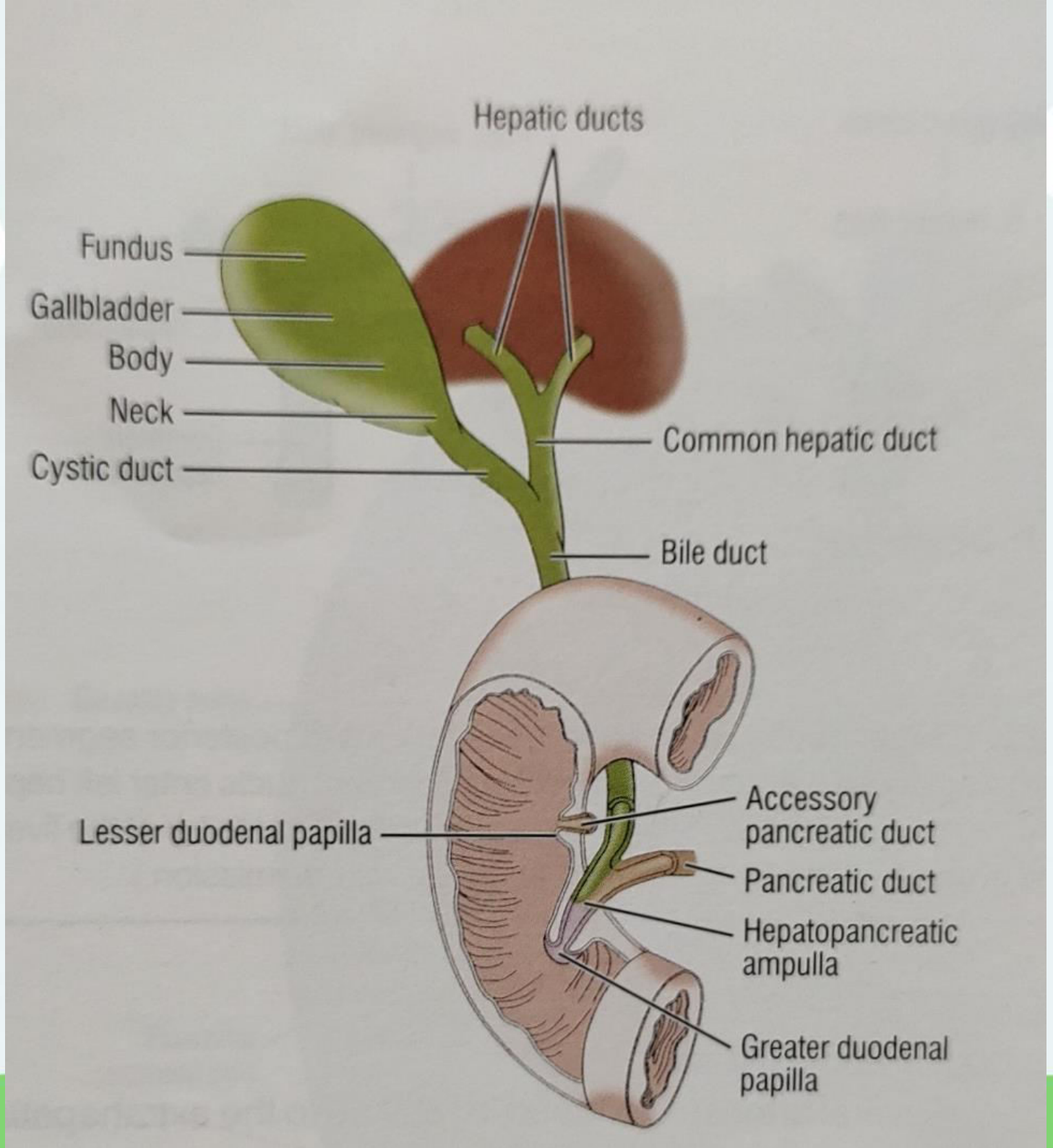
- The two ducts lie within a common adventitia for several millimeters.
- Thin mucosal membrane separates them before they become confluent.
- They end at the **papilla of vater.**



- On the posteromedial wall of the **second part of duodenum**




Common bile duct
Pancreatic duct
A Ampulla present
B No true ampulla
C Ducts open separately


Hepatic ducts
Fundus
Gallbladder
Body
Neck
Cystic duct
Common hepatic duct
Bile duct
Lesser duodenal papilla
Accessory pancreatic duct
Pancreatic duct
Hepatopancreatic ampulla
Greater duodenal papilla

Calot's triangle

- It is a **cystohepatic triangle of Calot**
- **Above** and laterally: under surface of liver (superiorly)
- **Below** and laterally:cystic duct (right)**.**
- **Medially**: common hepatic duct.
- **Cystic artery is a content.**
- Important while ligating pedicle of gall bladder
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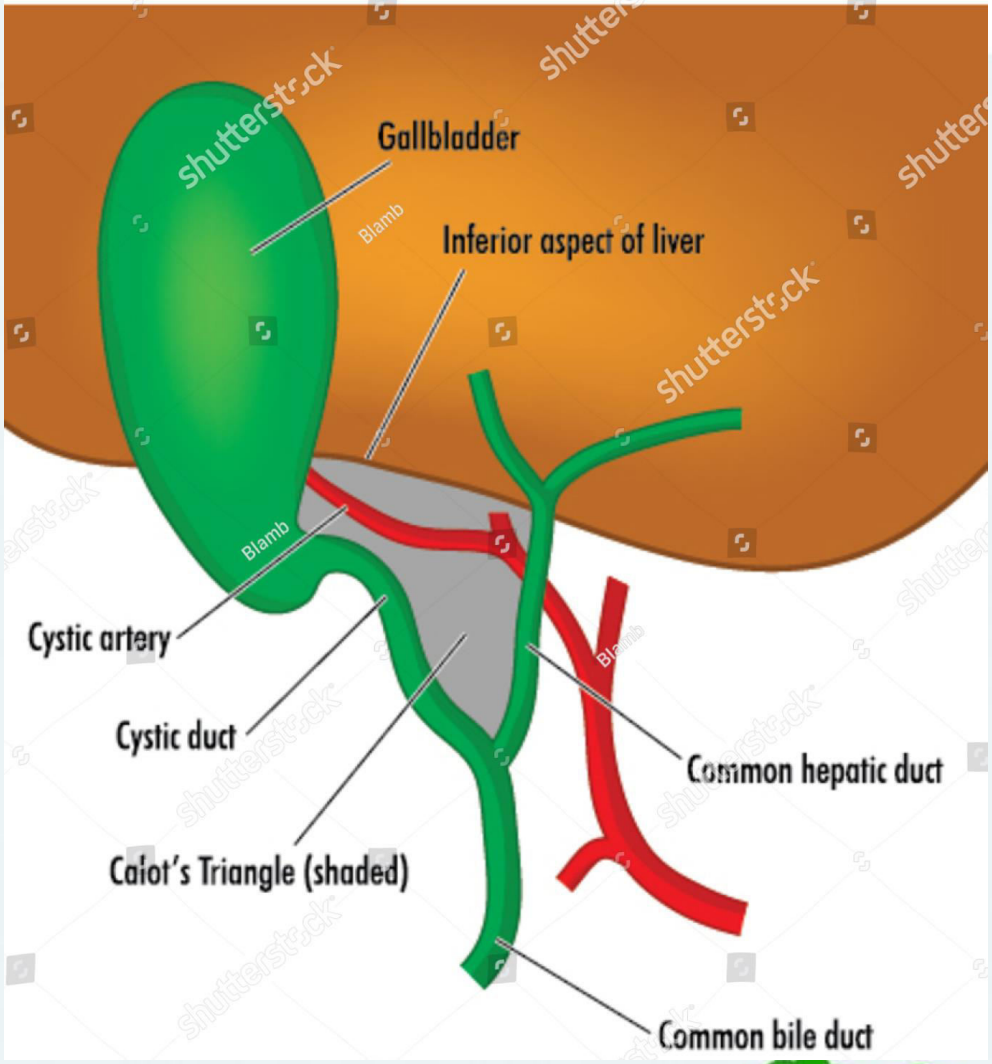

Clinical considerations

- A hazard in surgery: **arterial variation in calot's triangle.**
- The triangle contains important structures to be considered in cholecystectomy
- 90% of all cystic arteries, 82% of all right hepatic arteries, 95% of all accessory right hepatic arteries, 91% of all accessory bile ducts.
- They should not be clamped until they are positively identified.
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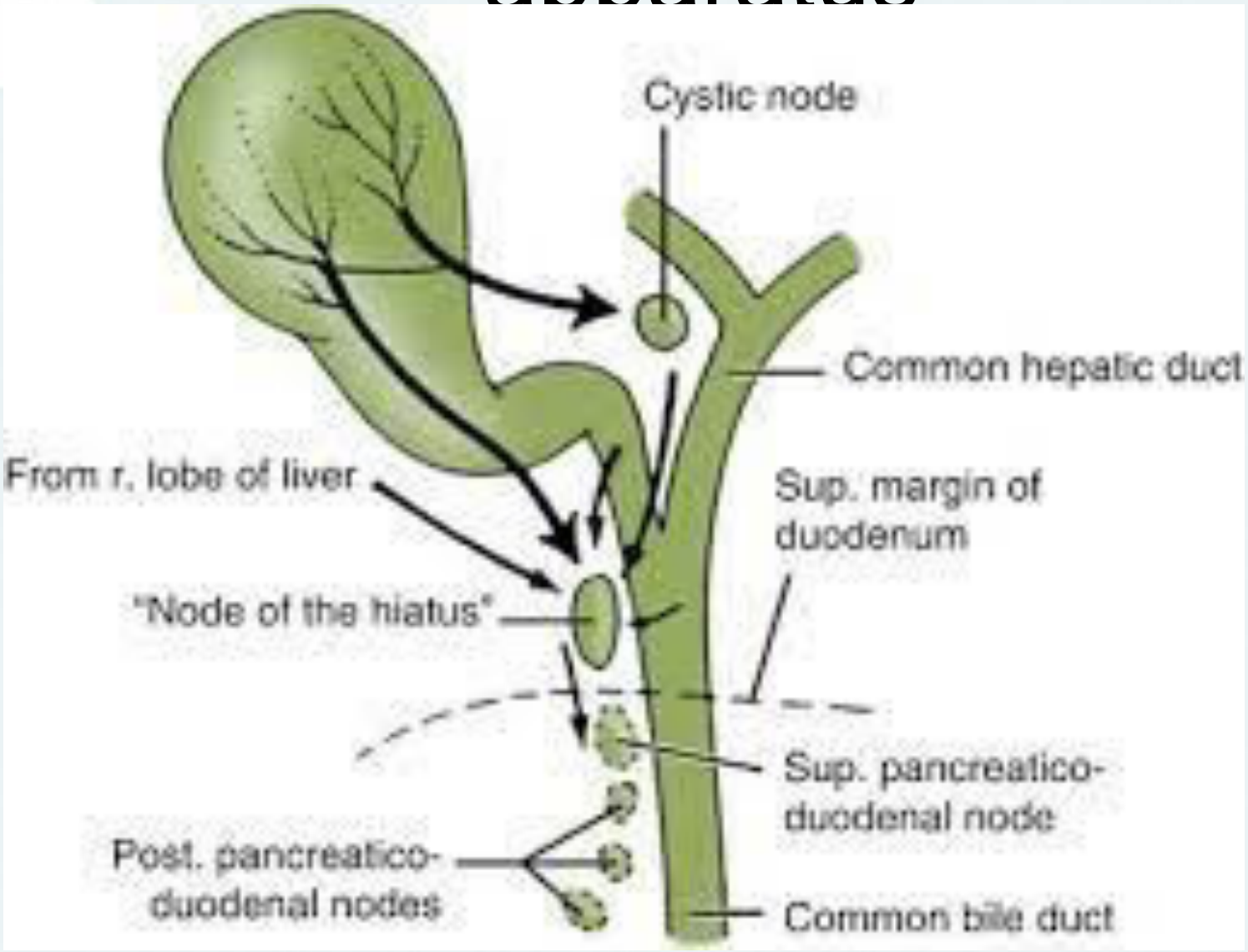
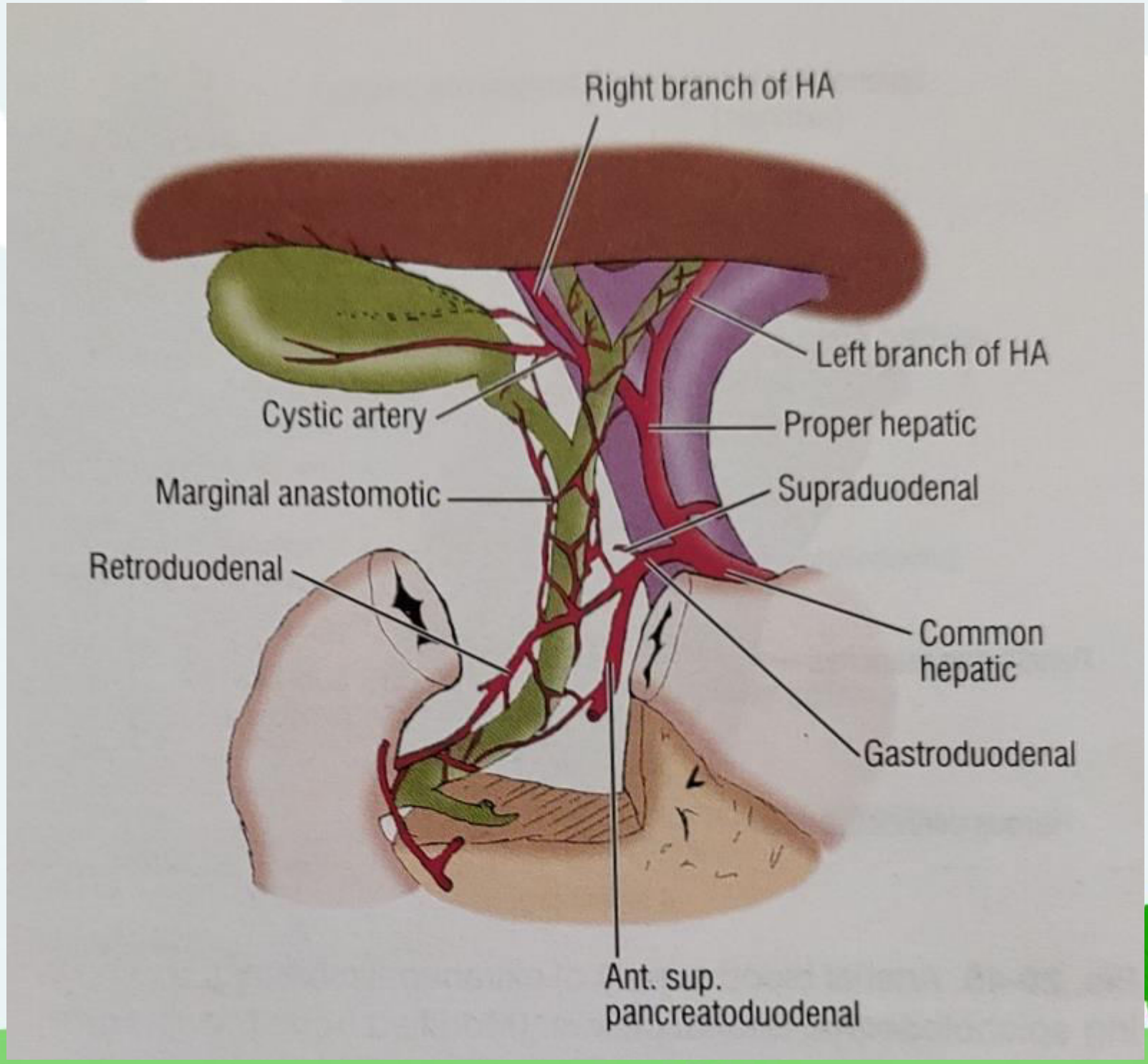
Lymphatic drainage of extrabiliary apparatus




Right branch of HA
Left branch of HA
Cystic artery
Proper hepatic
Marginal anastomotic
Supraduodenal
Retroduodenal
Common hepatic
Gastroduodenal
Ant. sup. pancreatoduodenal