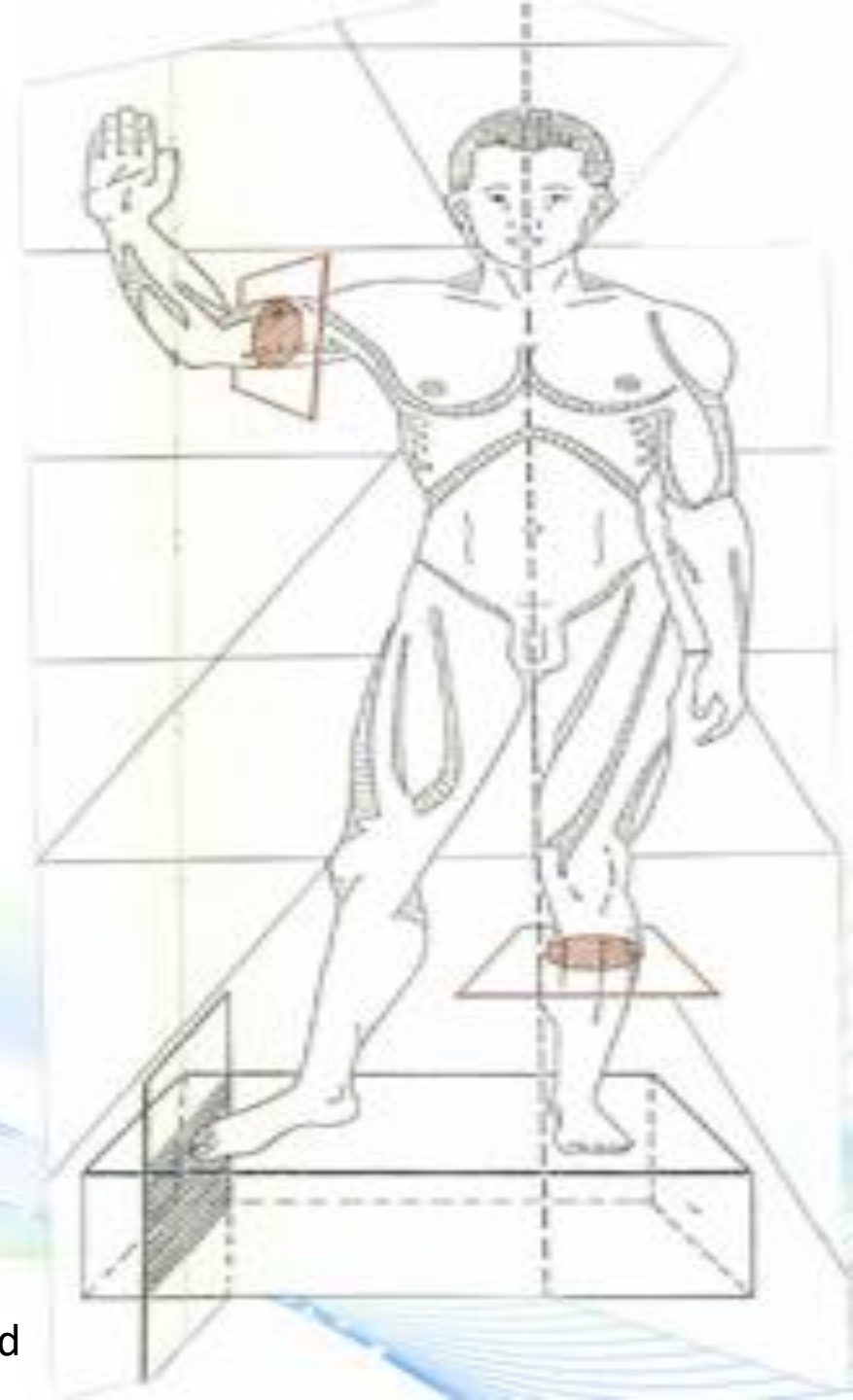


# LIVER AND BILIARY TRACT



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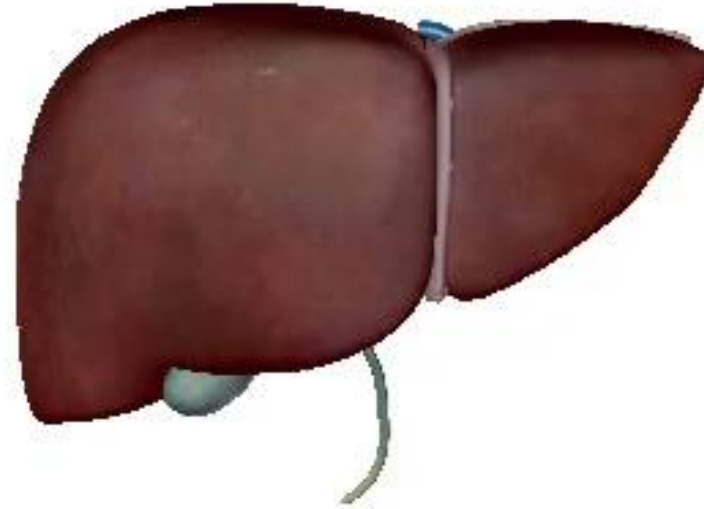
**VII. SURGICAL APPROACH**

**VIII. CONCLUSION**



# I. INTRODUCTION

- Largest gland in the body
- Vital organ
- Interposed between the gastrointestinal tract and systemic veins
- Heterocrine gland
- First destination of absorbed nutrients
- Major role in the human metabolism

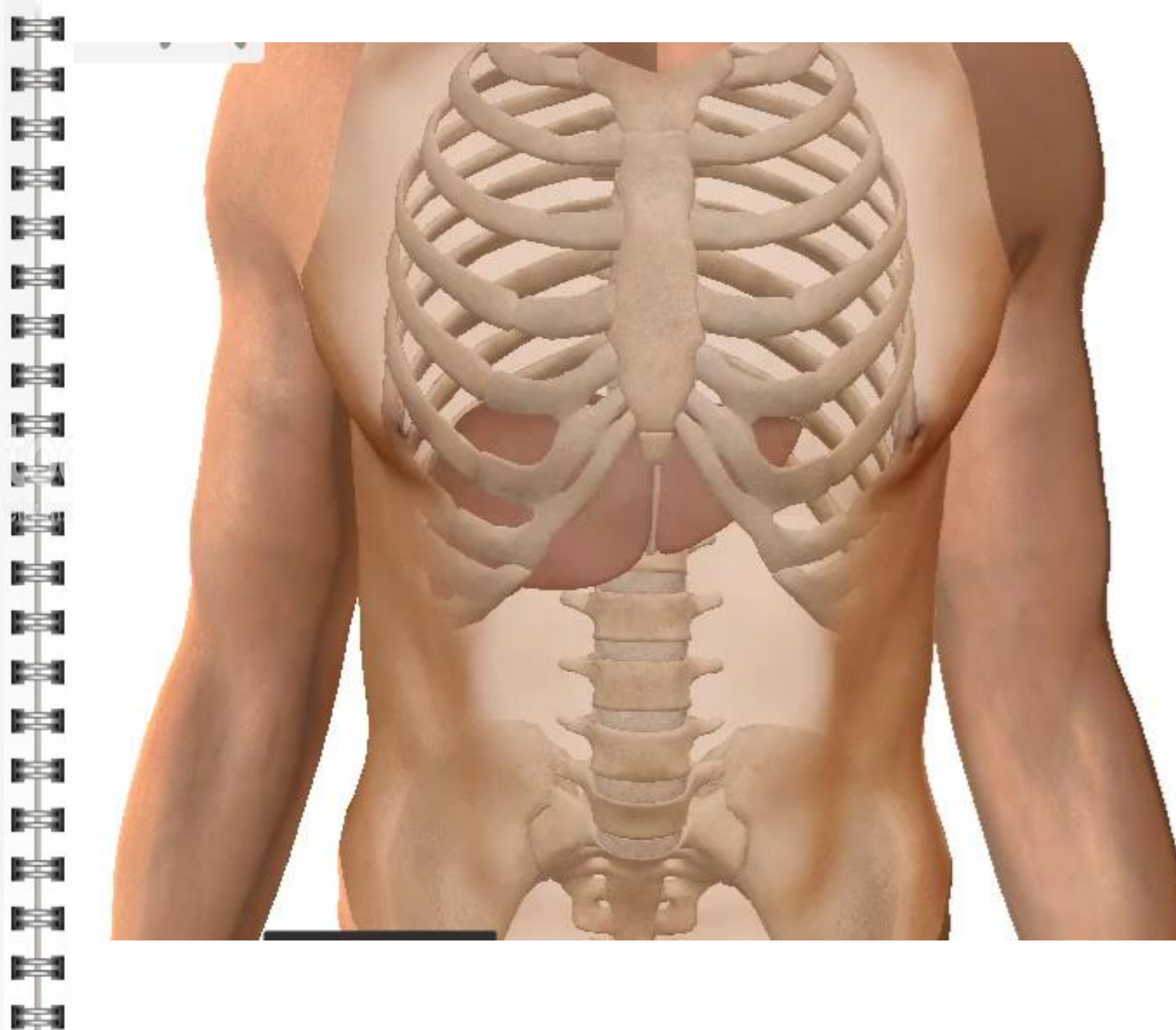


## II. DESCRIPTIVE ANATOMY

### A. LIVER

#### 1. Situation:

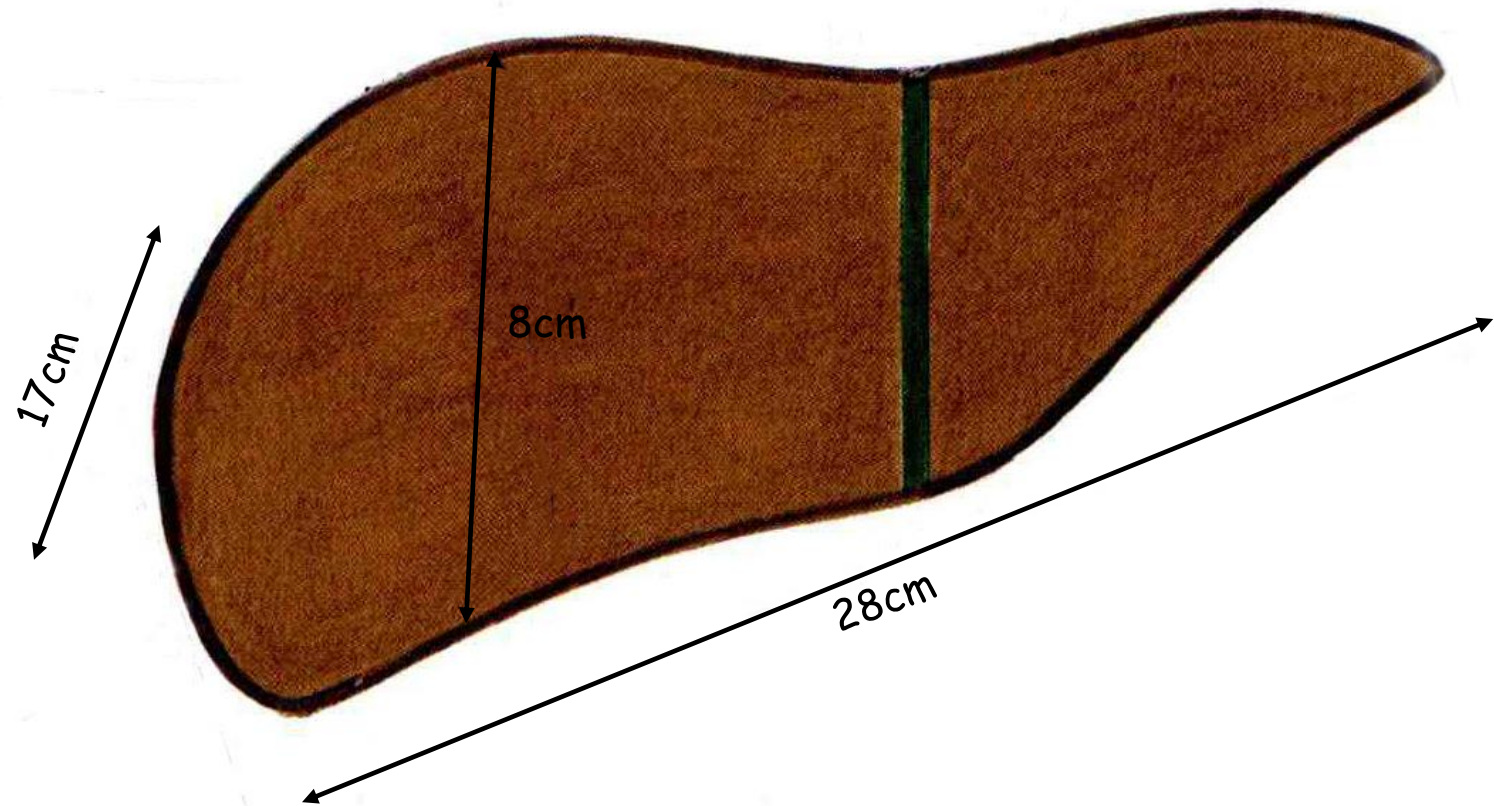
- Situated in the **supracolic compartment** of the abdominal cavity
- Lying mainly in the **right hypochondrial** and **epigastric** regions
- Much of it is under cover of the **lower ribs** and **diaphragm**
- Occupies a **limited triangular space** between:
  - On top: **diaphragm**
  - To the right: **thoracic wall** from the **4<sup>th</sup> intercostal space** to the **11<sup>th</sup> rib**
  - To the left: the intersection of the **mammillary line** with the **5<sup>th</sup> intercostal space**





## 2. Dimensions:

- Length: 28cm
- Width: 17cm
- Thickness: 8cm
- Weight: 1500 grams
- Blood flow: 1500 ml/min

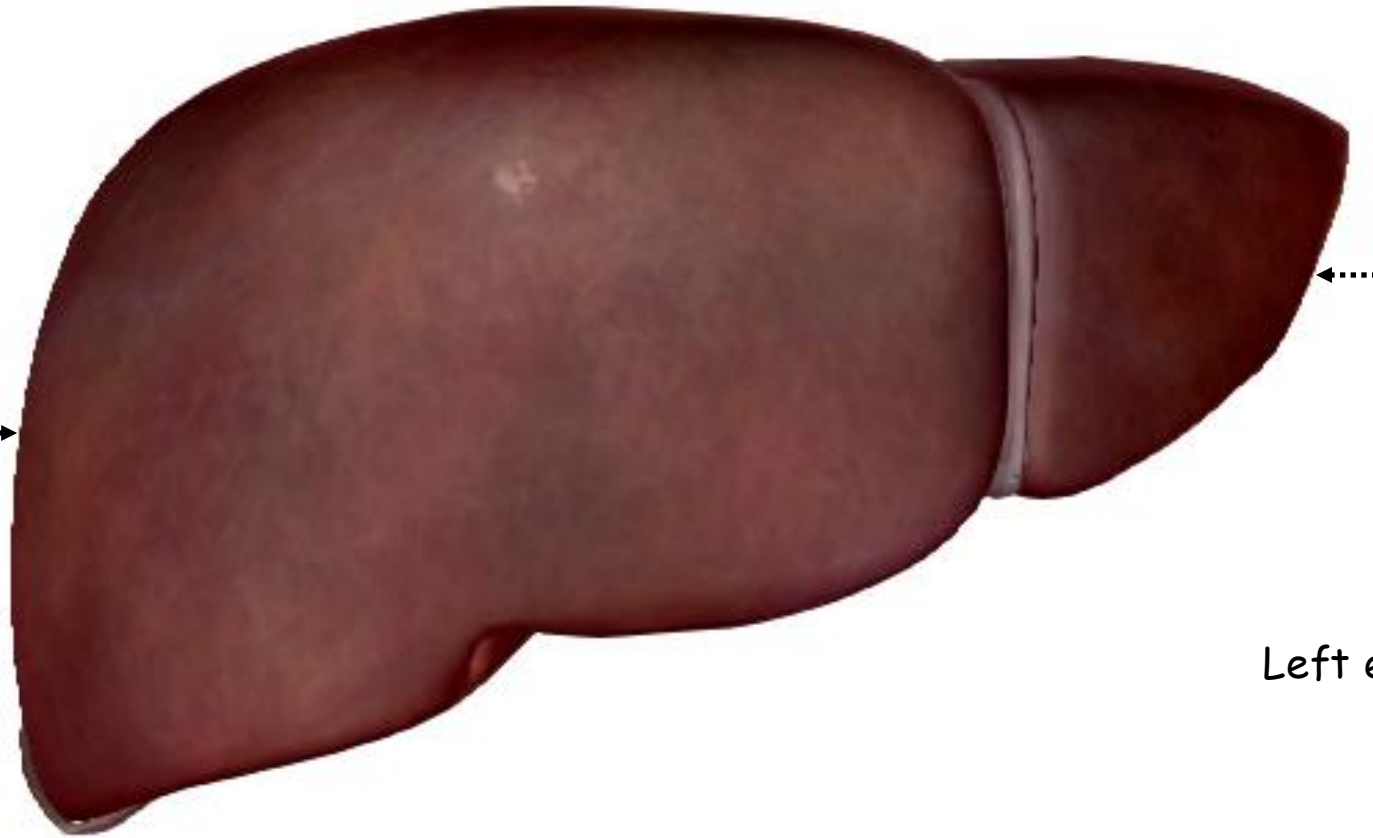


ANTERIOR VIEW OF THE LIVER

### 3. Shape:

- Red-brown in colour
- Ovoid
- Greater right end
- Lesser left end
- Firm consistency
- 3 borders
- 3 surfaces
- 3 fissures: H-shaped
- 3 lobes

Right end

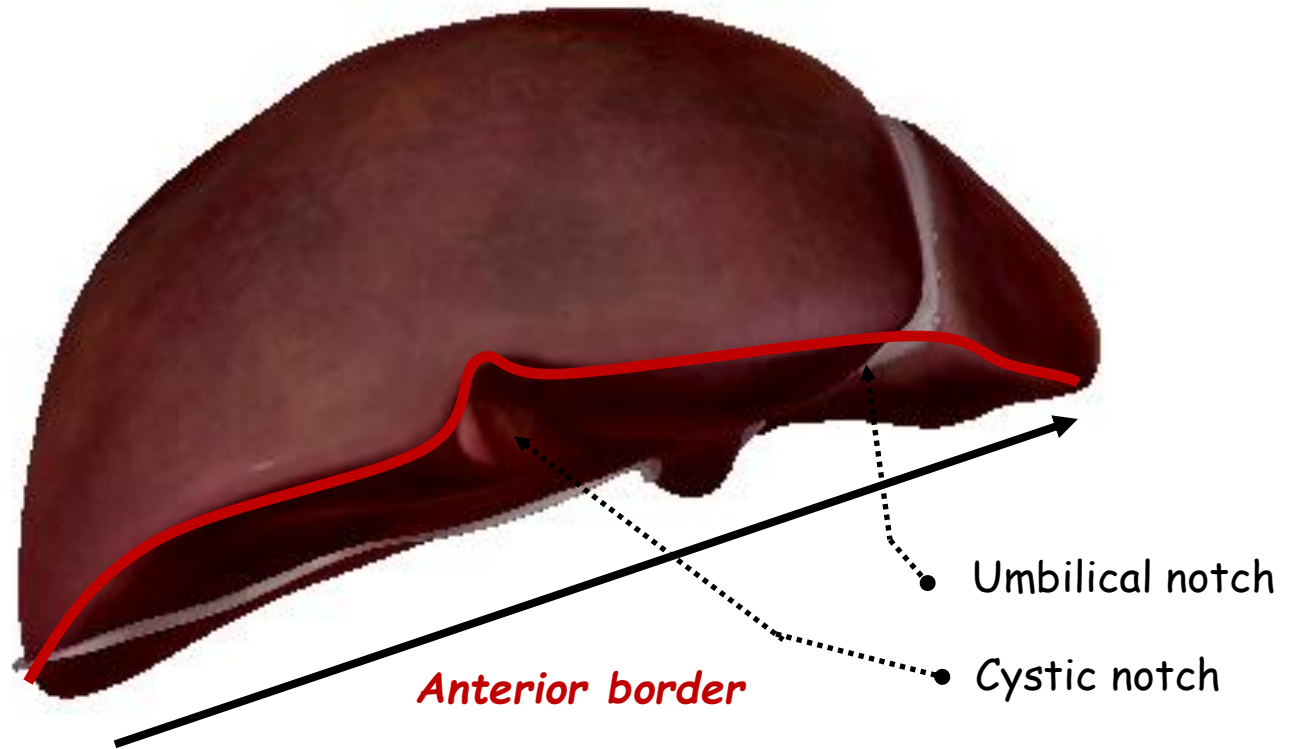


Left end

ANTERIOR VIEW OF THE LIVER

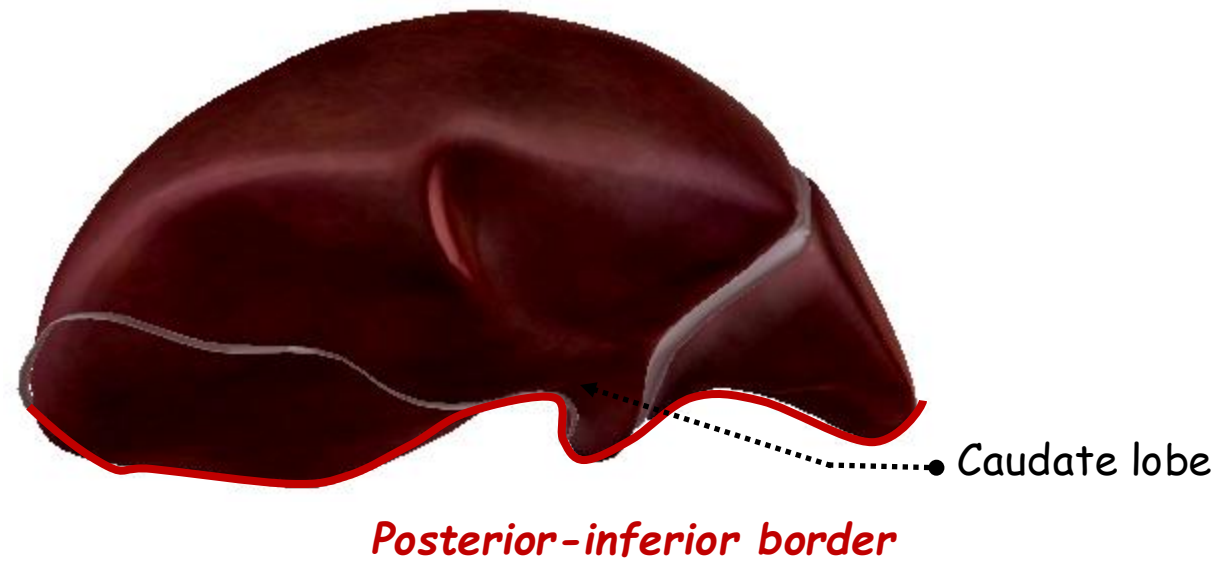
- **Anterior border:**

- Sharp
- Slopes up from right to left
- First along the right costal margin and then across the epigastrium
- Notch made by the ligamentum teres
- Notch made by the fundus of the gall bladder



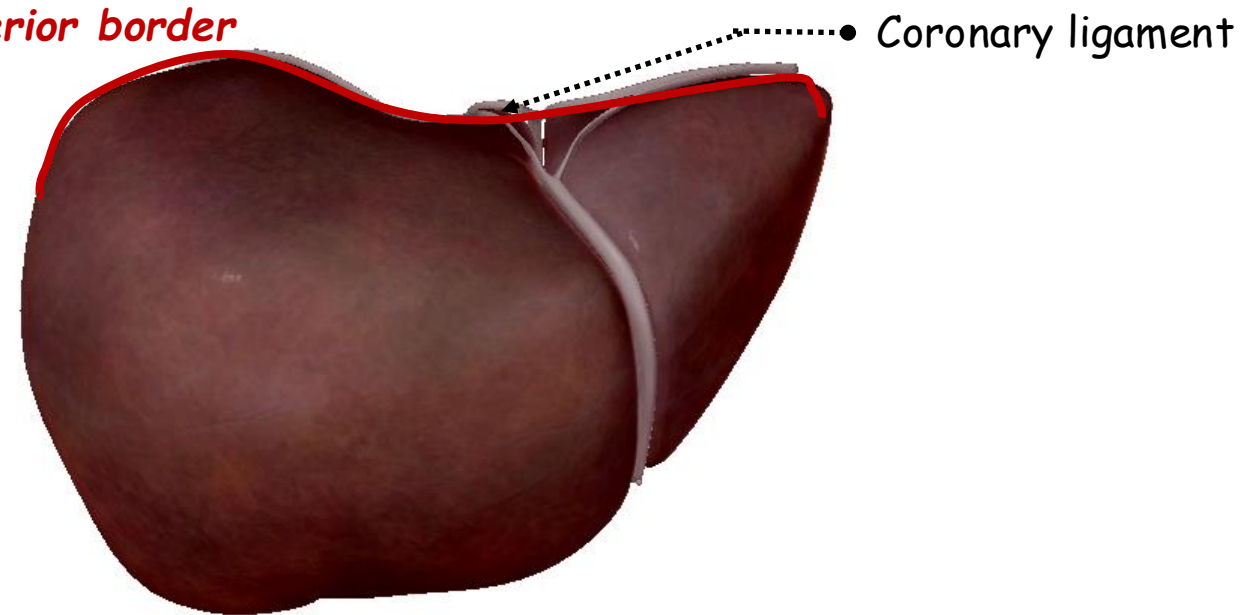
ANTERIOR AND INFERIOR VIEW OF THE LIVER

- **Inferior-posterior border:**
  - Papillary and caudate processes of the caudate lobe
- **Superior-posterior border:**
  - Reflection of the upper layer of coronary ligament



INFERIOR VIEW OF THE LIVER

*Posterior-superior border*



SUPERIOR-ANTERIOR VIEW OF THE LIVER

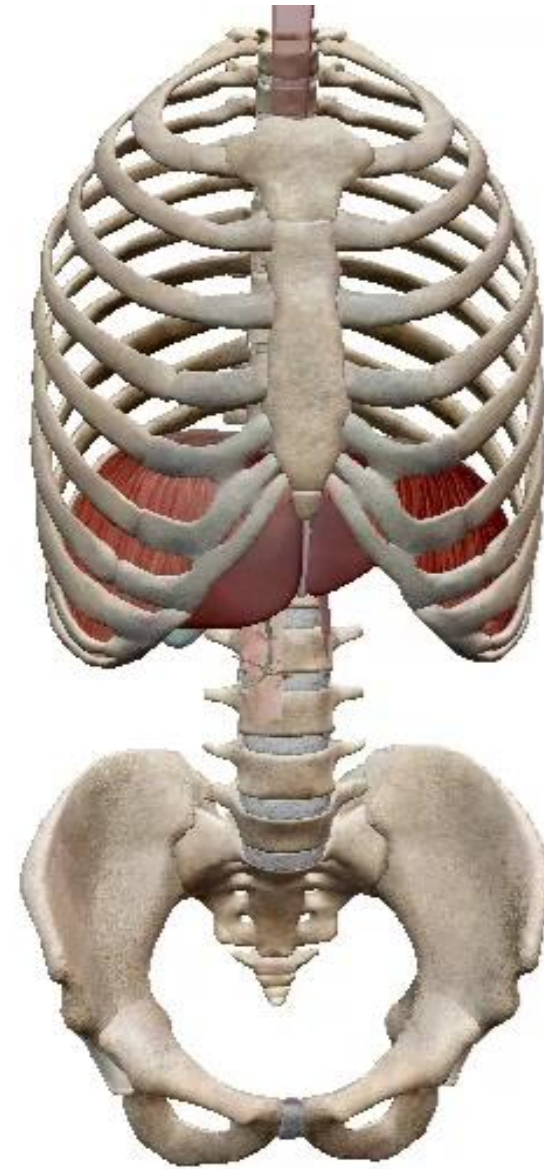


- **Diaphragmatic surface:**

- Convex and smooth

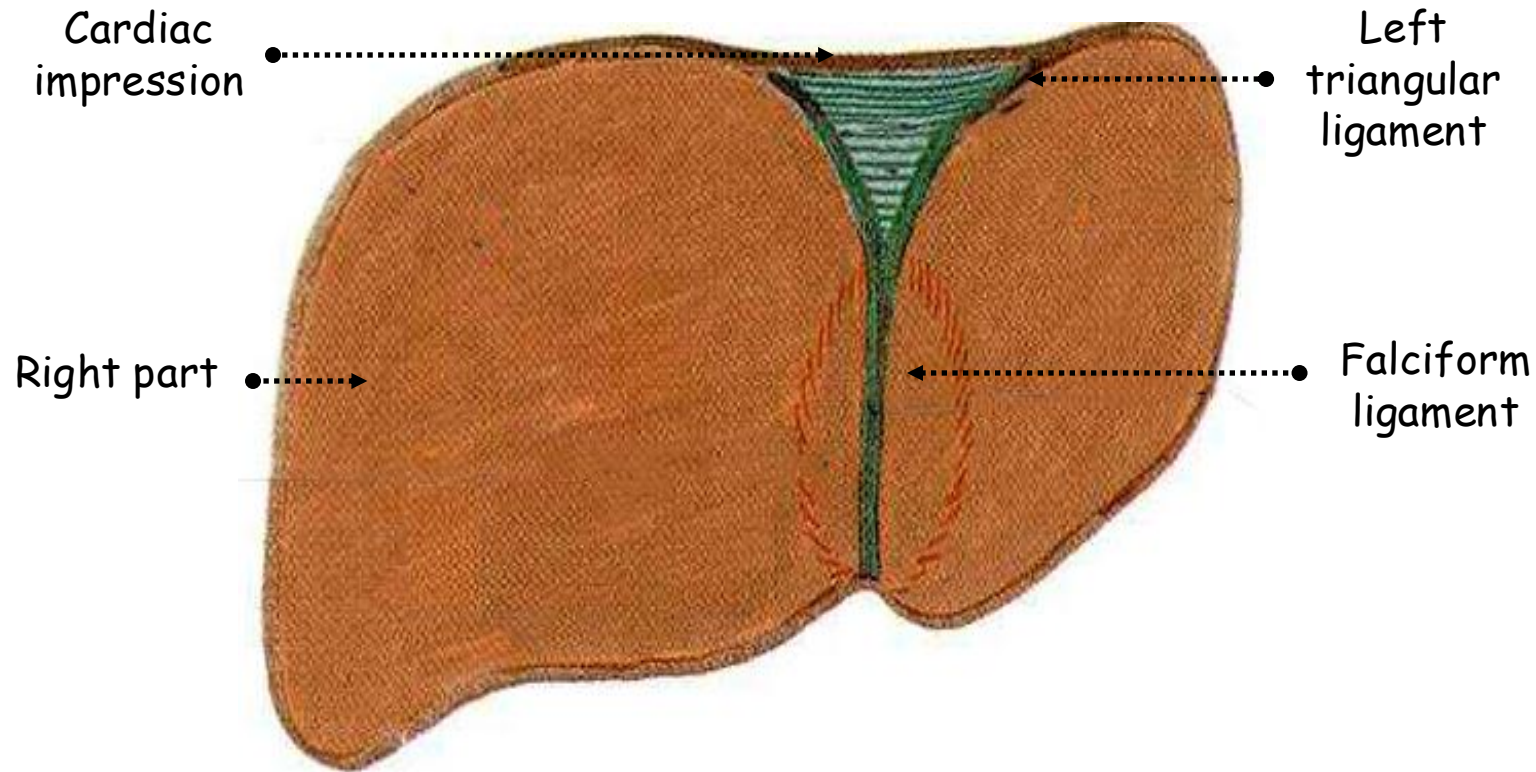
- Covered in peritoneum for the most part

- Anterior part: triangular and related to the diaphragm, lungs, pleura and ribs and costal cartilages 6-10 on the right and costal cartilages 6 and 7 on the left with a part behind the infracostal angle covered by the anterior abdominal wall of the epigastrium; the falciform ligament is attached from near the centre down to the notch made by the ligamentum teres in the lower border



-Superior part: against the diaphragm with above it the pericardium and heart centrally and the pleura and lung on each side, covered by the left triangular ligament to the left and the upper layer of coronary ligament to the right

-Right part: extends from ribs 7 to 11 and is related to the following logical sequence of structures; in its lower third to ribs and diaphragm; in its middle third to ribs, pleura and diaphragm; and in its upper third to ribs, pleura, lung and diaphragm



SUPERIOR-ANTERIOR VIEW OF THE LIVER

## • Posterior surface:

- Bare area: triangle to the right of the vena cava as its base with sides formed by the upper and lower layers of the coronary ligament
- Part of the right suprarenal impression
- Groove for the inferior vena cava
- Fissure for the ligamentum venosum: continuous forwards with the ligamentum teres forming the left limb of the H and the vertical part of the L-shaped liver attachment of the lesser omentum

Fissure for the ligamentum venosum

Caudate lobe

Groove for the inferior vena cava

**Posterior-superior border**

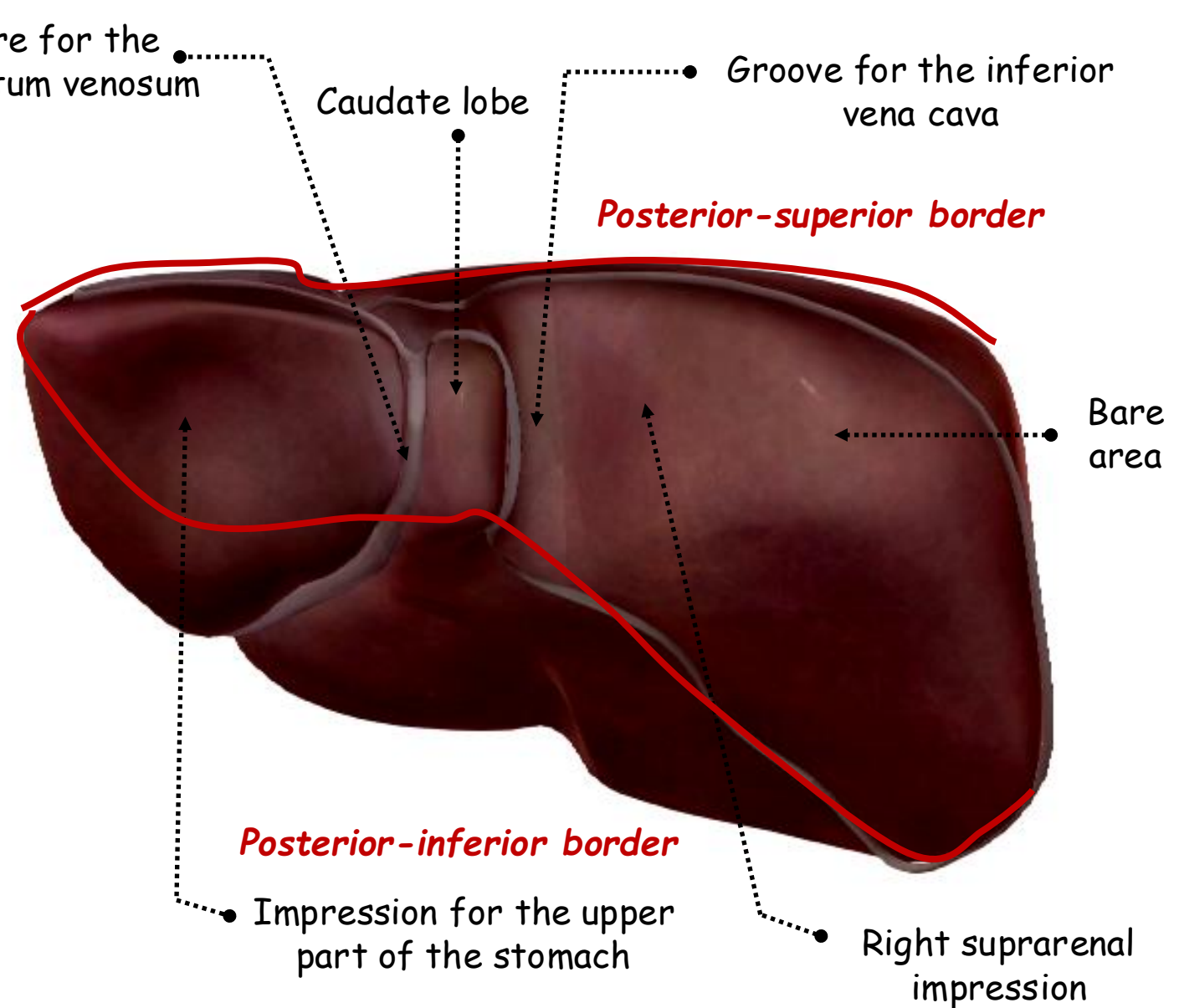
Bare area

**Posterior-inferior border**

Impression for the upper part of the stomach

Right suprarenal impression

**POSTERIOR VIEW OF THE LIVER**



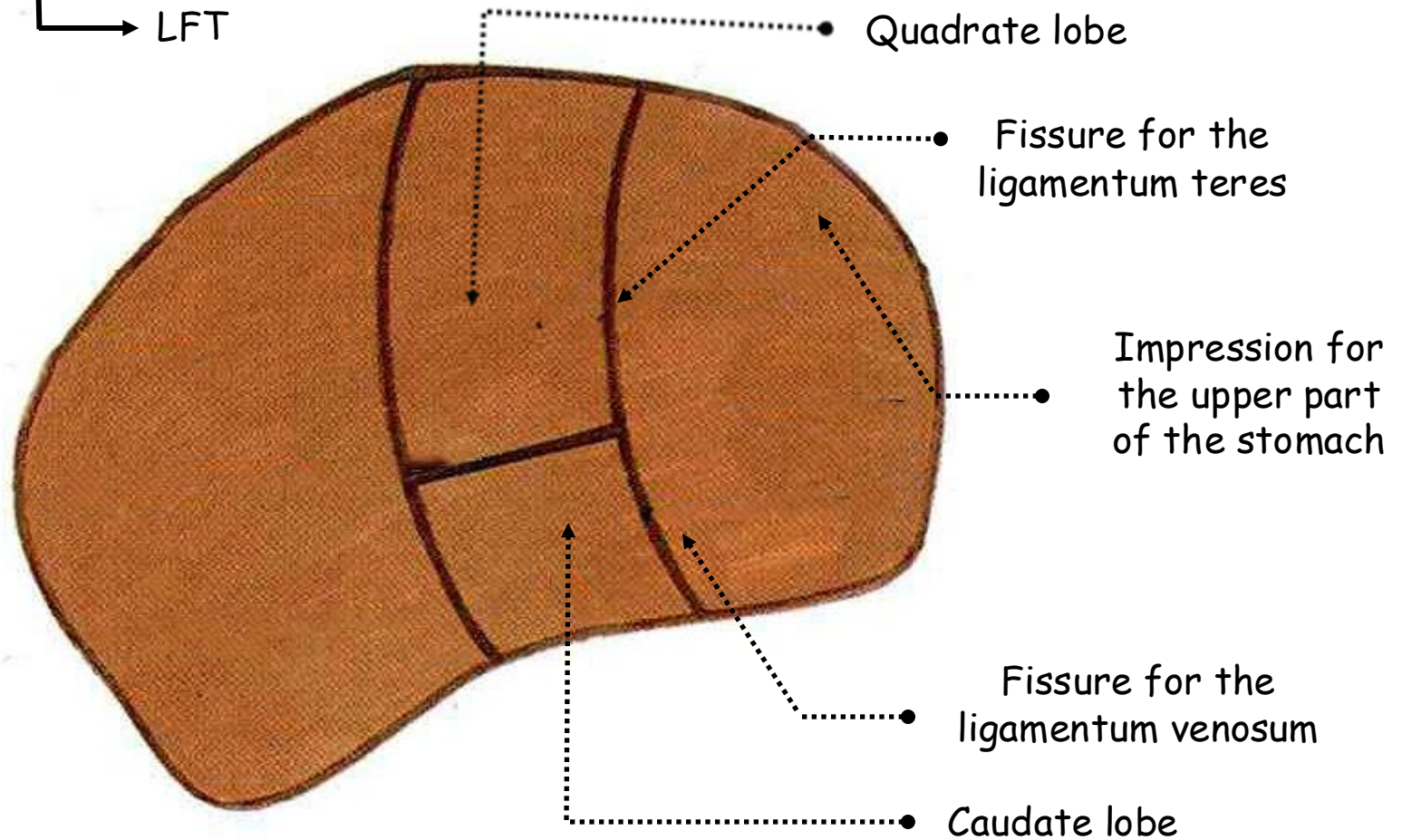


**-Caudate lobe and process**

enclosed in the upper recess of the lesser omentum between the left extension of the lower layer of the coronary ligament in front of the vena cava and the right leaf from the falciform ligament

**-Impressions for the oesophagus and upper part of the stomach and possibly the tuber omentale of the pancreas**

FRT  
LFT

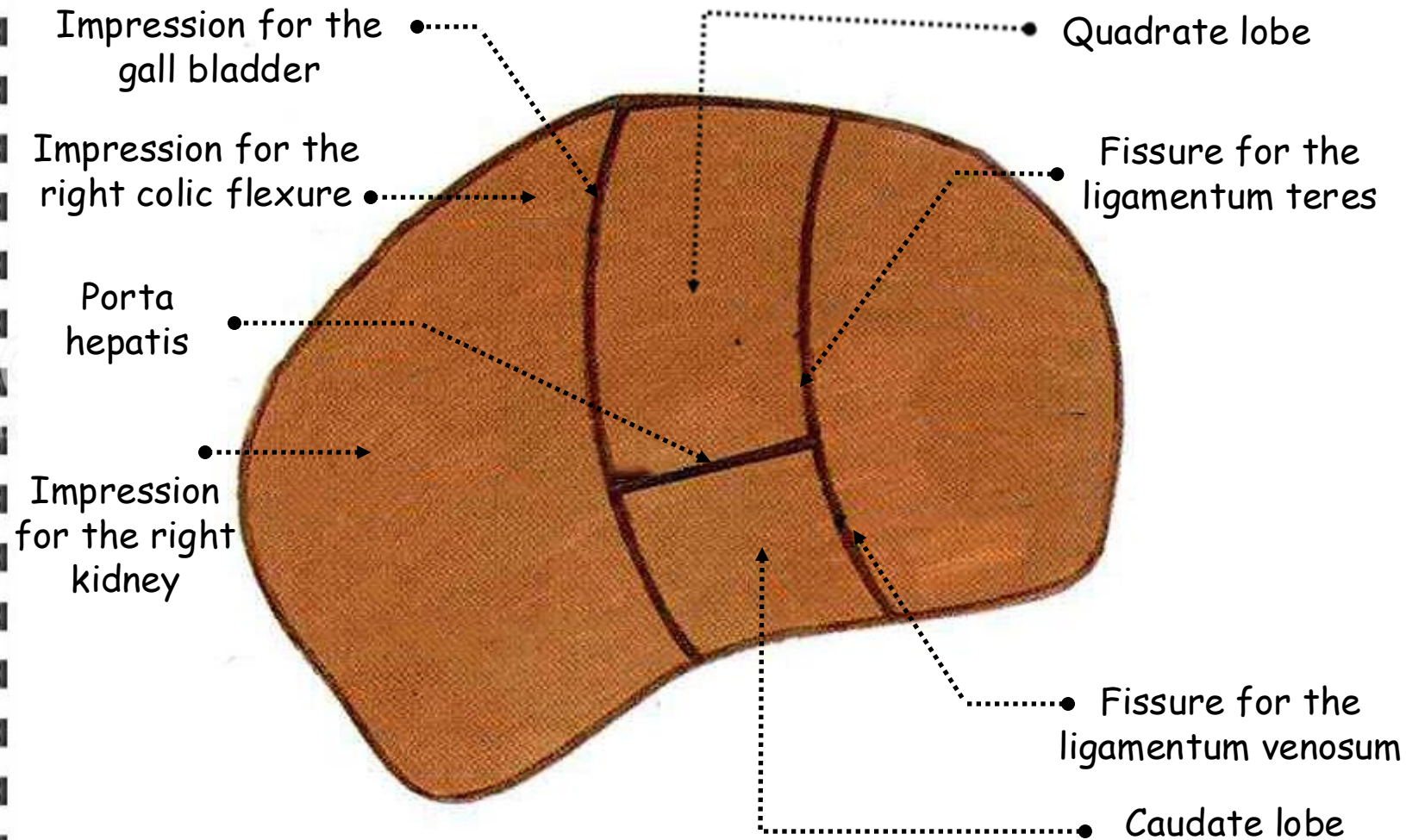


INFERIOR VIEW OF THE LIVER



• **Inferior surface:**

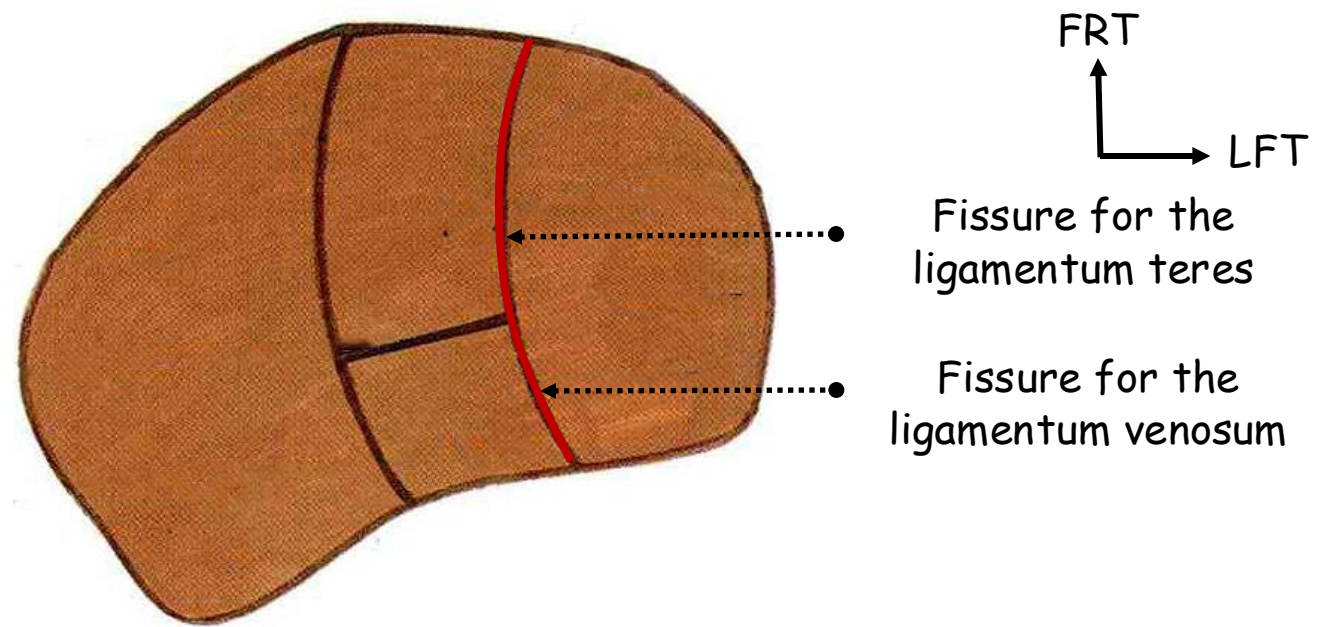
- Visceral
- Porta hepatis
- Impressions for parts of the right kidney and suprarenal gland, second part of the duodenum and right colic flexure, the gall bladder, the quadrate lobe, the fissure for the ligamentum teres and the rest of the gastric impression



INFERIOR VIEW OF THE LIVER

• **Fissure for the ligamentum venosum:**

- Left limb of the H
- Continuous forwards with the ligamentum teres
- Ends at the notch made by the ligamentum teres
- Remnant of ductus venosus

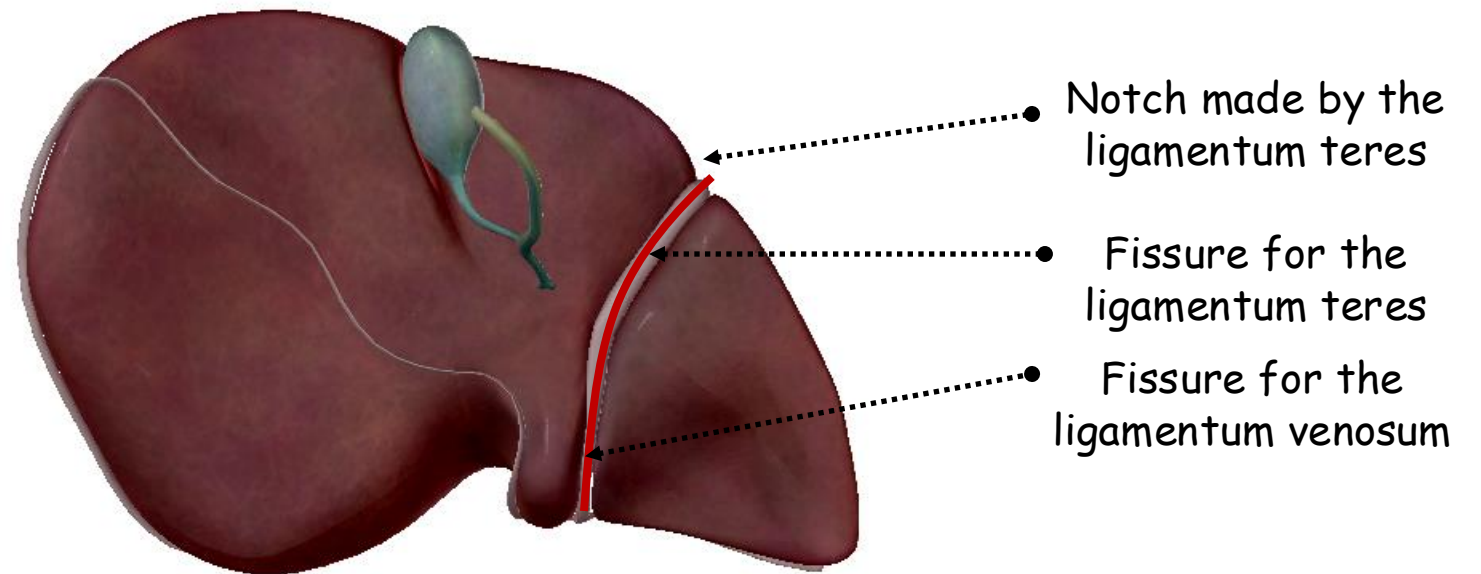


FRT  
LFT

Fissure for the ligamentum teres

Fissure for the ligamentum venosum

INFERIOR VIEW OF THE LIVER



Notch made by the ligamentum teres

Fissure for the ligamentum teres

Fissure for the ligamentum venosum

POSTERIOR-INFERIOR VIEW OF THE LIVER

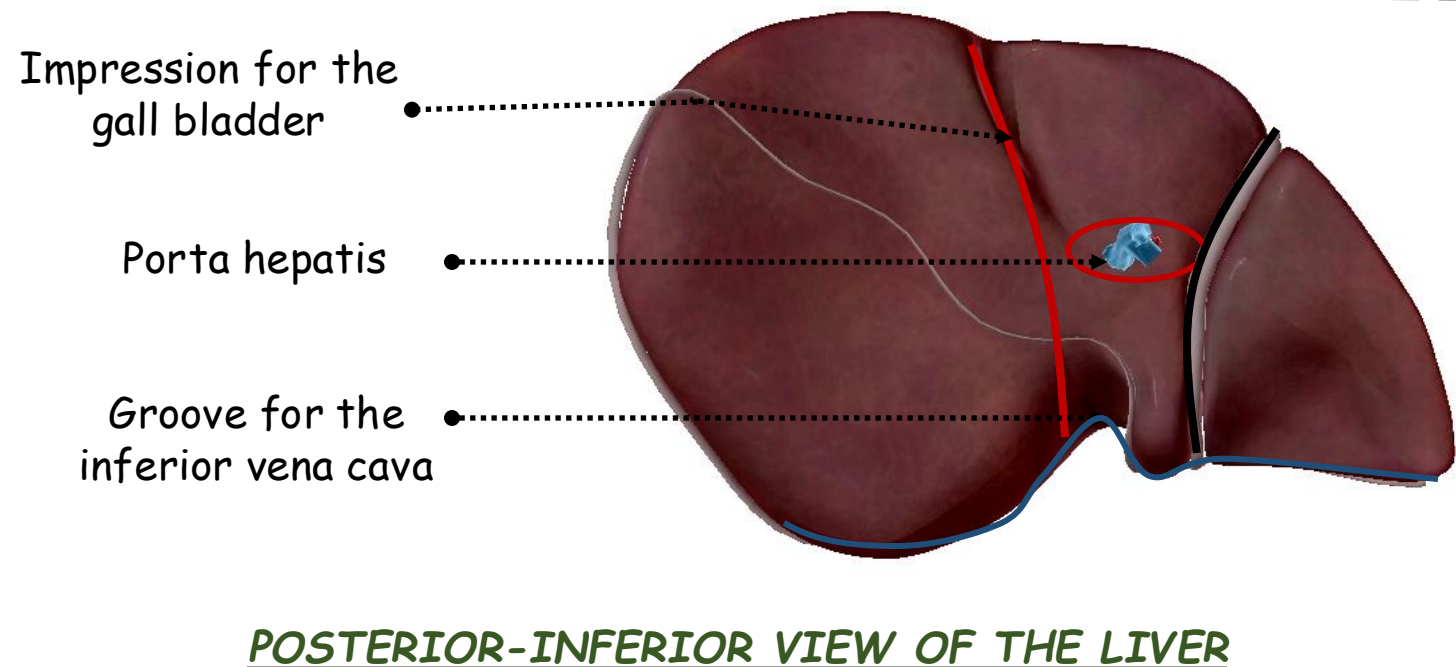
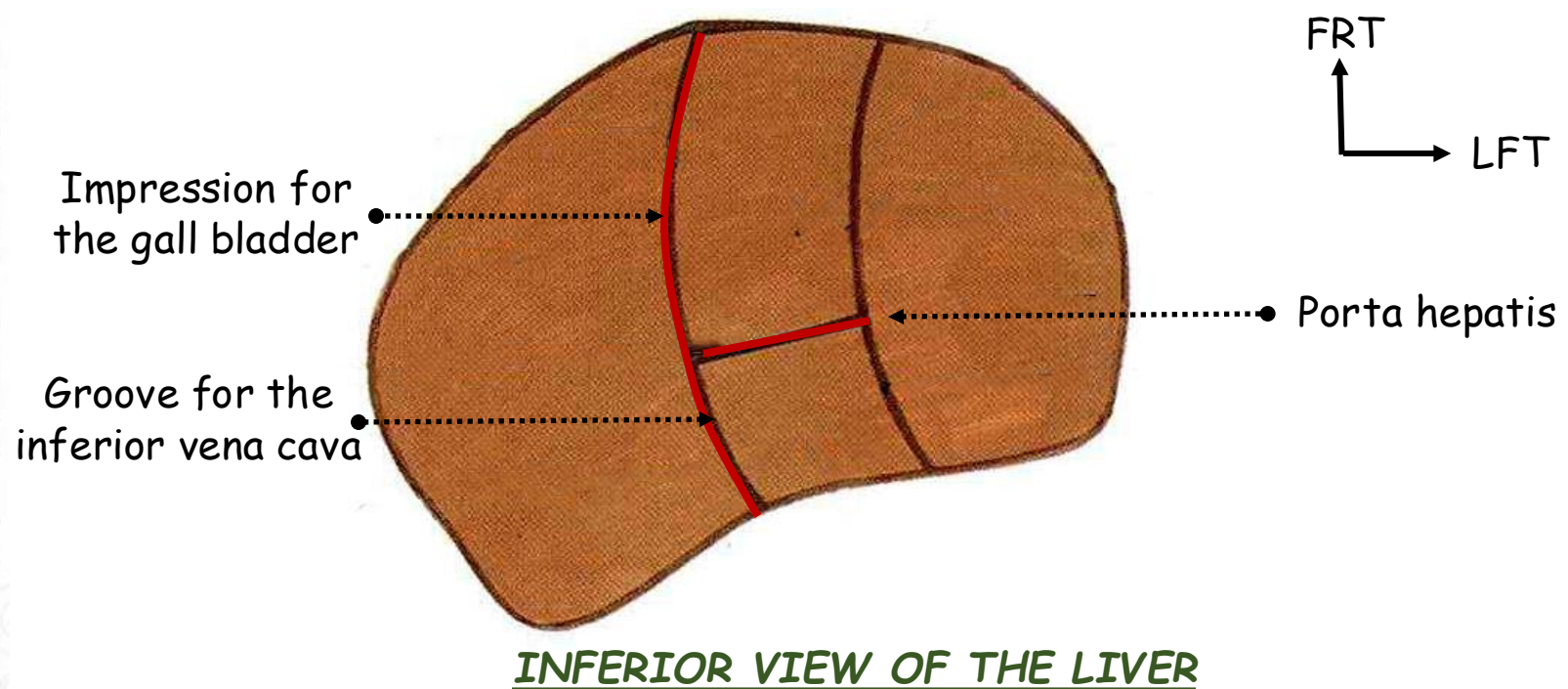


- **Impression for the gall bladder and groove for the inferior vena cava:**

- Right limb of the H
- Anterior shallow fossa
- Right end of porta hepatis
- Contains the gall bladder with its neck on top and fundus at the bottom
- Posterior groove for the vena cava

- **Porta hepatis:**

- Hilum of the liver
- Cross-piece of the H
- Horizontal part of the L-shaped liver attachment of the lesser omentum



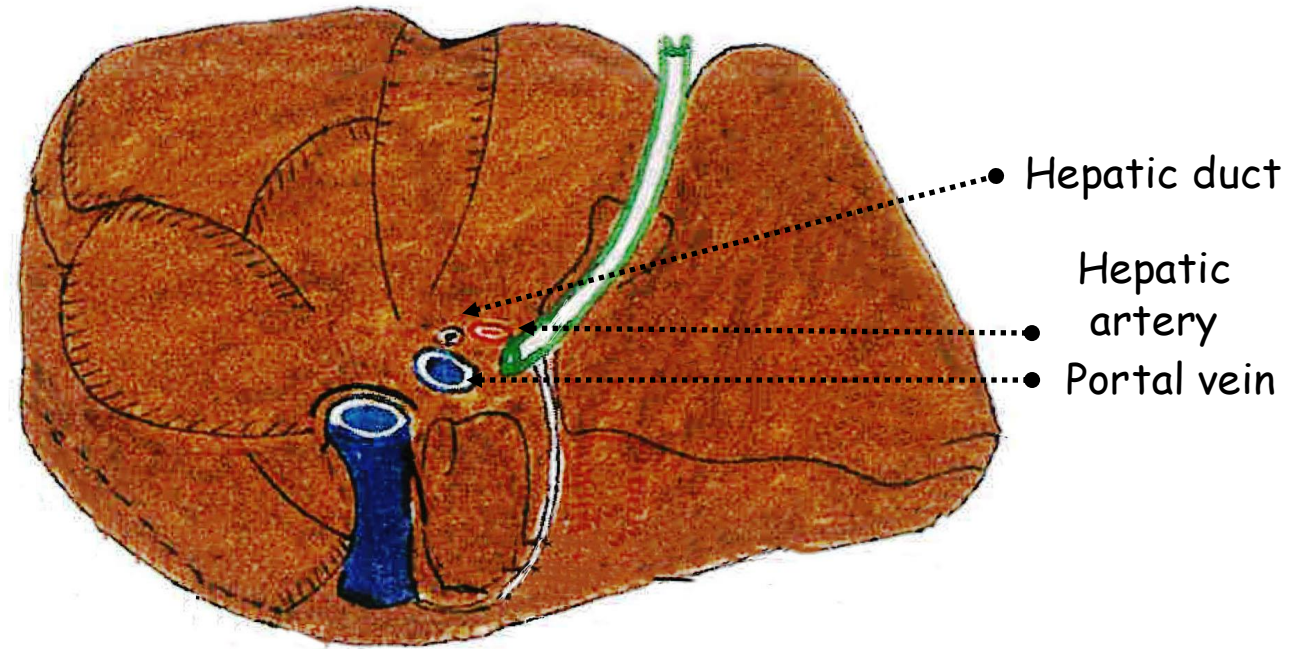
-Transverse slit perforated by the right and left hepatic ducts and the right and left branches of the hepatic artery and portal vein

-Vein-artery-duct order with the ducts in front

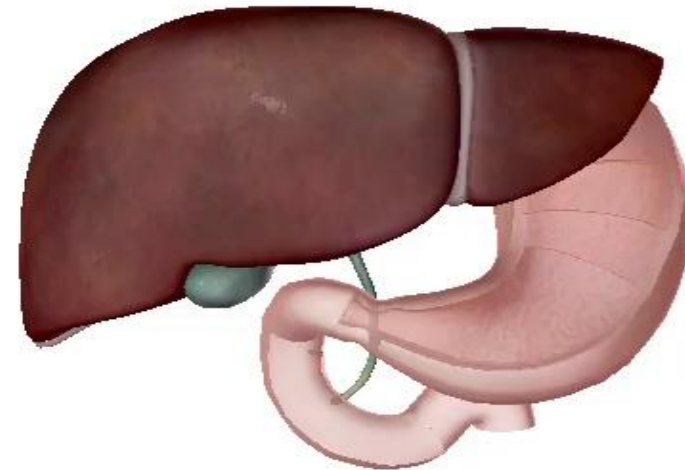
-The cystic duct lies in loose contact with the right end of the porta

- **Left lobe:**

-At the front and above, the falciform ligament divides the anatomical left and right lobes



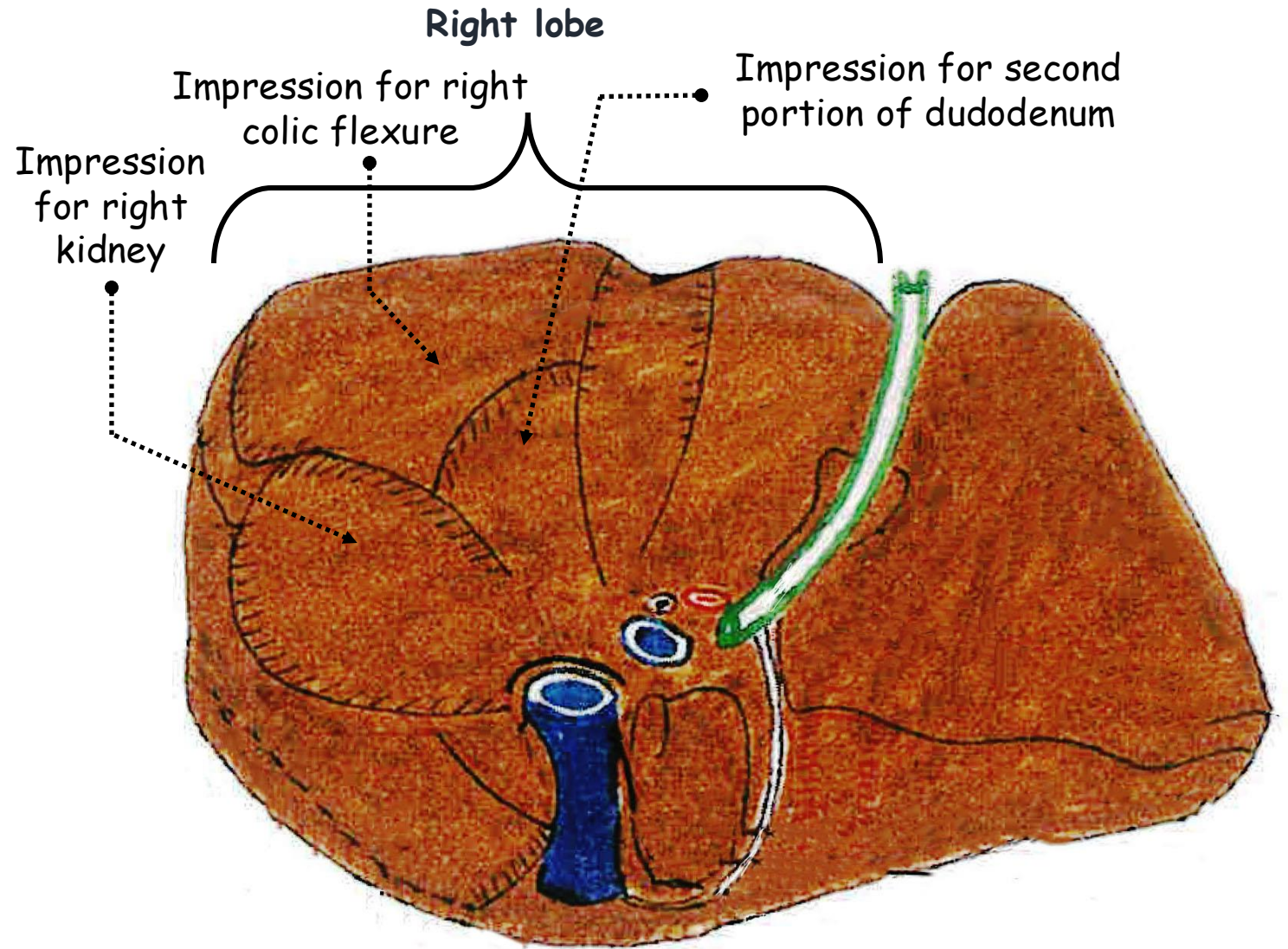
POSTERIOR-INFERIOR VIEW OF THE LIVER





• **Right lobe:**

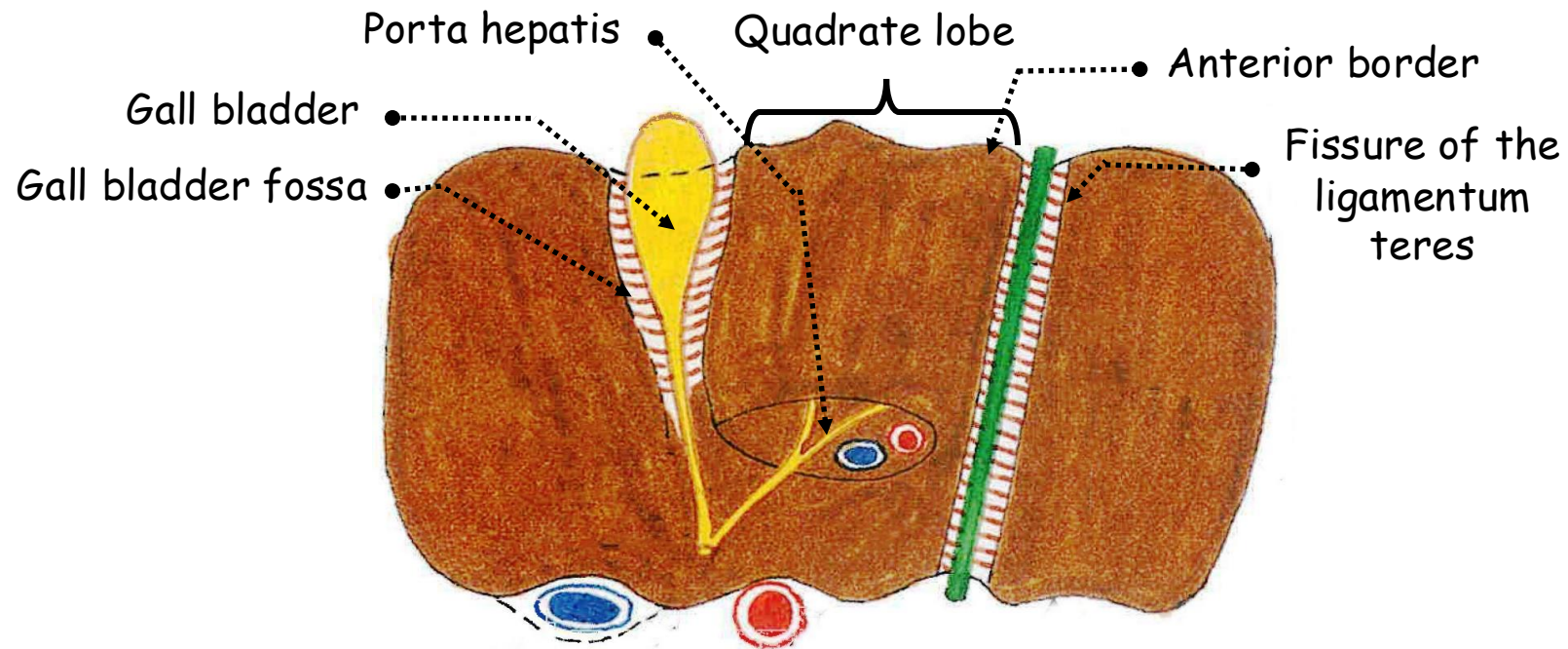
-Inferior surface: impressions for right colic flexure, right kidney and second portion of duodenum



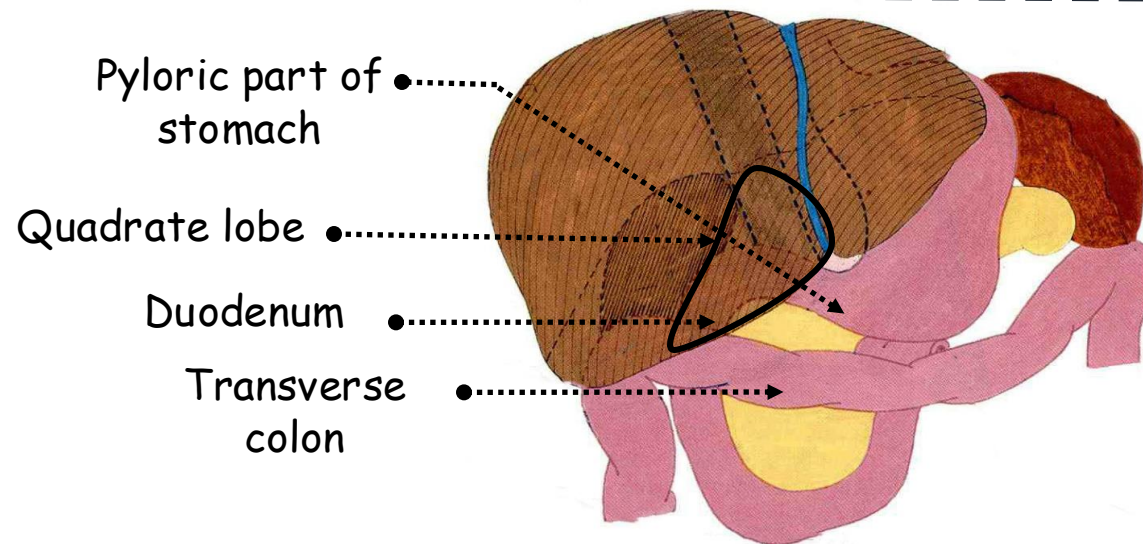
POSTERIOR-INFERIOR VIEW OF THE LIVER

## • **Quadrante lobe:**

- Between the gall bladder fossa and the fissure for the ligamentum teres
- In front of the porta hepatis and behind the anterior border
- Covers the pyloric part of stomach, first portion of duodenum and the prepancreatic part of the transverse colon



INFERIOR VIEW OF THE LIVER

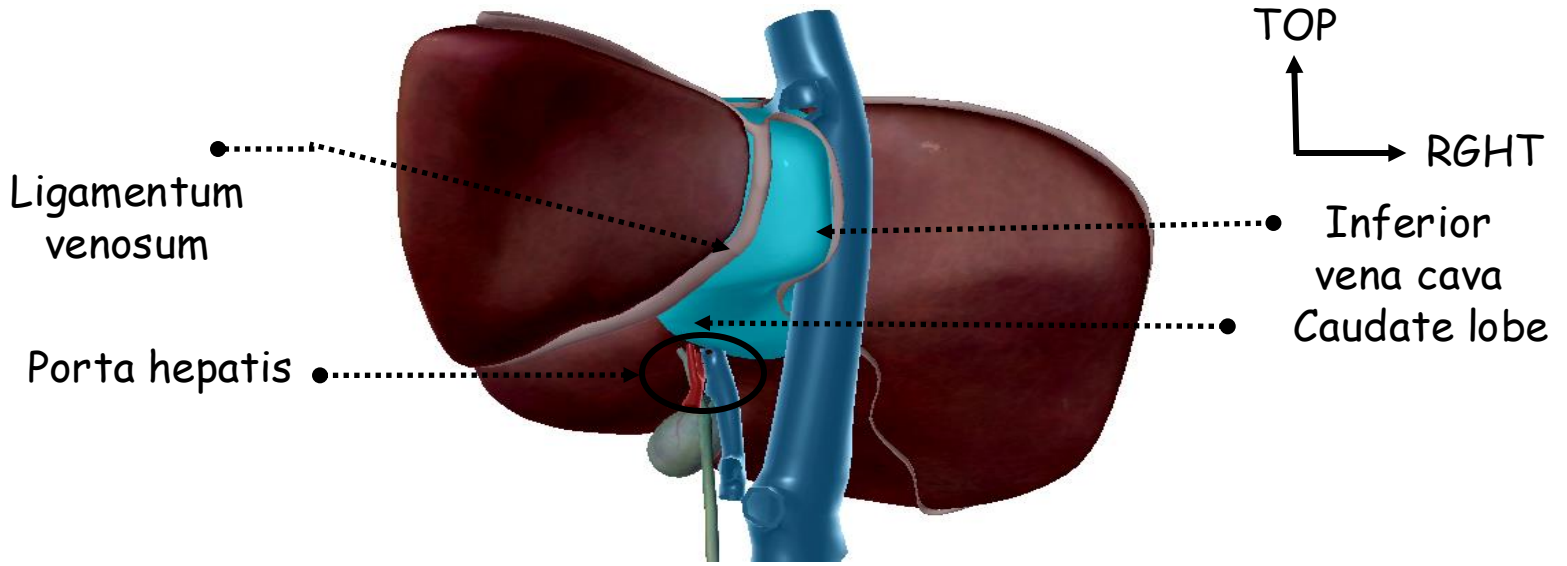


ANTERIOR VIEW OF THE ABDOMEN

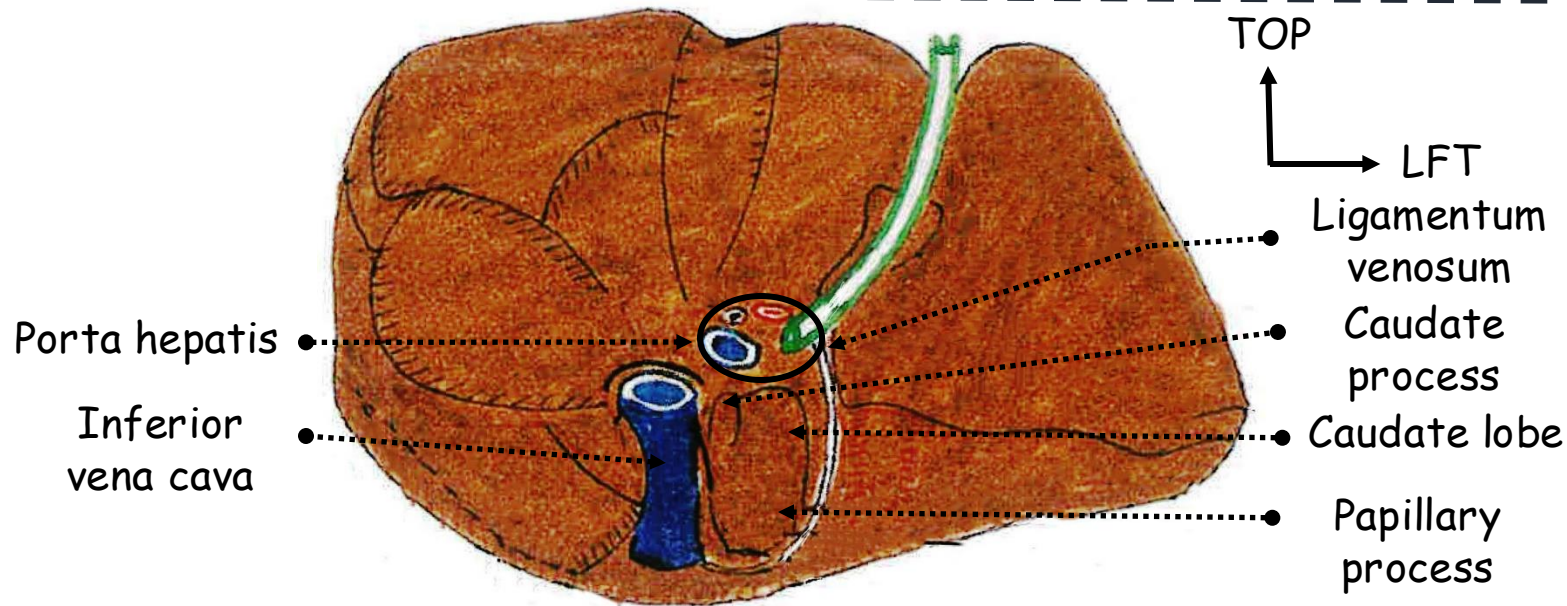


• **Caudate lobe:**

- Between the inferior vena cava and the fissure for the ligamentum venosum
- Connected to the right lobe to the right of the inferior vena cava by an isthmus of liver substance, the **caudate process**
- Connected to the left lobe to the left of the fissure for the ligamentum venosum by an isthmus of liver substance, the **papillary process**



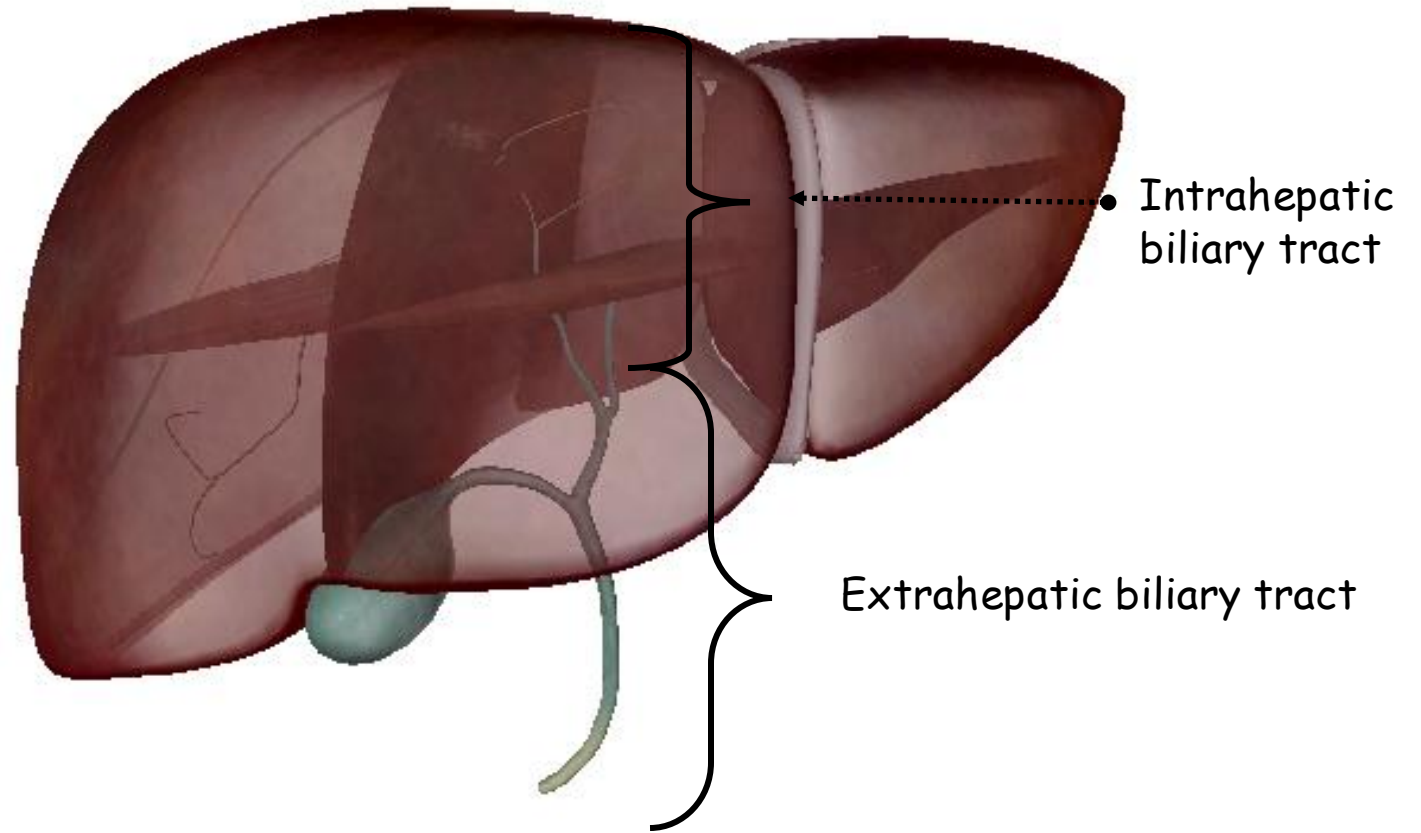
INFERIOR-POSTERIOR VIEW OF THE LIVER



POSTERIOR-INFERIOR VIEW OF THE LIVER

## B. BILIARY TRACT

- Extrahepatic biliary tract
- Intrahepatic biliary tract

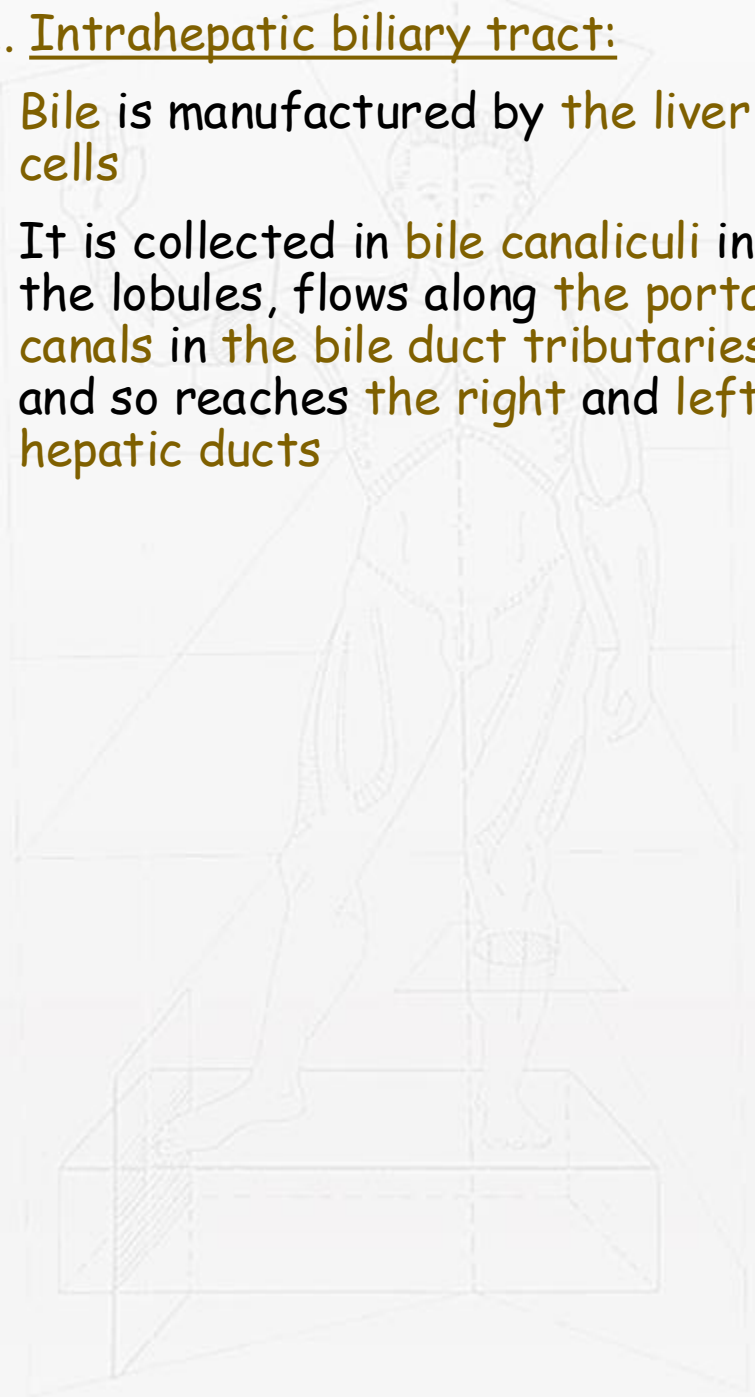


ANTERIOR VIEW OF THE LIVER



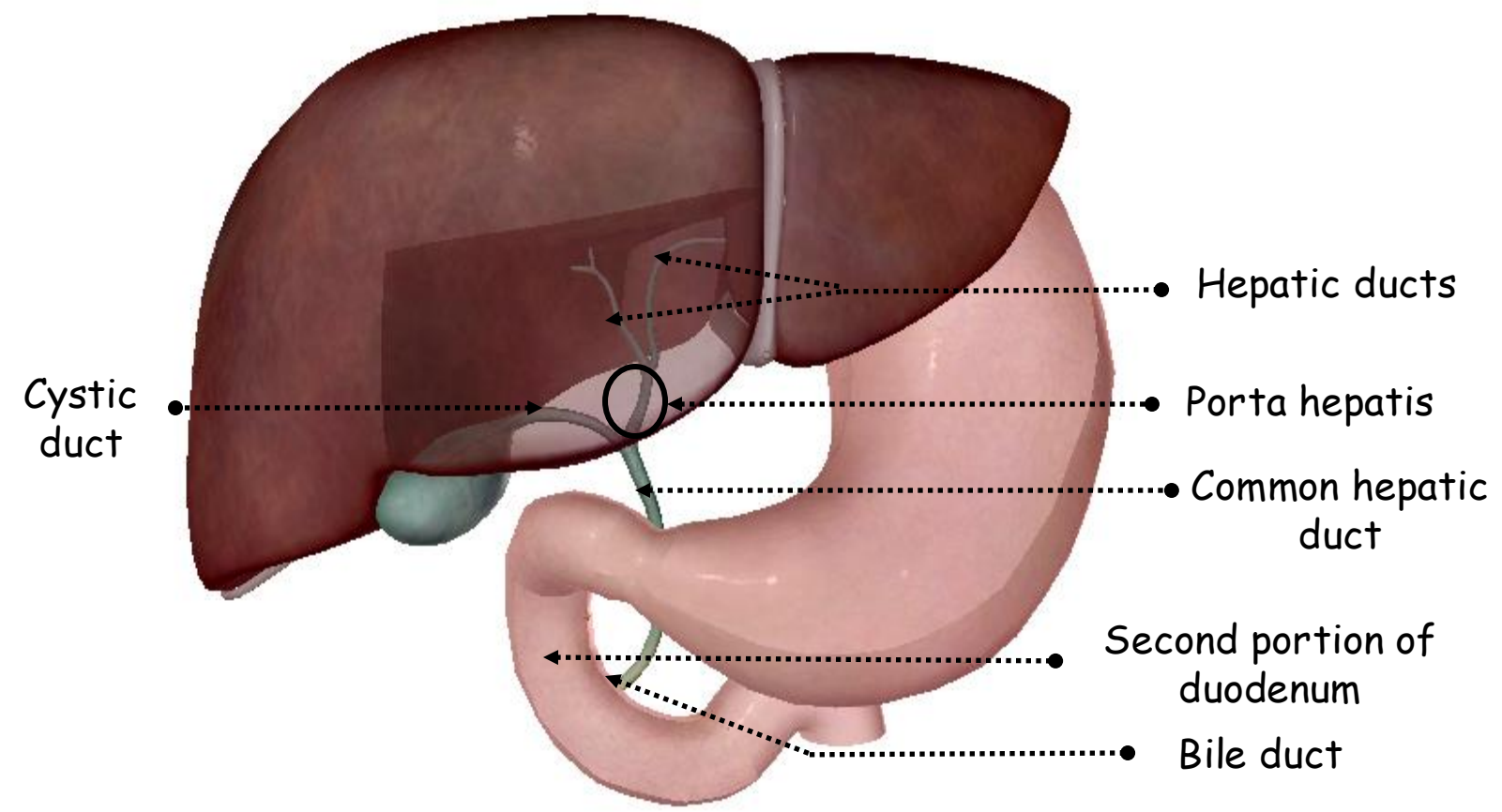
## 1. Intrahepatic biliary tract:

- Bile is manufactured by the liver cells
- It is collected in bile canaliculi in the lobules, flows along the portal canals in the bile duct tributaries and so reaches the right and left hepatic ducts



## 2. Extrahepatic biliary tract:

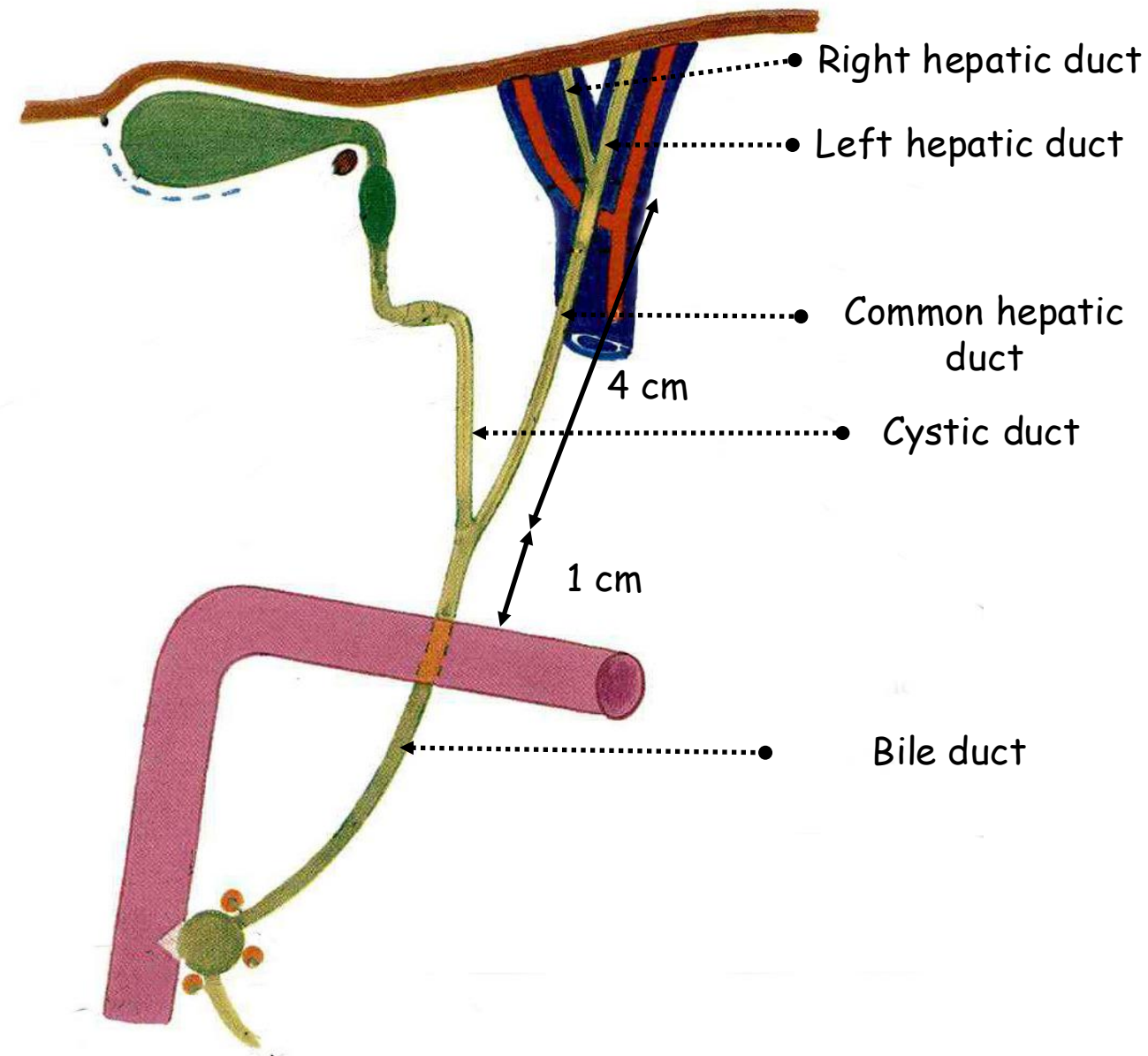
- Consists of the three hepatic ducts, right, left and common, the gall bladder, the cystic duct and the bile duct



ANTERIOR VIEW OF THE LIVER SHOWING THE EXTRAHEPATIC BILIARY TRACT

## • Common hepatic duct:

- The right and left hepatic ducts emerge from the porta hepatis and unite near its right margin in a Y-shaped manner to form the common hepatic duct
- Joined on its right side, usually after about 3 cm, by the cystic duct to form the bile duct 1 cm above the duodenum
- 4 cm long with a diameter of 4 mm
- Free edge of the lesser omentum
- In front of the right edge of the portal vein and the right hepatic artery and with the hepatic artery on its left
- Several anatomical relations

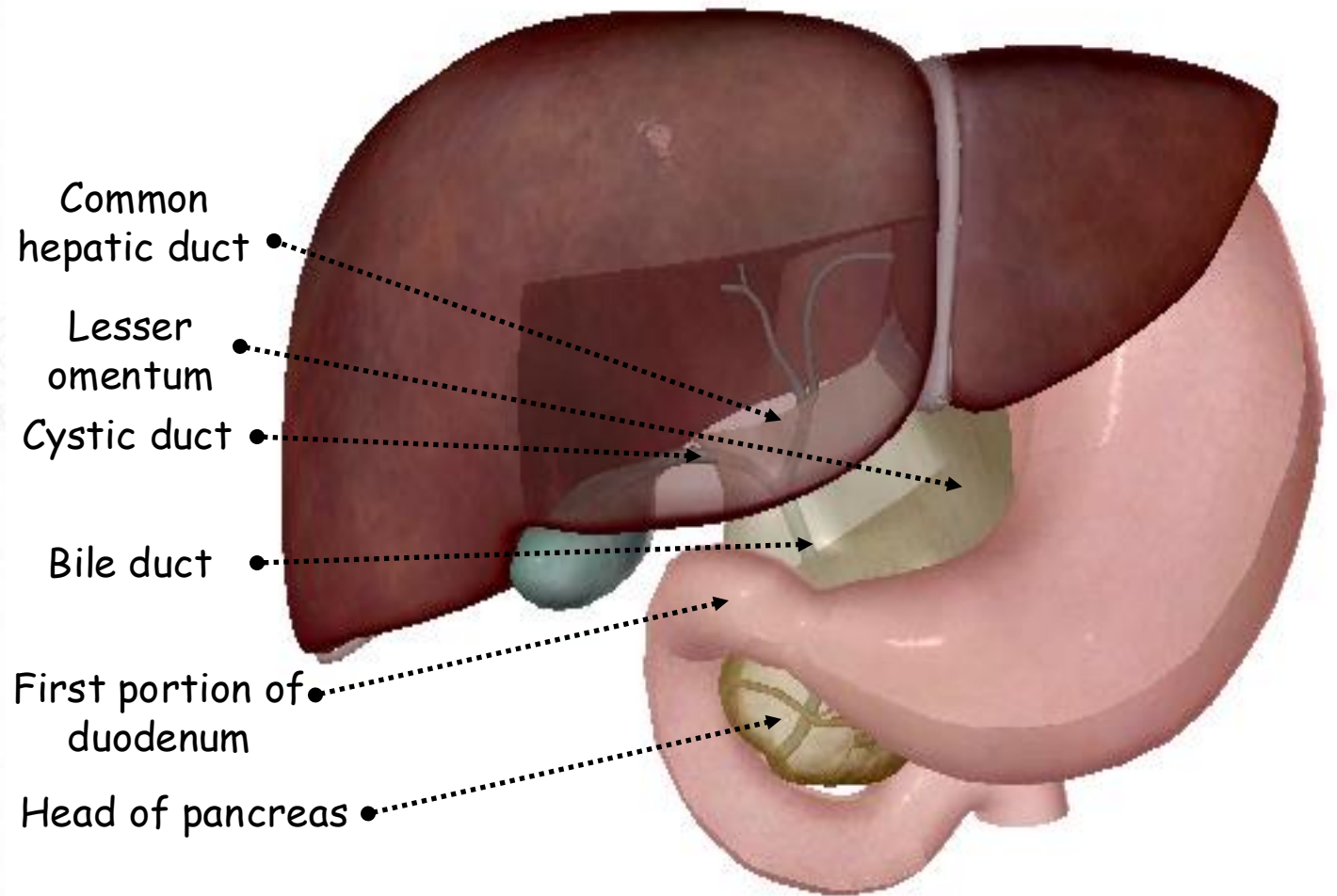


**FIGURE SHOWING EXTRAHEPATIC BILIARY TRACT**



- **Bile duct:**

- The common hepatic duct receives on its right side the cystic duct to form the bile duct
- 8 cm long and 8 mm in diameter
- Three thirds
- Supraduodenal: in the free edge of the lesser omentum in front of the portal vein and to the right of the hepatic artery, forming the anterior boundary of the epiploic foramen
- Retroduodenal: runs behind the first part of the duodenum and slopes down to the right of the portal vein which now lies to the left of the duct with the gastroduodenal artery in front of the inferior vena cava



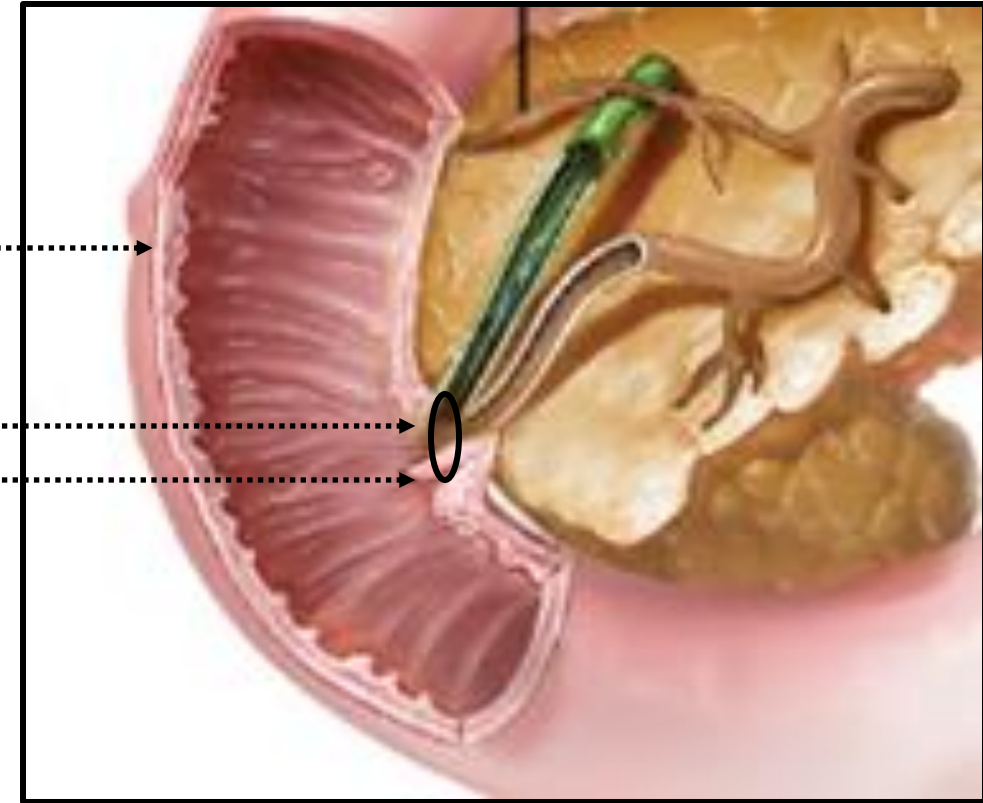
ANTERIOR VIEW OF THE LIVER SHOWING THE EXTRAHEPATIC BILIARY TRACT

-Paraduodenal: slopes further to the right in the groove between the back of the head of the pancreas and the second part of the duodenum and in front of the right renal vein, joins the pancreatic duct at an angle of about  $60^\circ$  at the hepatopancreatic ampulla of Vater surrounded by the ampullary sphincter of Oddi; the ampulla opens into the posteromedial wall of the second part of the duodenum at the major duodenal papilla

2<sup>nd</sup> portion of duodenum

Hepatopancreatic ampulla of Vater

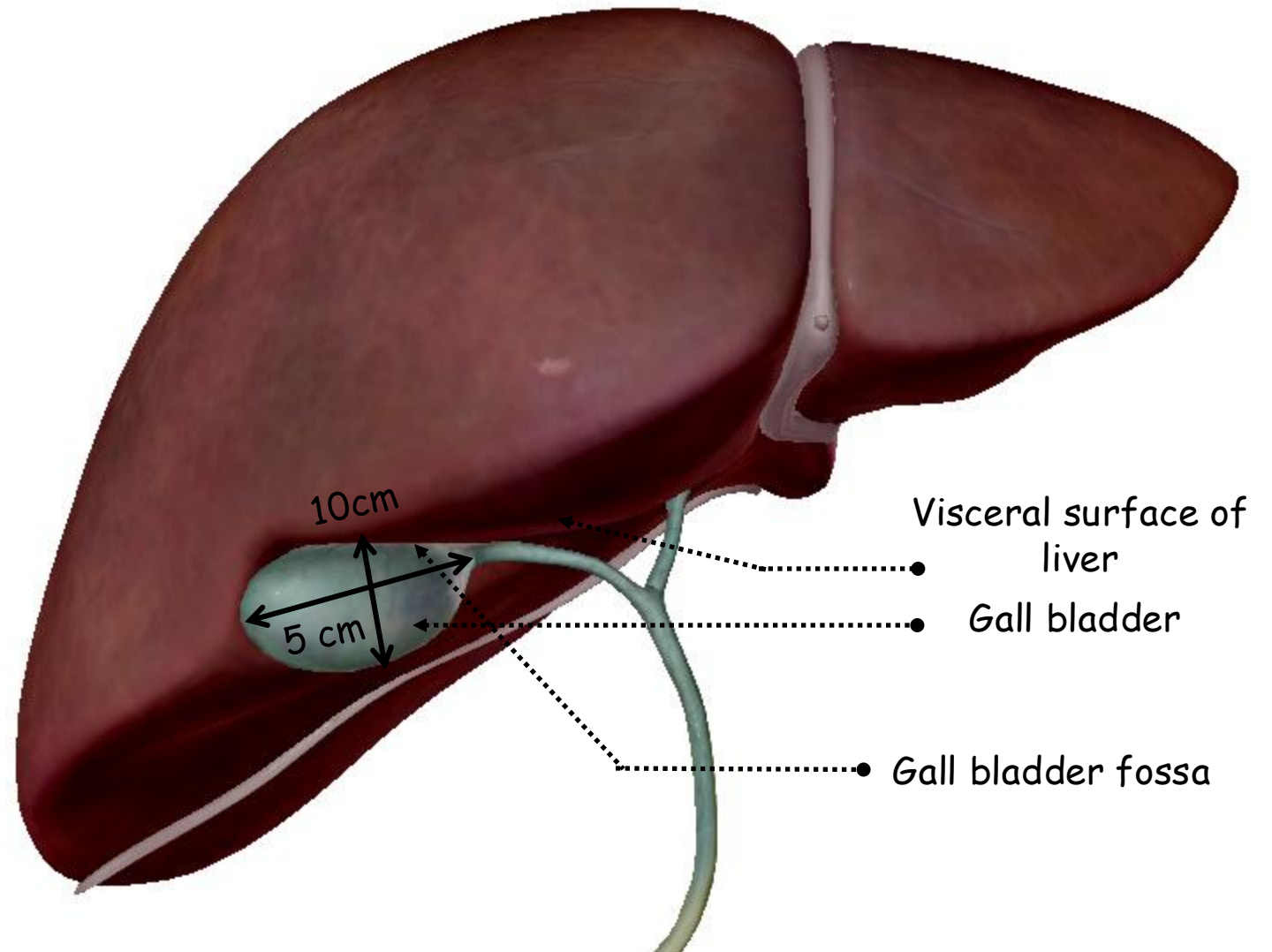
Major duodenal papilla



ANTERIOR VIEW OF THE DUODENUM AND PANCREAS SHOWING THE PARADUODENAL THIRD OF THE BILE DUCT

## • Gall bladder:

- Stores and concentrates the bile secreted by the liver
- Pear-shaped viscus
- Capacity of about 50 ml
- Length: 10 cm
- Width: 5 cm
- Attached to the gall bladder fossa by fibrous tissue
- Peritonised in its inferior surface
- 3 parts

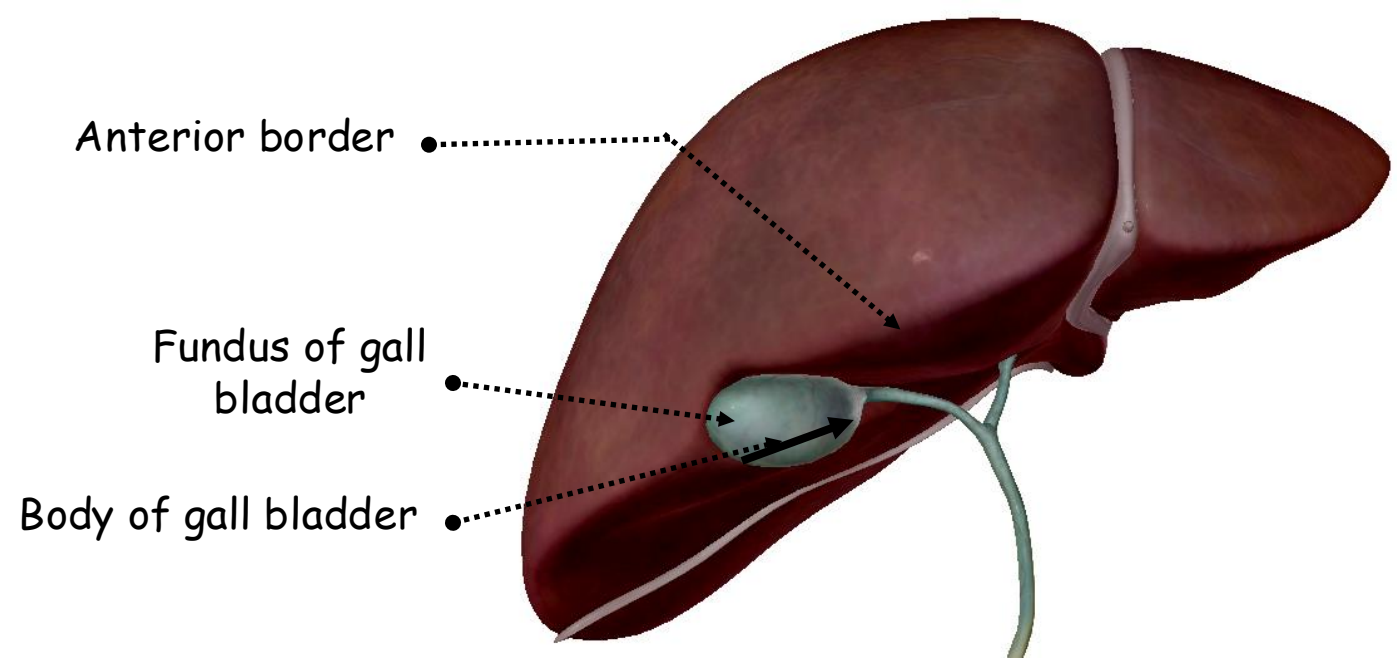


INFERIOR-ANTERIOR VIEW OF THE LIVER



-Fundus: projects a little beyond the sharp lower border of the liver on the commencement of the transverse colon, just to the left of the hepatic flexure and touches the parietal peritoneum of the anterior abdominal wall at the tip of the ninth costal cartilage

-Body: passes backwards and upwards towards the right end of the porta hepatis and is in contact with the first part of the duodenum



INFERIOR-ANTERIOR VIEW OF THE LIVER

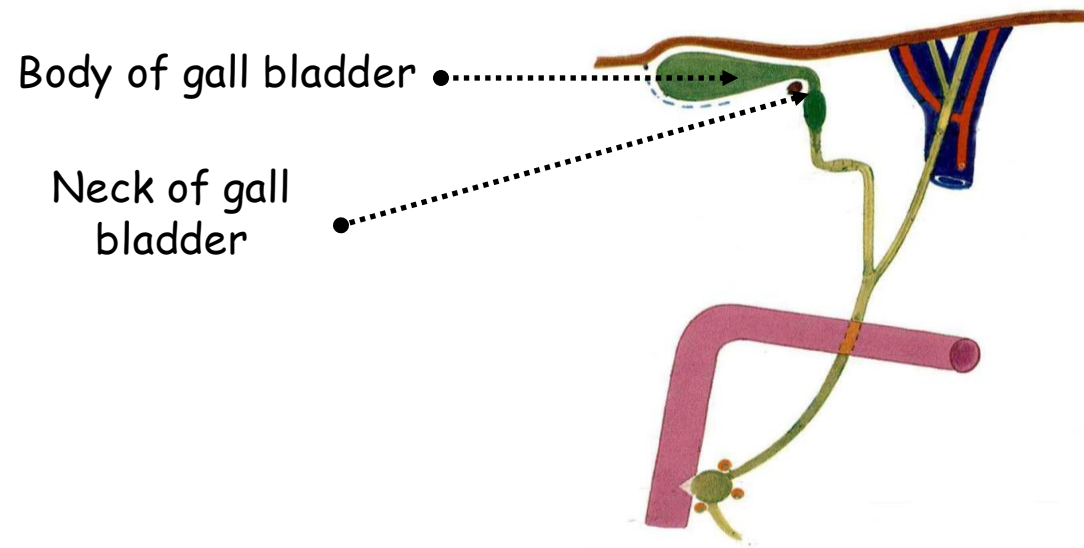


FIGURE SHOWING EXTRAHEPATIC BILIARY TRACT

-**Neck:** lies at a higher level than the fundus and against the free edge of the lesser omentum and may show a small diverticulum, Hartmann's pouch

• **Cystic duct:**

-2-3 cm long and 2-3 mm in diameter

-Runs towards the porta to join the common hepatic duct between the two layers of the free edge of the lesser omentum about 1 cm above the duodenum and usually in front of the right hepatic artery and its cystic branch

-Anatomical variations

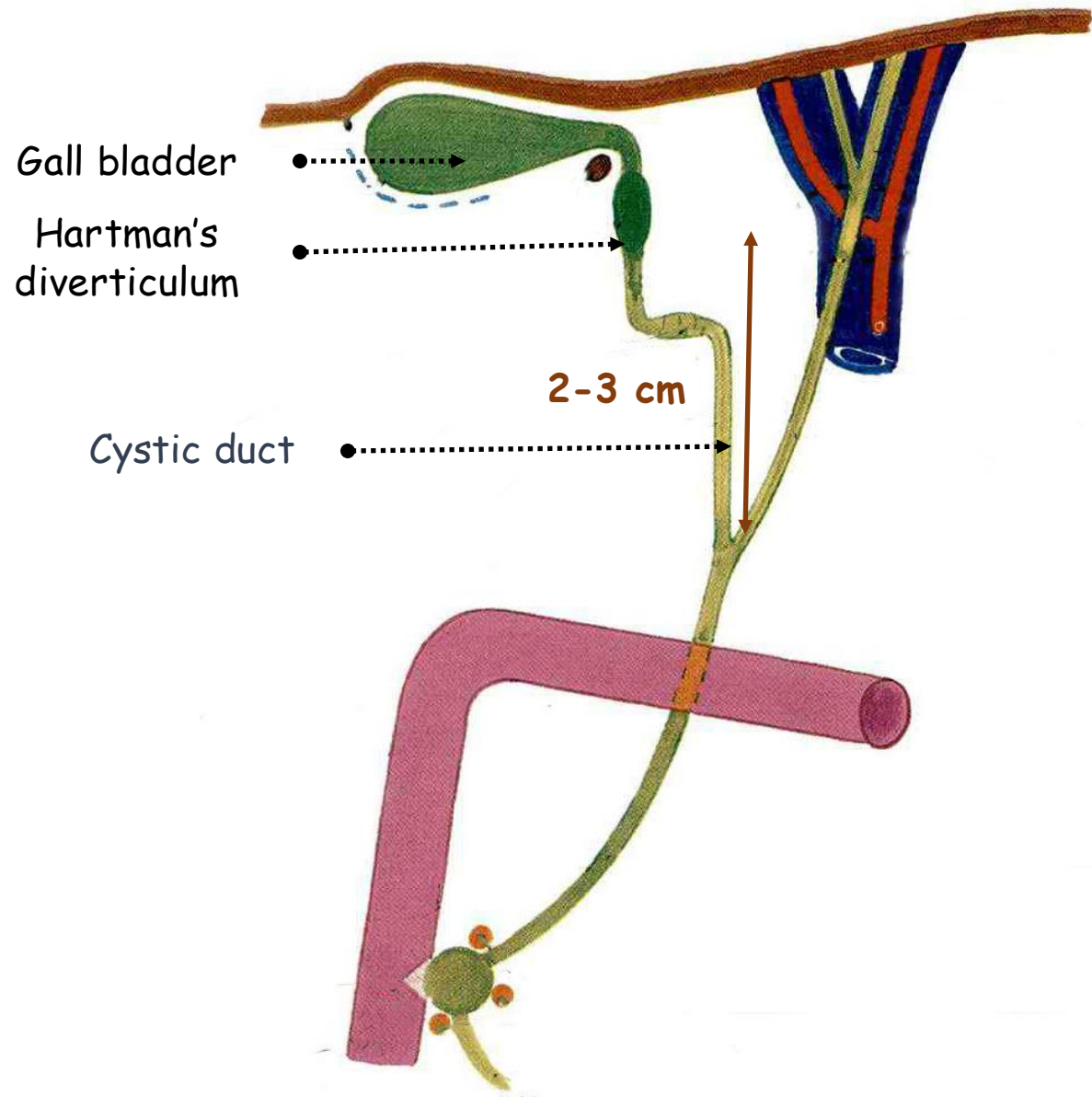


FIGURE SHOWING EXTRAHEPATIC BILIARY TRACT



### III. STRUCTURE

- Parenchyma covered with a capsule and mostly peritonised
- Serous coat: peritoneum
- Glisson's capsule: fibrous
- Liver lobule: pinhead size and hexagonal shape, with a central vein and sinusoids and plates or cords of hepatocytes radiating from it to the periphery of the lobule where there may be fine connective tissue septa separating it from adjacent lobules
- At the corners of the lobules small branches of the hepatic artery and portal vein are gathered with bile ductules, forming the portal canals united by anastomosing connexions
- Liver acinus: diamond-shaped area with central veins at one pair of opposite corners and portal canals at the other pair, consists of parts of two adjacent lobules

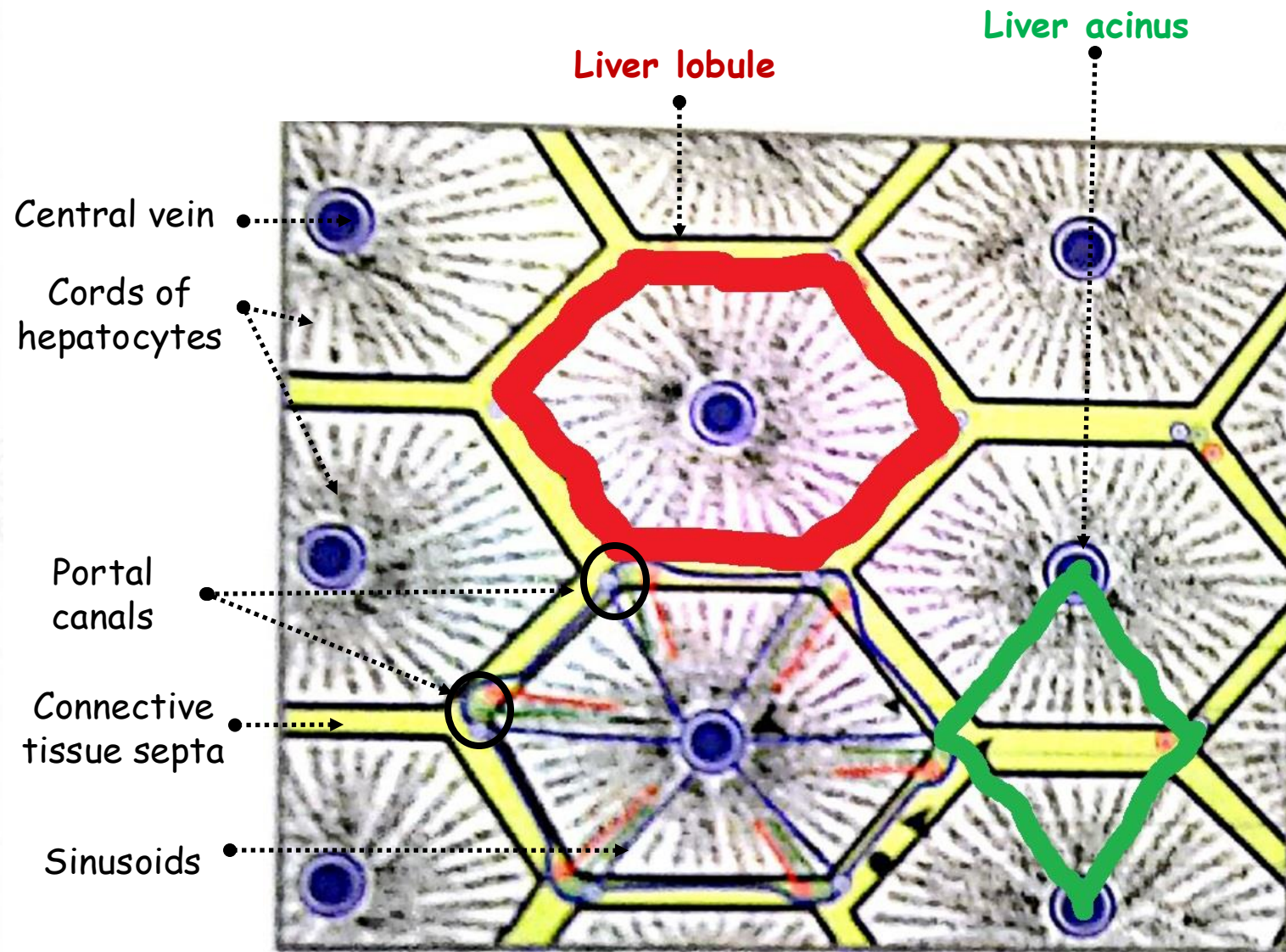
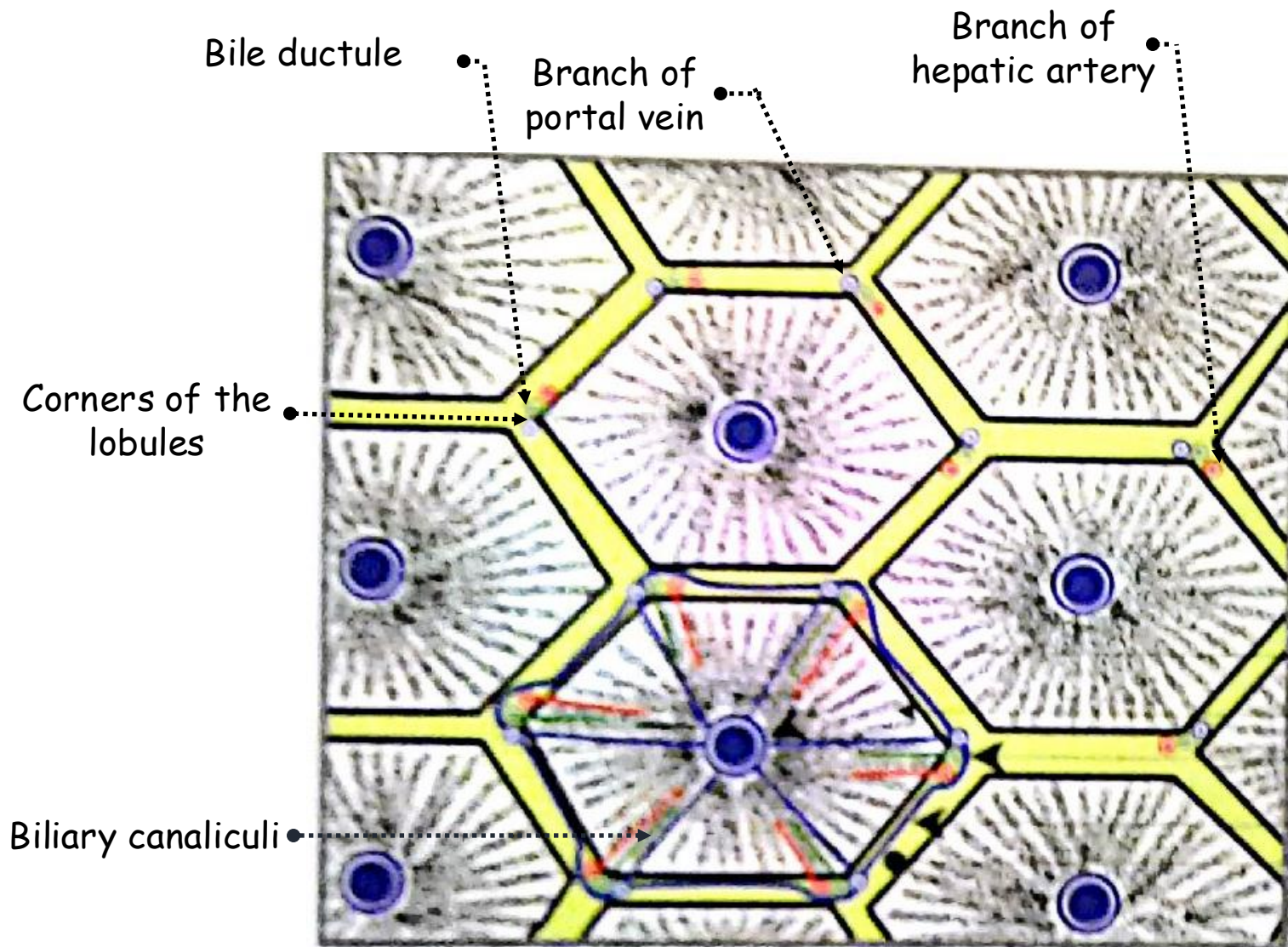


FIGURE SHOWING THE STRUCTURE OF THE LIVER



- The sinusoids intervening between the cords of hepatocytes allow plasma to leave the sinusoids and enter the perisinusoidal spaces so that exchange of materials can take place between plasma and liver cells
- Biliary canaliculi are situated between opposing sides of adjacent hepatocytes and drain into the bile ductules of the portal canals, and these in turn unite to form the larger intrahepatic ducts
- Central veins flow into hepatic veins
- **Gall bladder:**
  - Small amount of smooth muscle in its wall
  - Mucous membrane is a lax areolar tissue lined with a simple columnar mucous-secreting epithelium projected into folds



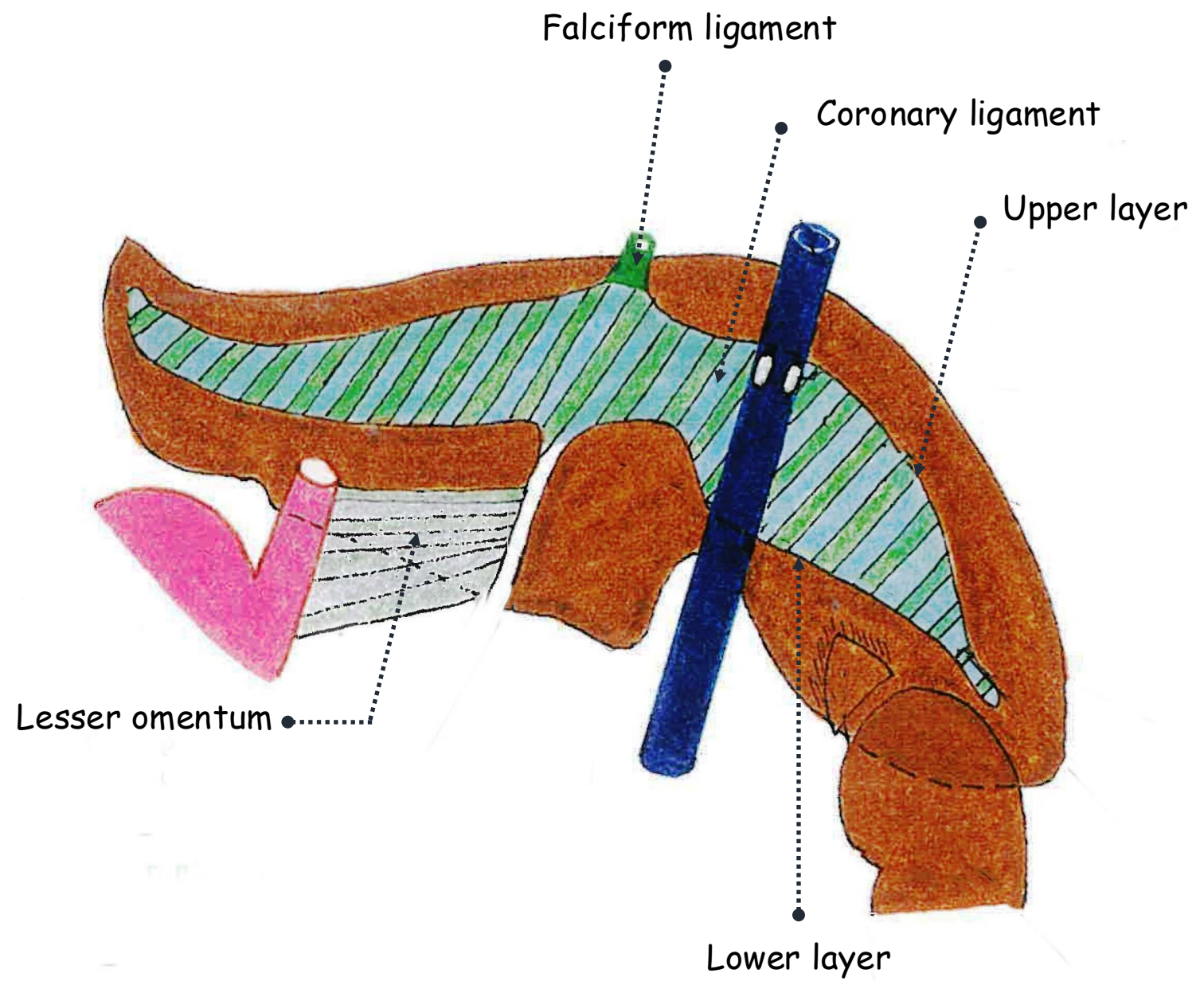
**FIGURE SHOWING THE STRUCTURE OF THE LIVER**



## IV. SUPPORTS

### A. CORONARY LIGAMENT

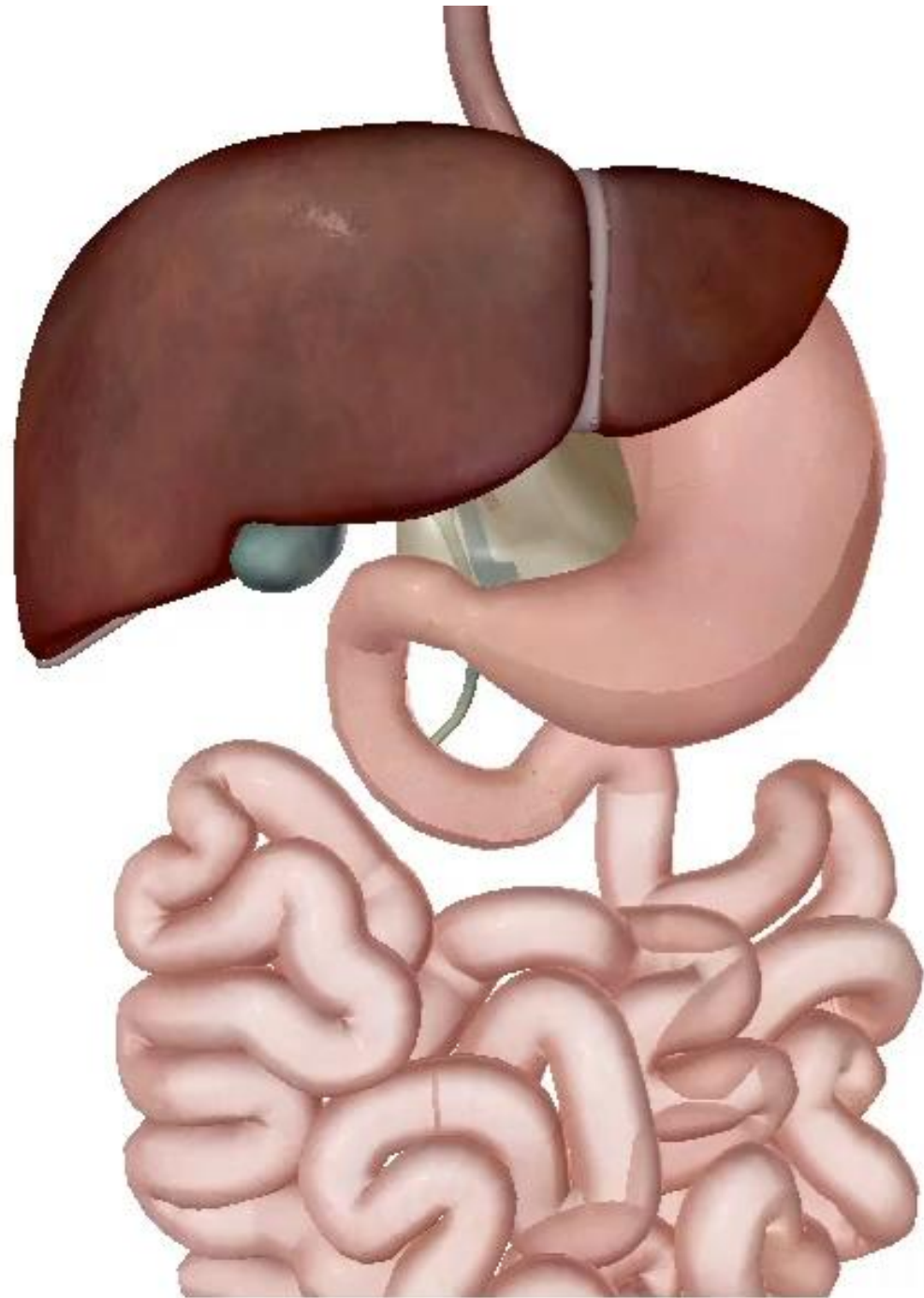
- Attaches the posterior surface to the diaphragm
- Upper layer: right leaf of the falciform ligament sweeping to the right over the summit of the right dome, to pass just in front of the inferior vena cava
- Lower layer: reduplication of the right leaf of the falciform ligament sweeping downwards to the right to pass just between the inferior vena cava and the porta hepatis
- Surrounds the bare area of the liver



POSTERIOR VIEW OF THE LIVER

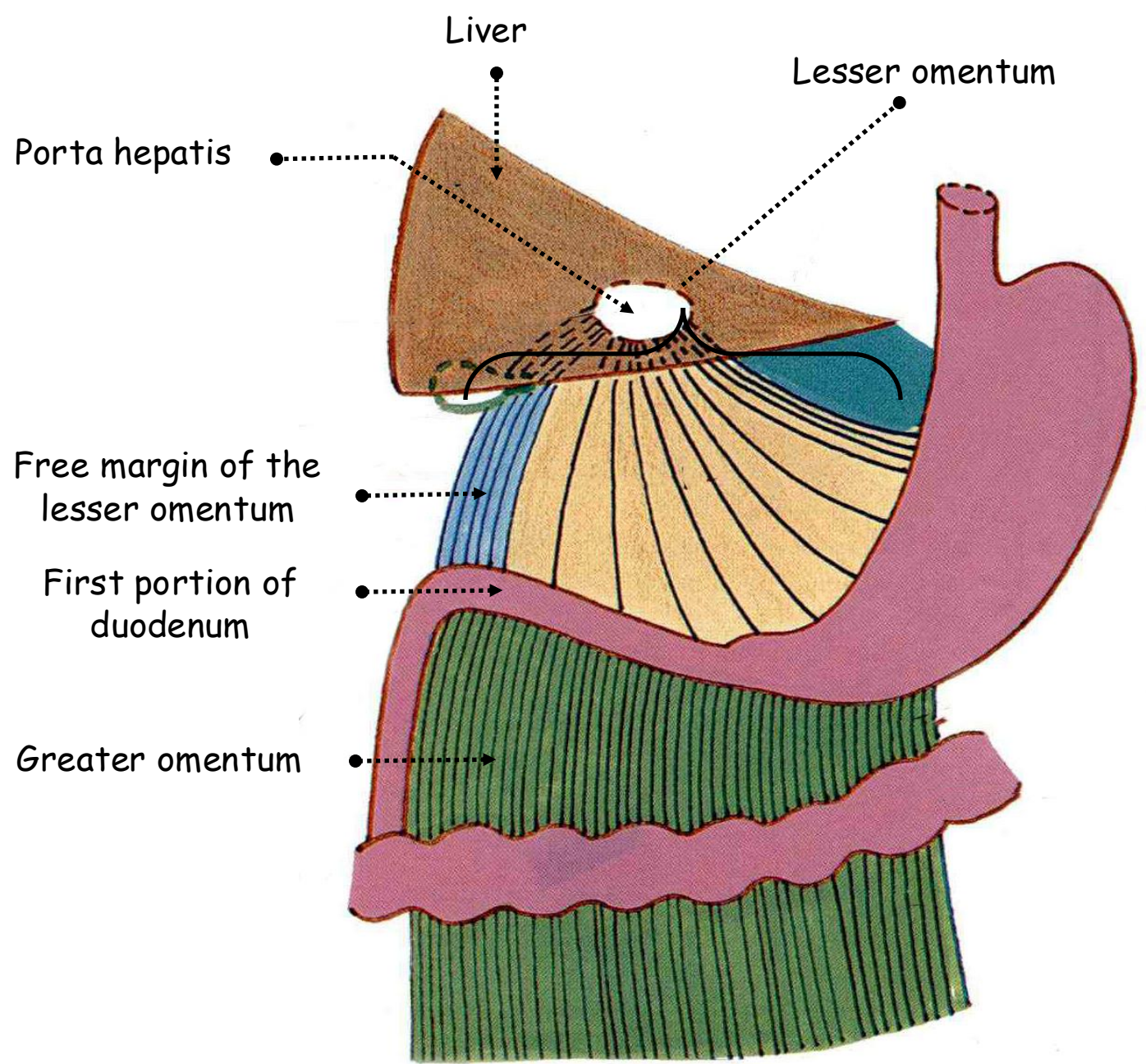
## B. LESSER OMENTUM

- Extends between the liver and the lesser curvature of the stomach
- Usually only seen when the liver is lifted up, away from the stomach
- Liver attachment:
  - L-shaped
  - To the fissure for the ligamentum venosum and the porta hepatis
- Continuous with the lower layer of the coronary ligament to the right of the fissure for the ligamentum venosum





- Between the duodenum and the liver it has a **right free margin**, where the **peritoneum of the greater and lesser sacs** become continuous
- **Anterior** boundary of the epiploic foramen of Winslow
- **Epiploic foramen of Winslow:**
  - Vertical slit about 2.5 cm high
  - Like the opening for a coin in a slot machine
  - Can be slightly stretched to admit the tips of **two fingers**
  - Upper boundary:** **caudate process of the liver**
  - Lower boundary:** the first portion of the duodenum



ANTERIOR VIEW OF THE ABDOMEN

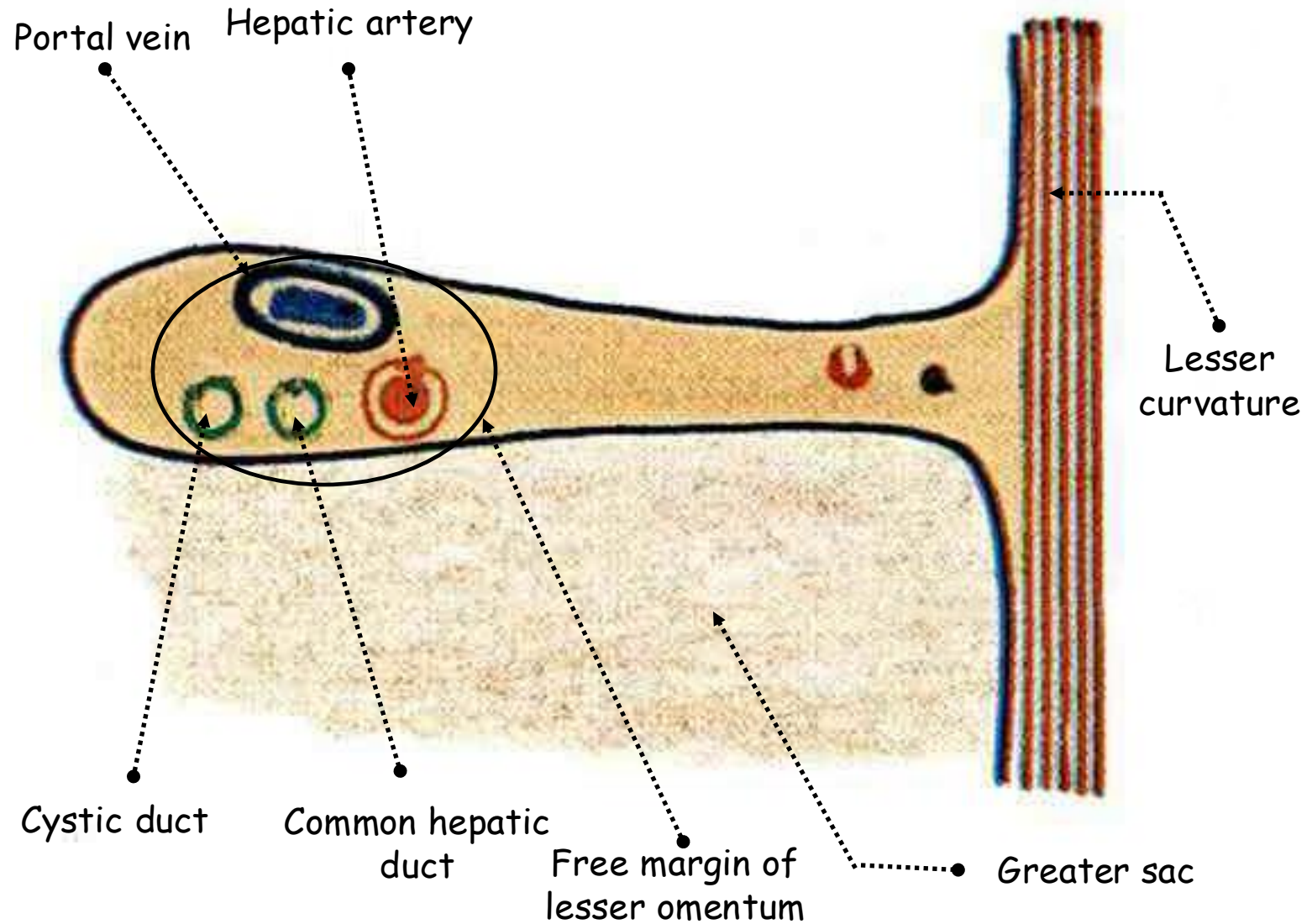
-Posterior boundary: the inferior vena cava covered by the parietal peritoneum of the posterior abdominal wall

• Within the free margin of the lesser omentum:

-Portal vein at the back

-Hepatic artery in front and to the left

-Bile duct to the front and right of the vein

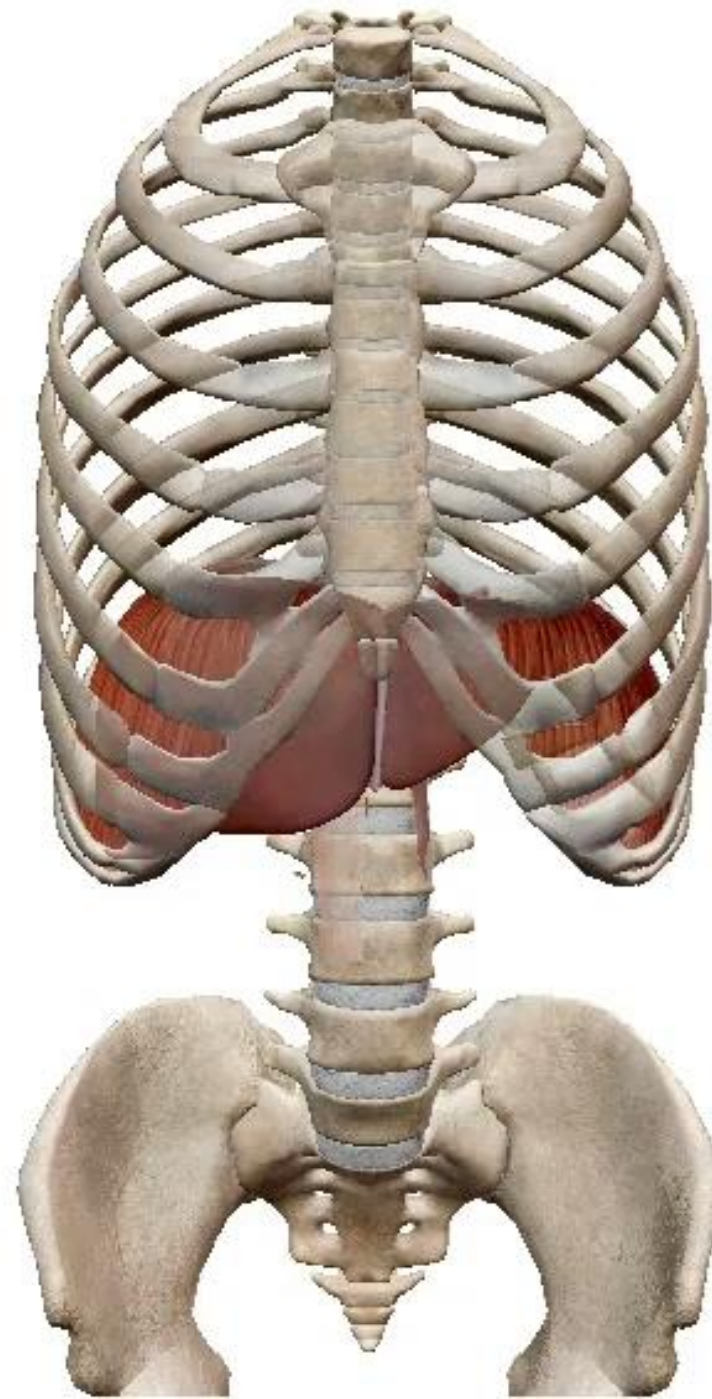


TRANSVERSAL SECTION OF THE GREATER OMENTUM



### C. FALCIFORM LIGAMENT

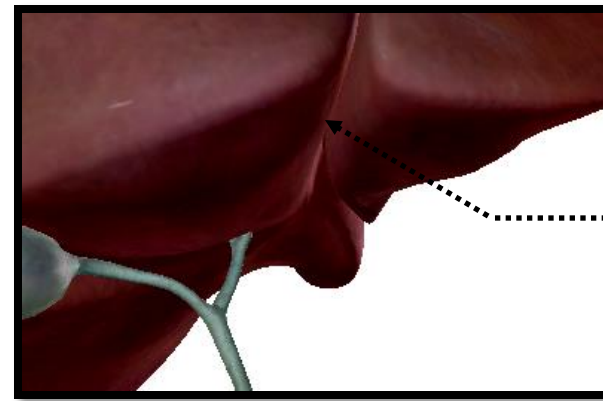
- Passes upwards from the umbilicus behind the linea alba towards the xiphisternum
- Contains in its posterior and slightly crescentic free margin the ligamentum teres
- Having delivered the ligamentum teres to the liver in its notch, this double-layered fold continues up and to the right of the midline, between the diaphragm and the anterior and superior surfaces of the liver, where the two layers separate
- One sweeps to the left along the upper surface of the liver as the left triangular ligament
- The other sweeps to the right, reduplicates and forms the upper and lower layers of the coronary ligament
- The latter meet at the apex of the bare area and form the right triangular ligament



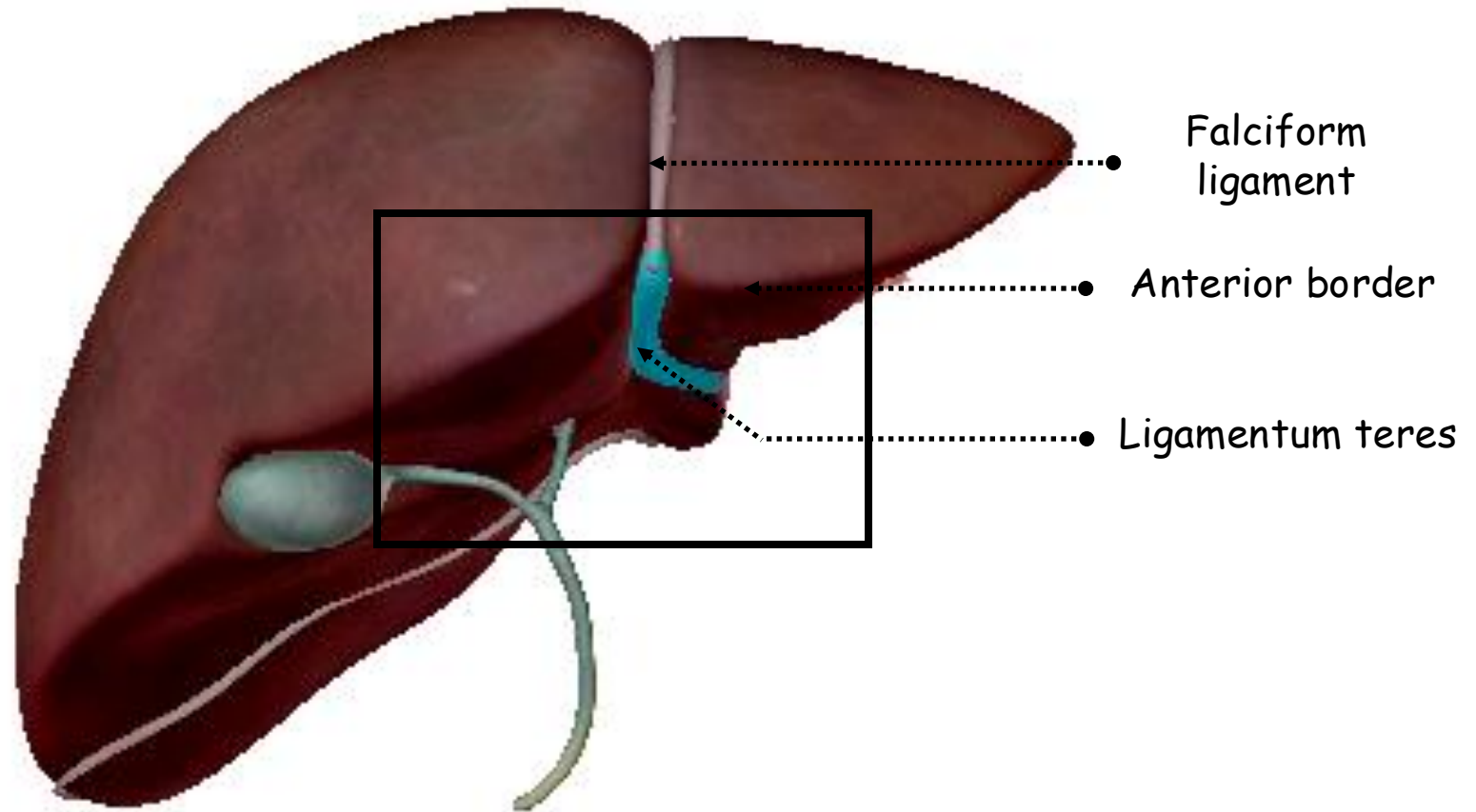


## D. LIGAMENTUM TERES

- Obliterated remains of the left umbilical vein
- In the posterior slightly crescentic free margin of the falciform ligament in the fissure for the ligamentum teres



Fissure for the  
ligamentum teres



Falciform  
ligament

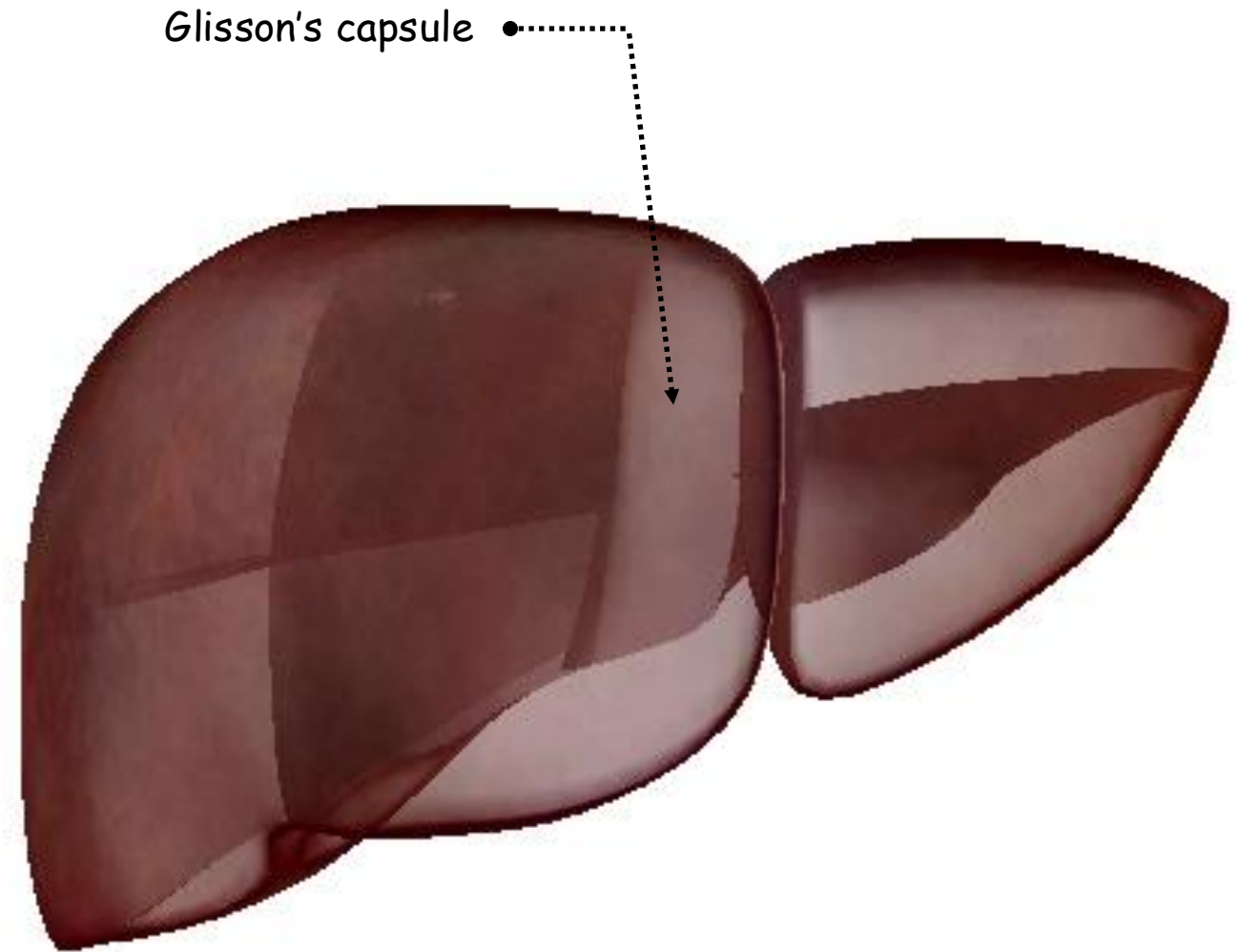
Anterior border

Ligamentum teres

INFERIOR-ANTERIOR VIEW OF THE LIVER

## E. GLISSON'S CAPSULE

- Thin and fibrous
- Lines the vessels and the hepatic ducts in the porta hepatis
- Reflects to line them inside the liver
- Continuous with fine connective tissue **septa separating the liver lobules**; though in the human liver the septa are poorly developed compared with those in many animals



ANTERIOR VIEW OF THE LIVER

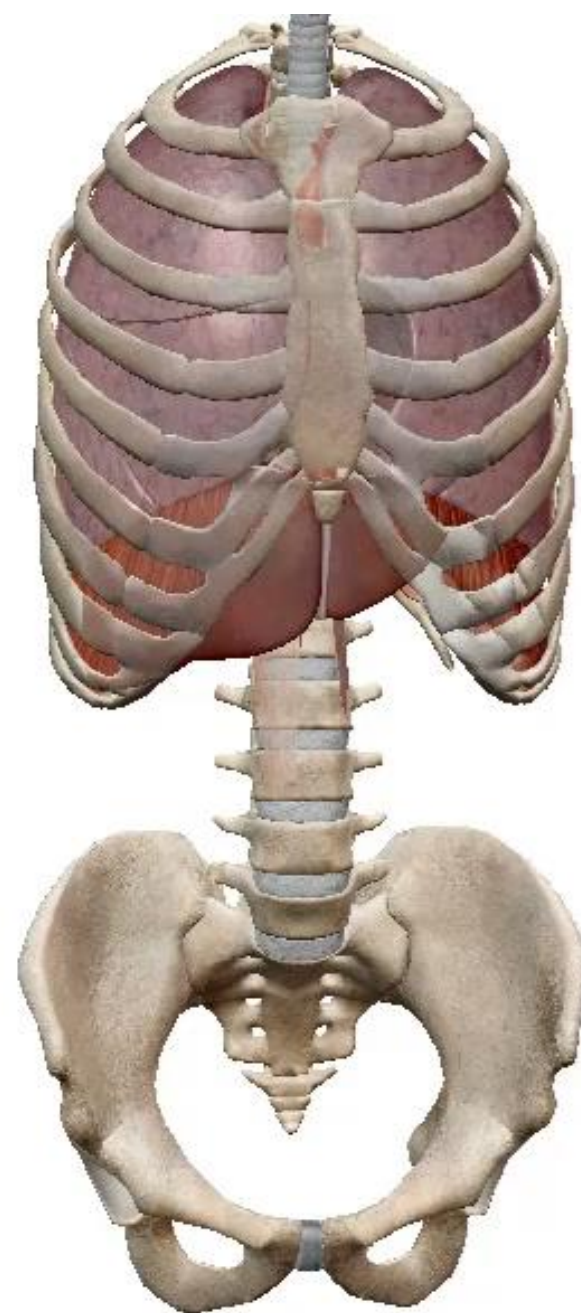
## V. ANATOMICAL RELATIONS

### A. DIAPHRAGMATIC SURFACE

- From the top to the bottom
- Through diaphragm
- Pericardium and heart
- Right pleura and lung to the right
- Left pleura and lung to the left
- Costal cartilages 6-10 on the right and costal cartilages 6 and 7 on the left
- Infracostal angle and the anterior abdominal wall of the epigastrium

### B. POSTERIOR SURFACE

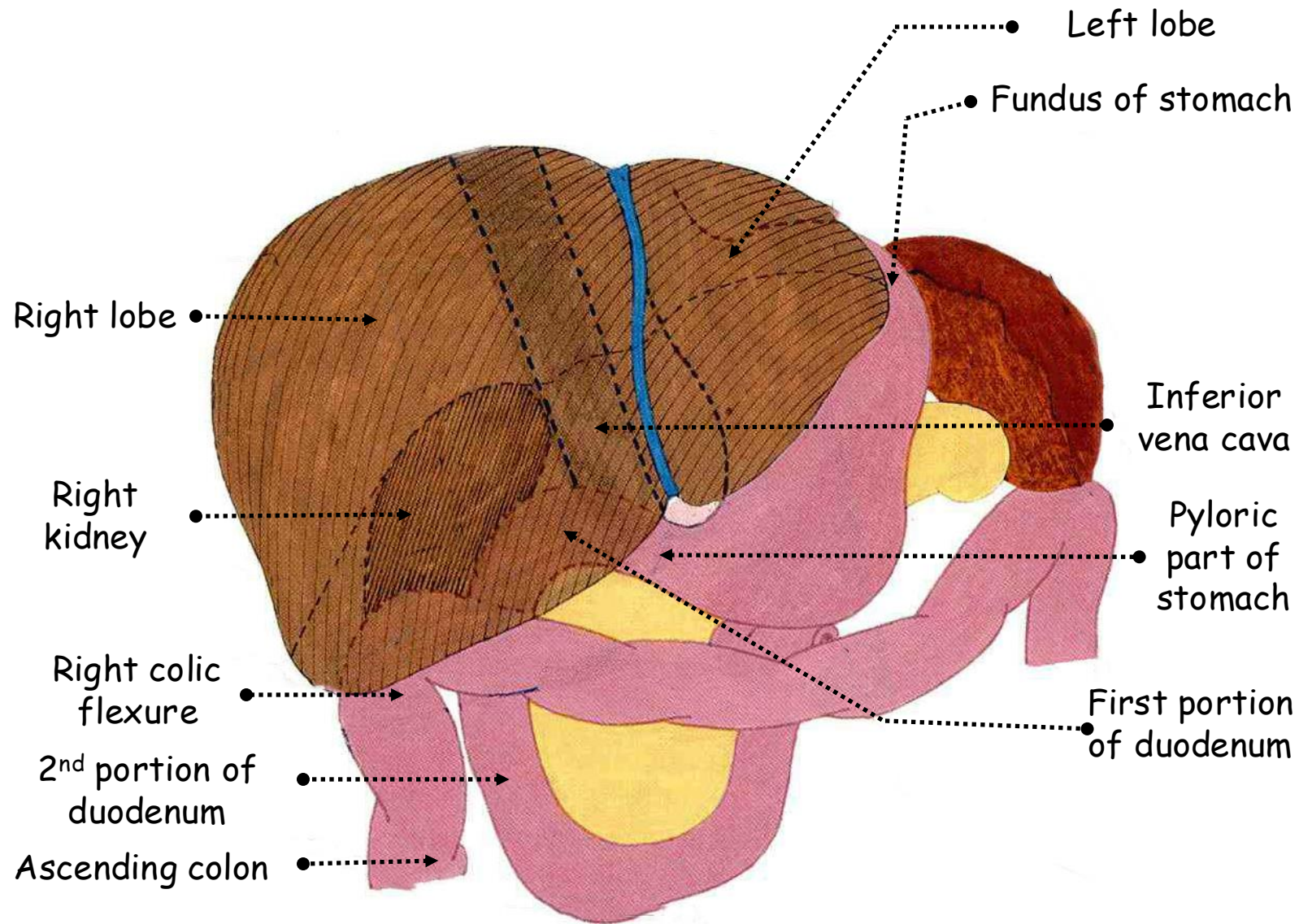
- Right crus of diaphragm
- Spine
- Oesophagus





## B. INFERIOR SURFACE

- Towards quadrante lobe: pyloric part of the stomach and first portion of duodenum
- Inferior vena cava
- Towards right lobe: right suprarenal gland, right kidney, 2<sup>nd</sup> portion of duodenum and right colic flexure
- Towards left lobe: oesophagus, stomach, tuber omentale of the pancreas



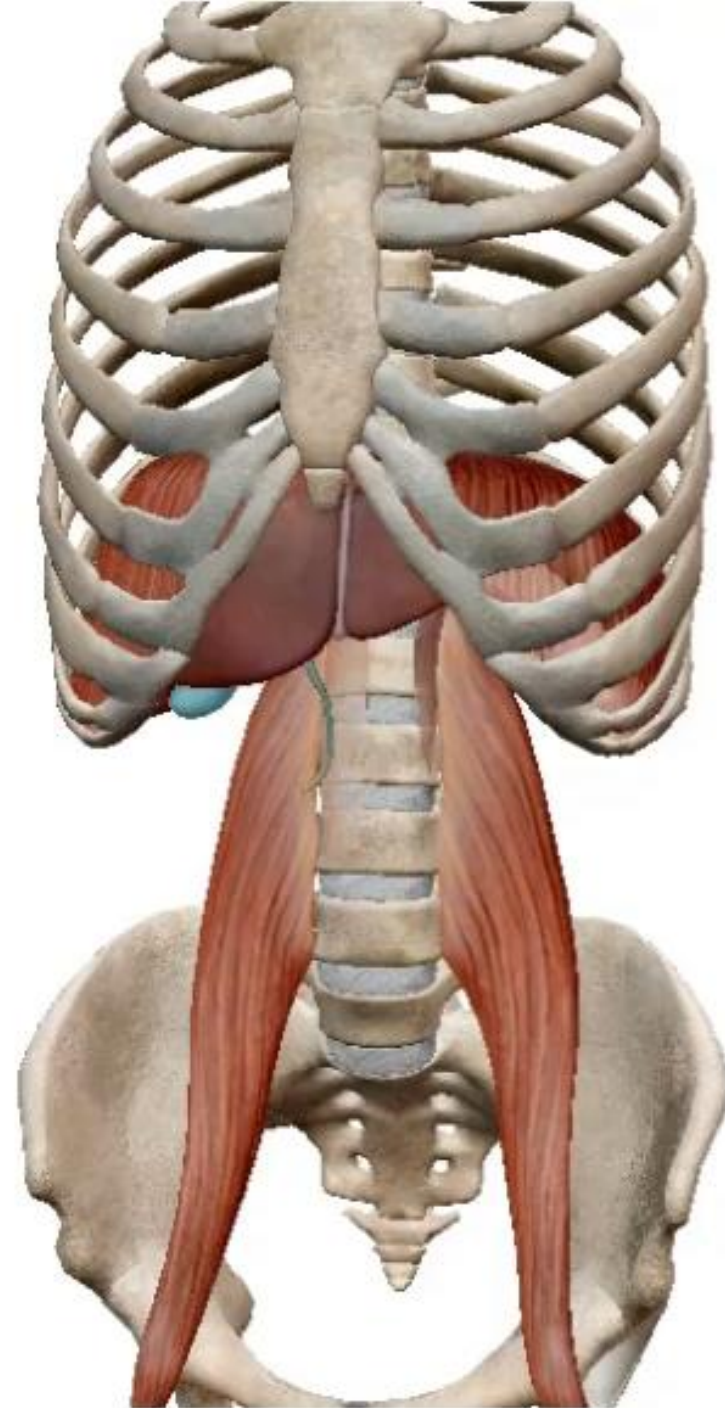
ANTERIOR VIEW OF THE ABDOMEN

### C. ANTERIOR BORDER

- From right to left
- Infracostal angle
- Anterior abdominal wall of epigastrium
- 6-7 left costal cartilages

### D. SUPERIOR-POSTERIOR AND INFERIOR-POSTERIOR BORDERS

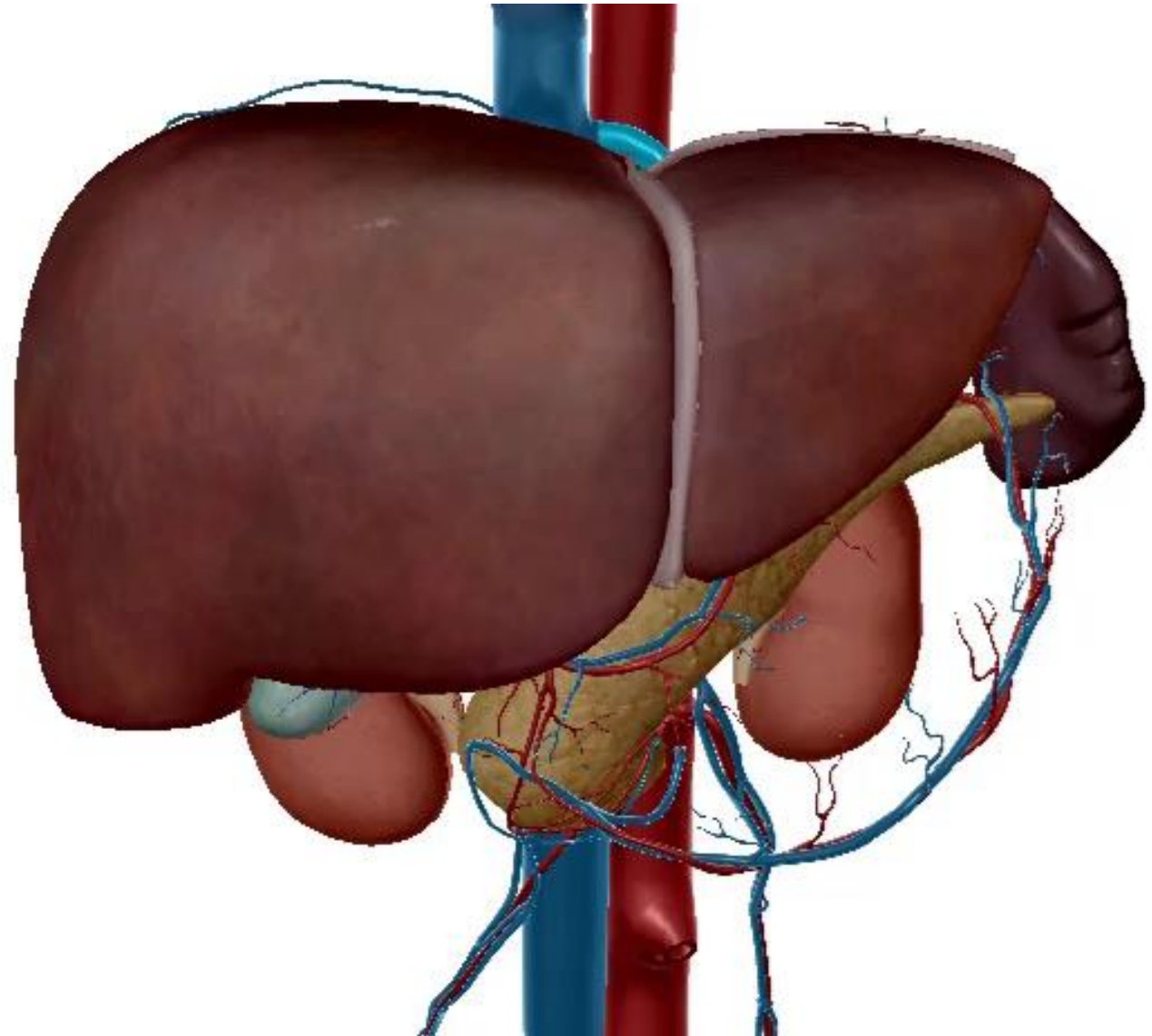
- Diaphragm





## VI. BLOOD SUPPLY; LYMPH DRAINAGE AND NERVE SUPPLY

- The liver receives blood from **two sources**
- **Arterial** blood is furnished by **the hepatic artery**
- **Venous** blood is carried to the liver by **the portal vein**
- **Venous return** is ensured by **3 main hepatic veins** that flow into the **inferior vena cava**





## A. ARTERIES

- Hepatic artery
- Continues the common hepatic artery curving upwards at the epiploic foramen into the space between the two layers of the lesser omentum
- Meets the bile duct and lies on its left side both in front of the portal vein between the duodenum and the porta hepatis surrounded by the peritoneum at the free edge of the lesser omentum
- Reaches the porta hepatis and divides into right and left branches to supply the right and left halves of the liver
- Y-shaped division
- The right branch of the hepatic artery normally passes behind the common hepatic duct and in the liver divides into anterior and posterior segmental branches
- The left branch divides into medial and lateral segmental branches

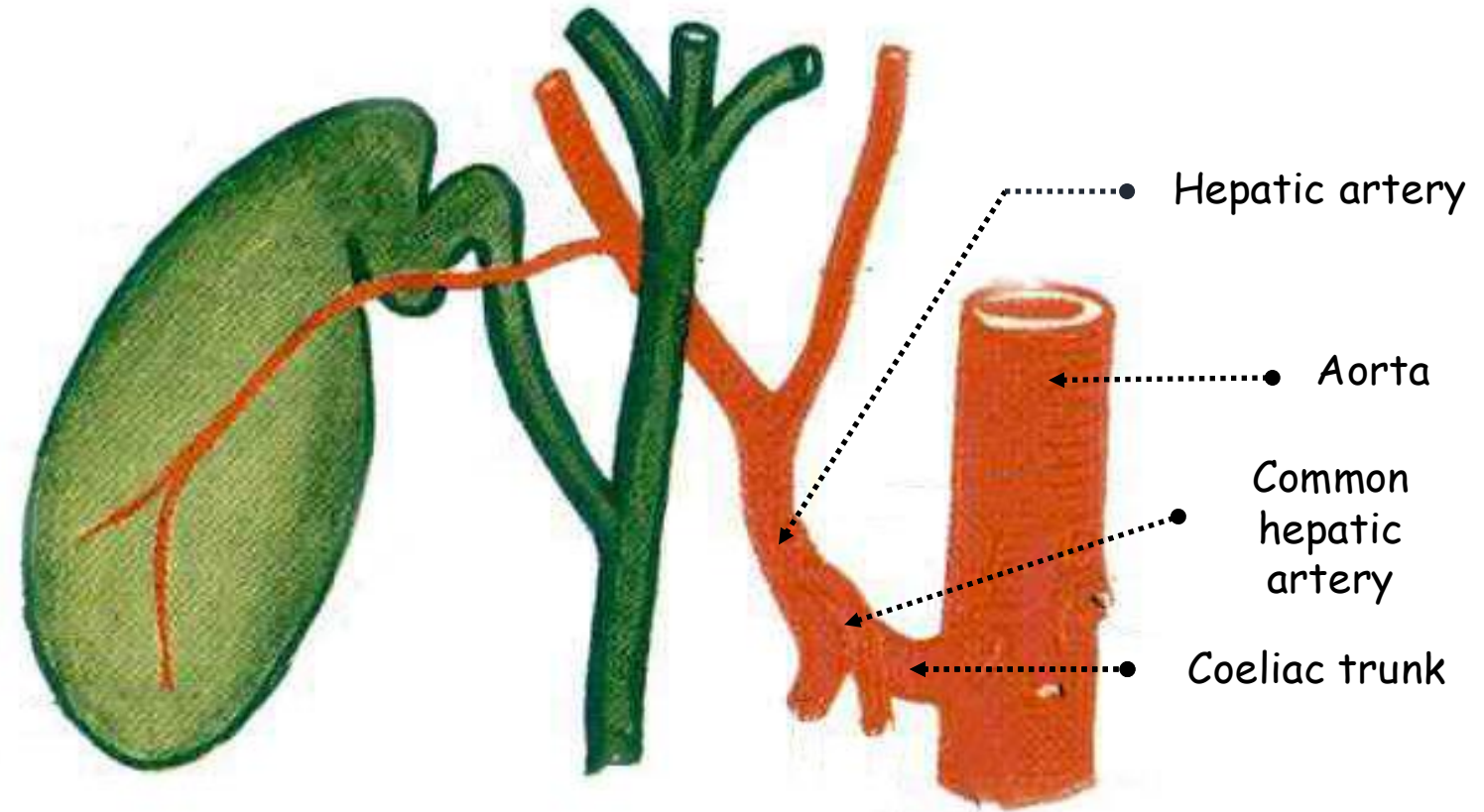
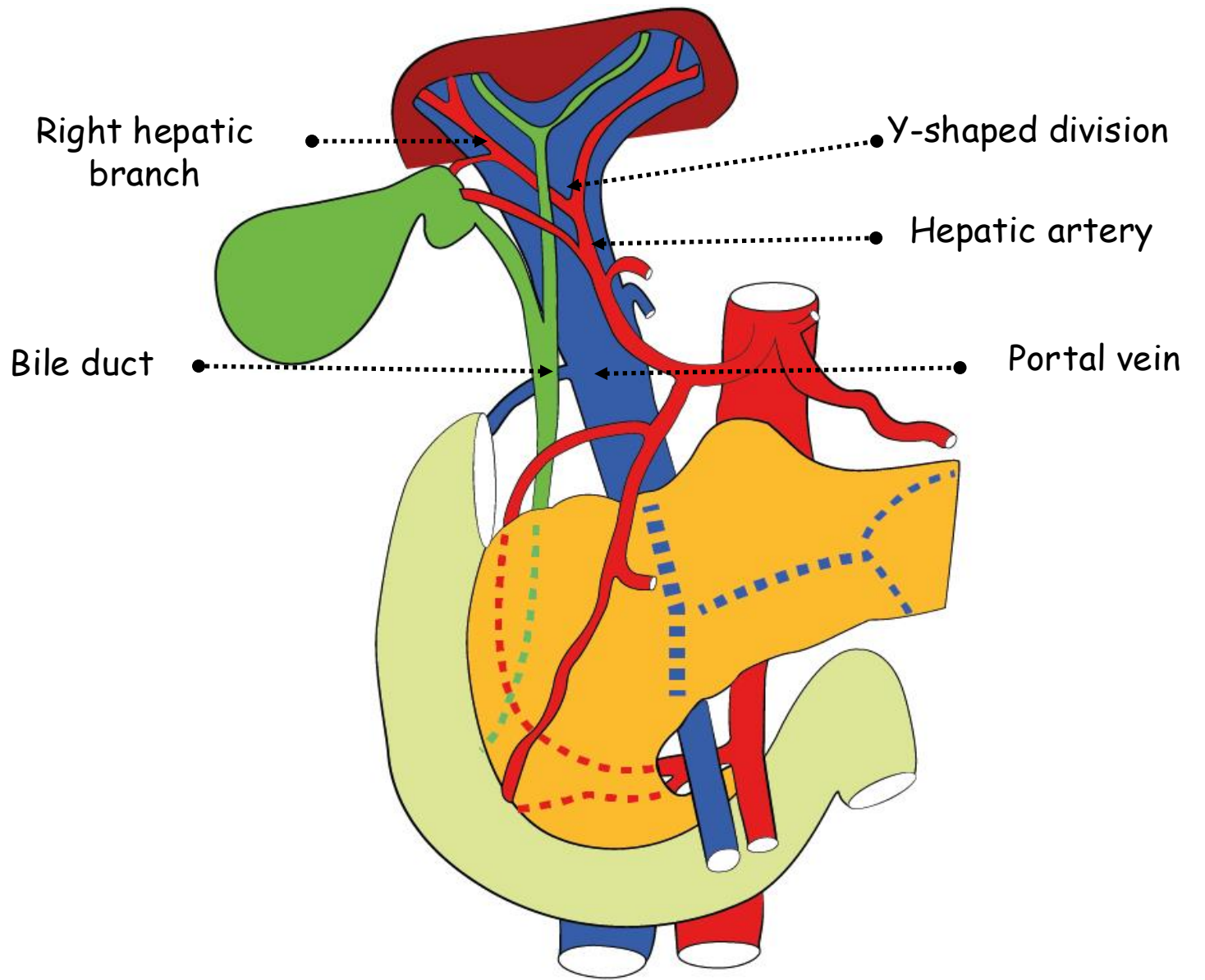


FIGURE SHOWING THE ARTERIES OF THE LIVER AND THE BILIARY TRACT

- Sometimes the common hepatic artery arises from the superior mesenteric artery or the aorta instead of the coeliac trunk in which case it usually runs behind the portal vein
- The right and left hepatic branches may themselves arise from the superior mesenteric or left gastric arteries respectively
- May either replace the normal branches or exist in addition to them and constitute the aberrant hepatic arteries
- The commonest is a left hepatic artery arising from the left gastric
- The cystic artery, usually a branch of the right hepatic, passes behind the cystic duct in the triangle formed by the liver, common hepatic duct and cystic duct, *Calot's triangle*, to reach the neck of the gall bladder and then branches out over the surface of the viscus
- Common anatomical variations

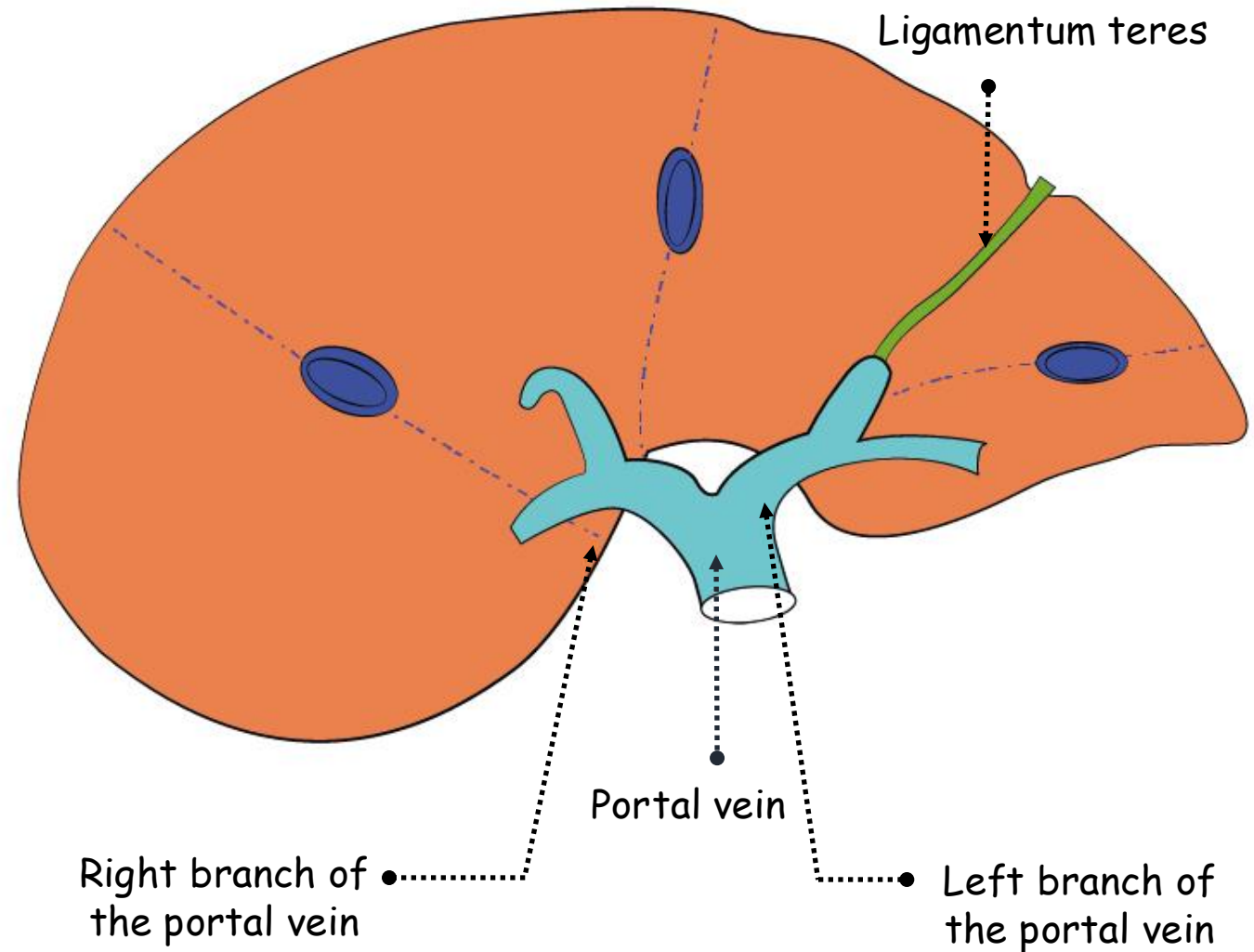


ANTERIOR VIEW OF THE DUODENUM AND PANCREAS SHOWING THE HEPATIC PEDICLE





- T-shaped division
- The right and left branches enter the respective halves of the liver
- Tributaries:
  - Superior mesenteric vein
  - Splenic vein
  - Inferior mesenteric vein
  - Right and left gastric veins
  - Superior pancreaticoduodenal veins
- Tributaries of its right branch:
  - Cystic veins
  - Periumbilical veins through not completely obliterated ligamentum teres
- Five site of portal/systemic anastomosis
- Cystic veins

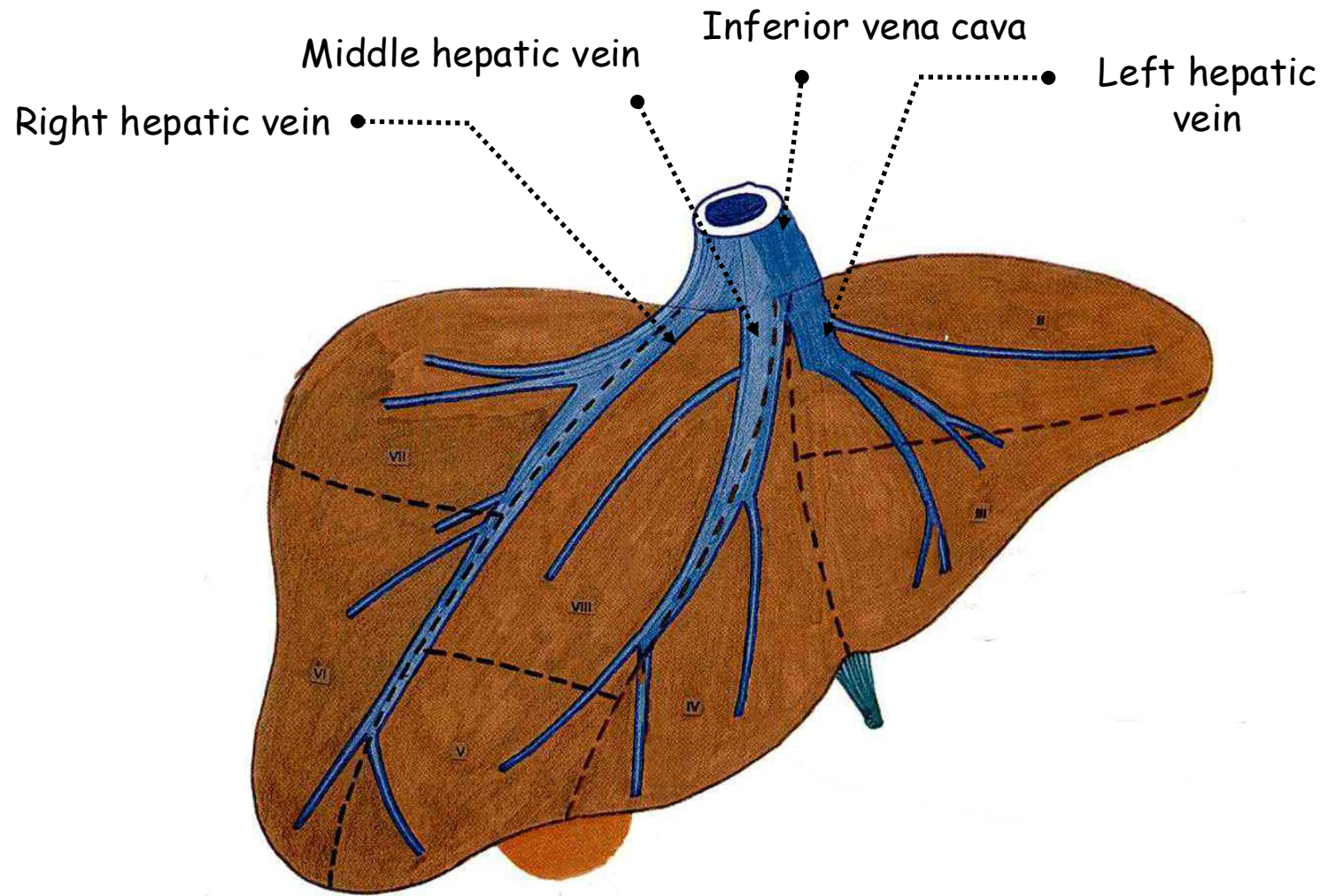


CORONAL SECTION OF THE LIVER SHOWING THE DIVISION OF THE PORTAL VEIN



## 2. Hepatic veins:

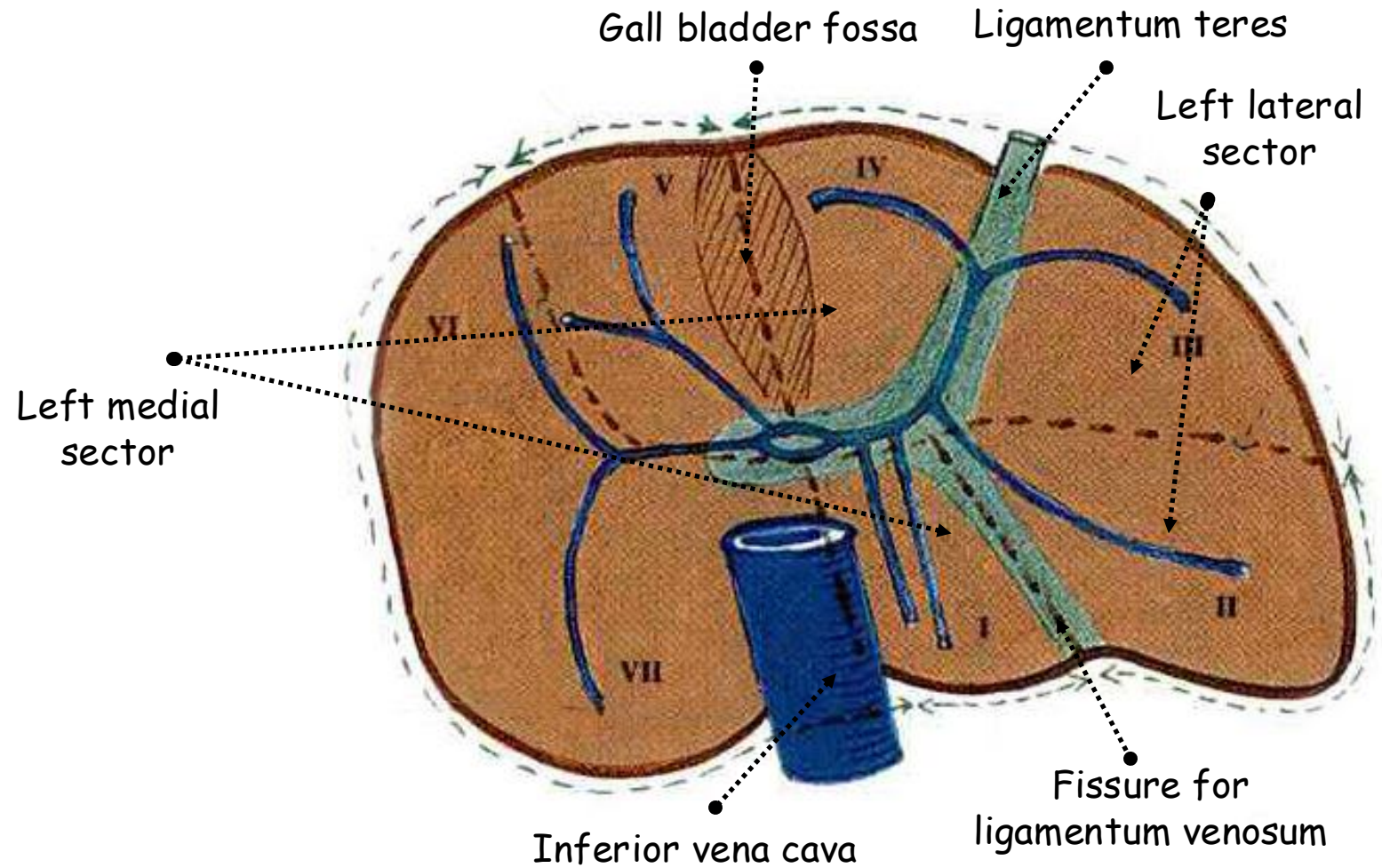
- The venous return differs in that it shows a mixing of right and left halves of the liver
- Three main hepatic veins
- High up near the diaphragmatic surface
- Drain into the inferior vena cava
- Middle hepatic vein: large central vein runs in the plane between right and left halves and receives from each
- Further laterally lie a right and left veins
- The entry of these large hepatic veins into the vena cava, already embedded in its deep groove of liver substance, is the main support for the liver rather than the peritoneal ligaments
- Several small accessory hepatic veins enter the vena cava below the main veins, including a separate vein from the caudate lobe



ANTERIOR VIEW OF THE LIVER SHOWING THE HEPATIC VEINS

### 3. Liver segmentation:

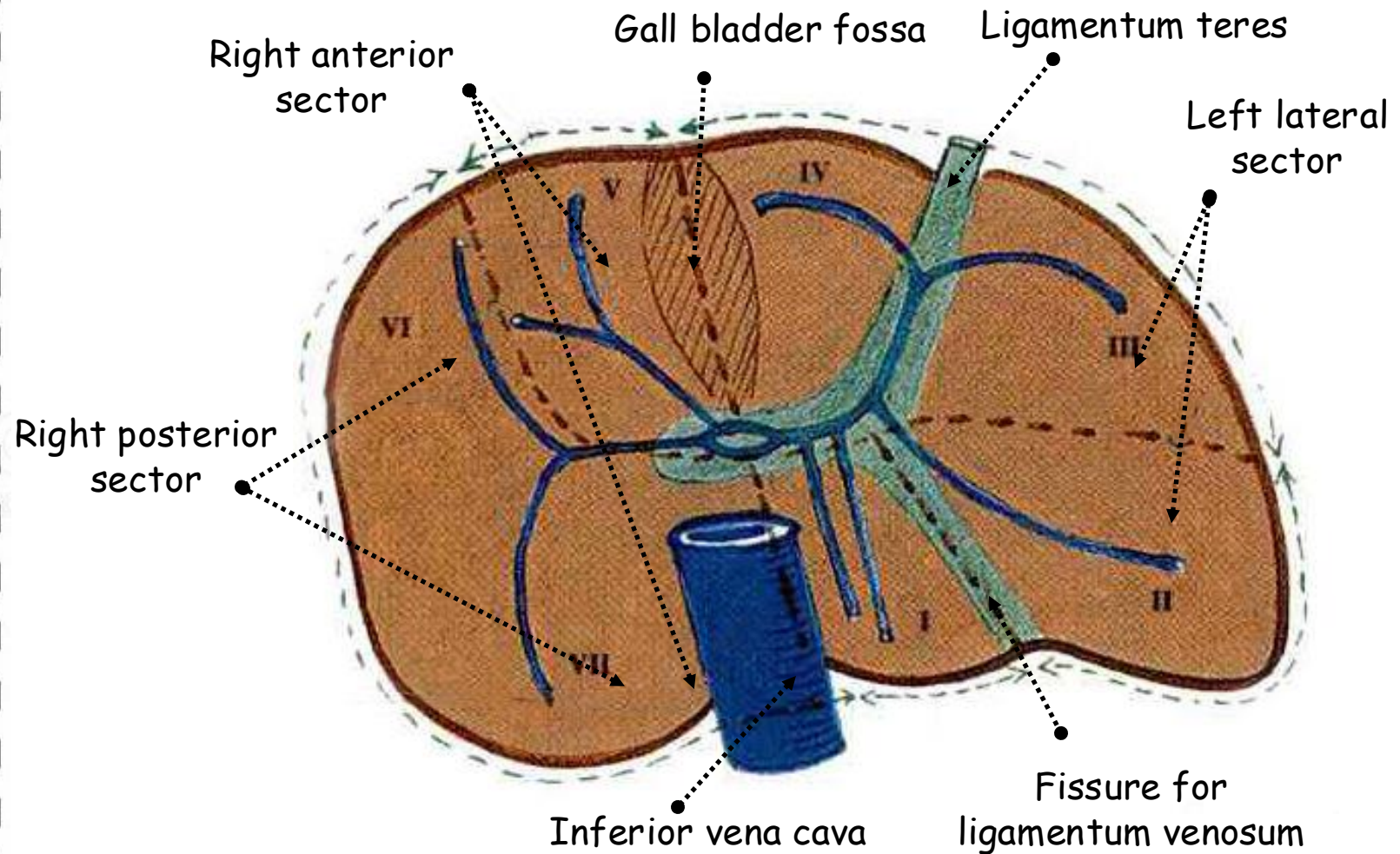
- 4 sectors based on the hepatic veins
- 8 segments based on the division of the portal vein
- Left lateral sector: left lobe of liver
- Left medial sector: caudate lobe and most of quadrate
- Separated by the line of the fissures for the ligamentum venosum and ligamentum teres
- Line of demarcation of the functional right lobe from the rest of the liver is along the vena caval groove and the gall bladder fossa forwards
- Right anterior and posterior sectors: have no visible external marking, but the line of division runs obliquely and medially from the middle of the front of the right lobe towards the vena caval groove



POSTERIOR-INFERIOR VIEW OF THE LIVER SHOWING THE HEPATIC SECTORS

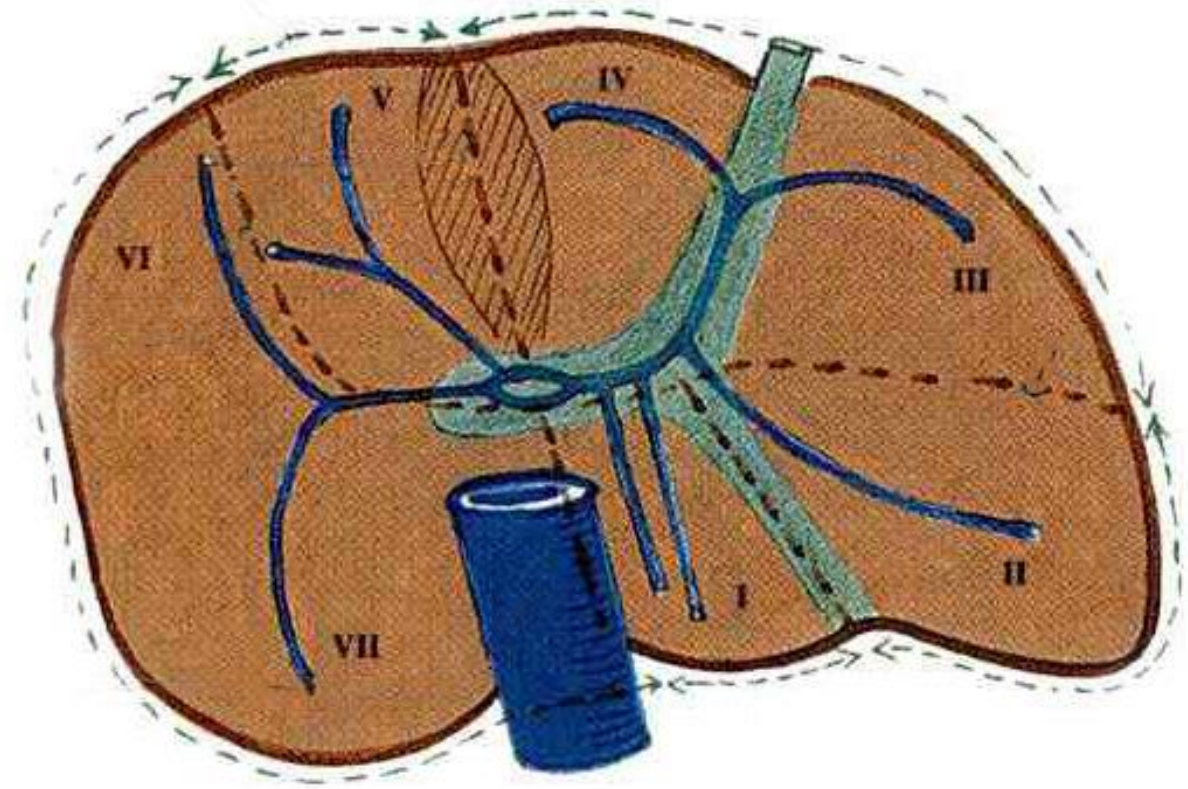


- A system using Roman numerals I-VIII is commonly adopted for segments
- Segment I is the caudate lobe
- Segment II corresponds to the upper posterior part of the left lateral sector
- Segment III is the lower anterior part of the left lateral sector
- Segment IV corresponds to most of the quadrate lobe
- Segment V corresponds to the lower anterior part of right anterior sector
- Segment VI corresponds to the lower anterior part of right posterior sector
- Segment VII corresponds to the upper posterior part of right posterior sector



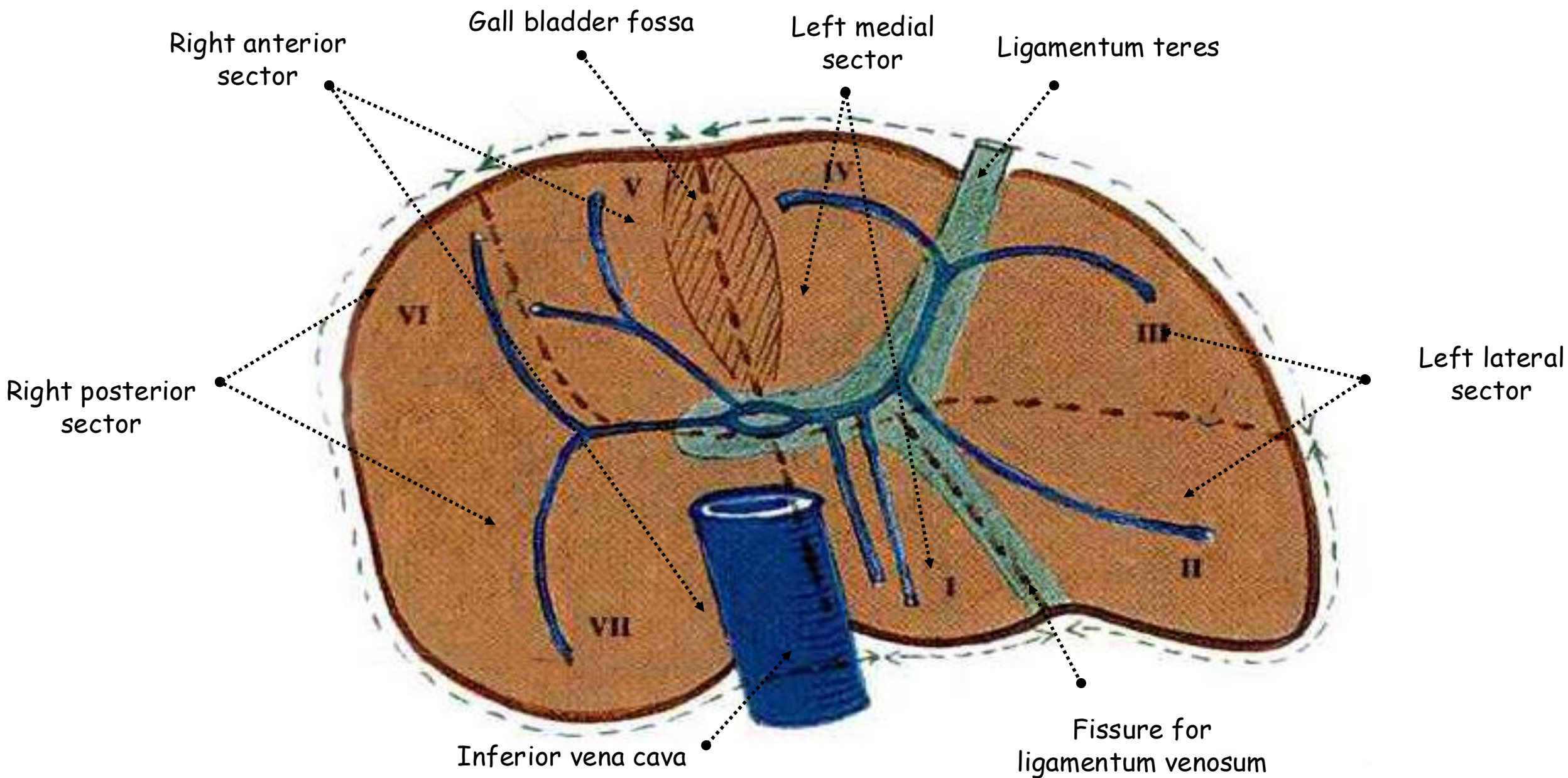
POSTERIOR-INFERIOR VIEW OF THE LIVER SHOWING THE HEPATIC SECTORS

- Segment VIII corresponds to the upper posterior part of right anterior sector
- Each segment is supplied by a segmental branch of division of portal vein and is independent with an arterial branch of hepatic artery and hepatic duct from right and left hepatic ducts
- Surgical interest



POSTERIOR-INFERIOR VIEW OF THE LIVER SHOWING THE HEPATIC SEGMENTS

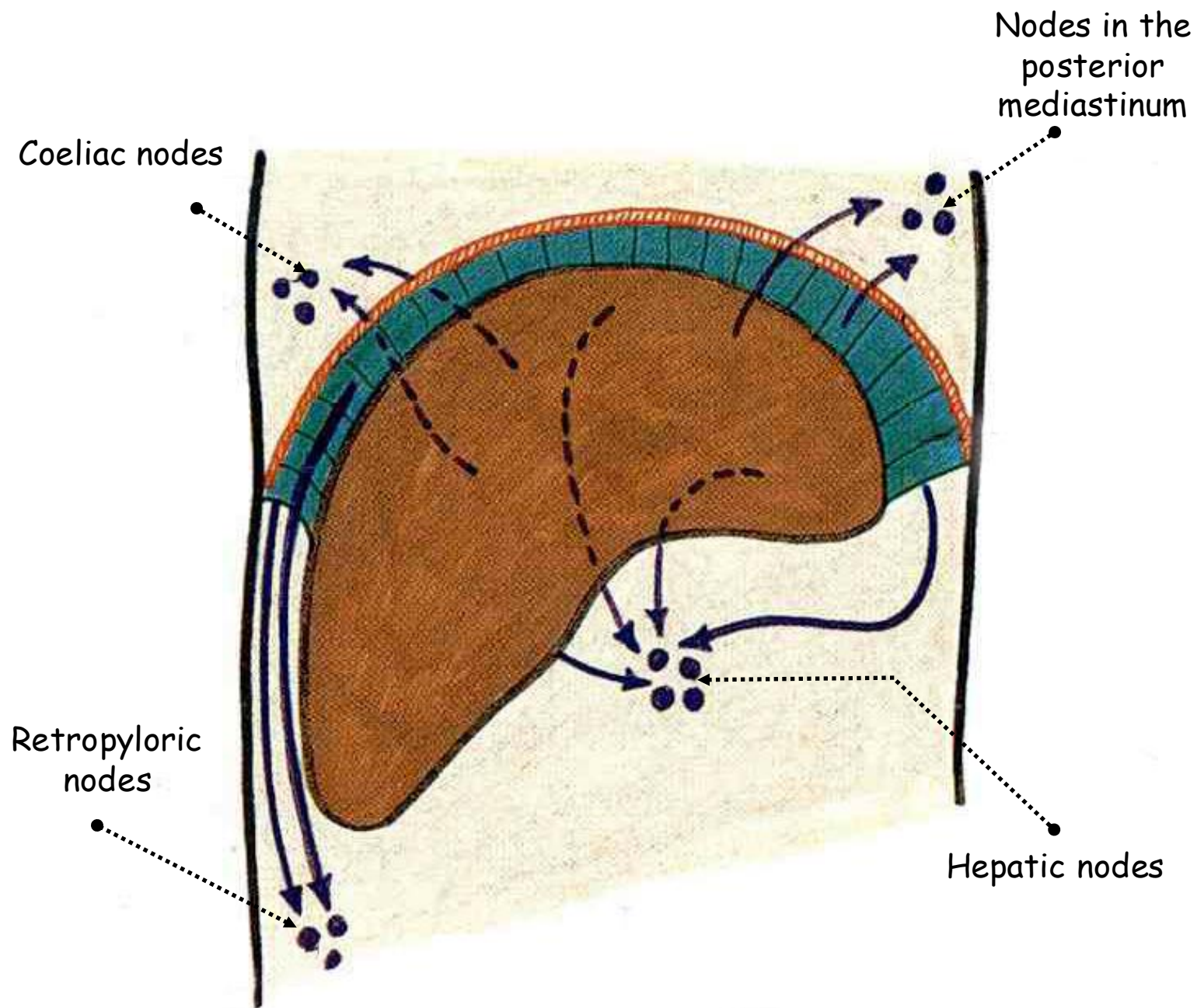




POSTERIOR-INFERIOR VIEW OF THE LIVER SHOWING THE HEPATIC SECTORS AND SEGMENTS

### C. LYMPH DRAINAGE

- Hepatic nodes in the porta hepatis
- Receive the lymphatics of the gall bladder
- Drain downwards alongside the hepatic artery
- Retropyloric nodes
- Coeliac nodes
- Nodes in the posterior mediastinum
- Cystic node in Calot's triangle at the junction of the common hepatic and cystic duct
- Node situated at the anterior border of the epiploic foramen

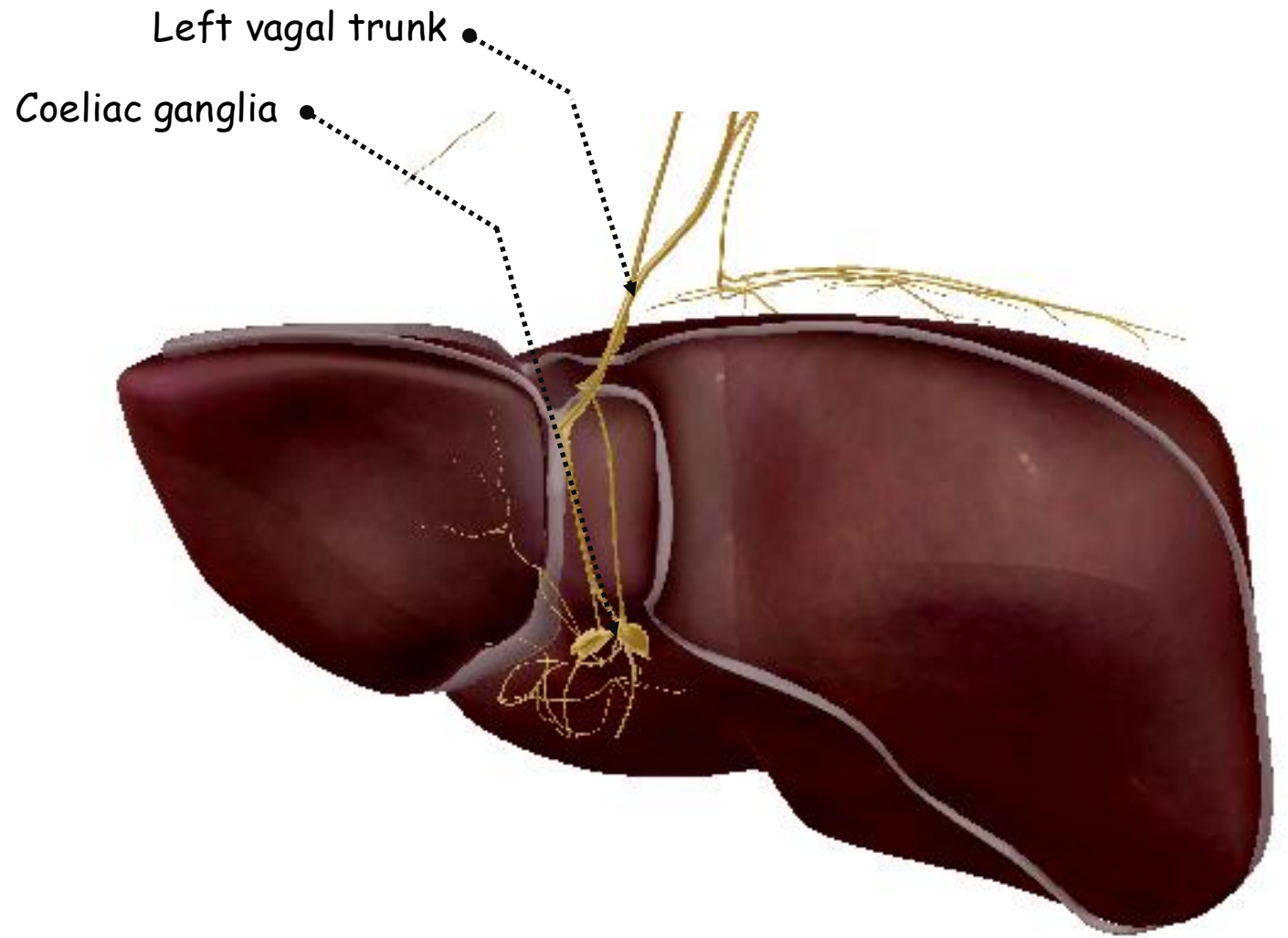


OVERVIEW OF THE LYMPH DRAINAGE OF THE LIVER



## D. NERVES

- Sympathetic and vagus
- **Sympathetic:**
  - Coeliac ganglia
  - Nerves run with the vessels in the free edge of the lesser omentum and enter the porta hepatis
- **Vagus:**
  - Left vagal trunk
  - Along the lesser curve of the stomach via the lesser omentum
  - Porta hepatis



POSTERIOR VIEW OF THE LIVER SHOWING ITS NERVES

## VII. SURGICAL APPROACH

### A. LIVER

- Needle biopsy
- Right hepatic lobectomy
- Left hepatic lobectomy
- Liver transplantation

### B. BILIARY TRACT

- Kocher's incision
- Cholecystectomy
- Choledochotomy
- Kocher's manoeuvre





## VIII. CONCLUSION

- Largest gland of the organism
- Annexed to alimentary tube
- Highly peritonised though fixed by vessels
- Secretes bile and hormones
- Several retroperitoneal and intraperitoneal relations
- Rich blood supply
- Nerves mainly provided from the vagi and sympathetic
- Lymph drainage is ensured by the celiac nodes
- Liver segmentation





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