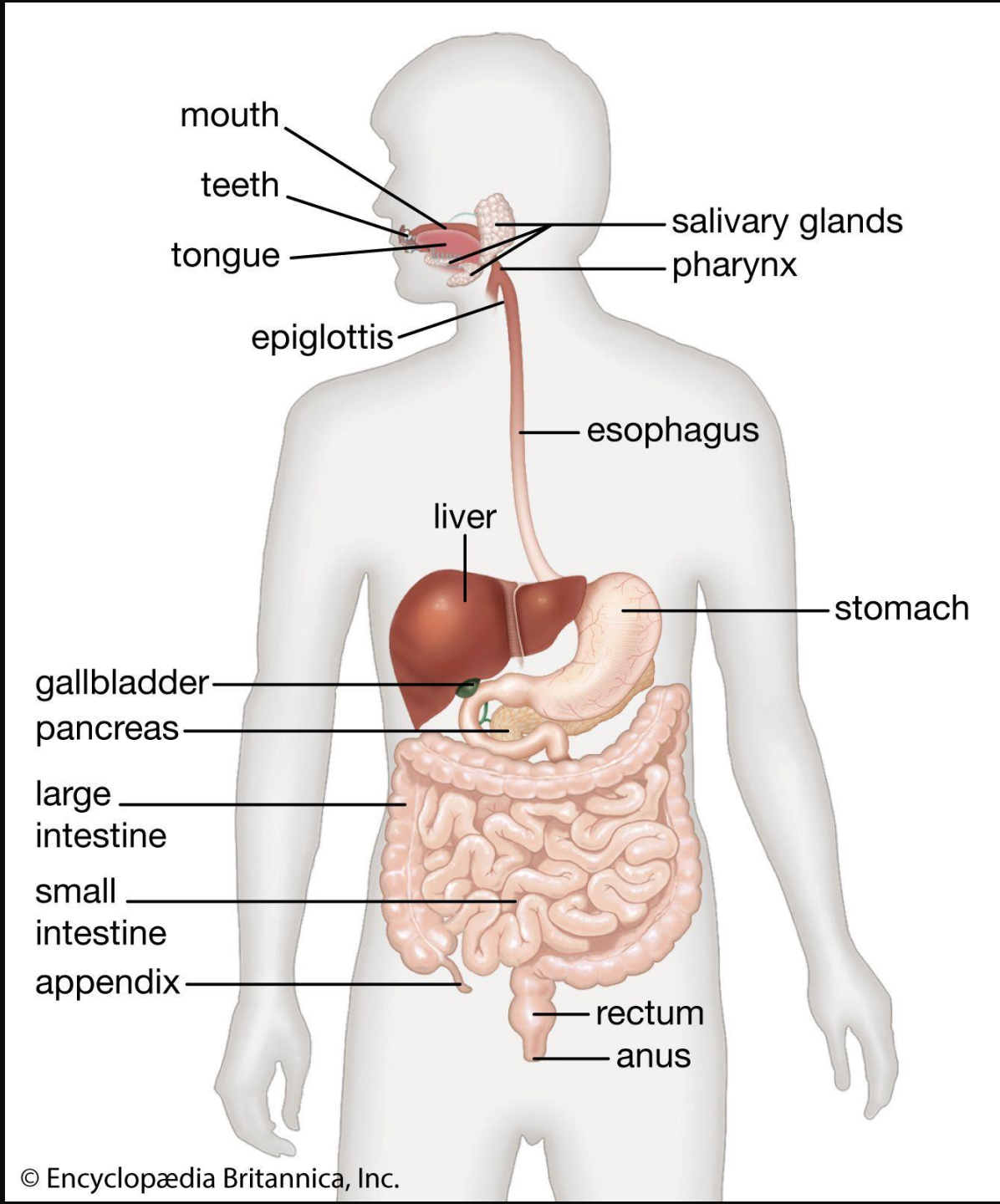
ANATOMY OF THE GASTROINTESTINAL SYSTEM

From an anatomical point of view, it is divided into:

- **DIGESTIVE TUBE:** oral cavity → pharynx → esophagus → stomach → small intestine → large intestine → rectum → anal canal.

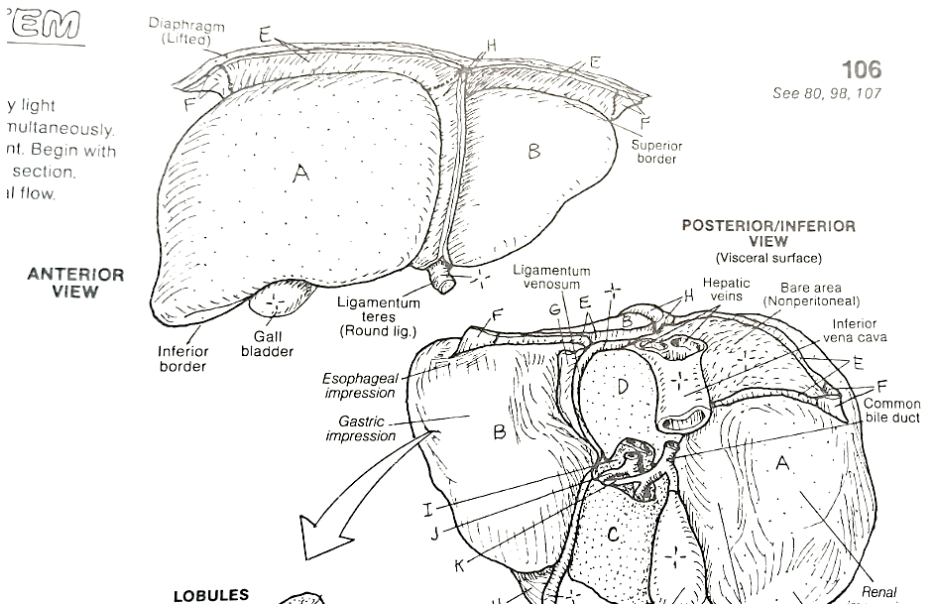
- **ACCESSORY GLANDS:** salivary glands, liver, bile ducts, pancreas.

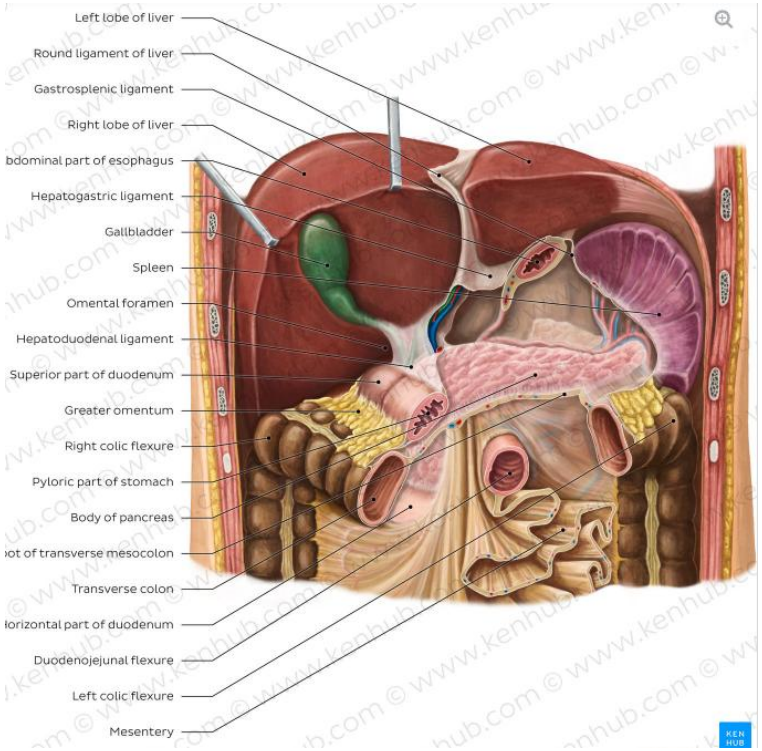


DIGESTIVE SYSTEM
LIVER

The **liver** is a large organ found in the upper right quadrant of the abdomen, and completely covered by visceral peritoneum, with the exception of the bare area, which is where the liver is in contact with the diaphragm

Gross Anatomy



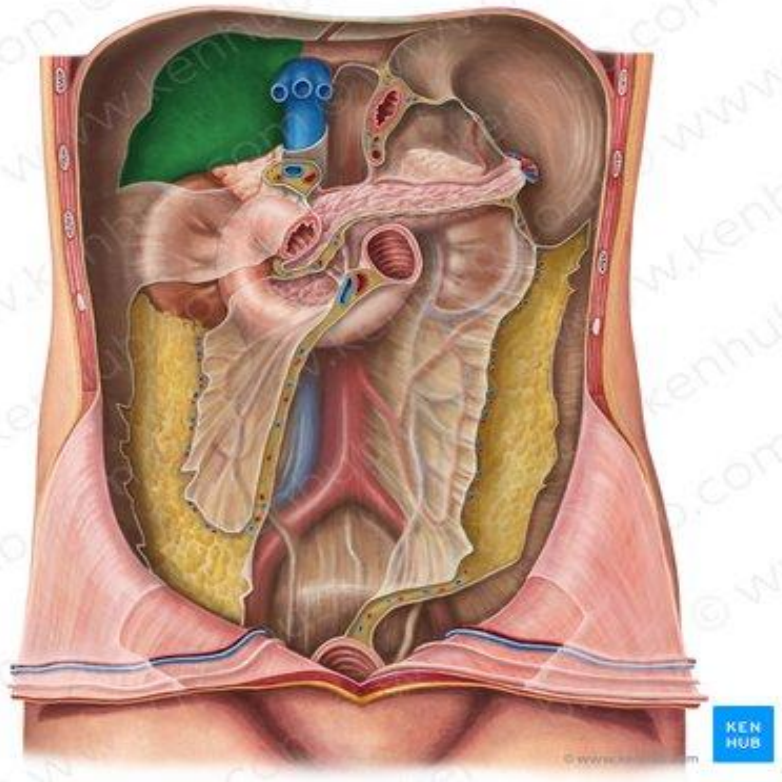


The peritoneum connects the liver in 4 locations: the coronary ligament, the left and right triangular ligaments, and the falciform ligament

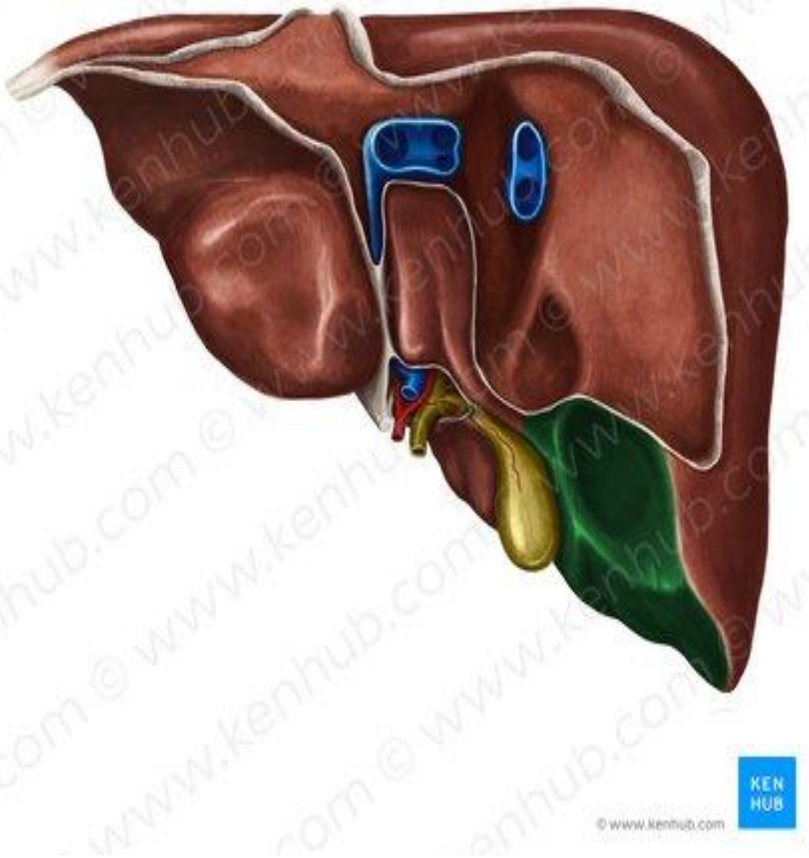
https://www.kenhub.com/en/library/anatomy/liver

DIGESTIVE SYSTEM
LIVER: SURFACES

Diaphragmatic surface of liver



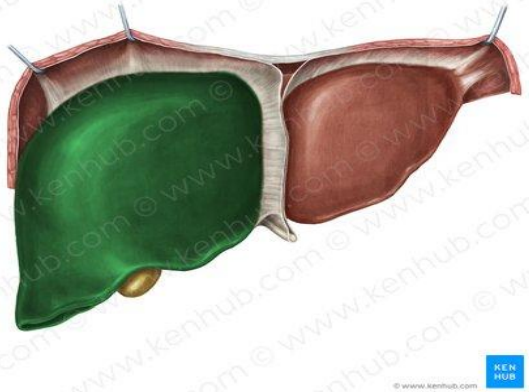
Visceral surface of right lobe of liver



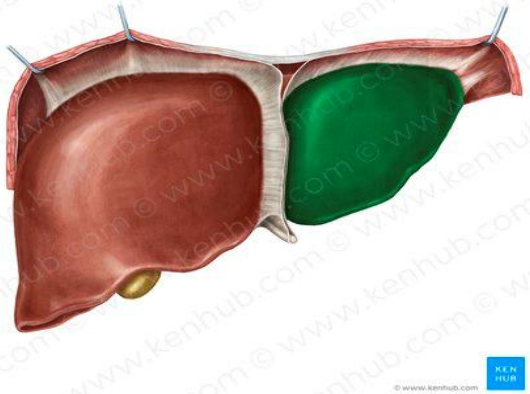
DIGESTIVE SYSTEM
LIVER: LOBES OF THE LIVER

Gross Anatomy

Right lobe (green color)

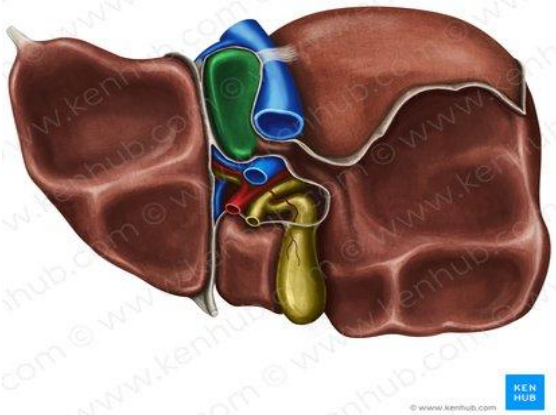


Left lobe

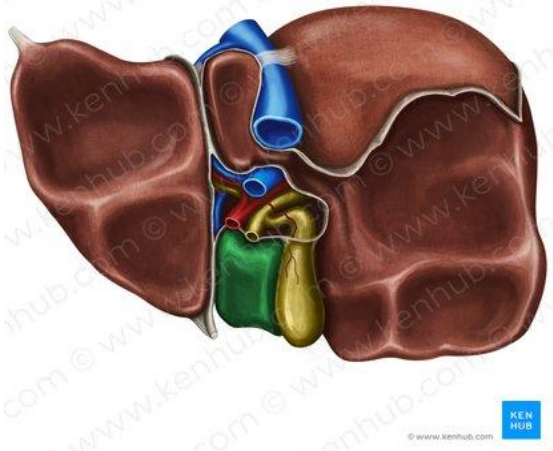


The **right lobe** is the largest of the four lobes and **the left lobe** is a flattened smaller one. These two lobes are separated by the fossae for the gallbladder and the inferior vena cava.

Caudate lobe



Quadrate lobe

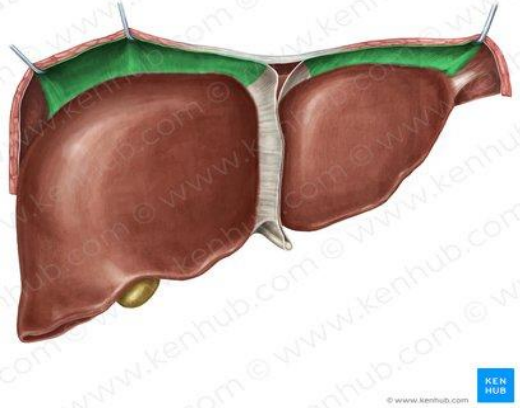


The small **caudate lobe** extends from the posterior side of the right lobe, **sits** between the fissure for the ligamentum venosum and the inferior vena cava,
The small **quadrate lobe** is inferior to the caudate lobe and extends from the posterior side of the right lobe, is located between the gallbladder and the fissure for the ligamentum teres hepatis

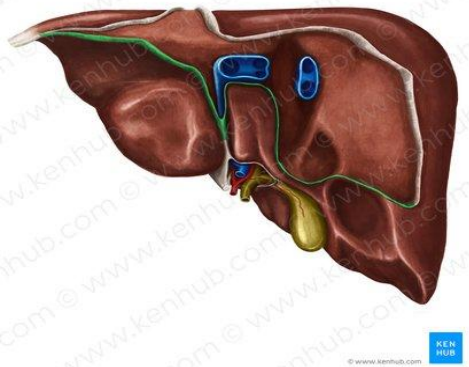
https://www.kenhub.com/en/library/anatomy/liver

DIGESTIVE SYSTEM
LIVER: LIGAMENTS (GREEN COLOR)

Anterior part of coronary ligament



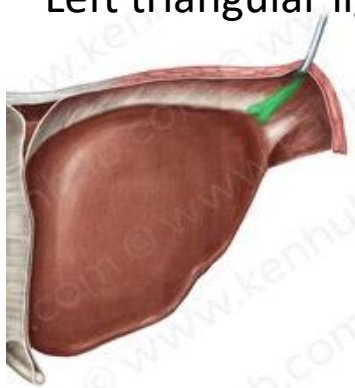
Posterior part of coronary ligament



Coronary ligament - formed by folds of peritoneum reflect from the inferior surface of the diaphragm, connecting this structure to the liver; has two layers: (anterior and posterior).

Right triangular ligament

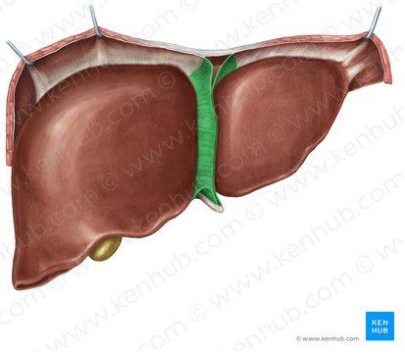
Left triangular ligament



Left and right triangular ligament - are the lateral extensions of the coronary ligaments and also connect the diaphragm to the left and right lobes of the liver, respectively.

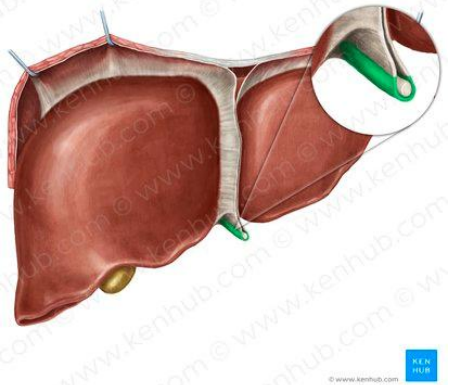
DIGESTIVE SYSTEM
LIVER: LIGAMENTS (GREEN COLOR)

Falciform ligament



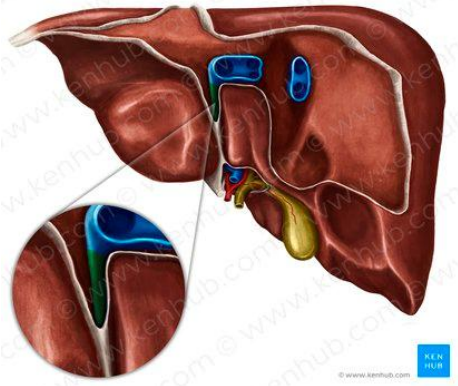
Falciform ligament - it is a peritoneal reflection that connects the liver to the upper anterior abdominal wall; has the round ligament of the liver on its free edge.

Round ligament



Round ligament or Ligamentum teres hepatis – it is a fibrous remnant of the umbilical vein, and extends from the internal aspect of the umbilicus up to the liver.

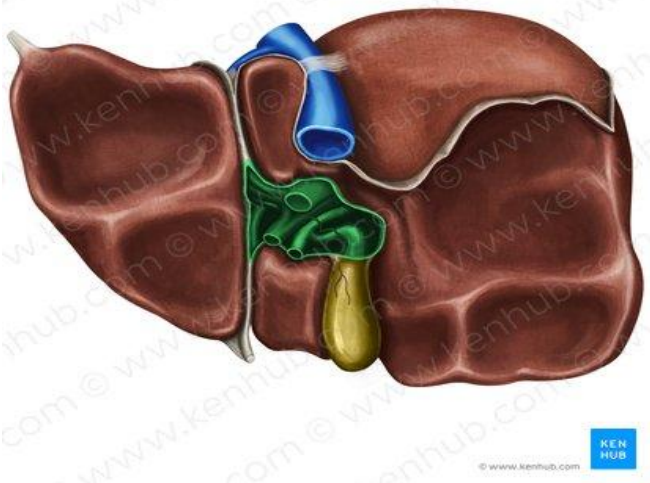
Ligamentum venosum



Ligamentum venosum - is also an embryonic remnant, in this case of the ductus venosus of the fetal circulation. In utero, the ductus venosus shunts blood from the umbilical vein to the inferior vena cava.

DIGESTIVE SYSTEM
LIVER: PORTA HEPATIS AND RECESSES (GREEN COLOR)

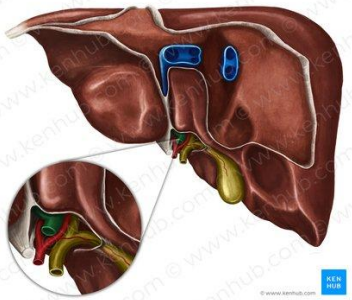
Porta hepatis



Porta hepatis

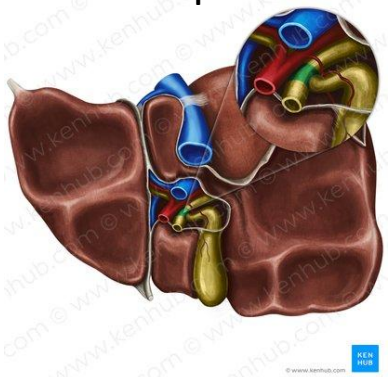
central intraperitoneal fissure of the liver that separates the caudate and the quadrate lobes. It is the entrance and exit point for the portal vein, the hepatic arteries, the hepatic ducts, the hepatic nervous plexus and the lymphatic vessels.

Hepatic portal vein

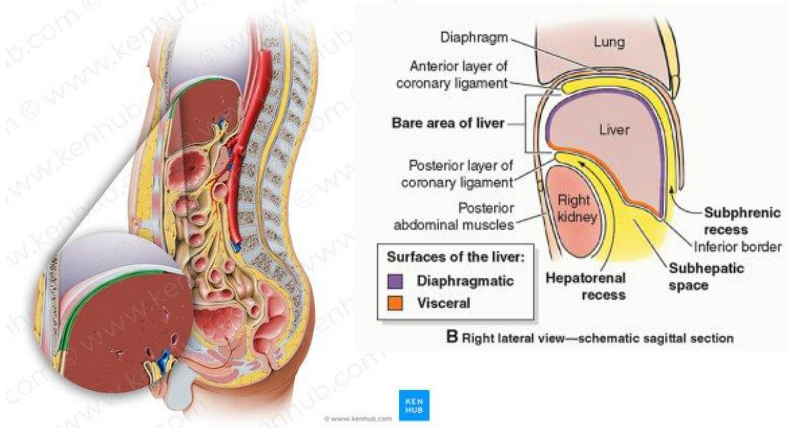


Right hepatic artery

Common hepatic duct



Subphrenic recess

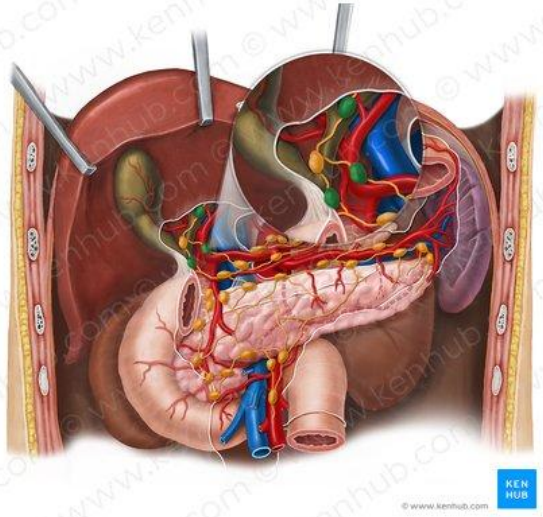


The **subphrenic recess** is a space between the diaphragmatic surface of the liver from the inferior surface of the diaphragm; it is split by the falciform ligament of the liver into right and left areas.

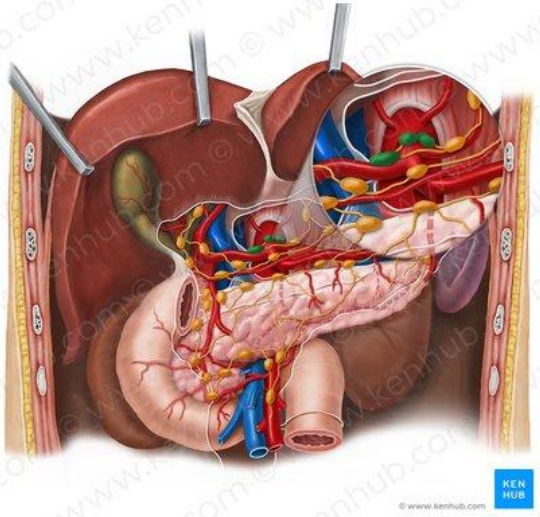
DIGESTIVE SYSTEM
LIVER: LYMPHATIC DRAINAGE (GREEN COLOR)

The **lymphatic drainage** of the liver **is split into deep and superficial drainage systems**

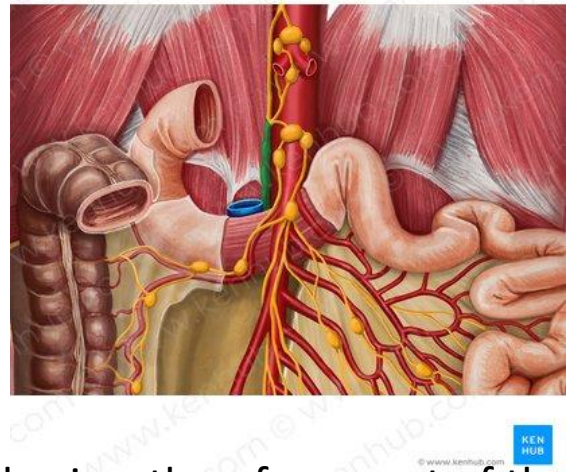
Hepatic lymph nodes



Celiac lymph nodes



Cisterna chyli



The **deep system** consists of hepatic lymph vessels which follow the hepatic portal veins, therefore most of the lymph will flow towards the hepatic nodes at the hilum of the liver, which drain to the celiac nodes. These drain to the cisterna chyli (if present) and on into the thoracic duct.

The superficial system transports lymphatic fluid through channels in the subserosal areolar tissue (Glisson's capsule) which envelopes the liver. Lymphatics from the anterior, superior and inferior surfaces of the liver drain into the hepatic lymph nodes located at the porta hepatis

DIGESTIVE SYSTEM
LIVER: BLOOD SUPPLY

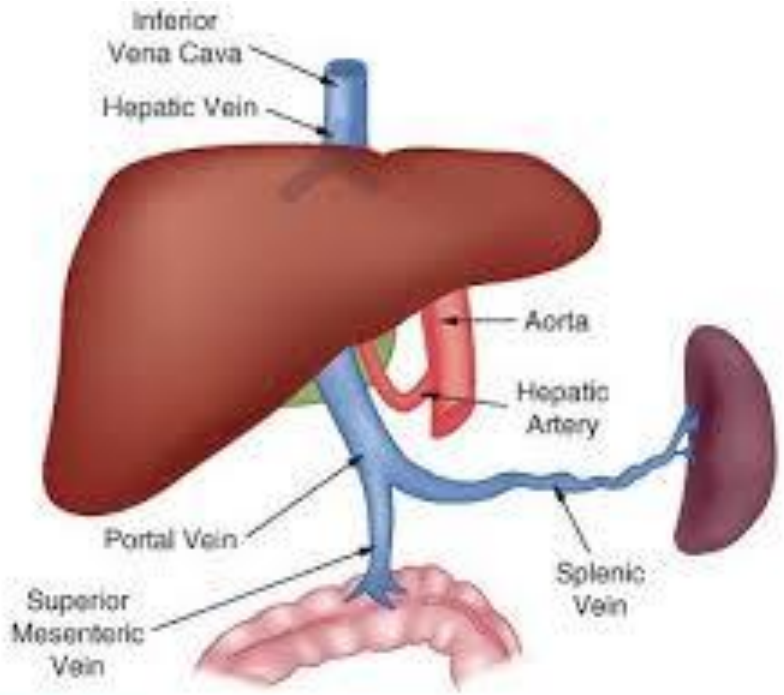
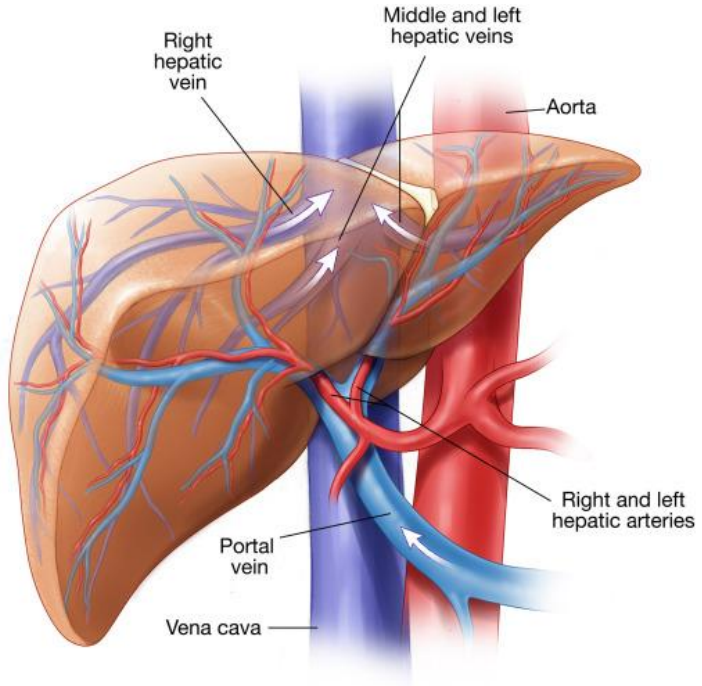


FIGURE 32-3 Schematic depiction of the dual afferent blood supply to the liver provided by the portal vein and hepatic artery.

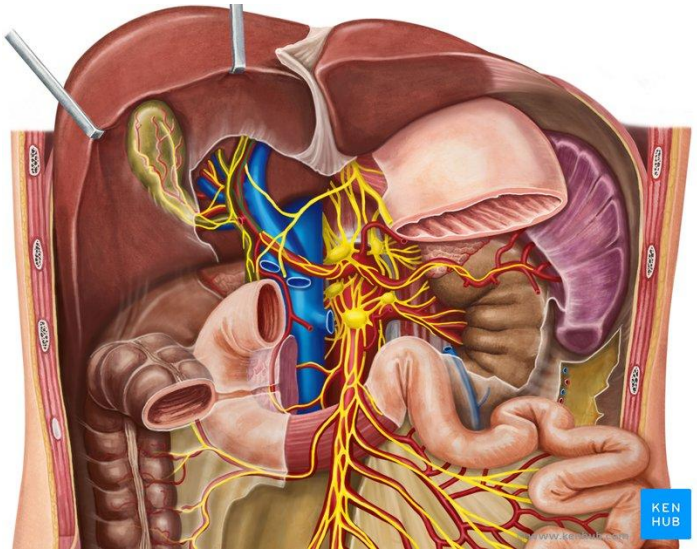


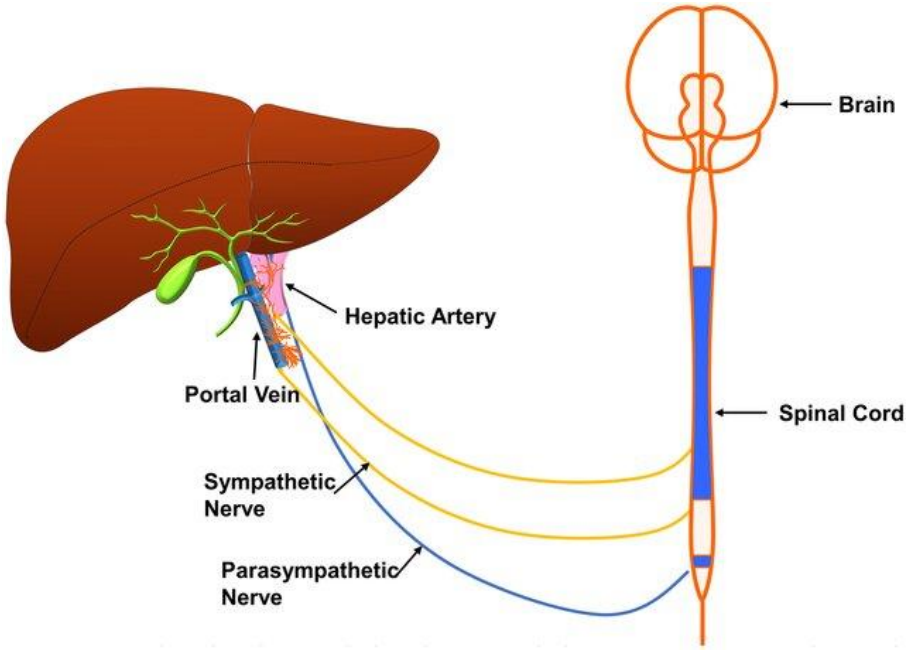
The majority of the vascular supply is brought into this organ by the **portal vein** which carries blood from the gastrointestinal tract filled with metabolites absorbed in the intestine.

The rest of the blood supply to this organ comes from the common **hepatic artery** which originates from the celiac trunk and carries oxygenated blood to the liver.

The **hepatic veins** are formed by the union of the central veins. They drain blood from the liver directly into the inferior vena cava just before it passes through the diaphragm.

DIGESTIVE SYSTEM
LIVER: INNERVATION





Kaili Yang et al, DOI: 10.1007/s10753-023-01854-x

The nervous supply of the liver comes from the **hepatic plexus** which travels along with the hepatic artery and the portal vein.

The liver also receives sympathetic fibers from the **celiac plexus** and parasympathetic fibers from the anterior and posterior **vagal trunks**.

DIGESTIVE SYSTEM
LIVER: MICROSCOPIC ANATOMY

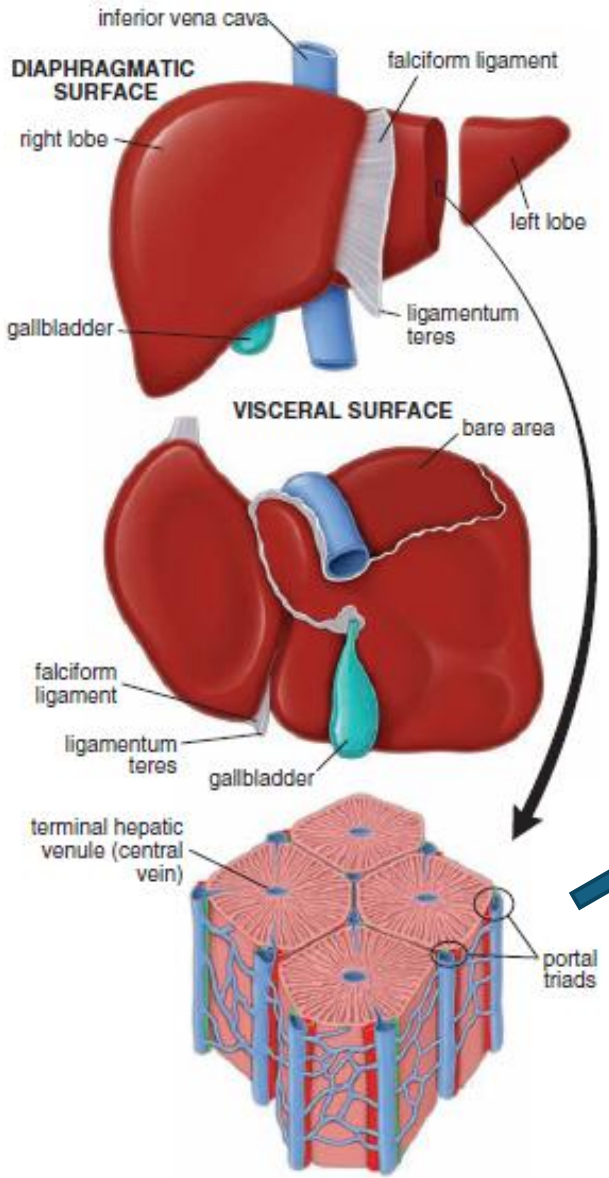
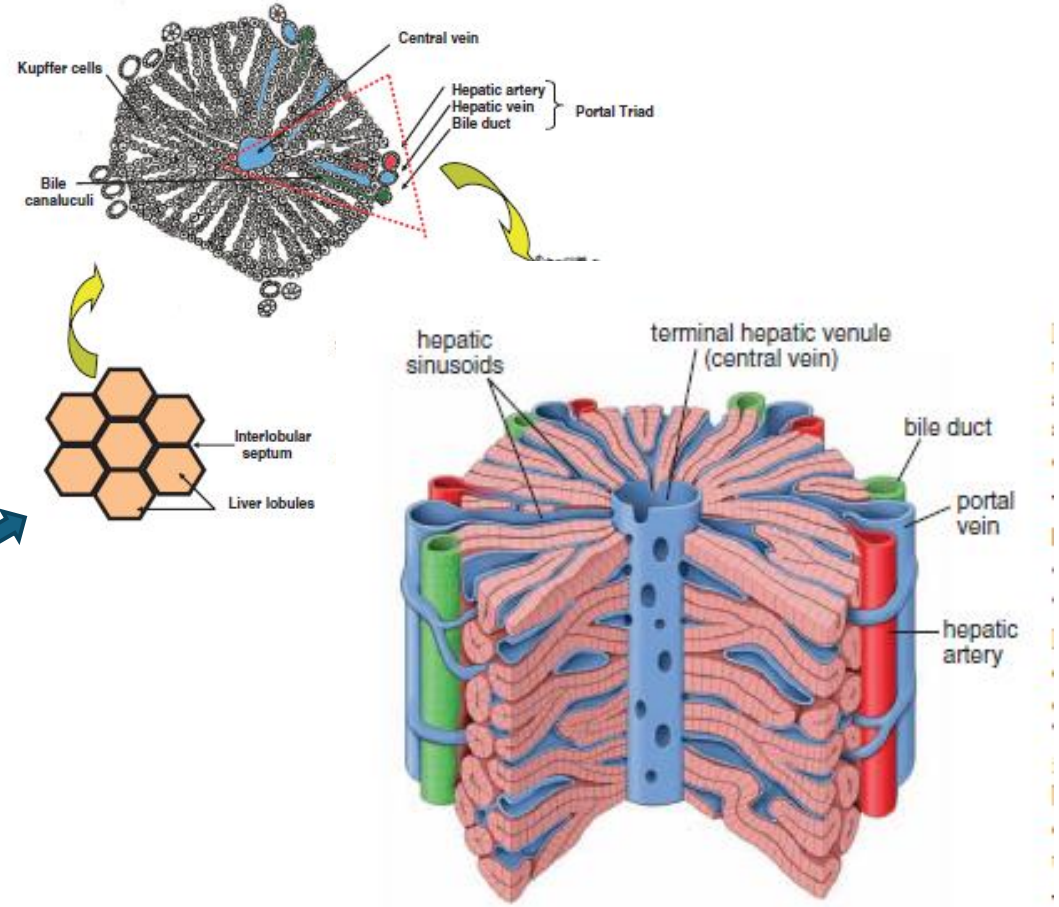


FIGURE 18.1 ▲ **Anatomic structure of the liver.** This diagram shows the gross view of the diaphragmatic and visceral surfaces of the liver, with labeled anatomic landmarks found on both surfaces. The enlarged cross-sectional area of the liver (*bottom*) shows the general microscopic organization of the liver into lobules. Note the presence of hepatic portal triads at the periphery of each lobule, with the terminal hepatic venule (central vein) in the center of the lobule.



Bile is **secreted by hepatocytes** and **enters the bile canaliculi**, which are narrow intercellular canals between the hepatocytes. **The bile empties into the bile ducts** located at the periphery of the lobules.

Each lobe of the liver has approximately 100,000 liver lobules, the functional unit of the liver

Lobules are approximately hexagonal in shape and are separated from each other by an interlobular septum.

At each corner of the hexagonal lobule is a portal triad consisting of a branch of the hepatic artery, a branch of the hepatic vein, and a bile duct

In addition to the endothelial cells lining the sinusoids, there are also star-shaped fixed macrophages called *Kupffer cells* that are confined to the liver.

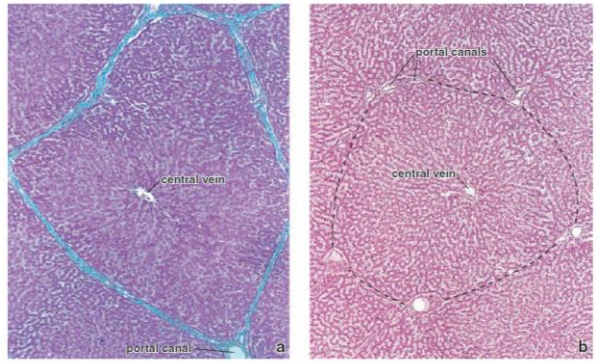
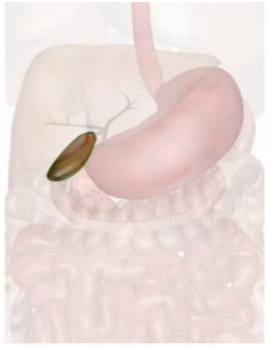


FIGURE 18.4 ▲ **Photomicrographs of pig and human livers. a.** This photomicrograph shows a cross-section of a pig liver lobule stained by

DIGESTIVE SYSTEM
GALLBLADDER

The **Gallbladder** is a small storage organ located inferior and posterior to the liver



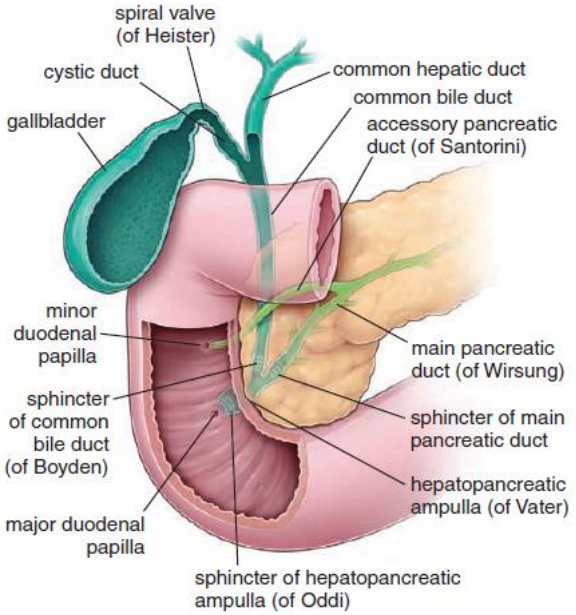


FIGURE 18.14 ▲ **Diagram showing the relationship of hepatic, pancreatic, and gallbladder ducts.** The gallbladder is a blind pouch joined to a single cystic duct in which numerous mucosal folds form the spiral valve (of Heister). The cystic duct joins with the common hepatic duct, and together they form the common bile duct that leads into the duodenum. At the entry to the duodenum, the common bile duct is joined by the main pancreatic duct to form the hepatopancreatic ampulla (of Vater), and together they enter the second part of the duodenum. Sphincters can be found at the distal part of these ducts. The sphincters of the common bile duct (of Boyden), the main pancreatic duct, and the hepatopancreatic ampulla (of Oddi) control the flow of bile and pancreatic secretion into the duodenum. When the common bile duct sphincter contracts, bile cannot enter the duodenum; it backs up and flows into the gallbladder, where it is concentrated and stored.

Anatomy of the Gallbladder

Hollow, muscular and pear-shaped, the gallbladder is a small organ --- only about 3 inches in length and 1.5 inches in width at its widest point.

The larger end of the gallbladder extends inferiorly and to the right while the tapered end points superiorly and medially.
The tapered end of the gallbladder narrows into a small bile duct known as the cystic duct. The cystic duct connects to the common hepatic duct that carries bile from the liver. These ducts merge to form the common bile duct that extends to the wall of the duodenum

DIGESTIVE SYSTEM
GALLBLADDER: MICROSCOPIC ANATOMY

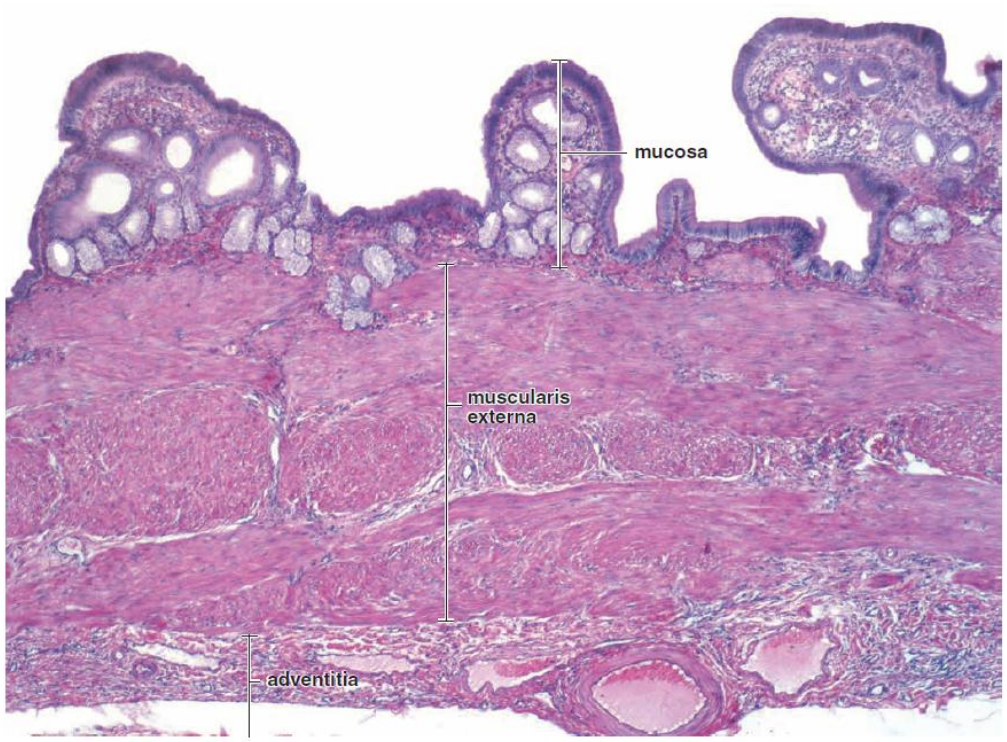


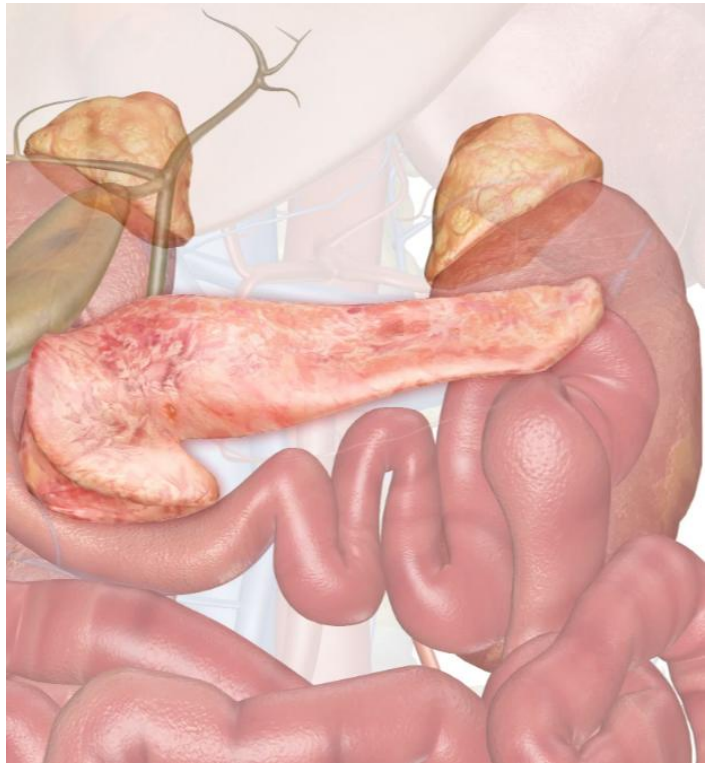
FIGURE 18.15 ▲ **Photomicrograph of the wall of the gallbladder.** The mucosa of the gallbladder consists of a lining of simple columnar

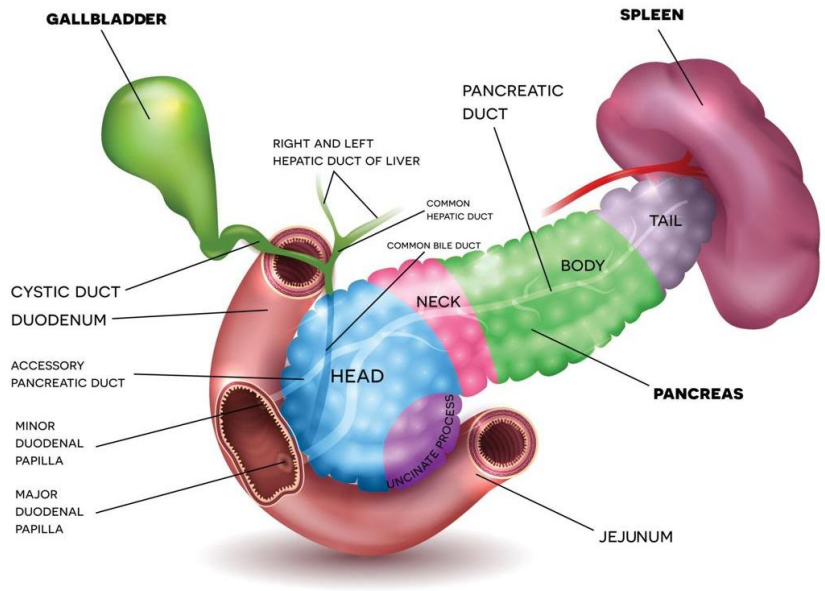
FIGURE 18.17 ▲ **Photomicrograph of the Rokitansky-Aschoff sinuses in the wall of the gallbladder.** This photomicrograph shows

Deep diverticula of the mucosa, called **Rokitansky-Aschoff sinuses**, sometimes extend through the muscularis externa

DIGESTIVE SYSTEM
PANCREAS

The **pancreas** is a glandular organ in the upper abdomen, but really it serves as two glands in one: a digestive exocrine gland and a hormone-producing endocrine gland.



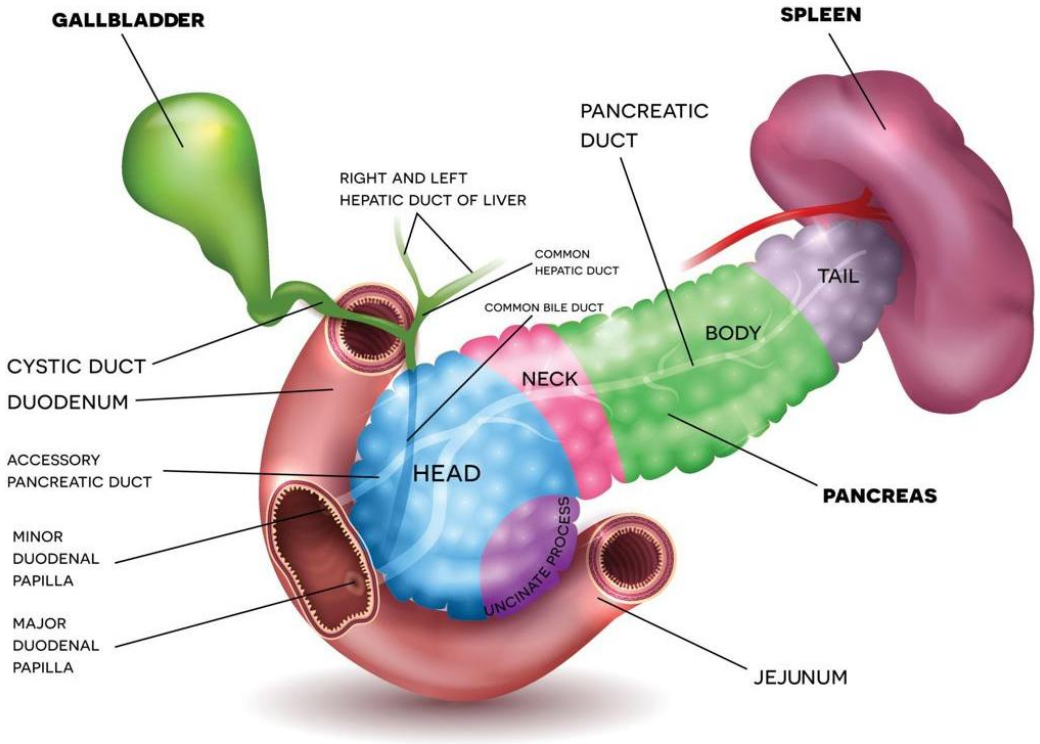


Pancreas is typically described in terms of its **location, parts, relations, ducts, and blood supply**

Location and General Features

- The pancreas lies **transversely across the posterior abdominal wall** at approximately the **L1–L2 vertebral level**.
- It extends **from the duodenum on the right to the spleen on the left**.
- Most of the organ is **retroperitoneal**, except for the **tail**, which lies within the **splenorenal ligament**.
- Average length: **15–20 cm**.
- Shape: **flattened and lobulated** gland.

DIGESTIVE SYSTEM
PANCREAS



Parts of the Pancreas

The pancreas is divided into **five main anatomical regions**:

Head

- The **broadest portion** of the pancreas.
- Lies within the **C-shaped curve of the duodenum**.
- Posteriorly related to the **inferior vena cava** and **right renal vessels**.

Uncinate Process

- A **hook-like projection** from the lower part of the head.
- Passes **posterior to the superior mesenteric vessels**.

Neck

- A **short constricted portion** connecting the head and body.
- Lies **anterior to the superior mesenteric vein**, where the **portal vein is formed**.

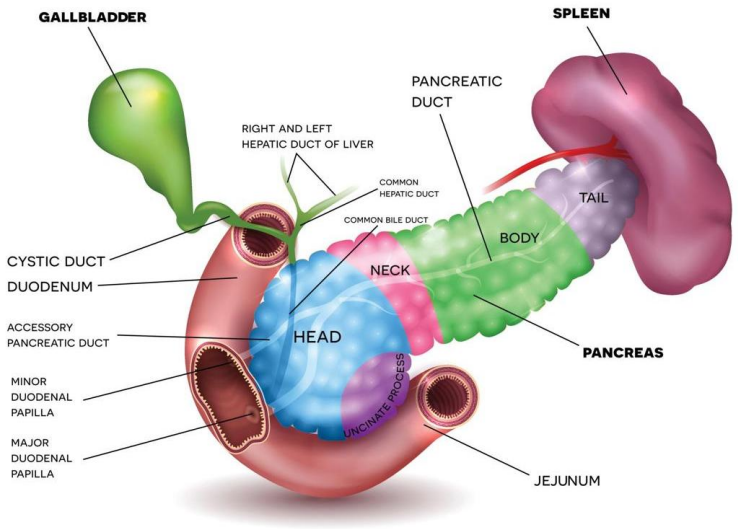
Body

- Extends **leftward across the midline**.
- Triangular in cross-section.
- Posterior relations include: **Aorta, Left kidney, Left renal vessels, Splenic vein**

Tail

- The **narrow terminal portion**.
- Extends to the **hilum of the spleen**.
- The **only intraperitoneal part** of the pancreas.

DIGESTIVE SYSTEM
PANCREAS



Duct System

The pancreas has **two major ducts**:

Main Pancreatic Duct (Wirsung)

- Runs from the **tail to the head**.
- Joins the **common bile duct**.
- Opens into the **duodenum at the major duodenal papilla**.

Accessory Pancreatic Duct (Santorini)

- Drains part of the **head of the pancreas**.
- Opens at the **minor duodenal papilla**.

Blood Supply

Arterial supply

- **Pancreaticoduodenal arteries** (from the superior mesenteric and gastroduodenal arteries) supply the **head**.
- **Branches of the splenic artery** supply the **body and tail**.

Venous drainage

- Into the **splenic vein** and **superior mesenteric vein**, forming the **portal vein**.

Lymphatic Drainage

- Drains to **pancreaticosplenic**, **pyloric**, and **superior mesenteric lymph nodes**, eventually reaching the **celiac lymph nodes**.

Innervation

- **Sympathetic fibers** from the **celiac plexus**.
- **Parasympathetic fibers** from the **vagus nerve**.

DIGESTIVE SYSTEM
PANCREAS

The pancreas is an exocrine and endocrine gland.

The dual functions of the pancreas are relegated to two structurally distinct components.

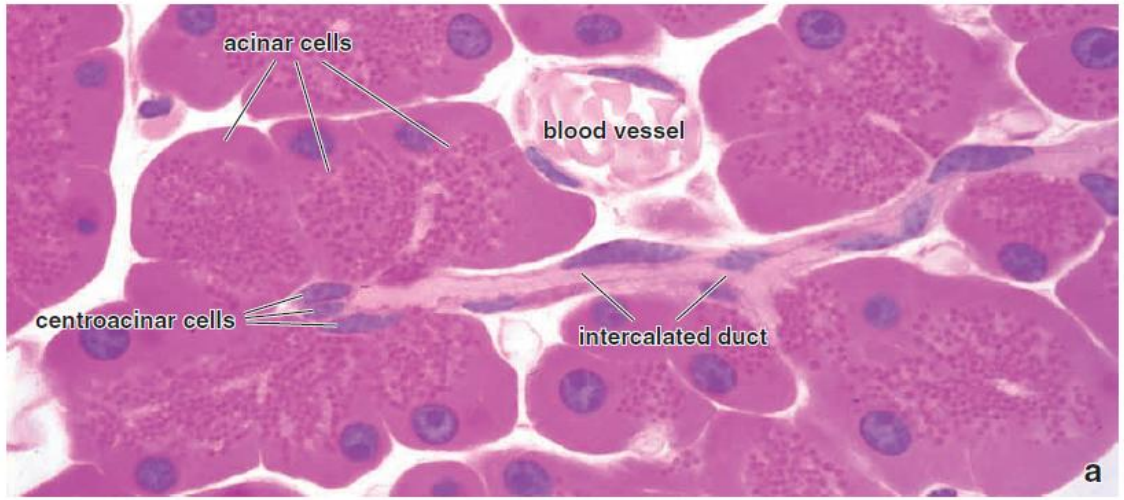
- The **exocrine component** synthesizes and **secretes enzymes** into the duodenum that are essential for digestion in the intestine.

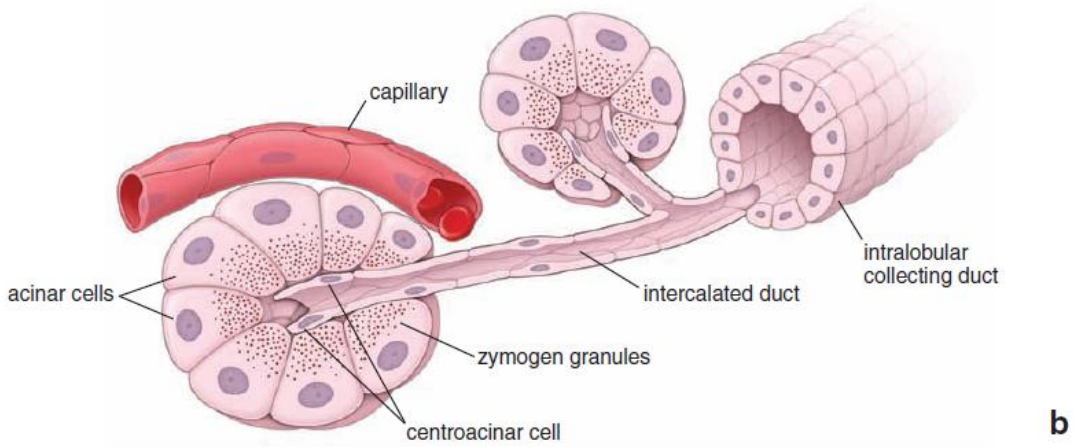
- The **endocrine component** synthesizes and **secretes** the **hormones insulin** and **glucagon** into the blood. These hormones regulate glucose, lipid, and protein metabolism in the body.

The exocrine pancreas is found throughout the organ; within the exocrine pancreas, distinct cell masses called **islets of Langerhans** are dispersed and constitute the endocrine pancreas.

DIGESTIVE SYSTEM
EXOCRINE PANCREAS

The exocrine pancreas is a serous gland.





The **secretory units (serous acini) are acinar or tubuloacinar** in shape and are formed by a simple epithelium of pyramidal serous cells

Pancreatic acini are unique because their intercalated ducts begin within the acinus: nuclei of duct cells located inside the acinus are referred to as **centroacinar cells**

DIGESTIVE SYSTEM
ENDOCRINE PANCREAS

The endocrine pancreas is a diff use organ that secretes hormones that regulate blood glucose levels.

The **islets of Langerhans**, the **endocrine component** of the pancreas, are scattered throughout the organ in cell groupings of varying size.

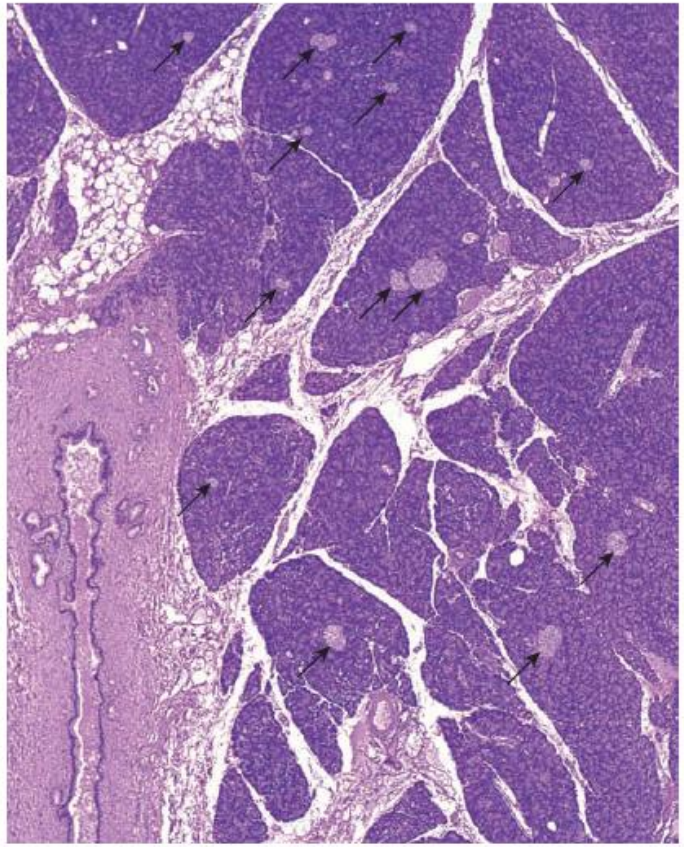


FIGURE 18.22 ▲ **Photomicrograph of the pancreas.** This H&E–

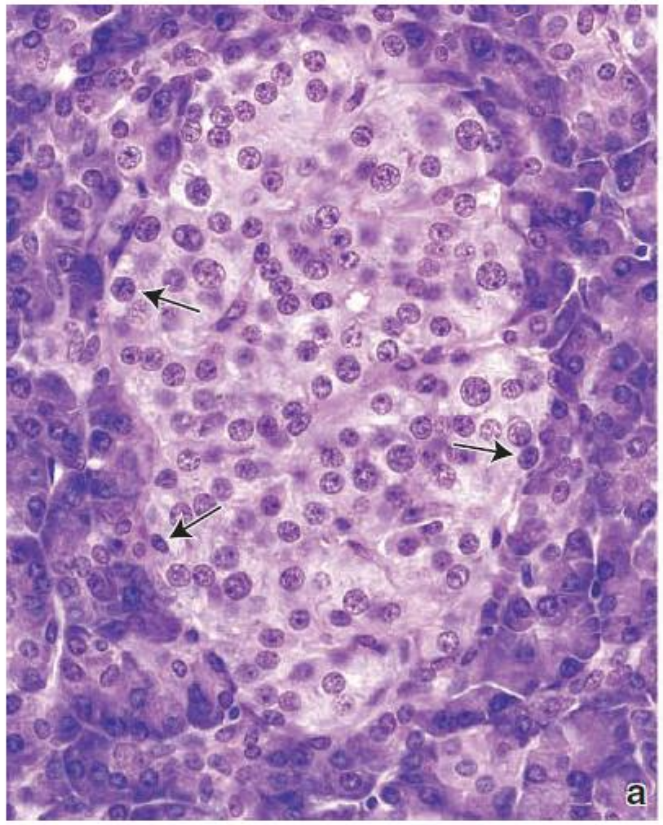


FIGURE 18.23 ▲ **Photomicrographs of islets of Langerhans.**

Their polygonal cells are arranged in short, irregular cords that are profusely invested with a network of fenestrated capillaries.

Islets of Langerhans contain three primary types of cells:

A cells (produce glucagon),
B cells (produce insulin),
D cells (produce somatostatin).

https://www.innerbody.com/image/digeov.html

https://www.kenhub.com/en/library/education/the-human-anatomy