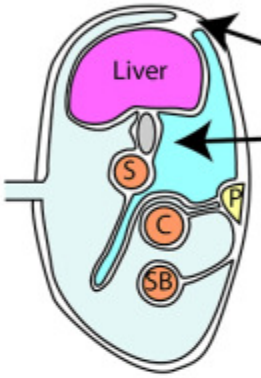
LIVER - DEVELOPMENT, LOBULES & HISTOLOGY

DEVELOPS

- In ventral mesogastrium
- As foregut ventral diverticulum which grows into septum transversum & induces generation of hepatocytes
- Grows into vitelline veins so that cells are directly exposed to blood

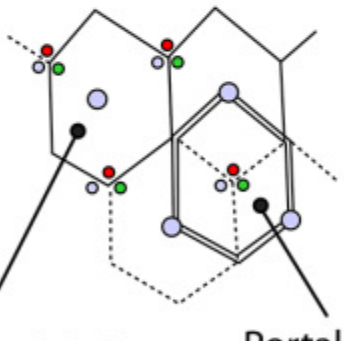


Falciform ligament

lesser omentum

VENTRAL MESENTERY

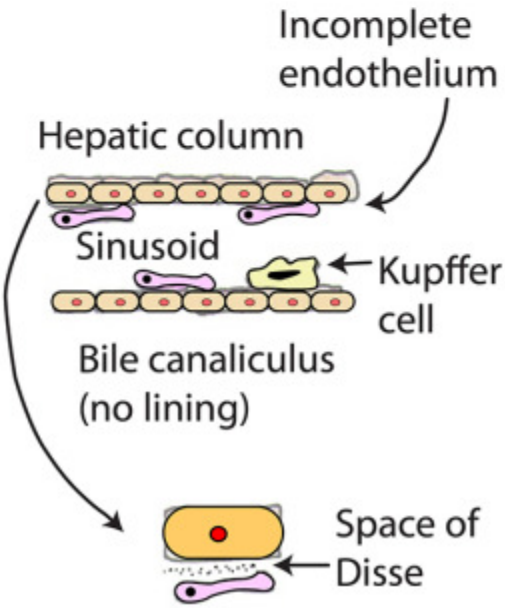
LOBULES



Hepatic lobule (anatomical lobule -central hepatic vein & 3 biliary triads)

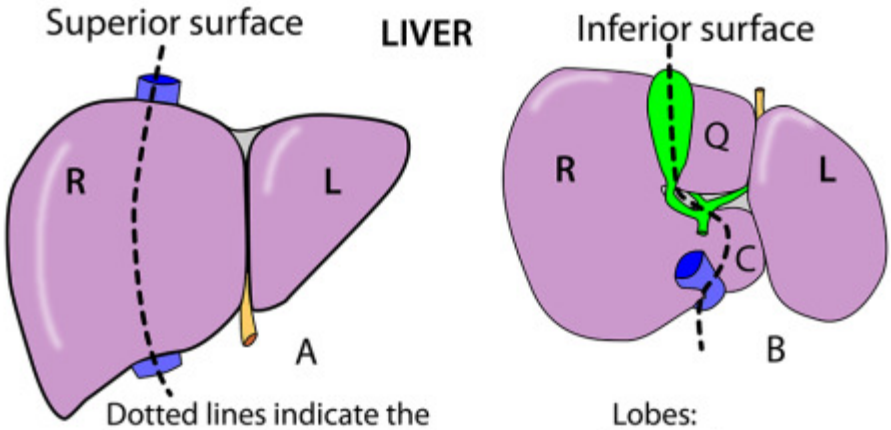
Portal lobule (physiological lobule - central triad radiating to 3 hepatic veins)

HISTOLOGY



LIVER - GENERAL DESCRIPTION

- Wedge shaped • largest organ in body • Weight 1500g
- 1500ml blood flow per minute (30% of cardiac output)
- Lies: Right-6-10 ribs/costal cartilages; Left-6-7 costal cartilages
- Surfaces: Anterior, superior, posteror, right - all smooth/convex
  Postero-inferior (visceral) concave & many features
- Supports: IVC & hepatic veins (+ ligamentum teres & peritoneum)
- Nerve supply: Right vagus via coeliac ganglia, left directly to porta hepatis. Sympathetics on vessels
- Reaches: T5 vertebra, nipples (5th intercostal space), xiphisternal joint

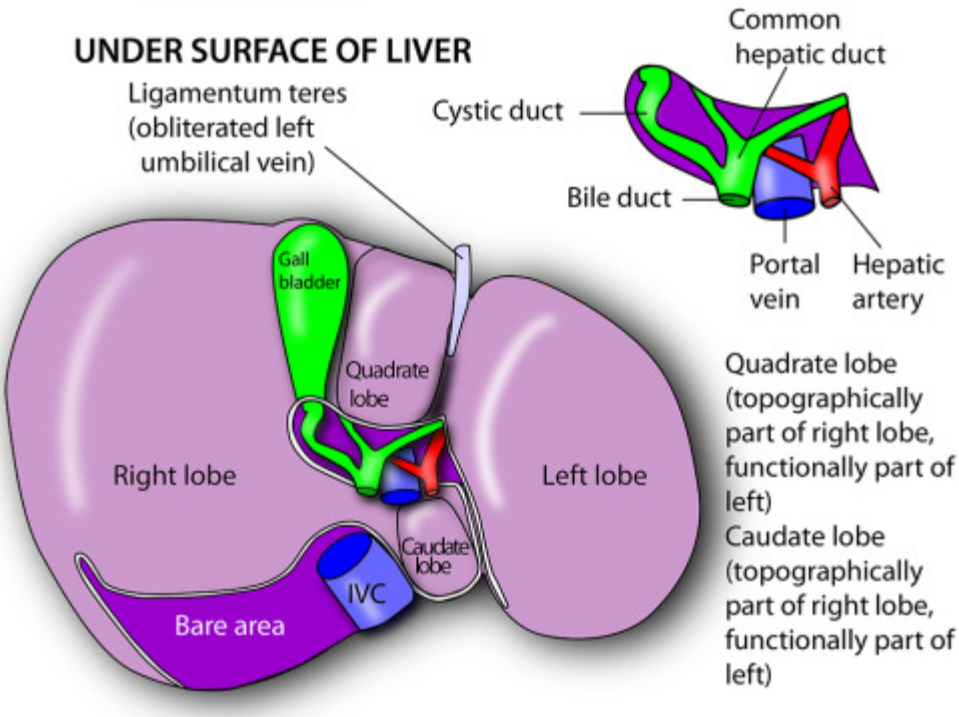


Dotted lines indicate the functional divisions of lobes of liver into L and R

Lobes:
C = caudate
Q = quadrate

- Left and right subphrenic & subhepatic spaces
- Main supports are hepatic veins & IVC
- Lymphatics to coeliac, para-aortic, post. mediastinal, axillary & inguinal

UNDER SURFACE OF LIVER



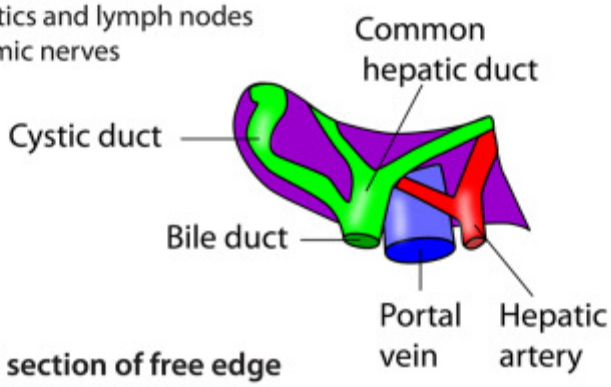
Quadrate lobe (topographically part of right lobe, functionally part of left)

Caudate lobe (topographically part of right lobe, functionally part of left)

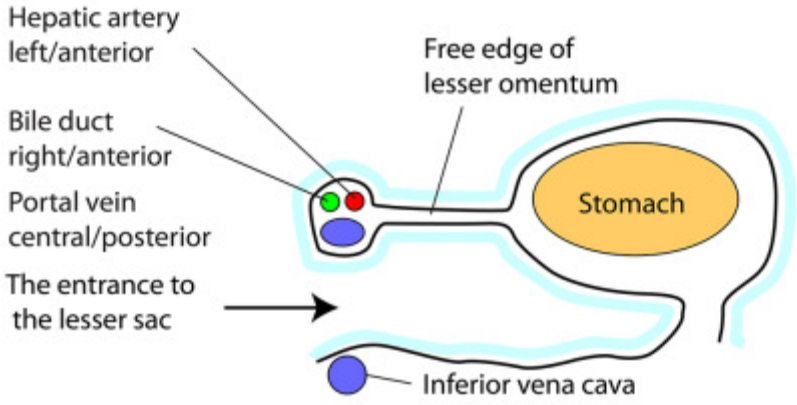
LIVER - PORTA HEPATIS

The porta hepatis is the area on the under surface of the liver at which the structures in the free edge of the lesser omentum enter/leave the liver. Peritoneum is reflected around it.
It contains the following structures:

- Portal vein
- Left/right branches of hepatic artery
- Left/right hepatic ducts
- Lymphatics and lymph nodes
- Autonomic nerves

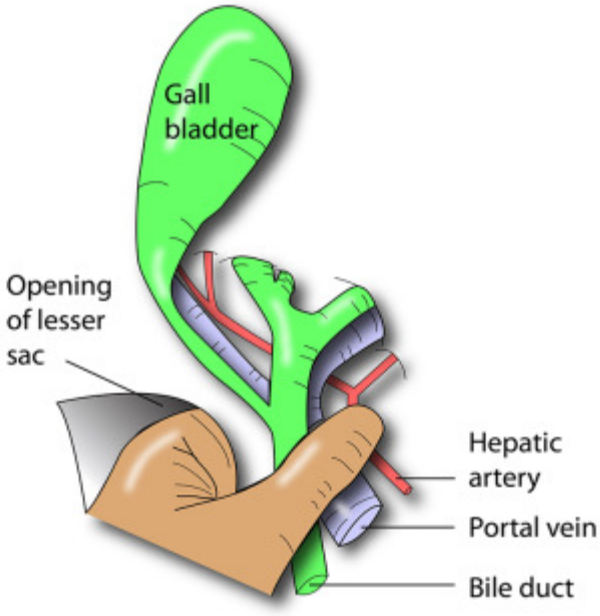


Cross (axial) section of free edge of lesser omentum looking up

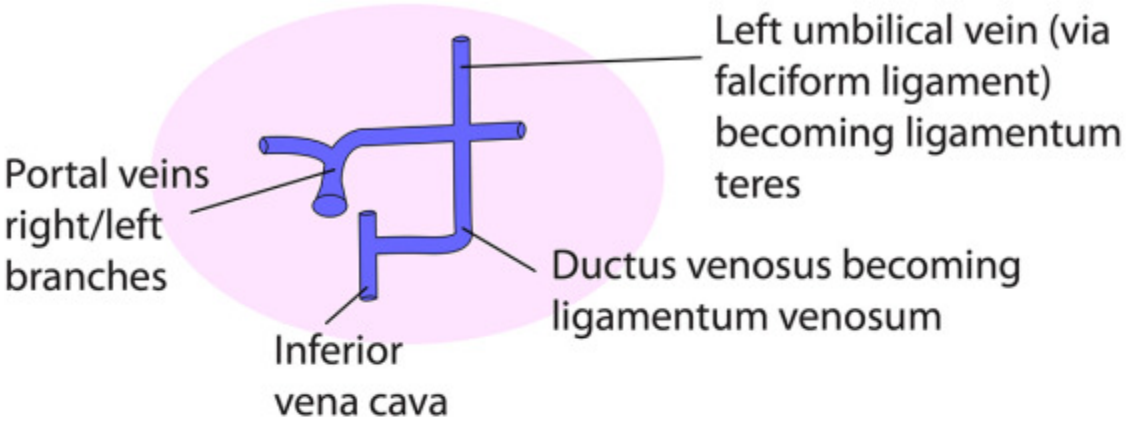


PRINGLE'S MANOEUVRE

Pressure is applied to both the portal vein and the hepatic artery to prevent bleeding from the liver



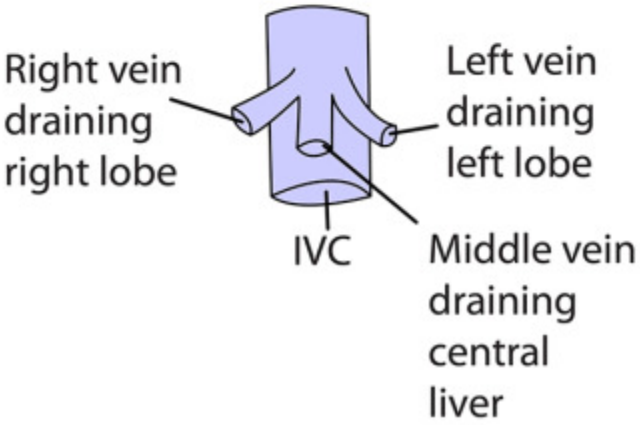
LIVER - FETAL CIRCULATION & HEPATIC VEINS

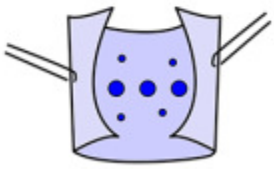


Blood returns from the placenta via left umbilical vein which joins the left branch of the portal vein. Most of the blood crosses over into the ductus venosus and hence to the inferior vena cava. Some blood enters the portal circulation and again reaches the inferior vena cava via the hepatic veins

HEPATIC VEINS

These veins drain the "cleansed" blood back into the systemic circulation from the liver. They do not follow the portobiliary segmentation. The veins suspend the liver from the inferior vena cava and are helped by the peritoneal reflections





Accessory veins drain the liver directly into the (opened) IVC

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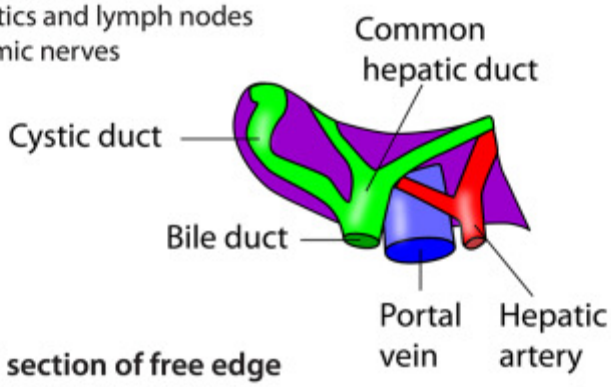

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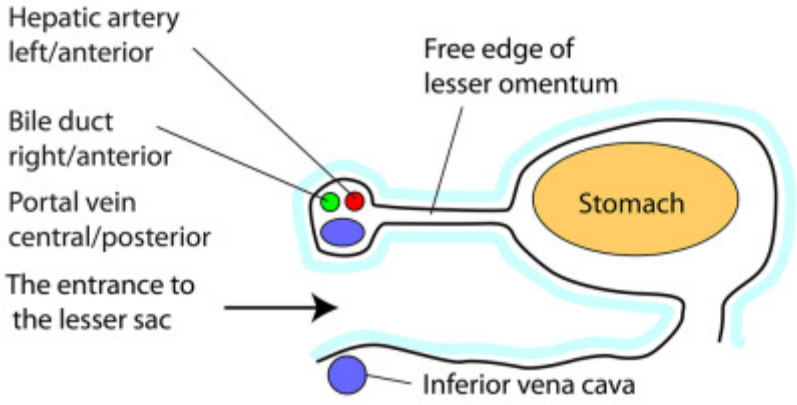

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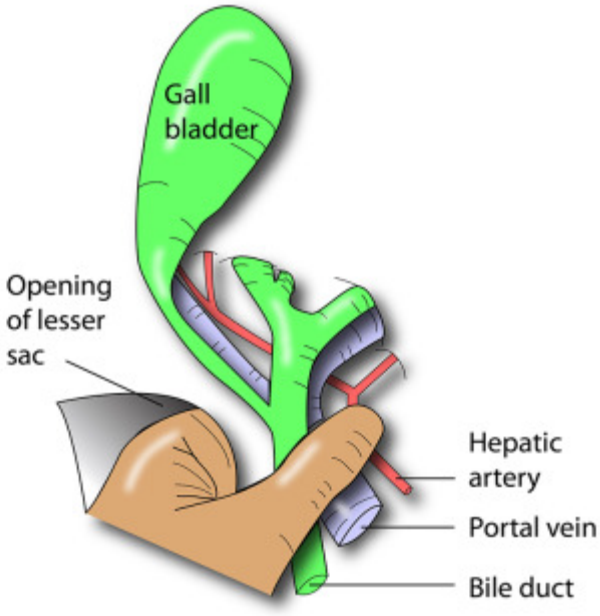
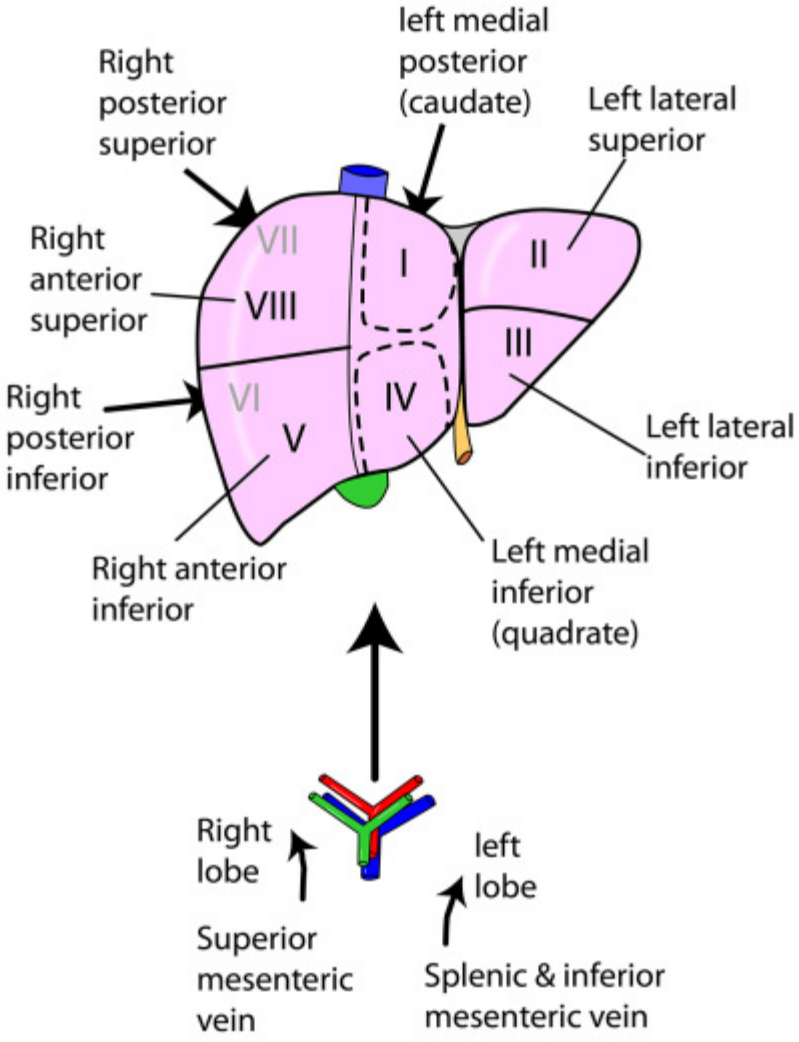
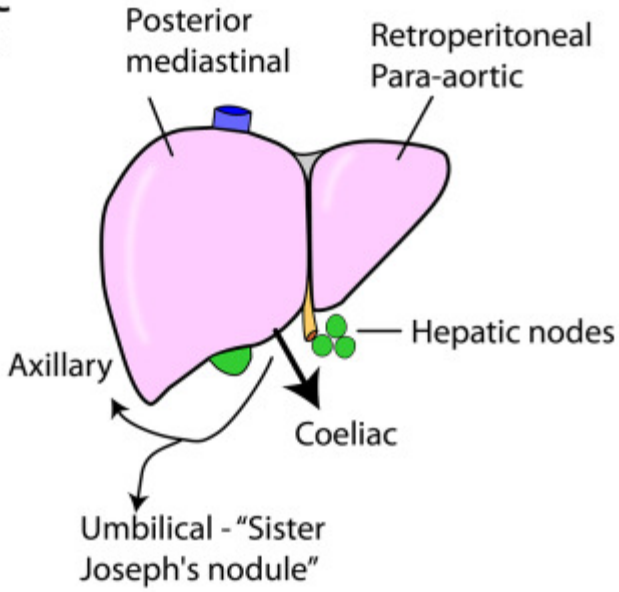


LIVER - PORTOBILIARY SEGMENTATION



LYMPHATIC DRAINAGE OF LIVER

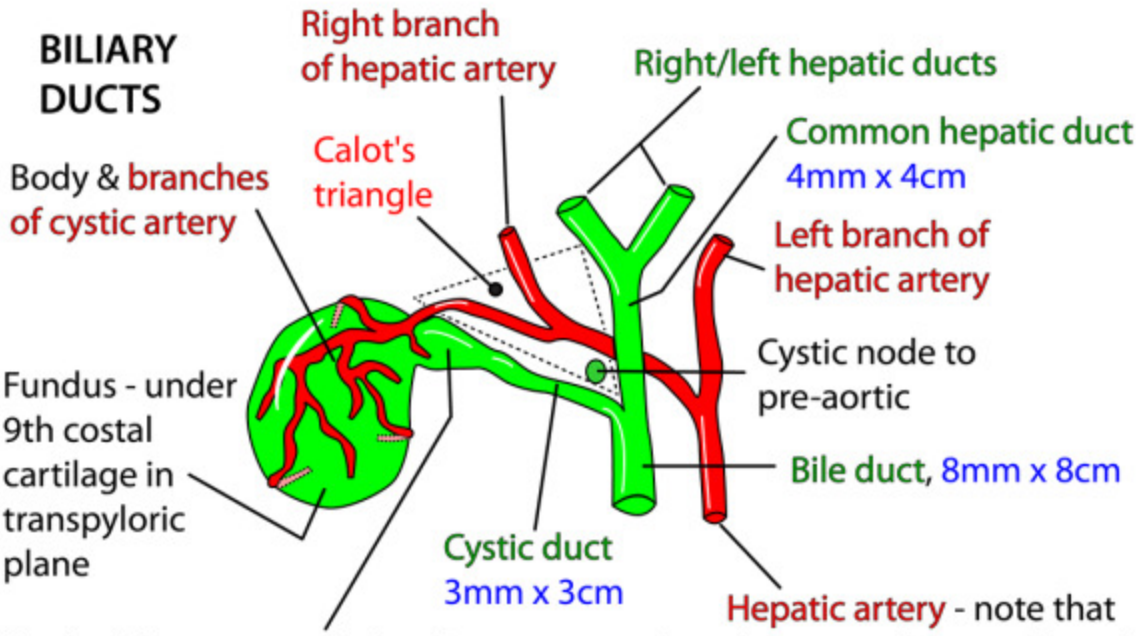


BILIARY TREE - GENERAL TOPOGRAPHY

GALL BLADDER

- Fibromuscular sac - stores & concentrates bile. Holds 50ml
- Lined by simple columnar epithelium. Mucous cells at neck only
- Veins directly to liver bed then to hepatic veins. Occasionally join the portal vein
- Lymphatics to porta hepatis
- Parasympathetics & sympathetics (see liver)
- Anterior: liver and abdominal wall
- Posterior: transverse colon & 1st part of duodenum

BILIARY DUCTS



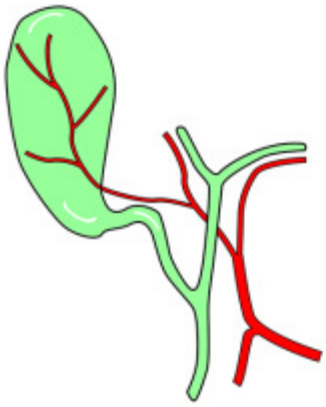
Neck with mucous cells leading to mucosal folds giving the spiral valve of Heister. When there is a swelling like this it is called Hartmann's pouch, usually formed by the presence, or previous presence of a stone

Hepatic artery - note that there are a few small arteries from bed of liver therefore there is usually no gangrene when cystic artery thromboses

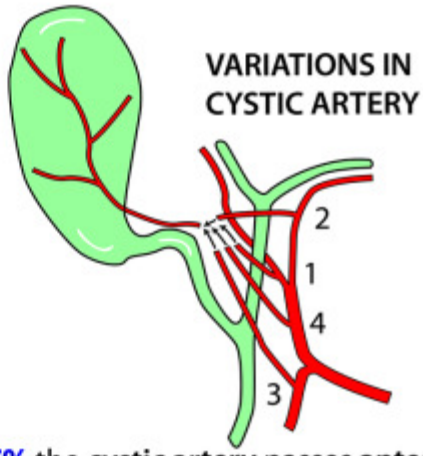
BILIARY TREE -
CYSTIC & ARTERIAL VARIATIONS

ARTERIAL VARIATIONS

- In the vast majority of people the cystic artery arises from the right branch of the hepatic artery
- In 27% it arises from the hepatic or common hepatic
- In 5% it arises from the left branch of the hepatic
- In 3% it arises from the gastroduodenal
- In 1% it arises from either the superior pancreaticoduodenal, left gastric, coeliac or superior mesenteric

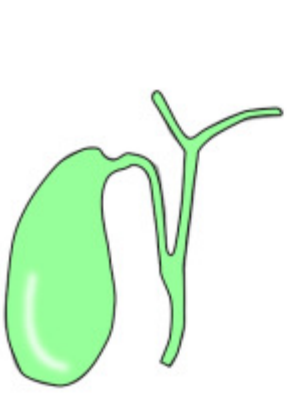


In **75%** of people the **cystic artery** is given off in Calot's triangle from the right branch of the hepatic artery which lies **posterior** to the common hepatic duct

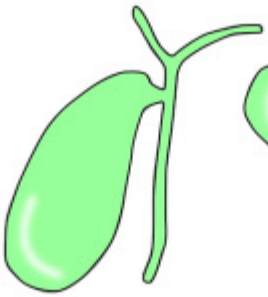


In **25%** the **cystic artery** passes **anterior** to the common hepatic duct & arises from
1. Right branch of hepatic artery (14%)
2. Left branch of hepatic artery (6%)
3. Gastroduodenal artery (3%)
4. Main hepatic artery (2%)

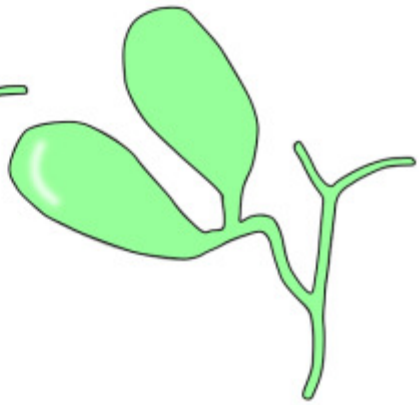
GALL BLADDER VARIATIONS



A long cystic duct joining the hepatic duct low, even behind the duodenum



Absent cystic duct. The gall bladder opens directly into the common hepatic duct



A rare double gall bladder resulting from a bific embryonic divereticulum from the hepatic duct

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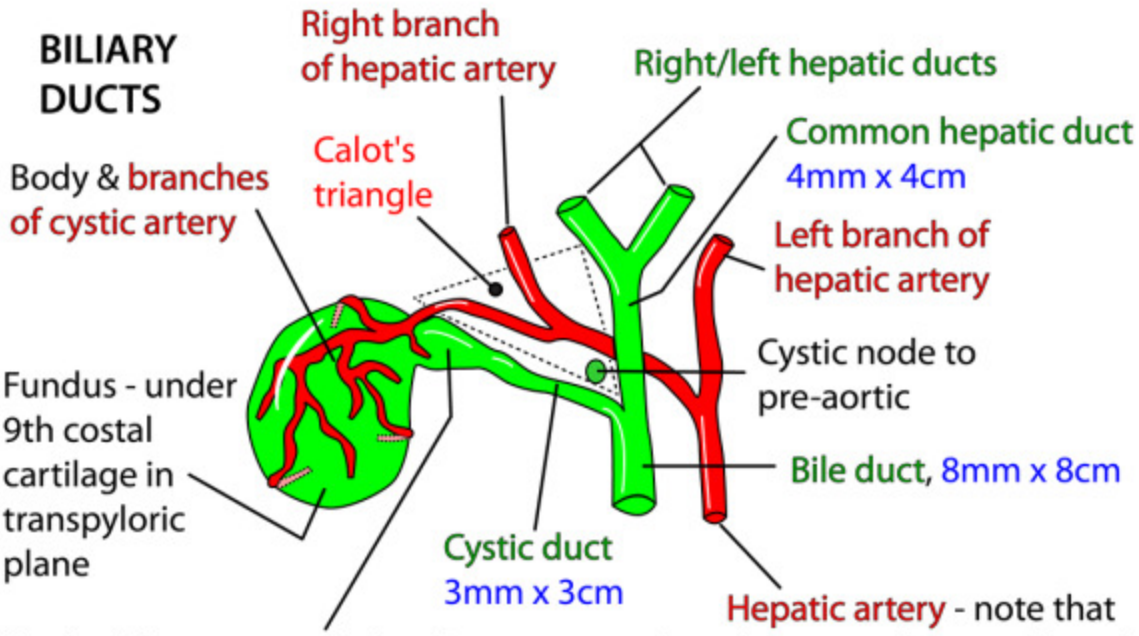

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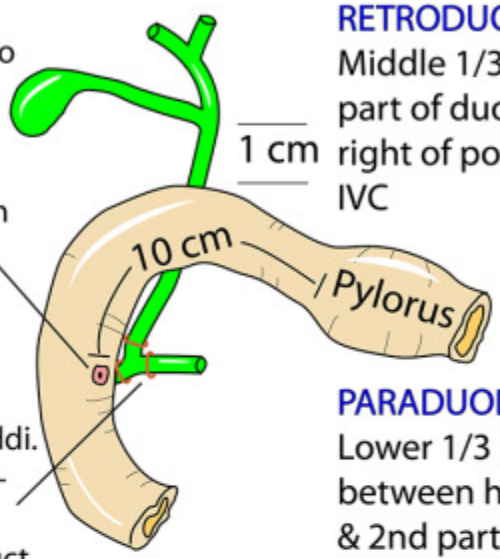
Hepatic artery - note that there are a few small arteries from bed of liver therefore there is usually no gangrene when cystic artery thromboses

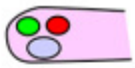
BILE DUCT
(8CM LONG
8 MM WIDE)

Ampulla of Vater opens into 2nd part of duodenum on posteromedial wall, 10cm from pylorus

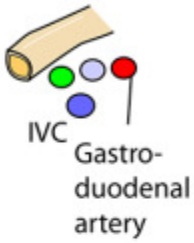


Sphincter of Oddi.
3 parts around -
1. Bile duct
2. Pancreatic duct
3. Ampulla

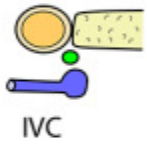
SUPRADUODENAL
Upper 1/3 in free edge of lesser omentum, with hepatic artery & portal vein



RETRODUODENAL
Middle 1/3 posterior to 1st part of duodenum, now to right of portal vein and on IVC



PARADUODENAL
Lower 1/3 in groove between head of pancreas & 2nd part of duodenum on right renal vein & IVC

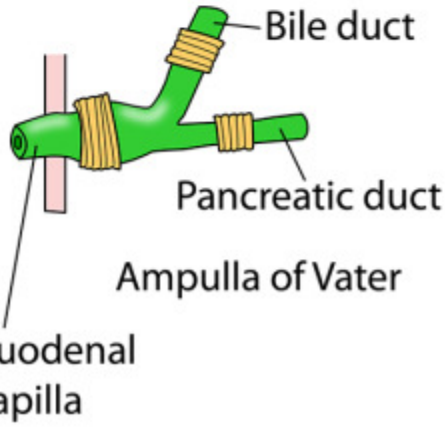


Blood:
cystic, hepatic, gastroduodenal arteries

Nerves:
Parasympathetic - anterior vagus for contraction of gallbladder, relaxation of sphincter of Oddi (+ cholecystokinin from small bowel)
Sympathetic - coeliac ganglion, relaxes gallbladder
Sensation: General visceral afferent with sympathetics and somatic via phrenic

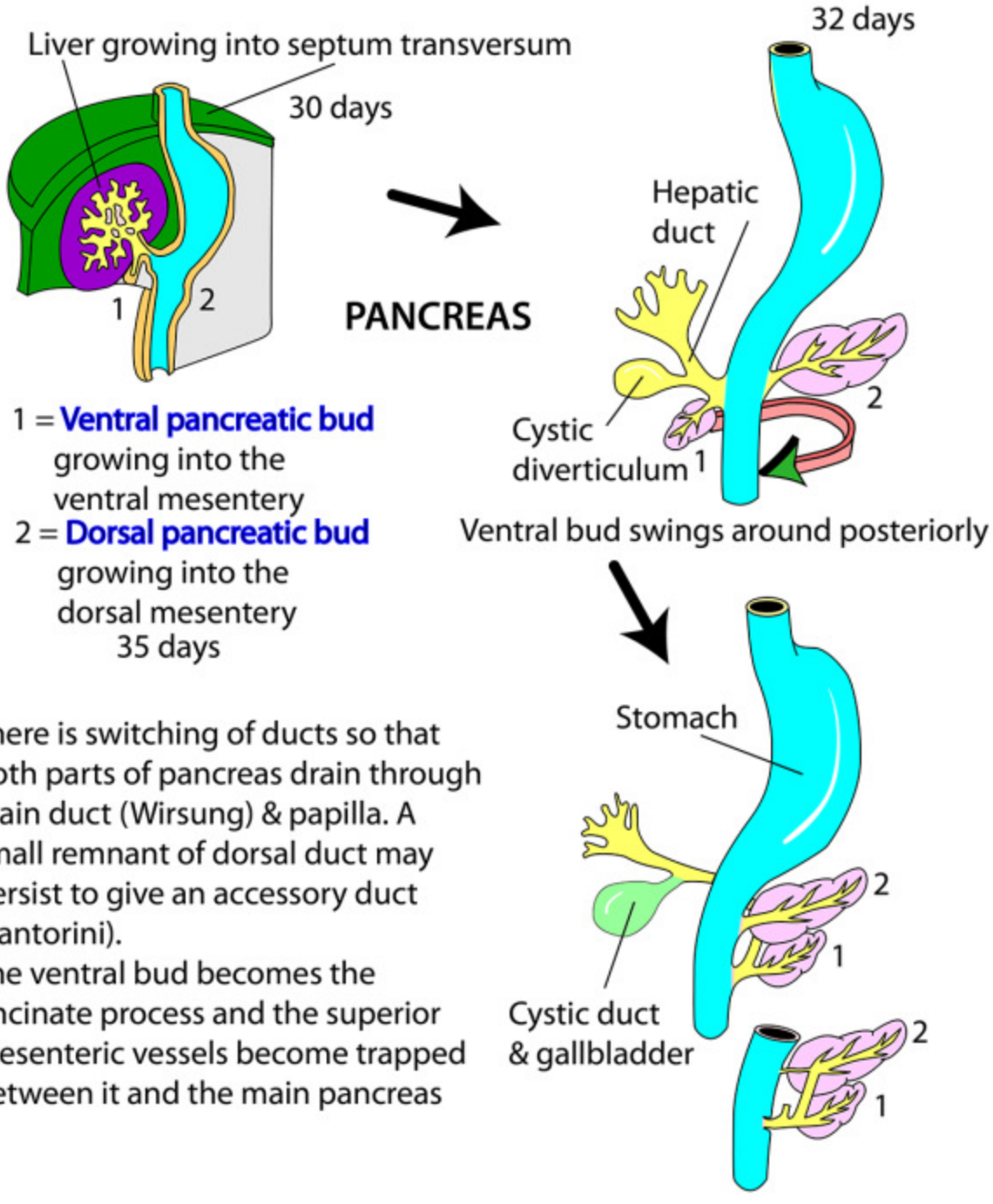
SPHINCTER OF ODDI

3 sphincters make up this Sphincter of Oddi. Biliary is always present - others may be missing



DEVELOPMENT OF GALL BLADDER & PANCREAS

A diverticulum grows from the ventral wall of the duodenum which differentiates into hepatic ducts and liver. A second diverticulum from the hepatic duct gives the gall bladder and cystic duct. Pancreas develops from vental and dorsal buds



1 = **Ventral pancreatic bud** growing into the ventral mesentery

2 = **Dorsal pancreatic bud** growing into the dorsal mesentery

35 days

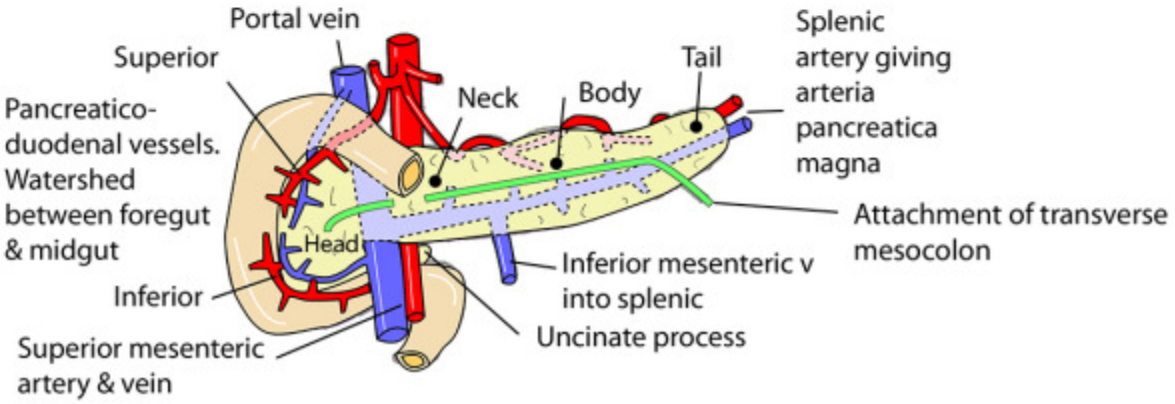
There is switching of ducts so that both parts of pancreas drain through main duct (Wirsung) & papilla. A small remnant of dorsal duct may persist to give an accessory duct (Santorini).

The ventral bud becomes the uncinate process and the superior mesenteric vessels become trapped between it and the main pancreas

Note: Endocrine cells invade tissue at around 3 months in utero & begin activity around 5 months in utero

PANCREAS - GENERAL

- Exocrine volume much greater than endocrine
- Lies retroperoneal, largely in the transpyloric plane
- 15cm long, lobulated with fine capsule
- Alveoli of serous secretory cells lead to ductules then to principal ducts
- Islets of Langerhans lie between alveoli
- Main duct (Wirsung) leads to ampulla of Vater
- Accessory duct (Santorini) from uncinate process opens proximally, may be absent, often communicates with main duct
- Arteries: Gastroduodenal, inferior/superior pancreaticoduodenal, arteria pancreatica magna from splenic
- Veins: Pancreaticoduodenal. Superior to portal, inferior to superior mesenteric
- Lymphatics: in groove between head and duodenum & root of superior mesenteric artery and vein
- Nerves: Parasympathetic (posterior vagus) to stimulate exocrine secretion. Sympathetic for vasoconstriction and pain
- Secretion: Amylase. Secretin causes juice rich bicarbonate; cholecystokinin causes juices rich in enzymes - trypsinogen, chymotrypsinogen and pancreatic lipase. Alpha islet cells give glucogon, beta cells give insulin, delta give somatostatin. Pancreatic polypeptide is produced by the tail of the pancreas.



PANCREAS - RELATIONS

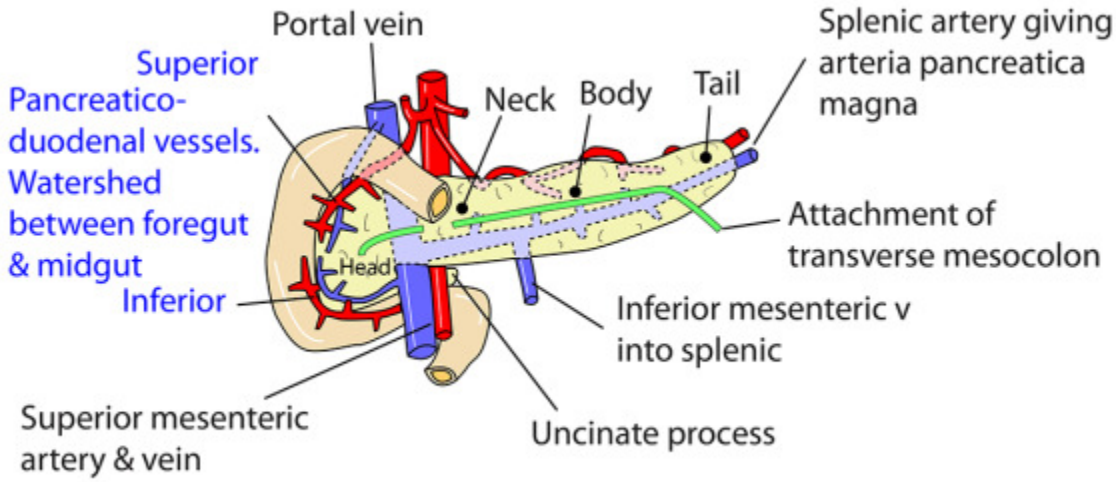
Anterior: lesser sac, pylorus, 1st part of duodenum, superior mesenteric artery & vein, transverse mesocolon, stomach

Superior: splenic artery

Lateral on right: 2nd part of duodenum, ampulla of Vater

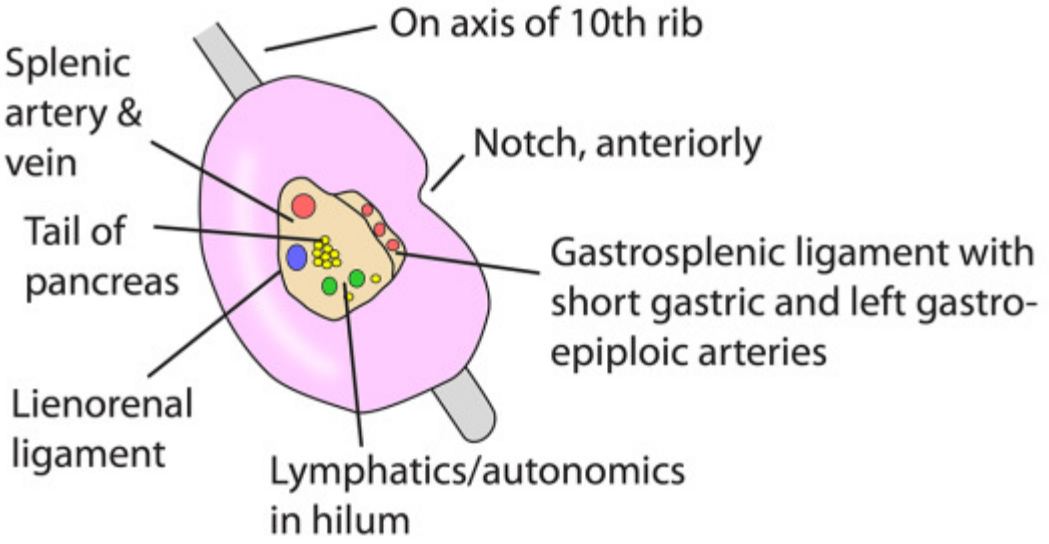
Lateral on left: hilum of spleen

Posterior: left crus of diaphragm, psoas, right renal vein, inferior vena cava, bile duct, spleen, left renal vessels, left kidney, left suprarenal gland, coeliac plexus, inferior mesenteric vein, splenic vein, portal vein, superior mesenteric artery & vein, aorta

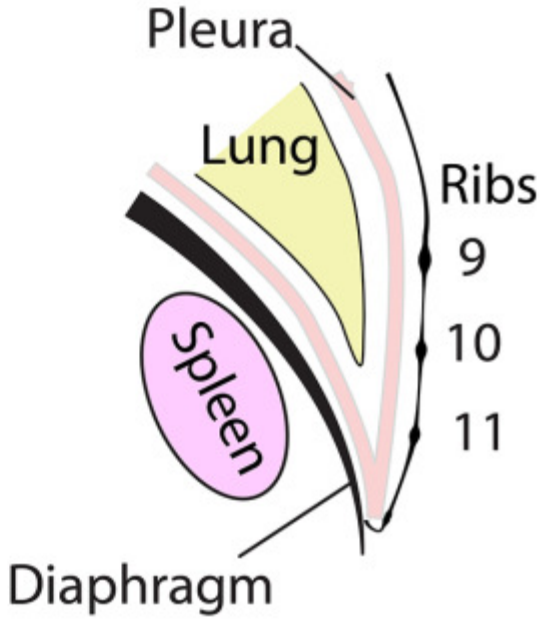


SPLEEN - GENERAL

- Size of a fist (1 x 3 x 5 inches) 2.5cm x 8cm x 13cm
- 200g in weight. Lies on ribs 9 -11
- Part of the reticuloendothelial system
- Becomes palpable when it is twice normal size
- Thin caspsule, has notch & moves on respiration (cf. kidney)
- Functions: Erythropoeisis, effete erythrocyte removal, immune defence (beta cells) and blood storage
- Blood supply: Splenic artery from coeliac trunk
- Venous drainage: Splenic vein to portal system
- Lymph: Coeliac (para-aortic)
- Nerve: Sympathetic from coeliac plexus



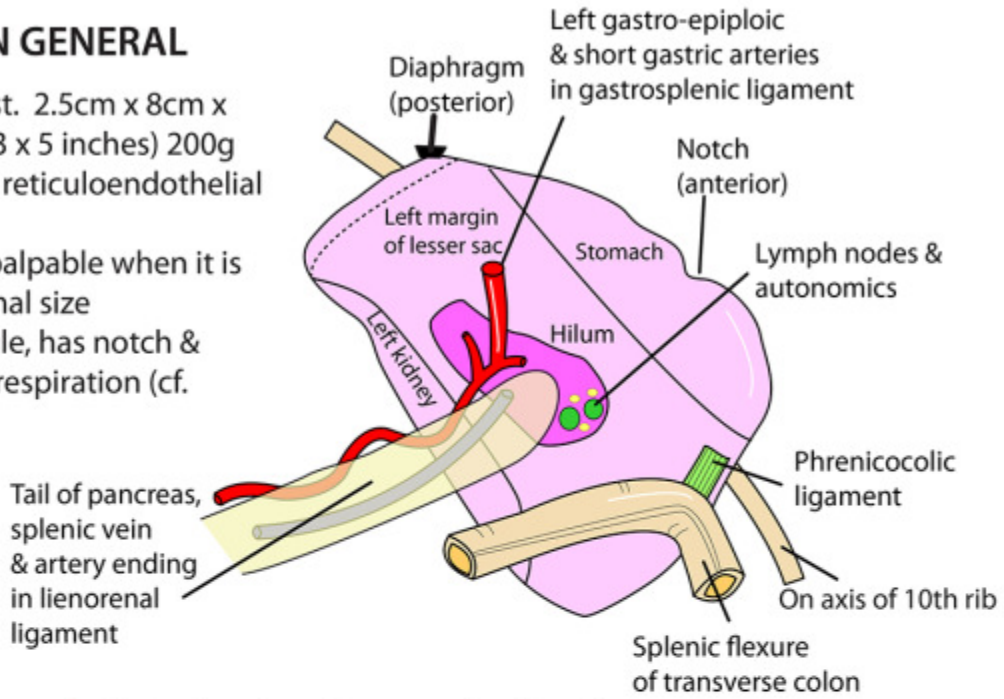
Note: lower pole is normally no further anteromedial than mid axillary line



SPLEEN - RELATIONS & DEVELOPMENT

SPLEEN GENERAL

- Size of a fist. 2.5cm x 8cm x 13cm (1 x 3 x 5 inches) 200g
- Part of the reticuloendothelial system
- Becomes palpable when it is twice normal size
- Thin capsule, has notch & moves on respiration (cf. kidney)



Blood supply: Splenic artery from coeliac trunk
Venous drainage: Splenic vein to portal system
Lymph: Coeliac (para-aortic)
Nerve: Sympathetic from coeliac plexus

DEVELOPMENT In dorsal mesoderm in dorsal mesogastrium