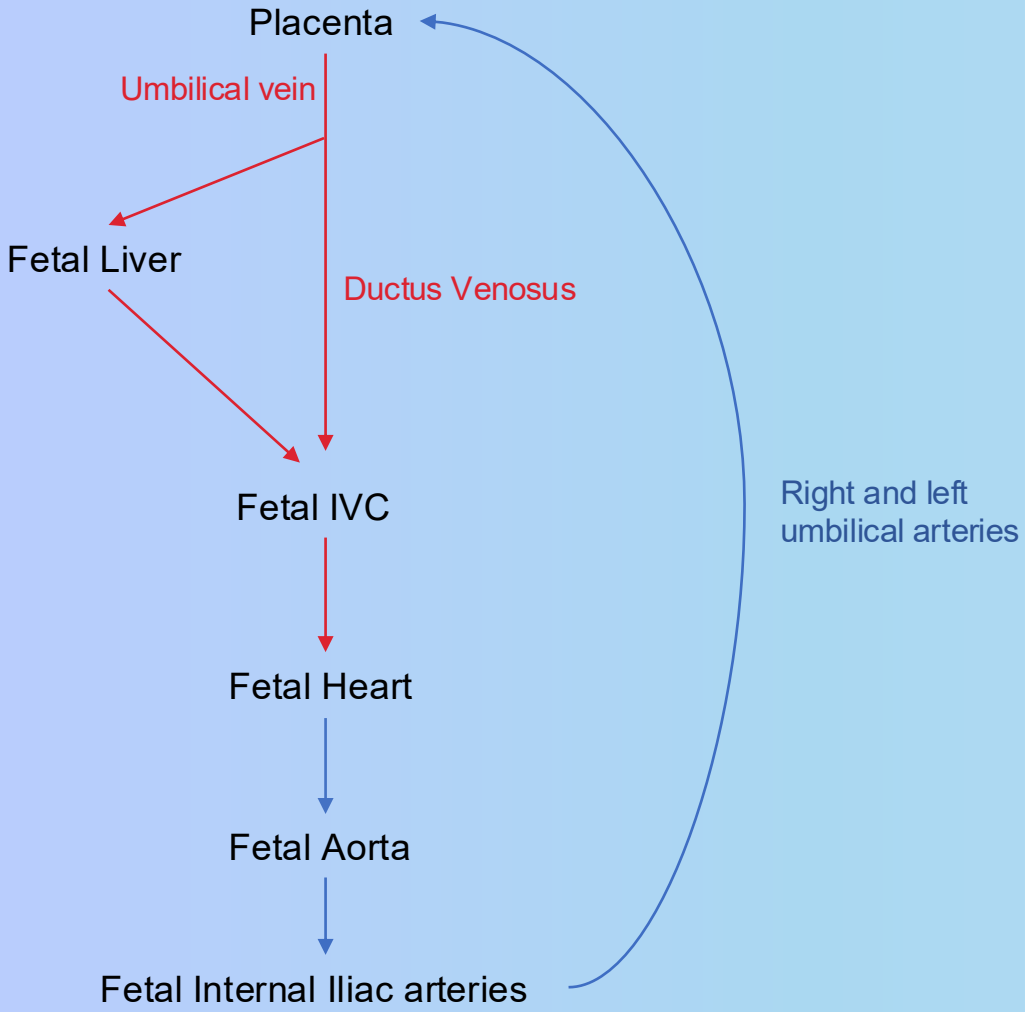
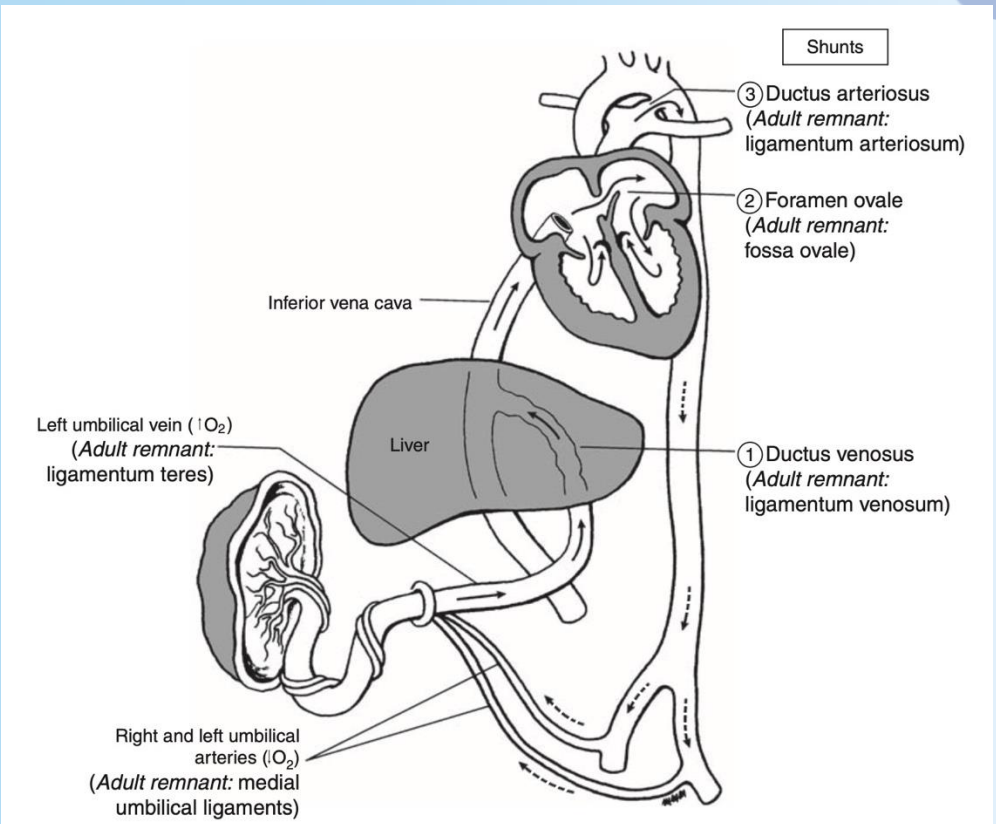
Embryology of kidneys and Anatomy of abdominal ligaments/spaces

By Andreas Tanke Holm

Fetal Circulation

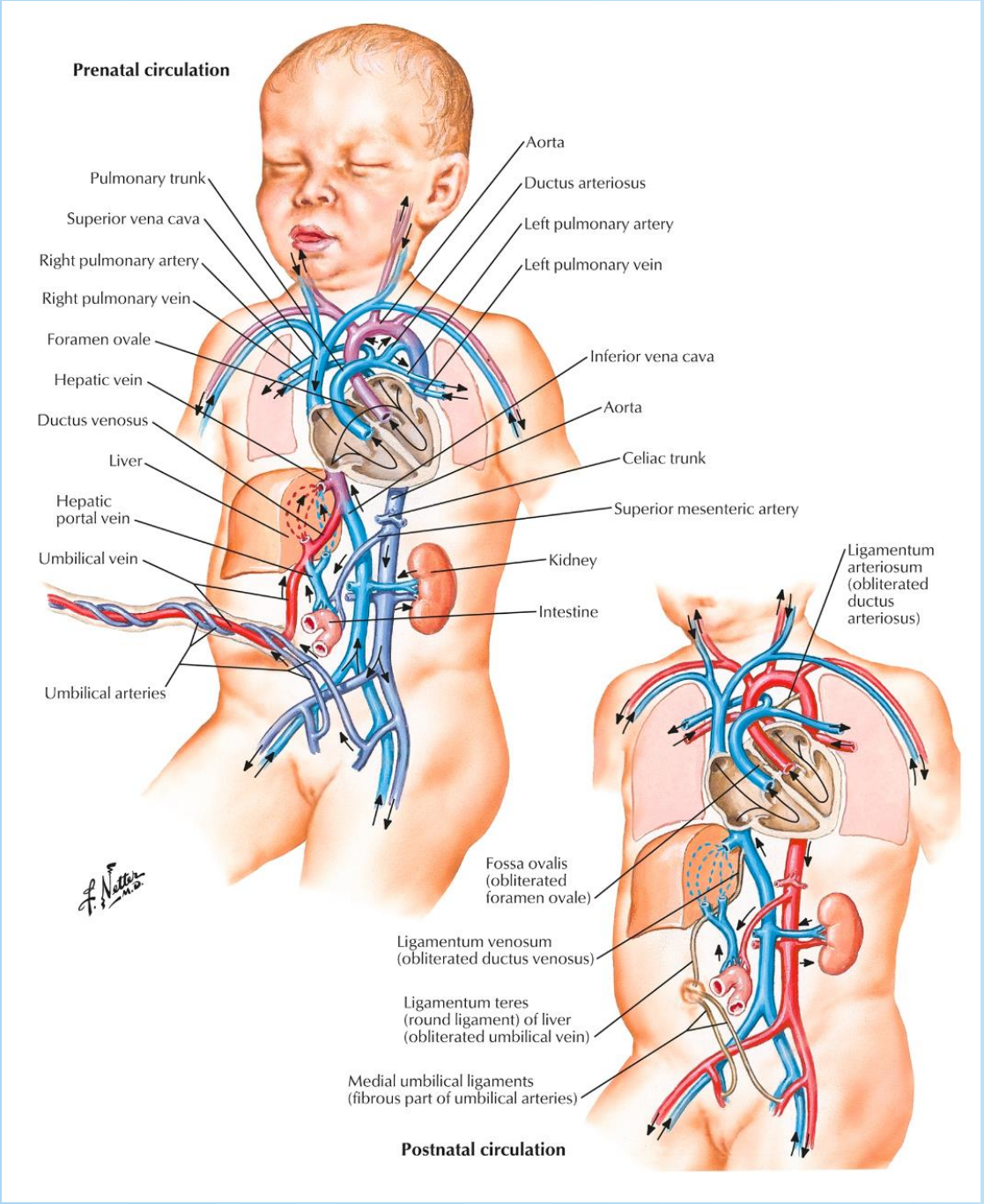




Remnants Created by Closure of Fetal Circulatory Structures	
Fetal Structure	Adult Remnant
Right and left umbilical arteries	Medial umbilical ligaments
Left umbilical vein	Ligamentum teres
Ductus venosus	Ligamentum venosum
Foramen ovale	Fossa ovale
Ductus arteriosus	Ligamentum arteriosum

FIGURE 6.5. Schematic diagram of fetal circulation and remnants of fetal circulatory structures.

IVC = Inferior Vena Cava


Prenatal circulation
Pulmonary trunk
Superior vena cava
Right pulmonary artery
Right pulmonary vein
Foramen ovale
Hepatic vein
Ductus venosus
Liver
Hepatic portal vein
Umbilical vein
Umbilical arteries
Aorta
Ductus arteriosus
Left pulmonary artery
Left pulmonary vein
Inferior vena cava
Aorta
Celiac trunk
Superior mesenteric artery
Kidney
Intestine
Ligamentum arteriosum (obliterated ductus arteriosus)
Fossa ovalis (obliterated foramen ovale)
Ligamentum venosum (obliterated ductus venosus)
Ligamentum teres (round ligament) of liver (obliterated umbilical vein)
Medial umbilical ligaments (fibrous part of umbilical arteries)
Postnatal circulation

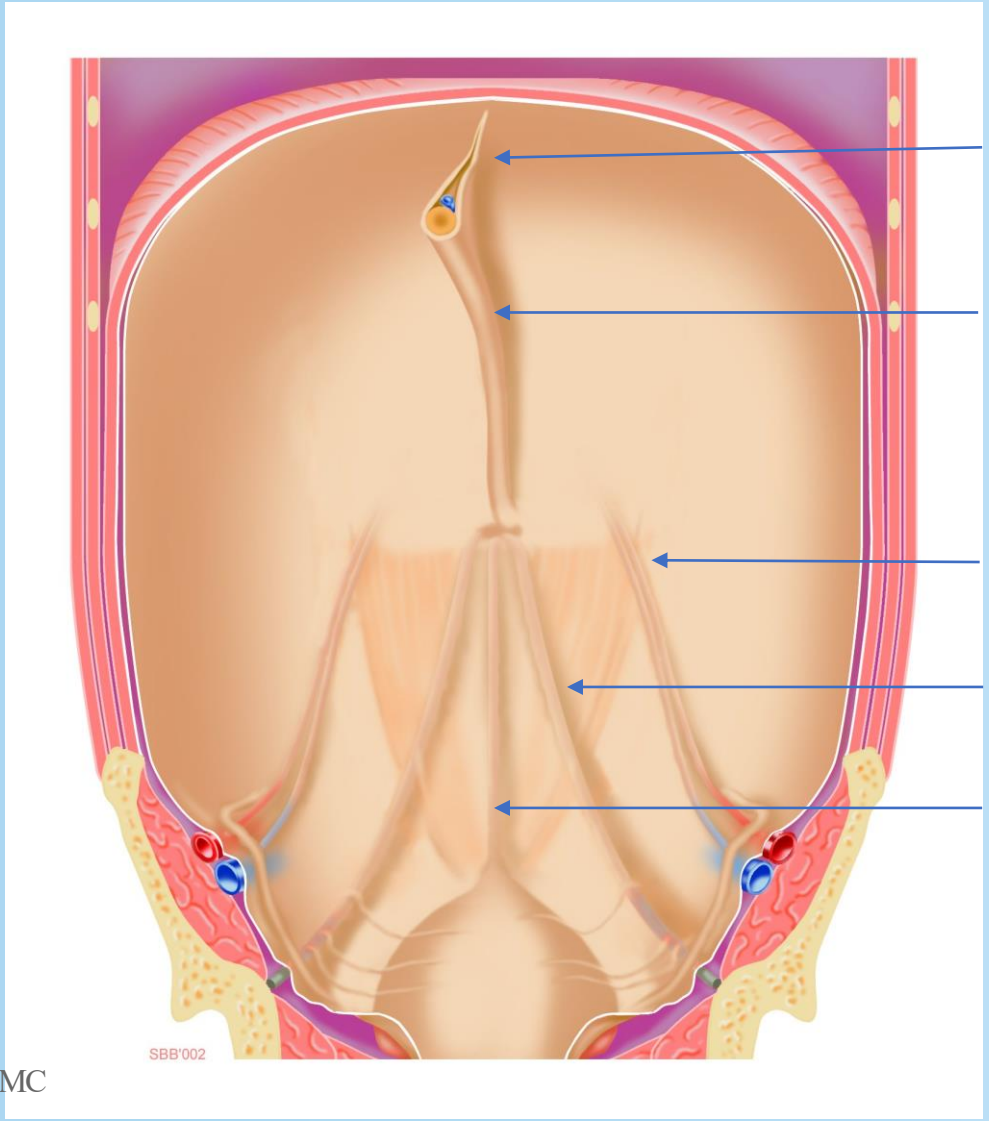
Vessels which become ligaments in the abdomen

Fetal vessel	Postnatal ligament
Umbilical vein	Ligamentum teres (round ligament) of liver
Ductus Venosus	Ligamentum venosus
Right / Left Umbilical artery	Right / Left Medial Umbilical Ligament

“Teres” = ”rounded” in latin

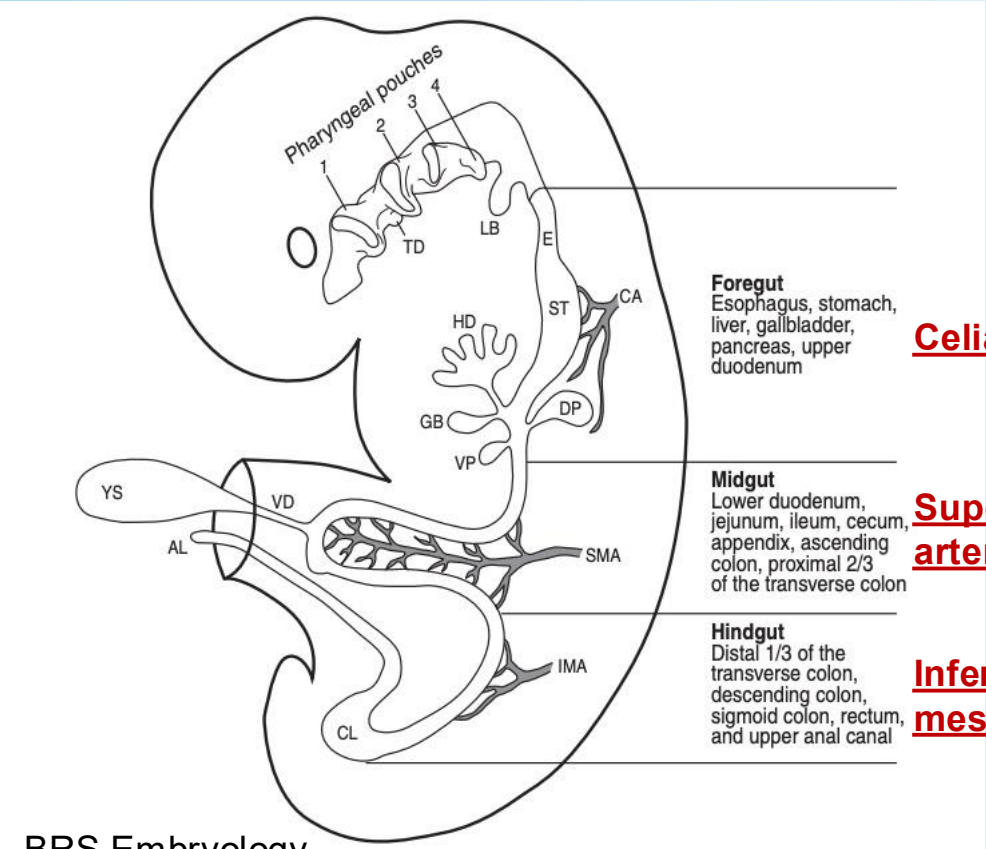
Anterior abdominal wall ligaments

UWAGA:
The practical structured are called FOLDS because they are lined with peritoneum



Quick digression

- The Urachus (median umbilical fold) is derived from the allantois (“AL” on picture)
- Function
  - Gas exchange and embryonic waste disposal
  - Forms the urinary bladder
- NO FUNCTION IN POSTNATAL BODY



BRS Embryology

Peritoneum

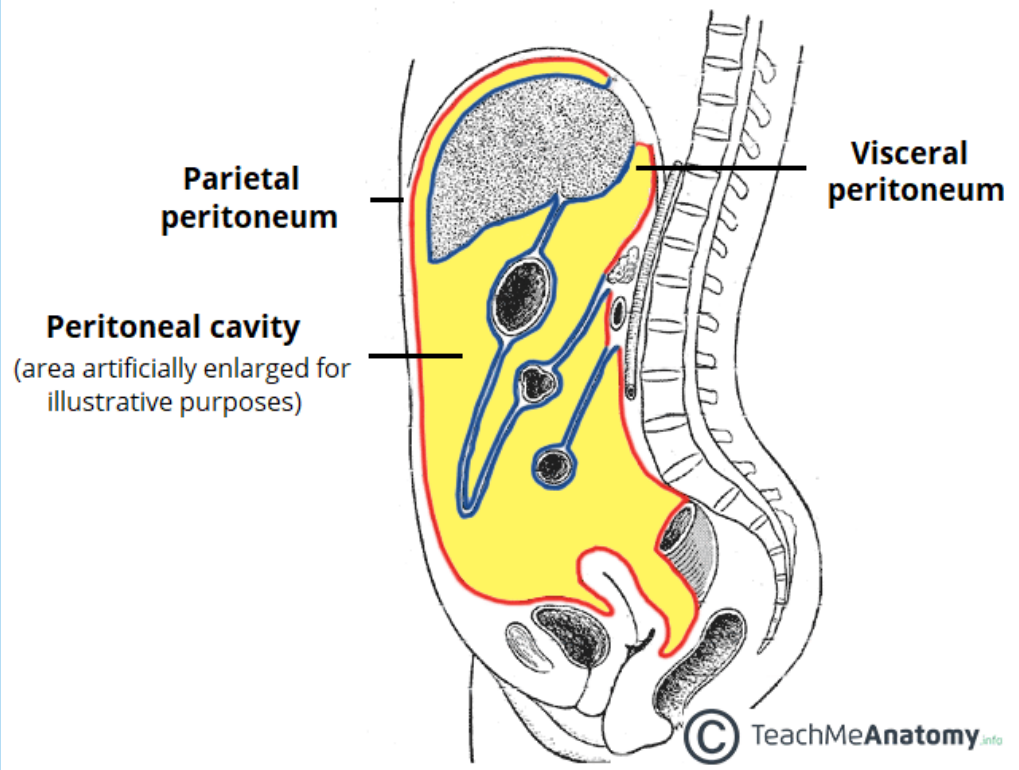
- Parts of peritoneum
- Visceral peritoneum
  - Intraperitoneal organs
  - Retroperitoneal organs
- Greater and lesser omentum
- Peritoneal cavity
  - Greater and lesser sac
  - Gutters and recesses
- Mesentery

Greek, περί, peri means "around", while τείνω, teino means "to stretch"; thus, "peritoneum" means "stretched over".

Parts of peritoneum

- Parietal peritoneum
  - Lines walls of abdominal cavity
- Visceral peritoneum
  - Lines organs within the abdominal cavity

- Organs can be:
  - Intraperitoneal
  - Extraperitoneal
    - Retroperitoneal
    - Subperitoneal
    - Preperitoneal



"Parietalis" = Belonging to a wall

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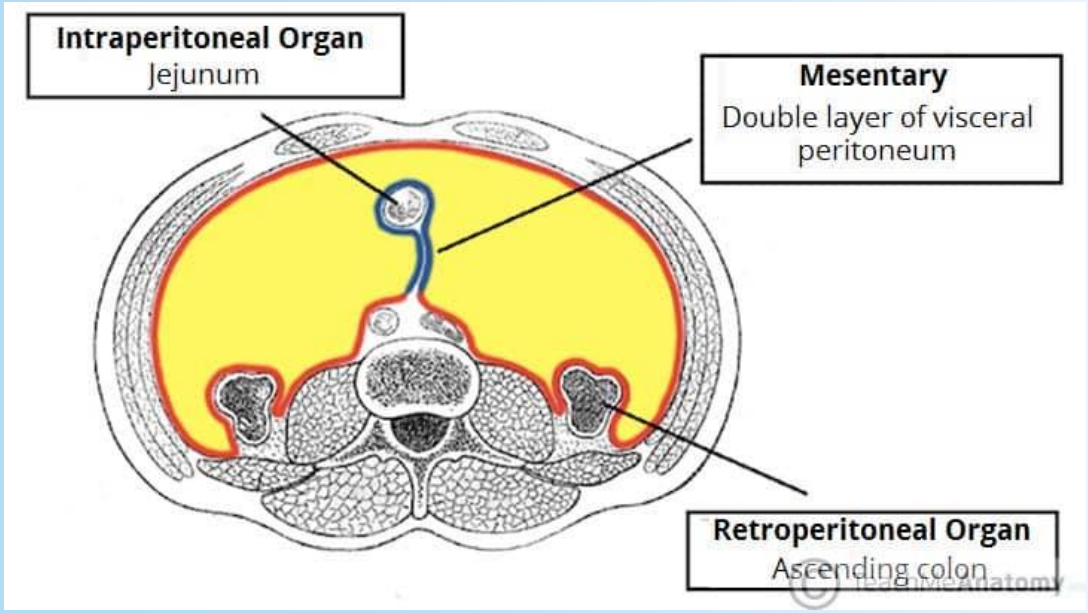
Visceral peritoneum

- Can cover organs in two different ways
  - Completely or partially
- Which place the organs in categories
  - Intraperitoneal
  - Retroperitoneal
    - Primary
    - Secondary
- Mesoperitoneal (Low Yield!)
  - A third category where “three” sides of an organ are covered by peritoneum

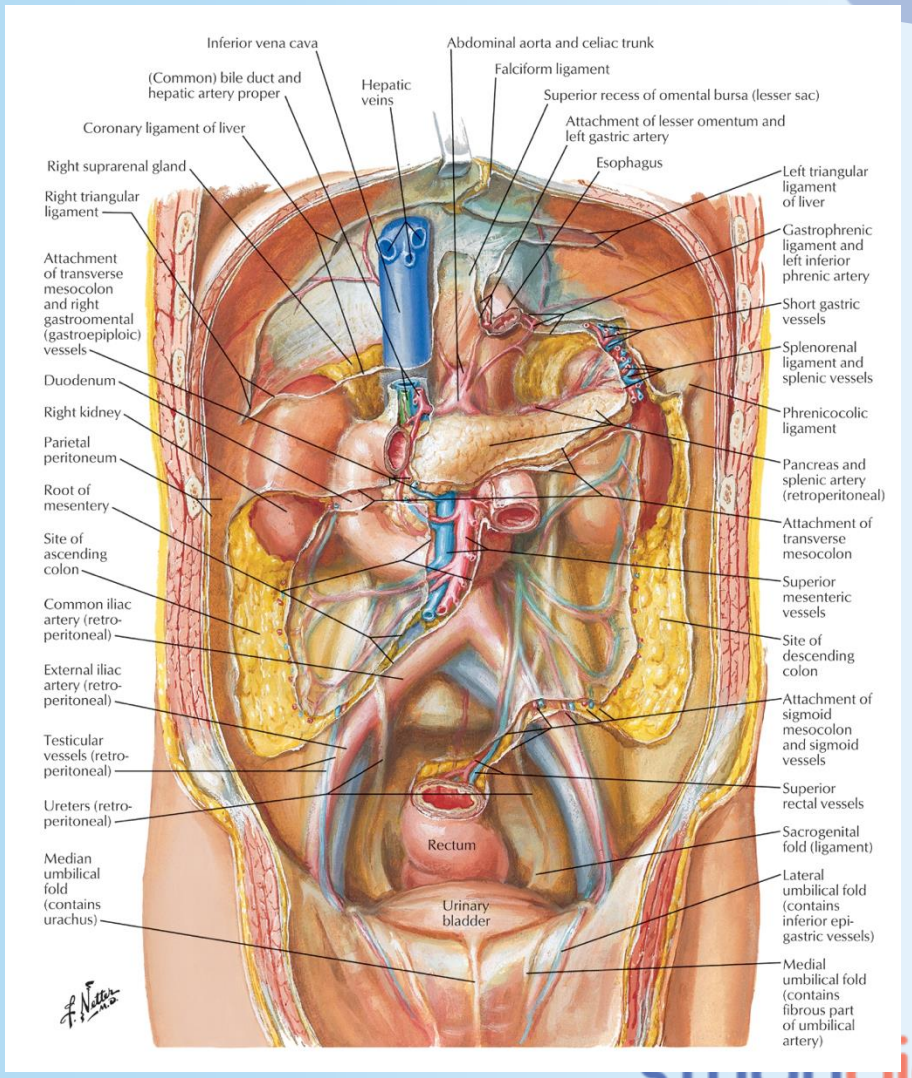


Intraperitoneal organs

- SALTDS SPRRS (pronounced “salted spurs”)
- S = Stomach
- A = Appendix
- L = Liver + gall bladder
- T = Transverse colon
- D = Duodenum (First part only)
- S = Small intestines (jejunum and ileum)
- P = Pancreas (only tail)
- R = Rectum (upper third)
- S = Spleen
- S = Sigmoid Colon

Retroperitonal Organs

- SAD PUCKER
- S = Suprarenal (adrenal) glands
- A = Aorta/IVC
- D = Duodenum (except the first 2cm)
- P = Pancreas (except tail)
- U = Ureters
- C = Colon (Ascending and descending)
- K = Kidneys
- E = Esophagus
- R = Rectum (lower two thirds)

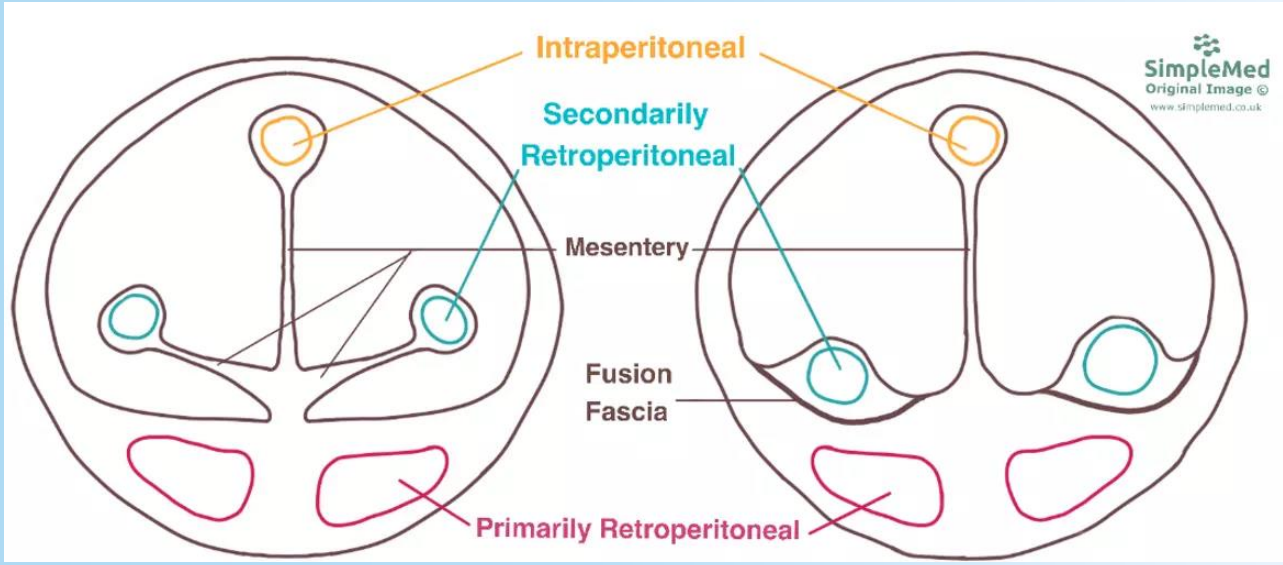


Retroperitoneal Subdivisions

- Primary retroperitoneal
  - Embryologically never been intraperitoneal

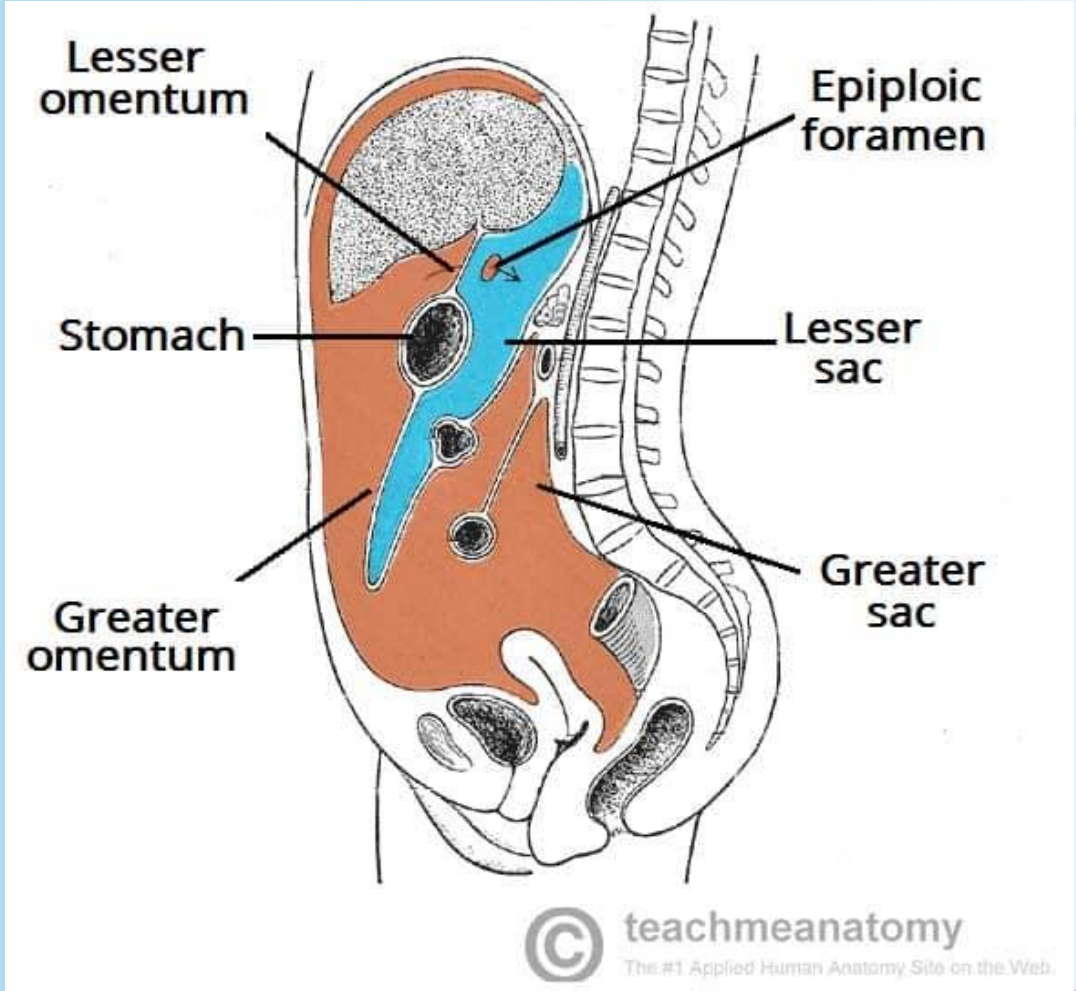
  - Esophagus
  - Anal canal
  - Kidneys + Adrenals
  - Ureters
  - Aorta + IVC

- Secondary retroperitoneal
  - Embryologically was intraperitoneal but later adhered to parietal peritoneum



Greater and lesser omentum

- Do not confuse with greater and lesser sac!
- Essentially just ligaments with fatty tissue

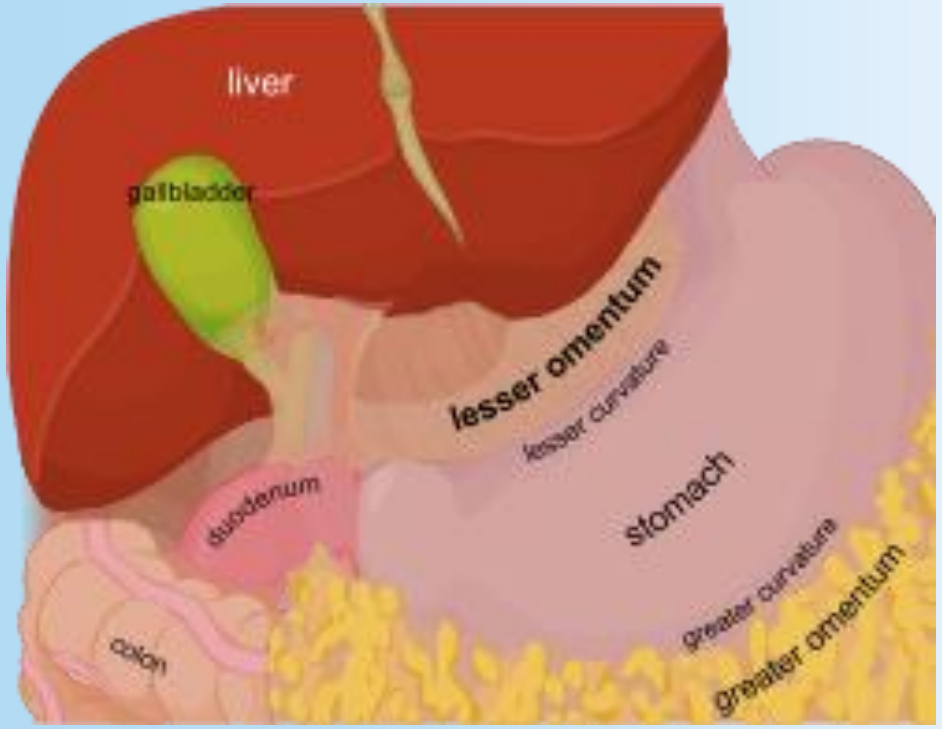


Omentum = “Apron” in latin

Lesser omentum

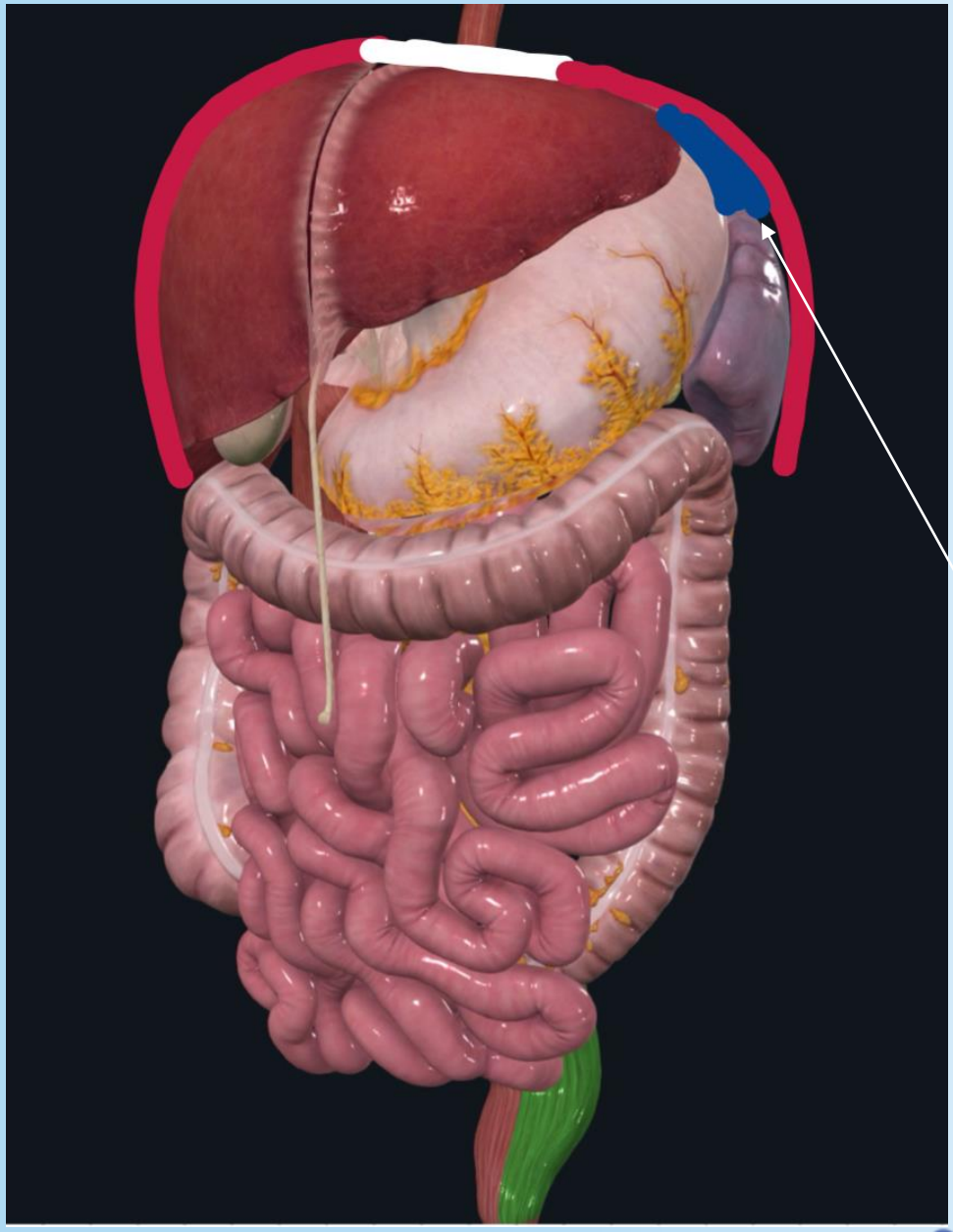
- Originate between LESSER curvature of stomach and liver
- Contain
  - Hepatogastric ligament
    - Contain all gastric vessels
  - Hepatoduodenal ligament

- Hepatoduodenal ligament contain
  - Hepatic portal vein
  - Proper hepatic artery
  - Common bile duct
  - Hepatic plexus

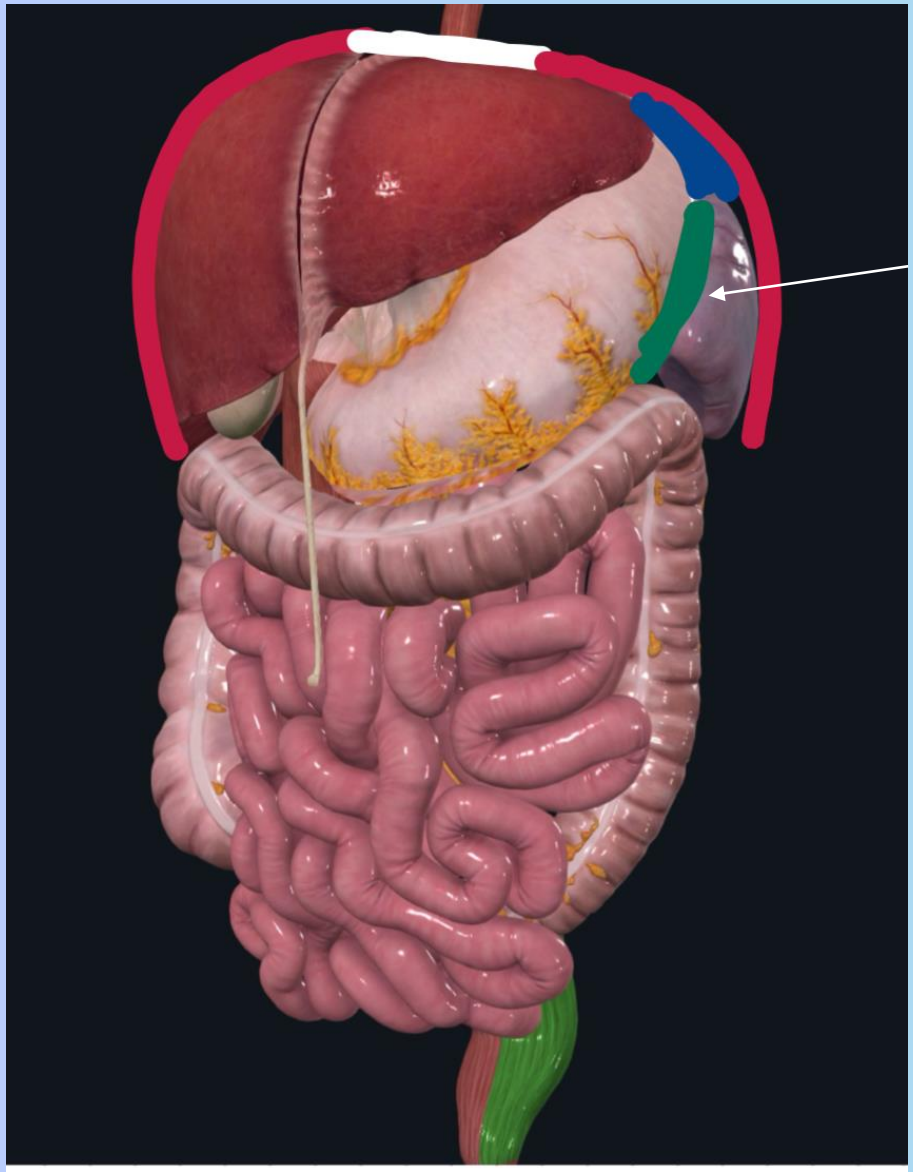


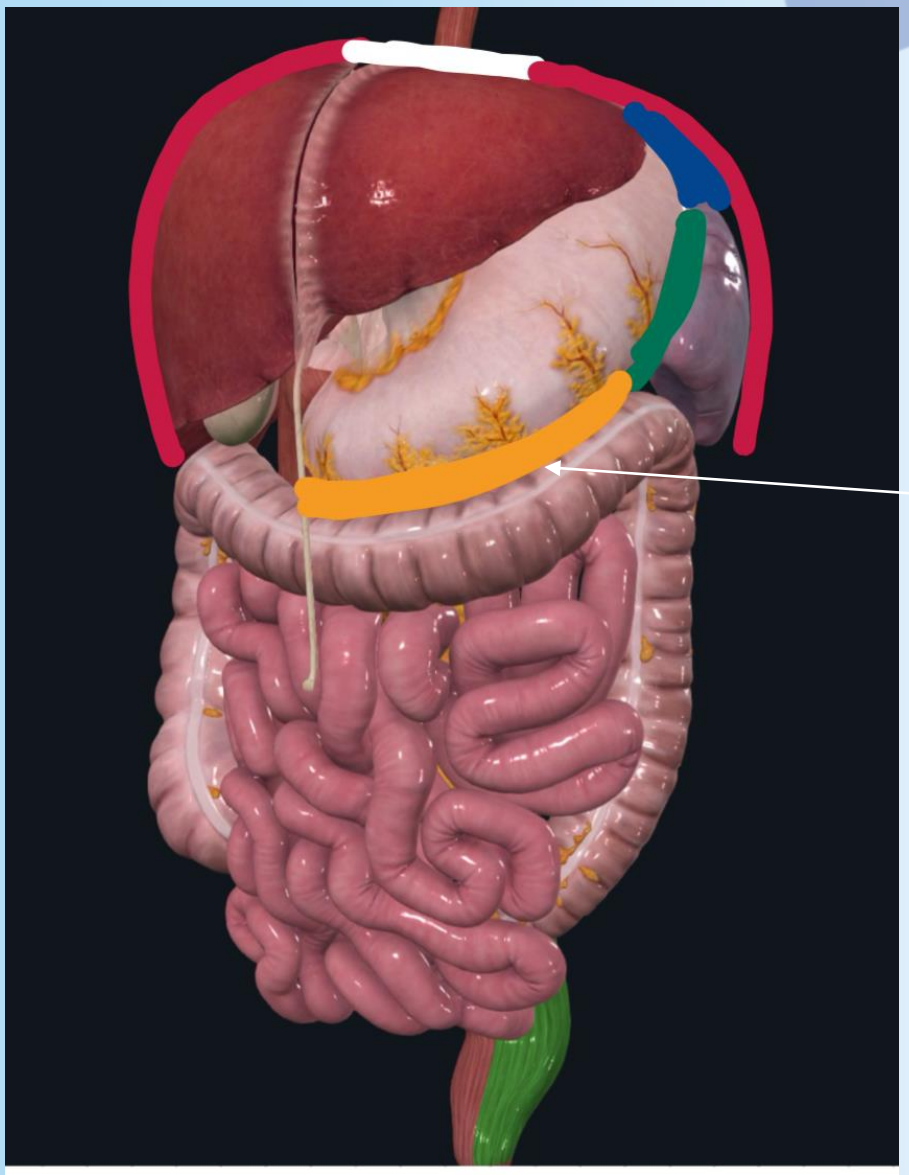
Greater omentum

- Originate from the GREATER curvature of stomach
- Consist of
  - Gastrophrenic ligament
  - Gastrosplenic ligament
  - Gastrocolic ligament
    - Gastroomental vessels
  - Omental apron (epiploe)



Gastrophrenic ligament

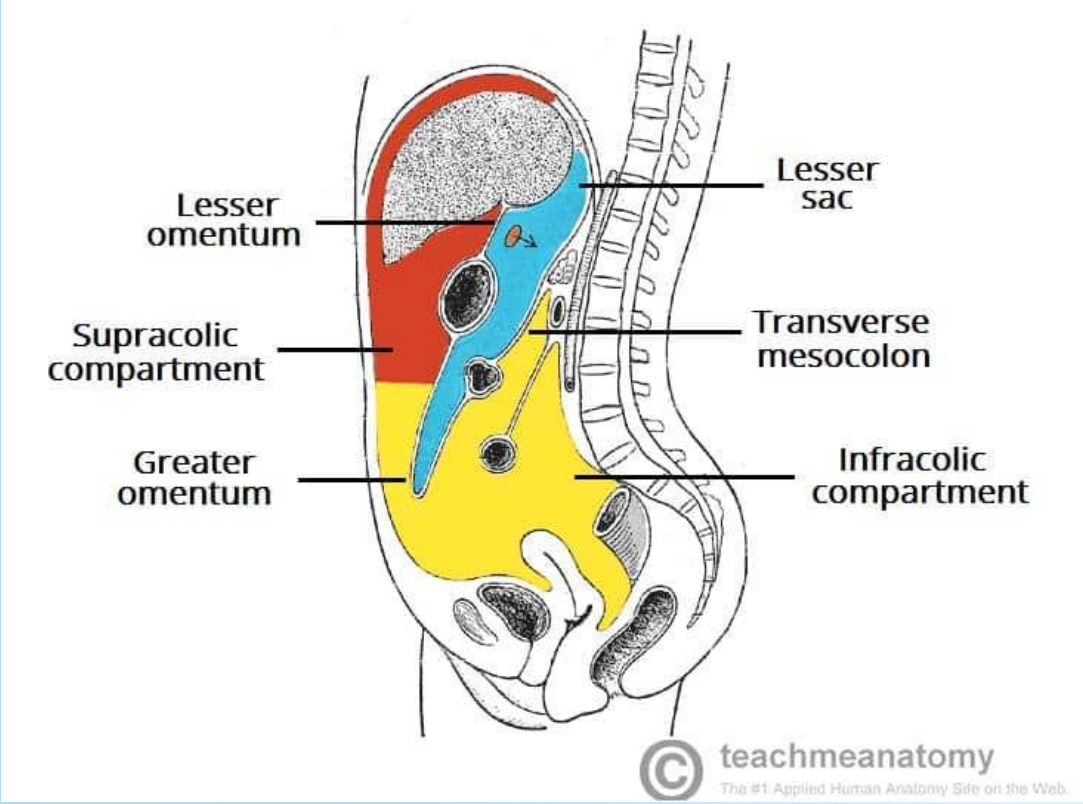




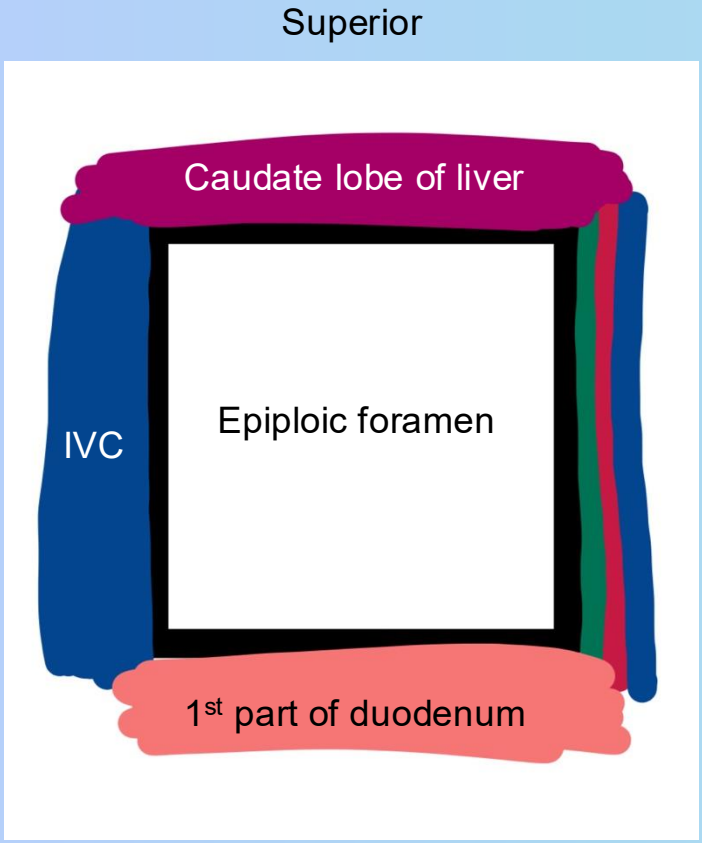
Greater and lesser sac

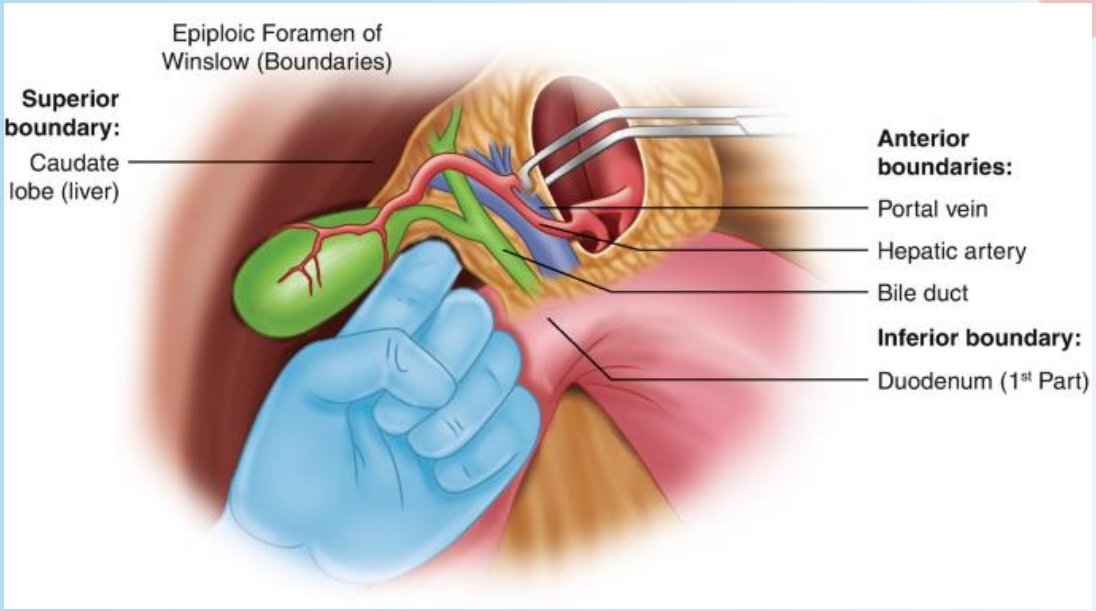
- Two compartments within the peritoneal cavity
- Connected only by the epiploic foramen
- Greater sac
  - Supracolic compartment
  - Infracolic Compartment

- UWAGA:
  - Lesser sac also called **<u>omental bursa</u>**



Epiploic (omental) foramen (of Winslow)





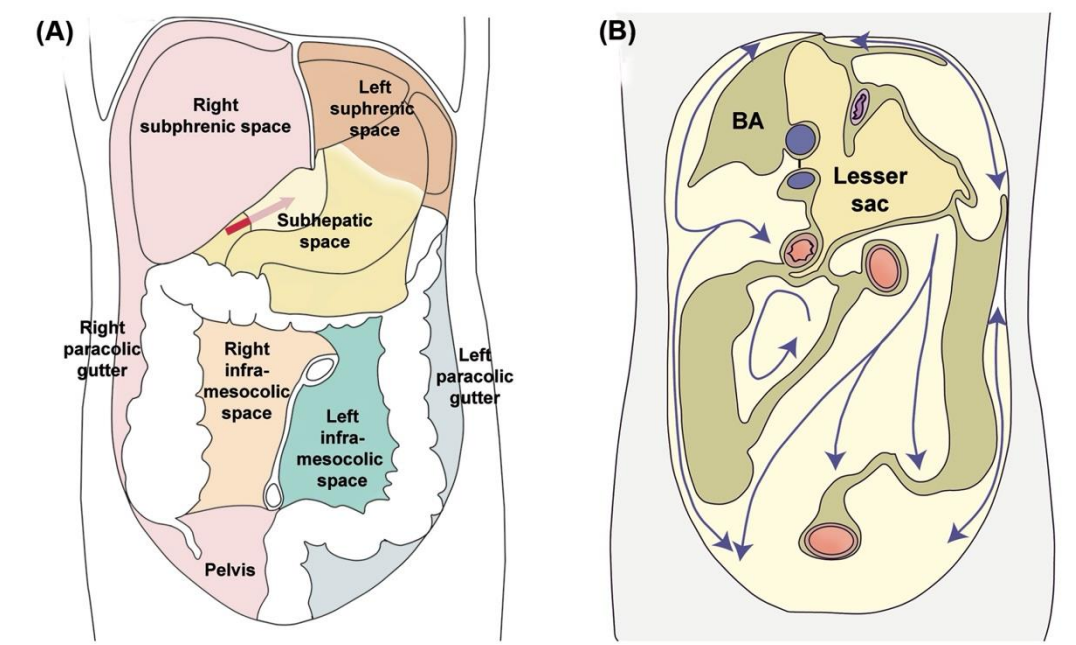
UWAGA: Hepatoduodenal ligament also contain: **Hepatic plexus**

Peritoneal gutters

- Hypothetical spaces which exist if filled with fluid
- Circulate serous fluid

- Right and left paracolic gutter
- Right and left paramesenteric gutter

- Hepatorenal recess
- Duodenal recesses



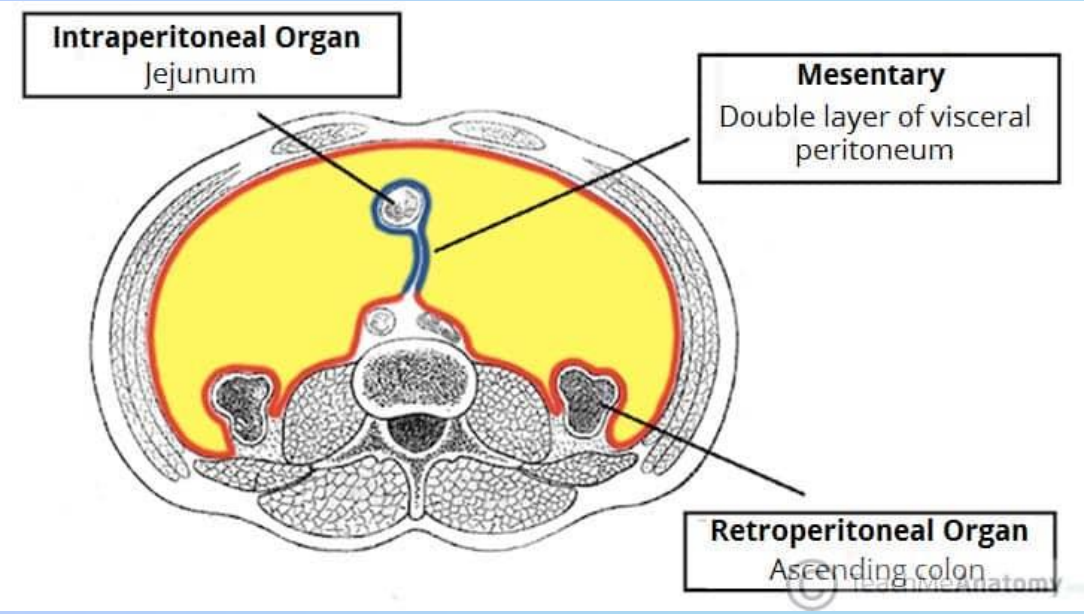
UWAGA: The paracolic gutter have multiple names e.g. paramesenteric recess and infracolic spaces

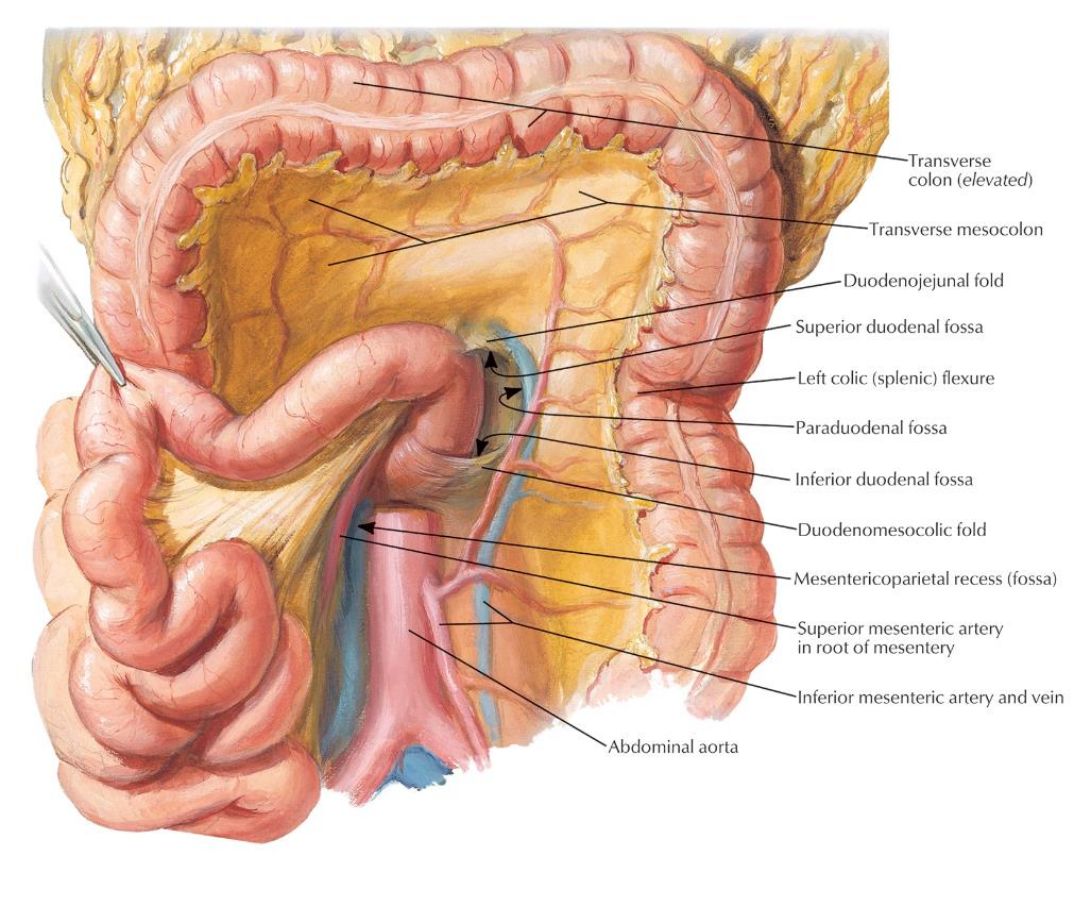
Mesentery

1. Mesentery proper
    - Origins from the mesenteric root at L2
    - Supply small intestines
2. Mesocolon
    - Transverse mesocolon
    - Sigmoid mesocolon
    - Mesorectum
    - Mesoappendix

- Function
    - Anchor viscera to the posterior abdominal wall
    - Contain blood vessels, nerves and lymph
    - Fat storage
    - Provide mobility to mobile parts of digestive tract

- All structures connected with mesentery are <u>intraperitoneal</u>


Intraperitoneal Organ
Jejunum
Mesentary
Double layer of visceral peritoneum
Retroperitoneal Organ
Ascending colon


Transverse colon (elevated)
Transverse mesocolon
Duodenojejunal fold
Superior duodenal fossa
Left colic (splenic) flexure
Paraduodenal fossa
Inferior duodenal fossa
Duodenomesocolic fold
Mesentericoparietal recess (fossa)
Superior mesenteric artery in root of mesentery
Inferior mesenteric artery and vein
Abdominal aorta

Dorsal and ventral mesenteries

GG has called these the POSTERIOR and ANTERIOR mesenteries on tests!

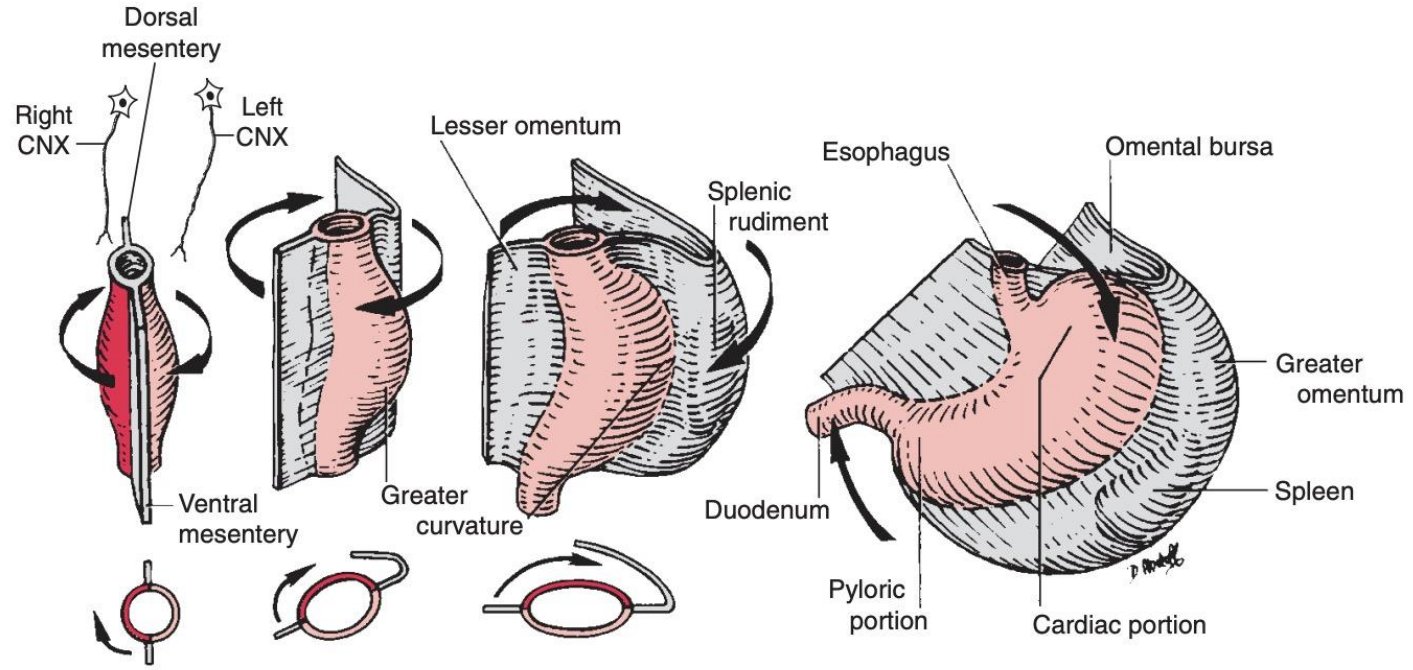


FIGURE 10.7. Diagram depicting the development and 90° rotation of the stomach from week 4 through week 6. CNX = cranial nerve X.

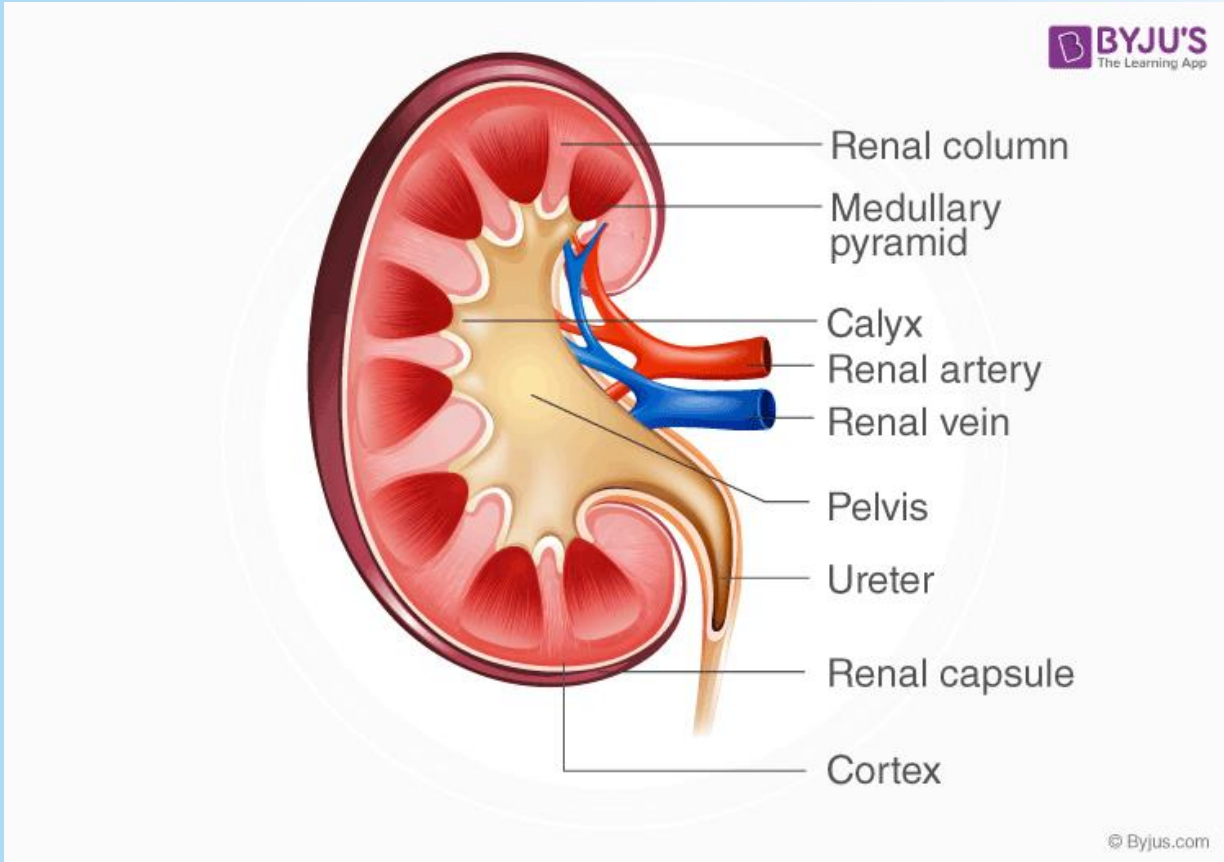
- Dorsal/posterior mesentery = GREATER OMENTUM + ALL MESENTERIES
- Ventral/anterior mesentery = LESSER OMENTUM + LIVER LIGAMENTS

table 10.1 Derivation of Adult Mesenteries

Embryonic Mesentery	Adult Mesentery
Ventral	Lesser omentum (hepatoduodenal and hepatogastric ligaments), falciform ligament of liver, coronary ligament of liver, triangular ligament of liver
Dorsal	Greater omentum (gastrorenal, gastrosplenic, gastrocolic, and splenorenal ligaments), mesentery of small intestine, mesoappendix, transverse mesocolon, sigmoid mesocolon

Kidney Embryology

- Consist of two parts
  - Excretory
    - Nephron/glomerulus
    - Collecting tubule
  - Collecting
    - Collecting duct
    - Calyxes
    - Pelvis
    - Ureters



Pro Tip: “Urinary System” Chapter in BRS Embryology is short and very informative/high yeald

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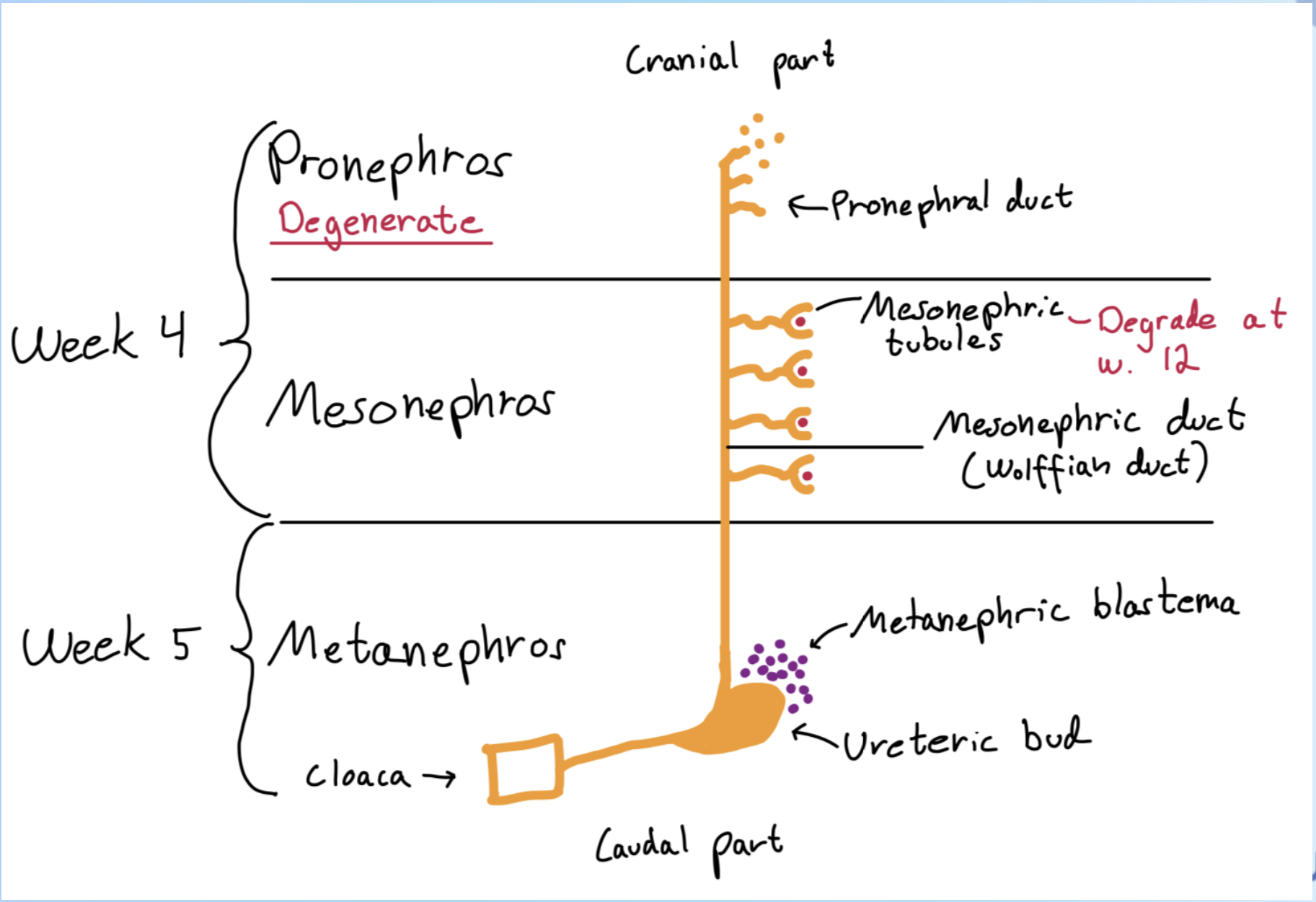
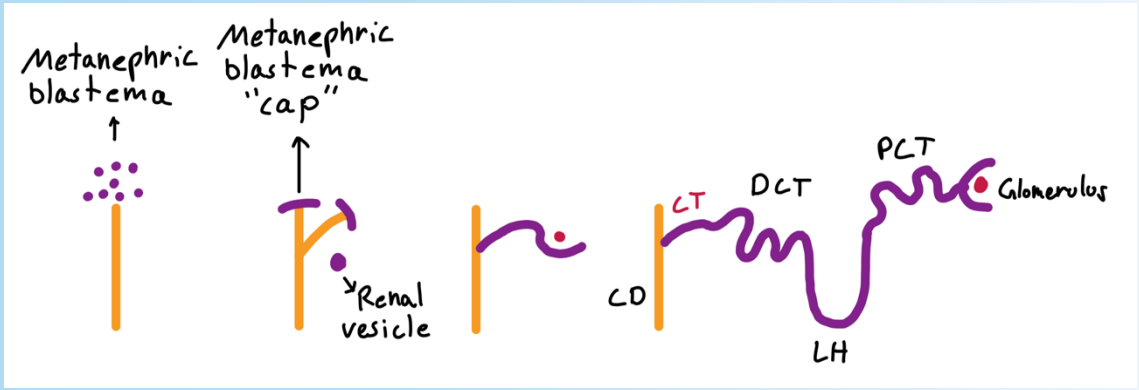
Development



Key points

- Ureteric bud = Collective kidneys
- Metanephric blastema = Excretory kidneys



- Pronephros becomes NOTHING
- Mesonephros = Gonads
- Mesonephric duct (Wolffian Duct) = Gartner cyst
- Metanephros = Kidneys

PCT = Proximal convoluted tubule, LH = Loop of Henle, DCT = Distal convoluted tubule, CT = Collecting Tubule, CD = Collecting Duct

High yeald questions

2. A urachal cyst is a remnant of the

(A) urogenital sinus
(B) urogenital ridge
(C) cloaca
(D) allantois
(E) mesonephric duct

3. During surgery for a benign cyst on the kidney, the surgeon notes that the patient's right kidney has two ureters and two renal pelves. This malformation is

(A) an abnormal division of the pronephros
(B) an abnormal division of the mesonephros
(C) formation of an extra mass of intermediate mesoderm
(D) a premature division of the metanephric blastema
(E) a premature division of the ureteric bud

7. The proximal convoluted tubules of the definitive adult kidney are derived from the

(A) ureteric bud
(B) metanephric vesicle
(C) mesonephric duct
(D) mesonephric tubules
(E) pronephric tubules

Questions from BRS Embryology

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