DEVELOPMENT OF THE DIGESTIVE SYSTEM I:

FUCUS ON FOREGUT & MIDGUT DEVELOPMENT

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Intended Learning Outcome:

1. State the embryonic origin(s) of the gastrointestinal tract and its associated glands
2. Name the parts and state the derivatives of each part of the primordial gut
3. Outline the vascular territories of the GIT and state their embryological basis
4. Describe the development of the esophagus and stomach
5. Outline the stages of midgut development
6. Name and identify common congenital anomalies of foregut and midgut, and explain the embryological basis of each

INTRODUCTION

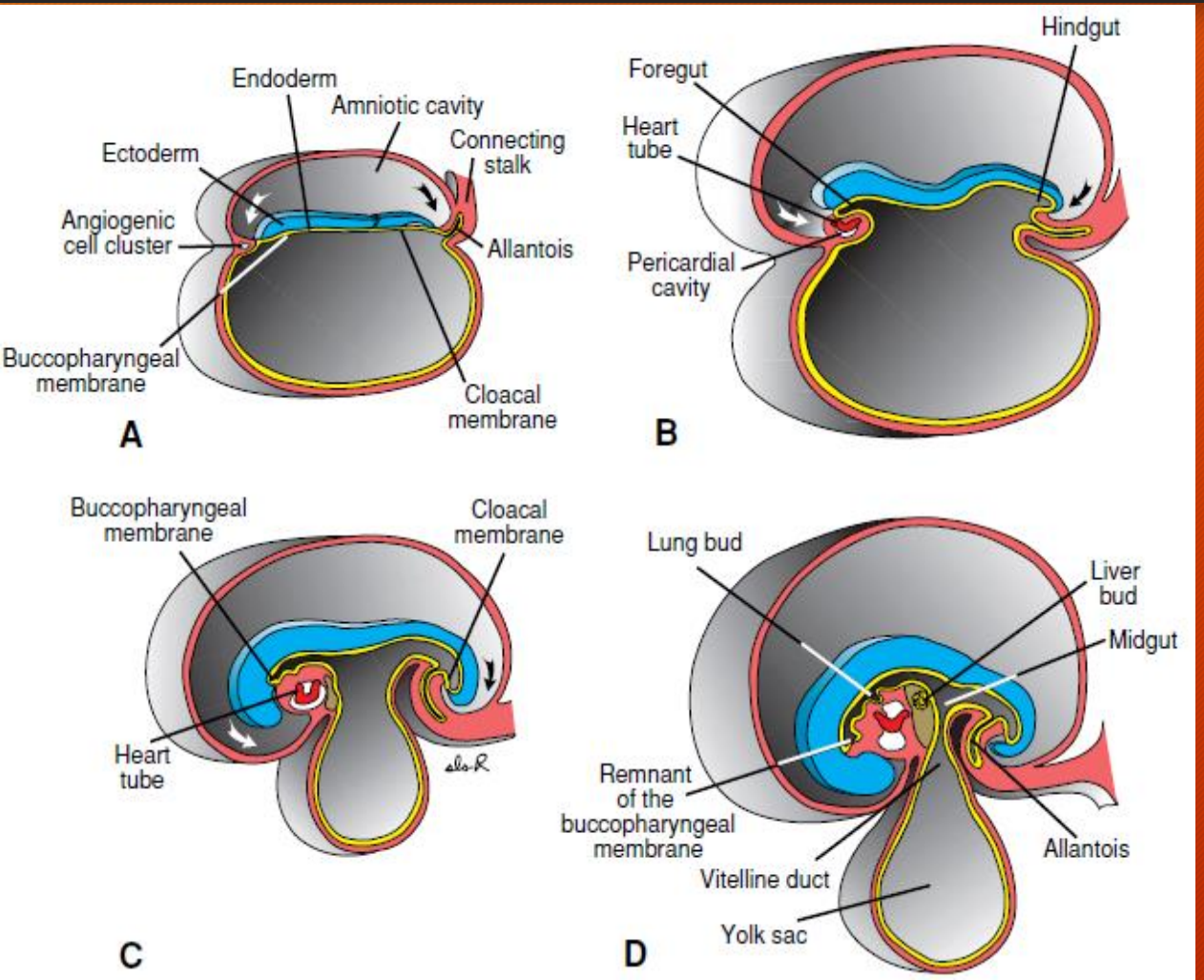
- The digestive system consists of the hollow GIT and the extrinsic glands
- Name the components of the hollow GIT in order
- Name the extrinsic glands of the digestive system
- The hollow GIT develops from the primordial gut, that forms during embryonic folding
- Extrinsic glands of the digestive system develop as diverticula from the developing gut, hence retain their connections with the GIT via their ducts

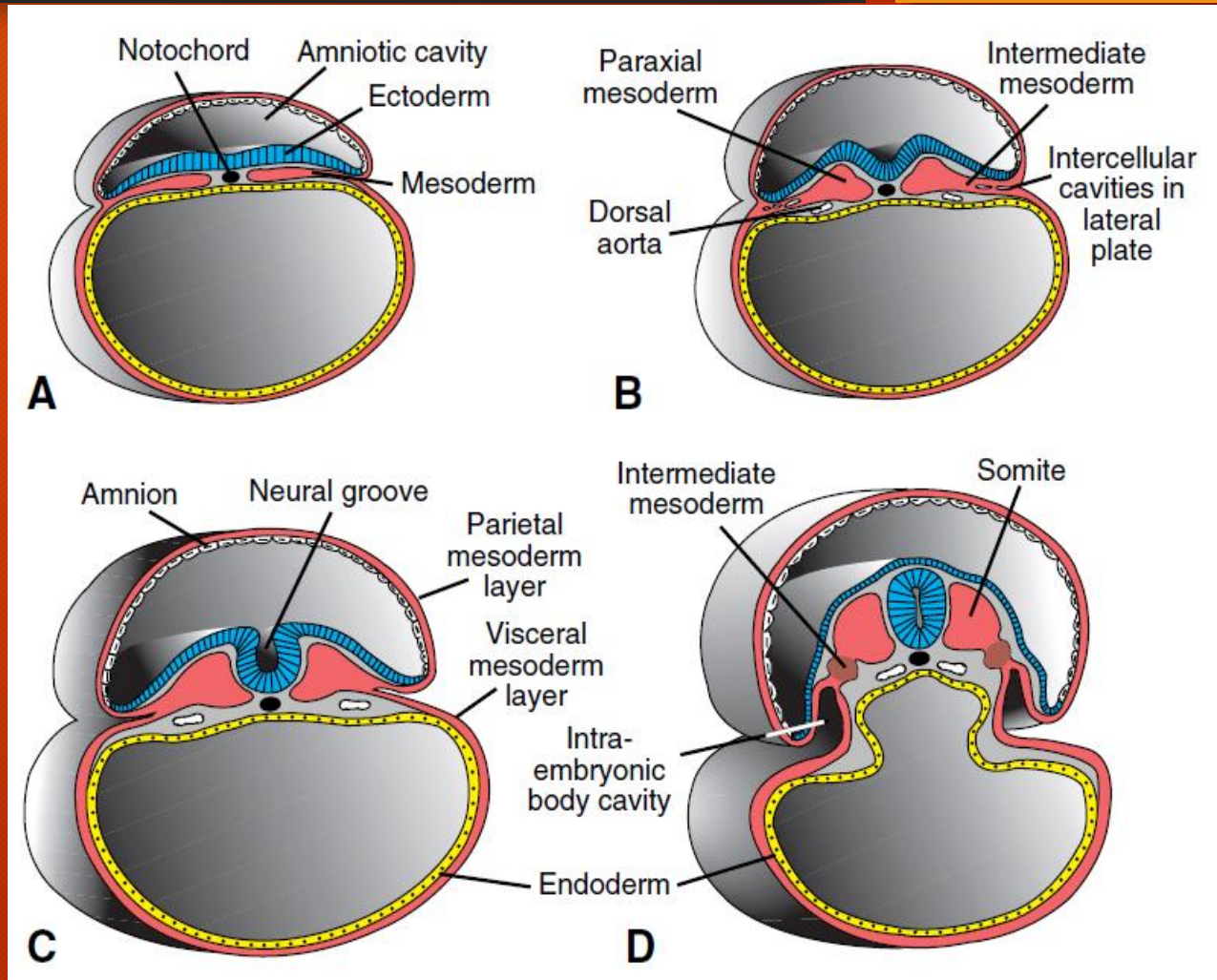
EMBRYONIC ORIGIN OF THE DIGESTIVE SYSTEM

- Viewed in the light of the alimentary canal (lumen), tissue components of the gut wall, and the glands (intrinsic and extrinsic)

- During embryonic folding, the dorsal part of the yolk sac is longitudinally incorporated into the embryo

EMBRYONIC ORIGIN OF THE DIGESTIVE SYSTEM





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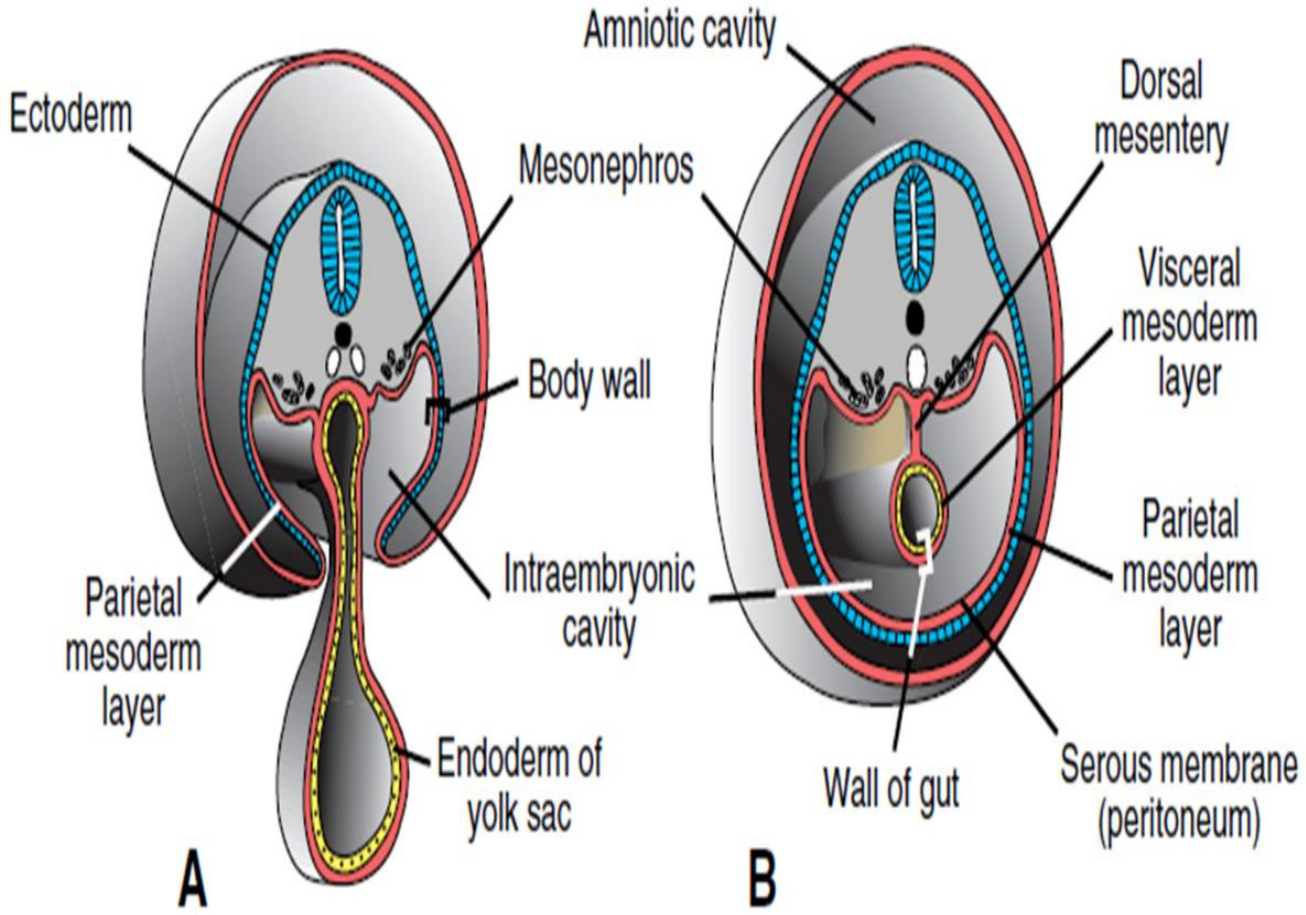
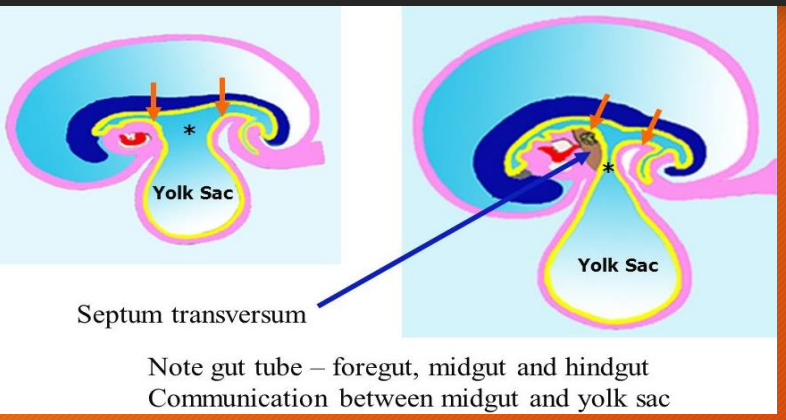
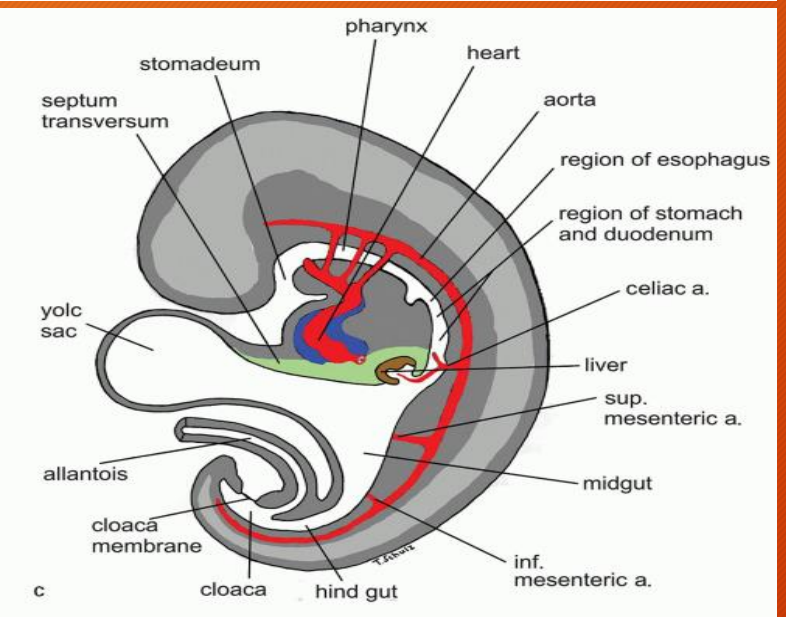


- Incorporated part yolk sac cavity forms the primordial gut
- Endoderm forms the epithelial lining and glands
- Splanchnic mesoderm forms connective tissue, muscular tissue and visceral peritoneum (+ mesentery)
- Neural crest cells form the enteric nervous system

PARTS & DERIVATIVES OF THE PRIMORDIAL GUT

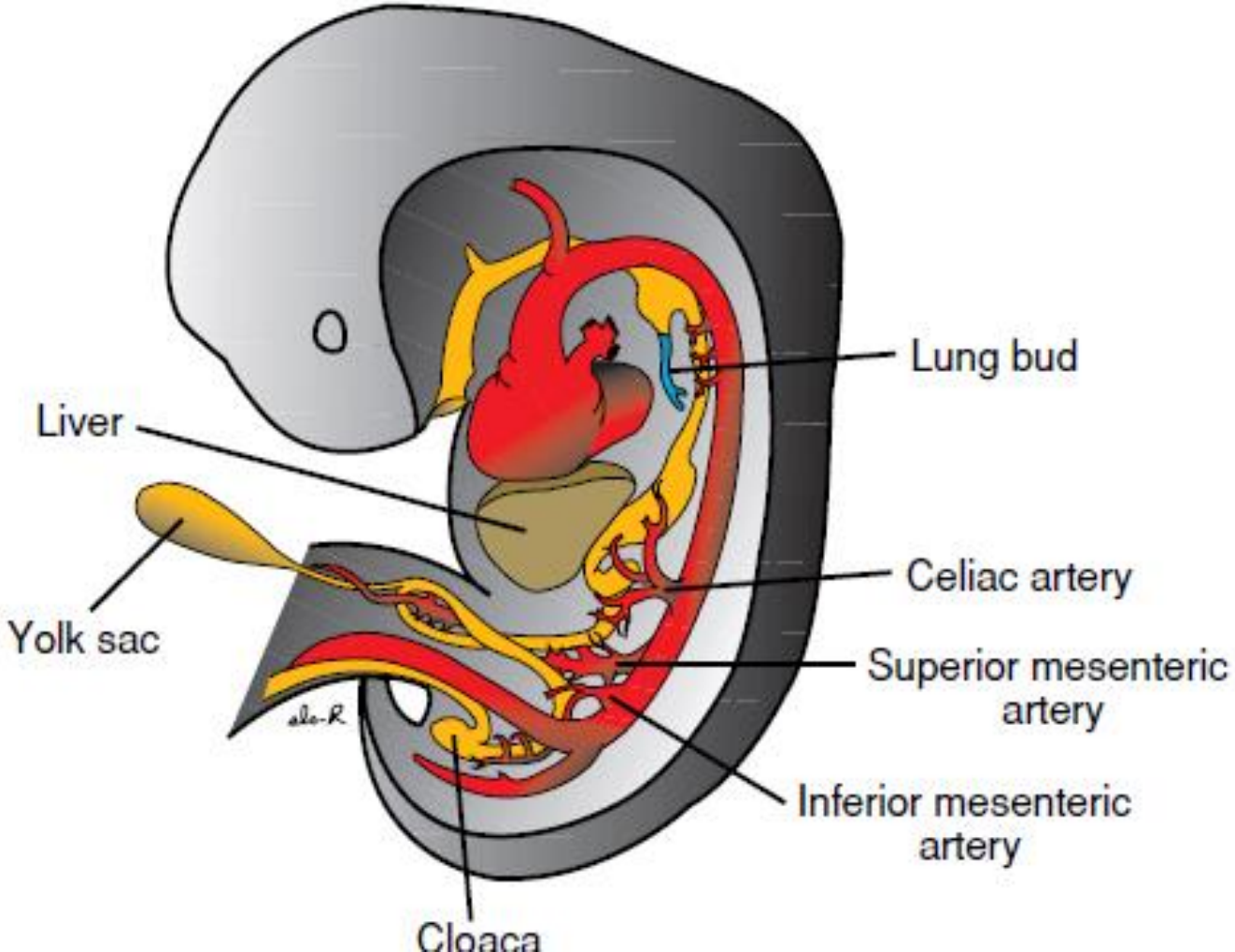


Note gut tube – foregut, midgut and hindgut
Communication between midgut and yolk sac



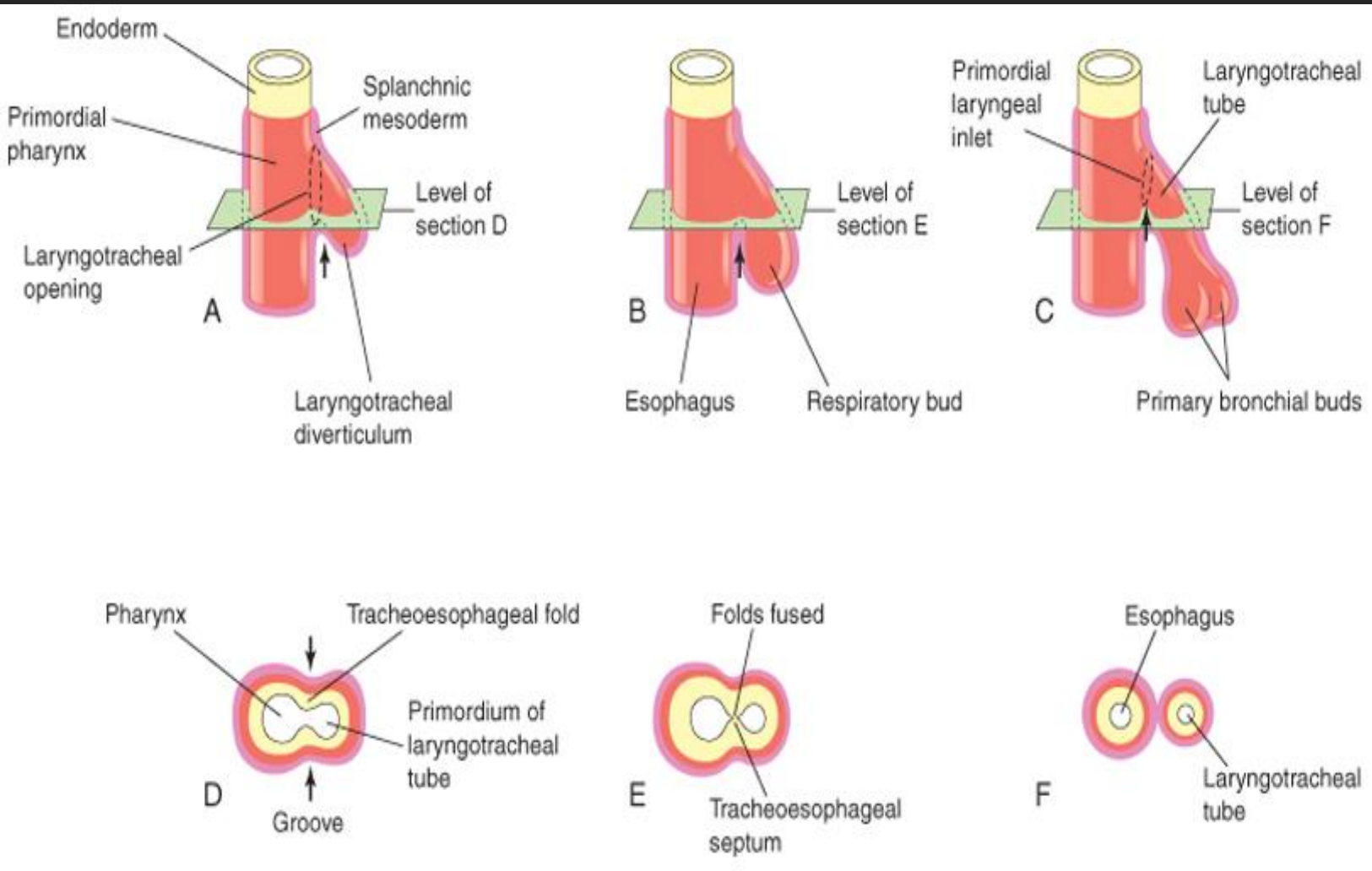
- Foregut - Pharynx to 2nd part of the duodenum
- Midgut – 2nd part of duodenum to ½ to 2/3 of T-Colon
- Midgut is connected to the yolk sac through the connecting stalk via the vitelline duct; degenerates
- Hindgut – T-Colon to the cloaca (anal tube)

VASCULAR TERRITORIES OF THE GUT



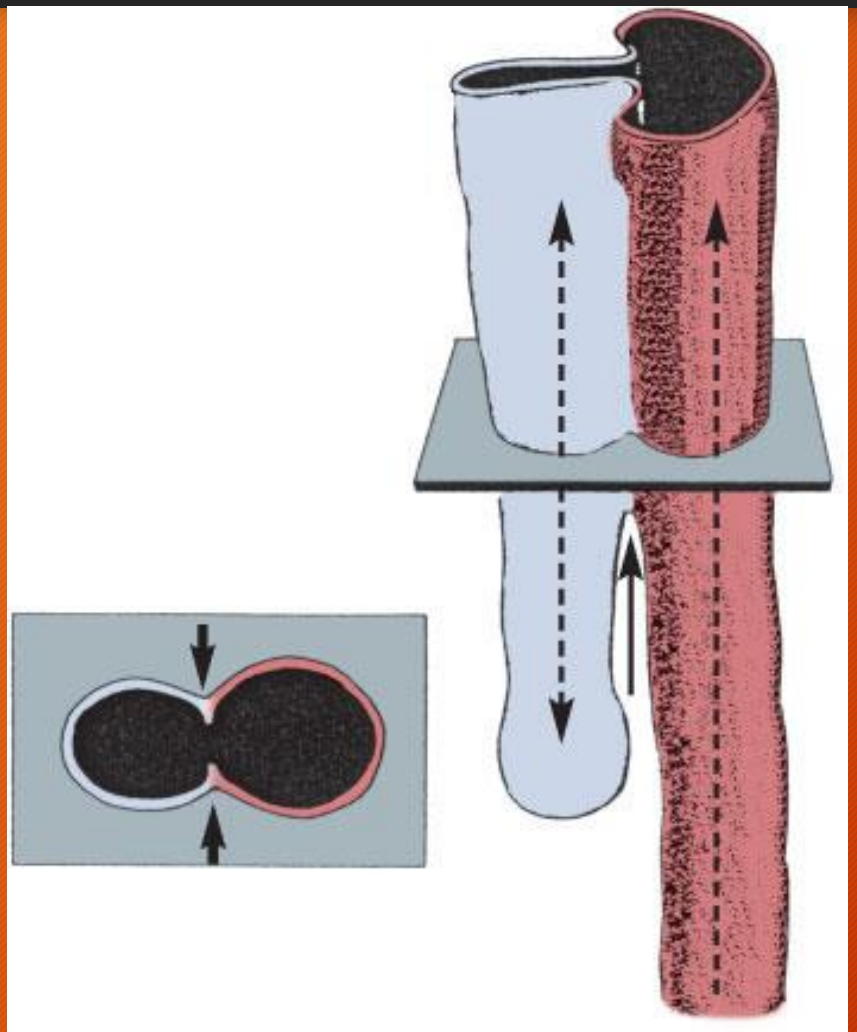
- Remnants of the primitive vitelline circulation to the yolk sac
- Pairs of arteries fuse, and their number reduced to three

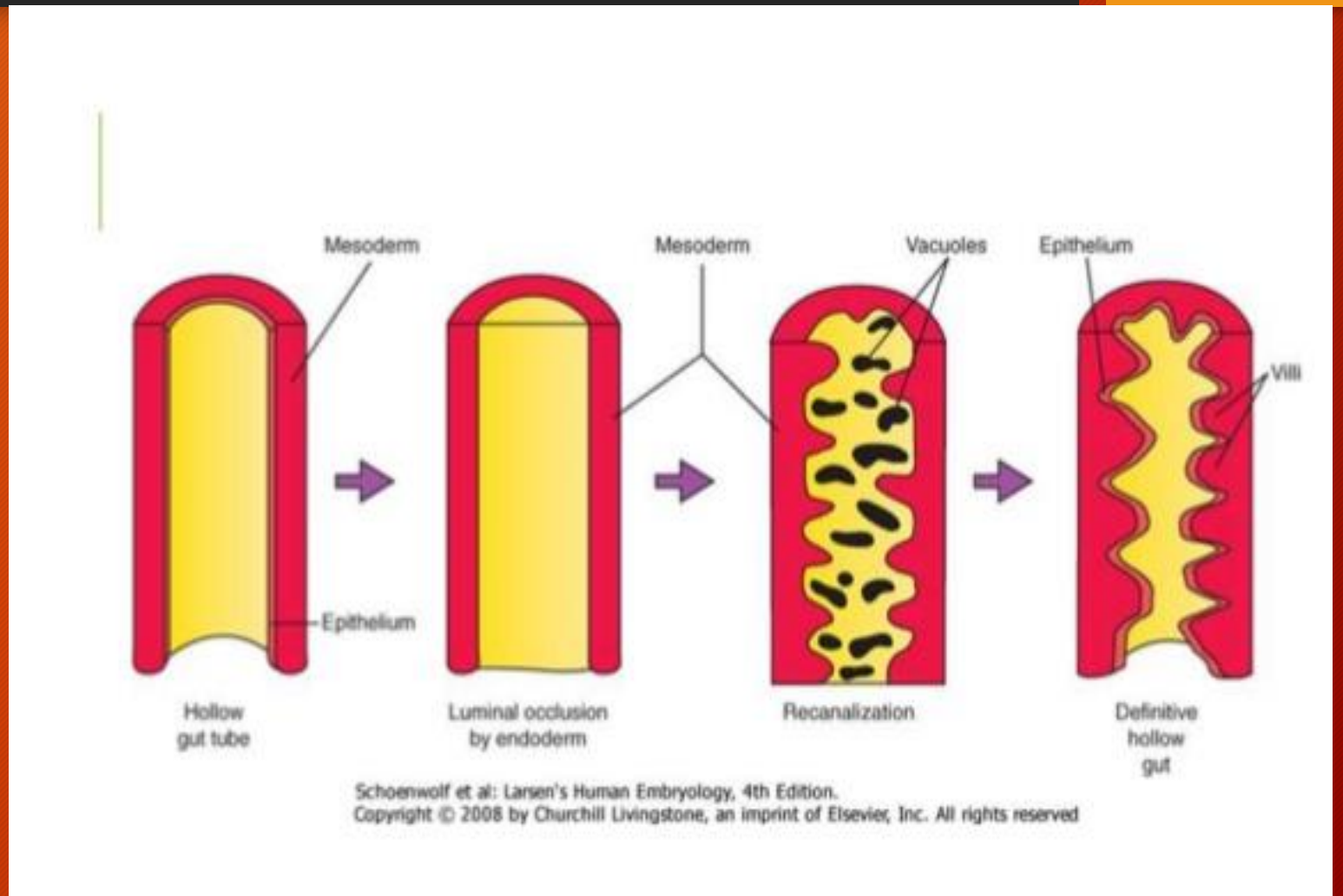
DEVELOPMENT OF THE ESOPHAGUS



- Origin (site and tissue elements)?
- Respiratory diverticulum
- Tracheoesopahgeal folds
- Tracheoesophageal septum
- Elongation
- “Solid stage”
- Recanalization

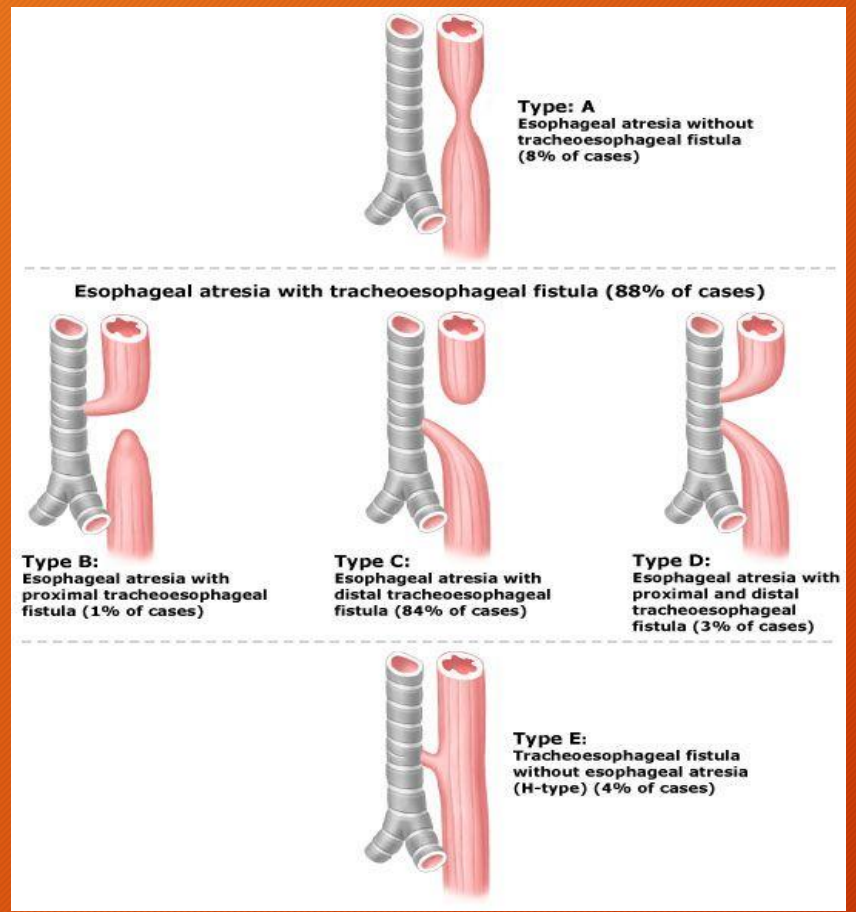
DEVELOPMENT OF THE ESOPHAGUS



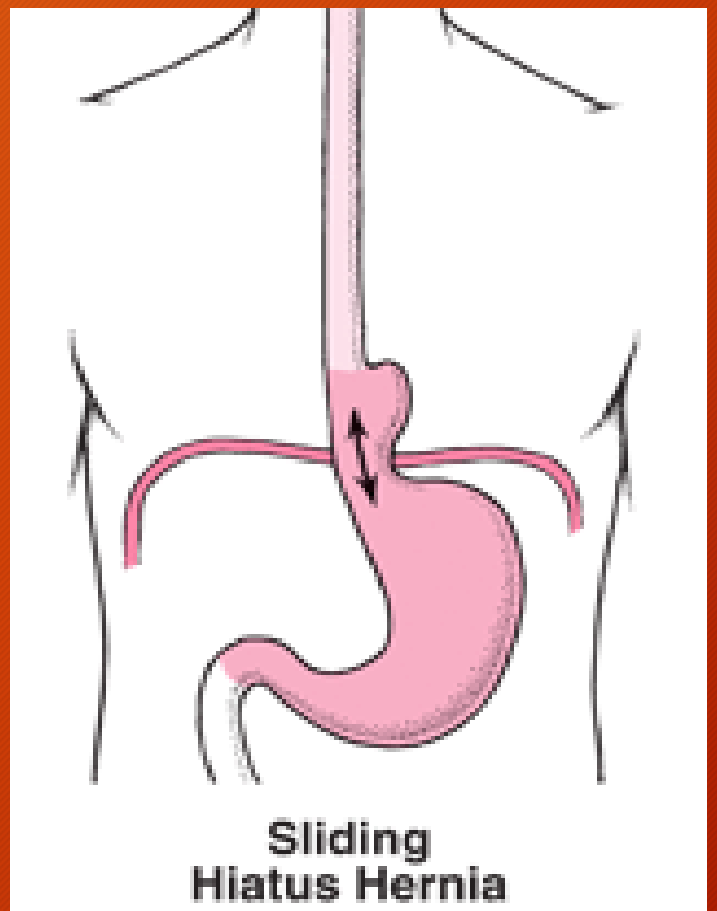


CONGENITAL ANOMALIES OF THE ESOPHAGUS

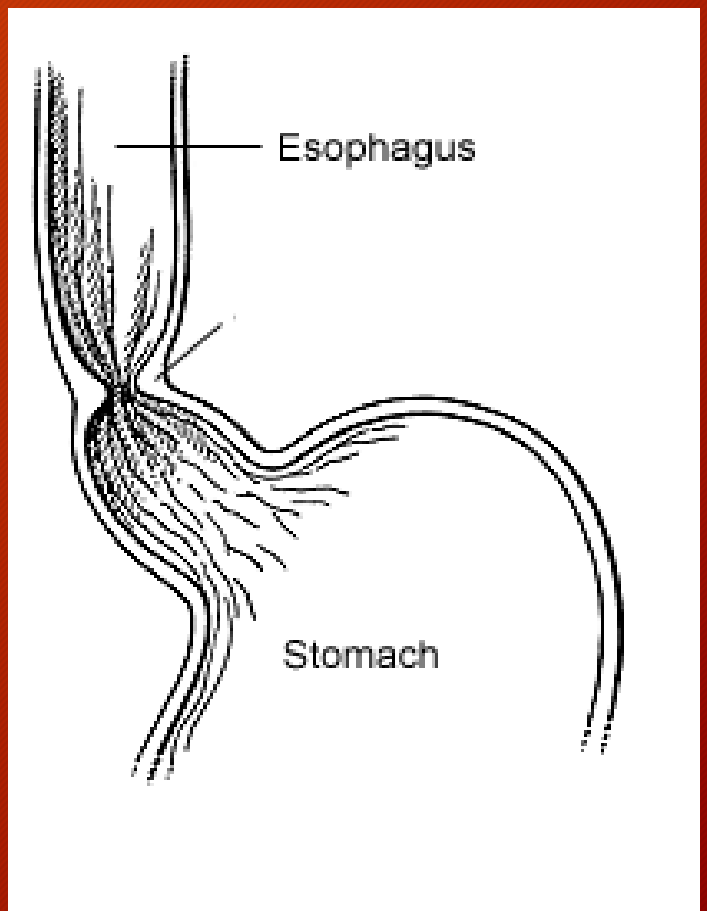
- Abnormal foregut septation



Inadequate elongation



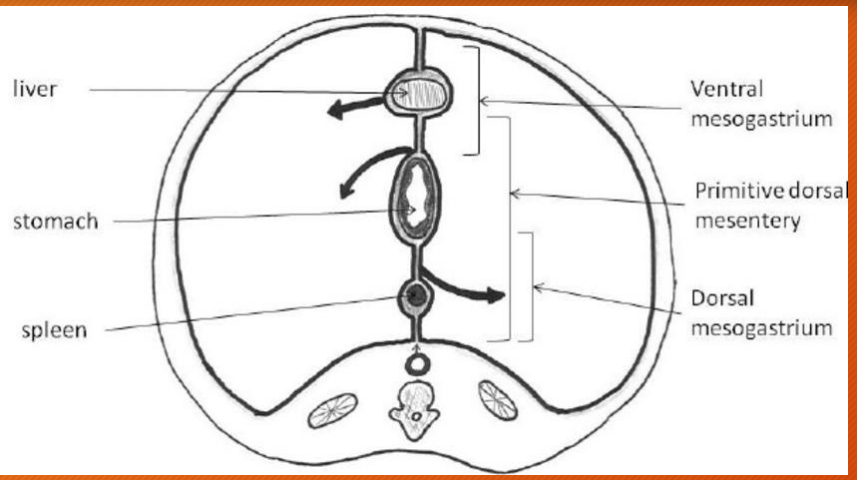
Defective recanalization

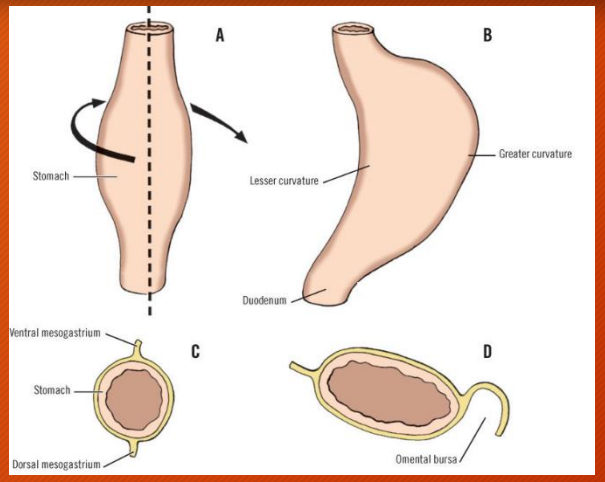


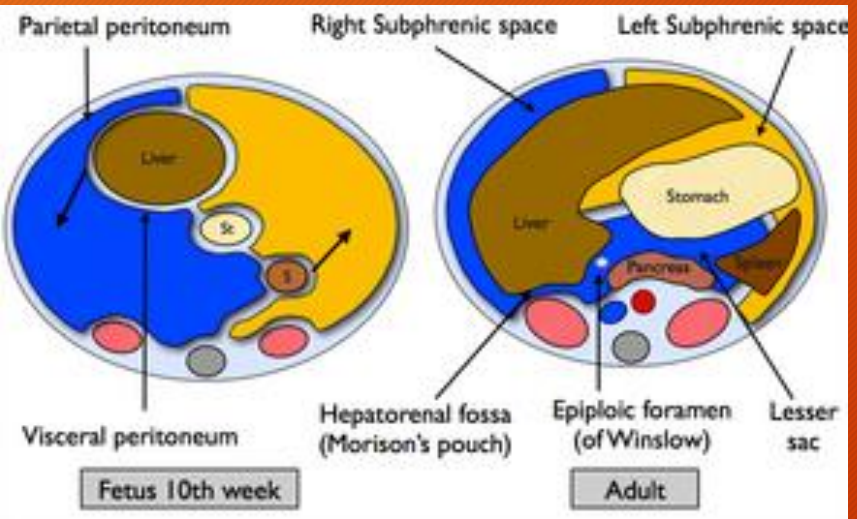
VACTERL ASSOCIATION OF ANOMALIES

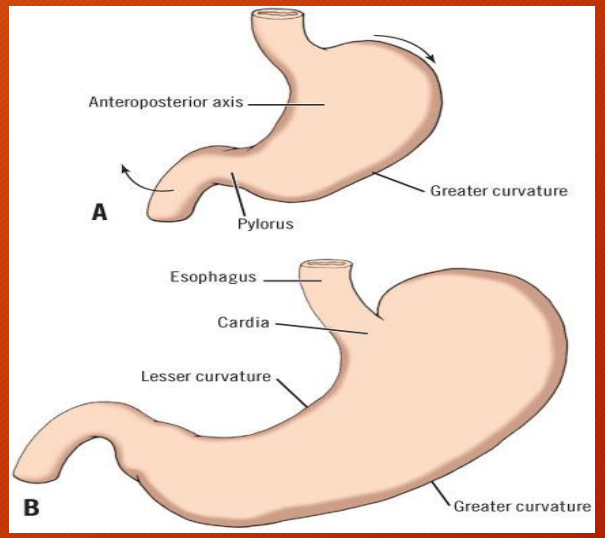
- Vertebral abnormalities
- Anal atresia
- Cardiac abnormalities
- Tracheoesophageal fistula and/or Esophageal atresia
- Renal agenesis and dysplasia
- Limb defects

DEVELOPMENT OF THE STOMACH



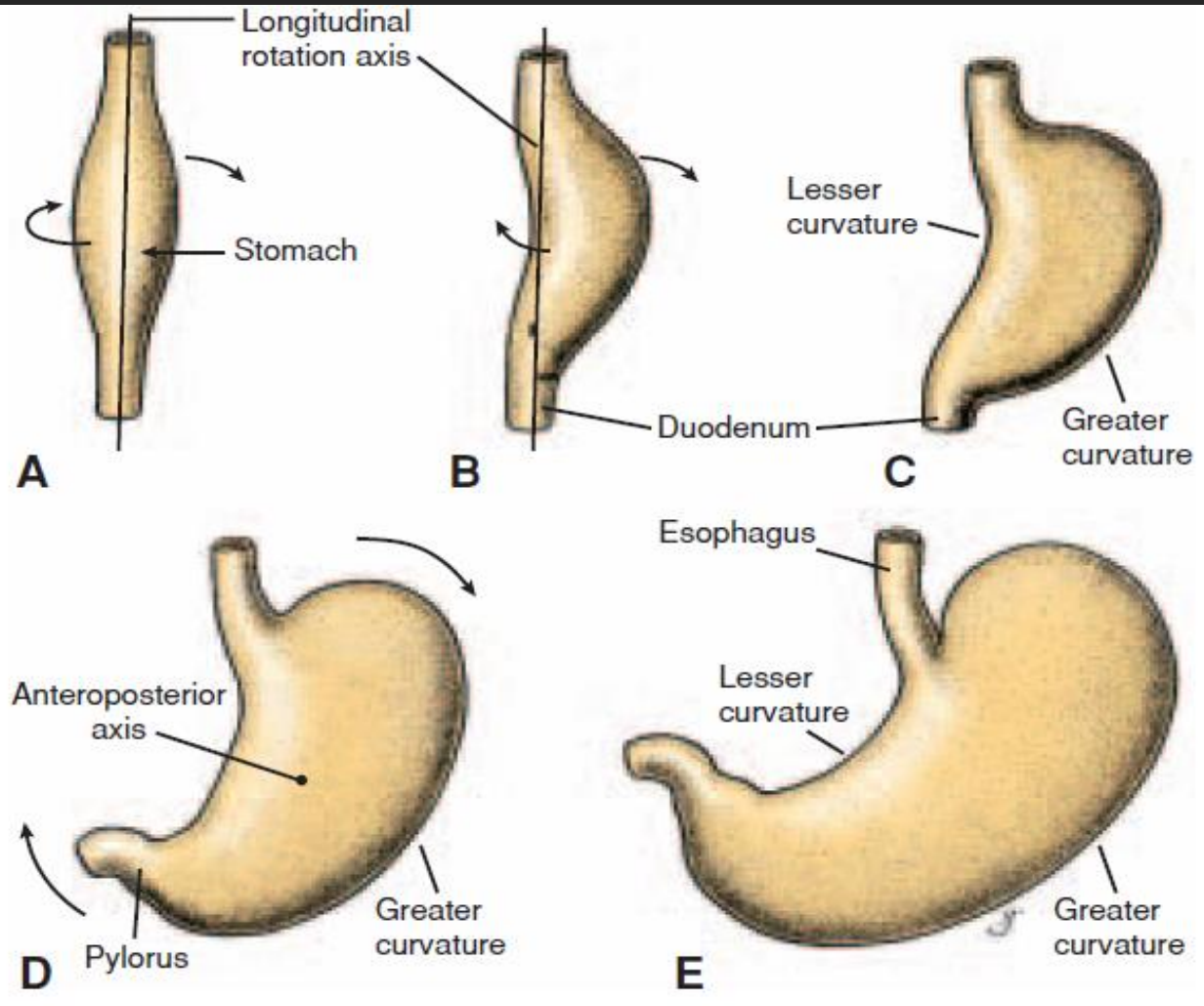






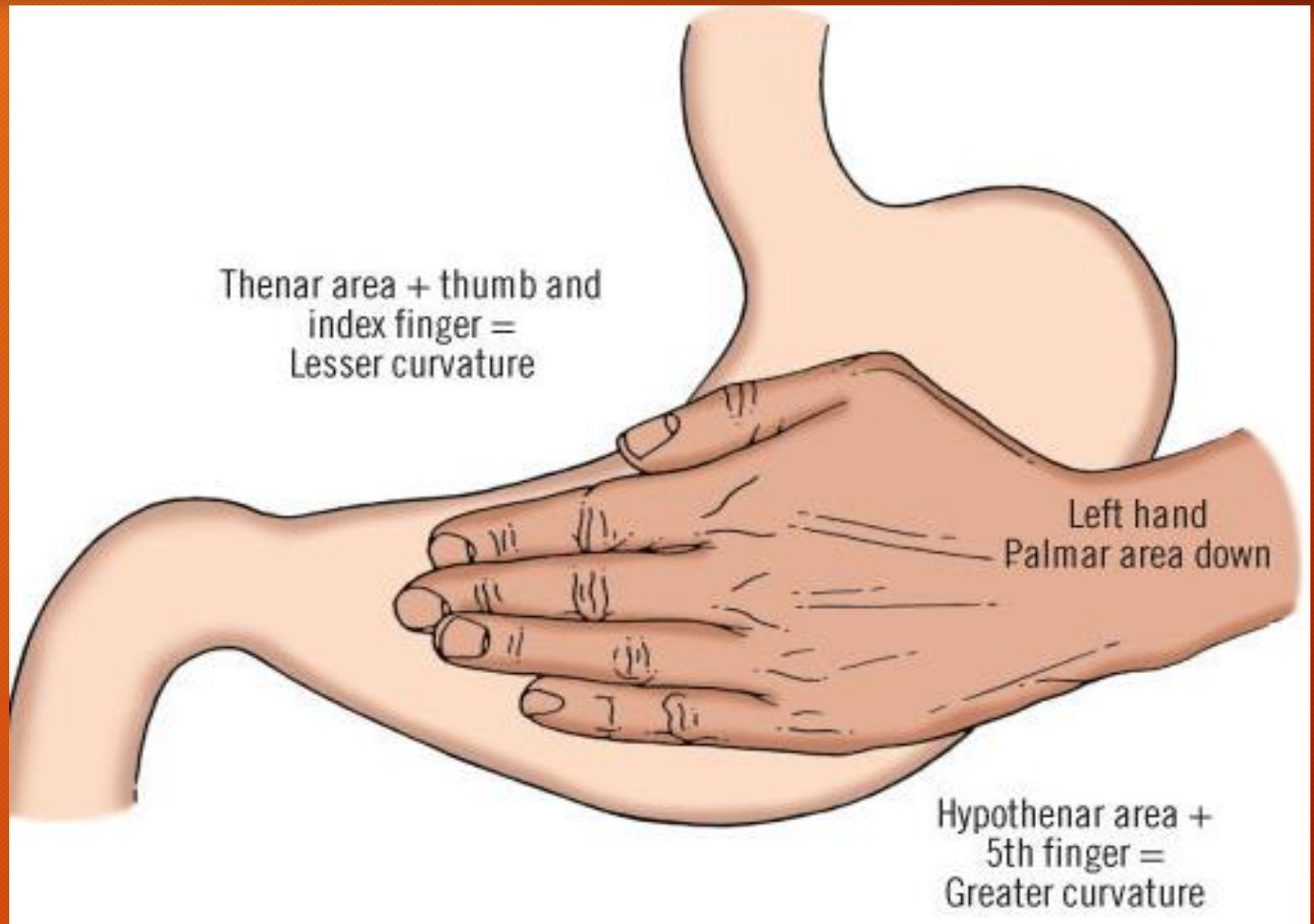
- Origin?
- Suspended by dorsal and ventral mesogastria
- Fusiform dilatation
- Differential growth
- Rotation in vertical axis
- Rotation in AP axis

RESULTS OF STOMACH "ROTATION"



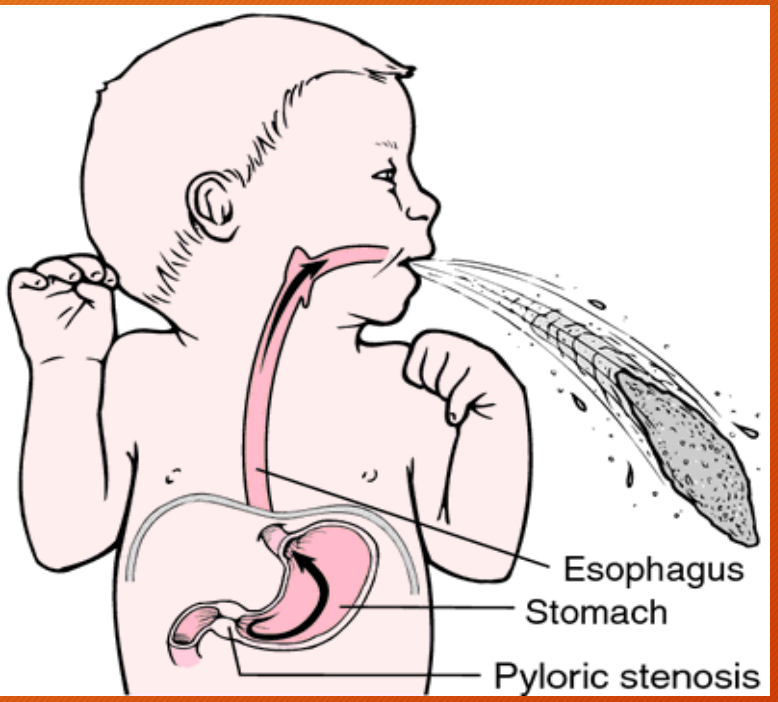
- Vertical axis: surfaces, curvatures, vagal nerves, mesogastria?
- Anteroposterior axis: pylorus, fundus, cardia, curvatures?

SUMMARY OF DEVELOPMENT OF THE STOMACH

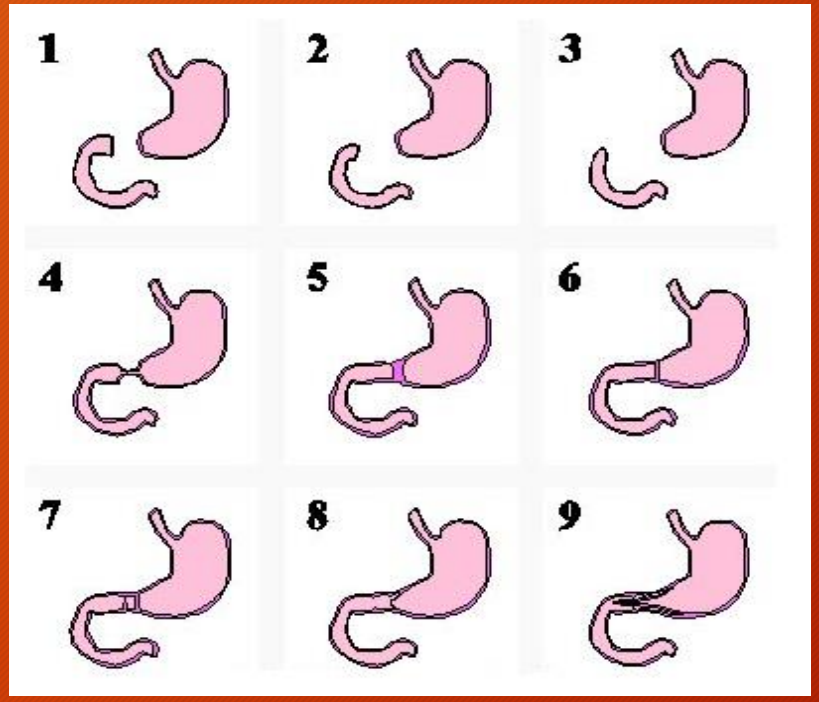


CONGENITAL ANOMALIES OF THE STOMACH

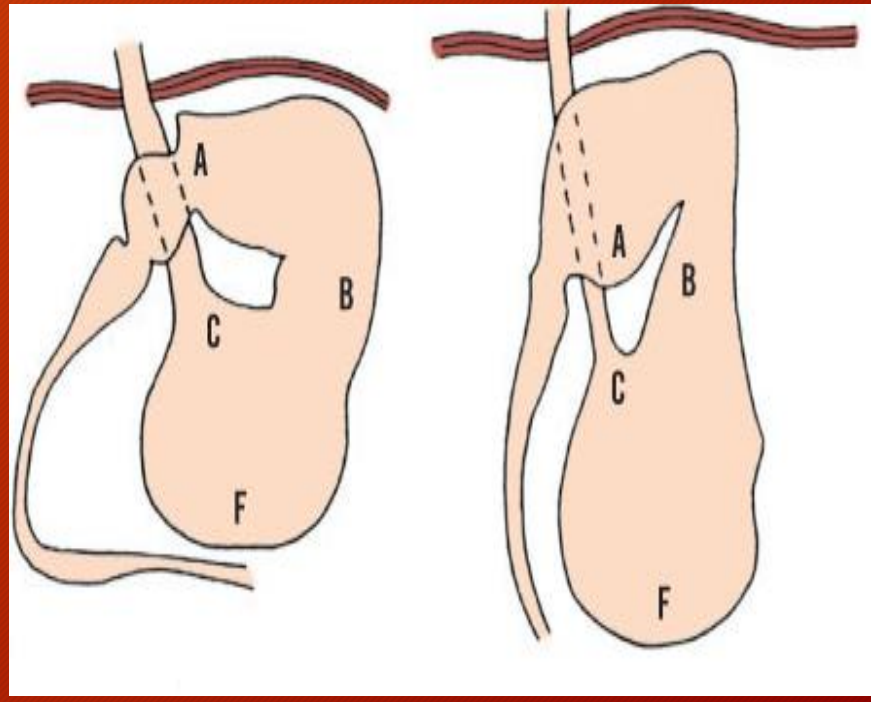
Congenital Hypertrophic Pyloric Stenosis



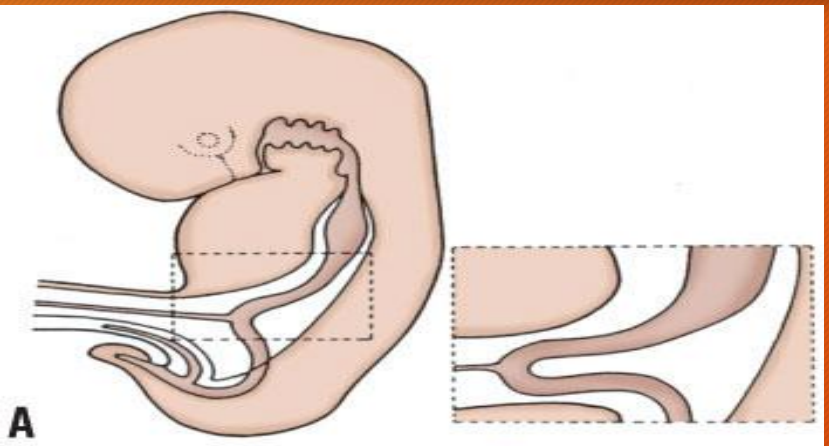
Gastric Atresia

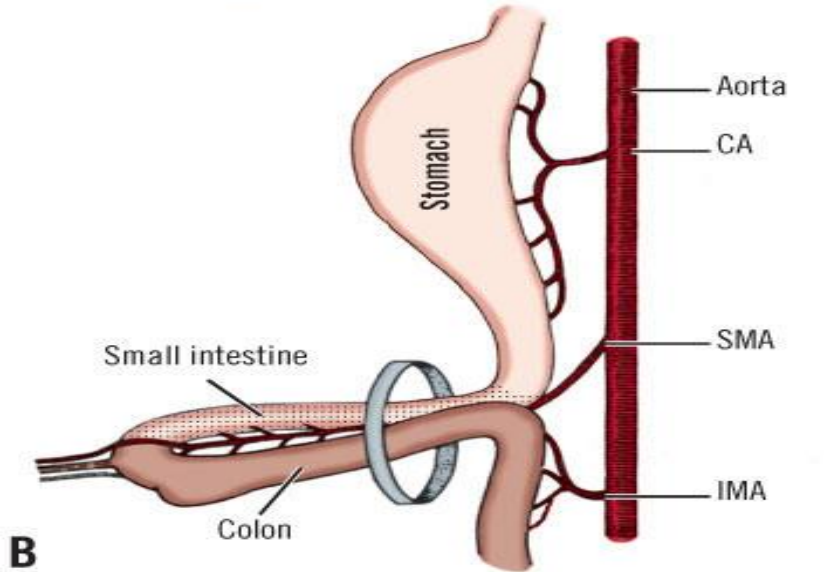


Gastric Inversion



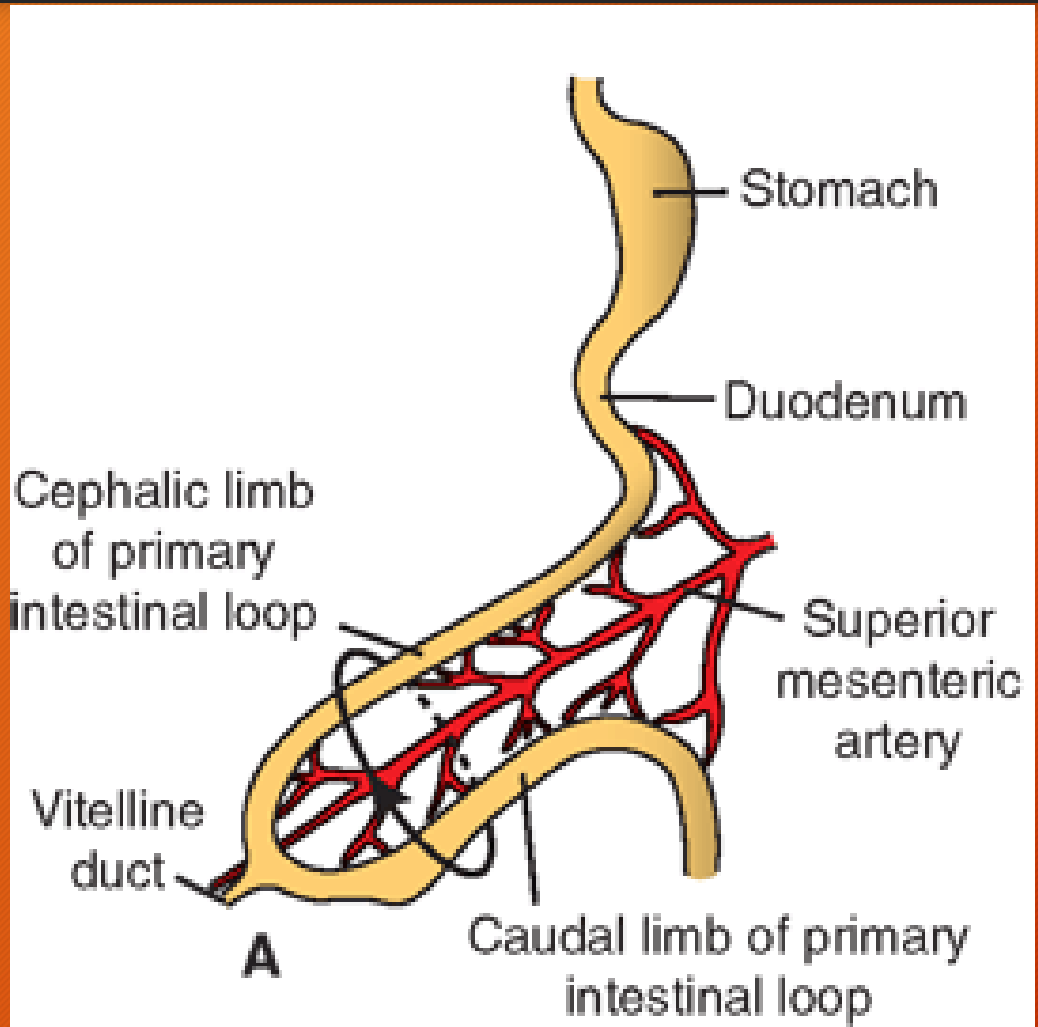
DEVELOPMETN OF THE MIDGUT





- From: Just distal to the ampulla of Vater (D2)
- To: Middle to 2/3 of the Transverse colon
- Components?
- Connected to yolk sac by the Vitelline duct at the level of the ileum
- Supplied by the superior mesenteric artery
- Events of midgut developemt are best described in stages/ sequences

STAGES OF MIDGUT DEVELOPMENT

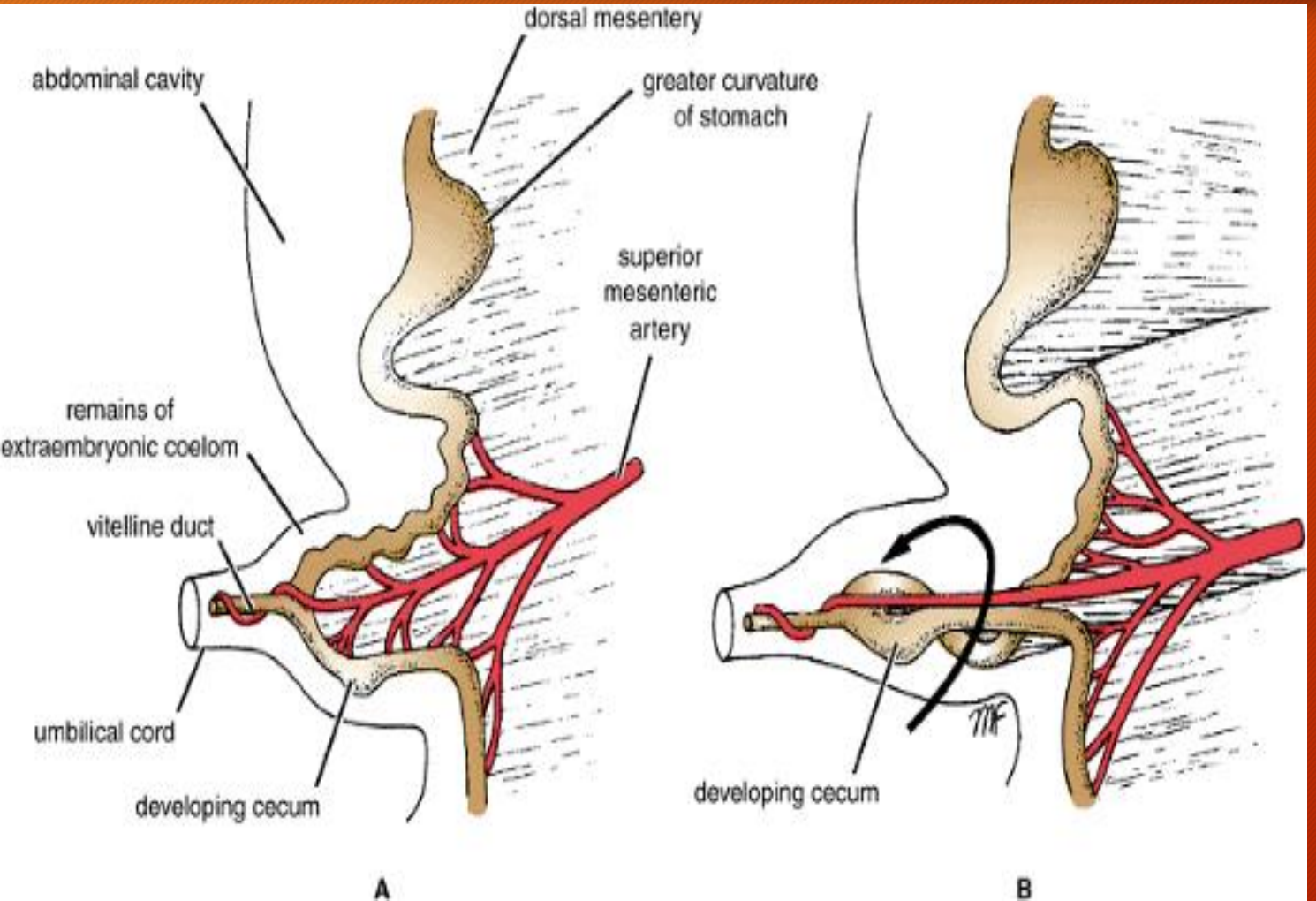


1. Rapid proliferation, causing elongation of the midgut
2. Formation of the primary intestinal loop (midgut loop)

Cephalic limb derivatives

Caudal limb derivatives

STAGES OF MIDGUT DEVELOPMENT

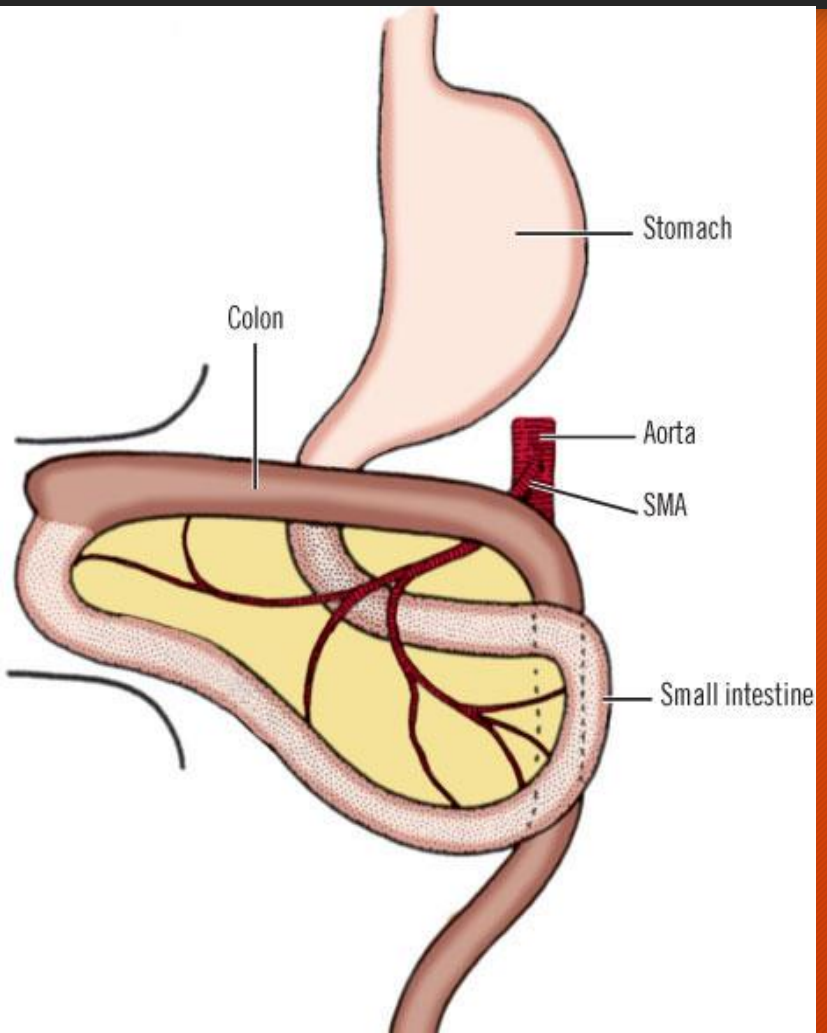


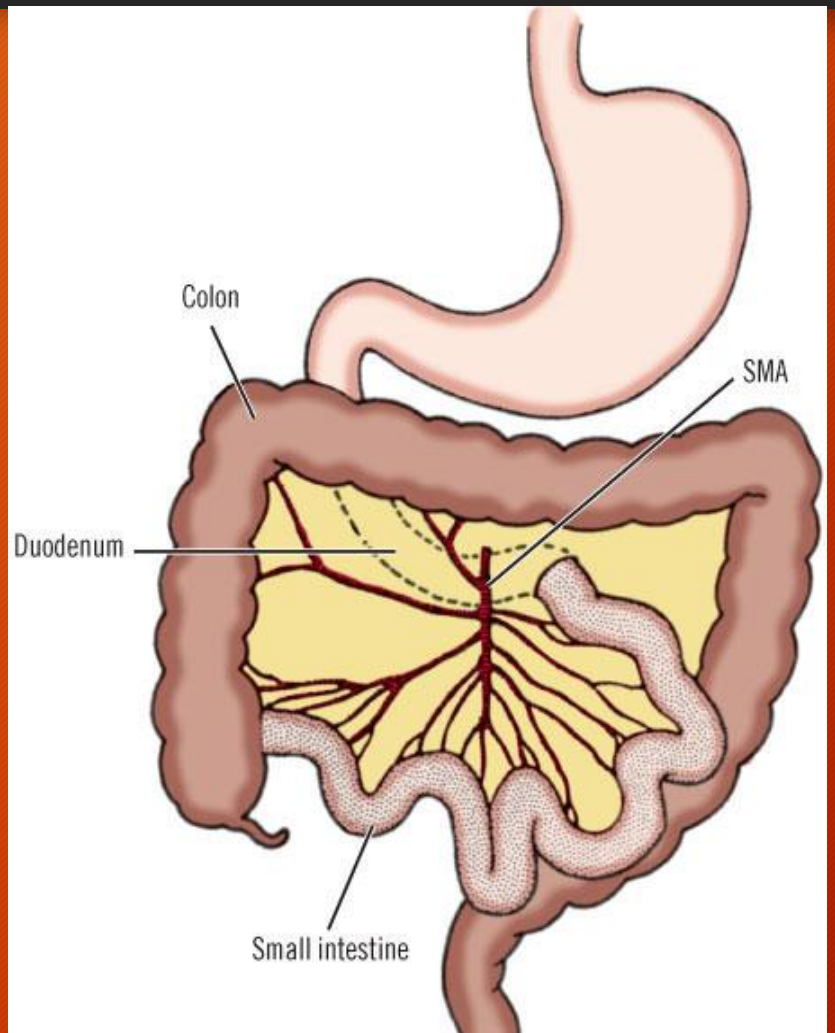
3. Physiological umbilical herniation

4. External rotation – 90 degrees anticlockwise

Results?

STAGES OF MIDGUT DEVELOPMENT



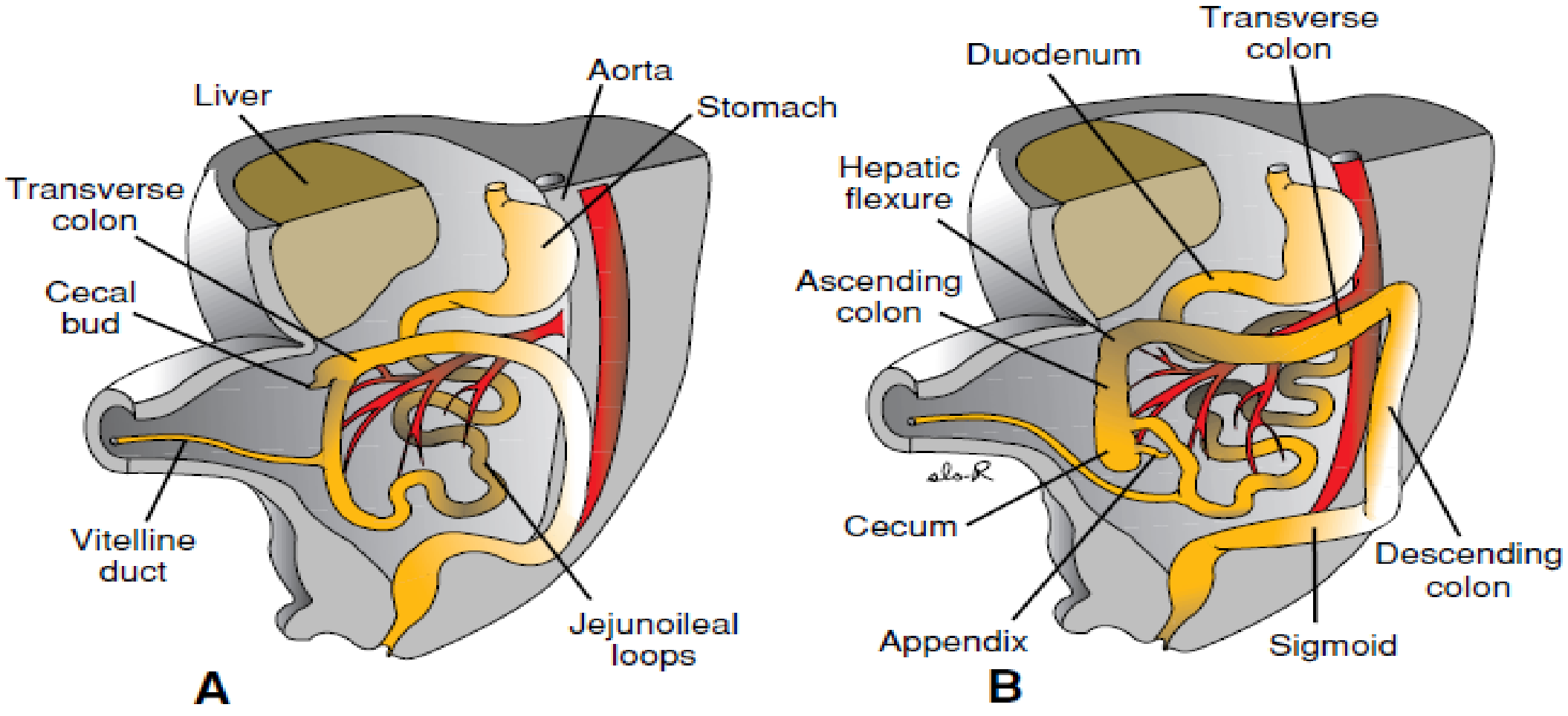


5. Hernia reduction (return of physiological hernia)
6. Internal rotation – 180 degrees anticlockwise

Results?

7. Midgut fixation

CAECUM AND APPENDIX



SUMMARY OF MIDGUT DEVELOPMENT

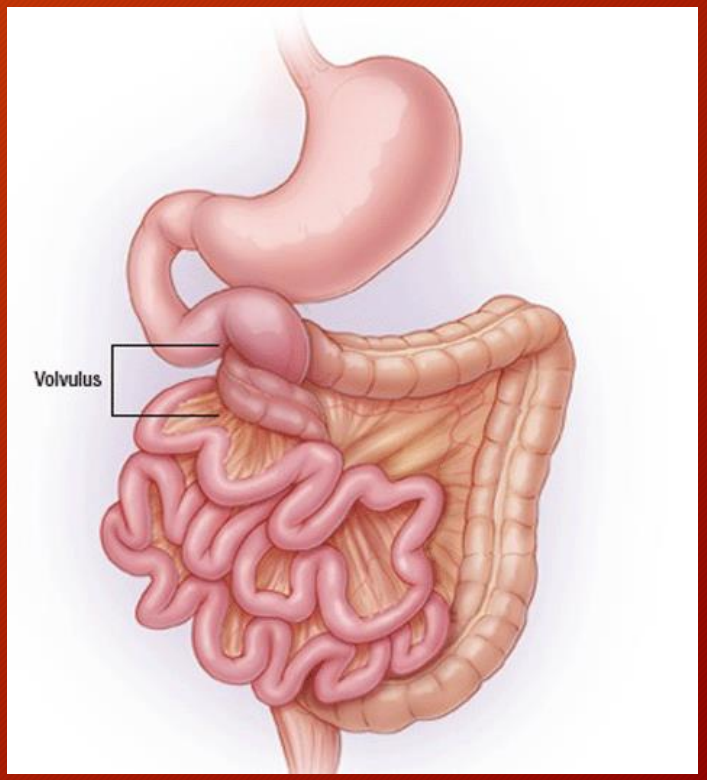
1. Rapid proliferation and elongation
2. Formation of the primary intestinal loop
    A. Cephalic limb
    B. Caudal limb
3. Physiological umbilical herniation
4. External rotation, 90^{o} anticlockwise
5. Hernia reduction
6. Internal rotation, 180^{o} anticlockwise
7. Fixation

CONGENITAL ANOMALIES OF THE MIDGUT

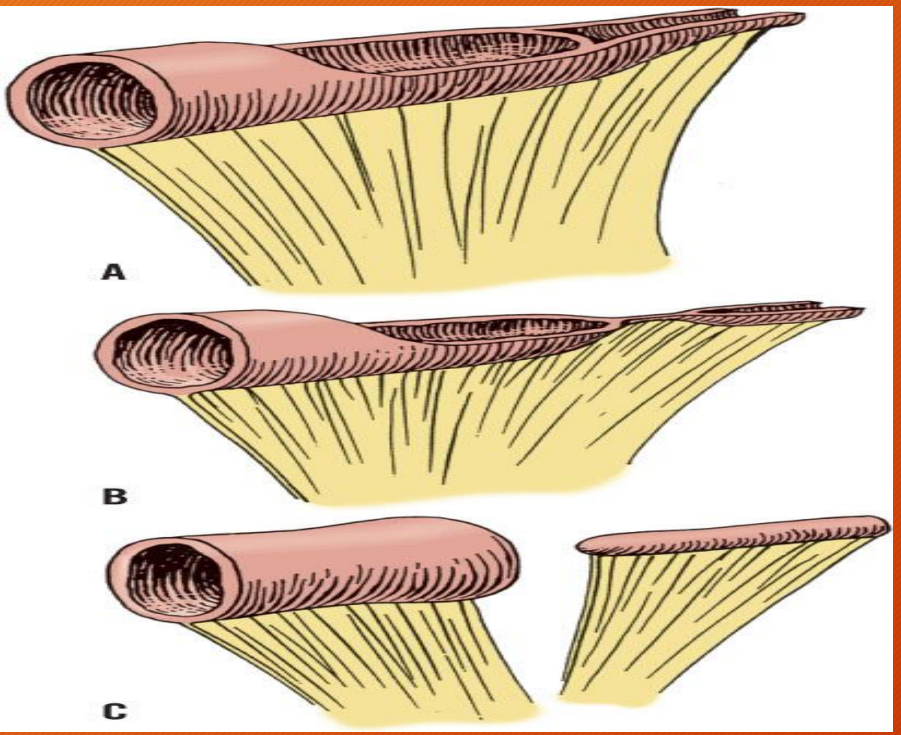
Omphalocele

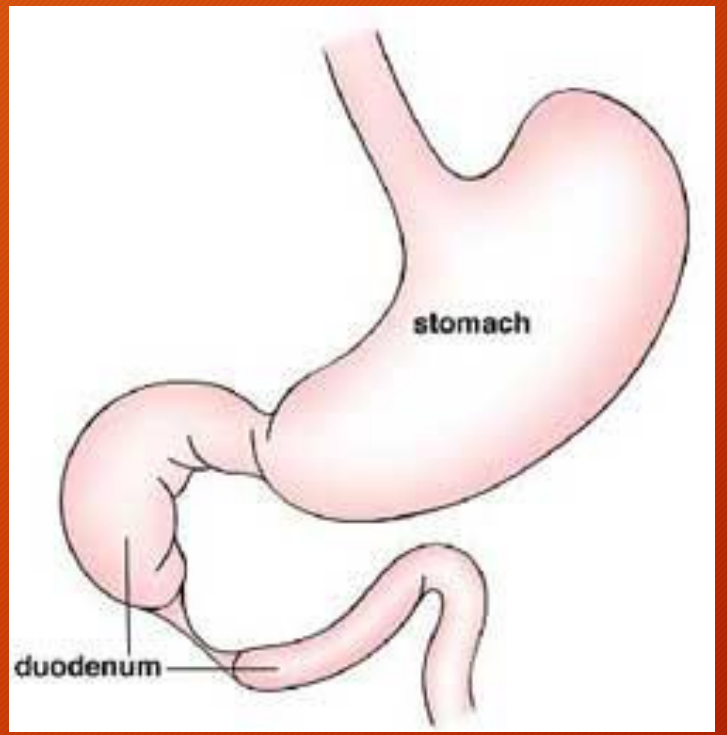
Gastroschisis

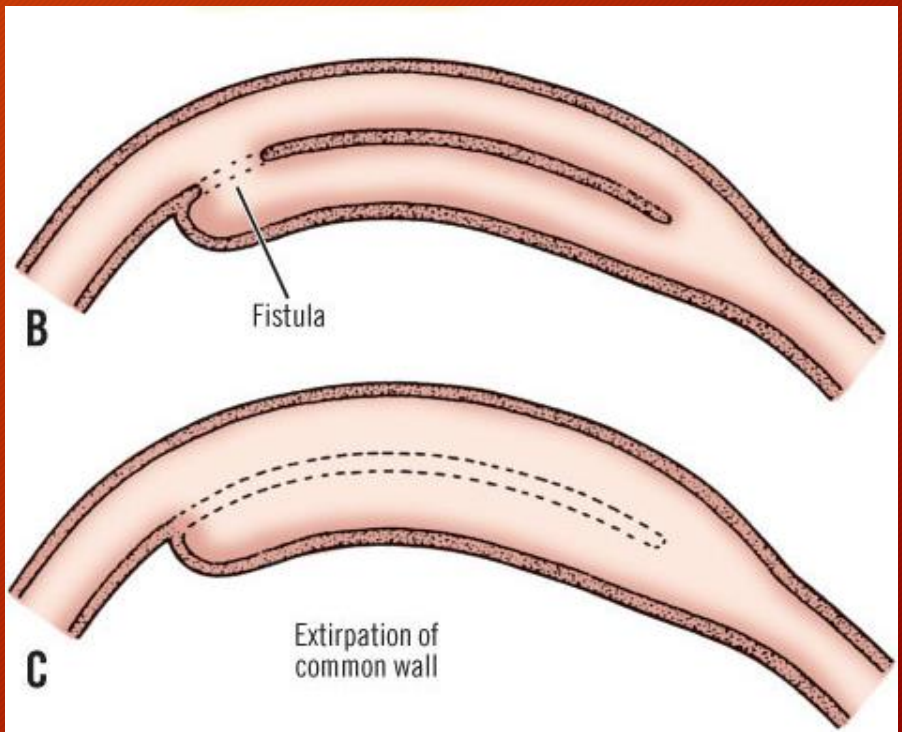
Gut Malrotation



CONGENITAL ANOMALIES OF THE MIDGUT







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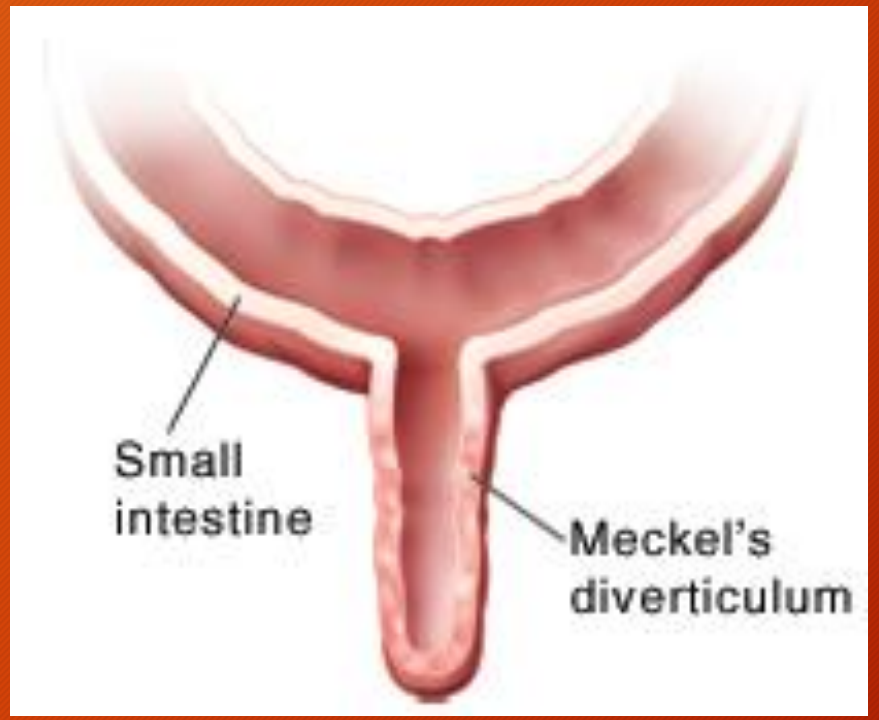

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