Entodermal derivatives: formation of the gut, liver, and pancreas

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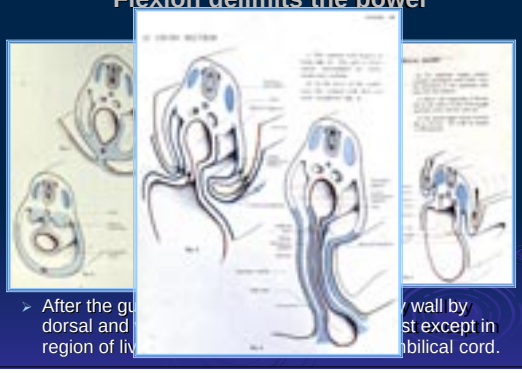
Folding forms the gut

- Primitive gut extends from buccopharyngeal to cloacal membrane.
  - Move toward each other
- Cardiogenic mesenchyme is originally rostral, but folding brings it caudal to buccal membrane.
- Foregut and hindgut become recognizable
- Portion of yolk sac is incoporated into the embro as bowel.
- Midgut remains open.

Cephalocaudal and lateral folding occur simultaneously

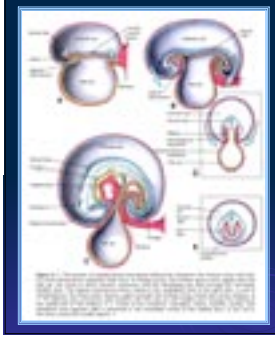
- Meeting and fusion of cranial, lateral, and caudal edges of the embryo create the primordial foregut and hindgut
  - Slow fusion of midgut-due to presence of yolk sac. Midgut remains open until week 6-donnects to yolk sac via *vitelline duct*.
  - Buccopharyngeal membrane opens at 4 and cloacal membrane at 7 weeks

Flexion delimits the bowel

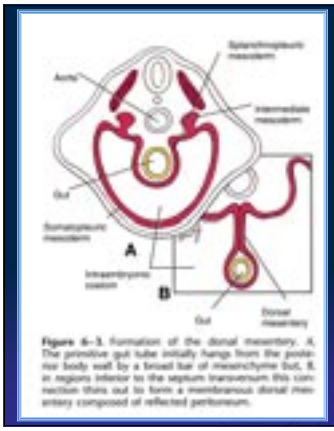


- After the gu… wall by dorsal and …st except in region of liv… …bilical cord.

Anterior-posterior and lateral folding form the primitive gut



- Embryonic disc grows faster in length than the yolk sac causing the embryo to bend.
  - Dorsal surface grows more rapidly than the ventral
- Lateral folding
  - Fusion with apposing side except in the region of the yolk sac, and allantois
- Folding brings the heart and septum transversum caudal to bucco-pharyngeal membrane.

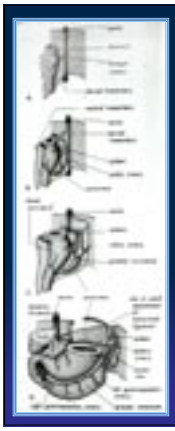


The dorsal mesentery thins to allow the gut to be flexibly suspended

The foregut has many derivatives

- Pharynx and its derivatives
- Lower Respiratory tract
- Esophagus
- Stomach
- Duodenum proximal to ampulla of Vater
- Liver
- Biliary Apparatus
- Pancreas

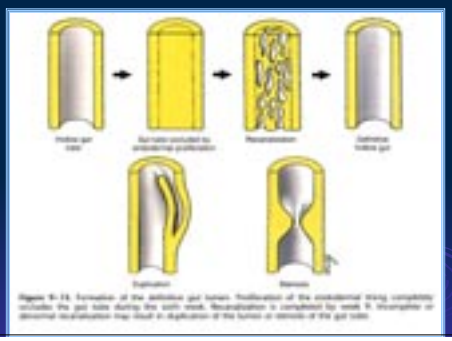
From stomach to biliary apparatus, all are supplied by the celiac artery, "the artery of the foregut."



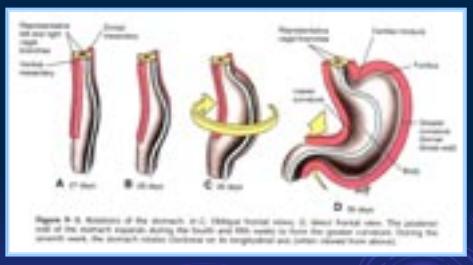
Esophagus elongates rapidly

- Appears to grow faster at its cranial than caudal end.
- Stomach does not descend but arises from a region just caudal to septum transversum that has been fated to be stomach.
- Epithelium obliterates lumen of esophagus and is recanalized by apoptosis (week 8).
  - Failure causes polyhydramnios
  - Esophageal atresia or tracheo-esophageal fistula.
- Stomach enlarges and rotates

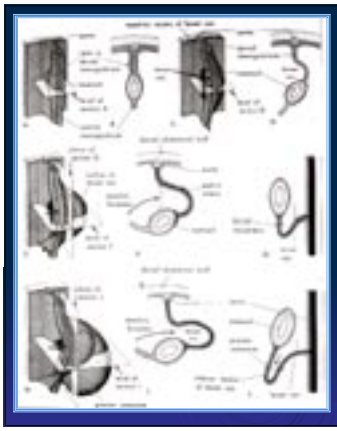
Obliteration of the lumen and recanalization occurs



The stomach rotates 90° in a clockwise direction



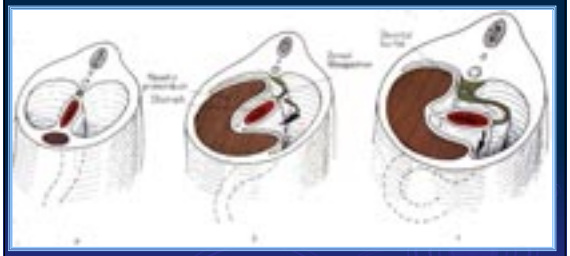
- Dorsal surface grows faster than the ventral to create the greater and lesser curvature. Acquires a transverse position



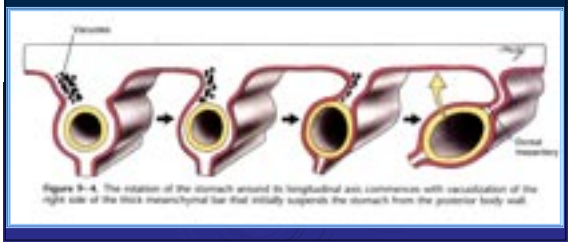
Rotation of the stomach creates the lesser sac

- Dorsal mesogastrium moves to left.
- Ventral mesogastrium attaches to liver and body wall.
- Inferior recess form the greater omentum
  - Layers fuse to obliterate the lesser sac

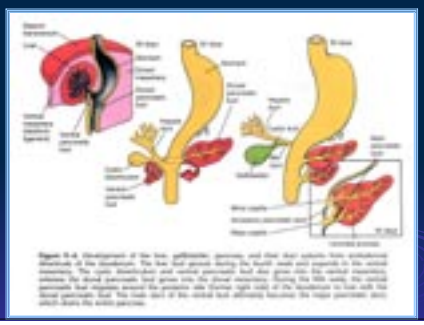
Rotation of the stomach forms the omental bursa



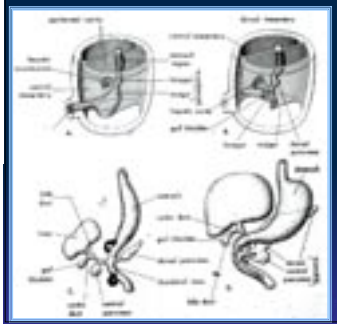
Movements of the mesentery and stomach are made possible by vacuolization due to selective apoptosis



Liver, biliary system and pancreas arise from the duodenum

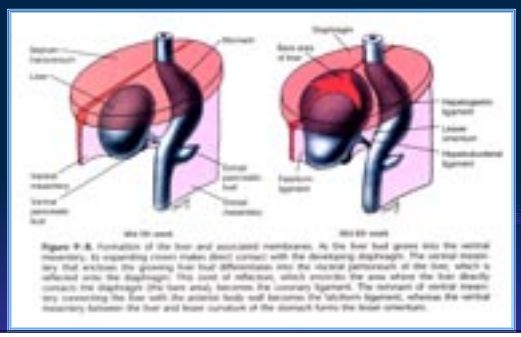


Hepatic diverticulum grows from the duodenum into the ventral mesentery

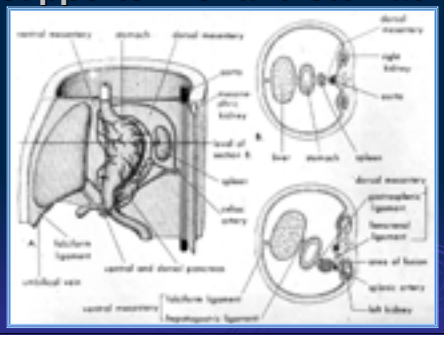


- Begins ~ week 4
- Divides into cranial and caudal buds.
- Cranial bud grows faster and becomes the hepatic parenchyma;
  - Hematopoietic colonists arrive ~ week 6
- Caudal bud gives rise to the biliary system.

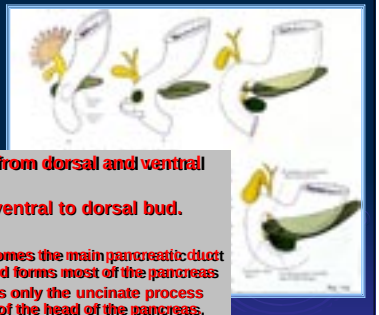
Ventral mesentery forms falciform ligament, hepatic peritoneum, and lesser omentum



Ventral mesogastrium supports liver and stomach

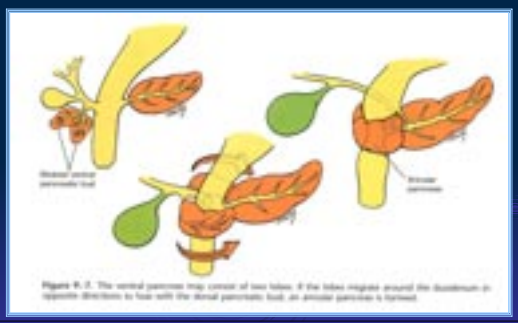


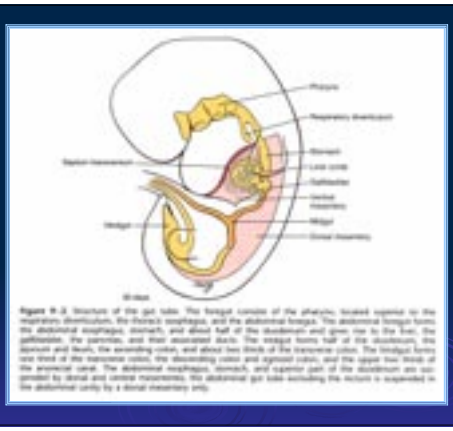
Rotation of the stomach shapes the pancreas



- **Pancreas arises from dorsal and ventral buds.**
- **Rotation brings ventral to dorsal bud.**
- **Buds fuse.**
  - **Ventral duct becomes the main pancreatic duct but the dorsal bud forms most of the pancreas**
  - **Ventral bud forms only the uncinate process and inferior part of the head of the pancreas.**

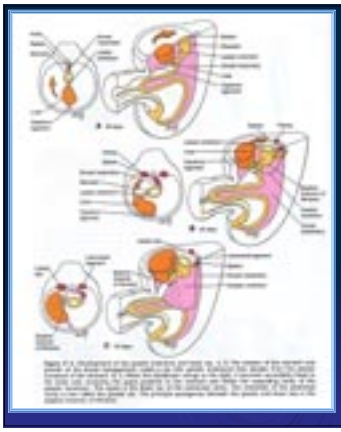
Aberrant rotation causes an annular pancreas





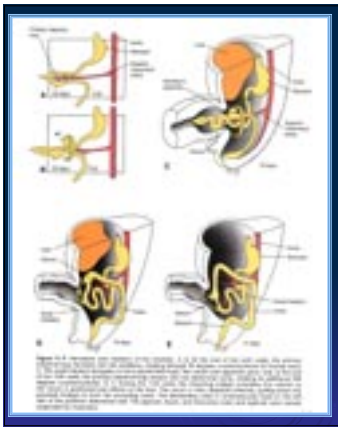
Derivatives of the midgut

- Small intestine (except for the proximal duodenum.
- Cecum
- Appendix
- Ascending colon
- Right 1/2 to 2/3 of the proximal transverse colon
- All are supplied by the superior mesenteric artery ("the artery of the midgut")



The midgut grows rapidly and herniates into the umbilical cord

Week 6



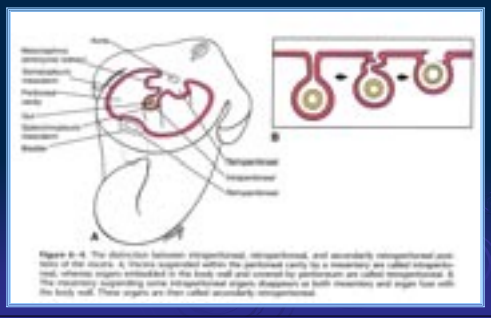
The midgut rotates around an axis of the superior mesenteric artery:
1. 90°
2. 180°

Midgut hernia reduced at week 10.

Rotation of the midgut

- 1. Cranial and caudal loop form.
- 2. Cranial growth >>> caudal growth.
- 3. Apex of loop is vitelline duct.
- 4. Cranial loop moves to right and caudal loop to left (90° counterclockwise).
- 4. Reduction of midgut hernia with rotation a further 180°.
  - Brings cecum to right
  - Moves down
  - Becomes secondarily retroperitoneal.

Loops of bowel fuse with the body wall and become secondarily retroperitoneal



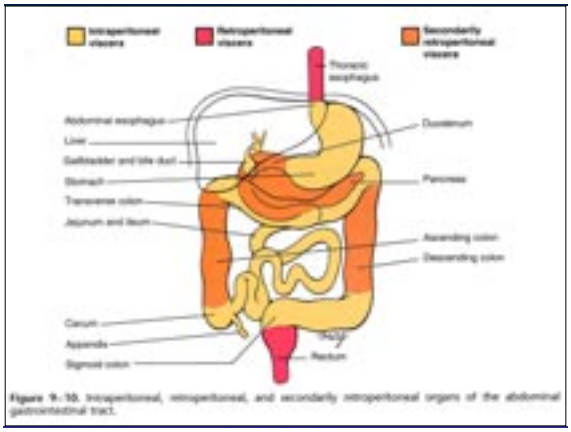


Figure 9-10. Intraperitoneal, retroperitoneal, and secondarily retroperitoneal organs of the abdominal gastrointestinal tract.

Volvulus is a serious complication of excessive flexibility

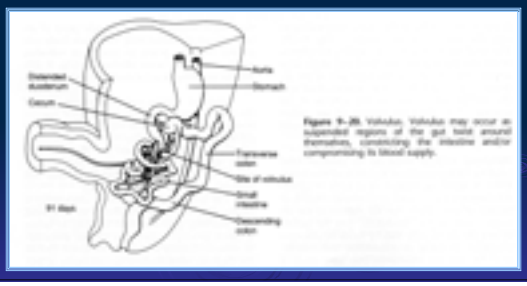


Figure 9-20. Volvulus. Volvulus may occur in suspended regions of the gut twist around themselves, constricting the intestine and/or compromising its blood supply.

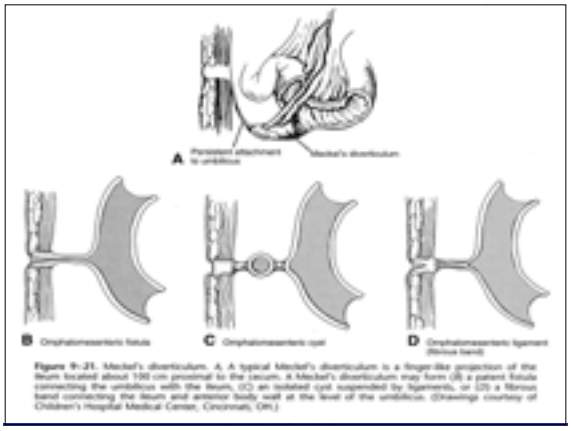
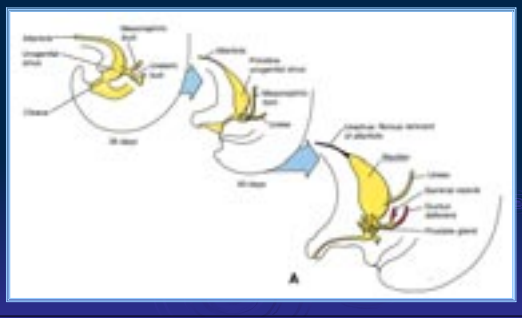


Figure 9-21. Meckel's diverticulum. A, A typical Meckel's diverticulum is a finger-like projection of the ileum located about 100 cm proximal to the cecum. A Meckel's diverticulum may form (B) a patent fistula connecting the umbilicus with the ileum, (C) an isolated cyst suspended by ligaments, or (D) a fibrous band connecting the ileum and anterior body wall at the level of the umbilicus. (Drawings courtesy of Children's Hospital Medical Center, Cincinnati, OH.)

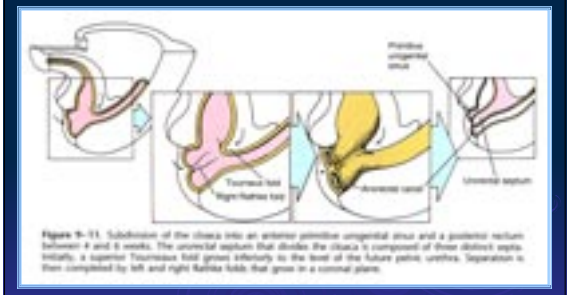
Derivatives of the hindgut

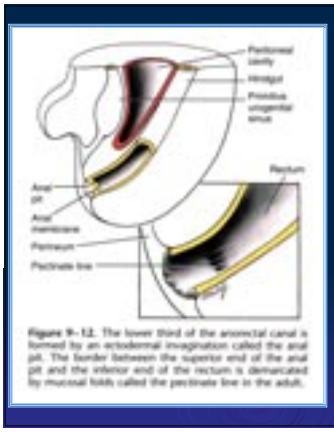
- Left 1/3 to 1/2 of the distal transverse colon
- Descending colon
- Sigmoid colon
- Rectum
- Superior part of anal canal
- Epithelium of unrinary bladder and most of the urethra
- **All are supplied by the inferior mesenteric artery, "the artery of the". hindgut**

The hindgut is originally a cloaca-partioned to form rectum and urogenital sinus

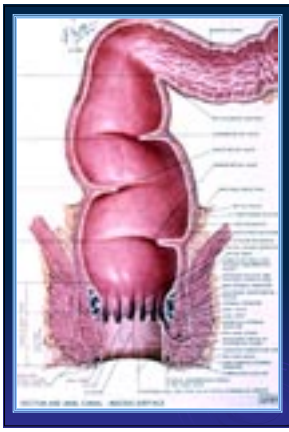


Urorectal septum divides the cloaca



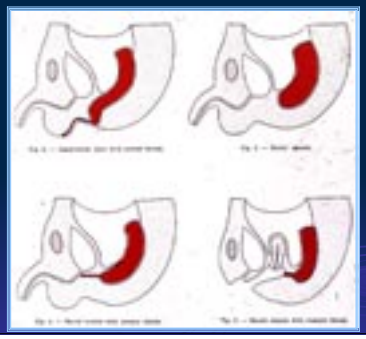


Hindgut forms superior 2/3 of rectal canal; proctodeum forms lower 1/3; divided at pectinate line



Never forget the pectinate line

If anything can go wrong it will; anorectal malformations



The END

Have a nice day!