

AANTOMY

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EMBRYOLOGY

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DEVELOPMENT OF GIT

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Development of GIT

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Development of GIT

Formation of the primitive gut tube

- The gut tube is formed from endoderm lining the yolk sac which is enveloped by the developing coelom as the result of cranial and caudal folding.
- During folding, **somatic mesoderm** is applied to the body wall to give rise to the **parietal peritoneum**. **Visceral (or splanchnic) mesoderm** is wraps around the gut tube to form the **mesenteries** that suspend the gut tube within the body cavity. The mesoderm immediately associated with the endodermal tube also contributes to most of the wall of the gut tube. **Nerves** and **neurons** found in the wall are derived from **neural crest**.
- Summary of germ layer contributions:
 - endoderm: **Mucosal epithelium, Mucosal glands, and Submucosal Glands** of the GI tract.
 - Mesoderm: **lamina propria, muscularis mucosae, submucosal connective tissue** and **blood vessels, muscularis externa, and adventitia/serosa**
 - Neural crest: **neurons** and **nerves** of the submucosal and myenteric plexes

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Basic subdivisions of the gut tube

- Cranio-caudal and lateral folding cause the opening of the gut tube to the yolk sac to draw closed (like a pursestring) forming a pocket toward the head end of the embryo called the "anterior (or cranial) intestinal portal" and a "posterior (or caudal) intestinal portal" toward the tail of the embryo. These are the future foregut and hindgut, respectively. The midgut remains open to the yolk sac.
- Further folding and growth of the embryo causes the communication of the gut with the yolk sac to continue to get smaller and the regions of the gut (foregut, midgut, and hindgut) to become further refined:

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Gut Derivative

FOREGUT	MIDGUT	HINDGUT
Trachea & respiratory tract	Lower duodenum**	Distal 1/3 of transverse colon
Lungs	Jejunum	Descending colon
Esophagus	Ileum	Sigmoid colon
Stomach	Cecum	Rectum
Liver	Appendix	Upper anal canal
Gallbladder & bile ducts	Ascending colon	Urogenital sinus
Pancreas (dorsal & ventral)	Proximal 2/3 of transverse colon	
Upper duodenum*		

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Definitive subdivisions of the gut tube

- Within the abdominal cavity, the gut is definitively divided into **foregut**, **midgut**, and **hindgut** **BASED ON THE ARTERIAL SUPPLY**:
 - **Foregut derivatives in the abdomen** are supplied by branches of the **celiac artery**
 - **Midgut derivatives** are supplied by branches of the **superior mesenteric artery**
 - **Hindgut derivatives** are supplied by branches of the **inferior mesenteric artery**

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D. Cranio-caudal patterning of the gut tube

- specific regions of the gut tube (i.e. that which will become lung vs. that which become esophagus vs. stomach, etc.) and important junctions (e.g. gastro-esophageal junction) are established by a cranial to caudal pattern of segmental, combinatorial "codes" of HOX gene expression in the endoderm and mesoderm of the early embryo.

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E. Radial patterning of the gut tube

- concentric layering of the gut tube is accomplished largely via expression of Sonic Hedgehog (SHH) in the endoderm which inhibits smooth muscle and neuronal differentiation close to the endoderm. Farther away from the endoderm, the SHH concentration is lower, thus permitting smooth muscle and neuronal differentiation in the muscularis externa. Later in development, the SHH expression goes away, allowing development of smooth muscle in the muscularis mucosae and neurons of the submucosal plexus.
- As the gut tube tube develops, the endoderm proliferates rapidly and actually temporarily OCCLUDES the lumen of the tube around the 5th week. Growth and expansion of mesoderm components in the wall coupled with apoptosis of some of the endoderm at around the 7th week causes re-canalization of the tube such that by the 9th week, the lumen is open again.

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F. Mesenteries of the gut tube (refer to the figure on the previous page)

- the thoracic esophagus and anus are anchored within the body wall and are therefore **retroperitoneal**
- the stomach and liver are suspended in a mesentery that is attached to the dorsal AND ventral body walls:
 - the **dorsal mesentery of the stomach** becomes the **greater omentum**
 - the **ventral mesentery of the liver** becomes the **falciform ligament**
 - the **mesentery between the stomach and liver** becomes the **lesser omentum**
- the rest of the GI tract is suspended by a dorsal mesentery, named according to the organ to which it is attached (mesoduodenum, mesoappendix, mesocolon, etc.)
- some portions of the GI tract remain **intraperitoneal** in the adult and are therefore suspended by a mesentery.
- some portions of the GI tract, however, are applied against the body wall during development and the dorsal mesentery becomes incorporated into the body wall, making the organ **secondarily retroperitoneal**.

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Gut in relation to Peritoneum

Retroperitoneal

thoracic
esophagus
rectum
anus

Intraperitoneal

abdominal
esophagus
spleen
stomach
liver & gallbladder
jejunum & ileum
cecum & appendix
sigmoid colon

Secondarily
retroperitoneal

pancreas
duodenum
ascending colon
descending colon

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