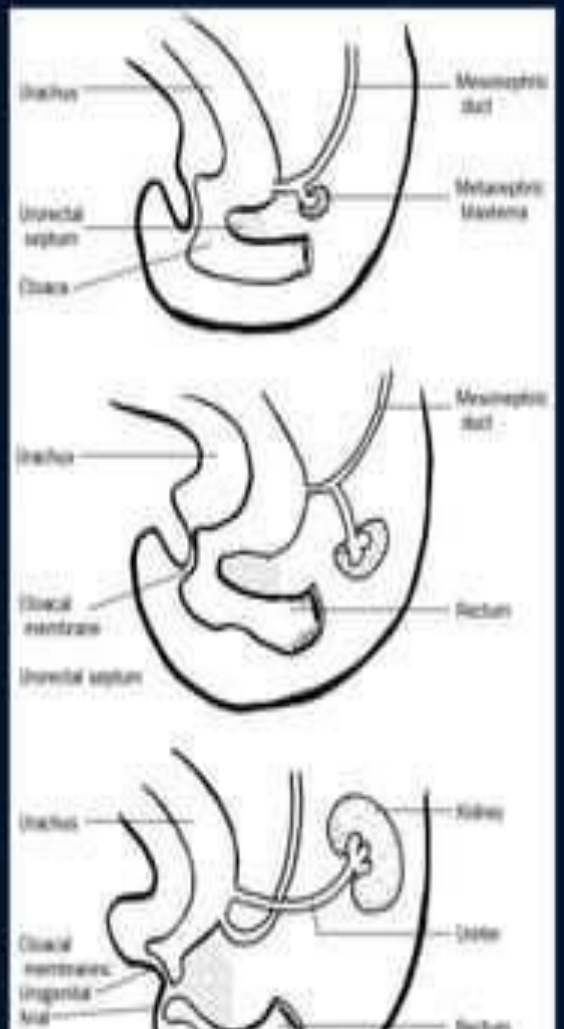
HINDGUT

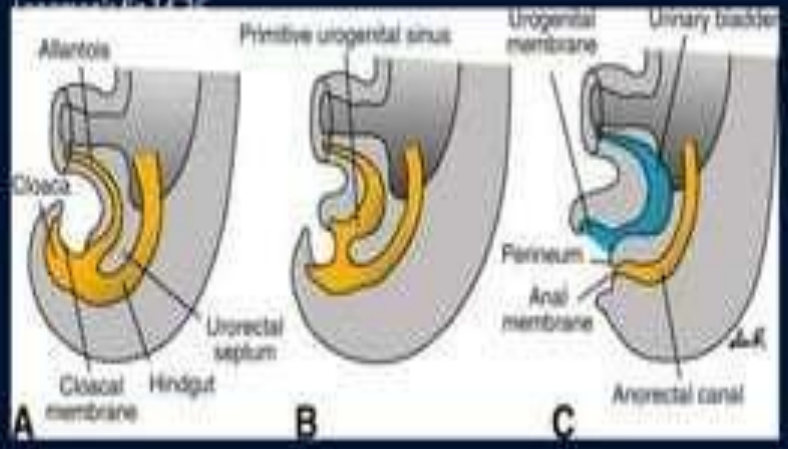
- Distal 2/3 transverse colon
- Descending colon
- Sigmoid colon
- Rectum Upper anal canal
- Urogenital sinus

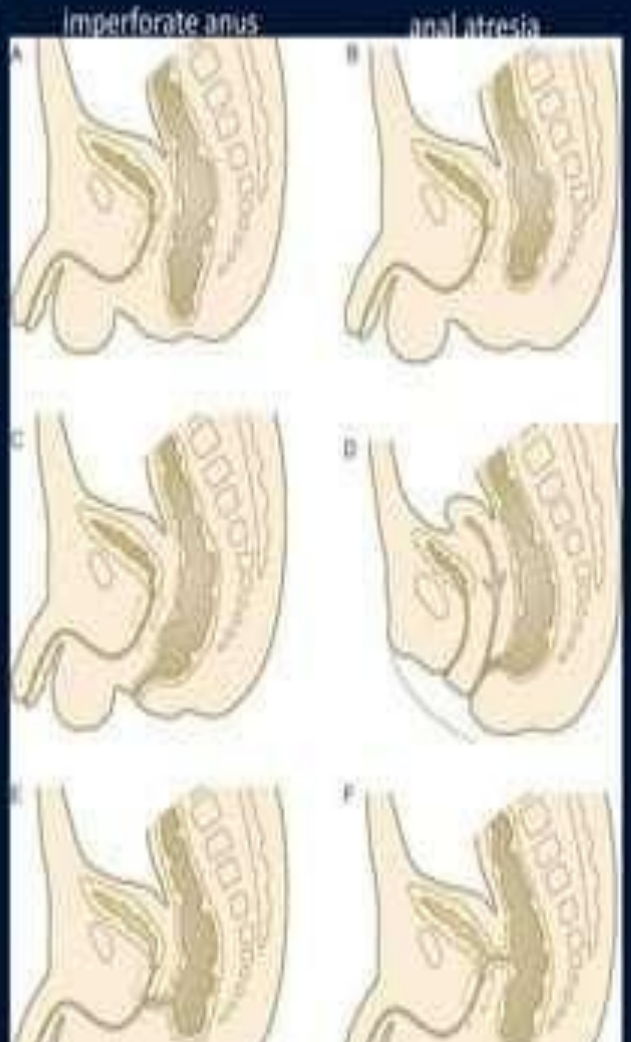
Hindgut

- Distal 1/3 of the transverse colon, descending colon and sigmoid colon develop from the cranial end of the hindgut.
- Upper anal canal develops from the terminal end of the hindgut with the urorectal septum dividing the upper anal canal and the urogenital sinus.



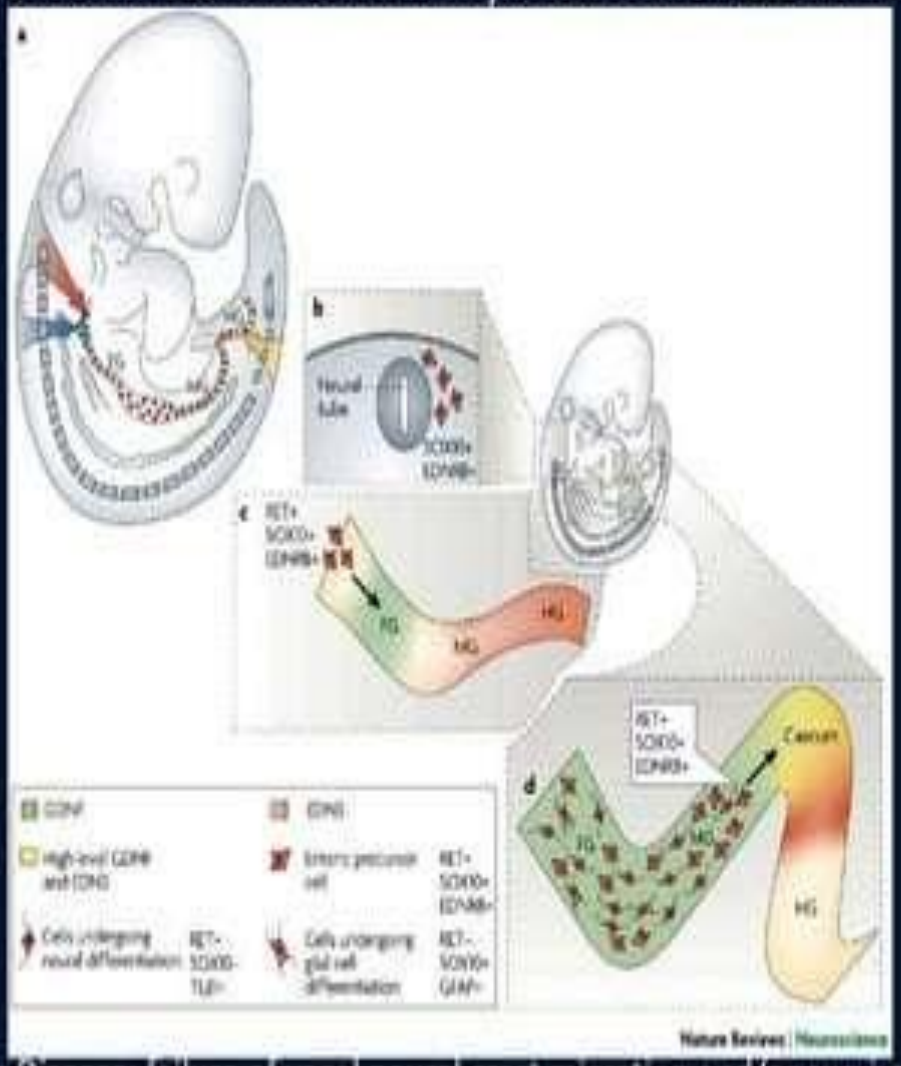
Development of the hindgut





- Derivatives of the hindgut include everything caudal to the distal 1/3 of the transverse colon.
- Distalmost portion (sigmoid colon and rectum) divides cloaca into the anorectal canal and urogenitial canals -errors in this process can lead to imperforate anus ("A" on right), atresia (B), and/or fistulas (C – F)
- As with the rest of the GI tract, enteric neurons in the hindgut arise from vagal neural crest (plus some sacral crest). Distalmost portions of the

Neural crest cells from vagal and sacral regions colonize the gut and give rise to the enteric neurons of the myenteric and submucosal plexes:



Hirschsprung's Disease: failure of vagal neural crest migration and/or survival, usually

- **Derivatives of the hindgut** are supplied by the **inferior mesenteric artery**.
- **A. Distal one third of the transverse colon, descending colon, sigmoid colon.**
- **1. Development.** The cranial end of the hindgut develops into the distal one third of the transverse colon, descending colon, and sigmoid colon. The terminal end of the hindgut is an endoderm-lined pouch called the **cloaca,** which contacts the surface ectoderm of the **proctodeum** to form the **cloacal membrane.**

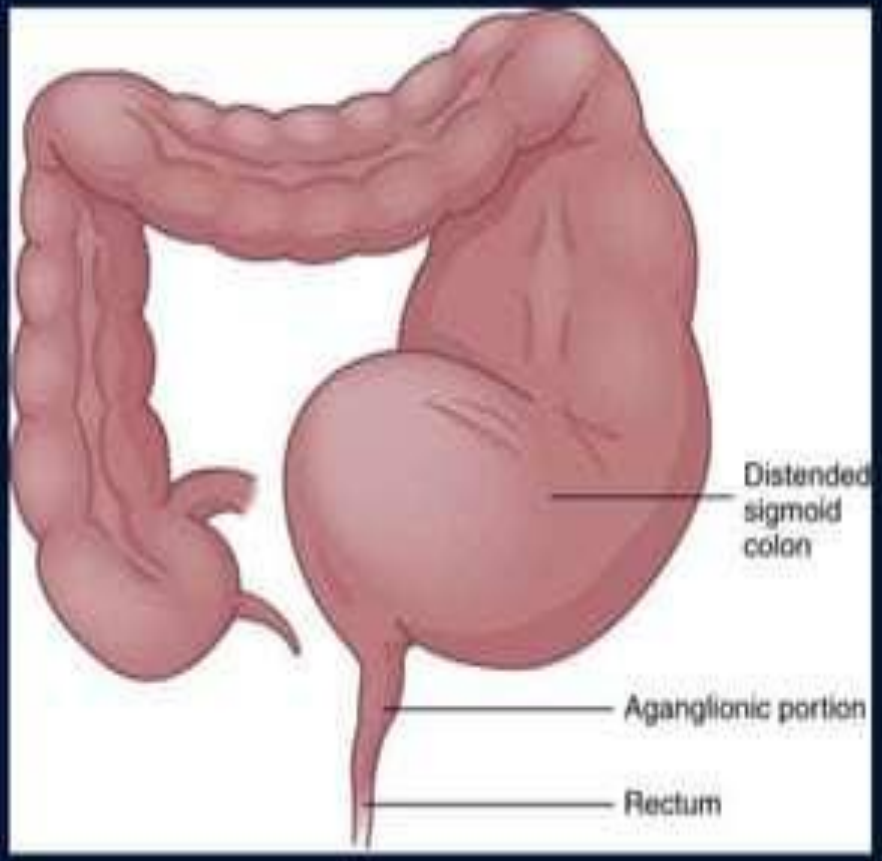
- **2. Sources.** Simple columnar absorptive cells lining hindgut derivatives, goblet cells, and enteroendocrine cells comprising the intestinal glands are derived from endoderm. The lamina propria, muscularis mucosae, submucosa, inner circular and outer longitudinal (taeniae coli) smooth muscle of the muscularis externa, and serosa are derived from visceral mesoderm.
- **B. Rectum and upper anal canal**
- **1. Development.** The cloaca is partitioned by the **urorectal septum** into the **rectum** and **upper anal canal** and the **urogenital sinus.** The cloacal membrane is partitioned by the urorectal septum into the **anal membrane** and **urogenital membrane.** Note: The urorectal septum fuses with the cloacal membrane at the future site of the gross anatomical **perineal body.**

Hindgut Anomalies

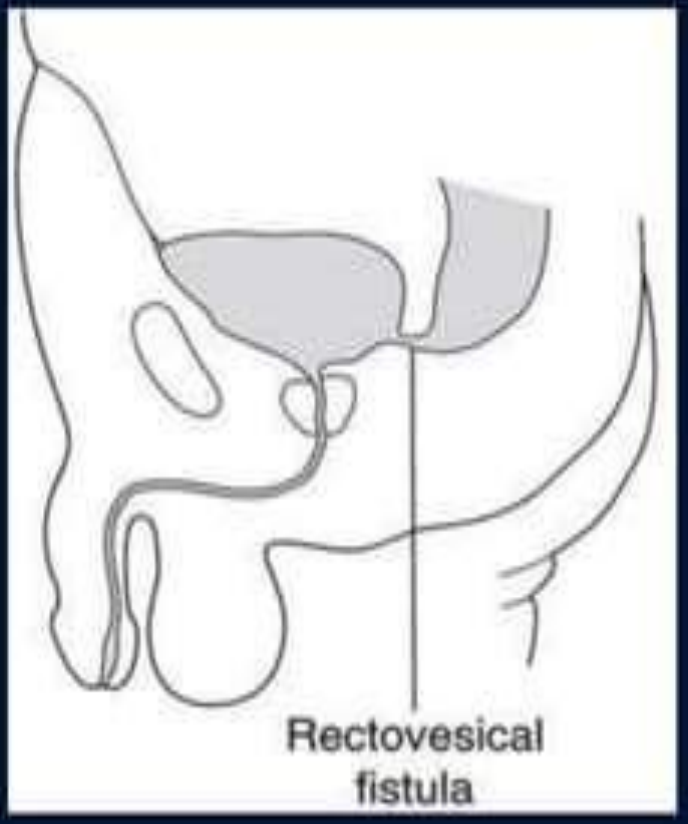
- **Clinical Correlation**
  - Anorectal agenesis occurs if the urorectal septum does not develop appropriately.
  - VACTERL Association
    - Vertebral anomalies, anal defects, cardiac defects, TEF, Renal and Limb defects
  - Hirschsprung disease – failure of the neural crest cells to form the myenteric plexus (see Enteric Nervous System).

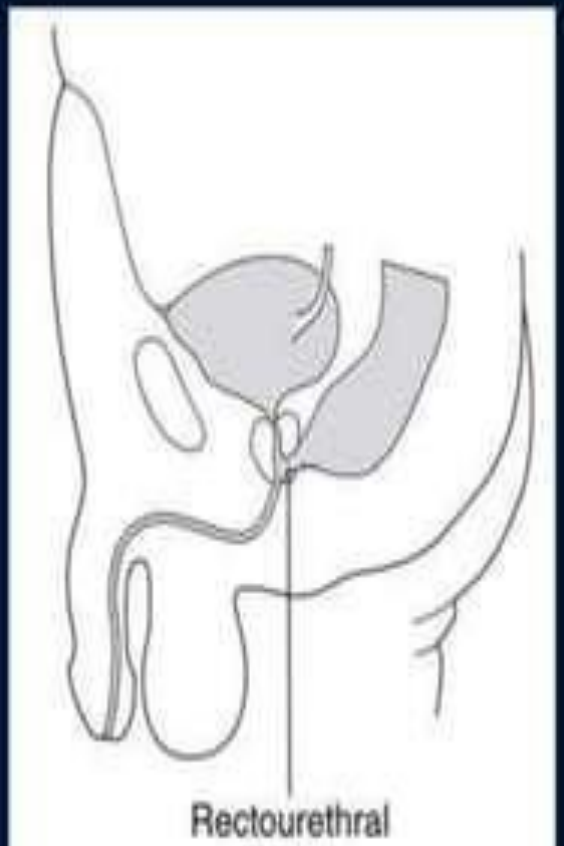
3. Clinical considerations

- **a. Colonic aganglionosis (Hirschsprung disease):** is caused by the arrest of the caudal migration of neural crest cells.
- The hallmark is the absence of ganglionic cells in the myenteric and submucosal plexuses, most commonly in the sigmoid colon and rectum, resulting in a narrow segment of colon (i.e., the colon fails to relax). Although the ganglionic cells are absent, there is a proliferation of hypertrophied nerve fiber bundles. The most characteristic functional finding is the failure of internal anal sphincter to relax following rectal distention (i.e., abnormal rectoanal reflex.
- It is associated clinically with a distended abdomen, inability to pass meconium, gushing of fecal material on a rectal digital exam, and a loss of peristalsis in the colon segment distal to the normal innervated colon.

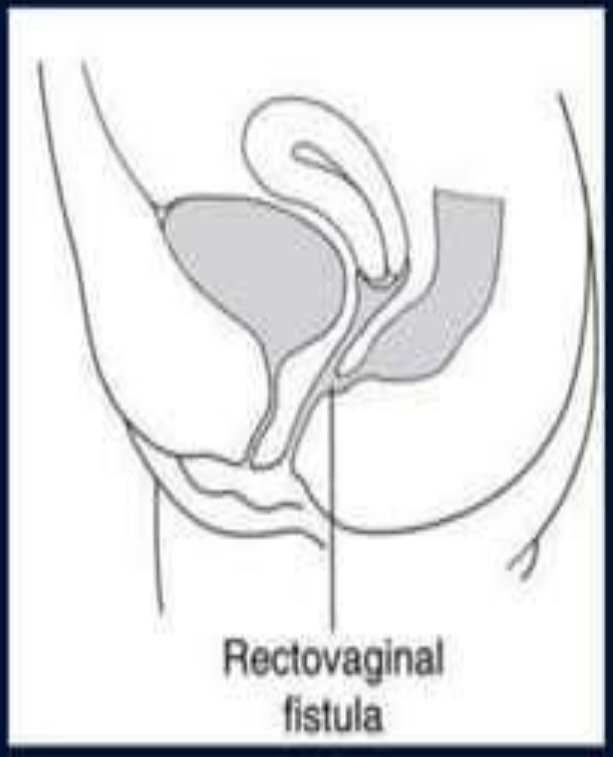

Distended sigmoid colon
Aganglionic portion
Rectum

- **b. Rectovesical fistula:** is an abnormal communication between the rectum and the urinary bladder due to abnormal formation of the urorectal septum. This fistula is clinically associated with the presences of meconium in the urine.
- **c. Rectourethral fistula:** is an abnormal communication between the rectum and the urethra due to abnormal formation of the urorectal septum. This fistula is clinically associated with the presences of meconium in the urine. A rectourethral fistula that generally occurs in males is associated with the prostatic urethra and is therefore sometimes called a **rectoprostatic fistula.**


Rectovesical
fistula


Rectourethral

- **d. Rectovaginal fistula:** is an abnormal communication between the rectum and vagina due to abnormal formation of the urorectal septum. This fistula is associated clinically with the presences
- of meconium in the vagina.
- **Anal canal**
- **A. Development.** The **upper anal canal** develops from the **hindgut.** The **lower anal canal** develops from the **proctodeum,** which is an invagination of surface ectoderm caused by a proliferation of mesoderm surrounding the anal membrane. The dual components (hindgut and proctodeum) involved in the embryological formation of the entire anal canal determine the gross anatomy of this area, which becomes important when considering the characteristics and metastasis of anorectal tumors. The junction between the upper and lower anal canals is indicated by the **pectinate line,** which also marks the site of the former **anal membrane.** In the adult, the pectinate line is located at the lower border of the anal columns.


Rectovaginal
fistula

- **B. Sources.** The simple columnar epithelium lining the upper anal canal is derived from endoderm, whereas the simple columnar and stratified columnar epithelia lining the lower anal canal are derived from ectoderm. The lamina propria, muscularis mucosae, submucosa, muscularis externa consisting of the internal and external anal sphincters, and adventitia are derived from mesoderm.

- **C. Clinical considerations**
- **1. Imperforate anus** occurs when the anal membrane fails to perforate; a layer of tissue separates the anal canal from the exterior.
- **2. Anal agenesis** occurs when the anal canal ends as a blind sac **below the puborectalis muscle** due to abnormal formation of the urorectal septum. It is usually associated with rectovesical, rectourethral, or rectovaginal fistula.
- **3. Anorectal agenesis** occurs when the rectum ends as a blind sac **above the puborectalis muscle** due to abnormal formation of the urorectal septum. It is the most common type of anorectal malformation and is usually associated with a rectovesical, rectourethral, or rectovaginal fistula.
- **4. Rectal atresia** occurs when both the rectum and anal canal are present but remain unconnected due to either abnormal recanalization or a compromised blood supply causing focal atresia.

- **VI. Mesentries**
- The primitive gut tube is suspended within the peritoneal cavity of the embryo by the **ventral mesentery** and **dorsal mesentery**, from which all adult mesenteries are derived.
- **Ventral:** Lesser omentum (hepatoduodenal and hepatogastric ligaments), falciform ligament of liver, coronary ligament of liver and triangular ligament of liver.
- **Dorsal:** Greater omentum (gastrorenal, gastrosplenic, gastrocolic, and splenorenal ligaments), mesentery of small intestine, mesoappendix, transverse mesocolon and sigmoid mesocolon.
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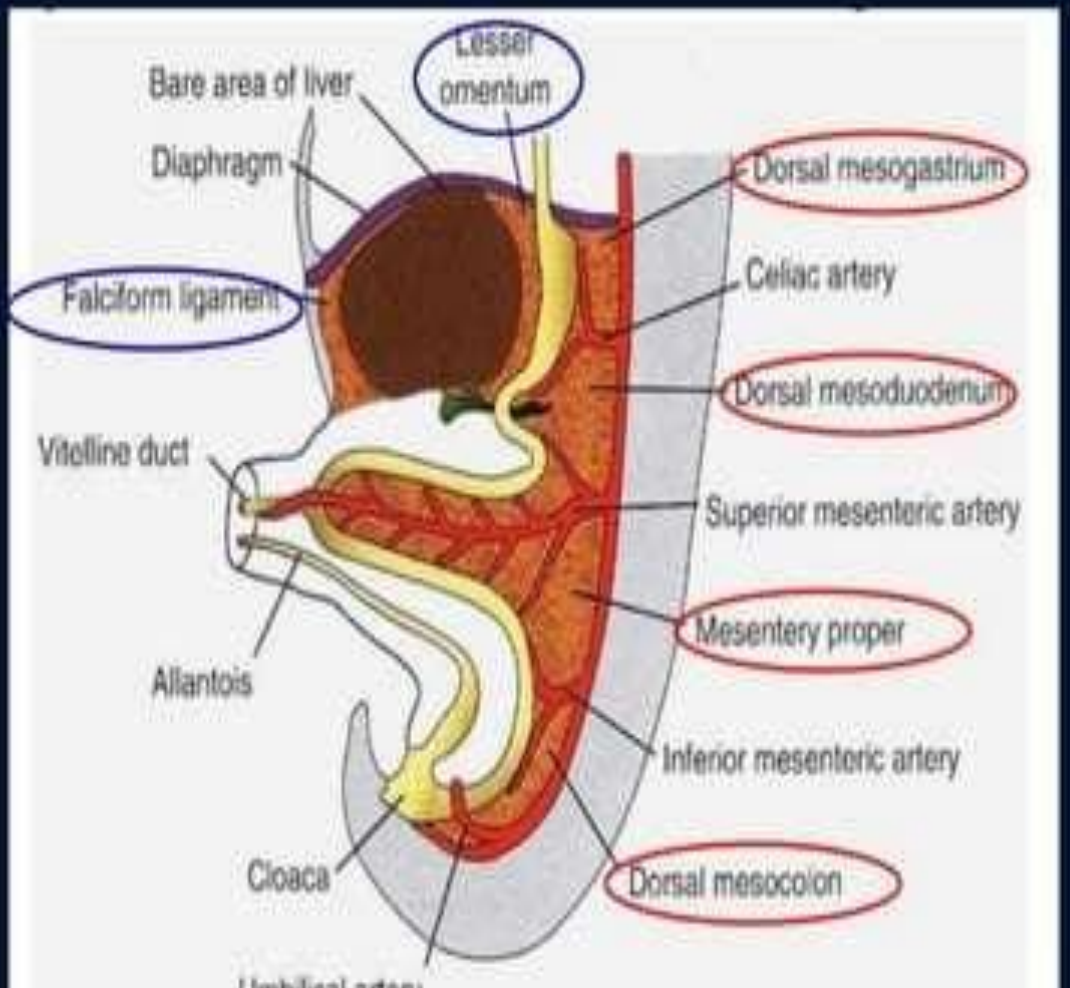
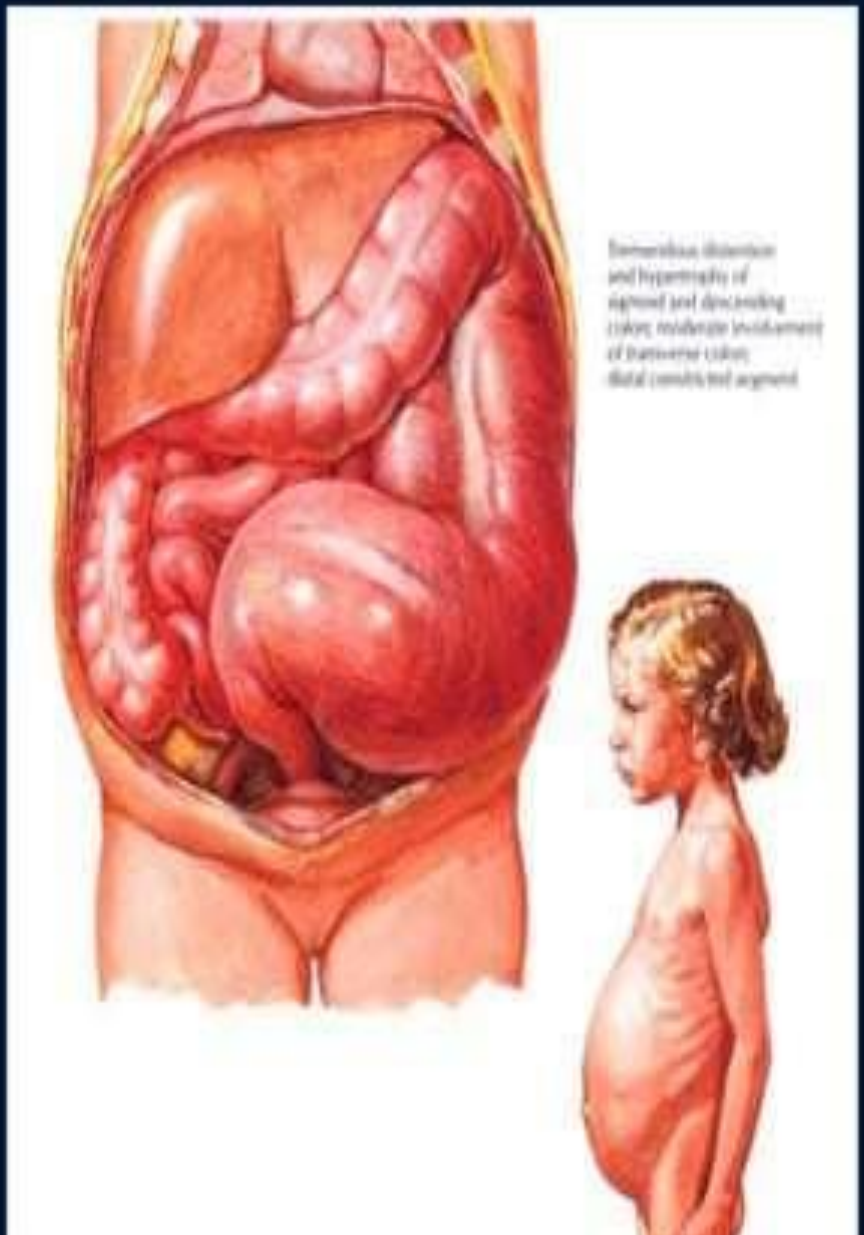

Lesser omentum
Bare area of liver
Diaphragm
Falciform ligament
Dorsal mesogastrium
Celiac artery
Dorsal mesoduodenum
Vitelline duct
Superior mesenteric artery
Mesentery proper
Allantois
Inferior mesenteric artery
Cloaca
Dorsal mesocolon



Hirschprung Disease (congenital megacolon)

- Occurs in ~1:5000 births
- Caused by failure of vagal neural crest cells to migrate into a portion of the colon
- Denervated region tonically constricted (role of myenteric plexus is largely INHIBITORY)
- Upstream regions become distended (hence "megacolon")
- Surgically repaired by removing affected region