Embryology

Sheet Slide

number 2

Done by Rossul Al-Bahadili

Correction Jamil Nazzal

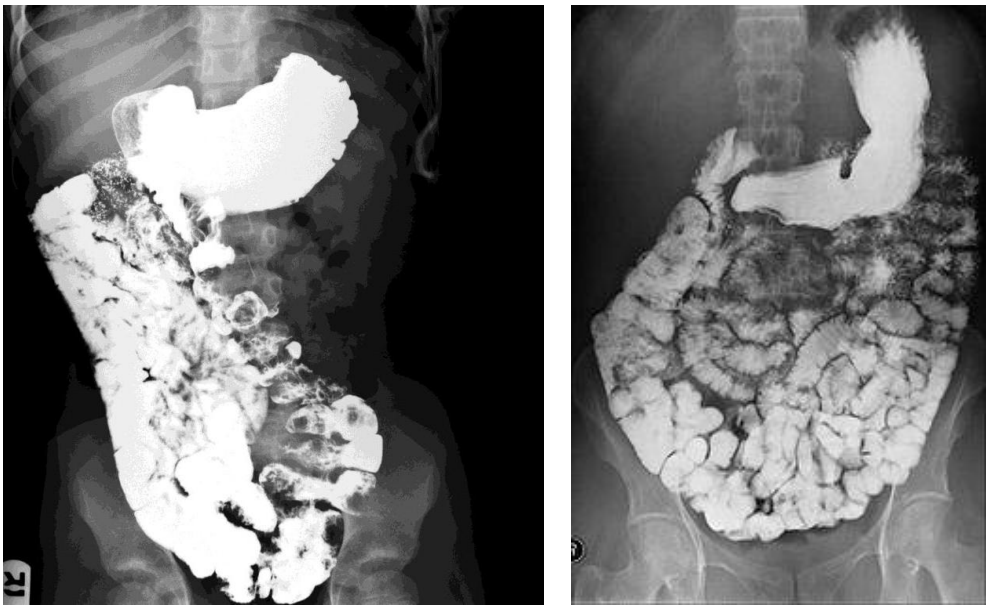
Doctor Fareed Khdair

This lecture is about the embryology of the midgut and hindgut.

Last lecture we learned that the foregut consists of the esophagus, stomach and duodenum until the upper half of the second part. The midgut consists of the rest of the duodenum (distal to the opening of the bile duct), jejunum, ileum, cecum, ascending colon till the proximal two thirds of the transverse colon. As for the hindgut, it consists of the distal third of transverse colon, descending colon, sigmoid, rectum and upper part of the anal canal.

Congenital Abnormalities of the Midgut

Case 1: a newborn started vomiting after feeding, a contrast image was taken, the result was the whole contrast shifted to the right side of the image, although normally the contrast must be distributed.



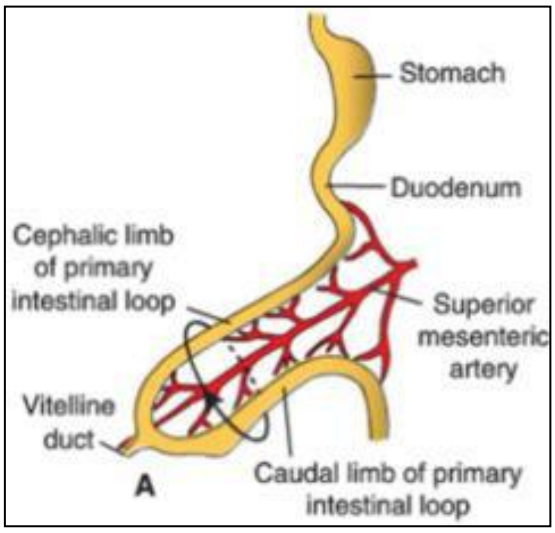
Left: malrotation, right: normal

Development of the Midgut

The **midgut** communicates with the **yolk sac** via the **vitelline duct**. Development starts with rapid elongation and formation of **the primary intestinal loop**.

The primary intestinal loop consists of a **cephalic limb** and a **caudal limb**. The cephalic limb develops into the distal part of duodenum, jejunum and part of ileum.

The caudal limb develops into the lower portion of the ileum, the cecum, the appendix, the ascending colon, and the proximal two-thirds of the transverse colon.



Later it passes through for phases:

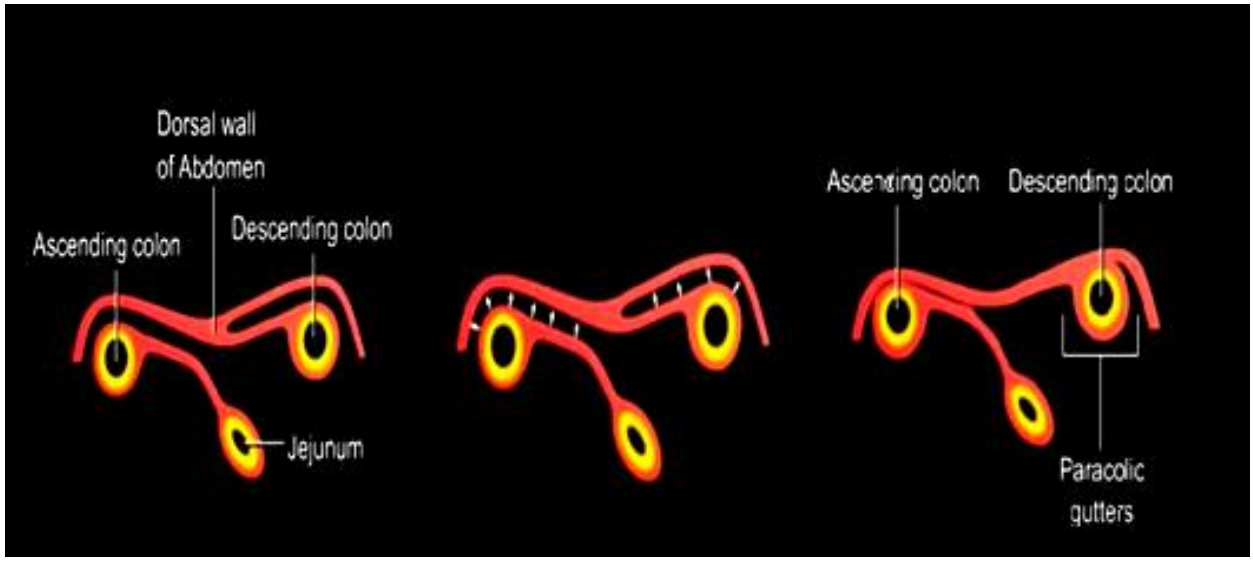
1- **Physiological umbilical herniation, at 6 weeks**
   The intestinal loop enters the extra embryonic cavity through the umbilical cord; due to rapid growth of the liver and the intestinal loop, and reduced size of the abdominal cavity
2- **90^{o} counterclockwise rotation**
   During the initial rotation the small intestine undergoes further elongation, the jejunum and ileum start coiling to increase the surface area for absorption. However, the large intestine is further elongated but not coiled.
3- **Retraction, at 10 weeks**
   The first part to return to the abdominal cavity is the jejunum, it returns to the left side. The last part to return is the cecum, it returns to the right upper quadrant (initial temporary position).
4- **Further 180^{o} rotation**
   The cecum acquires its final permanent position in the right lower quadrant. **The appendix** outgrows from the cecal bud in a retrocecal or retrocolic position.

Total rotation is 270^{o} counterclockwise around the superior mesenteric artery. Rotation occurs during herniation (about 90^{o}), as well as during retraction (180^{o})

Mesenteries of the Intestinal Loops

Last lecture we discussed how the dorsal mesentery is attached to different parts of the bowel and is subdivided into dorsal mesogastrium, mesentery proper and dorsal mesocolon. The ventral mesentery (septum transversum) gives the lesser omentum , liver and the falciform ligament.

The mesentery of the primary intestinal loop; the mesentery proper; undergoes further development and changes with rotation and coiling of the bowel. The dorsal mesentery twists around the origin of the superior mesenteric artery. In the ascending and descending colon it fuses with the posterior abdominal wall and these parts become retroperitoneal. However, the lower end of the cecum, the sigmoid and the appendix retain their free mesenteries which gives them free mobility within the peritoneal cavity. These parts, plus the transverse colon and the small bowel are all considered intra peritoneal.



Note: The mesentery of the jejuno-ileal loops is at first continuous with that of the ascending colon. Then obtains new attachment line : small bowel becomes intraperitoneal.

Congenital Abnormalities of the Midgut

1- **Malrotation**

   a- **Counterclockwise 90° only (incomplete rotation)**

   In this case the cecum is the first part to retract, and it returns to the left side, while the jejunum returns to the right side. The result is **left-sided colon.** When a contrast image is taken, the coils of the jejunum appear on

the right side, as in the picture in page 1. The mesenteries in this case are abnormal*very long*, which causes abnormal twisting and formation of volvulus, this results in compromise of blood supply and ischemia. Recurrent vomiting and abdominal pain also occur.

b- Reversed rotation (clockwise)

In this abnormality the transverse colon passes behind the duodenum and lies behind the superior mesenteric artery.

Symptoms usually occur early in life

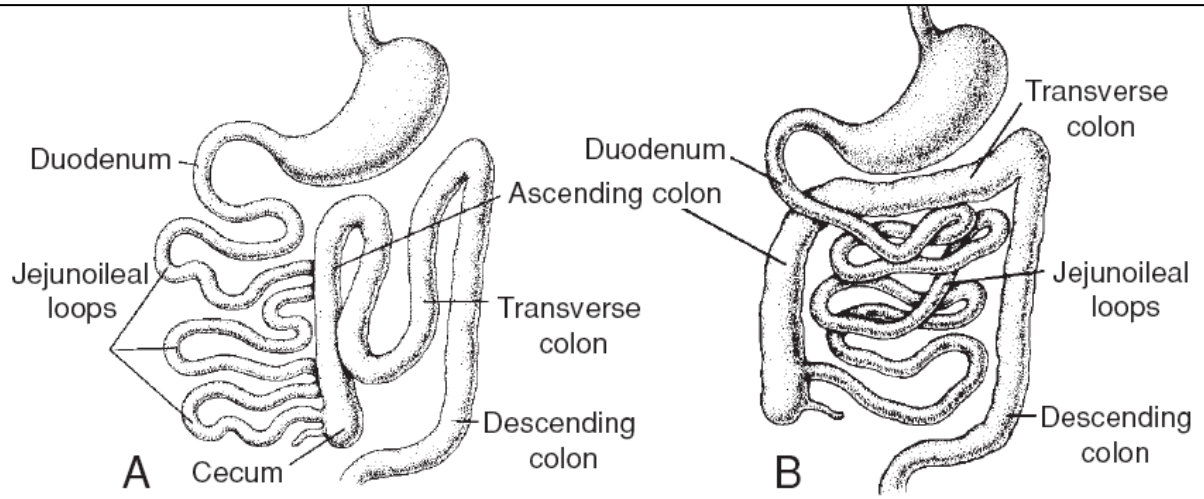


Figure 13.33 A. Abnormal rotation of the primary intestinal loop. The colon is on the left side of the abdomen, and the small intestinal loops are on the right. The ileum enters the cecum from the right. **B.** The primary intestinal loop is rotated 90° clockwise (reversed rotation). The transverse colon passes behind the duodenum.

2- Gut Atresias and Stenoses

Atresias and stenoses may occur anywhere along the intestine.

Most occur in the duodenum, fewest occur in the colon, and equal numbers occur in the jejunum and ileum (1/1500 births).

Atresias in the upper duodenum are probably due to a lack of recanalization

3- Body Wall Defects (Omphalocele and Gastroschisis)

	Omphalocele	Gastroschisis
Definition	Herniation of abdominal viscera through an enlarged umbilical ring, the viscera are covered by amnion.	Herniation of abdominal contents through the body wall directly into the amniotic cavity
Presence of amniotic cover	yes	no
Other abnormalities	cardiac anomalies, neural tube defects and chromosomal abnormalities.	not associated with other anomalies
Mortality rate	Higher <25%>	lower

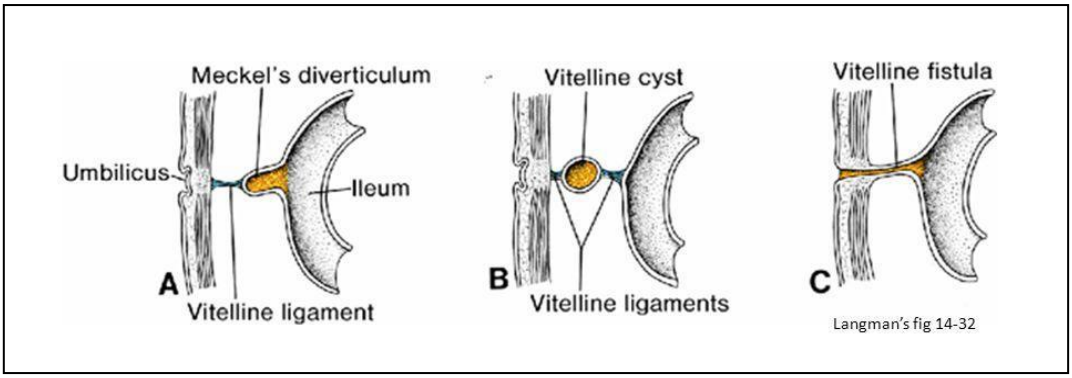
4- Vitelline Duct Abnormalities

The vitelline duct connects the yolk sac with the midgut, normally it gets atretic. However in some cases abnormalities occur, these include:

a- **Meckel's diverticulum**, when a small portion of the vitelline duct persists.it is present in 2% of people. It can be either asymptomatic or symptomatic when it contains other types of tissues (heterotropic; pancreatic or gastric) which causes ulceration, bleeding or perforation, in this case it needs surgical resection.

b- **Vitelline cyst**, when the two ends of the vitelline duct are closed and a middle cyst persists. It can be asymptomatic and coincidentally found.

c- **Umbilical fistula**, when the whole duct remains open. This can cause drainage.



Langman's fig 14-32

Congenital abnormalities of the hindgut

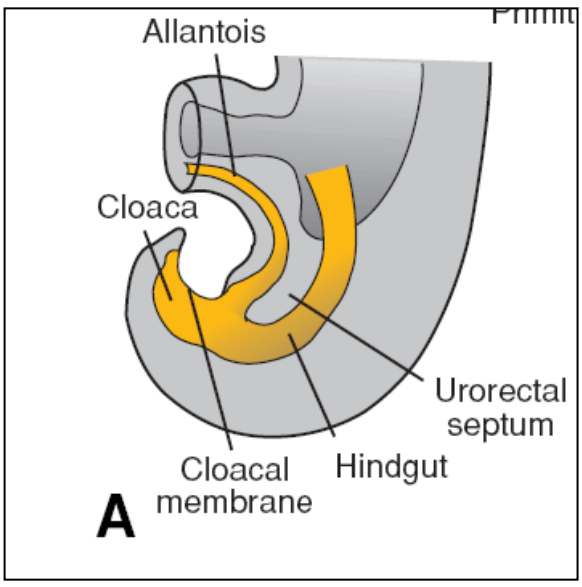
Case2: newborn did not pass meconium, on examination it appeared the baby has imperforated anus.

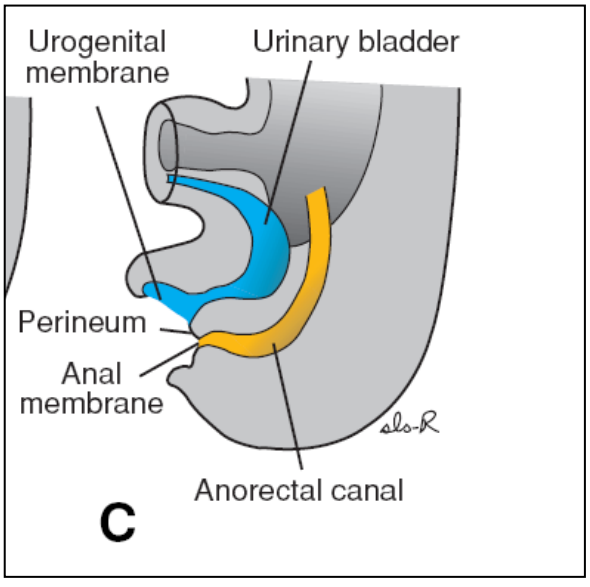
Development of the Hindgut

In the cloacal region, the **hindgut** enters posteriorly to form the future **anorectal canal**, anteriorly the **allantois** outgrows from the hindgut to form the future **urogenital sinus**. In between the hindgut and the allantois there is the **urorectal septum** which is derived from the mesoderm.

With further development the urorectal septum fuses with the cloacal membrane **(at 7 weeks)** forming urogenital opening (anteriorly) and the anal opening (posteriorly),the tip of the urorectal septum forms the perineal body. However, proliferation at the caudal end of the anal canal closes it, later, **at 9 weeks**, the region recanalizes.

The anal canal is divided into a **proximal part** derived from the hindgut endoderm. It is composed of columnar epithelium and supplied by the superior rectal artery (branch of the inferior mesenteric artery), and a **distal part** derived from the ectoderm, composed of stratified squamous epithelium and supplied by inferior recal artery (branch from internal pudendal artery). The junction betwee the endodernal and ectodernal parts is the **pectinate line**.

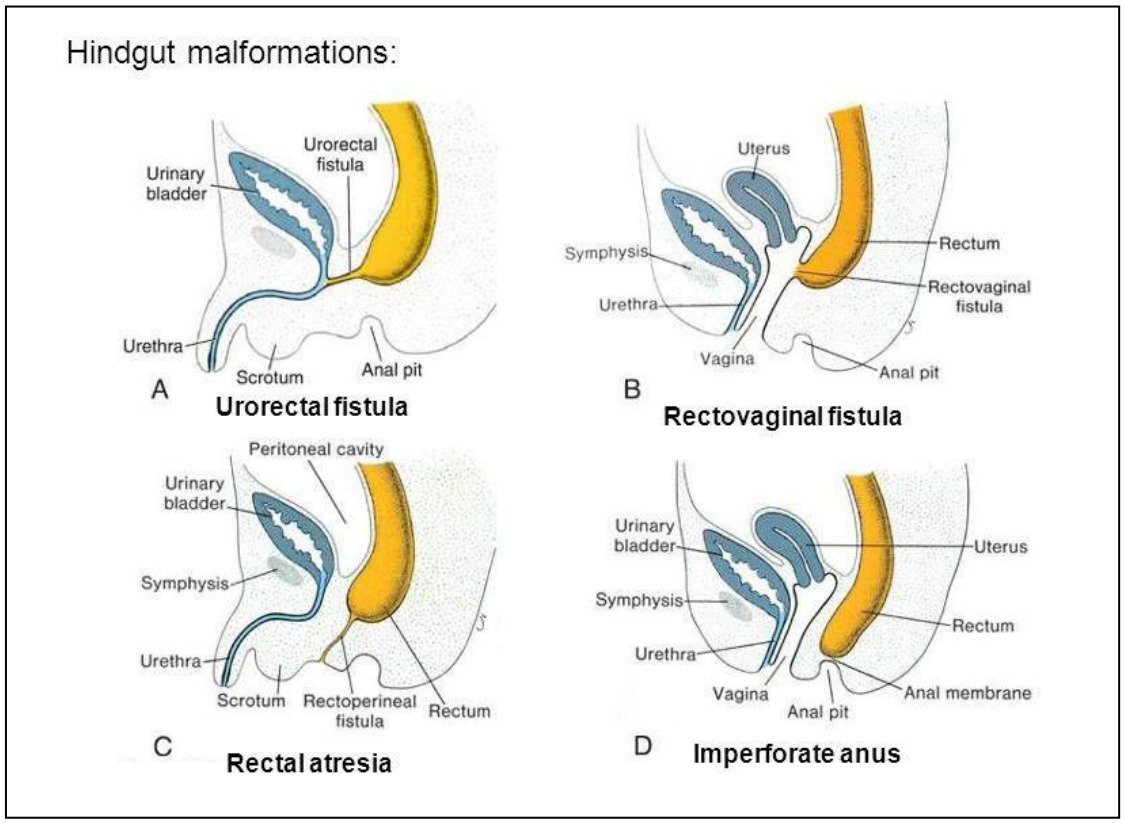




- The cloaca :
  an endoderm-lined cavity covered at its ventral boundary by surface ectoderm.
- Cloaca membrane:
  Membrane between hindgut endoderm, and ectoderm. Gives rise to anal canal and urogenital sinus openings

Congenital abnormalities of the hindgut

1- **Urorectal fistula**, rectum opens in the urinary tract, which results in urine mixed with stool.
2- **Rectovaginal fistula**, rectum is connected to vaginal opening.
3- **Rectal atresia**, in this case patients need reconstruction for the whole rectum.
4- **Imperforated anus**, failure of recanalization in the anal canal.



Good luck