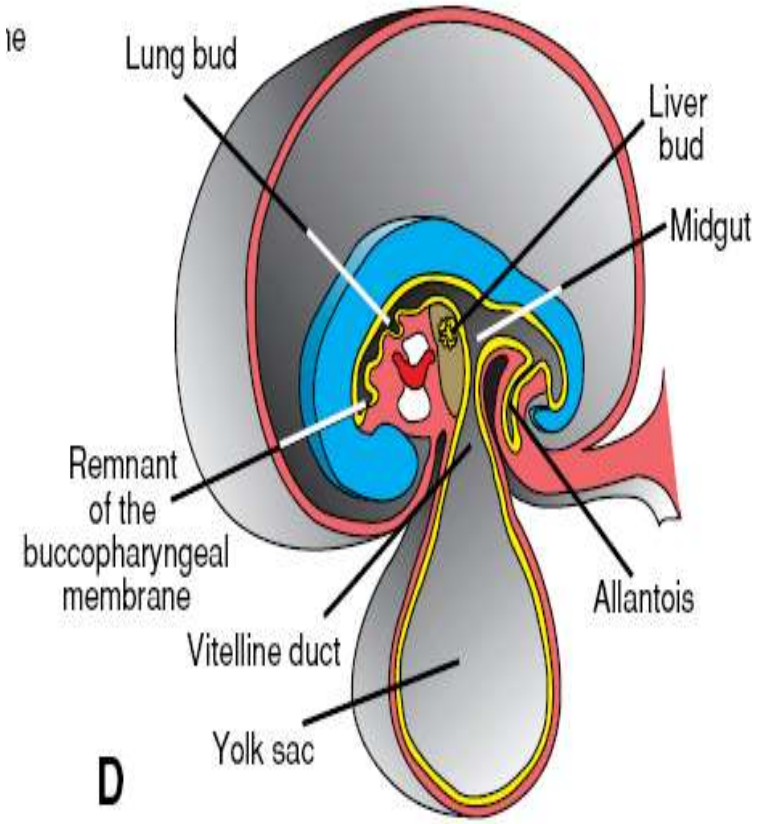
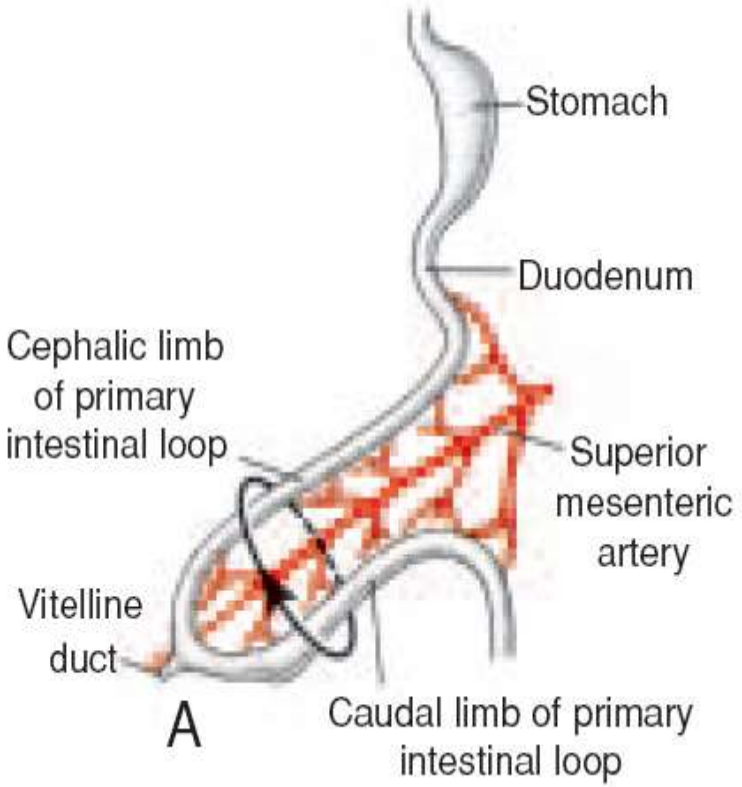
Gi Embryology 3

Midgut

- the midgut is suspended from the dorsal abdominal wall by a short mesentery and communicates with the yolk sac by way of the **vitelline duct or yolk stalk**
- Over its entire length the midgut is supplied by the **superior mesenteric artery**
- Development of the midgut is characterized by rapid elongation of the gut and its mesentery, resulting in formation of the **primary intestinal loop**
- At its apex, the loop remains in open connection with the yolk sac by way of the narrow **vitelline duct**



- In the adult the midgut begins immediately distal to the entrance of the bile duct into the duodenum
- terminates at the junction of the proximal two-thirds of the transverse colon with the distal third.
- The cephalic limb of the loop develops into the distal part of the duodenum, the jejunum, and part of the ileum.
- The caudal limb becomes the lower portion of the ileum, the cecum, the appendix, the ascending colon, and the proximal two-thirds of the transverse colon.



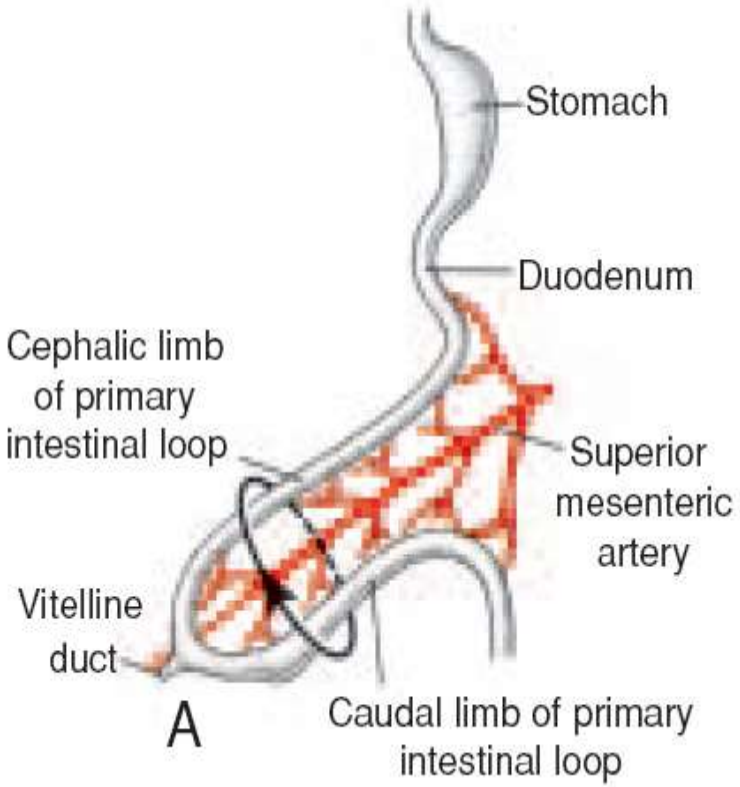
PHYSIOLOGICAL HERNIATION

- Development of the primary intestinal loop is characterized by rapid elongation, particularly of the cephalic limb.

- As a result of the rapid growth and expansion of the liver, the abdominal cavity temporarily becomes too small to contain all the intestinal loops, and they enter the extraembryonic cavity in the umbilical cord during the sixth week of development (**physiological umbilical herniation)**

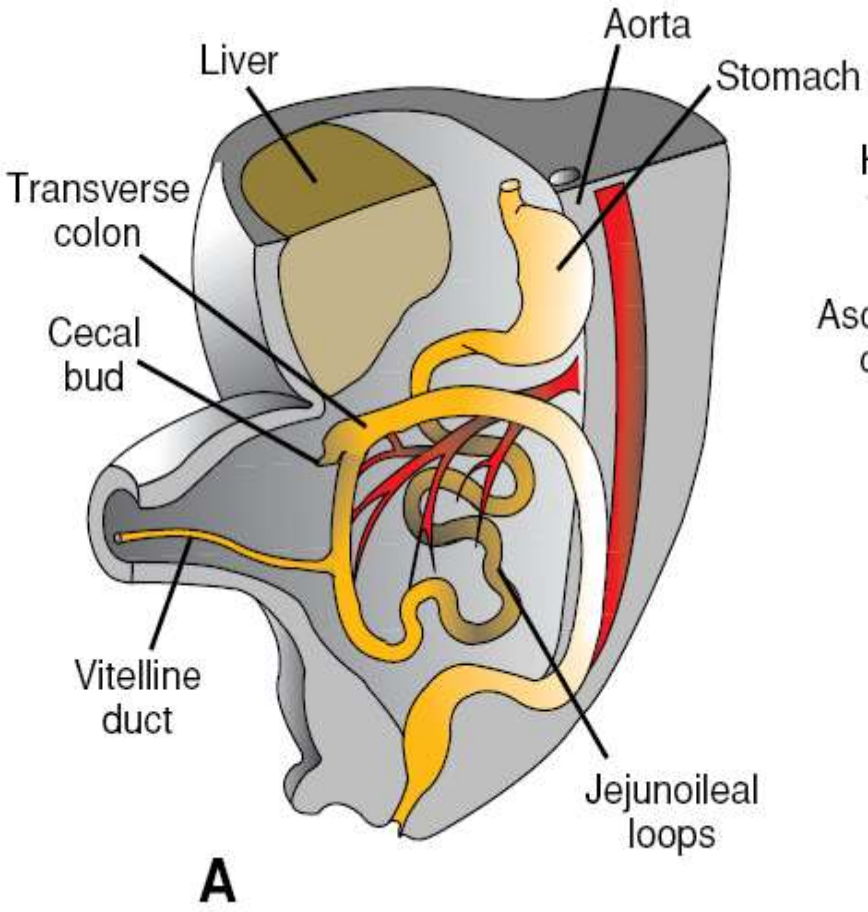
ROTATION OF THE MIDGUT

- Coincident with growth in length, the primary intestinal loop rotates around an axis formed by the **superior mesenteric artery**
- When viewed from the front, this rotation is counterclockwise, and it amounts to approximately 270◦ when it is complete
- Even during rotation, elongation of the small intestinal loop continues, and the jejunum and ileum form a number of coiled loops
- The large intestine likewise lengthens considerably but does not participate in the coiling phenomenon.
- Rotation occurs during herniation (about 90◦) as well as during return of the intestinal loops into the abdominal cavity (remaining 180◦)



RETRACTION OF HERNIATED LOOPS

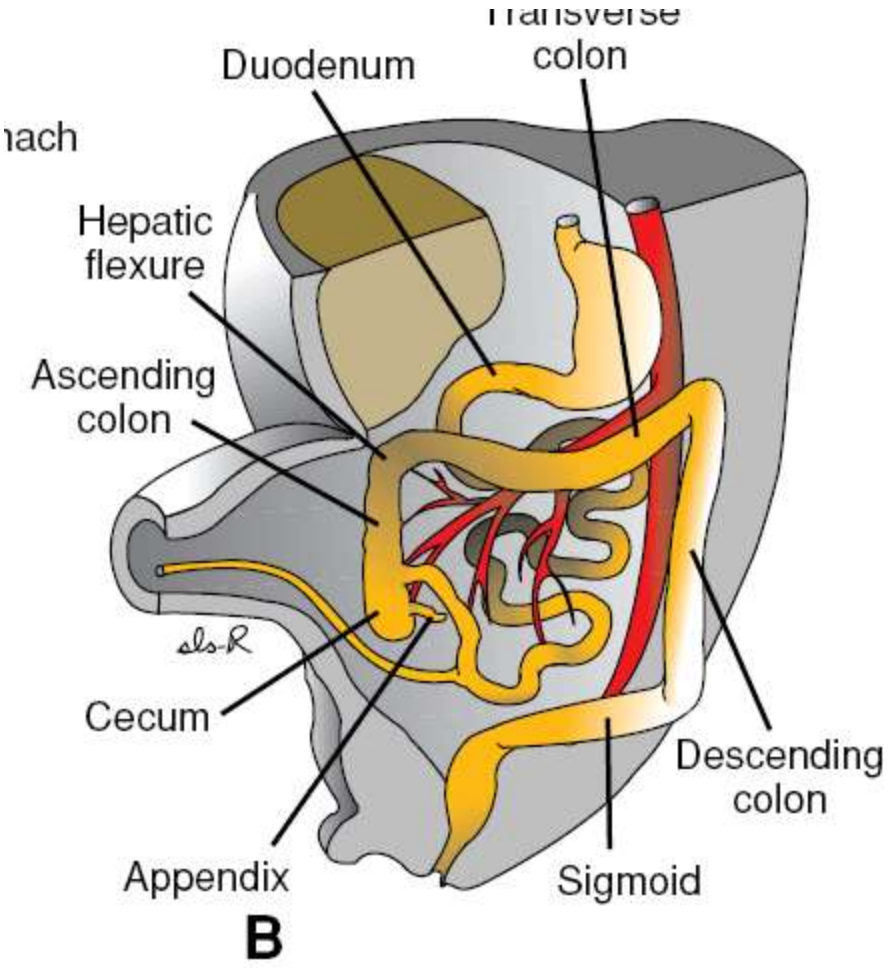
- During the 10th week, herniated intestinal loops begin to return to the abdominal cavity.
- is thought that regression of the mesonephric kidney, reduced growth of the liver, and expansion of the abdominal cavity play important roles.
- The proximal portion of the jejunum, the first part to reenter the abdominal cavity, comes to lie on the left side
- The later returning loops gradually settle more and more to the right.



- The **cecal bud, which appears** at about the sixth week as a small conical dilation of the caudal limb of the primary intestinal loop, is the last part of the gut to reenter the abdominal cavity.

- Temporarily it lies in the right upper quadrant directly below the right lobe of the liver

- From here it descends into the right iliac fossa, placing the **ascending colon and hepatic flexure on the right side of the abdominal** cavity



- During this process the distal end of the cecal bud forms a narrow diverticulum, the **appendix**
- Since the appendix develops during descent of the colon, its final position frequently is posterior to the cecum or colon.
- These positions of the appendix are called **retrocecal or retrocolic, respectively**

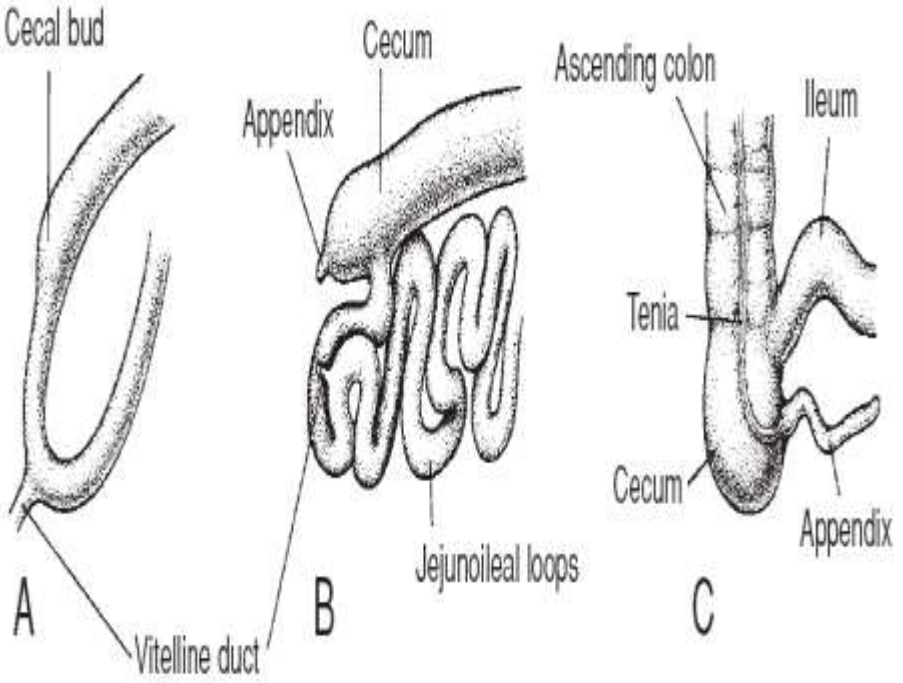


Figure 13.28 Successive stages in development of the cecum and appendix. **A.** 7 weeks. **B.** 8 weeks. **C.** Newborn.

MESENTERIES OF THE INTESTINAL LOOPS

- The mesentery of the primary intestinal loop, the **mesentery proper, undergoes** profound changes with rotation and coiling of the bowel.
- When the caudal limb of the loop moves to the right side of the abdominal cavity, the dorsal mesentery twists around the origin of the **superior mesenteric artery**
- Later, when the ascending and descending portions of the colon obtain their definitive positions, their mesenteries press against the peritoneum of the posterior abdominal wall

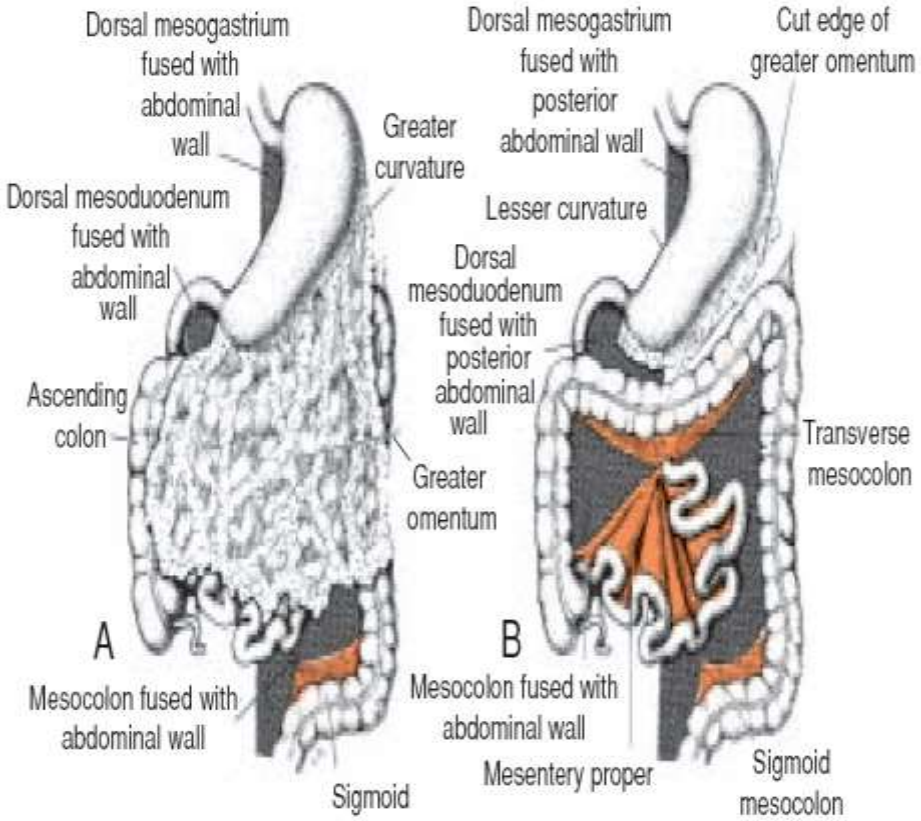
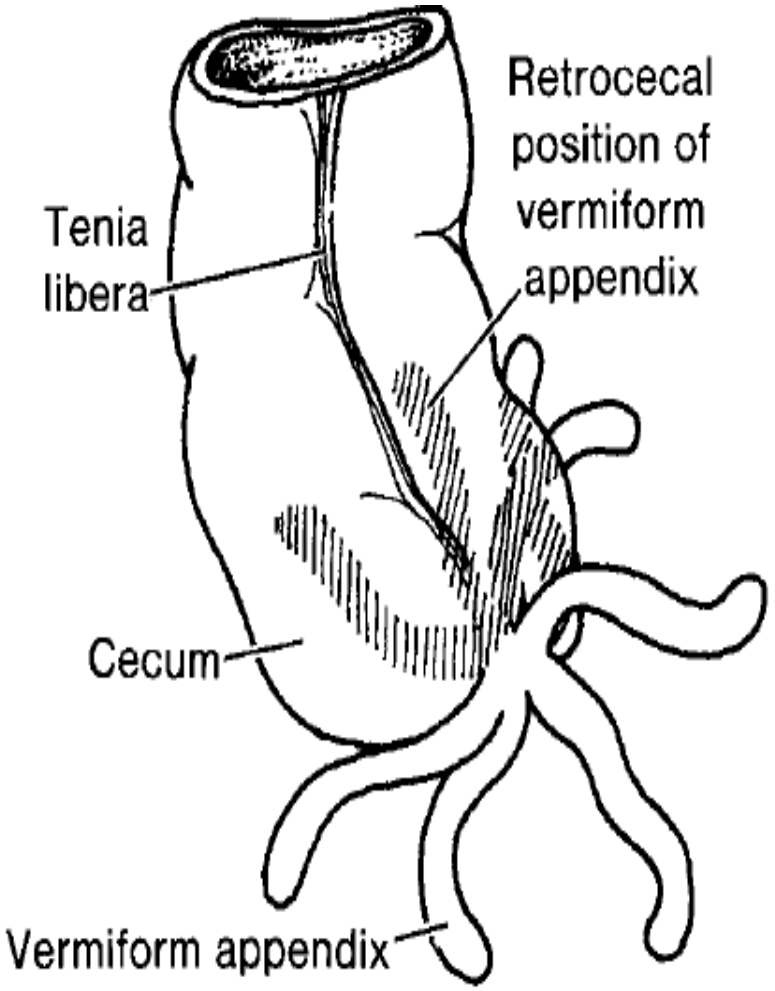


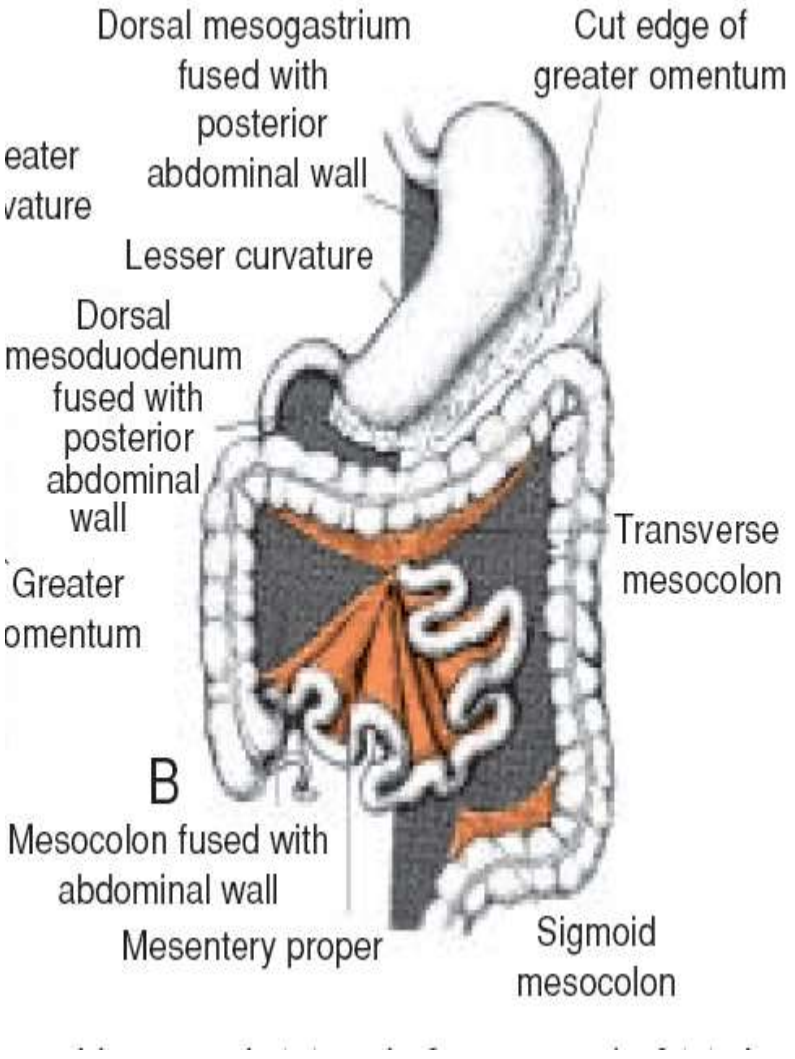
Figure 13.30 Frontal view of the intestinal loops with (**A**) and after removal of (**B**) the greater omentum. *Gray areas*, parts of the dorsal mesentery that fuse with the posterior abdominal wall. Note the line of attachment of the mesentery proper.

- After fusion of these layers, the ascending and descending colons are permanently anchored in a retroperitoneal position.
- The appendix, lower end of the cecum, and sigmoid colon, however, retain their free mesenteries
- The fate of the transverse mesocolon is different. It fuses with the posterior wall of the greater omentum but maintains its mobility.
- Its line of attachment finally extends from the hepatic flexure of the ascending colon to the splenic flexure of the descending colon



- The mesentery of the jejunoileal loops is at first continuous with that of the ascending colon

- When the mesentery of the ascending mesocolon fuses with the posterior abdominal wall, the mesentery of the jejunoileal loops obtains a new line of attachment that extends from the area where the duodenum becomes intraperitoneal to the ileocecal junction



Gut Rotation Defects

- **Abnormal rotation of the intestinal loop may result in twisting of the intestine (volvulus) and a compromise of the blood supply.**
- Normally the primary intestinal loop rotates 270◦ counterclockwise. Occasionally, however, rotation amounts to 90◦ only.
- When this occurs, the colon and cecum are the first portions of the gut to return from the umbilical cord, and they settle on the left side of the abdominal cavity
- The later returning loops then move more and more to the right, resulting in **left-sided colon.**

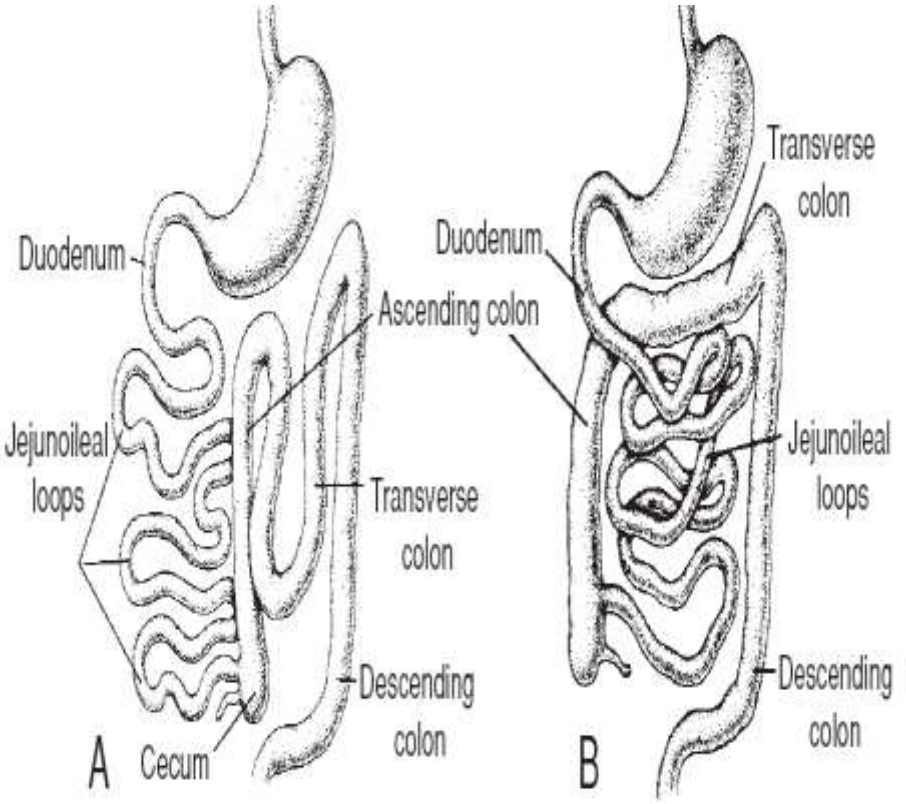
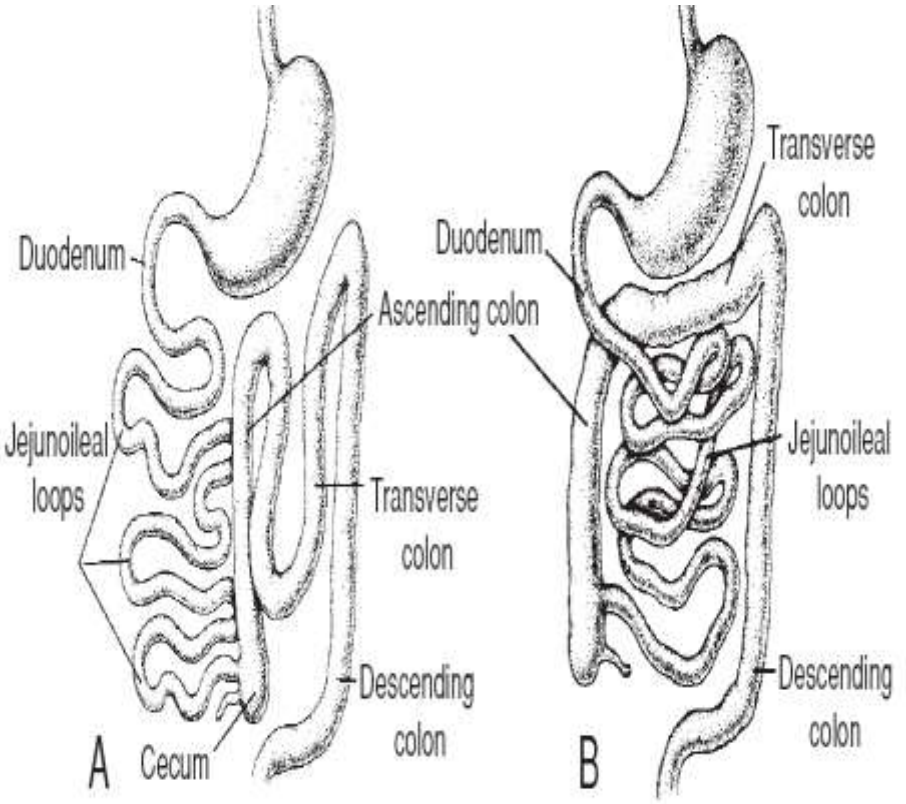


Figure 13.33 A. Abnormal rotation of the primary intestinal loop. The colon is on the left side of the abdomen, and the small intestinal loops are on the right. The ileum enters the cecum from the right. **B.** The primary intestinal loop is rotated 90° clockwise (reversed rotation). The transverse colon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

- **Reversed rotation of the intestinal loop occurs when the primary loop** rotates 90◦ clockwise
- In this abnormality the transverse colon passes behind the duodenum and lies behind the superior mesenteric artery.
- **Duplications of intestinal loops and cysts may occur anywhere along** the length of the gut tube
- They are most frequently found in the region of the ileum, where they may vary from a long segment to a small diverticulum.
- Symptoms usually occur early in life, and 33% are associated with other defects, such as intestinal atresias, imperforate anus, gastroschisis, and omphalocele



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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).

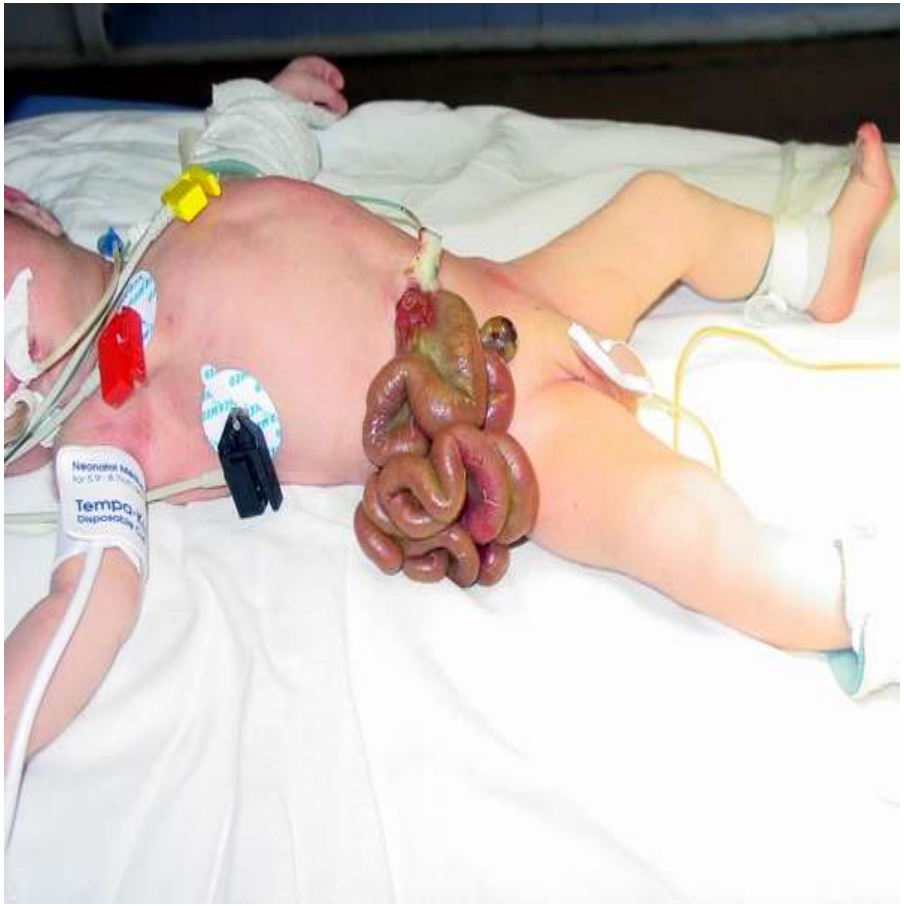
- Atresias in the upper duodenum are probably due to a lack of recanalization

Body Wall Defects

- **Omphalocele** involves herniation of abdominal viscera through an enlarged umbilical ring.
- The viscera, are covered by amnion.
- The origin of the defect is a failure of the bowel to return to the body cavity from its physiological herniation
- Omphalocele occurs in 2.5/10,000 births and is associated with a high rate of mortality (25%) and severe malformations, such as cardiac anomalies (50%) and neural tube defects (40%).
- Approximately half of live-born infants with omphalocele have chromosomal abnormalities.

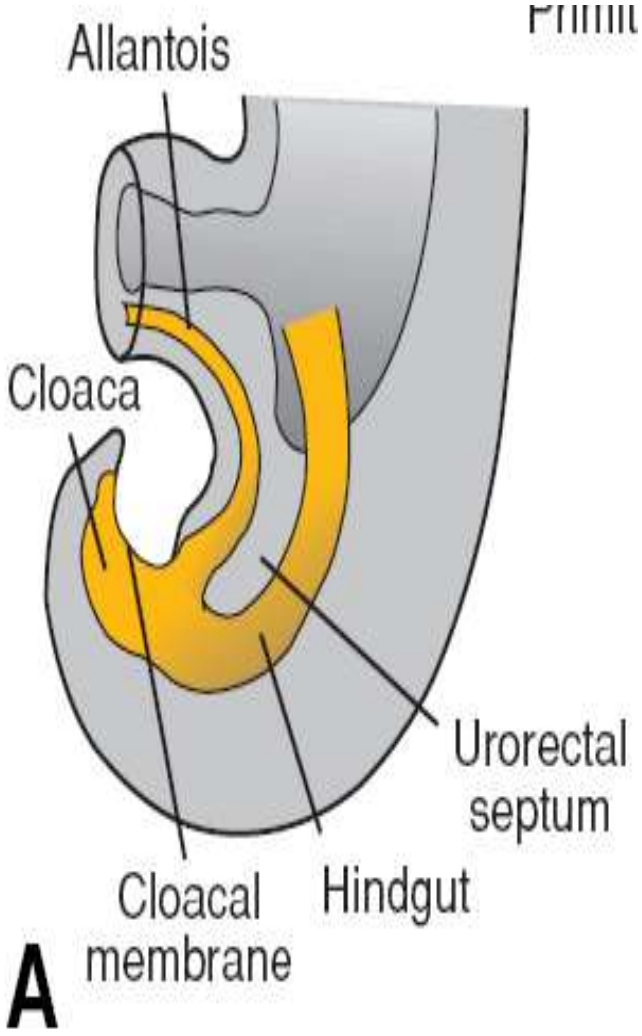
- **Gastroschisis** is a herniation of abdominal contents through the body wall directly into the amniotic cavity.

- It occurs lateral to the umbilicus usually on the right

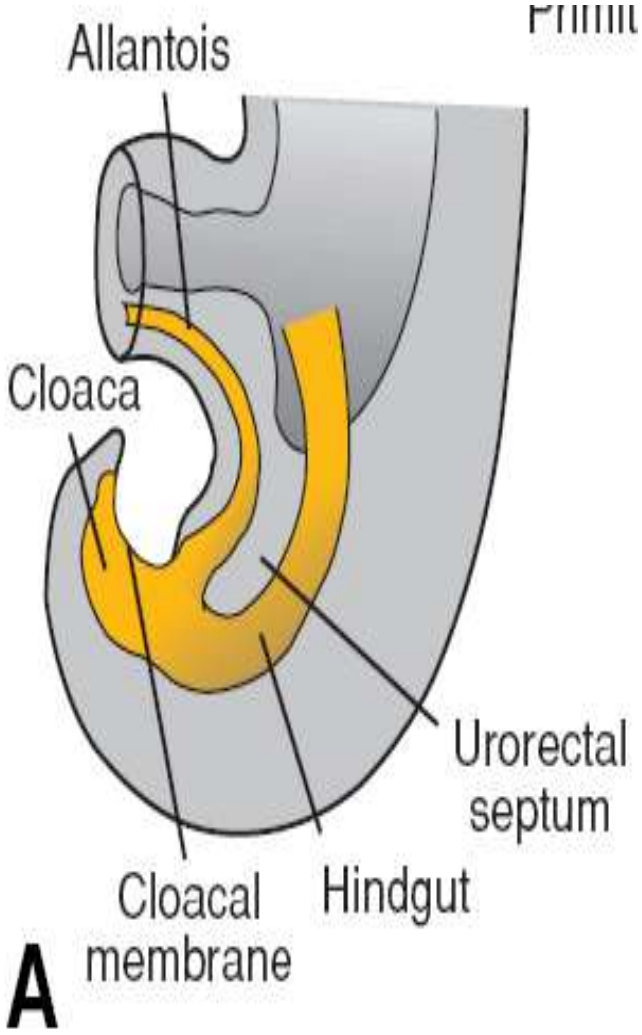


Hindgut

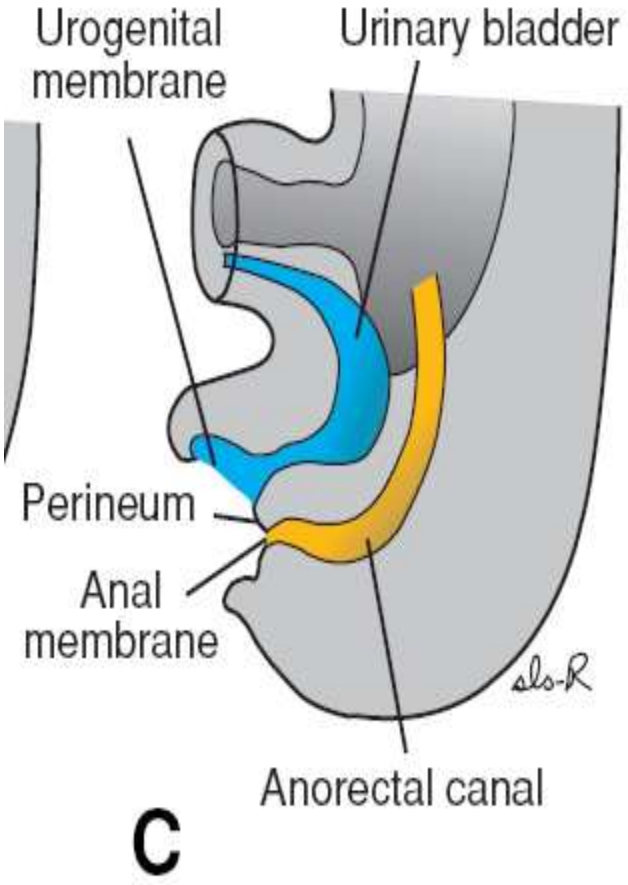
- The hindgut gives rise to the distal third of the transverse colon, the descending colon, the sigmoid, the rectum, and the upper part of the anal canal.
- The endoderm of the hindgut also forms the internal lining of the bladder and urethra
- The terminal portion of the hindgut enters into the posterior region of the cloaca, the primitive **anorectal canal; the allantois enters into the anterior** portion, the primitive **urogenital sinus**



- The cloaca itself is an endoderm-lined cavity covered at its ventral boundary by surface ectoderm.
- This boundary between the endoderm and the ectoderm forms the **cloacal membrane**
- A layer of mesoderm, the **urorectal septum, separates** the region between the allantois and hindgut.
- This septum is derived from the merging of mesoderm covering the yolk sac and surrounding the allantois



- At the end of the seventh week, the cloacal membrane ruptures, creating the anal opening for the hindgut and a ventral opening for the urogenital sinus.
- Between the two, the tip of the urorectal septum forms the perineal body
- proliferation of ectoderm closes the caudalmost region of the anal canal.
- During the ninth week, this region recanalizes
- Thus, the caudal part of the anal canal originates in the ectoderm, and it is supplied by the **inferior rectal arteries,** branches of the **internal pudendal arteries**



The junction between the endodermal and ectodermal regions of the anal canal is delineated by the **pectinate line, just below the anal columns**

- At this line, the epithelium changes from columnar to stratified squamous epithelium.

What are anorectal malformations?

- Anorectal malformations are birth defects in which the anus and rectum (the lower end of the digestive tract) don't develop properly. They occur in an estimated 1 in 4,000 newborns and can range from mild to complex.
- Anorectal malformations include several different abnormalities, including:
- The anal passage may be narrow.
- A membrane may be present over the anal opening.
- The rectum may not connect to the anus (imperforate anus).
- The rectum may connect to a part of the urinary tract or the reproductive system through an abnormal passage called a fistula.

- **Types of anorectal malformations:**
- Anorectal malformations, including imperforate anus, can affect male and female babies in different ways.
- In boys, the main anorectal malformations are perineal fistula, rectobulbarurethral fistula, rectoprostatic fistula and rectobladderneck fistula.

- In girls, the main anorectal malformations are rectoperineal fistula, rectovestibular fistula and cloaca.

- A type of anorectal malformation called imperforate anus can occur in both boys and girls.

Types of anorectal malformations