

**DEVELOPMENT OF MIDGUT**

**&**

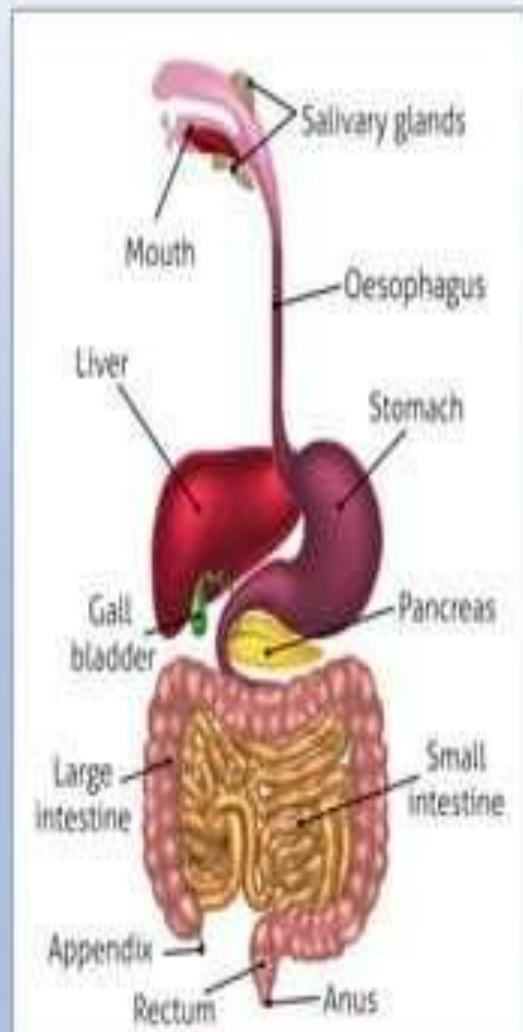
**HINDGUT**

## Midgut

**Extent:** Primitive midgut extends from the duodenum (distal to the opening of bile duct) to the proximal 2/3<sup>rd</sup> of transverse colon

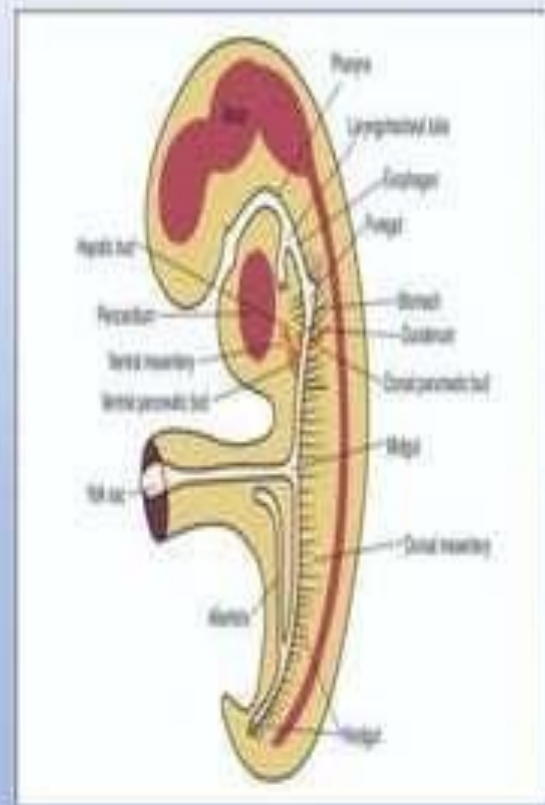
### Derivatives

1. Duodenum beyond the opening of common bile duct
2. Jejunum
3. Ileum
4. Appendix
5. Cecum
6. Ascending colon
7. Right colic flexure
8. Right 2/3 of transverse colon



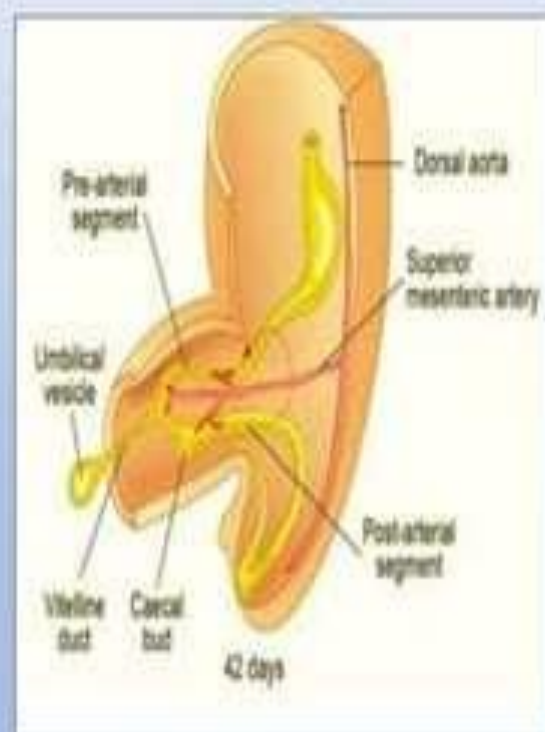
## Primitive Midgut

- Primitive midgut is a narrow tube like structure extending from **anterior intestinal portal** to **posterior intestinal portal**
- Suspended in median plane from posterior abdominal wall by a short primitive **dorsal mesentery** which contains the **superior mesenteric artery** which supplies the entire length of midgut
- Communicates with the yolk sac through Vitello intestinal duct.



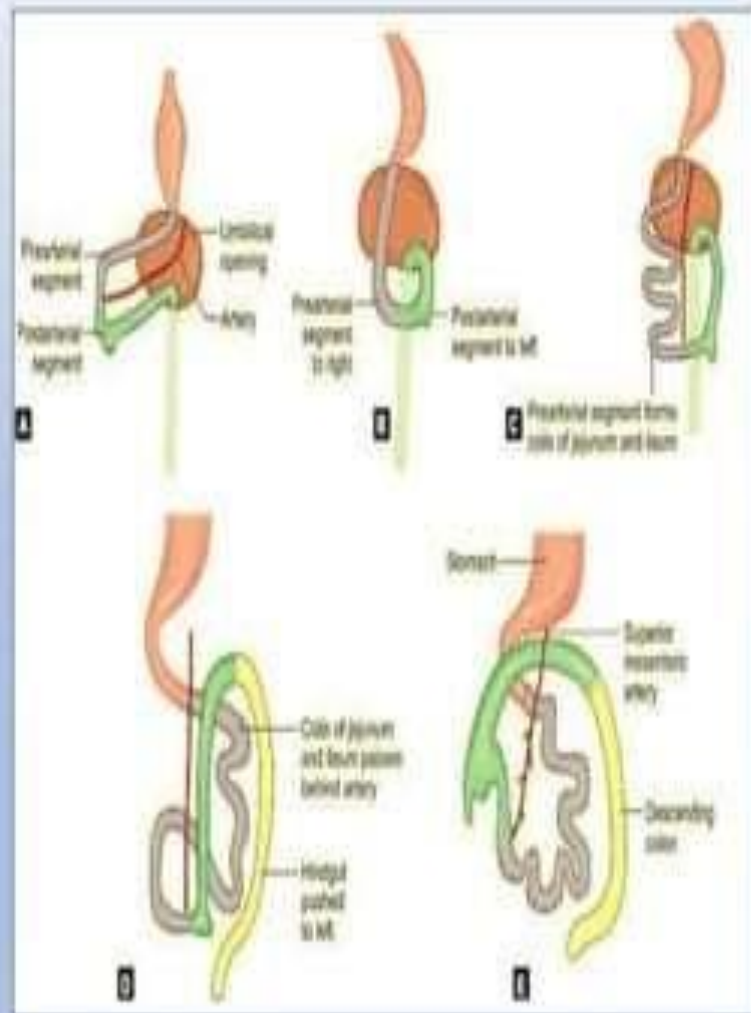
## Primary Intestinal Loop

- Rapid ventral elongation of midgut results in formation of primary Intestinal loop
- **SMA** runs in the loop & divides it into
- **Pre-arterial segment** which forms distal part of duodenum, jejunum & part of ileum
- **Post-arterial segment** which forms terminal part of ileum, caecum, appendix, ascending colon & right two-thirds of transverse colon



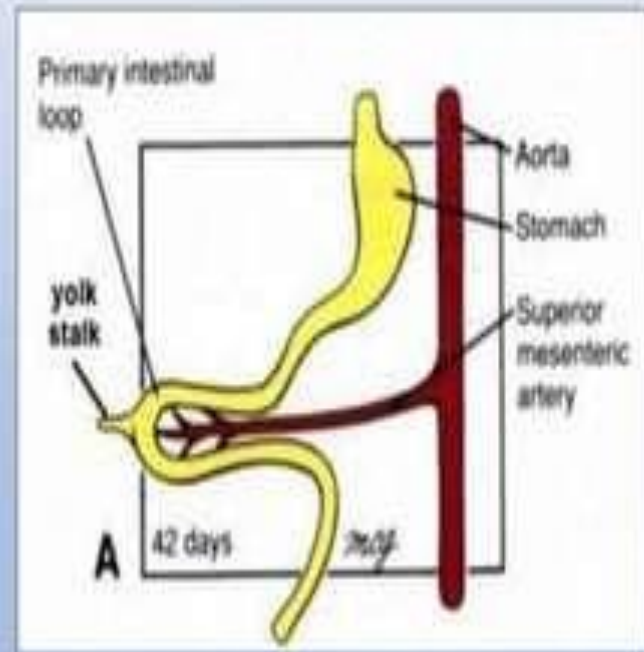
## Stages of Midgut development

- Physiological Umbilical hernia
- Rotation of the midgut loop
- Retraction of herniated loops to abdomen
- Fixation of intestines



## Physiological Umbilical Hernia

- During 3<sup>rd</sup>-6<sup>th</sup> week of IUL, pre arterial segment elongates rapidly to form coils of jejunum & ileum
- At the same time there is rapid growth of liver & mesonephric kidney due to which the abdominal cavity becomes too small to accommodate all the intestinal loops.
- Therefore during 6<sup>th</sup> week of IUL, midgut loop enters the extraembryonic coelomic cavity through the umbilical cord. This herniation of intestinal loop is called **Physiological Umbilical Hernia**.



## Retraction of Midgut Loop

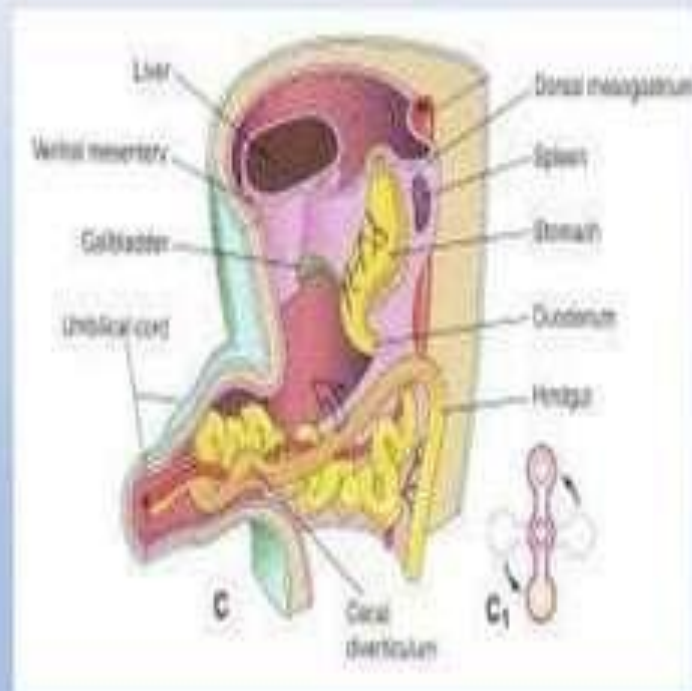
- During 10th week, herniated loops return to abdominal cavity.

- **This is due to**

**Regression of mesonephric kidney**

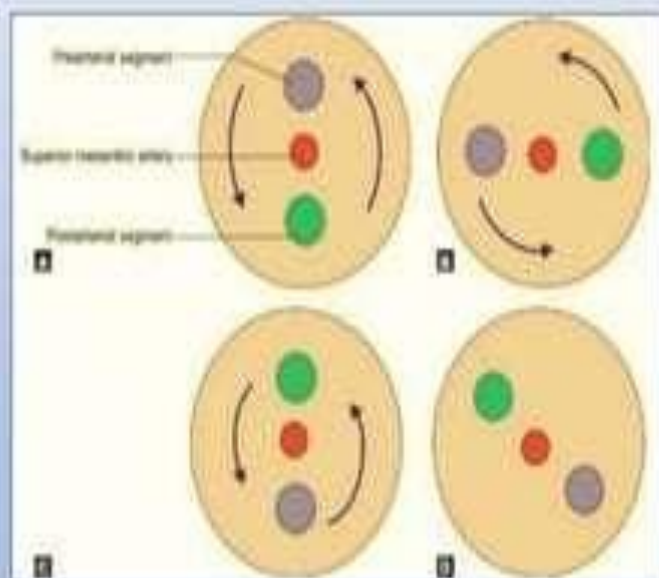
**Reduced growth of liver**

**Expansion of abdominal cavity.**



## Rotation of Midgut

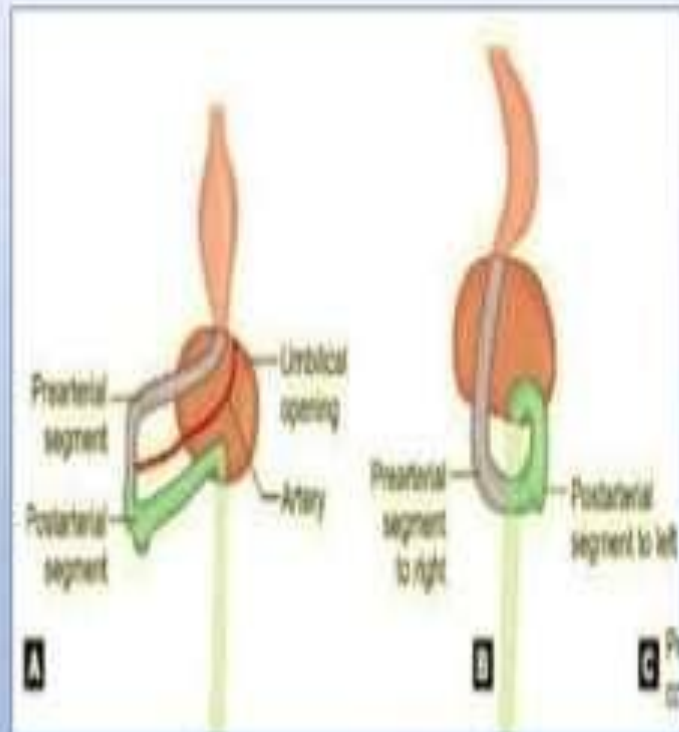
- During herniation & retraction the midgut loop makes a rotation of total **270°** in **anti clockwise direction** around the axis of **SMA**
- Total rotation of midgut can be divided into **3 stages of 90°** each.
- **First 90°** rotation occurs during herniation of loop & **rest 180°** during return of intestinal loop into the abdominal cavity.
- The elongation of intestinal loop continues during rotation forming coils of jejunum and ileum





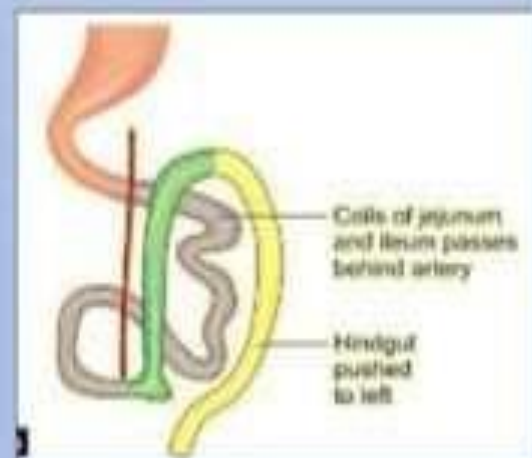
## First Stage Rotation

- Initially, the loop lies in the sagittal plane having a **Pre arterial** segment which is cranial & a **Post arterial** segment which is caudal
- It undergoes rotation by 90° in anticlockwise direction with the result that it now lies in the horizontal plane
- The **pre arterial** segment comes to lie on the right side & the **post arterial** segment on the left of the **SMA** which forms the axis



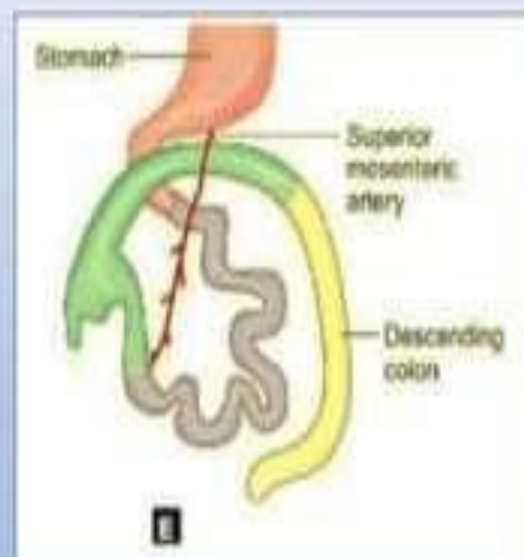
## Second Stage Rotation

- The **pre arterial** segment increases in length & forms coils of jejunum & ileum which are still outside the Abd cavity.
- The **pre arterial** segment returns first. It undergoes rotation of  $90^\circ$  in anticlockwise direction & coils of jejunum & ileum pass behind SMA into left half of Abd cavity.
- Duodenum comes to lie behind SMA & coils of jejunum & ileum occupy the posterior & left part of Abd cavity.



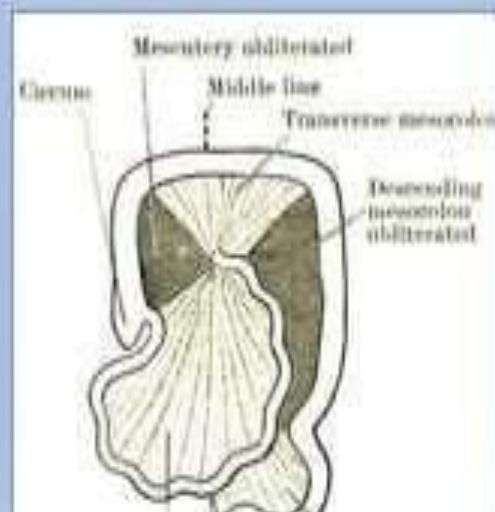
## Third Stage Rotation

- The **post arterial** segment of the midgut loop returns to the abdominal cavity. As it does so, it also rotates in an anticlockwise direction of 90°
- With the result, the transverse colon lies anterior to **SMA**, and caecum comes to lie on the right side just below the liver.
- Gradually, the caecum descends to the iliac fossa, & the ascending, transverse & descending colon will be formed.



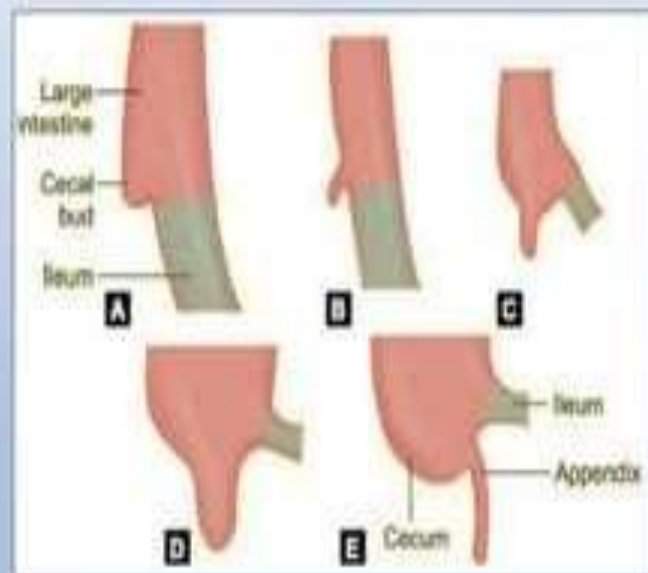
## Fixation of Gut

- Initially all parts of small & large intestines have a dorsal mesentery
- After complete rotation of gut, the duodenum, ascending colon, descending colon & rectum become retroperitoneal by fusion of their mesenteries with posterior abdominal wall
- Only the mesenteries of small intestine, transverse colon & sigmoid colon persists as **the mesentery proper, transverse mesocolon & sigmoid mesocolon.**



## Development of Caecum & Appendix

- Caecum develops from **Caecal bud** which appears in the **6th week** of IUL as diverticulum from **post-arterial segment** of the midgut loop.
- **Proximal part**: dilates to form the **Caecum**
- **Distal part**: persists as narrow tube: **Vermiform appendix**.
- Initially the appendix is attached to the apex of caecum but due to differential growth of the walls of caecum the attachment of the appendix shifts medially.

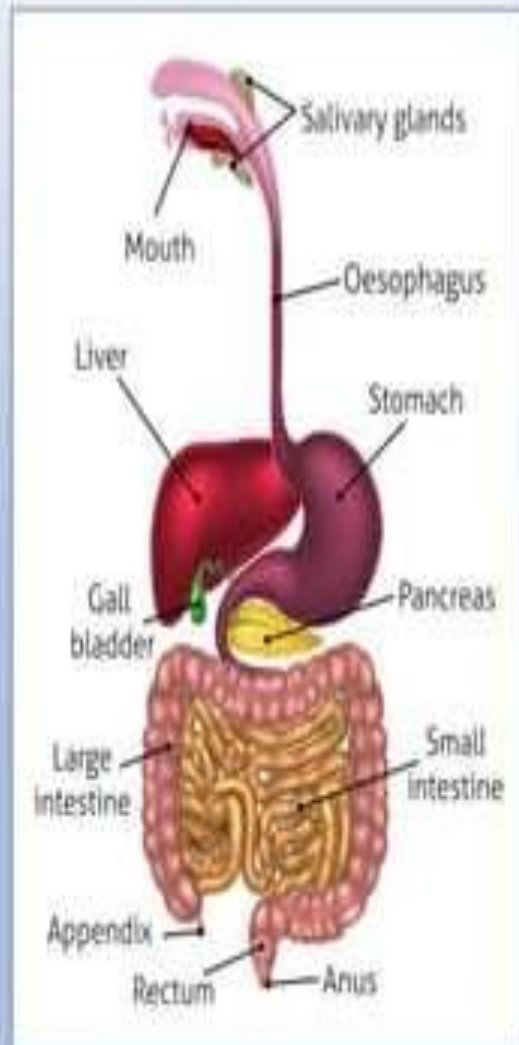


## Hindgut

**Extent:** From the junction of right 2/3<sup>rd</sup> and left 1/3<sup>rd</sup> of transverse colon to the upper part of anal canal

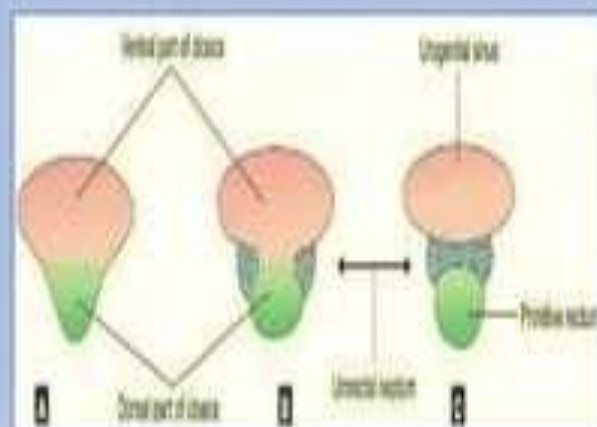
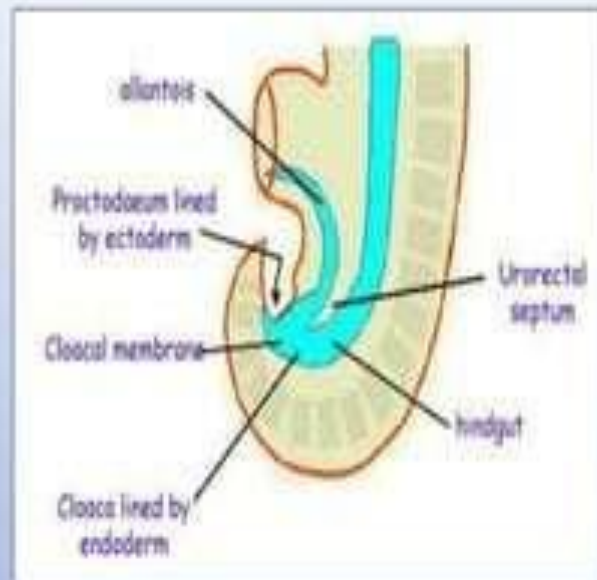
### Derivatives

1. Left 1/3 of transverse colon.
2. Left colic flexure.
3. Descending colon.
4. Sigmoid colon.
5. Rectum.
6. Upper ½ of anal canal.
7. Primitive urogenital sinus derivatives.



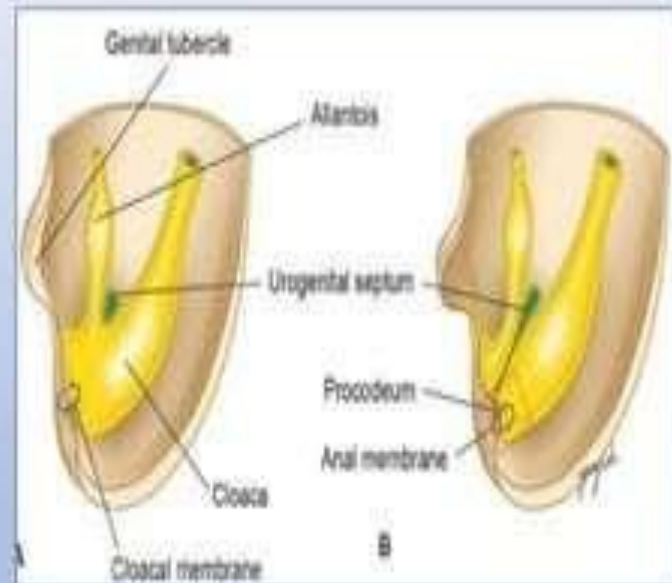
## Development of Hindgut

- **Allantoic diverticulum** opens into the ventral aspect of the hindgut
- The part of the hindgut caudal to the attachment of allantoic diverticulum is called **Cloaca**.
- Due to mesenchymal condensation **Urorectal septum** is formed which divides cloaca into two parts:
- **Primitive Urogenital Sinus**: Broad ventral part
- **Primitive Rectum**: Narrow dorsal part



## Development of Hindgut

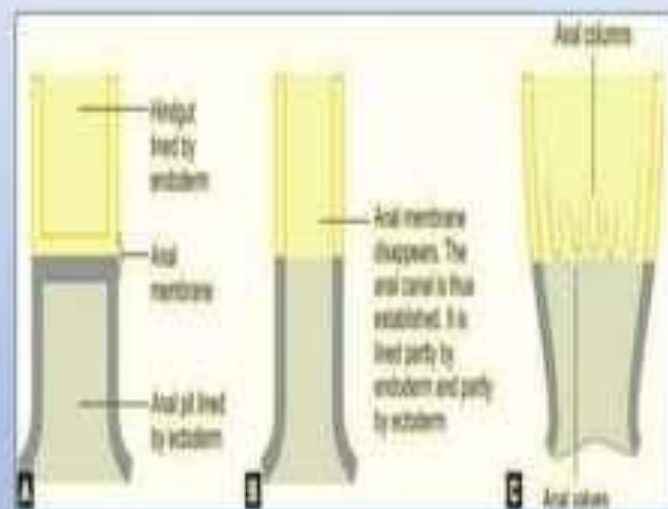
- Urorectal septum also divides the cloacal membrane into two parts
- **Urogenital membrane:** related to urogenital sinus
- **Anal membrane:** related to rectum.
- Mesoderm around the anal membrane gets heaped up to form **anal pit or proctodaeum** which contributes to the formation of anal canal.





## Development of Anal Canal

- Anal canal is derived from **two** sources:
- **Cloaca (Endoderm)** : Forms upper part of anal canal above the pectinate line.
- **Anal pit (Ectoderm)**: Forms lower part of anal canal below the pectinate line
- The **anal membrane** ruptures and hindgut communicates with exterior.
- Junction of two parts is represented by **pectinate line** of the anal canal.



## Development of Anal Canal

	Above pectinate line (upper part of anal canal)	Below pectinate line (lower part of anal canal)
<b>Origin</b>	Endoderm	Ectoderm
<b>Develops from</b>	Cloaca (Primitive rectum)	Proctodaeum (Anal pit)
<b>Arterial supply</b>	Superior rectal artery	Inferior rectal artery
<b>Venous drainage</b>	Superior rectal vein (Portal vein)	Inferior rectal vein (Systemic vein)
<b>Nerve supply</b>	Autonomic nerves	Somatic nerves
<b>Epithelium</b>	Simple columnar	Stratified squamous non keratinized

## Development of Colon & Rectum

### Transverse colon:

Right two-thirds from the post arterial segment of midgut, supplied by **SMA**

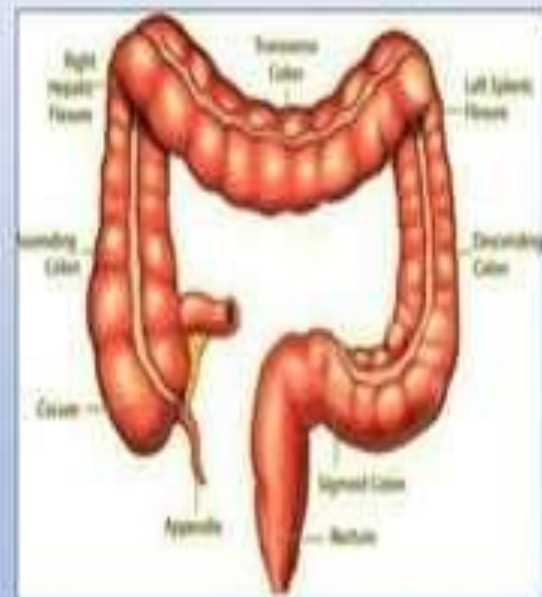
Left one-third from the hindgut. supplied by **IMA**

### Descending Colon & Sigmoid colon

Develop from the hindgut.

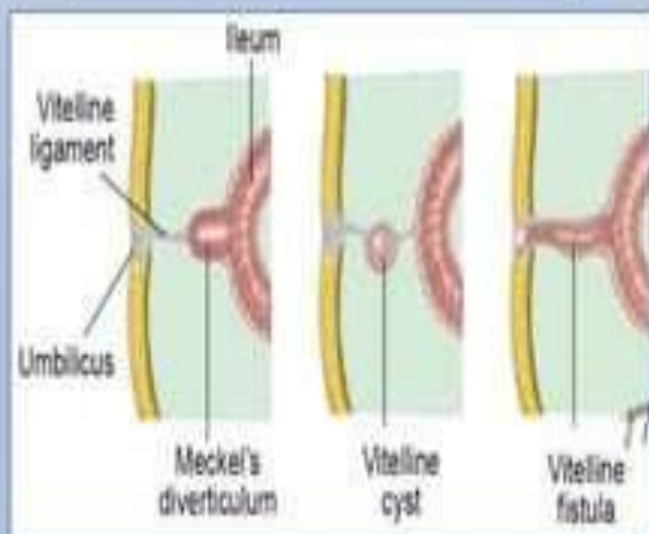
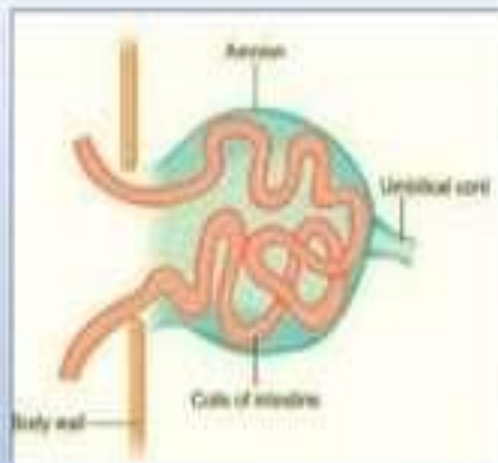
### Rectum

Primitive rectum, i.e. the dorsal subdivision of the cloaca.



## Congenital Anomalies

- Exomphalos or Omphalocele
- Umbilical hernia
- Umbilical fecal fistula
- Enterocystoma (Vitelline cyst)
- Raspberry tumor
- Meckel's diverticulum



## Congenital Anomalies

- **Errors of midgut rotation & fixation**

Non rotation

Reversed rotation

Mixed rotation & Volvulus

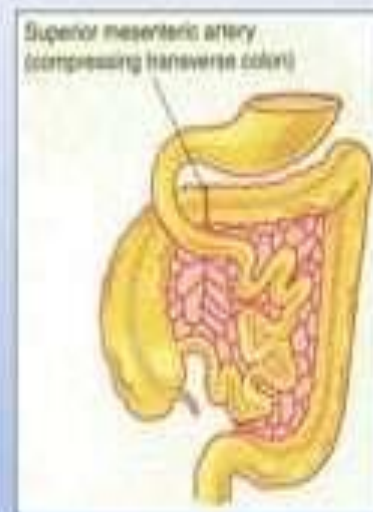
- **Errors of fixation of gut**

Persistence of mesentery

Abnormal adhesion of peritoneum

- **Duplication of intestine**

- **Abnormalities of caecum**



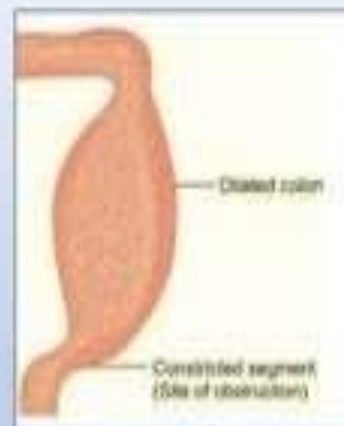
## Congenital Anomalies

- **Hirschsprung's disease (Congenital megacolon)**

Dilated segment of colon due to congenital absence of PS ganglia in the wall of gut.

Incidence: 1 in 5,000 newborns.

Treatment: Resection of constricted segment.



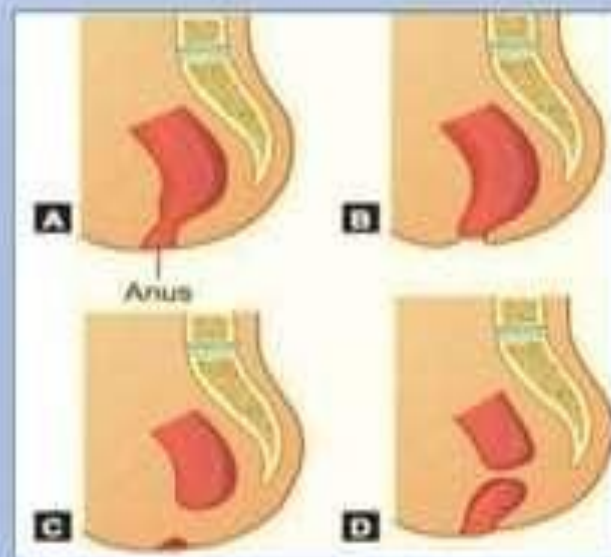
- **Imperforate anus:** Distal part of gut does not communicate with exterior

**Causes:**

Failure of rupture of anal membrane

Failure of development of ectodermal proctodaeum

Failure of rectal development (rectal atresia).



## Congenital Anomalies

- **Rectal fistula** : Abnormal communication between two organs.

### Types :

Recto-vesical fistula

Recto-urethral fistula

Recto-vaginal fistula

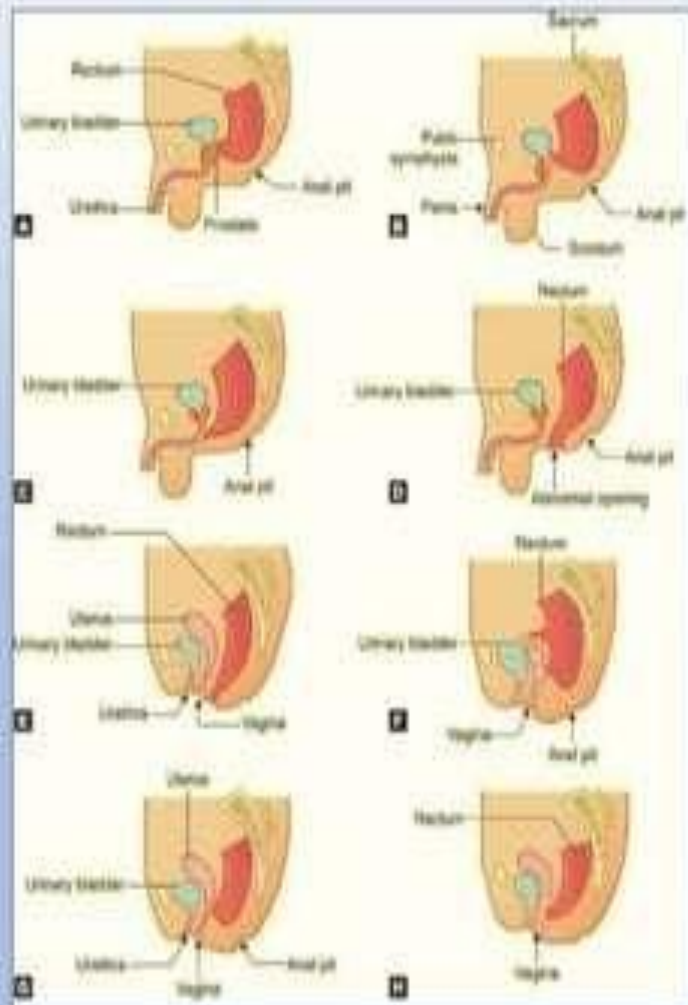
- **Ectopic anus**

### Sites :

In **female**: within the vestibule.

In **male**: at the base of scrotum

- **Anal stenosis**



THANK YOU