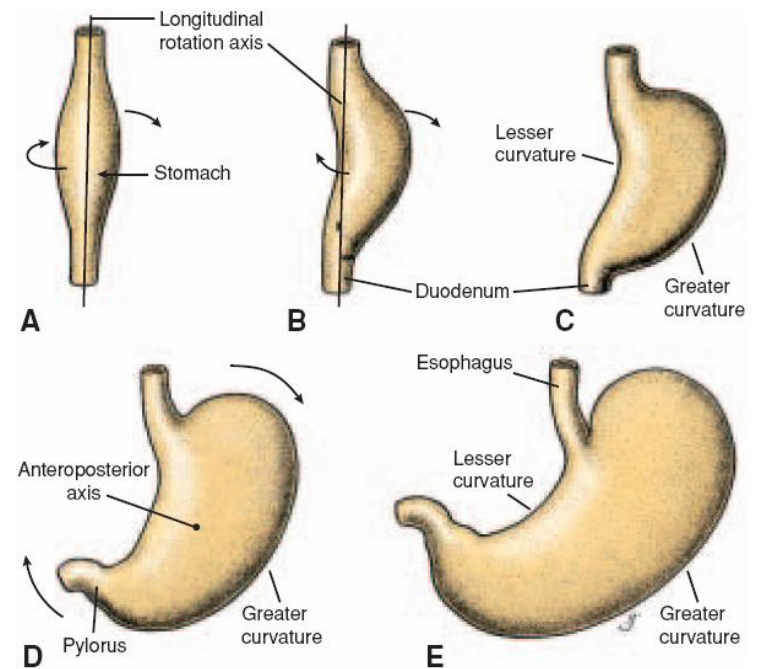
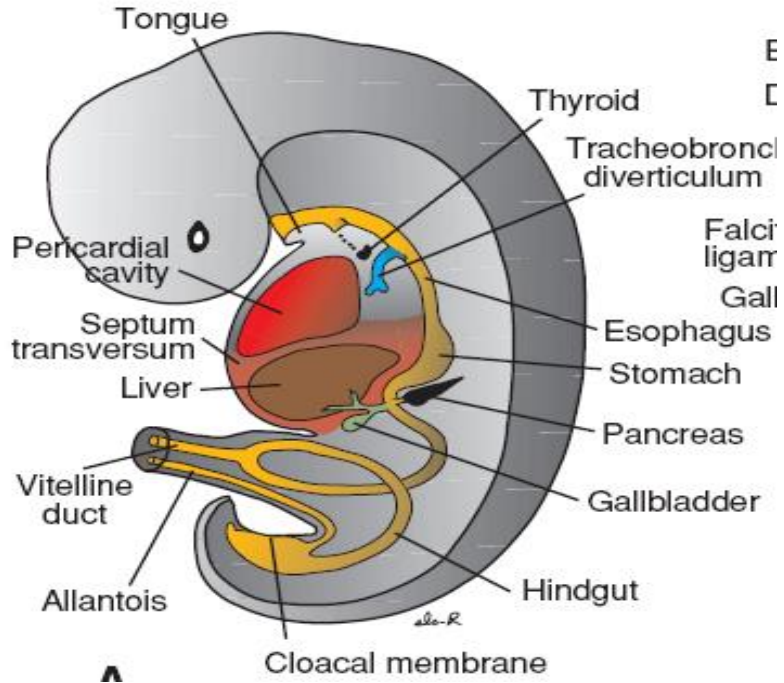


# DEVELOPMENT OF GI TRACT



Dr.Priti Acharya

# Primitive gut

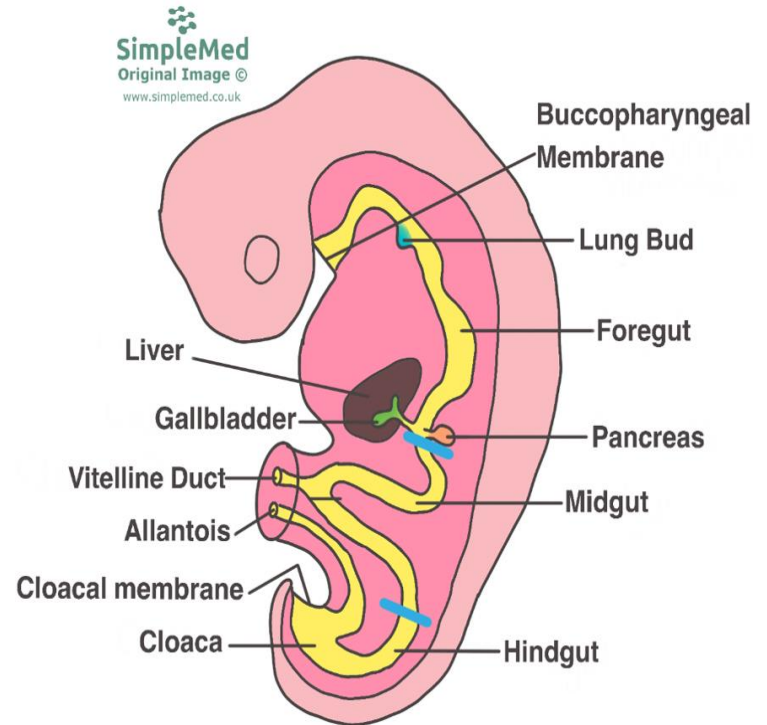
- During 4<sup>th</sup> week from the endoderm of yolk sac.
- Gut is divided in

Foregut,  
Midgut &  
Hindgut.

Foregut extends from buccopharyngeal membrane to its junction with the midgut, known as anterior intestinal portal/loop.

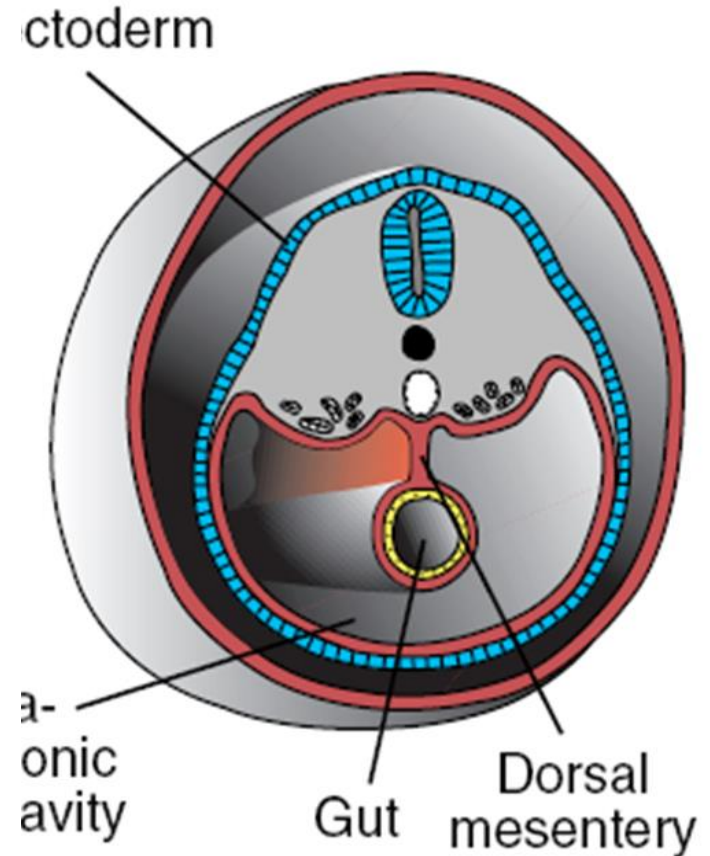
Midgut extends from anterior intestinal portal to posterior intestinal portal.

Hindgut extends from posterior intestinal portal to the cloacal membrane.



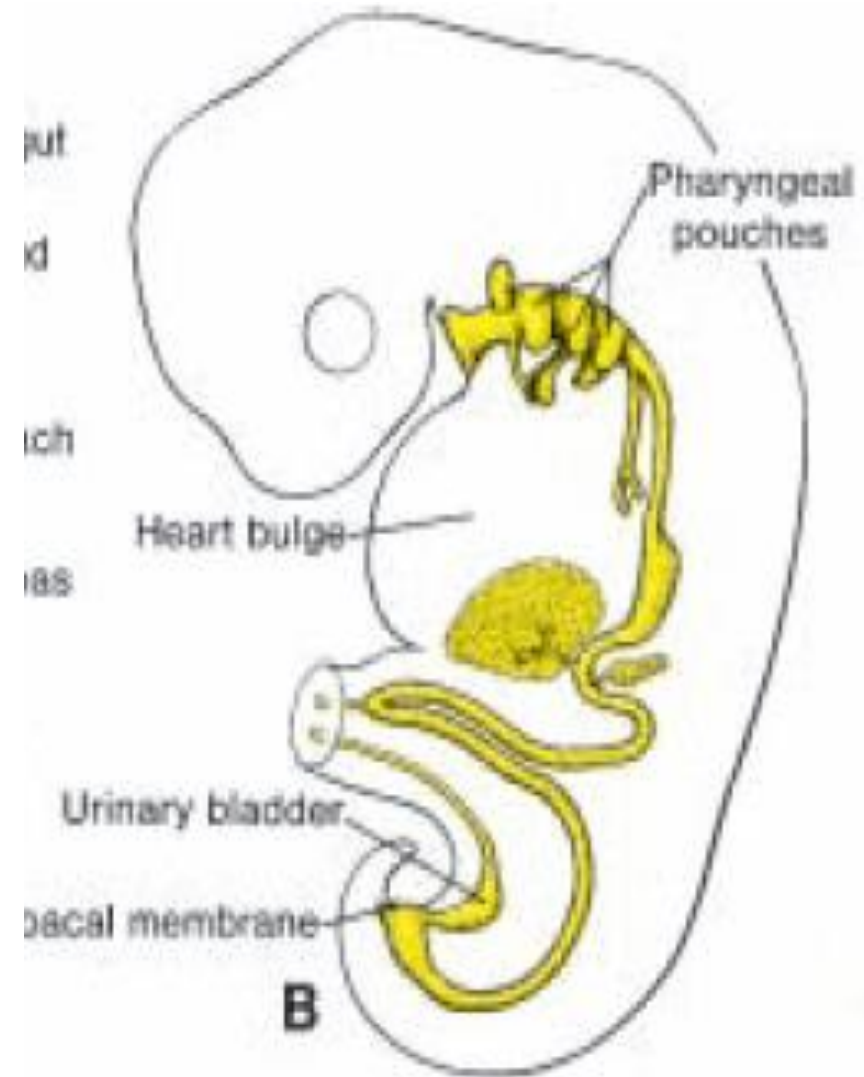
# Wall of all gut

- Epithelial lining of GI Tract & all glands in lamina propria are derived from endoderm of primitive gut..
- Epithelial lining of mouth and anal canal are formed by ectoderm of stomatodaeum and proctodaeum respectively.
- Muscular, Connective, peritoneal layers are derived by mesenchyme surrounding the primitive gut.



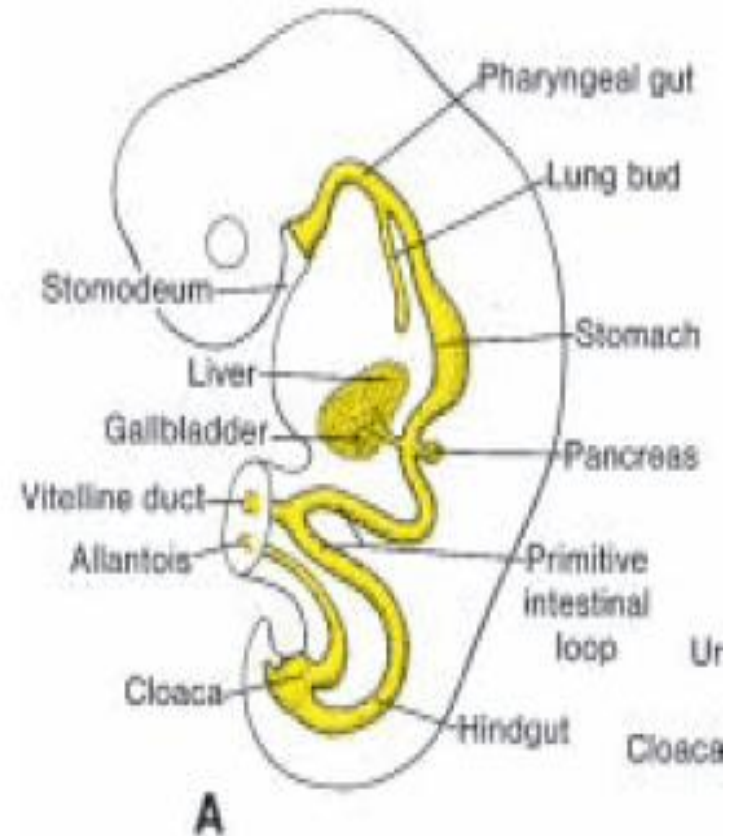
# Derivatives of foregut

- Oral cavity, pharynx, tongue, salivary glands.
- Upper respiratory tract.
- Esophagus
- Stomach
- 1<sup>st</sup> and upper half of 2<sup>nd</sup> part of duodenum
- Liver & biliary tract
- Pancreas
  
- Artery of foregut is coeliac trunk. It supplies all structures developed from it.



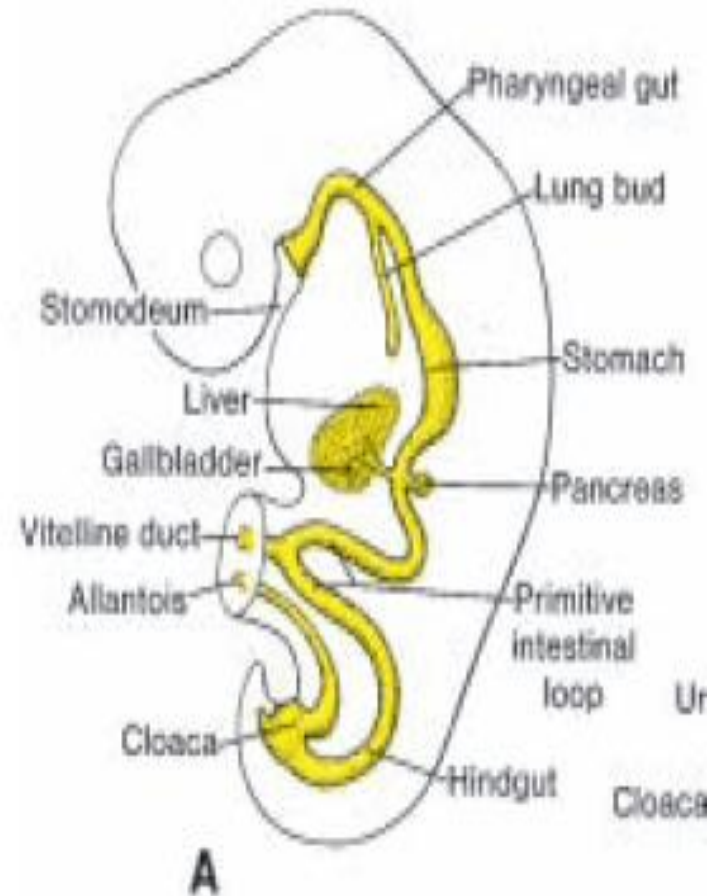
# Derivatives of midgut

- Distal part of duodenum
- Jejunum
- Ileum
- Caecum
- Appendix
- Ascending colon
- Proximal 2/3<sup>rd</sup> of transverse colon
- Artery of midgut is superior mesenteric artery



# Derivatives of hindgut

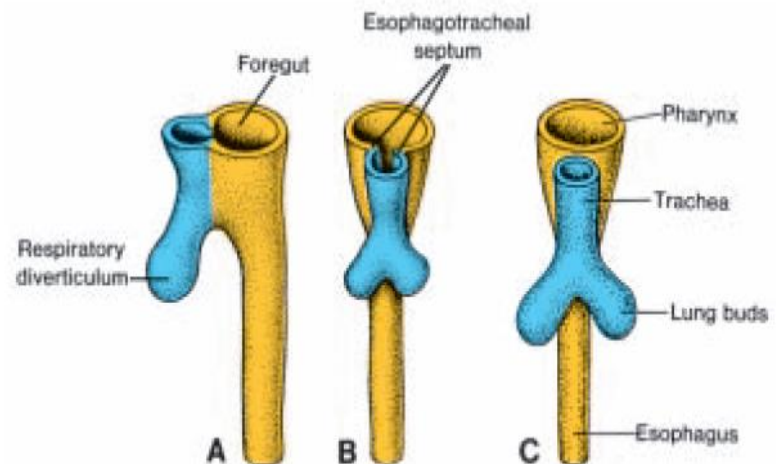
- Distal 1/3<sup>rd</sup> of transverse colon
- Descending colon
- Sigmoid colon
- Rectum
- Upper part of anal canal
- Artery of hind gut is inferior mesenteric artery





# Esophagus

- At the 4<sup>th</sup> weeks lungs bud appear as ventral wall of fore gut
- Respiratory diverticulum starts forming from its anterior aspect.
- Tracheo esophageal septum divides & separates trachea from esophagus.
- This septum starts separation from below upwards till upper end of respiratory diverticulum.



- At first, the esophagus is short but with descent of the heart and lungs, it lengthens rapidly
- The muscular coat, which is formed by surrounding splanchnic mesenchyme, is striated in its upper two-thirds and innervated by the vagus
- the muscle coat is smooth in the lower third and is innervated by the splanchnic plexus



- **Anomalies—**

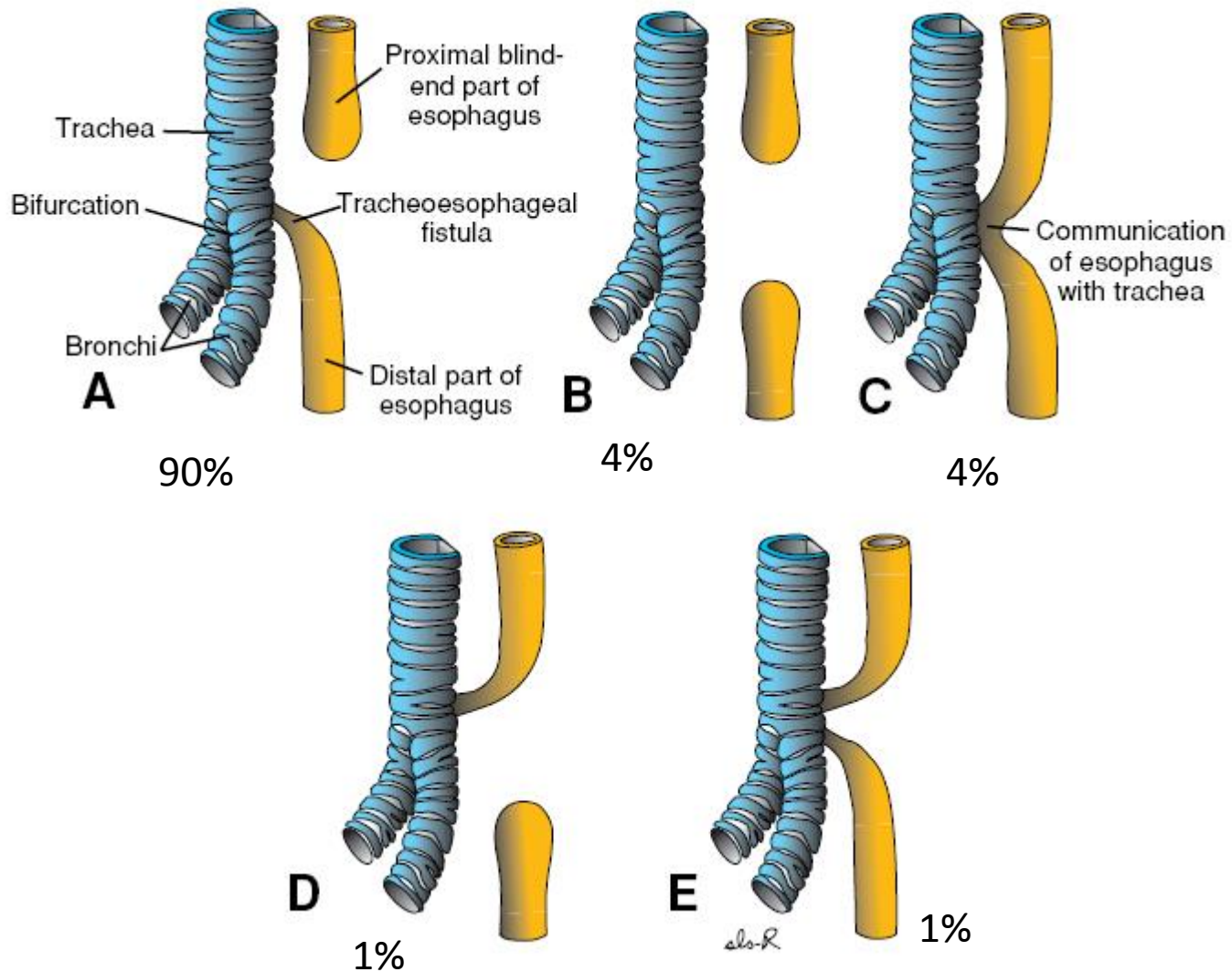
- 1. short esophagus**

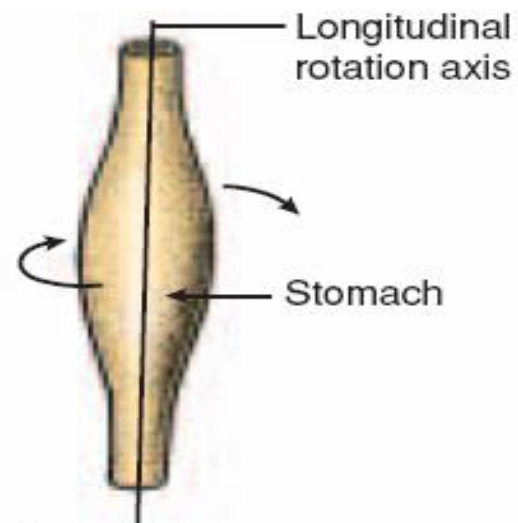
- 2. esophageal atresia**

- 3. Tracheo esophageal fistula**

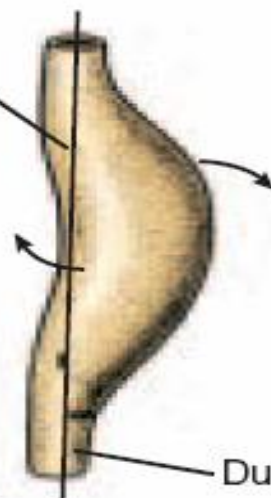
- Atresia of the esophagus prevents normal passage of amniotic fluid into the intestinal tract, resulting in accumulation of excess fluid in the amniotic sac (polyhydramnios).
- In addition to atresia, the lumen of the esophagus may narrow, producing esophageal stenosis

# Tracheo esophageal fistula

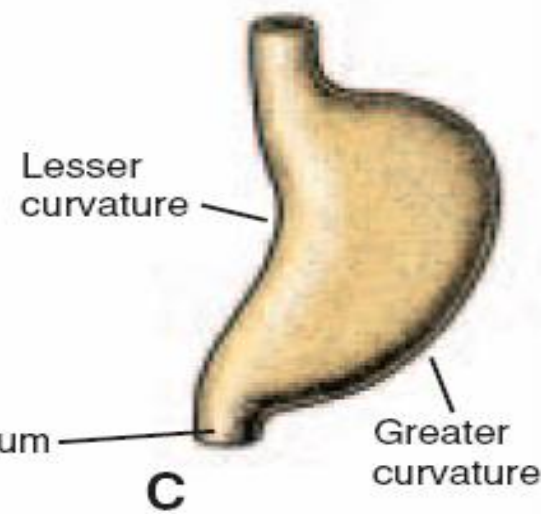




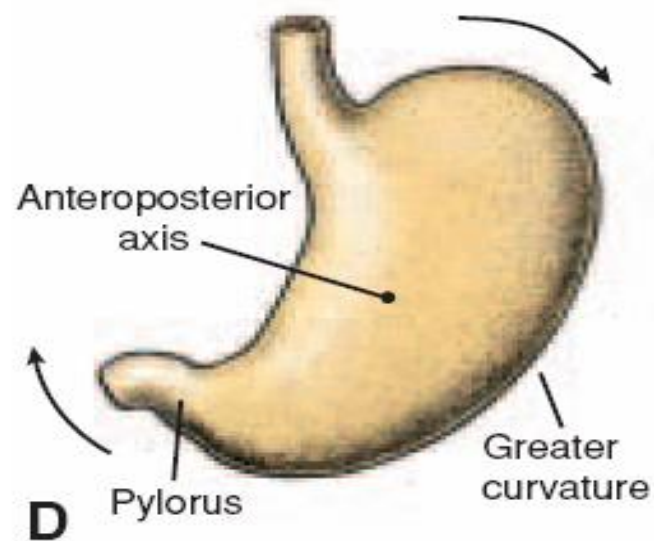
**A**



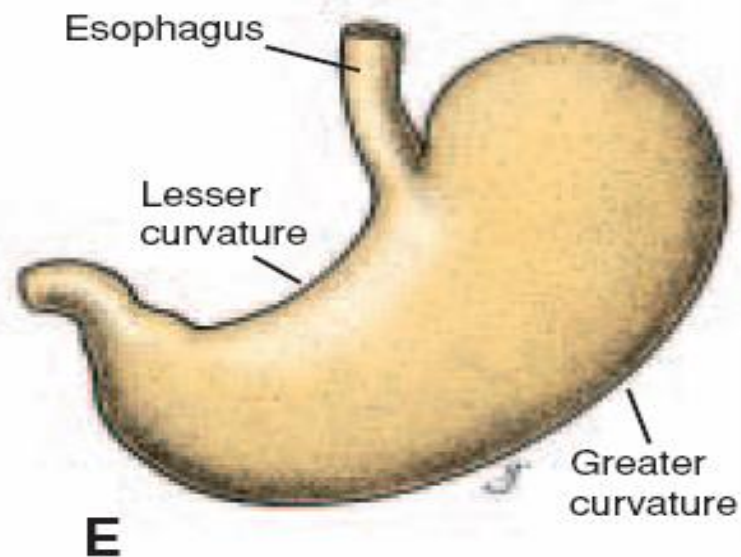
**B**



**C**



**D**



**E**

## **Stomach:**

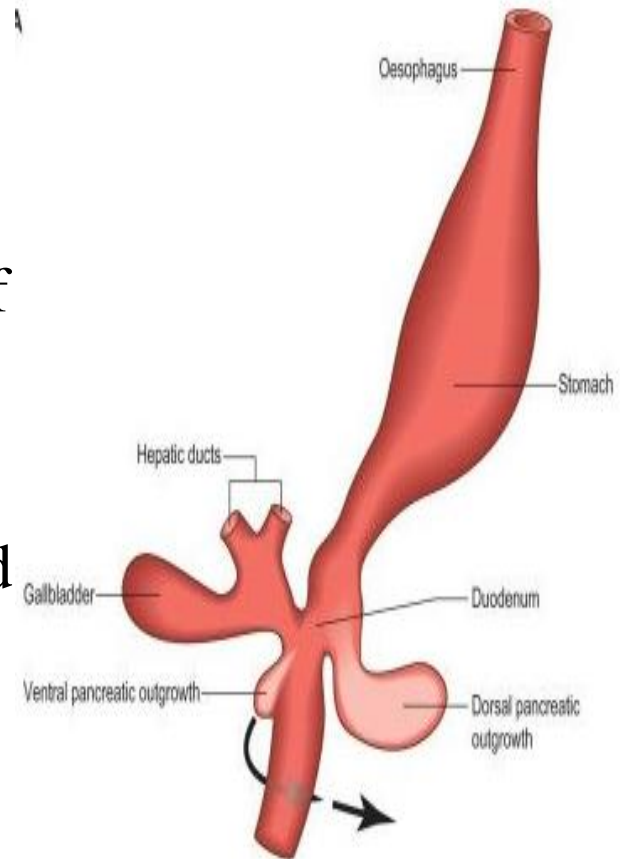
- The stomach rotates 90° clockwise around its longitudinal axis, causing its left side to face anteriorly and its right side to face posteriorly
- Hence, the left vagus nerve, initially innervating the left side of the stomach, now innervates the anterior wall; similarly, the right nerve innervates the posterior wall.
- During this rotation, the original posterior wall of the stomach grows faster than the anterior portion, forming the greater and lesser curvatures

- The cephalic and caudal ends of the stomach originally lie in the midline
- But during further growth the stomach rotates around an anteroposterior axis, such that the caudal or pyloric part moves to the right and upward
- And the cephalic or cardiac portion moves to the left and slightly downward
- The stomach thus assumes its final position, its axis running from above left to below right

- Pyloric stenosis occurs when the circular and, to a lesser degree, the longitudinal musculature of the stomach in the region of the pylorus hypertrophies
- Duplications and a prepyloric septum,

- Develops from caudal end of foregut & upper part of midgut.
- Duodenum loses its mesentery & becomes fixed to post. Abdominal wall.
- It is thus retroperitoneal.
- Earlier, duodenum has right & left surfaces.
- After rotation, left one is anterior & right one is posterior.
- Now there is differential growth of walls of duodenum.
- Anterior wall grows much faster than the posterior wall.
- The result is that most of the wall is formed by anterior wall.
- Duodenum now is obliterated by endodermal cell growth.(5<sup>th</sup>-6<sup>th</sup> week)
- It now recanalizes.(8<sup>th</sup> week)

# Duodenum





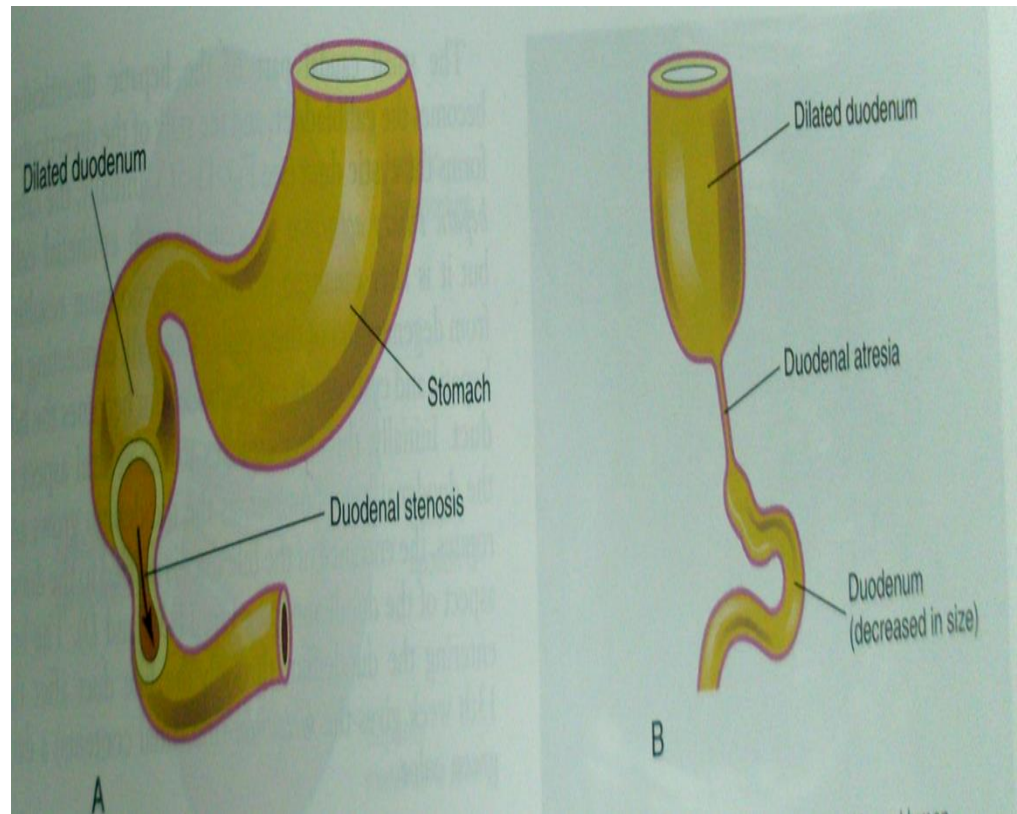
# Duodenum

- Due to its development by both fore & midgut, duodenum is supplied by branches of coeliac & superior mesenteric arteries.

## Anomalies –

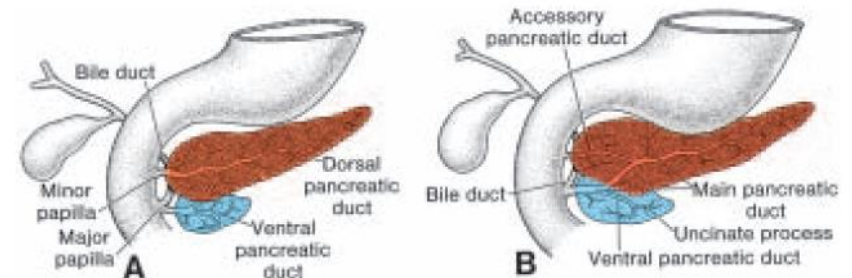
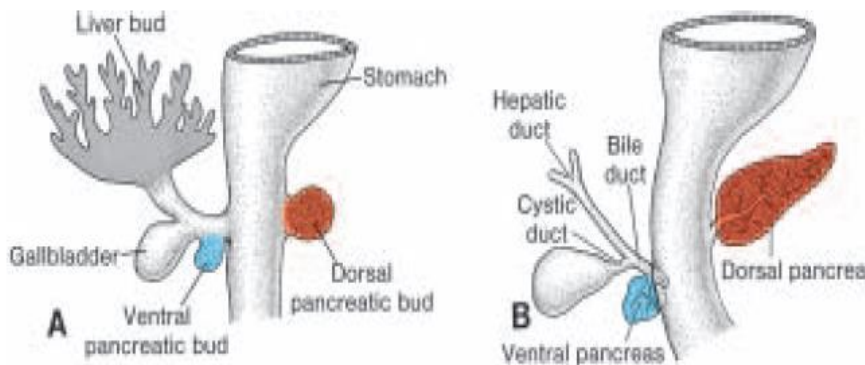
Duodenal atresia

Duodenal stenosis



# Pancreas

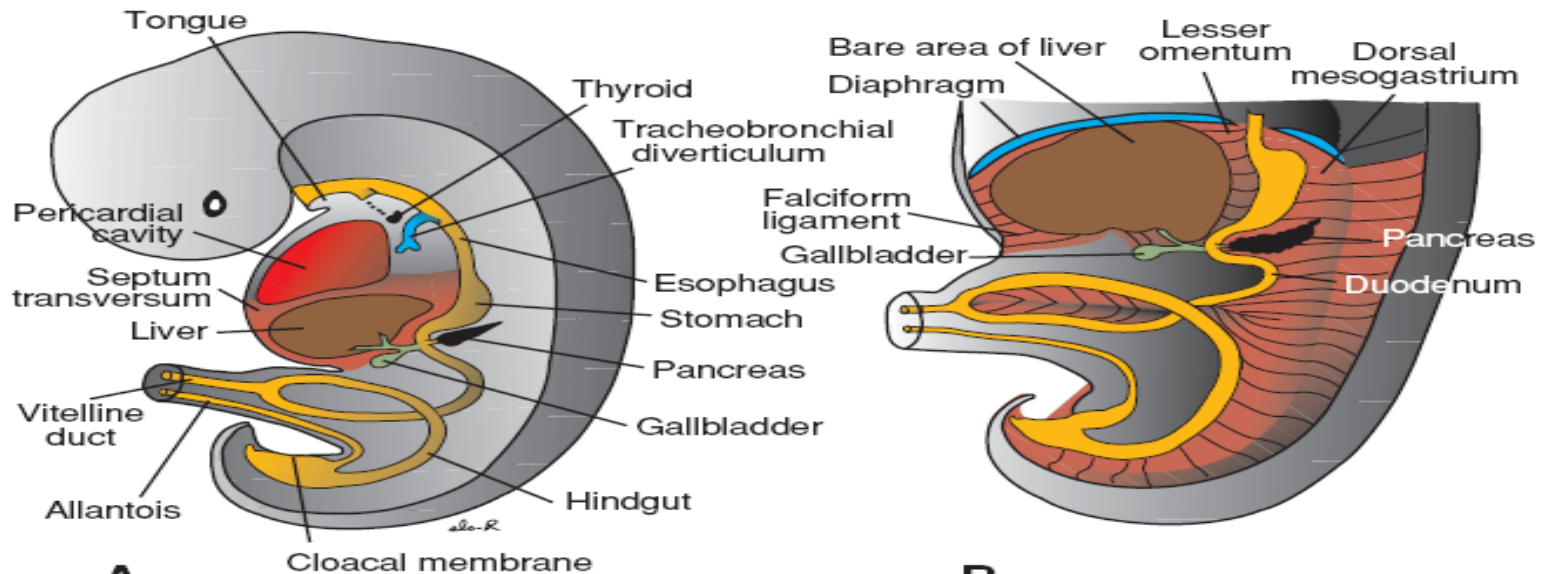
- Is of Endodermal origin during 7<sup>th</sup> week of intrauterine life.
- Pancreas develops from fusion of a ventral & a dorsal pancreatic bud from the dorsal part of foregut.
- Ventral bud is smaller, placed slightly lower than dorsal one, extends in ventral mesogastrium.
- Dorsal bud is larger, placed a little higher, develops first & extends in dorsal mesogastrium.
- Ventral pancreatic bud – forms uncinate process & an inferior part of head of pancreas.
- Dorsal pancreatic bud – forms part of the head whole of the neck, body & tail of pancreas.



**Figure 13.22** A. Pancreas during the sixth week of development. The ventral pancreatic bud is in close contact with the dorsal pancreatic bud. B. Fusion of the pancreatic ducts. The main pancreatic duct enters the duodenum in combination with the bile duct at the major papilla. The accessory pancreatic duct (when present) enters the duodenum at the minor papilla.

# Liver

- Liver, gall bladder and biliary apparatus develop from an endodermal diverticulum that arises from the ventral aspect of terminal part of foregut during 4<sup>th</sup> week.
- This diverticulum grows into the ventral mesogastrium and reaches the septum transversum and divides into 2 parts:
- Pars hepatica: the larger cranial part which will form the liver and
- Pars cystica: the smaller caudal part which will form the gall bladder.

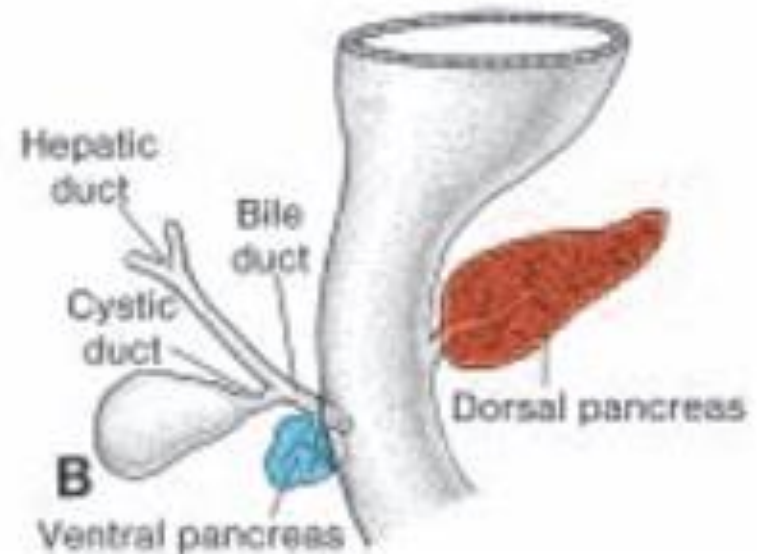
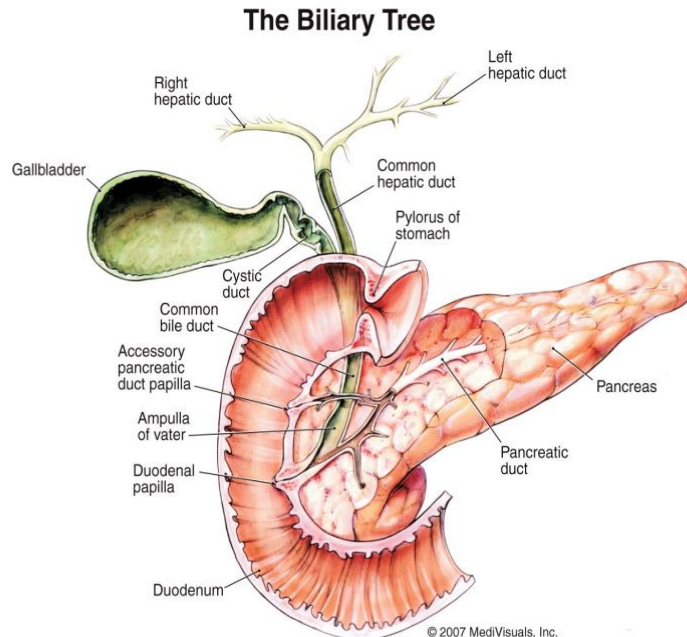


# Liver

- The pars hepatica grows into the septum transversum and divides into right and left branches which forms the right and left lobes of liver.
- Both lobes are of the same size but right soon becomes larger.
- Liver is large in 7<sup>th</sup> & 9<sup>th</sup> week.
- Haemopoiesis starts in 6<sup>th</sup> week.
- Due to this liver is large.
- Bile formation starts by 12<sup>th</sup> week.
- **Mesenchyme** of septum transversum forms **Kupffer cells**.

# Extra hepatic biliary apparatus

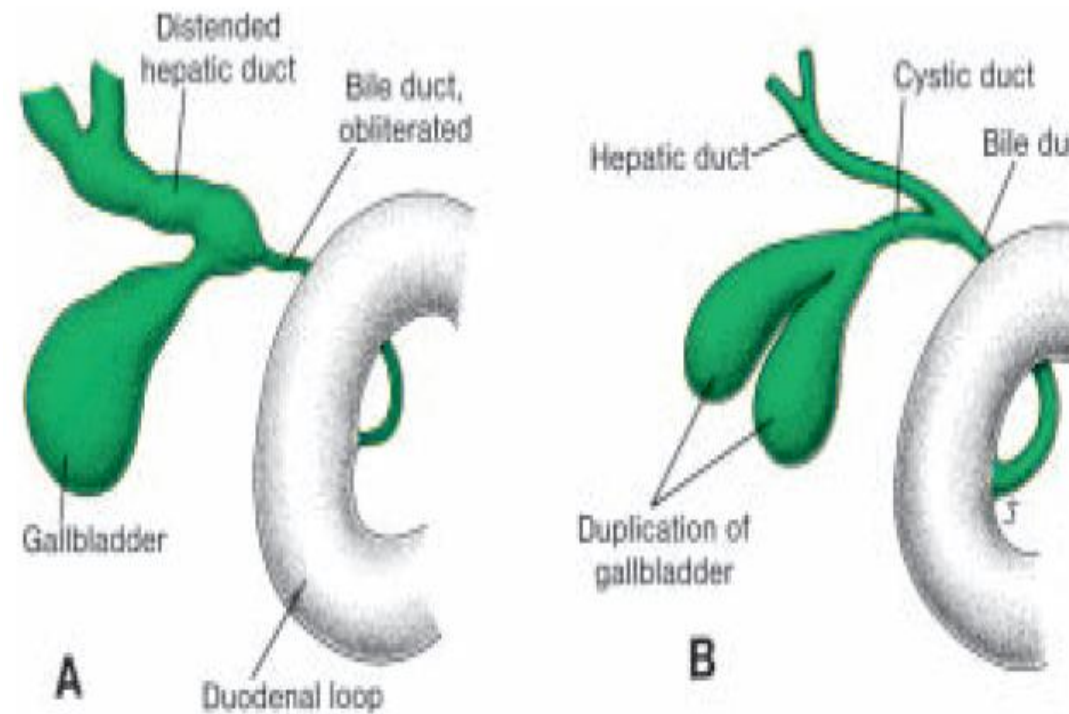
- Caudal part of the hepatic diverticulum enlarges to form gall bladder.
- The stalk does not dilate & forms cystic & bile ducts.
- In the beginning, all these parts are obliterated but then they recanalize.





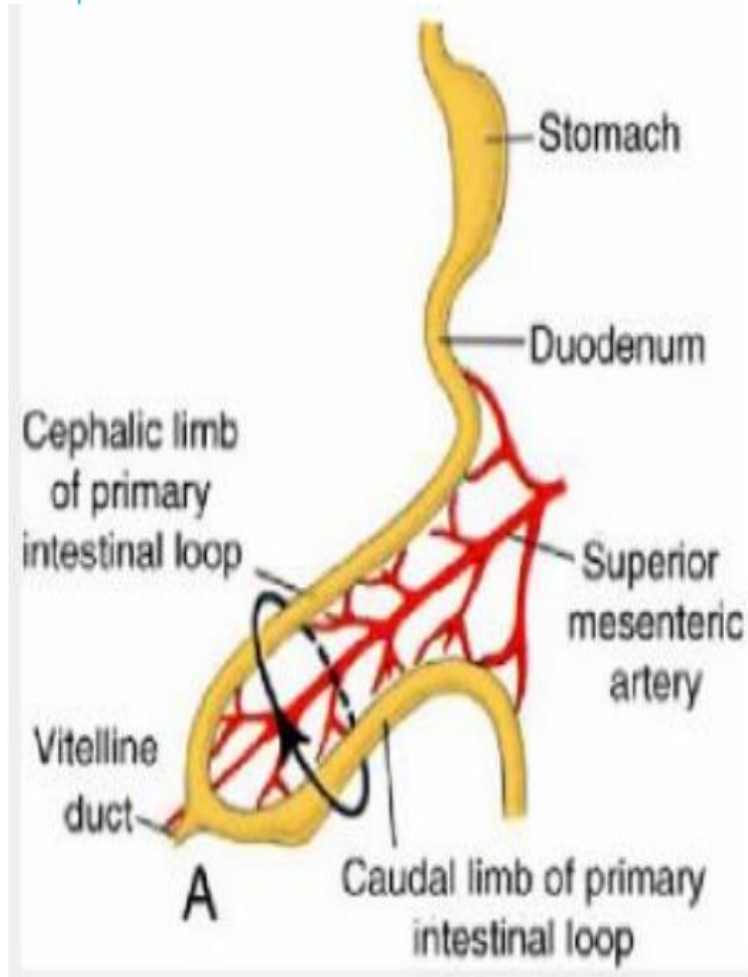
# Bile duct-anomalies

- Bile is secreted in the 2<sup>nd</sup> part of duodenum after 13<sup>th</sup> week, gives intestinal contents green colour. This content is called 'meconium.'
- Double gall bladder.
- Bile duct atresia-most serious, seen in 1:15000 births, gives rise to jaundice.



**Figure 13.20** A. Obliteration of the bile duct resulting in distention of the gallbladder and hepatic ducts distal to the obliteration. B. Duplication of the gallbladder.

# Midgut

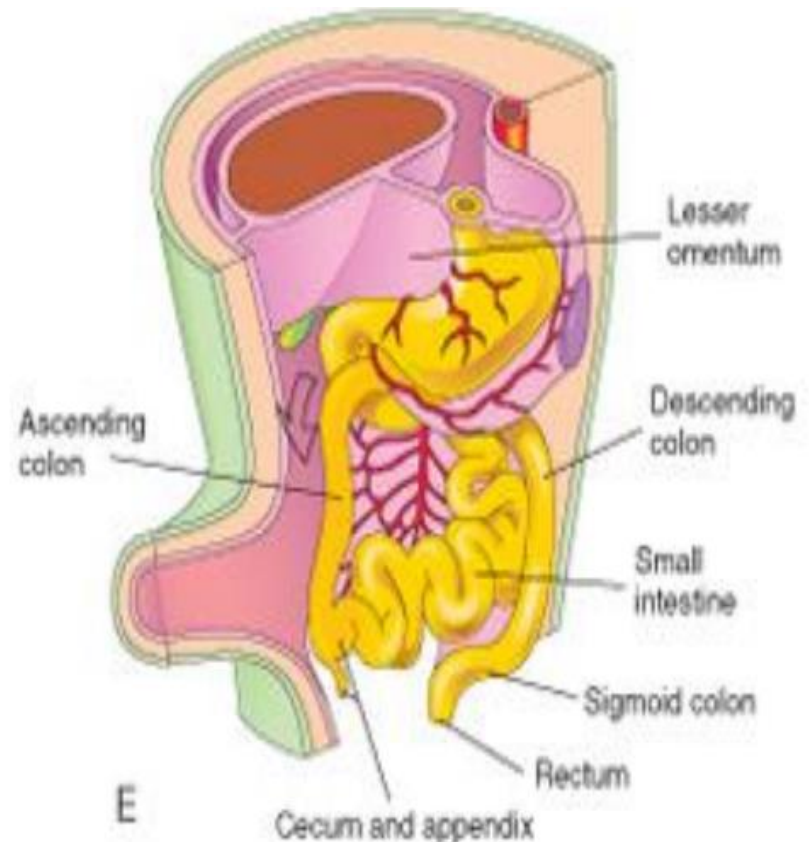


- Mid gut loop has cephalic & caudal limb with superior mesenteric artery forming the axis
- ☐Cephalic limb distal part of the duodenum, the jejunum, and part of the ileum
- ☐Caudal limb-lower portion of the ileum, the cecum, the appendix, the ascending colon, right two-thirds of the transverse colon



# Rotation of mid gut loop

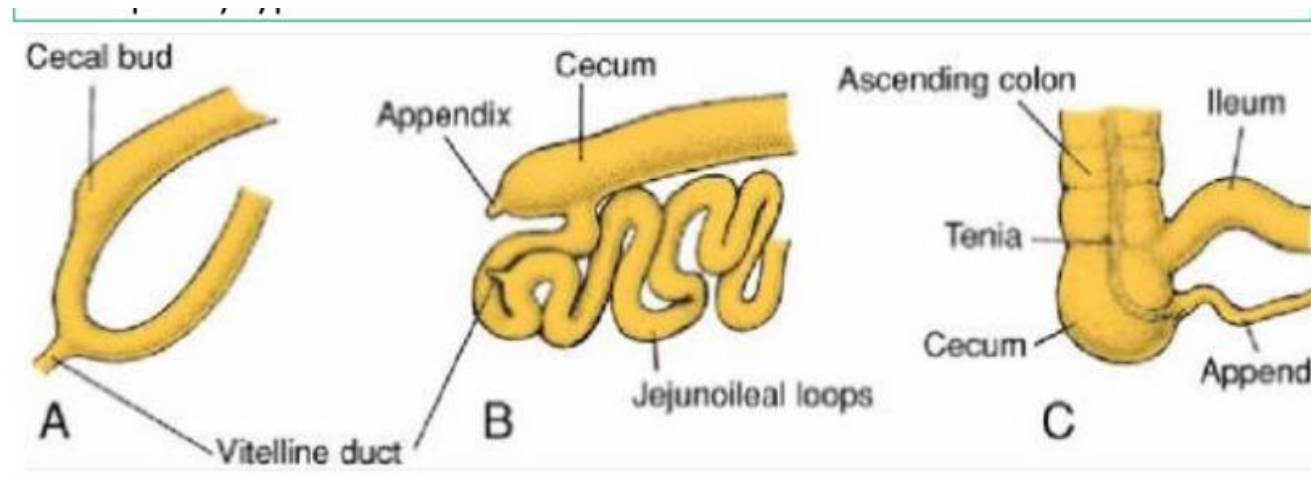
- Axis -superior mesenteric artery
- Undergoes counterclockwise rotation of approx 270 degree
- ☐During physiological herniation(6th week)  
☐Loop rotate 90 counterclockwise
- ☐Cranial limb to right
- ☐Caudal limb to the left



- Cranial limb elongates --- forms intestinal loops– jejunum & ileum  
Endoderm– epithelial lining & glands  
Splanchnic mesoderm– lamina propria, submucosa, muscularis externa

# Caecum

- Primordium- cecal swelling/diverticulum
  - ☐Sixth week
  - ☐Elevation on the antimesenteric border of the caudal limb of the midgut loop
- ☐Caecum:
  - ☐Caecal bud
  - ☐Right upper quadrant below right lobe of liver
  - ☐Descend to right iliac fossa



# Appendix

- Apex of the cecal swelling
- Small conical diverticulum
- Pass posterior to caecum k/a retrocecal or retrocolic appendix
- Appendix develop during descend of colon & caecum

# DEVELOPMENT OF ASCENDING, TRANSVERSE COLON

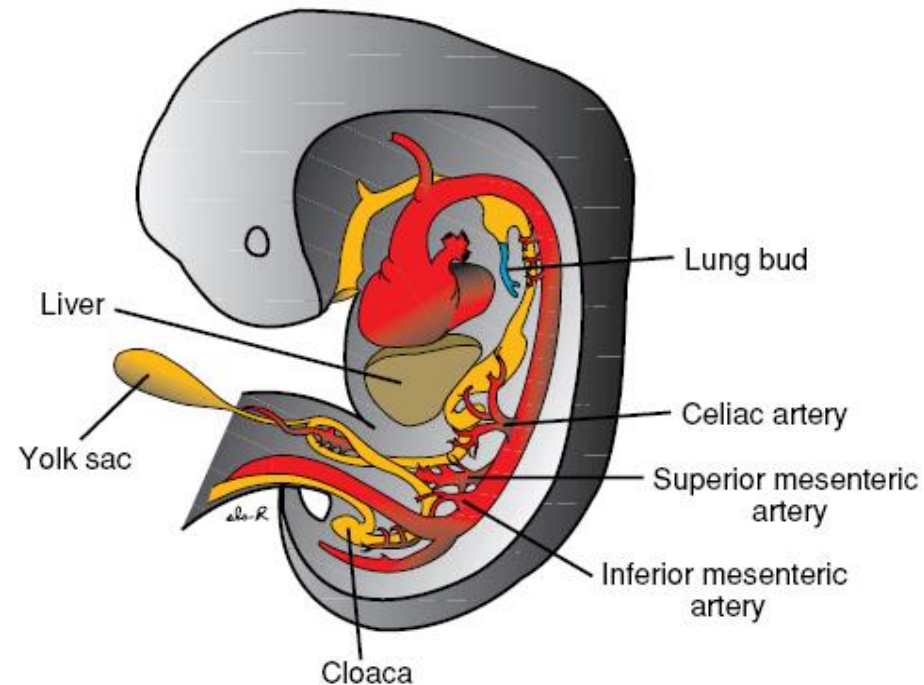
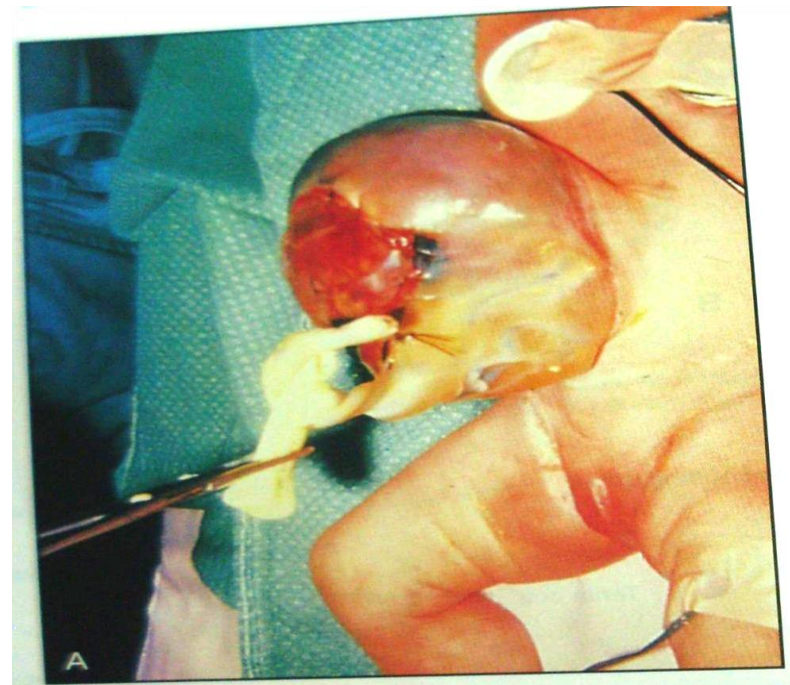
- Caudal limb of midgut loop
- Forms the ascending colon, hepatic flexure, right 2/3rd part of transverse colon
- Endoderm– epithelial lining & glands
- Splanchnic mesoderm– lamina propria, submucosa, muscularis externa

# Omphalocele

Physiological umbilical hernia does not reduce.

Midgut loop fails to return. 6<sup>th</sup> to 10<sup>th</sup> week

Protusion contains greater omentum with intestines covered by amnion



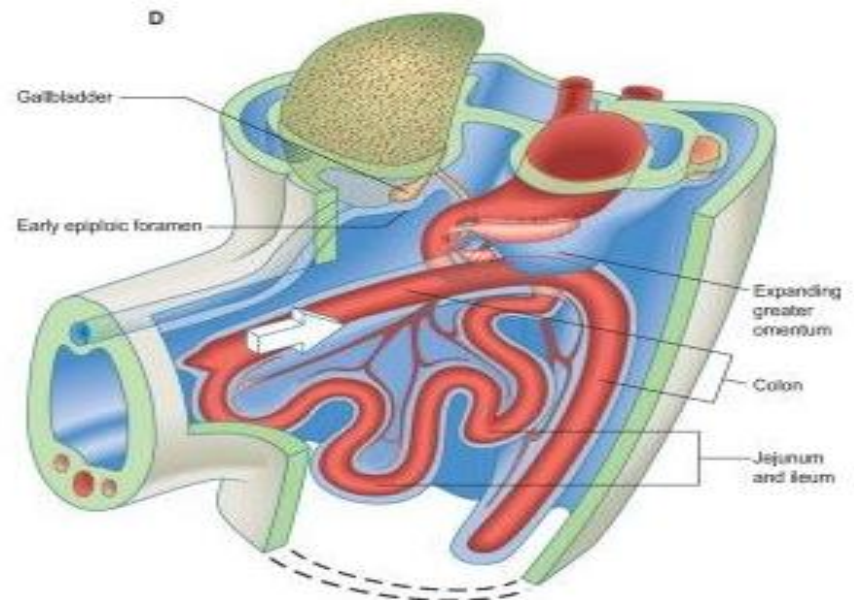
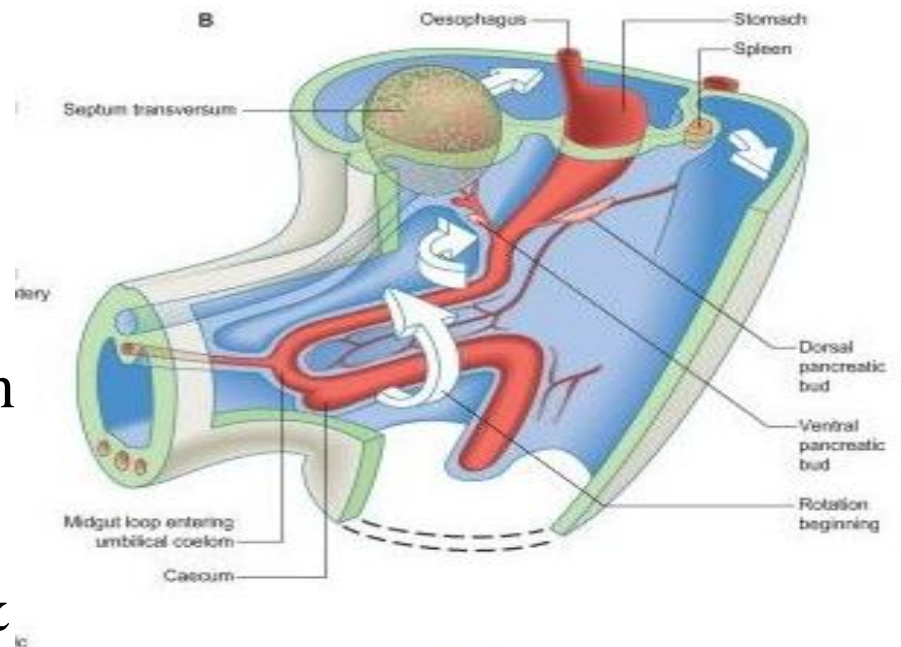
# Gastroschisis

- Congenital abdominal wall defect
- Defect in lateral to the median plane of anterior abdominal wall
- Failure of closure of body wall around the connecting stalk
- Viscera protude into the amniotic cavity without involving of umbilical cord
- Protuding viscera are not covered by peritoneum or amnion & may be damaged by exposure to amniotic fluid



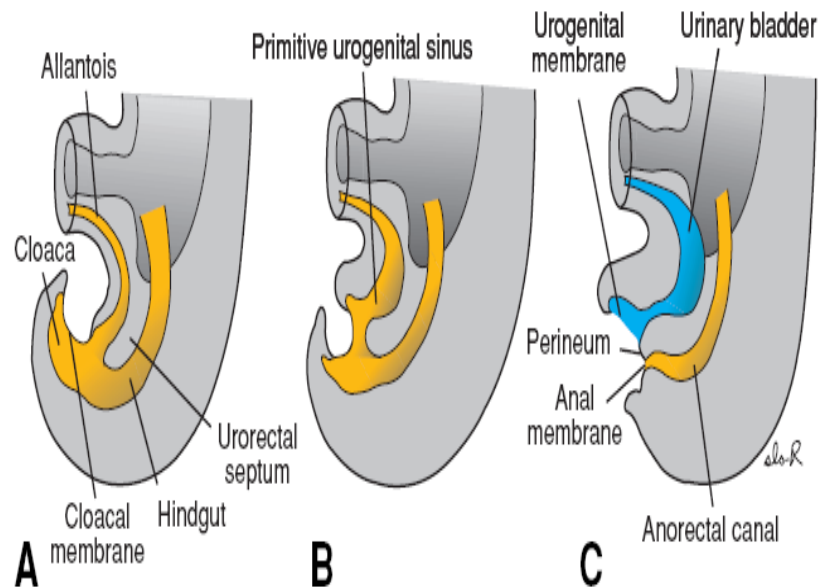
- Extends from end of midgut loop till the end of cloaca at cloacal membrane.
- Lies in midline attached by dorsal mesentery to posterior abdominal wall.
- Forms left ½ of transverse colon descending & sigmoid colon, rectum & part of anal canal.
- Epithelium of urinary bladder & most of urethra.
- Inferior mesenteric artery is the artery of hindgut.
- Except transverse & sigmoid colon descending colon is fixed.

## Hindgut



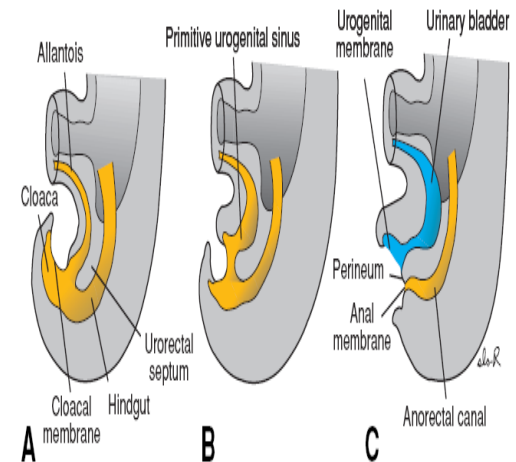
# Cloaca

- It is the lower expanded part of hindgut.
- Is closed by cloacal membrane.
- Lined by endoderm of yolk sac.
- Anteriorly attached to it is allantois.



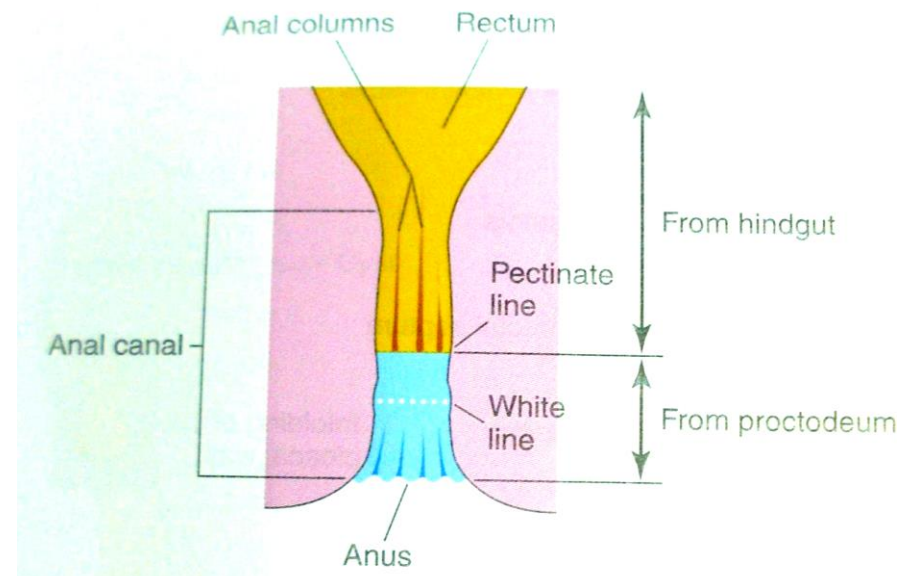
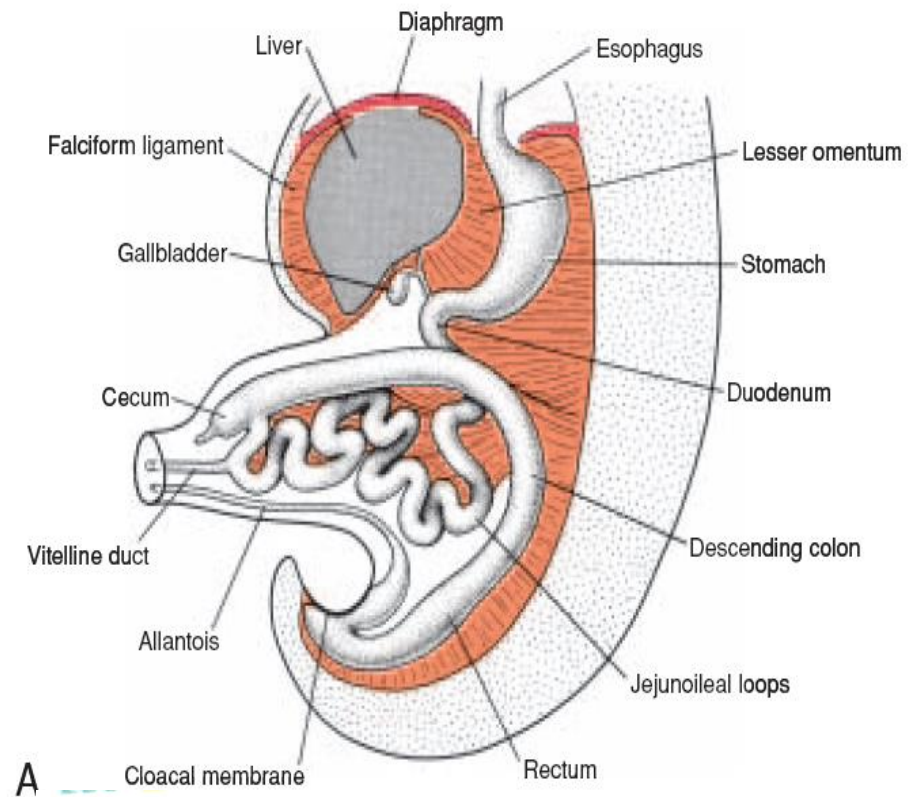
# Cloaca

- Expanded terminal part of hind gut lined by endoderm
  - Contact with surface ectoderm at cloacal membrane
  - Divided into dorsal & ventral parts by wedge of mesenchyme k/a urorectal septum
- □ Ventral part – urogenital sinus- part of urinary & reproductive system
- □ Dorsal part– cranial part – rectum, caudal part– anal canal



# Rectum & anal canal

- Lowest part of hindgut lying in midline forms rectum.
- Splanchnic mesoderm forms muscles & other constituents of walls of rectum.
- Endoderm forms epithelium & glands.
- Upper 2/3 of anal canal develops from hindgut & lower 1/3 is from proctodeum.
- The junction between these is shown by pectinate line below anal valves.



# Anal canal-correlation

- **Upper 2/3**
  - Develops from hindgut.
  - Epithelium is from endoderm.
  - Walls including muscles is from splanchnic mesoderm.
- **Lower 1/3**
  - Develops from proctodeum.
  - Epithelium is of ectodermal origin.
  - Walls develop from splanchnic mesoderm.

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# Anorectal anomalies

- Rectal atresia
- Anal agenesis
- Anal stenosis
- Imperforate anus-anal membrane does not perforate.
- Anorectal agenesis with fistula.

THANK U