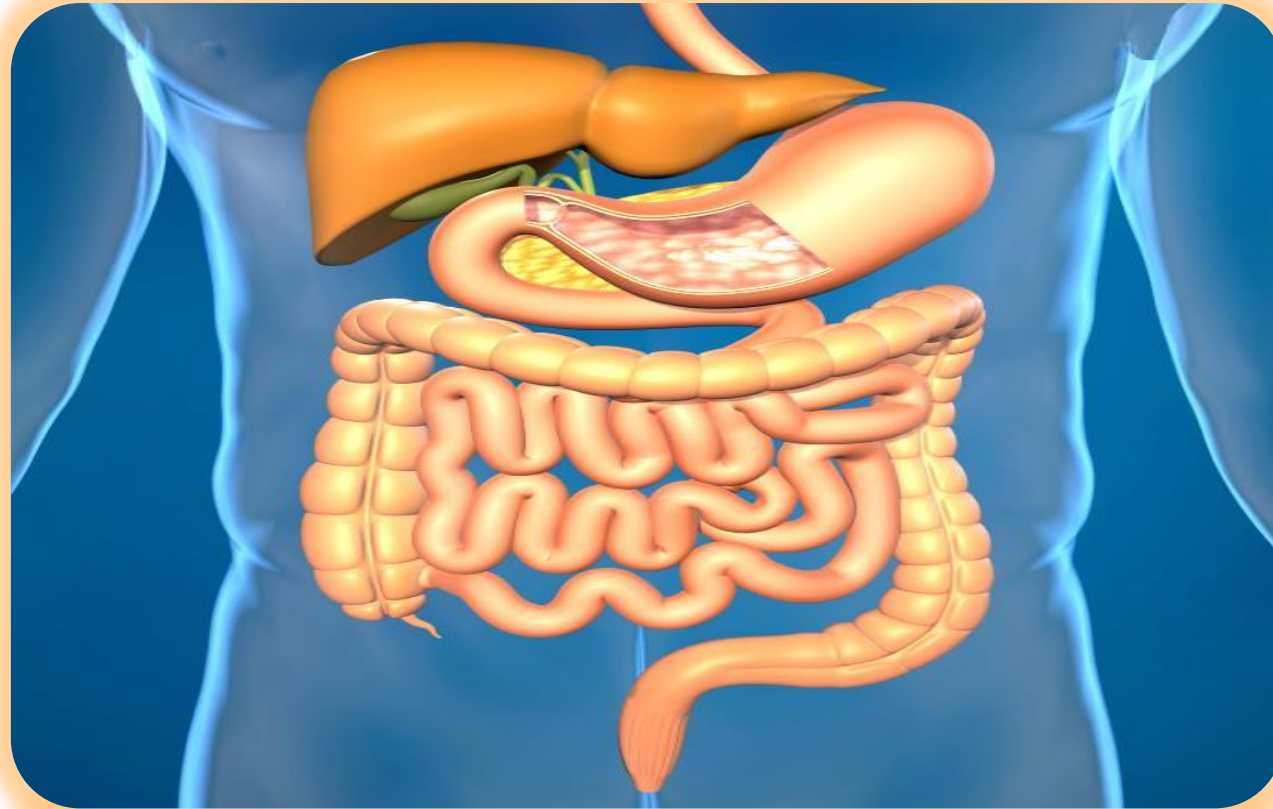




G.I.T



Lecture: Development of pancreas & small intestine
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If there is any mistake or suggestions please feel free to
contact us: anatomyteam32@gmail.com

Contents:

- *Introduction*
- *Small Intestine Development*
- *Pancreas Development*
- *Understanding tools*
- *Questions*

Objectives:

- *Describe the development of the duodenum.*
- *Describe the development of the pancreas.*
- *Describe the development of the small intestine.*
- *Identify the congenital anomalies of the duodenum, pancreas, and the small intestine.*

Introduction:

First of all you remember our three main layers forming the embryo :

Ectoderm

Mesoderm

Endoderm

Most of the GIT structures are derived from **Endoderm**.

Endoderm forms foregut, midgut & hindgut, where digestive and respiratory organs come from.

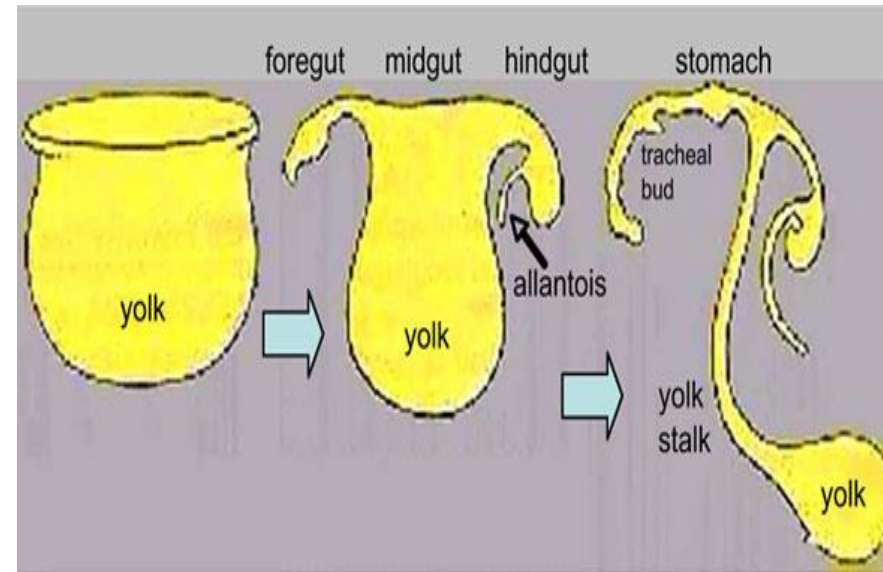
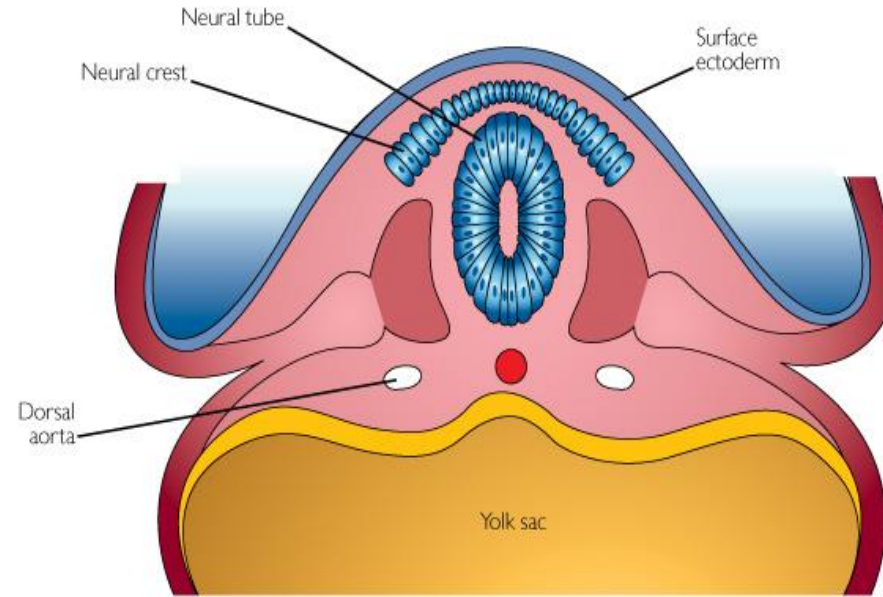
Foregut:

Pancreas
Upper part of duodenum

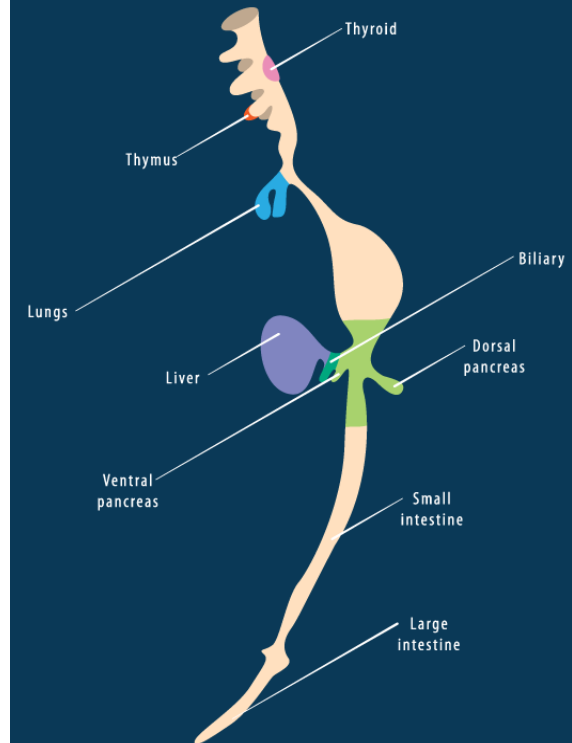
Midgut:

Lower part of duodenum
Jejunum & ileum.

Hindgut



Anterior



Posterior

Small Intestine

Origin

1) Duodenum :

Upper part : from foregut

Lower part : from midgut & splanchnic mesoderm

The junction of the two parts of the gut lies just below or distal to the origin of bile duct

2) Jejunum and ileum :

both derived from midgut

1) Duodenum:

A- Changes

1) C shaped formation

2) **Turning** : at first it grows ventrally (but according to our information it's lateral !! How it comes?) it'll turn laterally to be in the opposite direction with the stomach (put this turning in mind we'll back to it later when talking about pancreas) because of this turning it comes to lie on the posterior abdominal wall : becomes retroperitoneal (there are pics explains this rotation in understanding tools slide, go check it)

3) Normal obstruction and opening of the tract :

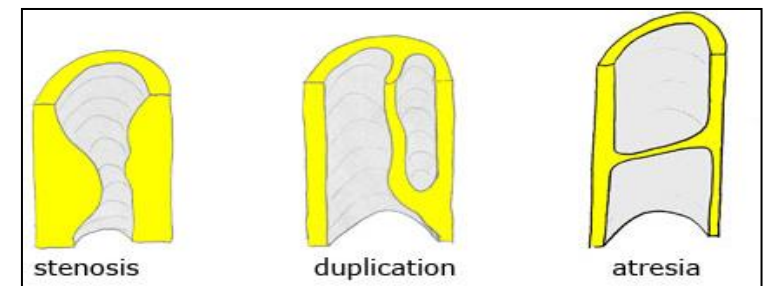
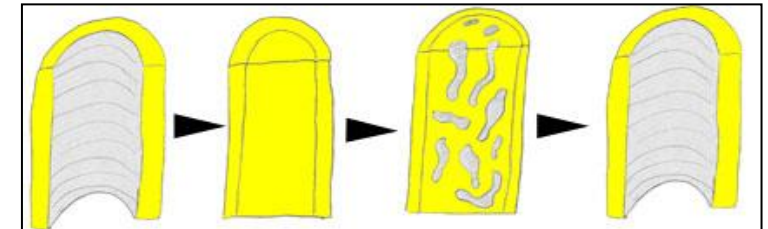
5th – 6th week: Obstructed by the proliferation of the epithelial cells.

8th week: some of these cells goes under normal degeneration (apoptosis) to recanalize (re-open) the tract.

1) **Stenosis** (partial obstruction, or narrowing) : result from incomplete recanalization.

2) **Atresia** (complete obstruction) : result from failure of recanalization (autosomal recessive inheritance) leads to complete occlusion of duodenal lumen.

B- Anomalies

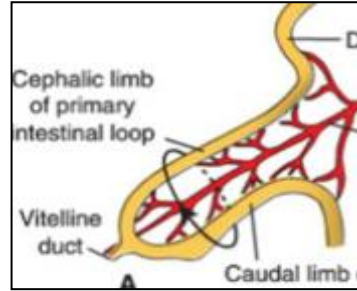


2) Jejunum & Ileum

A- Growing Stages :

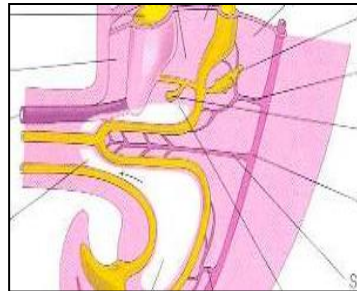
1 Preherniation stage

- Elongation of midgut
- Formation of U shaped midgut loop (ventrally)
- Communicate with yolk sac by vitelline duct (or yolk stalk)



2 Physiological umbilical hernia (temporarily)

- Rapidly growing liver and kidneys in a small abdomen push midgut loop into the umbilical cord (temporal umbilical herniation)



3 Rotation (counterclockwise) عكس عقارب الساعة

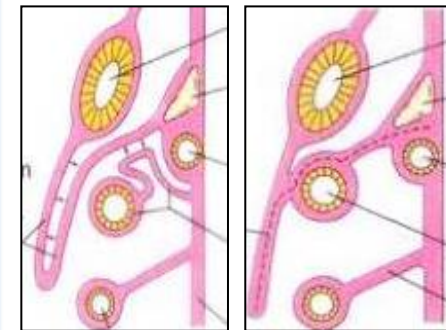
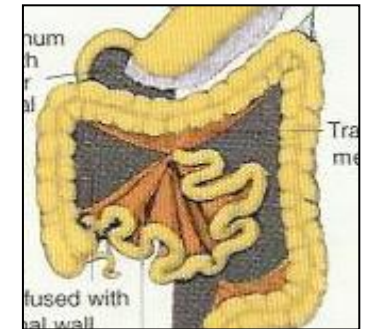
- 270° divided as: 1st rotation = 90°, 2nd rotation = 180°
- Midgut loop has cranial and caudal limbs.
- 1st rotation (90°) around the axis of Superior Mesenteric Artery brings the cranial limb to the right and caudal to the left, the cranial limb elongate to form intestinal coiled loops (2nd rotation is after next stage)

4 Reduction (10th week)

- Return of midgut to the abdomen due to expansion of abdominal cavity, and regression of liver & kidneys (midgut occupies central part of abdomen)
- 2nd rotation (rotation is completed) → midgut occupies right side of the abdomen.
- Coiling of intestine → midgut occupies left side of abdomen
- Cecum at 1st lies below the liver but later descends to lie in the right iliac fossa.

5 Fixation

- 1) Enlargement of colon pushes duodenum and pancreas toward the posterior wall → absorption of duodenal mesentery → duodenal & pancreas become retroperitoneal organ (except the first 2.5 cm above the transvers colon)
- 2) AC & JI has the same mesentery connect them with the posterior wall, but when AC mesentery is fused with the posterior wall and it becomes retroperitoneal, JIM becomes fan shaped.



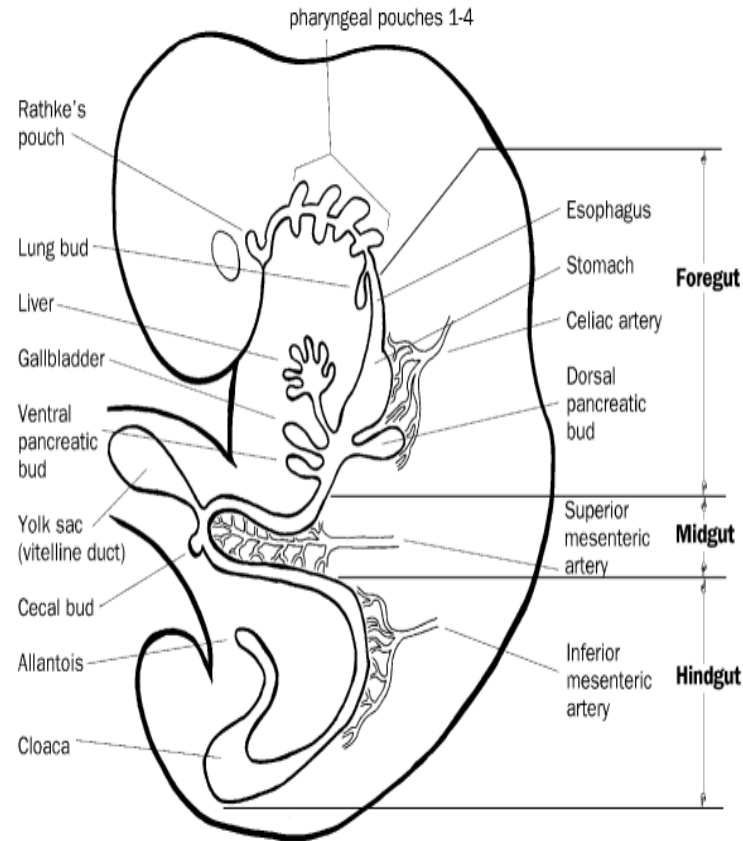
There are videos describe the whole pattern of rotation, go check understanding tools

(beginning of 6th week)

Derivatives of Midgut:

- **Derivatives of cranial part of midgut:**

- 1. Lower part of duodenum.**
- 2. Jejunum.**
- 3. Upper part of ileum.**



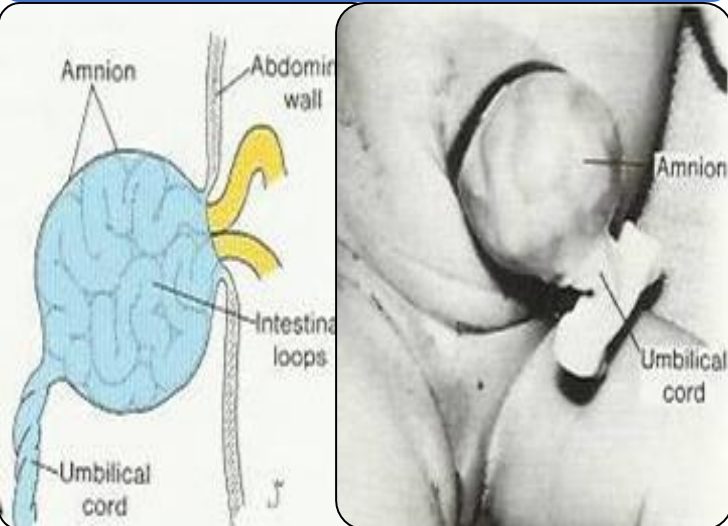
- **Derivatives of caudal part of midgut:**

- 1. Lower part of ileum.**
- 2. Cecum and appendix**
- 3. Ascending colon and proximal 2/3 of transverse colon.**

B- Anomalies

1) Omphalocele

- herniation of abdominal contents into umbilical cord due to failure of reduction of physiological hernia to abdominal cavity.
 - Herniation of intestines (1 of 5000 births)
 - Herniation of liver & intestines (1 of 10,000 births)
 - Accompanied by small abdominal cavity.
- hernial sac is covered by the epithelium of the umbilical cord, removed surgically

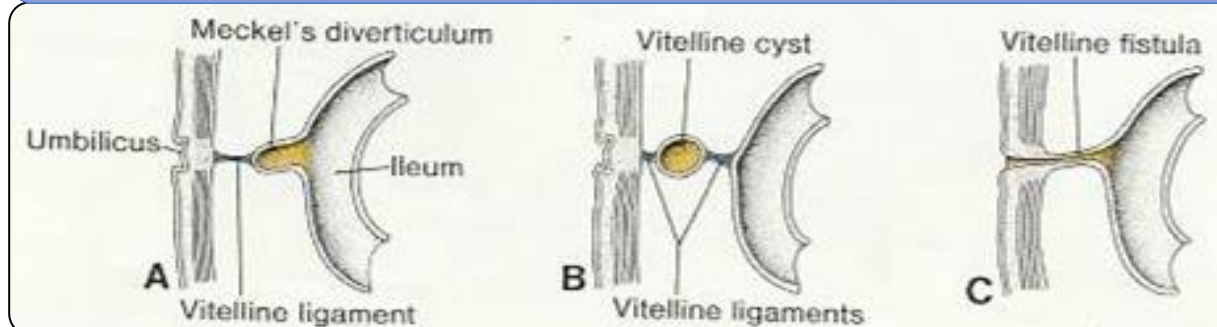


2) Umbilical Hernia

- **imperfectly closed umbilicus** after normal reduction. Is the commonest
 - The herniation usually contain the greater omentum & small intestine.
 - The hernial sac is covered by skin & subcutaneous tissue.
 - **It protrudes during crying, straining or coughing** and can be easily reduced through the fibrous ring at umbilicus.
- Surgery is performed at age of 3-5 years**

3) Ileal (Meckel) Diverticulum

- one of the most common anomalies of the digestive tract (especially in males)
- It is a small pouch from the ileum (the remnant of nonobliterated (not closed) part of **vitelline duct**), and may contain small patches of gastric & pancreatic tissues
- causing ulceration, bleeding or even perforation. (severe rectal bleeding and fainting attack)
- It arises from antimesenteric border of ileum, 1/2 meter from ileocecal junction.
- Sometimes it becomes inflamed and causes symptoms similar to **appendicitis** (tenderness in right iliac region)
- It may be connected to the umbilicus by a fibrous cord, and the middle portion forms a **cyst (B)** or may remain patent (opened) forming the **fistula (C)** in this situation, feces will be carried through the duct into umbilicus.
- A child with this condition should be operated.



Pancreas

Origin

The whole organ is formed by fusion of two buds, both originate from the lower (caudal) part of foregut

Ventral bud

develops from the proximal end of hepatic diverticulum

Forms : uncinated process + lower part of the head

Dorsal bud

develops from dorsal wall of duodenum

Forms : upper part of head + neck + body + tail.

Changes

Rotation of the duodenum: (remember when I told you keep it in mind?) due to duodenal rotation ventral pancreatic bud rotates (posteriorly) to meet dorsal bud and fuse with it. After this rotation ventral bud becomes below and behind dorsal bud, and both lie in the dorsal mesentery.

Mature pancreas characterized by:

1) **Lies in dorsal mesentery**

2) **Pancreatic parenchyma** : derived from endodermal cells of pancreatic buds. And contains :

A- acini (cell clusters) : develop from cells around ends of the tubules .

B- Islets (between acini) : develop from cells separated from the tubules

3) **Pancreatic duct** :

A- main pancreatic bud : ventral bud + distal part of dorsal bud

B- accessory pancreatic bud : proximal part of dorsal bud

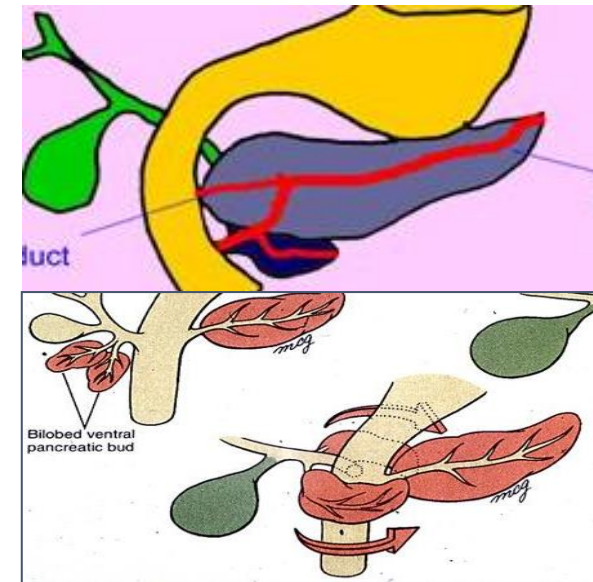
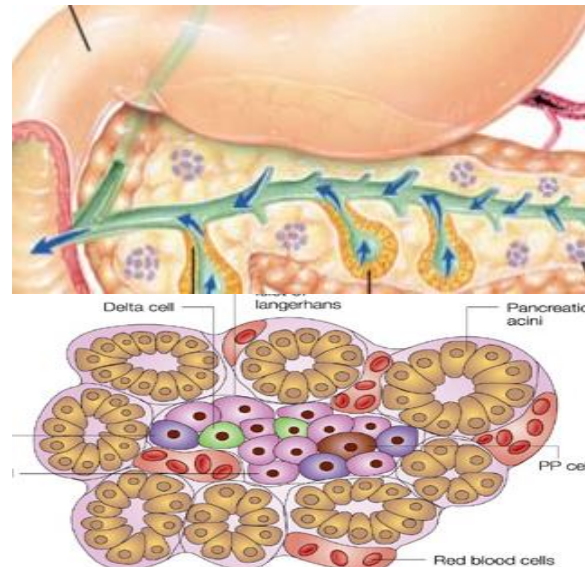
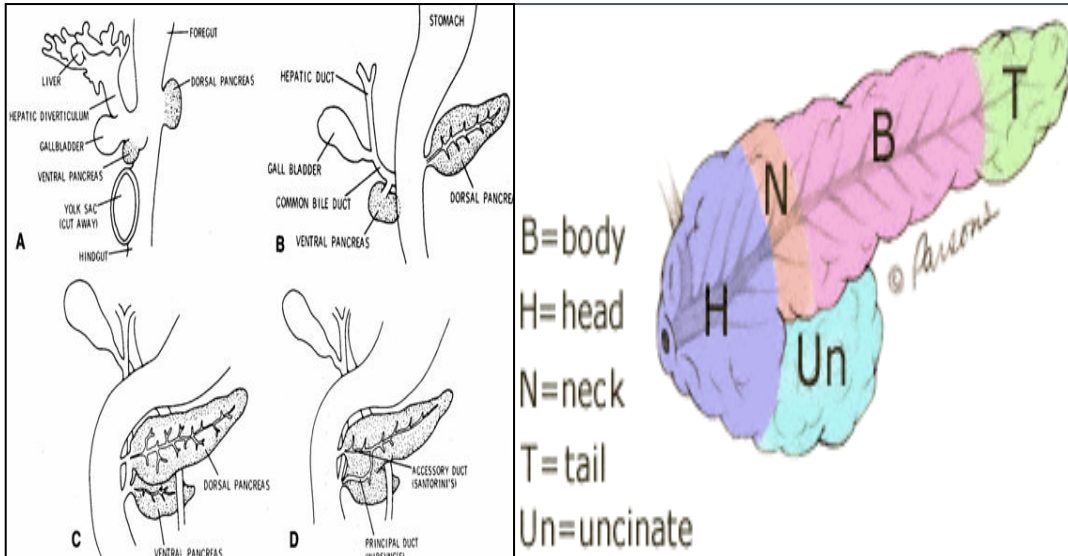
Anomalies

1) **Annular pancreas** :

A Thin pancreatic tissue surrounding the second part of the duodenum, causing duodenal obstruction

2) **Accessory pancreatic tissue**

When a pancreatic tissue is found in other organ. E.g., : stomach, duodenum or ileal diverticulum.

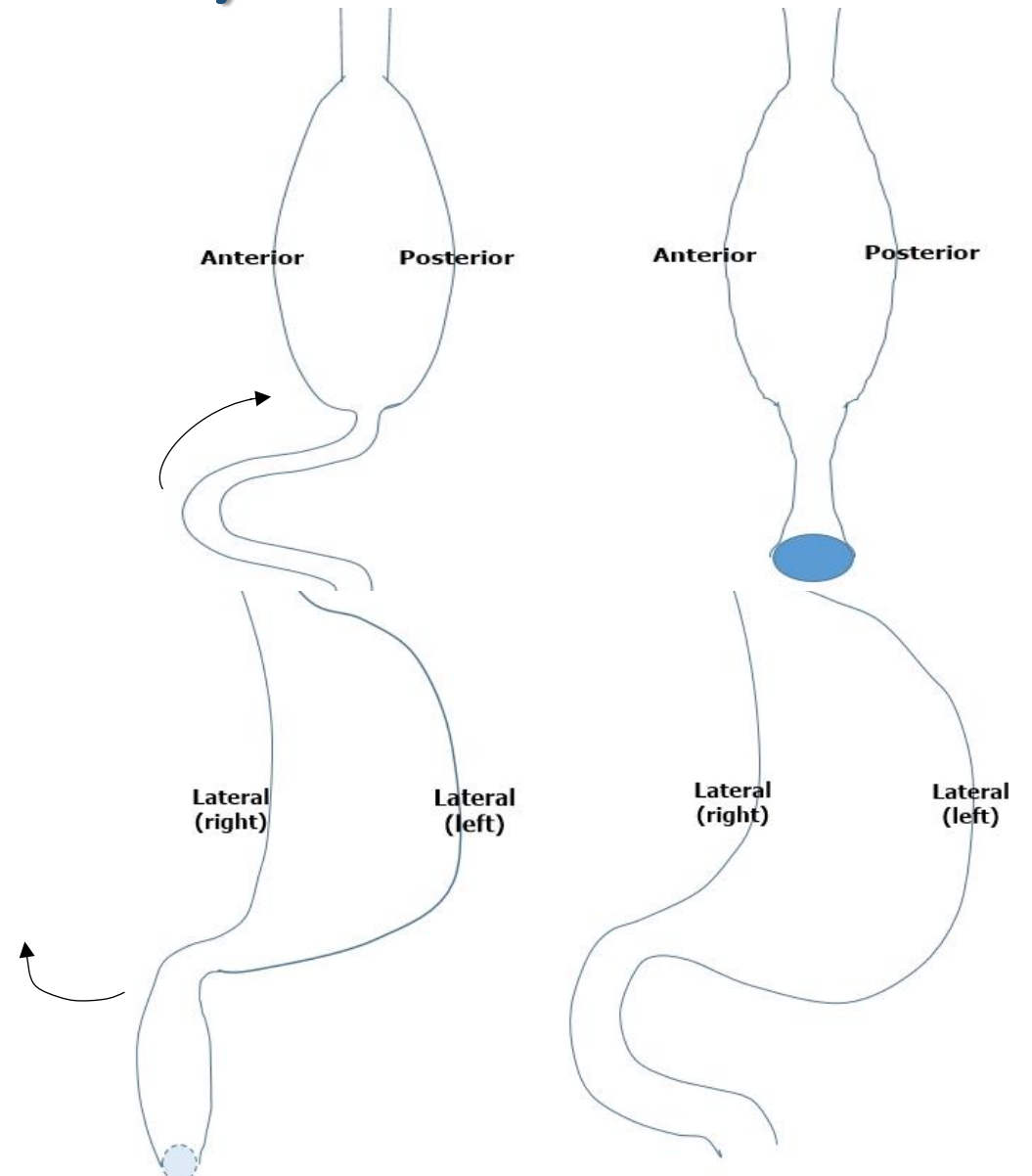


Understanding tools:

1) Additional videos

GIT development	http://meded.duke.edu/symbrio/site/gi.html
Rotation of the <u>midgut</u>	http://www.youtube.com/watch?v=AscKR_cQExY&list=PL_EYqVgKyIJB73d_jvcK75UYFv4yaf00W
	http://www.youtube.com/watch?v=49awxUGZvdY
Peritoneum	http://www.youtube.com/watch?v=s2cNCUL1r3A

2) Duodenal rotation



Questions :

Q1 _ 90° rotation of the midgut occurs in which of these stages? (doctor said that this one was in MCQ's)

A- Fixation

B- Rotation

C- Physiological herniation

Q2 _ Ileal diverticulum is caused by ?

A- Imperfectly closed umbilicus

B- Remnant of nonobliterated part of vitelline duct

C- Stenosis of the intestine



1- C

2- B

Q3 _ In which week will Insulin can be detected ?

A- 10th

B- 15th

C- 6th

Q4 _ Which one is derivative from the foregut?

A- Jejunum

B- Appendix

C- Pancreas

*Q5 _ All the following arise from splanchnic mesoderm
Except?*

A- Duodenum

B- Small intestine

C- Pancreas

Q6 _ The accessory pancreatic duct formed from ?

A- Distal part of dorsal bud

B- Proximal part of dorsal bud

C- Ventral duct

*Q7 _ In which abnormality the lesion will be covered by
the skin and subcutaneous tissue?*

A- Congenital Omphalocele

B- Umbilical hernia

C- Meckle diverticulum

3- A

4- C

5- C

6- B

7- B