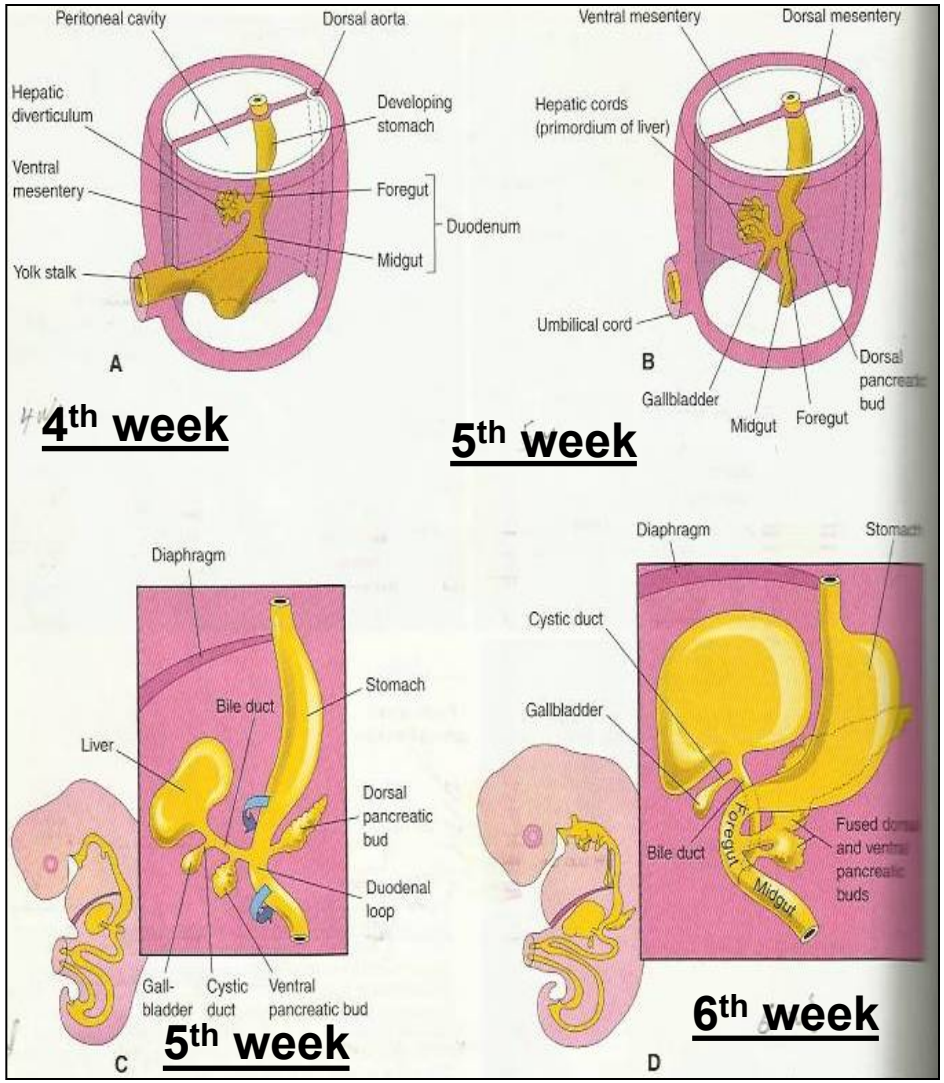
DEVELOPMENT OF PANCREAS AND SMALL INTESTINE

DR. SANAA AL-SHAARAWY DR. ESSAM ELDIN SALAMA

OBJECTIVES

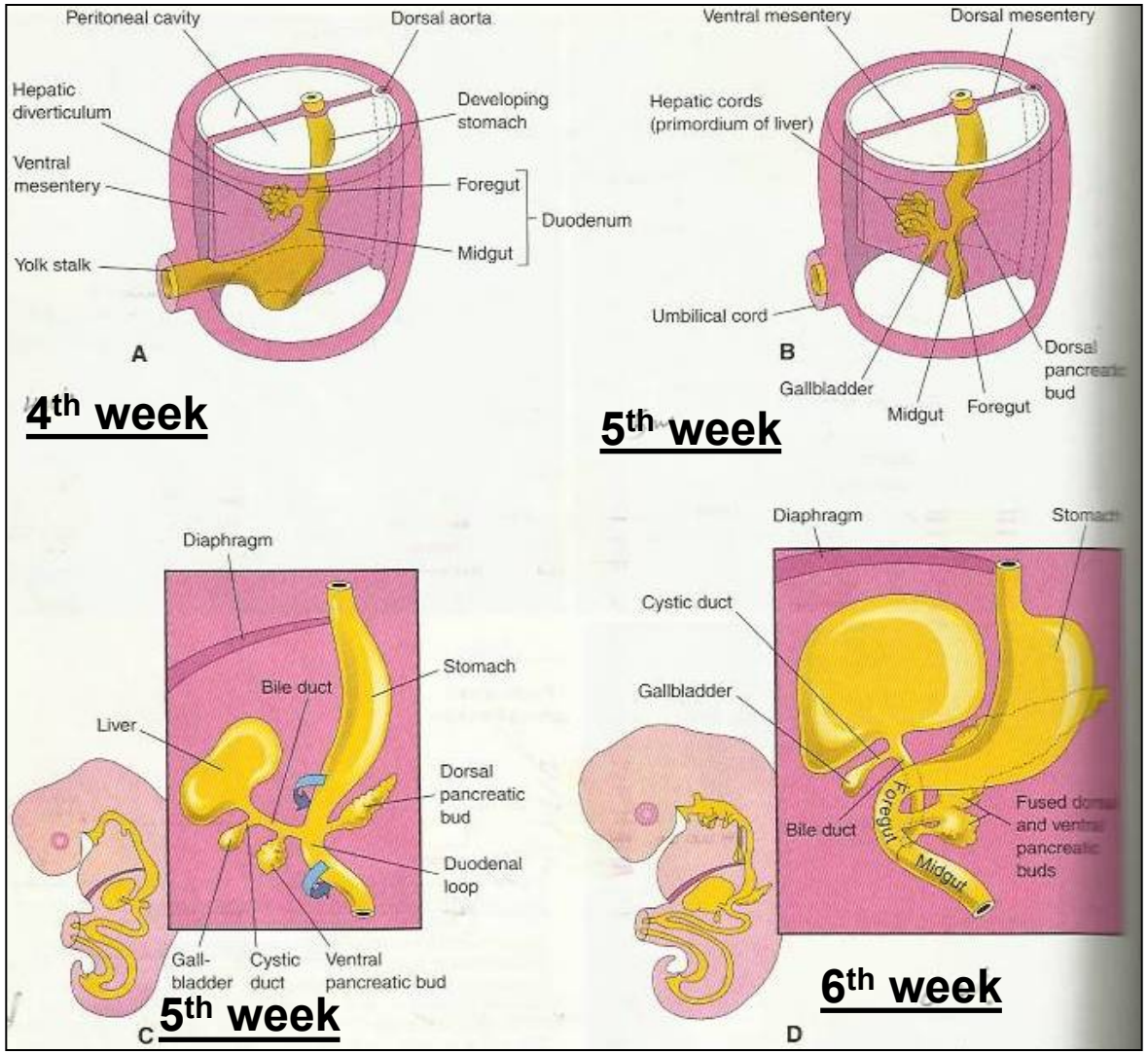
- **At the end of the lecture, the students should be able to :**
- Describe the development of the duodenum.
- Describe the development of the pancreas.
- Describe the development of the small intestine.
- Identify the congenital anomalies of the small intestine :
- **Congenital omphalocele.**
- **Umbilical hernia.**
- **Meckel's diverticulum.**

DEVELOPMENT OF THE DUODENUM



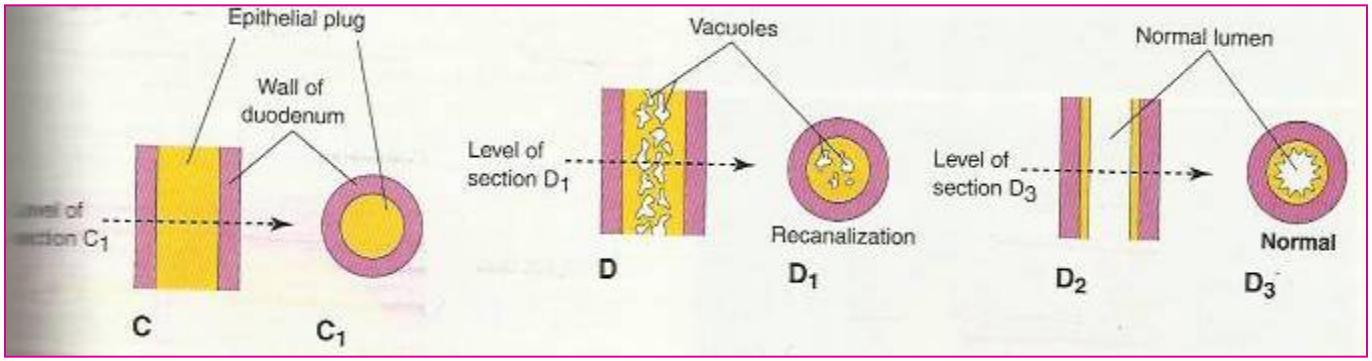
- **Stages in the development of duodenum, liver, biliary ducts and pancreas (A-D).**
- **Early in the 4th week, the duodenum develops from the endoderm of primordial gut of :**
- **Caudal part of foregut.**
- **Cranial part of midgut & from :**
- **Splanchnic mesoderm.**
- The junction of the 2 parts of the gut lies just below or distal to the origin of bile duct (C &D).

DEVELOPMENT OF THE DUODENUM



- **The duodenal loop** is formed and projected ventrally, forming **a C-shaped loop (C).**
- **The duodenal loop** is rotated with the stomach to the right and comes to lie on the posterior abdominal wall retroperitoneally with the developing pancreas.

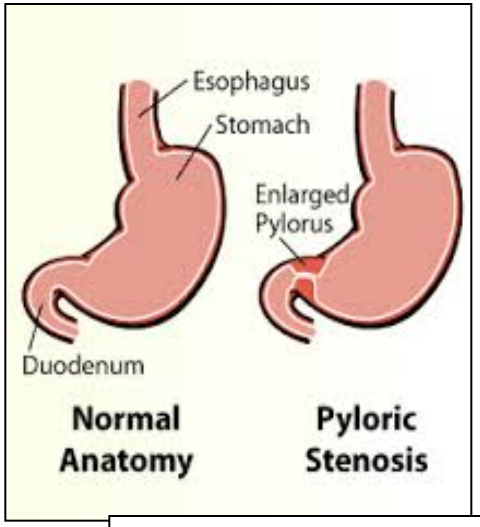
DEVELOPMENT OF THE DUODENUM

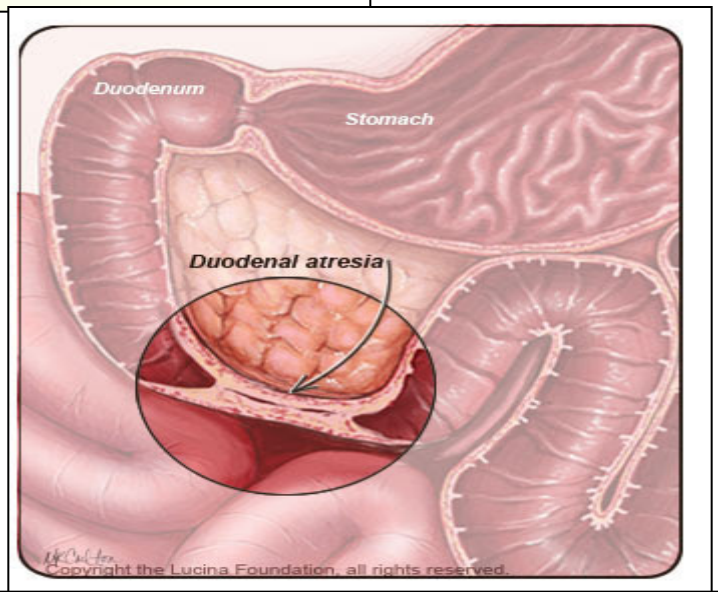


- During 5th & 6th weeks, the lumen of the duodenum is temporarily obliterated because of proliferation of its epithelial cells.
- Normally degeneration of epithelial cells occurs, so the duodenum normally becomes recanalized by the end of the embryonic period.

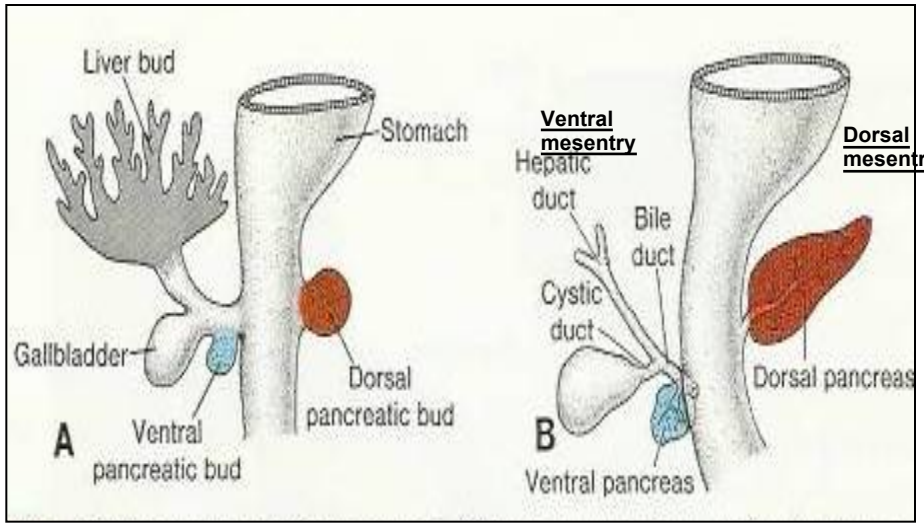
Congenital anomalies

- **Duodenal stenosis**; results from incomplete recanalization of duodenum.
- **Duodenal atresia**; results from failure of recanalization leading to complete occlusion of the duodenal lumen, (autosomal recessive inheritance).



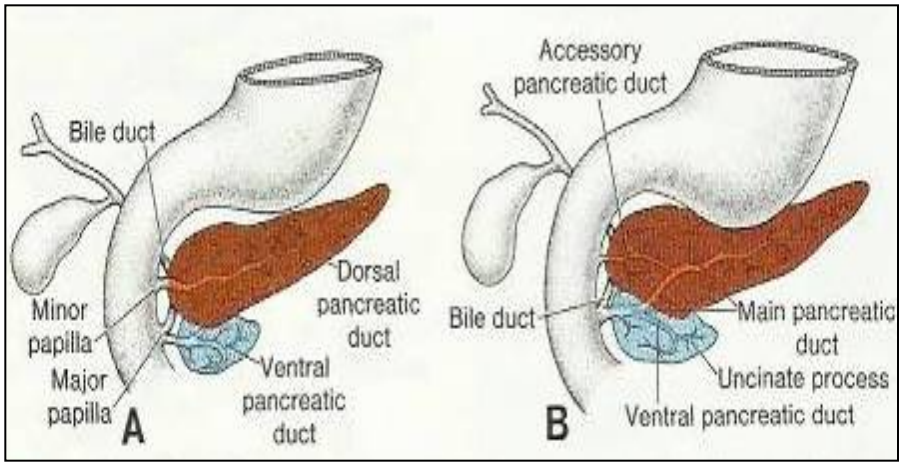


DEVELOPMENT OF PANCREAS



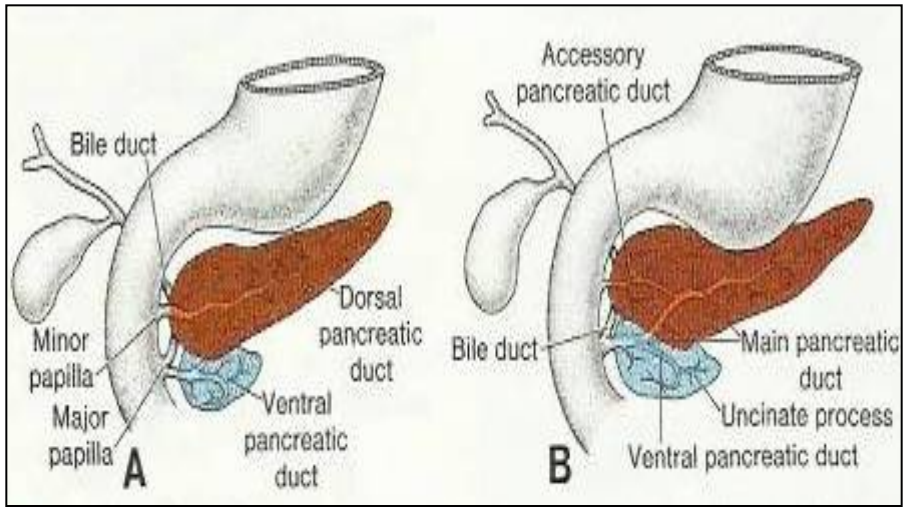
- The pancreas develops from 2 buds arising from the endoderm of the caudal part of foregut :
- **A ventral pancreatic bud :** which develops from the proximal end of hepatic diverticulum (forms the liver & gall bladder).
- **A dorsal pancreatic bud :** which develops from dorsal wall of duodenum slightly cranial to the ventral bud.
- **Most of pancreas** is derived from the dorsal pancreatic bud.

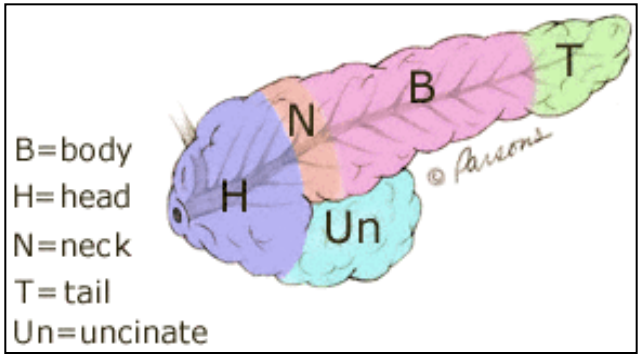
DEVELOPMENT OF PANCREAS



- When the duodenum rotates to the right and becomes C-shaped, the ventral pancreatic bud moves dorsally to lie below and behind the dorsal bud.
- Later the 2 buds fused together and lying in the dorsal mesentery.

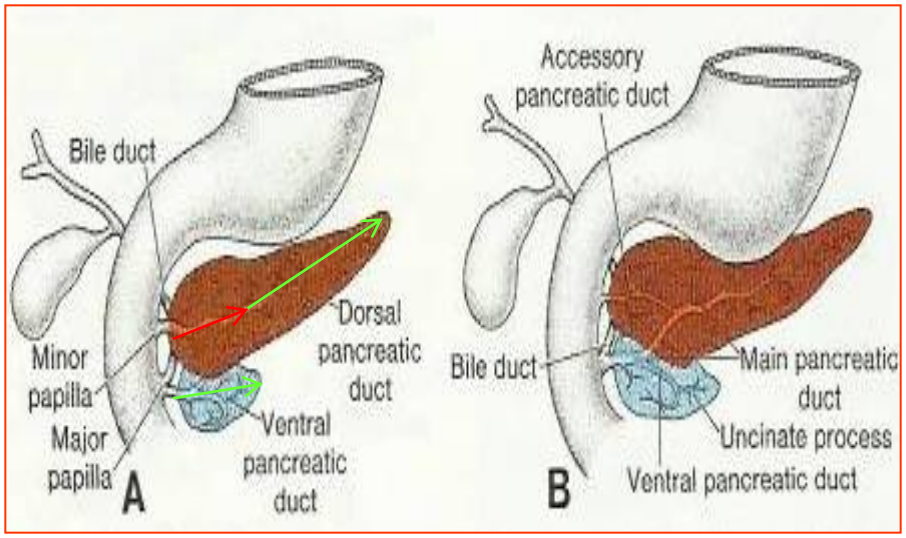
DEVELOPMENT OF PANCREAS

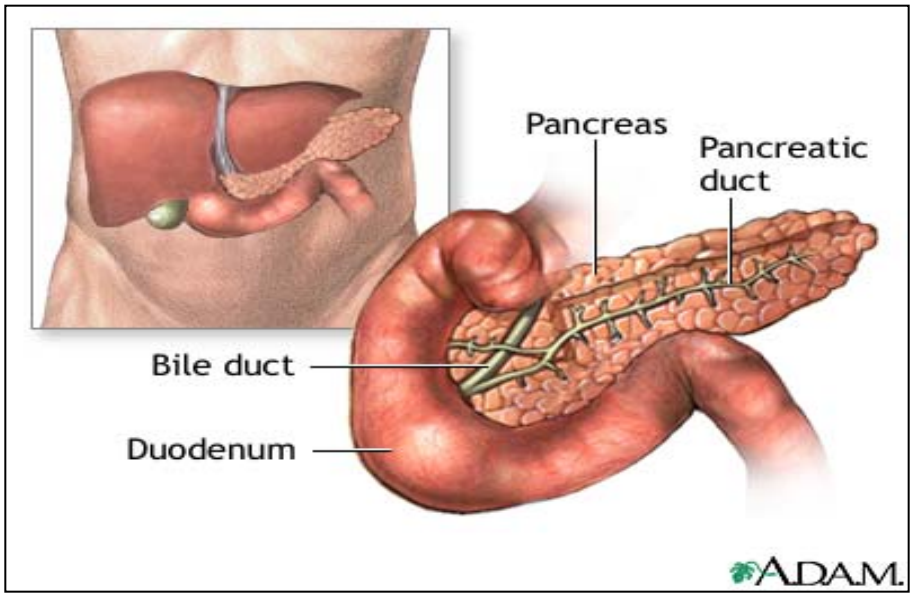




- **The ventral bud forms :**
- Uncinate process.
- Inferior part of head of pancreas.
- **The dorsal pancreatic bud forms :**
- Upper part of of head.
- Neck.
- Body &
- Tail of pancreas.

DEVELOPMENT OF PANCREAS

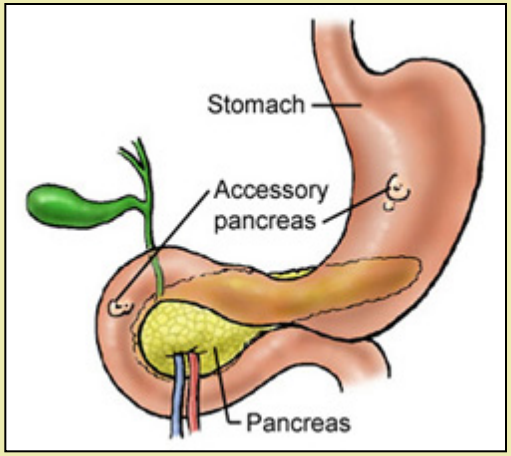


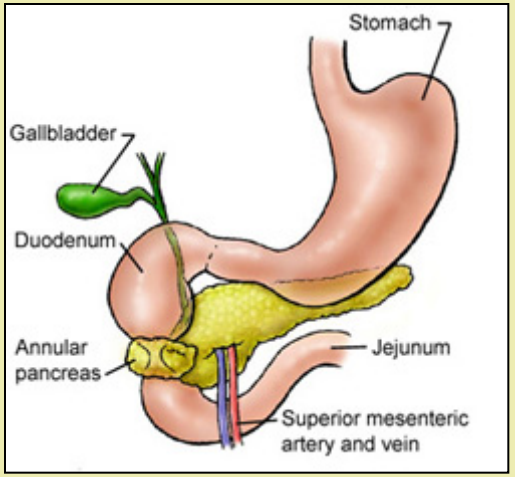


- **The main pancreatic duct is formed from :**
- The duct of the ventral bud.
- The distal part of duct of dorsal bud.
- **The accessory pancreatic duct is derived from :**
- Proximal part of duct of dorsal bud.
- **The parenchyma of pancreas** is derived from the endoderm of pancreatic buds.
- **Pancreatic islets** develops from parenchymatous pancreatic tissue.
- **Insuline secretion** begins at 5th month of pregnancy.

Congenital anomalies

- **Accessory pancreatic tissue**; located in the wall of the stomach or duodenum.
- **Anular pancreas**; a thin flat band of pancreatic tissue surrounding the second part of the duodenum, causing duodenal obstruction.





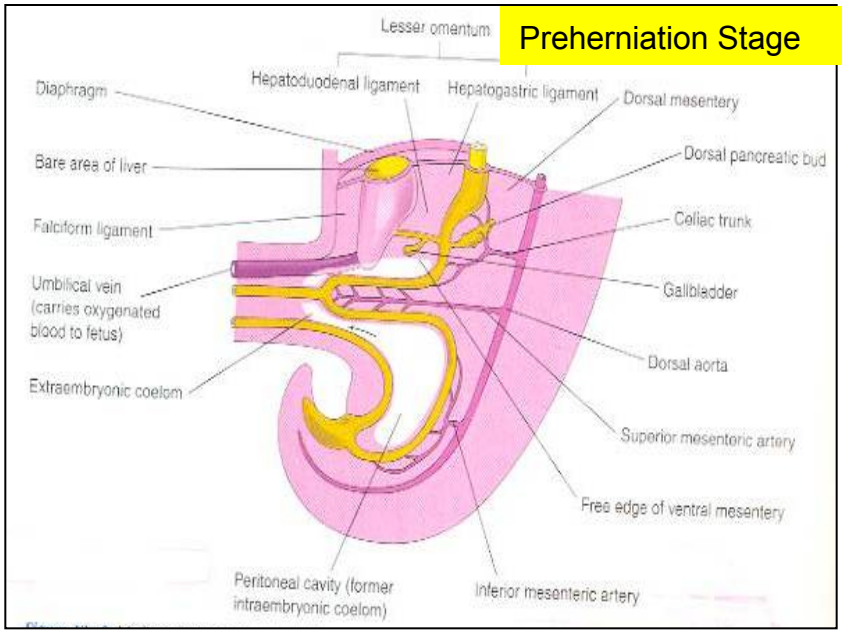
DEVELOPMENT OF SMALL INTESTINE

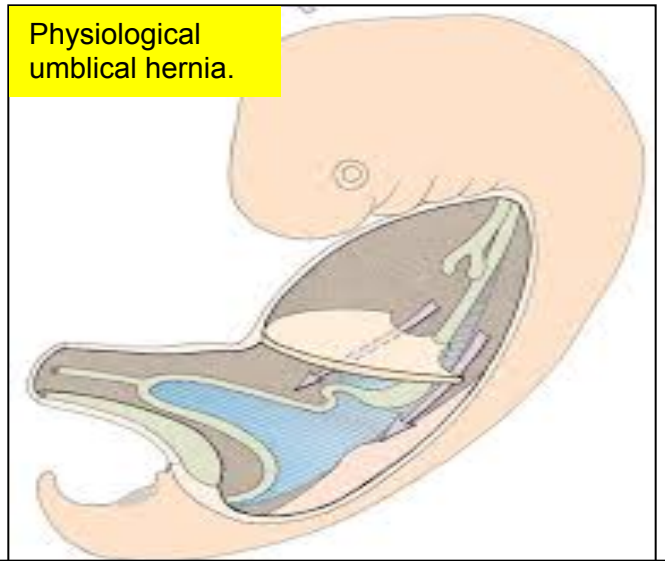
- **Derivatives of cranial part of the midgut loop :**
- **Distal** part of the **duodenum** (**proximal** part of **duodenum** is developed from **caudal part of foregut**)
- Jejunum
- Upper part of the ileum.
- **Derivatives of the caudal part of midgut loop :**
- Lower portion of ileum.
- Cecum & appendix.
- Ascending colon + proximal 2/3 of transverse colon.
- **So, the small intestine is developed from :**
- **Caudal part of foregut.**
- **All midgut.**
- **Midgut is supplied by** superior mesenteric artery (artery of midgut).

STAGES OF DEVELOPMENT OF SMALL INTESTINE

- Preherniation stage.
- Stage of physiological umbilical hernia.
- stage of rotation of midgut loop.
- Stage of reduction of umbilical hernia.
- Stage of fixation of various parts of intestine.

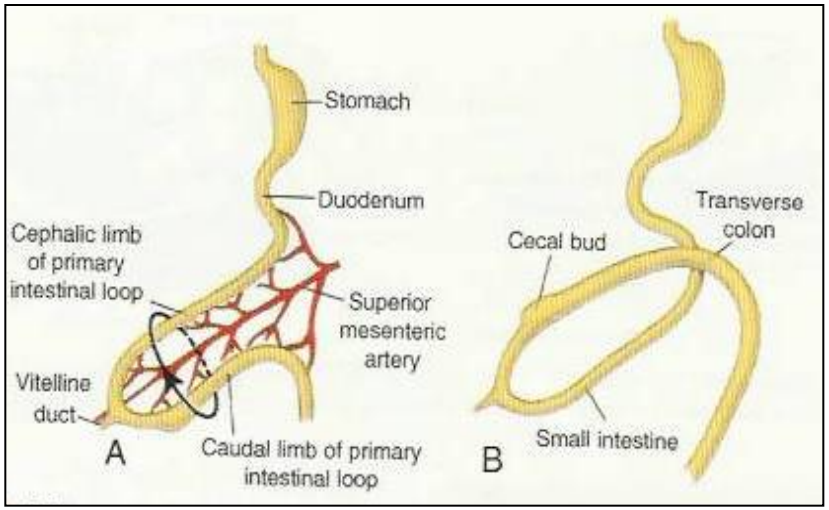
Development of midgut loop

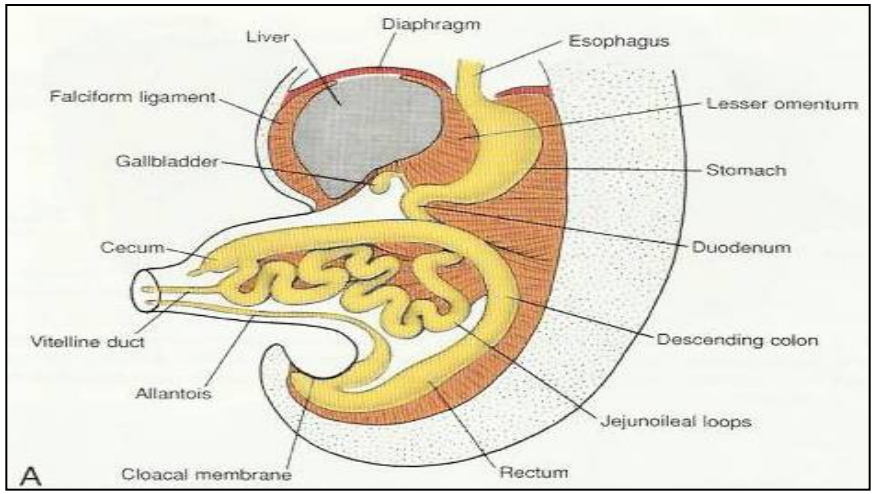




- **At the beginning of 6th week,** the midgut elongates to form a **venteral U-shaped midgut loop.**
- **Midgut loop communicates with the yolk sac by vitelline duct or yolk stalk.**
- **As a result of rapidly growing liver, kidneys & gut** ,the abdominal cavity is temporarily too small to contain the developing rapidly growing intestinal loop.
- So ,Midgut loop projects into **the umbilical cord** …this is called **physiological umbilical herniation (begins at 6th w.).**

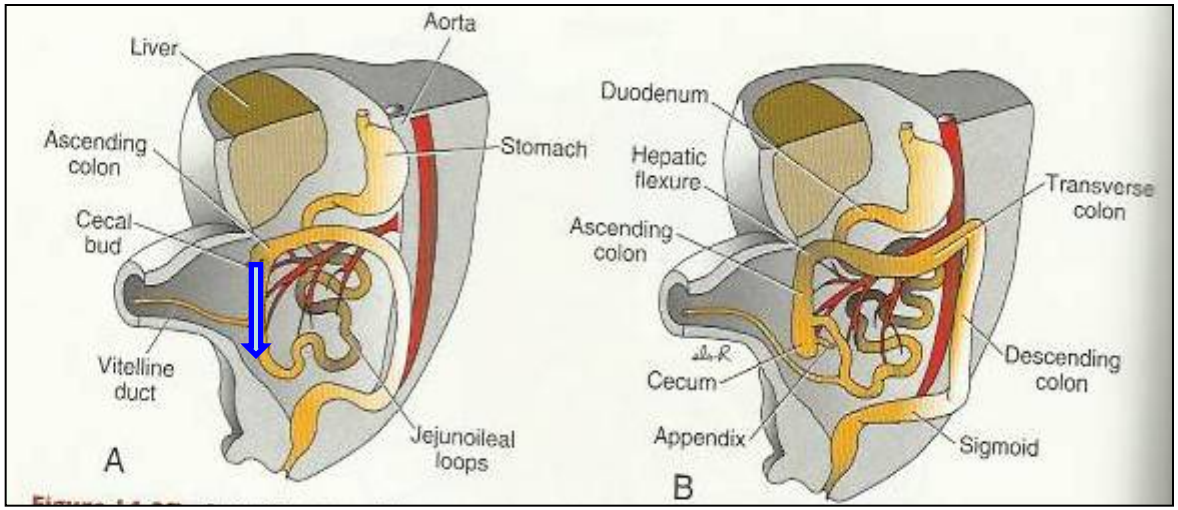
ROTATION OF THE MIDGUT LOOP





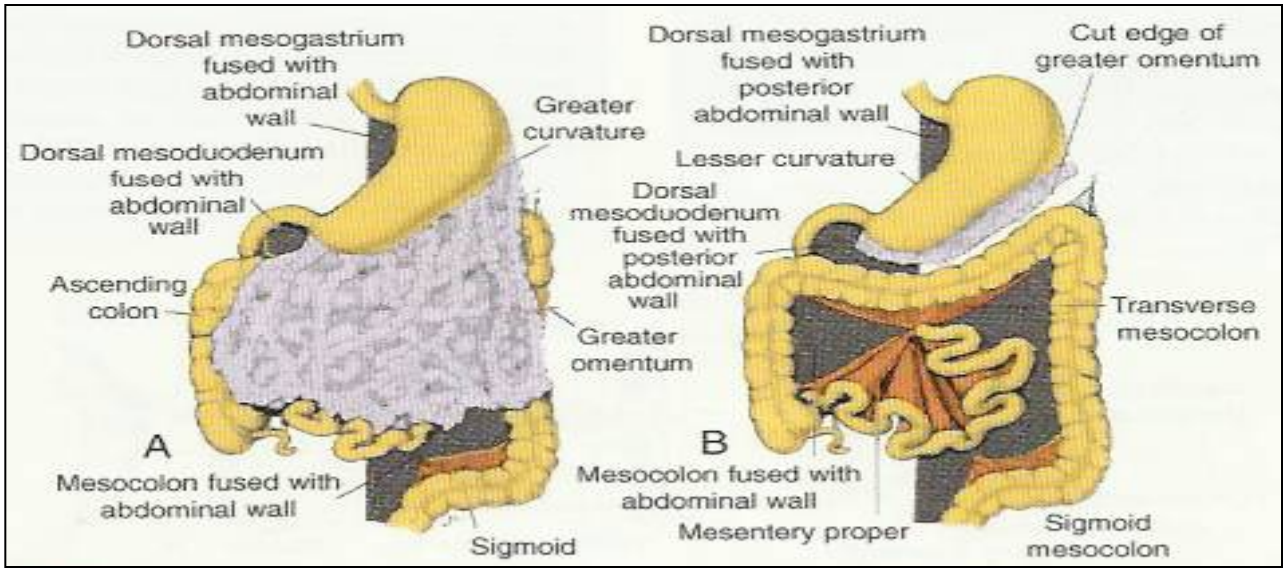
- Midgut loop has a cranial limb & a caudal limb.
- Midgut loop rotates around the axis of the superior mesenteric artery.
- Midgut loop rotates first 90 degrees to bring the cranial limb to the right and caudal limb to left during the physiological hernia.
- The cranial limb of midgut loop elongates to form the intestinal coiled loops (jejunum & ileum).
- This rotation is counterclockwise and it is completed to 270 degrees, so after reduction of physiological hernia it rotates to about 180 degrees.

RETURN OF MIDGUT TO ABDOMEN



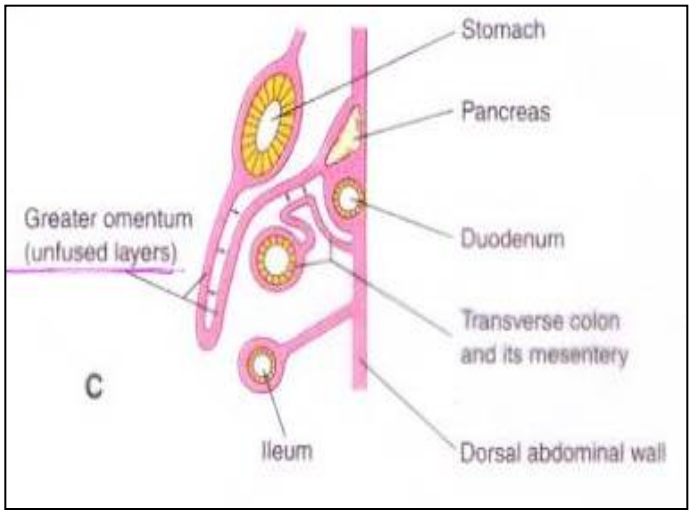
- **During 10th week**, the intestines return to the abdomen due to regression of liver & kidneys + expansion of abdominal cavity. It is called **reduction of physiological midgut hernia.**
- Rotation is completed and the coiled intestinal loops lie in their final position in the left side.
- **The caecum** at first lies below the liver, **but later** it **descends** to lie in the **right iliac fossa.**

FIXATION OF VARIOUS PARTS OF INTESTINE

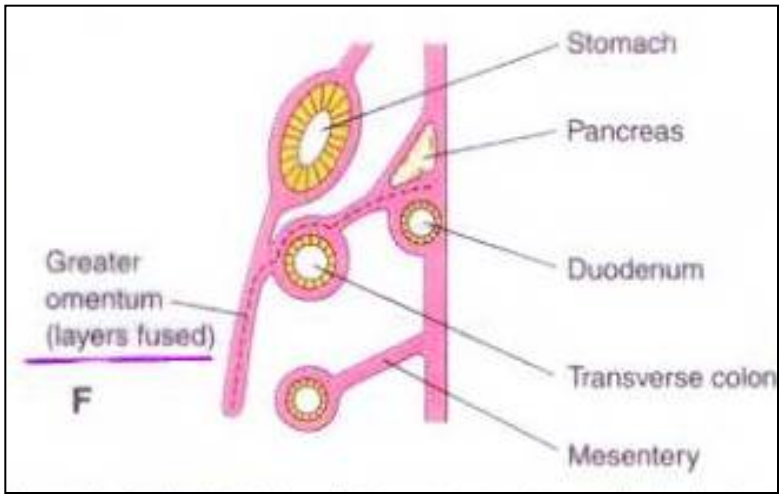


- **The mesentry of jejunoileal loops** is at **first continuous with that** of the **ascending colon.**
- When the **mesentry of ascending** colon **fuses with** the **posterior abdominal wall**, **the mesentry of small intestine** becomes **fan-shaped** and acquires a new line of attachment that passes from duodenojejunal junction to the ileocecal junction.

Fixation of various parts of intestines



Intestines prior to fixation

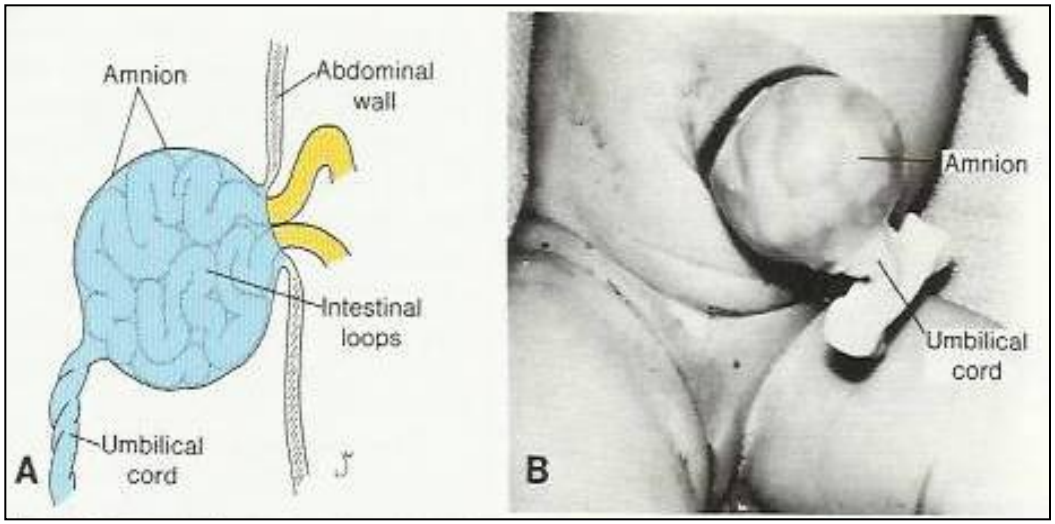


Intestines after fixation

- The enlarged colon presses the duodenum & pancreas against the posterior abdominal wall. **C & F**

- Most of duodenal mesentery is absorbed, **so most of duodenum** (except for about the first 2.5 cm derived from foregut) **& pancreas become retroperitoneal.** **C & F**

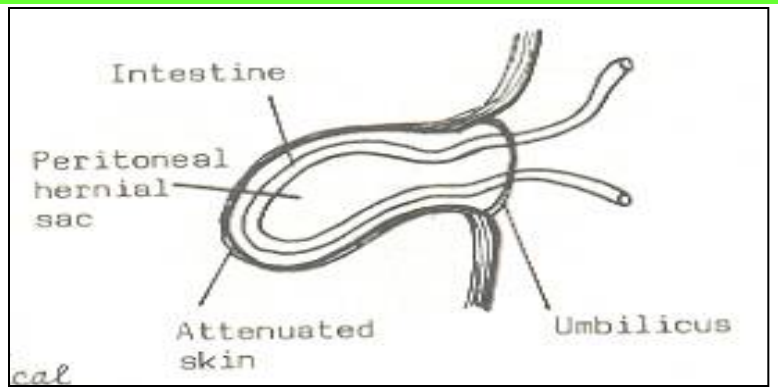
Congenital Omphalocele



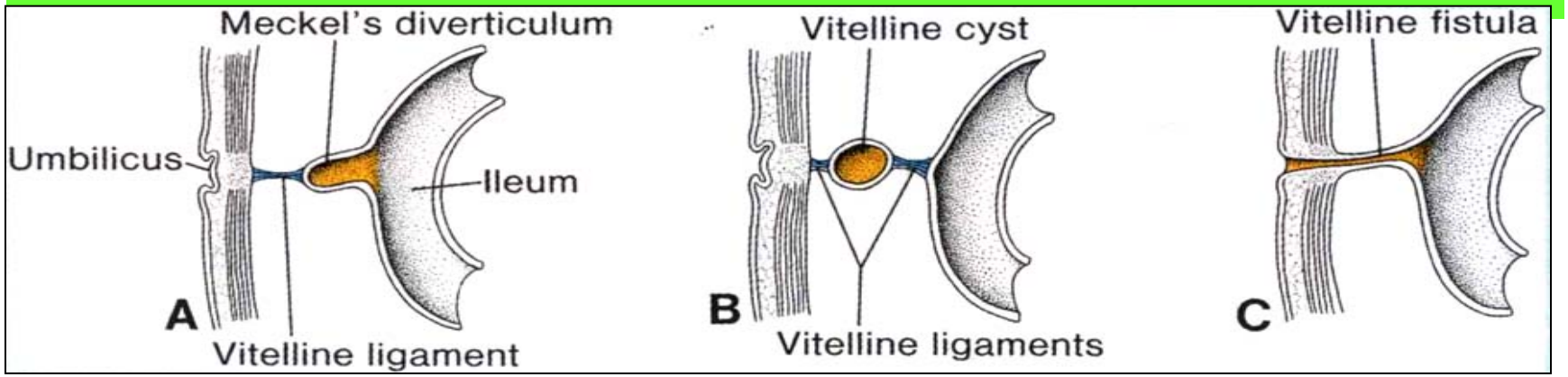
- It is a persistence of herniation of abdominal contents into proximal part of umbilical cord due to failure of reduction of physiological hernia to abdominal cavity at 10th week.
- Herniation of intestines occurs in 1 of 5000 births – herniation of liver & intestines occurs in 1 of 10,000 births.
- It is accompanied by small abdominal cavity.
- The hernial sac is covered by the epithelium of the umbilical cord/ the amnion.
- Immediate surgical repair is required.

Congenital Umbilical Hernia

- The intestines return to abdominal cavity at 10th week, but herniated through an imperfectly closed umbilicus
- It is a common type of hernia.
- The herniated contents are usually 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 fibrous ring at umbilicus.
- Surgery is performed at age of 3-5 years.



Ileal (Meckel's) Diverticulum



- It is one of the most common anomalies of the digestive tract, present in about 2% -4% of people, more common in males.
- **It is a small pouch from the ileum,** and may contain small patches of gastric & pancreatic tissues causing ulceration, bleeding or even perforation.
- It is the remnant of proximal part **nonobliterated part of yolk stalk** (or vitelline duct).
- **It arises from antimesenteric border of ileum**, 1/2 meter from ileocecal junction.
- It is sometimes becomes **inflammed** and causes **symptoms that mimic appendicitis.**
- It may be connected to the umbilucus by a fibrous cord, and the middle portion forms a cyst or may remain patent forming **the fistula** so, faecal matter is carried through the duct into umbilicus.

THANK YOU

SUMMARY

- **The foregut gives rise to** :
- **Duodenum** (proximal to the opening of the bile duct).
- **Pancreas.**
- **Biliary apparatus.**
- **The pancreas develops from :**
- Dorsal & ventral pancreatic buds that develop from **the endodermal lining of the caudal part of foregut.**

SUMMARY

- **The midgut gives rise to The small intestine :**
- **Duodenum** (distal to bile duct).
- **Jejunum & ileum.**
- **physiological umbilical hernia :**

  The midgut forms a U-shaped intestinal loop that herniates into the umbilical cord during 6th week.
- **Omphalocele** results from failure of return of the intestine into the abdomen.
- **Ileal diverticula** are common; however, only a few of them become inflamed and produce pain.

1. **Which part of the pancreas the ventral pancreatic bud forms ?**
   1.Upper part of the head.
   2.Lower part of the head.
   3.Body.
   4.Tail.

2. Which artery the midgut loop rotates around its axis ?
   a.Splenic artery.
   b.Inferior mesenteric artery.
   c.Superior mesenteric artery.
   d.Celiac trunk.

3. The cranial limb of midgut loop gives rise :
   a.The liver.
   b.The pancreas.
   c.The stomach.
   d.The jejunum & ilum.

4. The umbilical hernia is:

a.Uncommon type.
b.Resulting from imperfect closed umbilicus.
c.Covered by the epithelium of umbilical cord.
d.Not be easily reduced at the umbilicus.

5. The congenital omphalocele is :

a. A small pouch from the ileum.
b.Covered by the epithelium of the umbilical cord.
c.An abdominal wall defect.
d.Covered by skin.

6. The Meckel's diverticulum :

a.Is a duodenal pouch.
b.Arises from the mesenteric border of the ileum.
c.Is a remnant of the proximal nonobliterated part of yolk stalk.
d.Is a physiological hernia of intestine.