

*Development
of
pancreas
and
Small Intestine*

ANATOMY DEPARTMENT

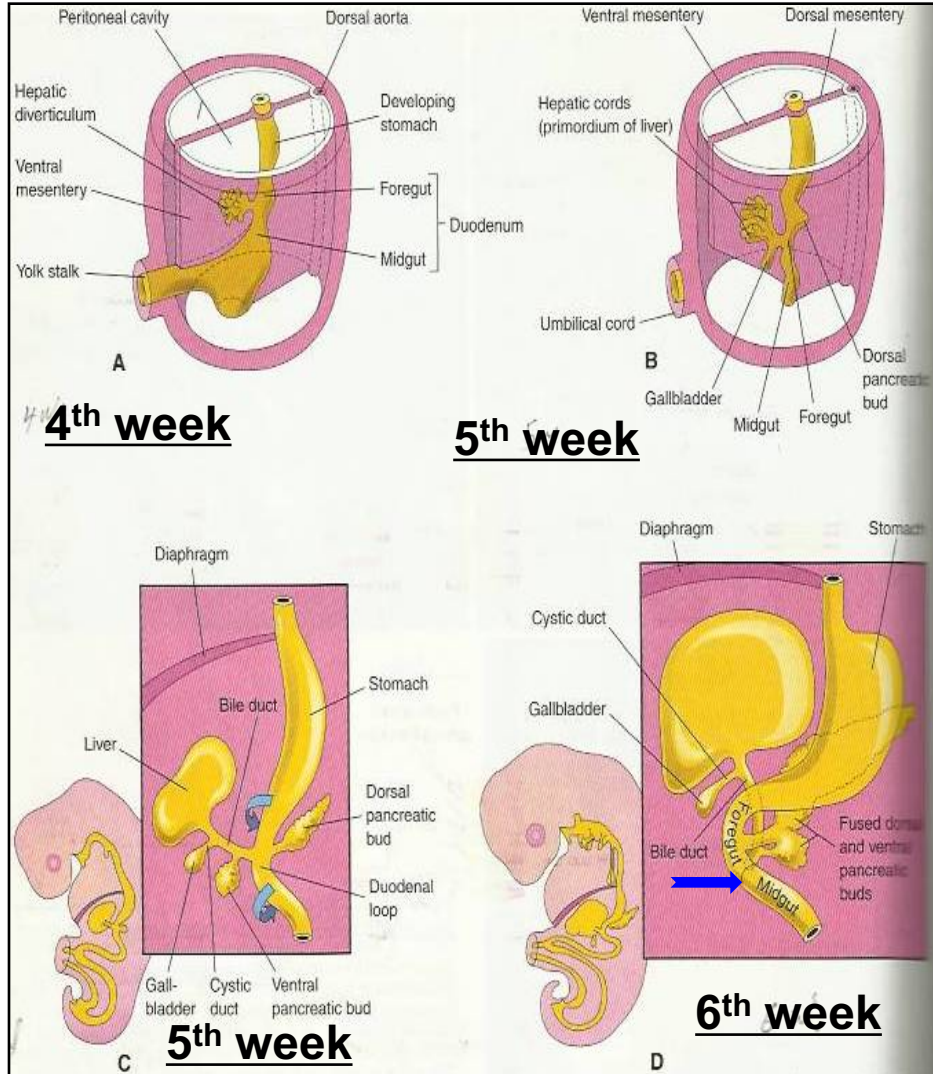
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DR.ESSAM Eldin Salama

OBJECTIVES

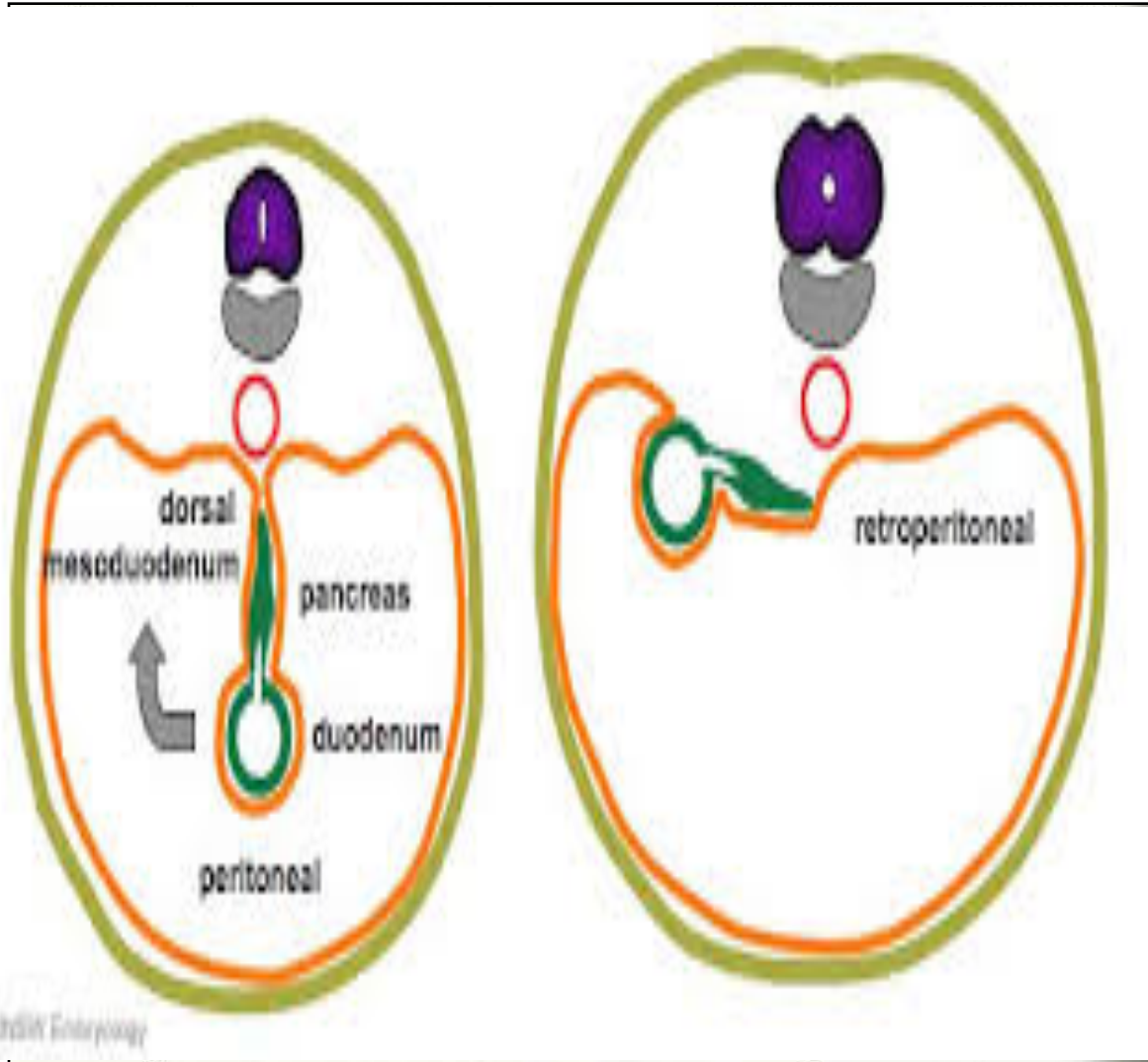
- **At the end of the lecture, the students should be able to :**
- Describe the development of the duodenum.
- Describe the development of the pancreas.
- Describe the development of the small intestine.
- Identify the congenital anomalies of the small intestine :
- **Congenital omphalocele.**
- **Umbilical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

DEVELOPMENT OF THE DUODENUM



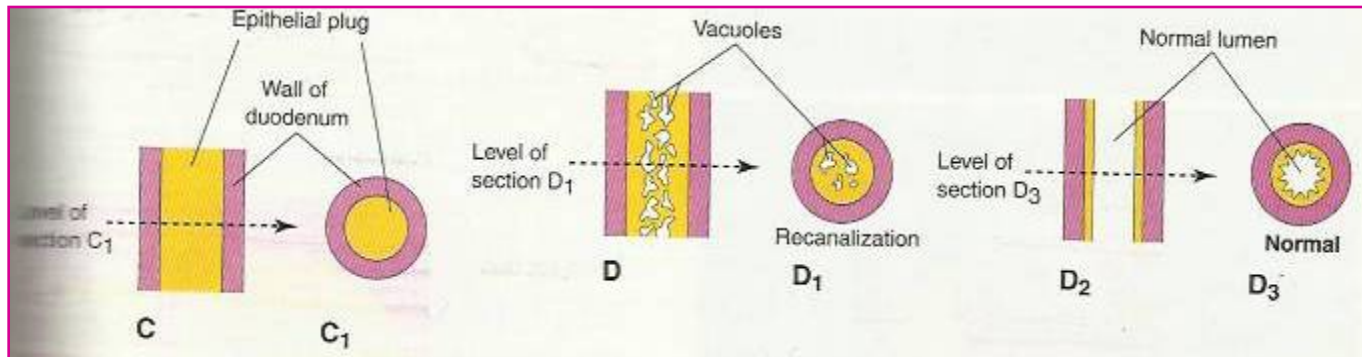
- Stages in the development of duodenum, liver, biliary ducts and pancreas (A-D).
- Early in the 4th week, the duodenum develops from the endoderm of primordial gut of :
 - Caudal part of foregut.
 - Cranial part of midgut & from :
 - Splanchnic mesoderm.
- The junction of the 2 parts of the gut lies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

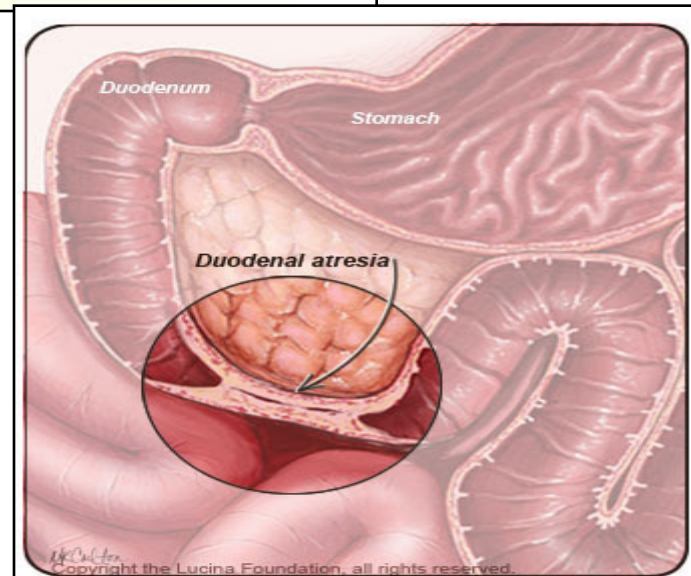
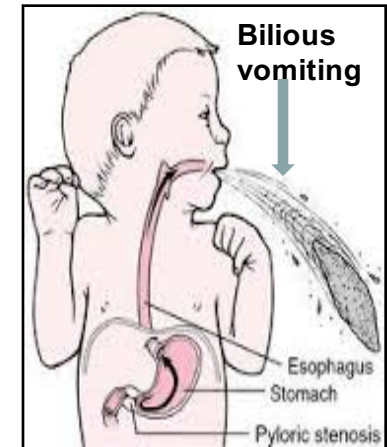
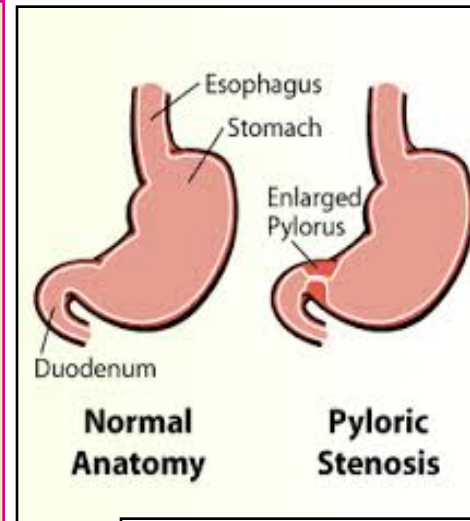
DEVELOPMENT OF THE DUODENUM



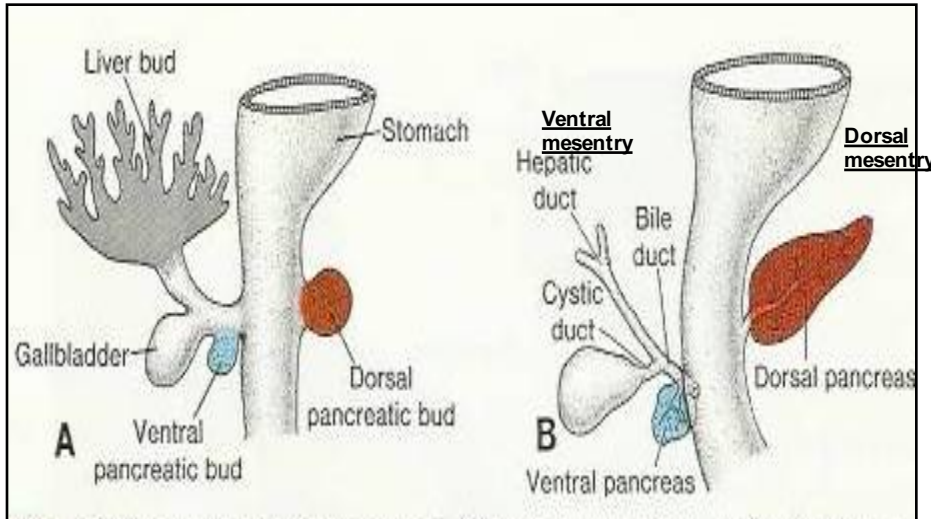
- During 5th & 6th weeks, the lumen of the duodenum is **temporarily obliterated** because of proliferation of its epithelial cells.
- Normally degeneration of epithelial cells occurs, so the duodenum normally becomes **recanalized** by the end of the embryonic period (end of 8th week).

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).

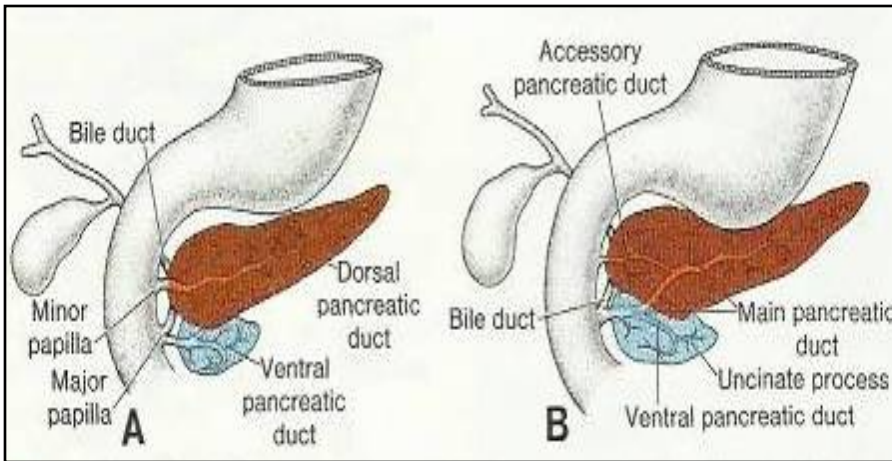


DEVELOPMENT OF PANCREAS



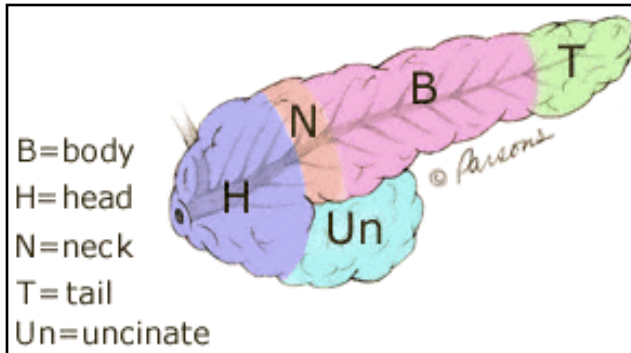
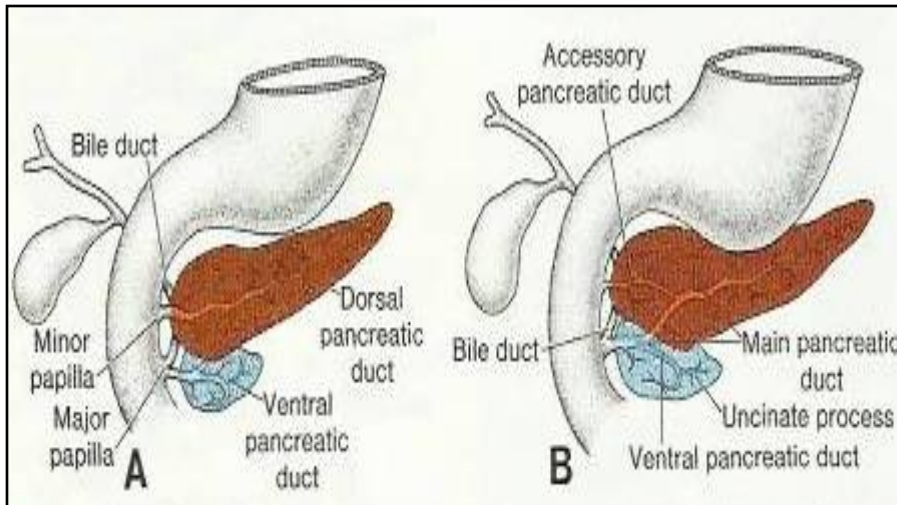
- The pancreas develops from 2 buds arising from the **endoderm** of the caudal part of foregut :
- **A ventral pancreatic bud** : which develops from the proximal end of hepatic diverticulum (forms the liver & gall bladder).
- **A dorsal pancreatic bud** : which develops from dorsal wall of duodenum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

DEVELOPMENT OF PANCREAS



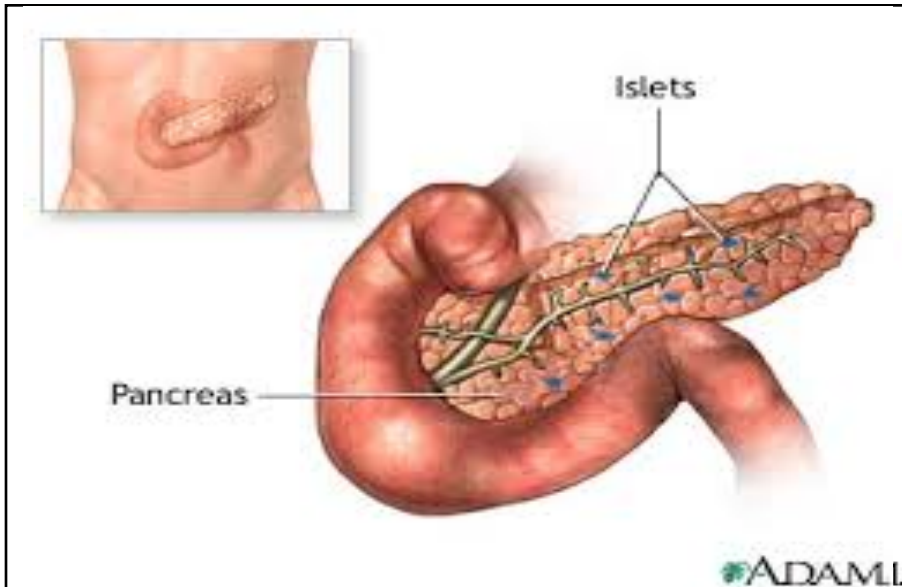
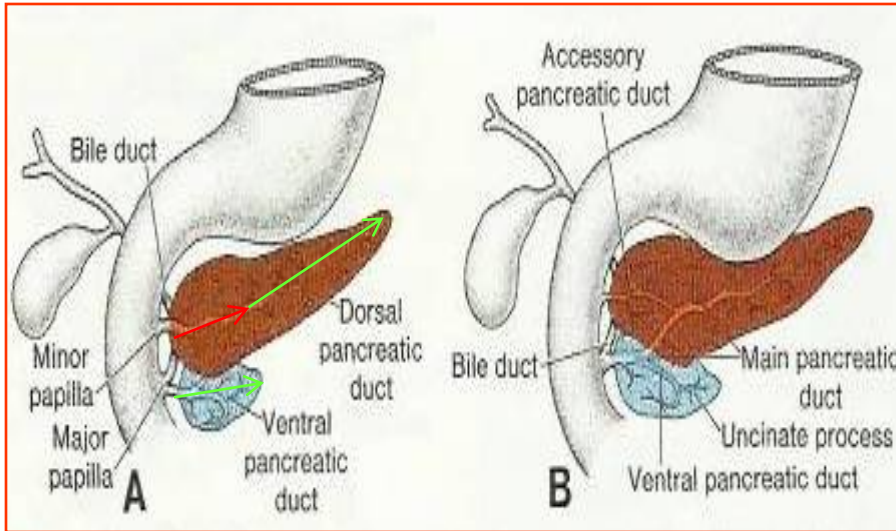
- When the **duodenum rotates to the right** and becomes C-shaped, the ventral pancreatic bud moves dorsally to lie below and behind the dorsal bud.
- Later the **2 buds fused together** and lying in the dorsal mesentery.

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.

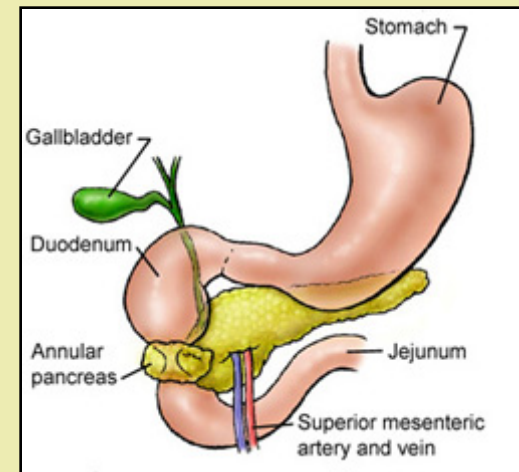
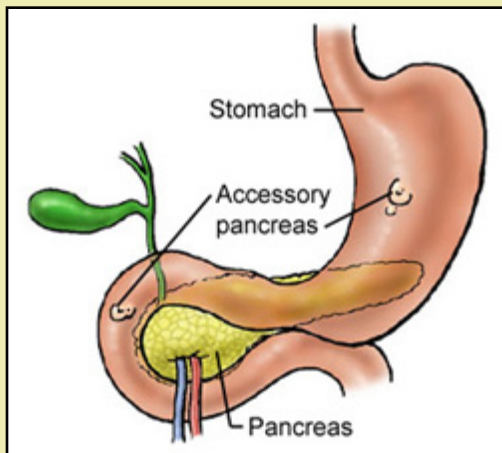
DEVELOPMENT OF PANCREAS



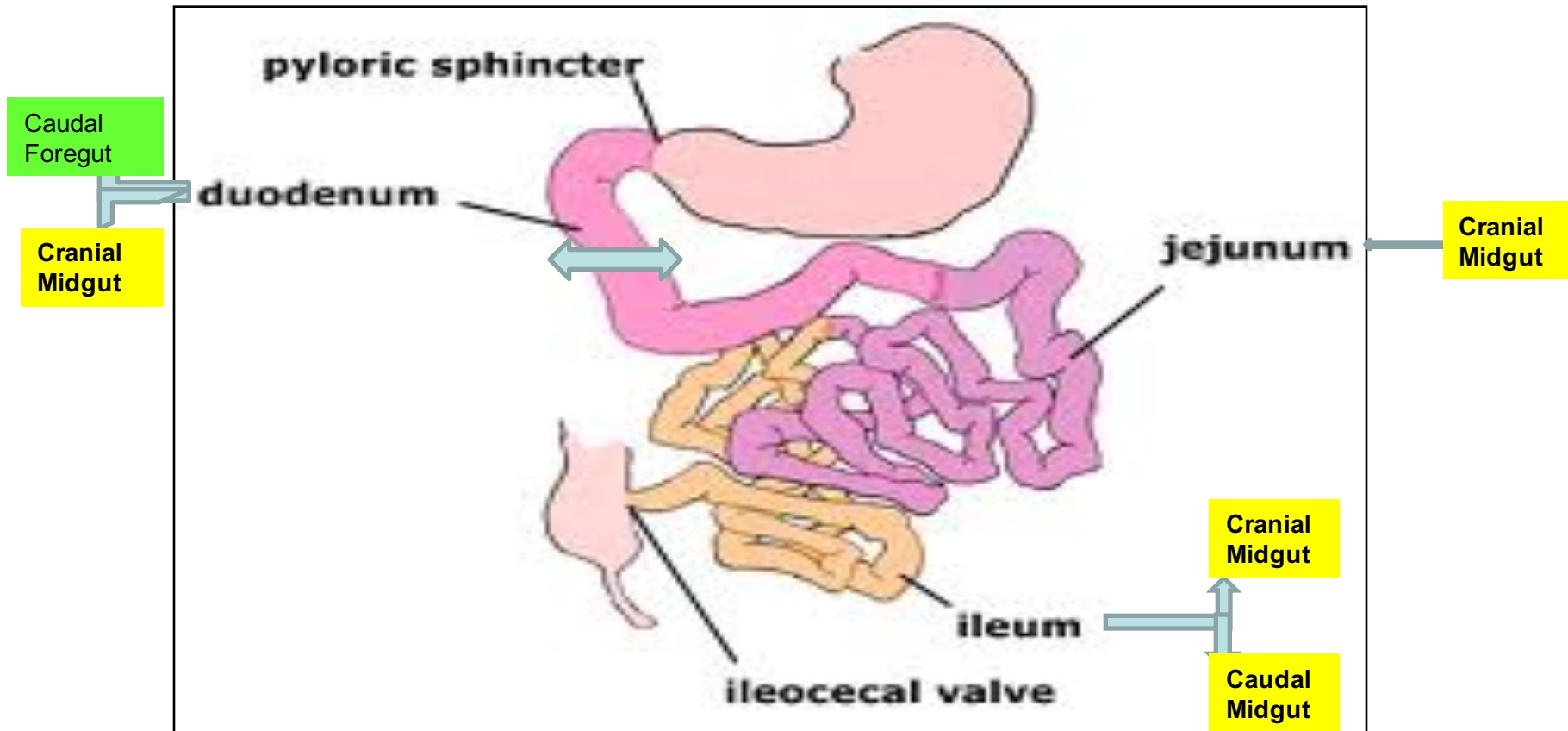
- **The main pancreatic duct is formed from :**
- The duct of the **ventral bud**.
- The distal part of duct of **dorsal bud**.
- **The accessory pancreatic duct is derived from :**
- Proximal part of duct of **dorsal bud**.
- **The parenchyma of pancreas** is derived from the **endoderm** of pancreatic 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



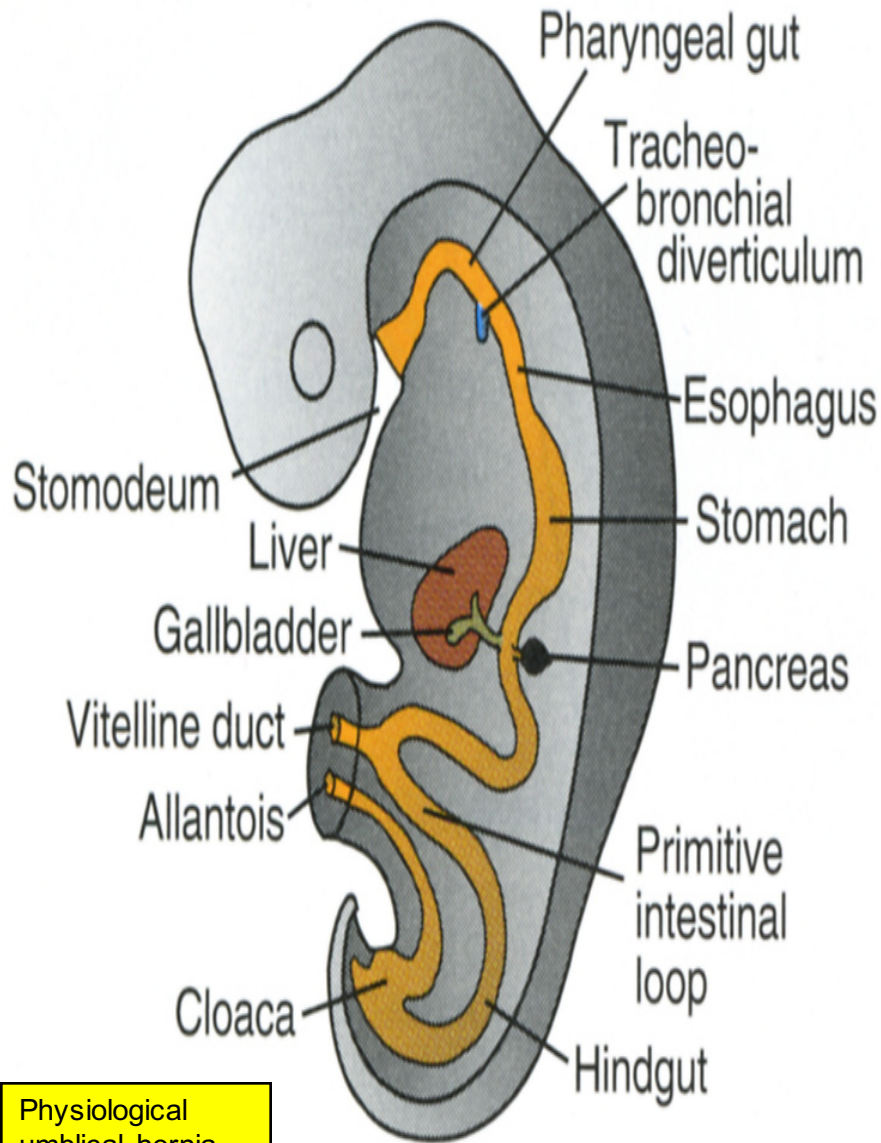
DEVELOPMENT OF SMALL INTESTINE

- **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.

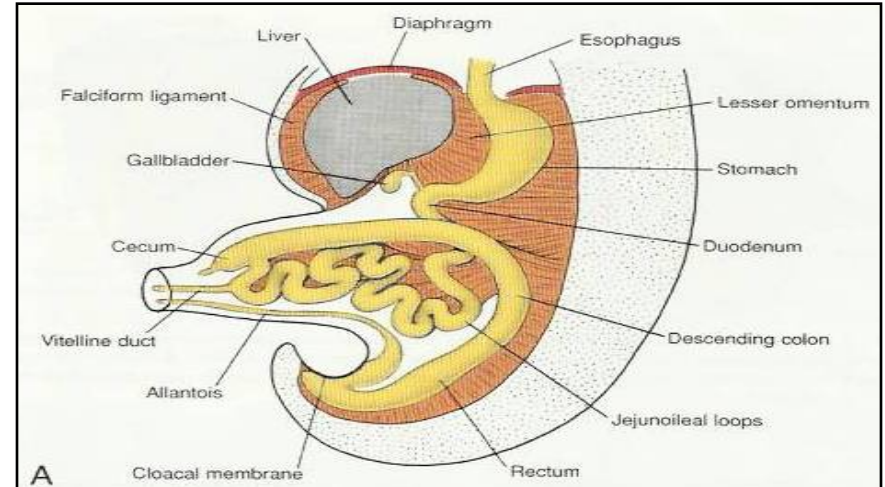
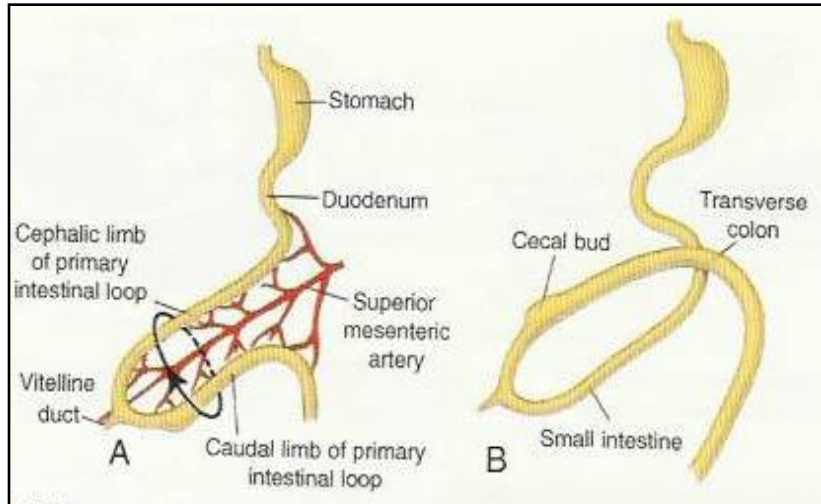
Development of midgut loop



- **At the beginning of 6th week**, the midgut elongates to form a **ventral 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.)**.

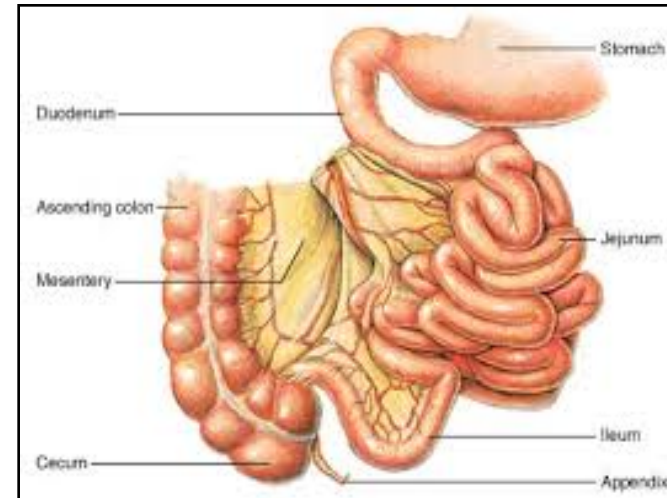
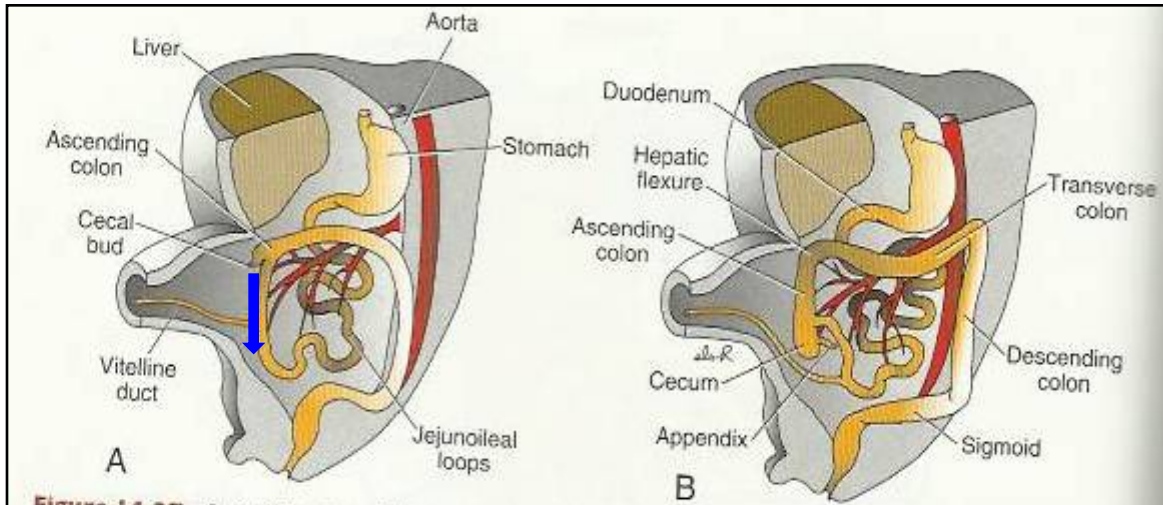
Physiological umbilical hernia.

ROTATION OF THE MIDGUT LOOP



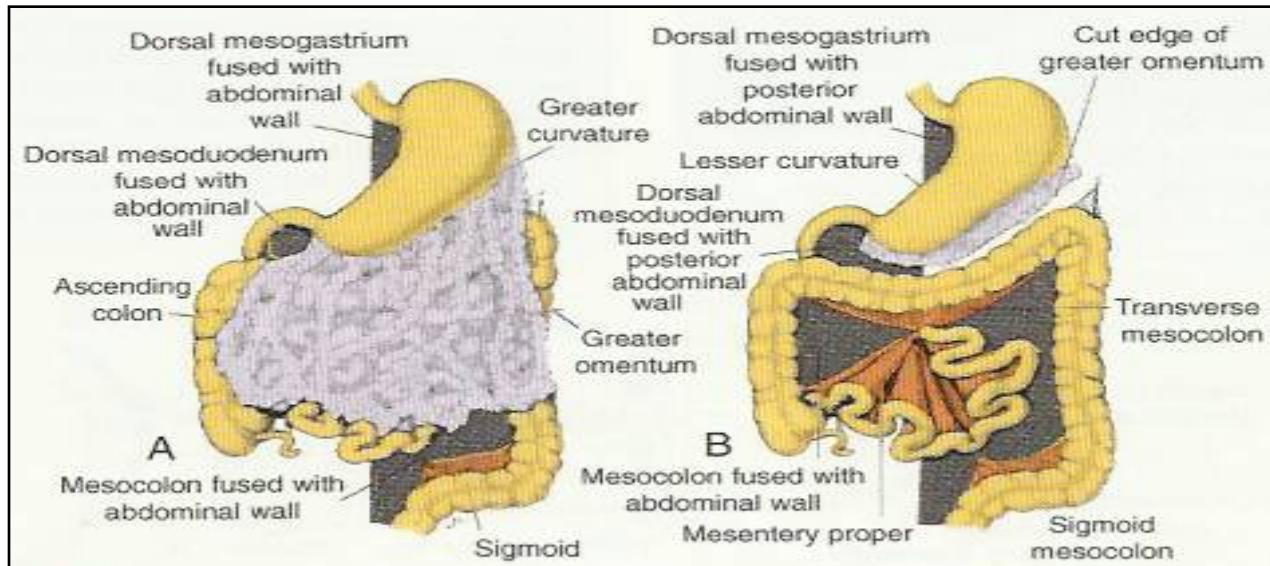
- Midgut loop has a cranial limb & a caudal limb.
- Midgut loop rotates around the axis of the **superior mesenteric artery**.
- **Midgut loop rotates first 90 degrees to bring the cranial limb to the right and caudal limb to left during the physiological hernia.**
- **The cranial limb of midgut loop 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



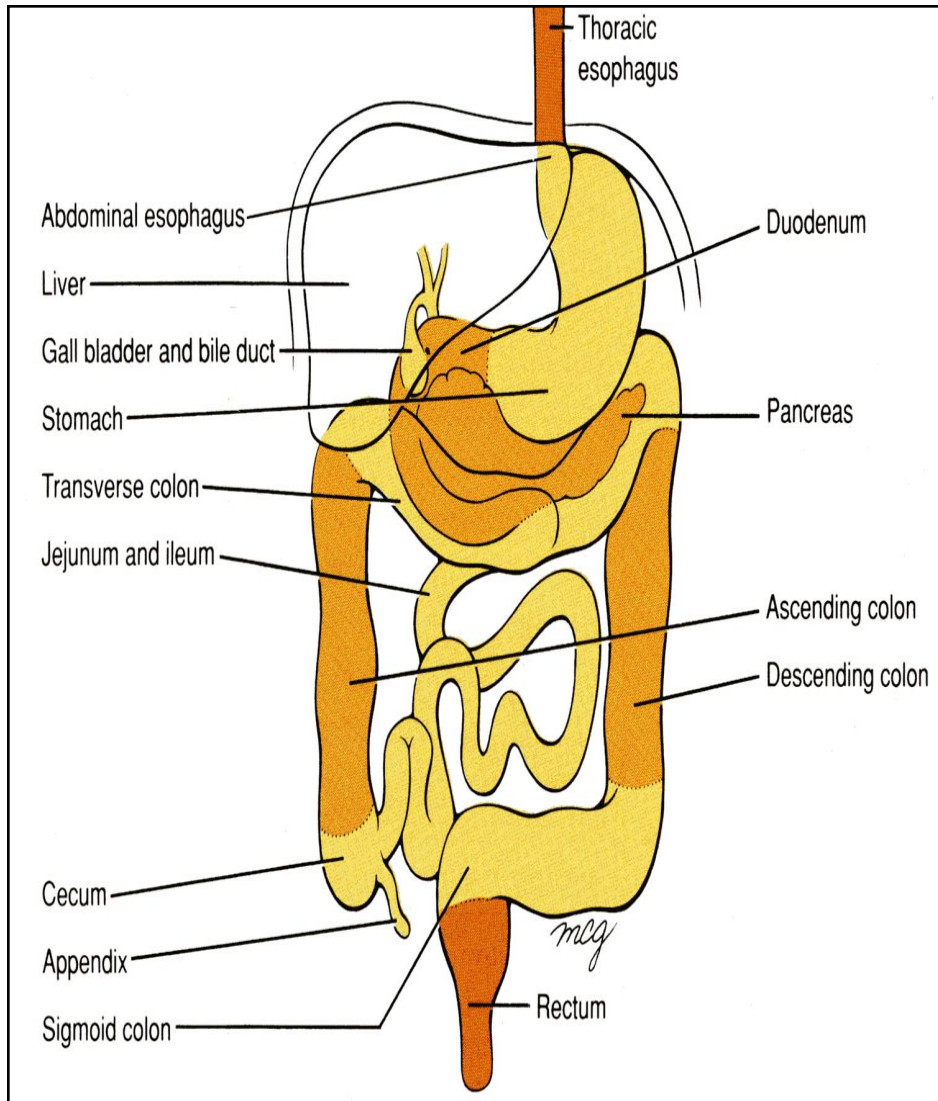
- **During 10th week**, the intestines return to the abdomen due to regression of liver & kidneys + expansion of abdominal cavity. It is called **reduction of physiological midgut hernia**.
- Rotation is completed and the coiled intestinal loops lie in their final position in the left side.
- **The caecum**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

FIXATION OF VARIOUS PARTS OF INTESTINE



- **The mesentery of jejunoileal loops** is at first continuous with that of the ascending colon.
- When the mesentery of ascending colon fuses with the posterior abdominal wall, **the mesentery 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



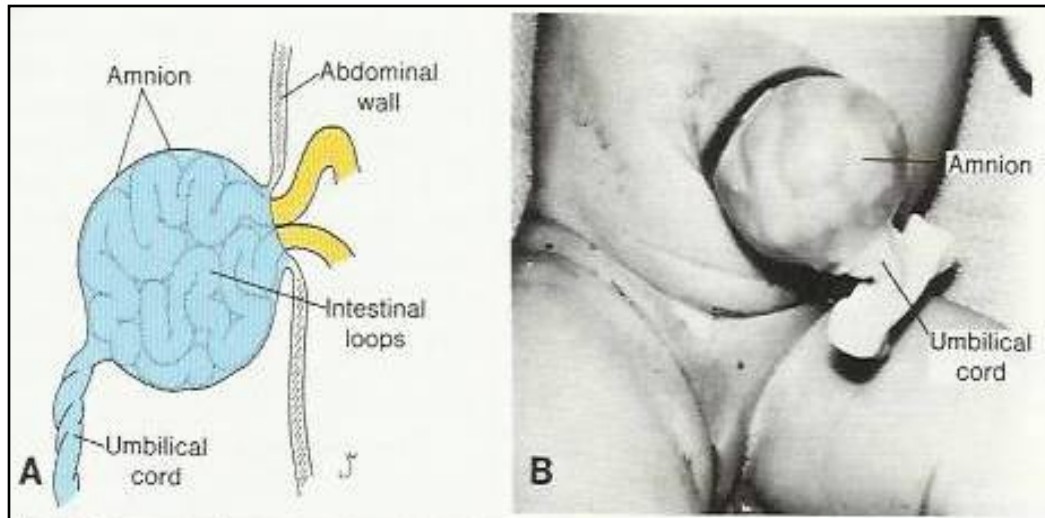
➤ The enlarged colon presses the duodenum & pancreas against the posterior abdominal wall.

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

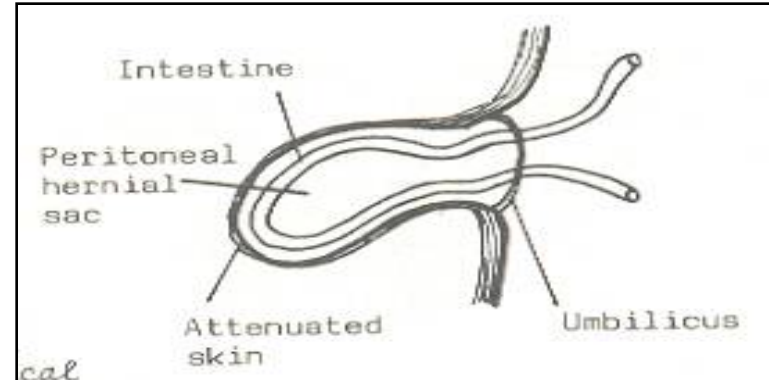
Congenital Omphalocele



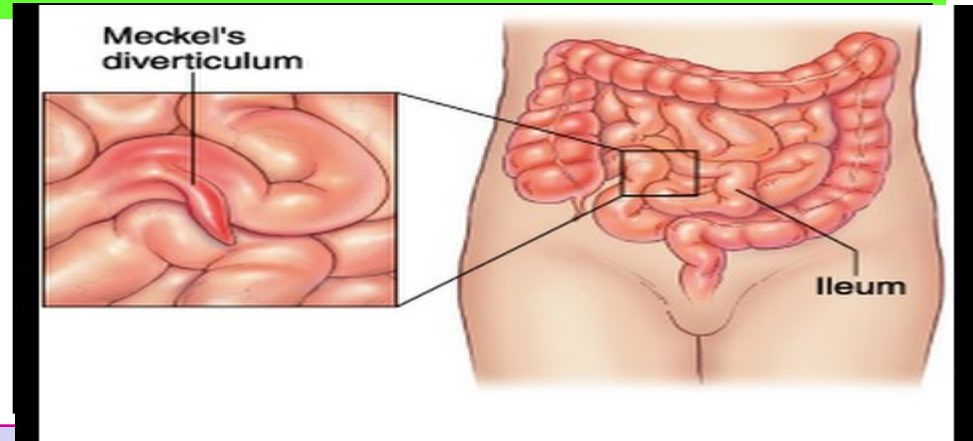
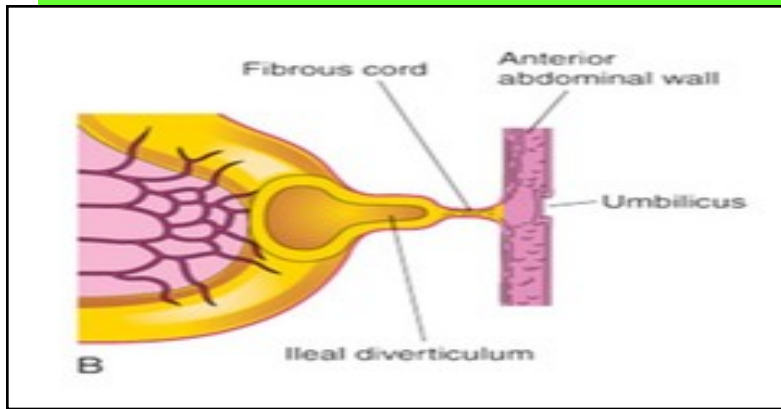
- It is a persistence of herniation of abdominal contents into proximal part of umbilical cord due to failure of reduction of physiological hernia to abdominal cavity at 10th week.
- Herniation of intestines occurs in 1 of 5000 births – herniation of liver & intestines occurs in 1 of 10,000 births.
-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

Congenital Umbilical Hernia

- The intestines return to abdominal cavity at 10th week, but herniate 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 **inflamed** and causes symptoms that mimic appendicitis.
- It may be connected to the umbilicus by a fibrous cord, **or** 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

- **Duodenum** (distal to bile duct).
- **Jejunum & ileum.**
- **physiological umbilical hernia :**

- The small intestine :

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.
- **Yolk stalk:** A narrow tube present in the early embryo that connects the midgut of the embryo to the yolk sac outside the embryo through the umbilical opening.
- It is usually obliterated, but a remnant of it may persist: most commonly as a finger-like protrusion from the small intestine known as Meckel's diverticulum.
- **Ileal diverticula** are common; however, only a few of them become inflamed and produce pain.