



Anatomy Team
MED 439

Revised & Approved



MED439
KING SAUD UNIVERSITY

Development of the Pancreas & Small Intestine

GNT Block

Color index:

Content
Male slides
Female slides
Important
Doctors notes

Extra information, explanation

Don't forget to check the [Editing File](#)

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Objectives

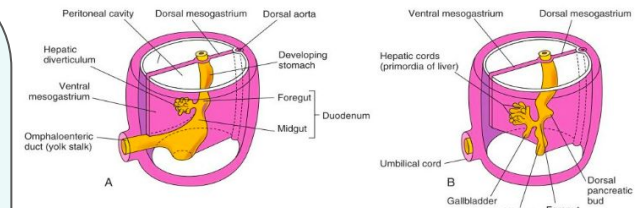
At the end of the lecture, students should be able to:

- 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
- Identify the congenital anomalies of the small intestine, Pancreas and Duodenum.

DEVELOPMENT OF THE DUODENUM

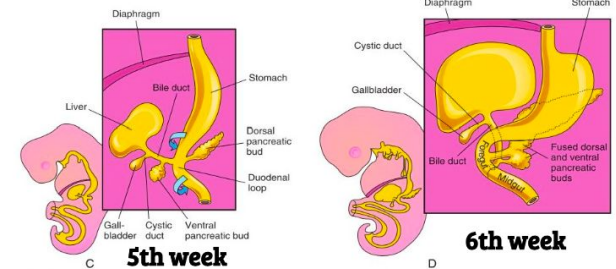
Early in the 4th week:

- Stages in the development of duodenum, liver, biliary ducts and pancreas (picA-D)
- The duodenum develops from the endoderm of primordial gut of:
 - 1- Caudal part of foregut.
 - 2- Cranial part of midgut
 - 3- Splanchnic mesoderm.
- The junction of the 2 parts of the gut lies just below or distal to the origin of bile duct (picC & D)
- The duodenal loop is formed and projected ventrally, forming a C- shaped loop (picC).
- 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.



4th week

5th week

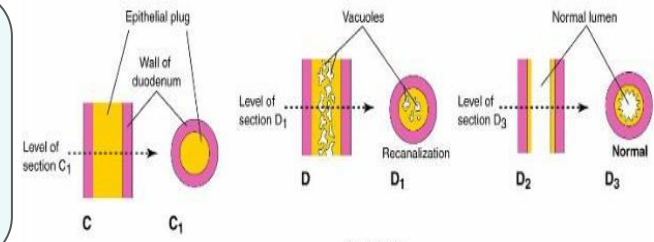


5th week

6th week

During 5th & 6th weeks:

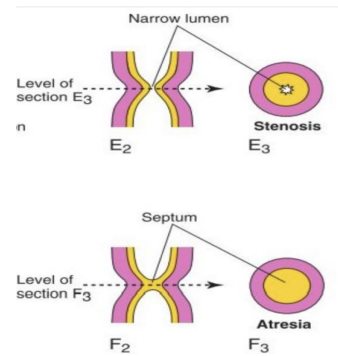
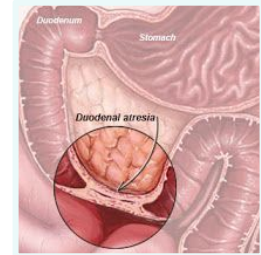
- the lumen of the duodenum is temporarily obliterated because of proliferation of its epithelial cells.
- Normally degeneration of epithelial cells occurs, so the duodenum normally becomes recanalized by the end of the embryonic period (**end of 8th week**).



Congenital anomalies of the Duodenum:

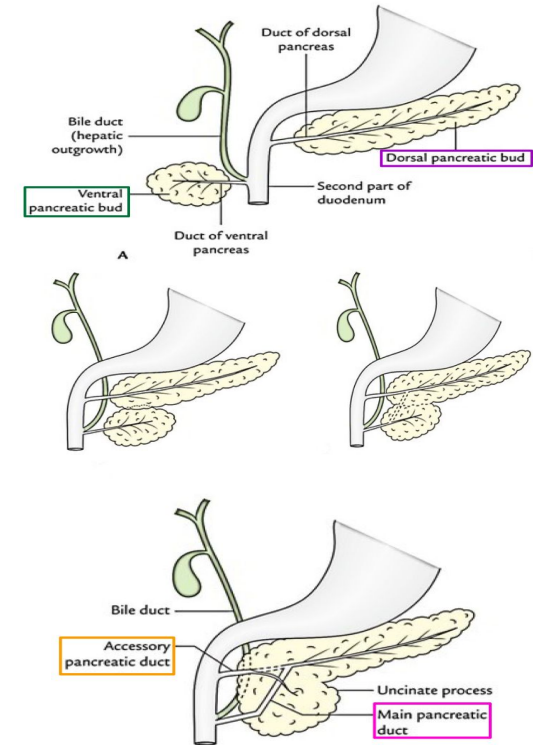
- Duodenal stenosis; results from **incomplete recanalization** of duodenum.
 - Duodenal atresia; results from **failure of recanalization** leading to complete occlusion of the duodenal lumen, (autosomal recessive inheritance).
- (Bilious vomiting could be manifested in both of these anomalies)

Duodenal atresia



Development of the Pancreas

- It develops from **2 buds** arising from the endoderm of the **caudal part of foregut** :
 - 1- A **ventral pancreatic bud (VPB)**: which develops from the proximal end of hepatic diverticulum (forms the liver & gallbladder).
 - 2- A **dorsal pancreatic bud (DPB)**: which develops from dorsal wall of duodenum slightly cranial to the ventral bud. (**Most of pancreas is derived from it**).
- When the duodenum rotates to the right and becomes C-shaped, the **VPB** moves dorsally to lie below and behind the **DPB**.
- Later the 2 buds fused together and lying in the **dorsal mesentery**.



Pancreatic Ducts

1- The **main pancreatic duct** is formed from :

- The duct of the **ventral bud**.
- The **distal** part of duct of **dorsal bud**.

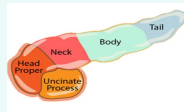
2- The **accessory pancreatic duct** is derived from :

- **Proximal** part of duct of **dorsal bud**.

- The parenchyma of pancreas (**acinar cells**) is derived from the endoderm of pancreatic buds.
- Pancreatic islets develops from parenchymatous pancreatic tissue to **secrete insulin**.
- ★ **Insulin secretion begins at 5th month of pregnancy.**

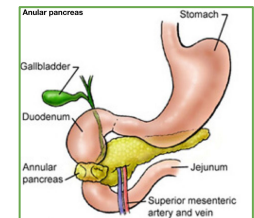
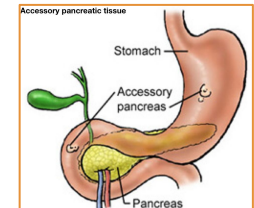
Pancreatic Buds

- The **VPB** forms :
 - Uncinate process.
 - Inferior part of head of pancreas
- The **DPB** forms :
 - Upper part of head
 - Body
 - Neck & Tail



Congenital Anomalies

- **Accessory pancreatic tissue (rare)**: 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

1. Distal part of the **duodenum** (proximal part of duodenum is developed from caudal part of foregut)
2. **Jejunum**
3. Upper part of the **ileum**.

★ Derivatives of the **caudal** part of midgut loop

1. Lower portion of **ileum**.
2. Cecum & appendix.
3. Ascending colon + proximal 2/3 of transverse colon.

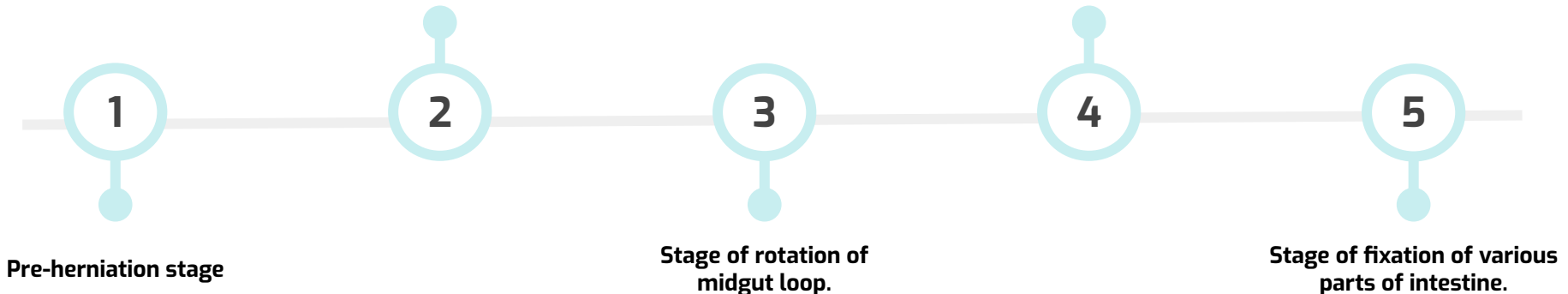
So, the small intestine is developed from :

- Caudal part of foregut.
- All midgut. **Whither it's (cranial or caudal)**
- Midgut is supplied by **superior mesenteric artery** (artery of midgut)

5 Stages Of Development

Stage of physiological
umbilical hernia

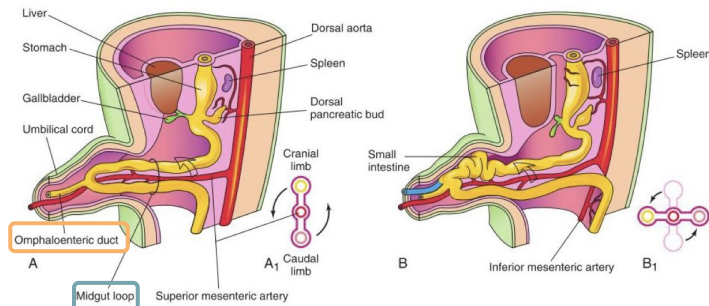
Stage of reduction of
umbilical hernia.



Development Of Small Intestine

Stage 1 and 2 Development Of Midgut Loop

- **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** also known as yolk stalk or omphaloenteric duct
- 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 week.)**
- **It ends at the 10th week.**



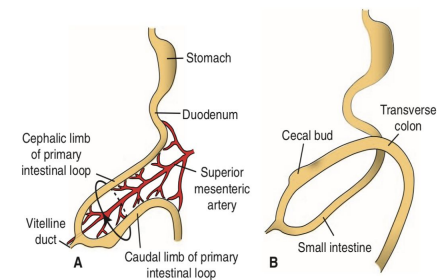
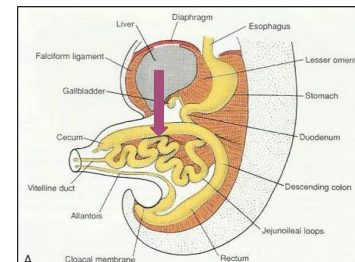
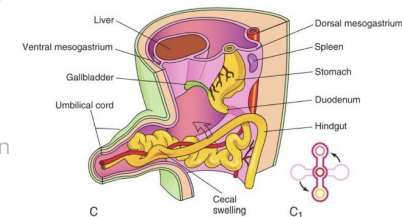
Stage 3 2:51 min Rotation Of The Midgut Loop

- 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**).
- After reduction of physiological hernia it rotates to about **180 degrees**.
- The total **counterclockwise** rotation is **270 degrees** (90+ 180= 270)

Note:

The cecal bud is found in
The caudal limb not the
Cranial limb

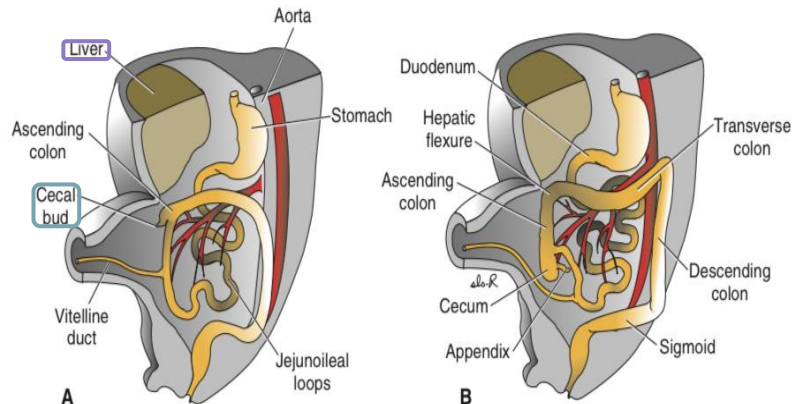
(a way to differentiate between
The two) .



Development Of Small Intestine

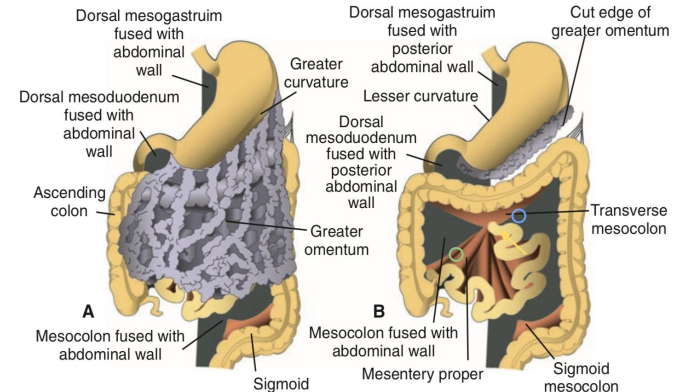
Stage 4 Return Of Midgut To Abdomen

- 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 (cecal bud) at first lies below the liver(picA), but later it descends to lie in the right iliac fossa(picB).



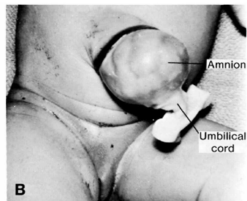
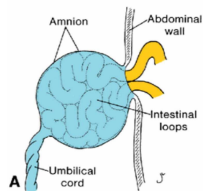
Stage 5 Fixation Of Various Parts Of Intestines

- The mesentery of jejunioileal loops is at first continuous with the mesentery of ascending colon.
- The mesentery allows free movement of the small intestine.
- 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.
- The enlarged colon presses the duodenum & pancreas against the posterior abdominal wall.
- Most of duodenal mesentery is absorbed, so most of duodenum (except for about the first 2.5 cm derived from foregut) & pancreas become retroperitoneal.
- The duodenum is the most fixed part of the small intestine, only partially covered by peritoneum.



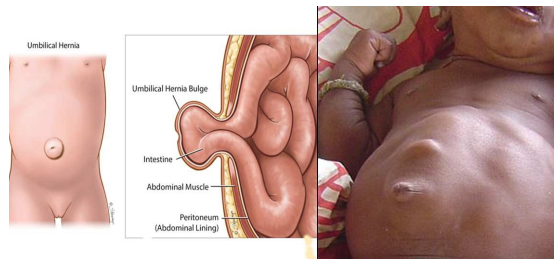
Congenital Omphalocele

- 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.
- 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.



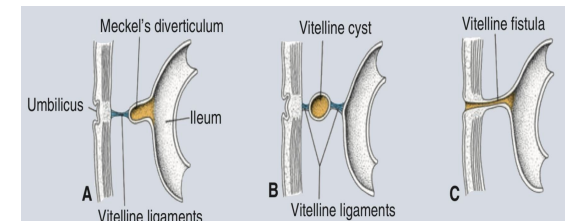
Congenital Umbilical Hernia

- The intestines **return to abdominal cavity at 10th week**, but herniated through an **imperfectly closed umbilicus**. *This is the cause*
- **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 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 (more in males) anomalies of the digestive tract, present in about 2% -4% of people.
- **It is a small pouch from the ileum**.
- may contain small patches of **gastric & pancreatic tissues causing ulceration, bleeding or even perforation**.
- **It is the remnant of proximal part** non-obliterated 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 (picA), **or** the middle portion forms a cyst (picB) **or** may remain patent forming the fistula (picC) so, faecal matter is carried through the duct into umbilicus.



Summary

❖ **The foregut gives rise to:**

1- Duodenum (proximal to the opening of the bile duct). 2- Pancreas. 3- Biliary apparatus.

❖ **The pancreas develops from :**

Dorsal & ventral pancreatic buds that develop from the endodermal lining of the caudal part of foregut.

❖ **The midgut gives rise to 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.

❖ **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 **Meckelis diverticulum**.

❖ **Ileal diverticula** are common; however, only a few of them become inflamed and produce pain.

Q1: Which part of the pancreas the ventral pancreatic bud forms ?

A: Upper part of the head.

B: Lower part of the head.

C: Body.

D: Tail.

Q2: Which artery the midgut loop rotates around its axis ?

A: Splenic artery.

B: Inferior mesenteric artery.

C: Superior mesenteric artery.

D: Celiac trunk.

Q3: The cranial limb of midgut loop gives rise :

A: The liver.

B: The pancreas.

C: The stomach.

D: The jejunum & ilium.

Q4: 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.

Q5: 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.

Q6: 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.

Answer key:

1 (B) , 2 (C) , 3 (D) , 4 (B) , 5 (B) , 6 (C)

MCQ

Q7: which of the following stages of small intestine development will occur during 10th week

A: Return Of Midgut To Abdomen

B: Pre-herniation stage

C: Stage of physiological umbilical hernia

D: Stage of fixation of various parts of intestine.

Q8: Midgut loop communicates with the yolk sac by

A: umbilical cord

B: vitelline duct

C: yolk stalk

D: B&C

Q9: Early in the 4 th week the duodenal loop is rotated with the stomach to

A: the right

B: the left

C: the ventral

D: the dorsal

Q10: Duodenal atresia is a disease

A: X-linked dominant

B: autosomal recessive

C: Autosomal dominant

D: none of them

Q11: Insulin secretion begins at of pregnancy.

A: fifth week

B: fourth week

C: fifth month

D: fourth month

Q12: The accessory pancreatic duct is formed from :

A: the duct of ventral bud

B: the proximal part of duct of dorsal bud

C: the distal part of duct of dorsal bud

D: both A and C

Answer key:
7(A) , 8(D) , 9(A) , 10(B) , 11(C) , 12(B)

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