

## *Development of pancreas and Small Intestine*

# Embryology Team

430



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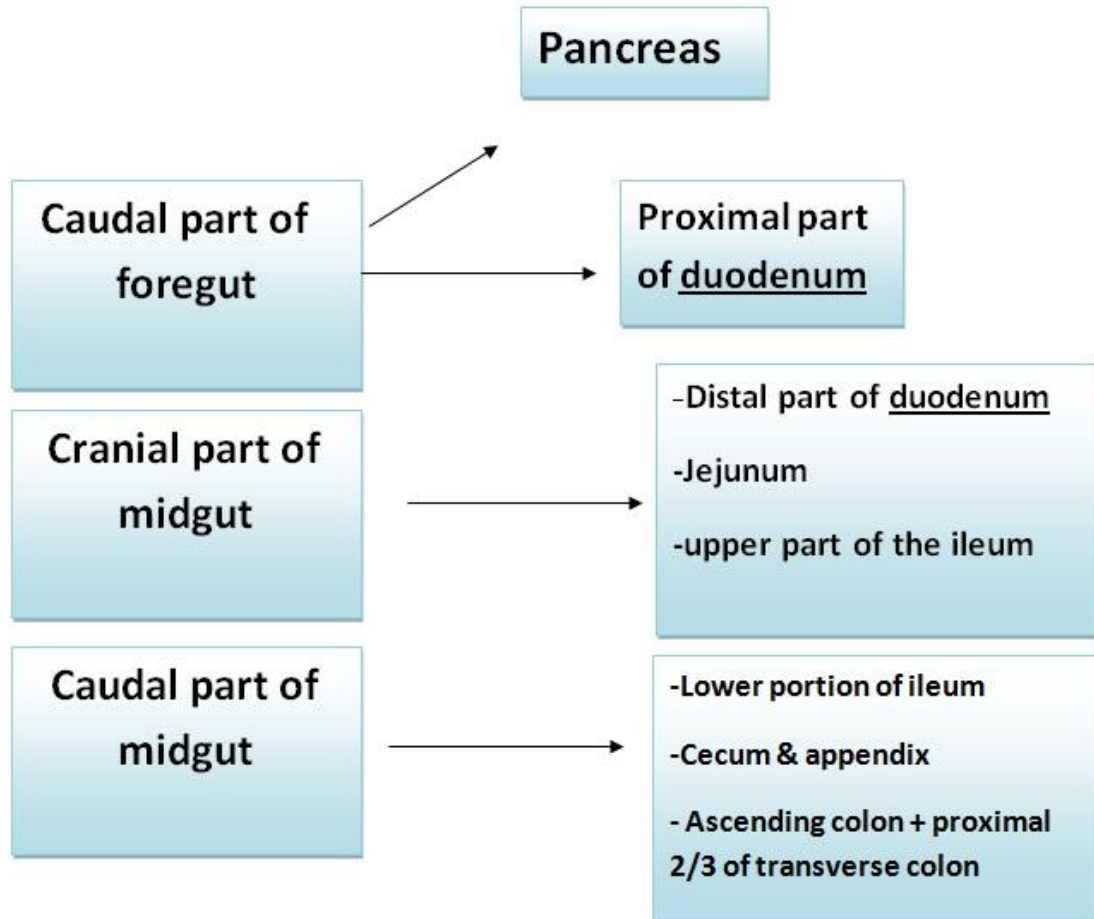
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\*Red: the most important things.

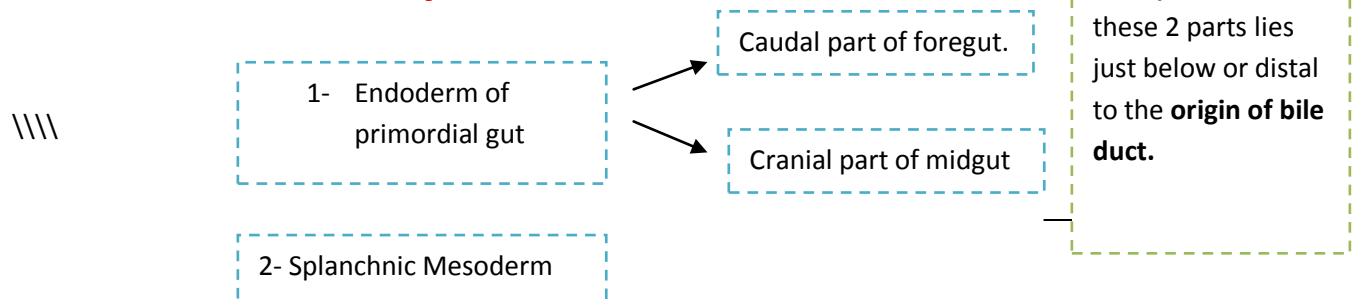




So, the small intestine is developed from:  
caudal part of foregut, all midgut which is supplied by the **superior mesenteric artery**.

### Development of the duodenum

The duodenum develops **Early in the 4<sup>th</sup> week**, from:



Developing duodenum elongates, forming C-shaped loop that projects **ventrally**.

As stomach rotates, **duodenal loop rotates to right and comes to lie retroperitoneally** (external to peritoneum) with the developing pancreas.

During 5<sup>th</sup> & 6<sup>th</sup> weeks

1. the lumen of the duodenum is temporarily obliterated (why ?)

→ **because of proliferation of its epithelial cells.**

2. **degeneration** of epithelial cells occurs , so the duodenum normally becomes **recanalized** (when?) **by the end of the embryonic period**. ( which is at the end of the 8<sup>th</sup> week )

#### CONGENITAL ANOMALIES :

3. Duodenal stenosis : results from incomplete recanalization of the duodenum.
4. Duodenal atresia : leads 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:

#### 1)Ventral pancreatic bud:

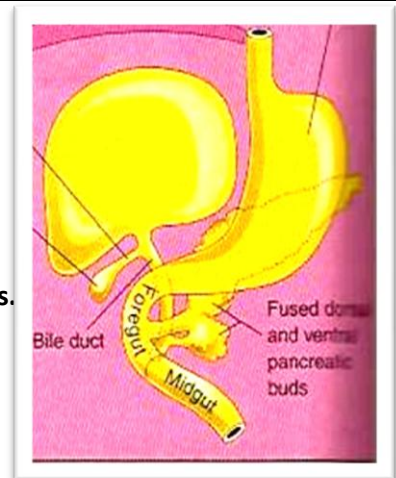
- Develops from the proximal end of hepatic diverticulum.
- Forms the liver & gall bladder.

#### 2)Dorsal pancreatic bud:

- develops from dorsal wall of duodenum.
- slightly cranial to the ventral bud.
- **Most of pancreas is derived from the dorsal pancreatic bud.**

The 2 buds will fuse together when the ventral pancreatic bud moves dorsally to lie below and behind the dorsal bud.

The ventral bud forms:



- Uncinate process.
- Inferior part of head of pancreas.

The **dorsal** pancreatic bud forms :

- Upper part of head.
- Neck.
- Body &
- Tail 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 —————> derived from the **endoderm of pancreatic buds**.
- Pancreatic islets —————> develop from **parenchymatous pancreatic tissue**.

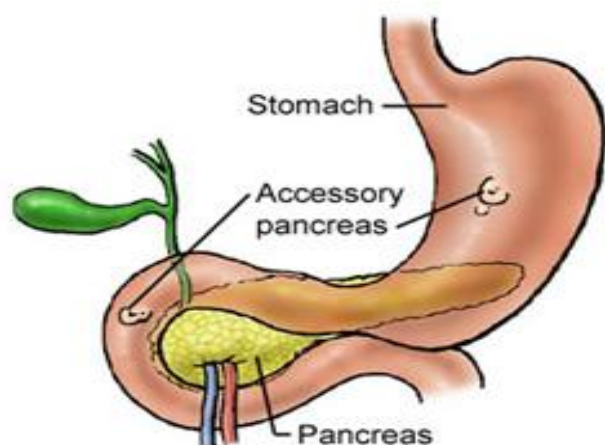
**\*Insuline secretion** begins at **5<sup>th</sup> month** of pregnancy.

**Congenital anomalies:**

#### 1) Accessory pancreatic tissue:

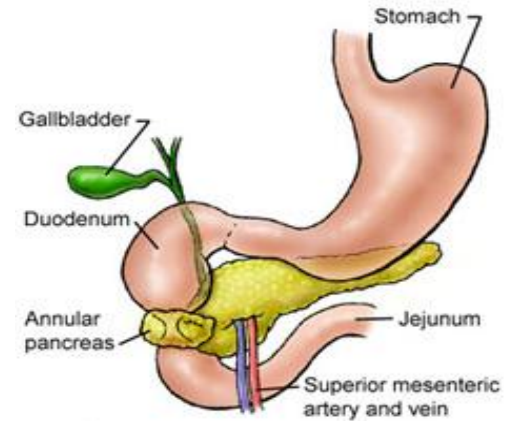
Located in the wall of the stomach or duodenum.

**For your information:** **Accessory pancreas** is a rare condition in which small groups of pancreatic cells are separate from the pancreas. They may occur in the mesentery of the small intestine, the wall of the duodenum, the upper part of the jejunum, or more rarely, in the wall of the stomach, ileum, gallbladder or spleen.



## 2) Anular pancreas:

a thin flat band of pancreatic tissue surrounding the second part of the duodenum, causing duodenal obstruction.



### **Stages of development of small intestine:**

- 1 •preherniation stage.
- 2 •physiological umbilical hernia.
- 3 •reduction of umbilical hernia.
- 4 •fixation of various parts of intestine.

#### Physiological umbilical hernia:

time: **6th week.**

**Originally 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.

#### Midgut loop :

- has a cranial limb & a caudal limb
- Rotates around the axis of the superior mesenteric artery.
- 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.**

### Reduction of physiological midgut hernia:

Time: **10th week**.

the intestines return to the abdomen due to regression of liver & kidneys + expansion of abdominal cavity.

### 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**.

#### **Congenital Omphalocele**

**Failure of reduction of physiological hernia to abdominal cavity at 10<sup>th</sup> week.**

herniation of intestine & liver.

**The hernial sac is covered by the epithelium of the umbilical cord/the amnion.**

It is accompanied by small abdominal cavity.

**Immediate surgical repair.**

#### **Umbilical Hernia**

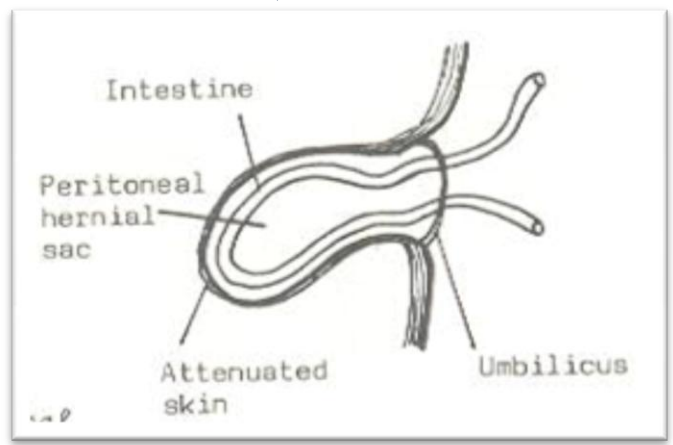
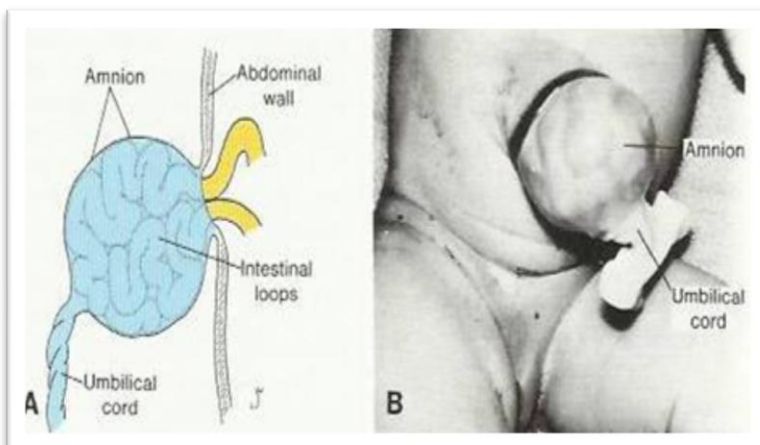
**The intestine returns to abdominal cavity at 10<sup>th</sup> week BUT herniate through an imperfectly closed umbilicus.**

herniation of the greater omentum & small intestine.

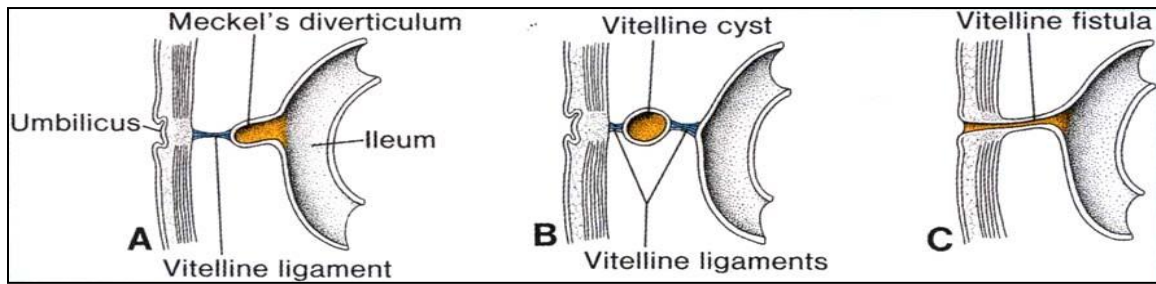
**The hernia sac is covered by skin & subcutaneous tissue**

Can be easily reduced.

**Surgery is performed at age of 3 - 5 years.**



## Ileal (Meckel) Diverticulum



\*It is one of **the most common anomalies** of the digestive tract, 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 a cyst or may remain patent **forming the fistula** so, faecal matter is carried through the duct into umbilicus.

## Summary:

- The duodenum develops **Early in the 4<sup>th</sup> week**
- The small intestine is developed from **: Caudal part of foregut and all midgut**
- The duodenum develops from the **caudal part of foregut and cranial part of midgut.**
- The pancreas develops from the **caudal part of foregut**
- Most of pancreas is derived from the **dorsal pancreatic bud**
- 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.**
- **Insuline secretion** begins at **5<sup>th</sup> month** of pregnancy
- The physiological umbilical herniation begins at **6<sup>th</sup> week.**
- Midgut loop rotates first 90 degrees **during the physiological hernia.**
- And rotates to about 180 degrees **during reduction of physiological hernia.**
- Reduction of physiological midgut hernia happens in **10<sup>th</sup> week**
- Congenital Omphalocele: **failure of reduction of physiological hernia**
- Umbilical Hernia: **imperfectly closed umbilicus**

To test yourself:

<http://quizlet.com/3506924/gastrointestinal-embryology-2-duodenum-liver-flash-cards/>

**Thank you!**