



Development of Pancreas And Small Intestine





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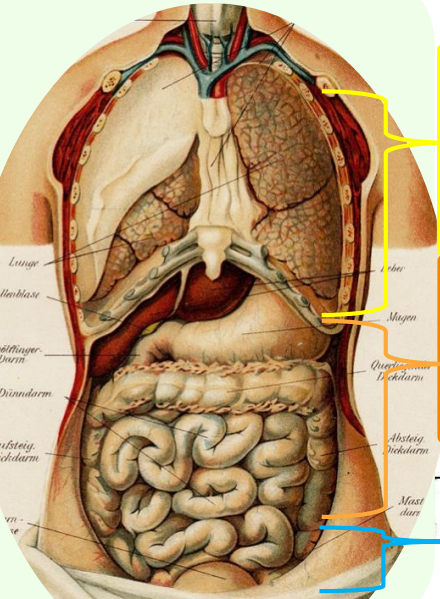
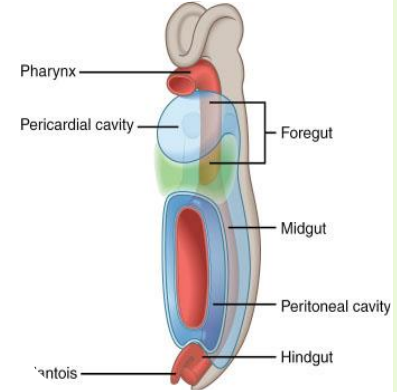
LECTURE OBJECTIVES :

- 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 small intestine :
 - Congenital omphalocele.**
 - Umbilical hernia.**
 - Meckel's diverticulum.**



to understand the lecture and the development of the alimentary canal in general you should know these little concepts:

- **The whole GIT tract is developed from ENDODERM.**
- Primitive gut is gradually patterned into three segments:
 1. Foregut
 2. Midgut
 3. hindgut
- Each segment is supplied by a special artery and give raise to a number of organs as shown bellow.



- Foregut**
- Thymus
 - Esophagus
 - Lung
 - Stomach
 - Duodenum
 - Pancreas

celiac artery

- Midgut**
- Appendix
 - Ileum
 - Cecum
 - Ascending colon

superior mesenteric artery

- Hindgut**
- Distal large bowel
 - Rectum

supplied by inferior mesenteric artery

Additional slide



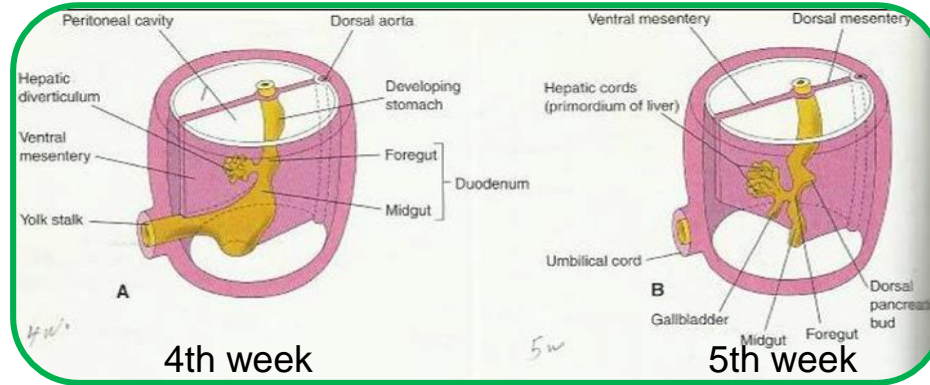
DEVELOPMENT OF THE DUODENUM

Early in the **4th week**, the **duodenum** develops from:

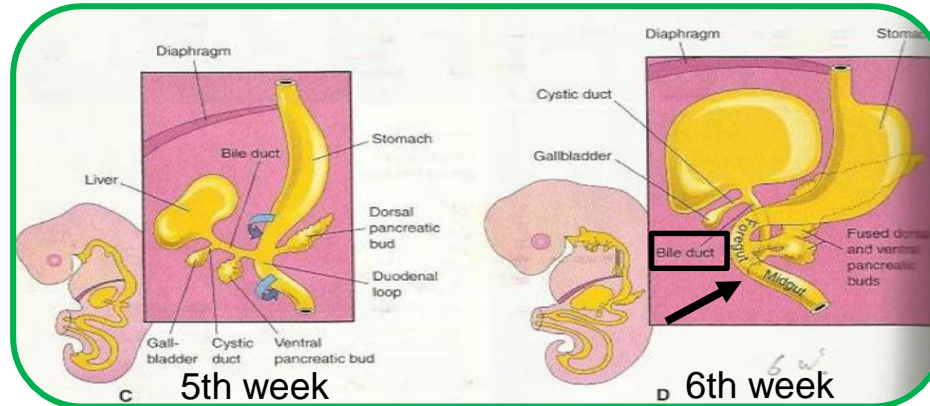
Caudal part of foregut.
(endoderm)

Cranial part of midgut
(endoderm)

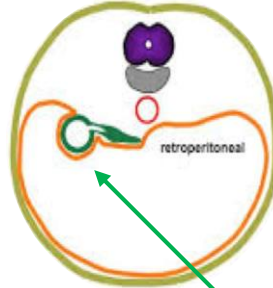
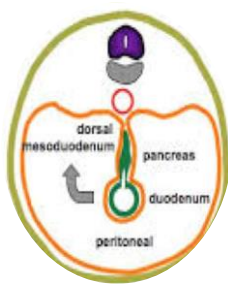
Splanchnic mesoderm



<- Stages of development of **duodenum**, liver, biliary ducts and **pancreas**
See the pics: (A-D).



The junction of the 2 parts of the gut **lies just below** or distal to the **origin of bile duct**

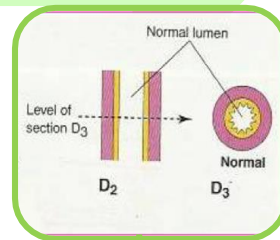
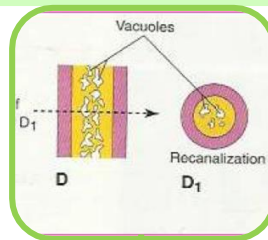
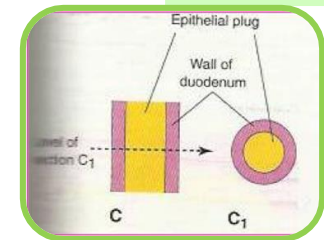


• Duodenal loop:

The duodenal loop is formed and projected ventrally, forming a **C-shaped loop**.

The duodenal loop is rotated with the stomach to **the right**

It comes to lie on the posterior abdominal wall **retroperitoneally** with the developing pancreas.



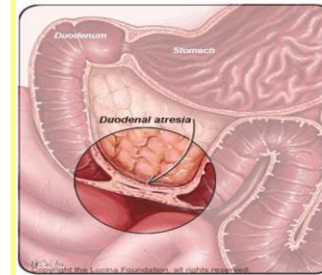
During **5th & 6th weeks**, the lumen of the duodenum is temporarily obliterated because of **proliferation of its epithelial cells**.

Normally **degeneration** of epithelial cells occurs

the duodenum normally becomes **recanalized** by the end of the embryonic period

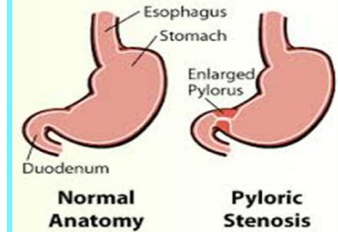
Congenital anomalies:

Duodenal atresia



- 1- results from failure of recanalization
- 2- complete occlusion of the duodenal lumen
- 3- autosomal recessive inheritance

Duodenal stenosis:



- 1-results from incomplete recanalization of duodenum.
- 2-partially canalized



Bilious vomiting

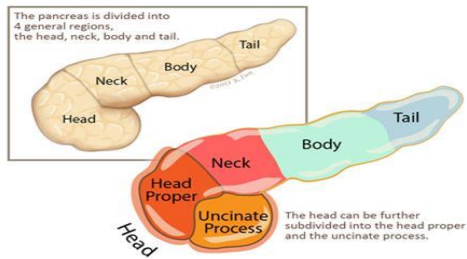
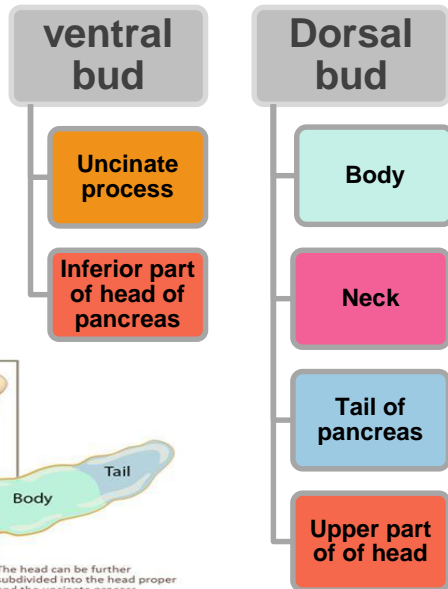




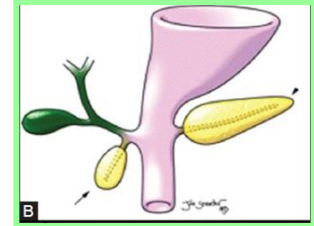
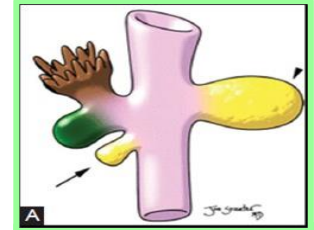
DEVELOPMENT OF PANCREAS

The pancreas develops from 2 buds arising from the endoderm of the caudal part of foregut:

- ventral pancreatic bud** : which develops from the proximal end of hepatic diverticulum (forms the liver & gall bladder).
- dorsal pancreatic bud** : which develops from dorsal wall of duodenum slightly cranial to the ventral bud.



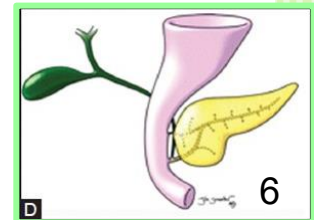
The two pancreatic buds are developed

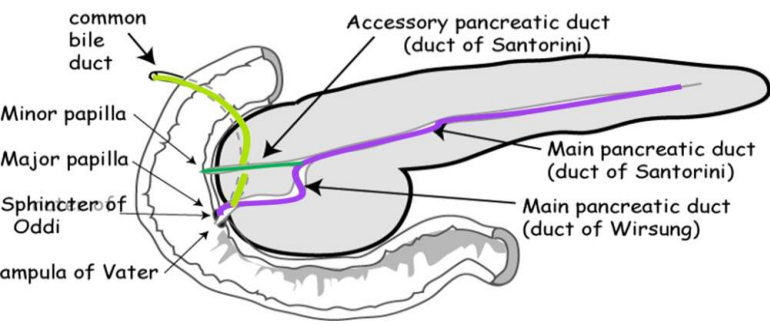


duodenum rotates to the right and becomes C-shaped the ventral pancreatic bud moves dorsally to lie below and behind the dorsal bud



Later the 2 buds fused together and lying in the dorsal mesentery

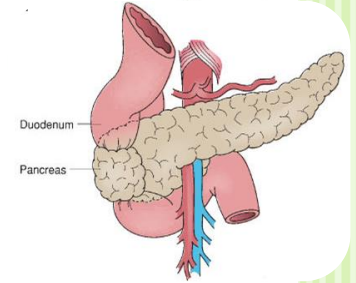




Congenital anomalies:

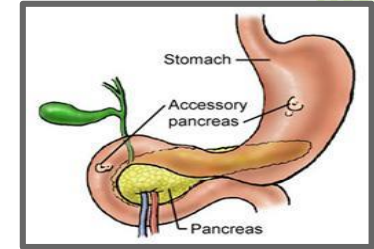
Anular pancreas;

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



Accessory pancreatic tissue;

located in the wall of the stomach or duodenum.



main pancreatic duct is formed from :

- duct of the ventral bud.
- Distal part of duct of dorsal bud.

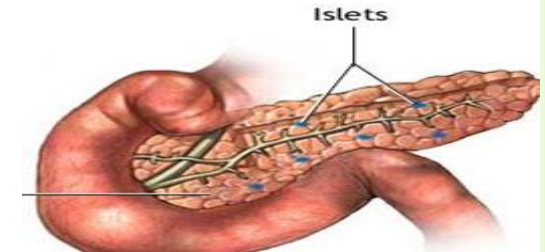
accessory pancreatic duct is derived from:

- Proximal part of duct of dorsal bud.

The parenchyma of pancreas is derived from the endoderm of pancreatic buds.

Pancreatic islets develops from it

Insuline secretion begins at 5th month of pregnancy.





DEVELOPMENT OF THE SMALL INTESTINE

- the small intestine is developed from :
- Caudal part of foregut.
- All midgut. (**supplied by superior mesenteric artery**).

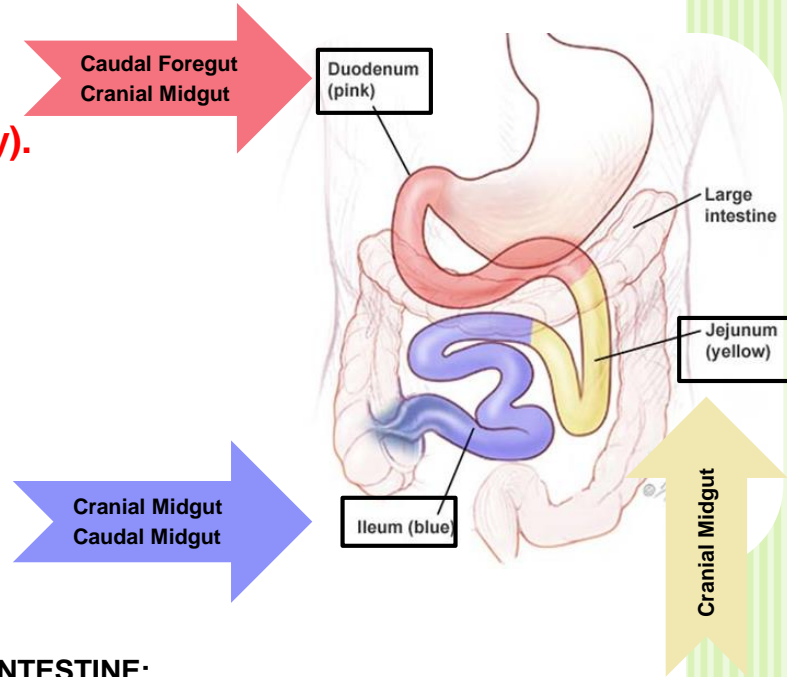
MIDGUT LOOP

cranial part

- Distal part of the duodenum
(**proximal part of duodenum is developed from caudal part of foregut**)
- Jejunum
- Upper part of the ileum

caudal part

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



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 THE MIDGUT LOOP

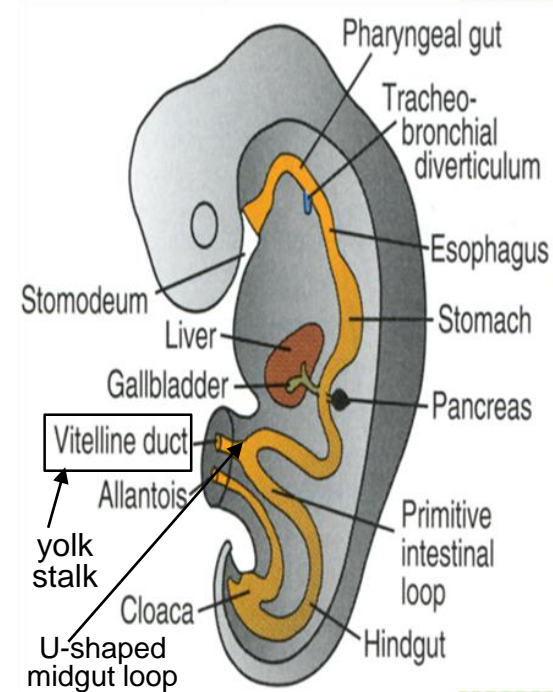
•At the beginning of **6th week**, the midgut elongates to form a ventral **U-shaped midgut loop**.

•Midgut loop communicates with the yolk sac by vitelline duct or **yolk stalk**.

Midgut loop projects into the umbilical cord ...this is called **physiological umbilical herniation (begins at 6thw.)**

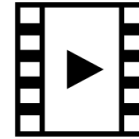
WHY ?!

•As a result of **rapidly growing liver, kidneys & gut**, so the abdominal cavity is **temporarily too small** to contain the developing rapidly growing intestinal loop.





ROTATION OF THE MIDGUT LOOP



This video is highly recommended to understand this part :)

general characteristics of the rotation :

1- total rotation is **270 degrees** (90 in the stage of physiological hernia and 180 in the reduction of the physiological herniation stage).

2- the rotation axis is around the **superior mesenteric artery**.

3- the rotation is **counterclockwise**(1).

(1): عكس عقارب الساعة

Limbs of the midgut loop

- Cranial
- Caudal
- See fig.A

First rotation

- 90 degrees see fig.B
- Result **the cranial limb become on the right and caudal limb on the left**
- Stage : this event happen during **the physiological hernia**

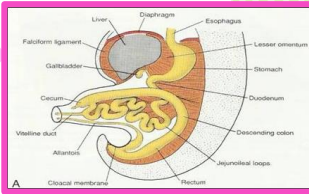
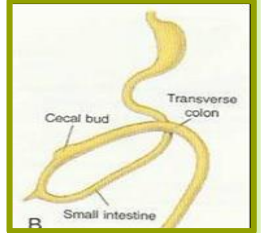
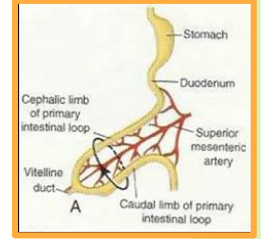
Fate

- The cranial limb (on the right now) of midgut loop elongates to form the **intestinal coiled loops (jejunum & ileum)**. See figC

Second rotation

- Additional 180 degrees
- Stage: **reduction of physiological hernia**

will be explained in the coming slide

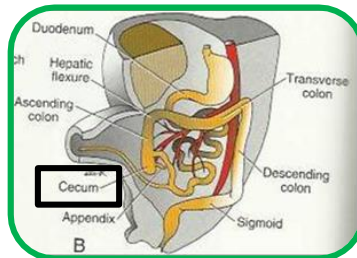
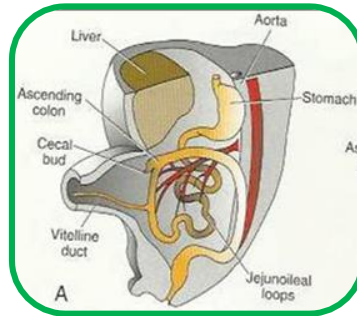




RETURN OF MIDGUT TO ABDOMEN:

reduction of physiological midgut hernia:

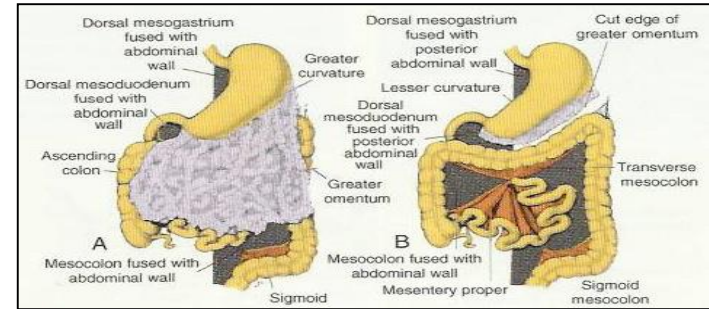
- 1- it is a stage that the intestines return to the abdomen due to regression of liver & kidneys + expansion of abdominal cavity.
- 2- happens during the **10th week**.
- 3- Rotation is completed and the **coiled intestinal loops** lie in their final position in the **left side**.
(after 270 degrees)



The caecum:

- The caecum at first lies below the liver, but later it descends to lie in the right iliac fossa.

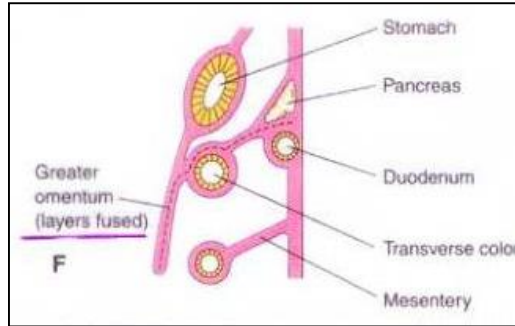
FIXATION OF VARIOUS PARTS OF INTESTINE



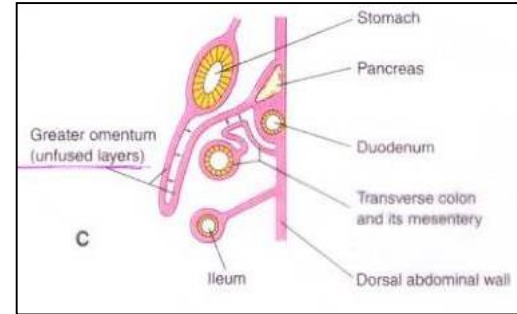
1. At first the **mesentery of jejunioileal loops** is continuous with that of the ascending colon.
2. then, the mesentery of ascending colon fuses with the posterior abdominal wall.
3. So the **mesentery of small intestine** becomes fan-shaped and acquires a new line of attachment that passes from duodenojejunal junction to the ileocecal junction.



FIXATION OF VARIOUS PARTS OF INTESTINE



Intestines after fixation



Intestines prior to fixation

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

**Congenital
Omphalocele**

**Congenital
Umbilical Hernia**

**Ileal (Meckel's)
Diverticulum**

Congenital anomaly	Congenital Omphalocele	Congenital Umbilical Hernia <u>common type of hernia</u>	Meckel's Diverticulum <u>most common anomalies</u>
Definition	it is a persistence of herniation of abdominal contents into proximal part of umbilical cord	The intestines return to abdominal cavity at 10th week, but herniate through an imperfectly closed umbilicus	It is a small pouch from the ileum, and may contain small patches of gastric & pancreatic tissues causing ulceration, bleeding or even perforation
Cause	failure of reduction of physiological hernia to abdominal cavity at 10th week.		
covered by	epithelium of the umbilical cord/ the amnion.	by skin & subcutaneous tissue.	
Notes	<ul style="list-style-type: none"> • Herniation of intestines occurs in 1 of 5000 • Herniation of liver & intestines occurs in 1 of 10,000 • accompanied by small abdominal cavity 	<ul style="list-style-type: none"> • The herniated contents are usually the greater omentum & small intestine. • It protrudes during crying, straining or coughing • easily reduced through fibrous ring at umbilicus. 	<ul style="list-style-type: none"> • about 2% -4% of people, more common in males • It arises from antimesenteric border of ileum • 1/2 m from ileocecal junction. • inflamed >> causes symptoms that mimic appendicitis • may be connected to the umbilicus by one of the following : <ul style="list-style-type: none"> • 1 - a fibrous cord • 2 - middle portion forms a cyst • 3 - remain patent forming the fistula • so, faecal matter is carried through the duct into umbilicus..

Congenital anomaly

Congenital Omphalocele

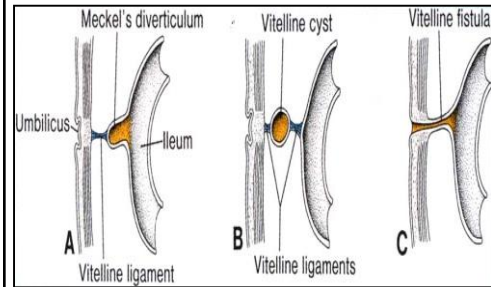
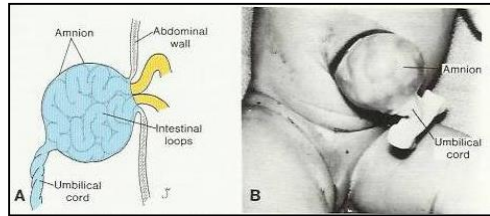
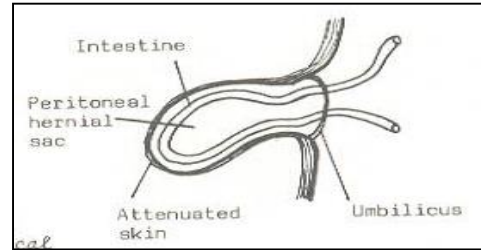
Congenital Umbilical Hernia
common type of hernia

Ileal (Meckel's) Diverticulum
most common anomalies

Management

Immediate surgical repair is required.

Surgery is performed at age of 3-5 years.



parts	SMALL INTESTINE		PANCREAS	
	DUODENUM	JEJUNUM +ILLUME		
Origin (all from endoderm)	Duodenal lobe from: Caudal part of foregut. + Cranial part of midgut + Splanchnic mesoderm.	Mid gut lobe from : <div style="text-align: center;"> <p style="margin-left: 100px;">Cranial part Part of duodenum Jejunum upper part of illume</p> <p style="margin-left: 100px;">caudal part lower part of illume Cecum & appendix. Ascending colon +2/3 of transverse</p> </div>	the caudal part of foregut: ventral bud: from proximal end of hepatic diverticulum dorsal bud: from dorsal wall of duodenum	
Notes	_____	<ul style="list-style-type: none"> ..Midgut is supplied by superior mesenteric artery ..Midgut loop communicates with the yolk sac by vitelline duct or yolk stalk. ..Midgut loop has a cranial & a caudal limbs 	ventral bud forms : Uncinate process. And Inferior part of head dorsal bud forms : Upper part of head, Neck, Body &Tail hepatic diverticulum forms: liver & gall bladder	
Changes	<ul style="list-style-type: none"> ..Duodenal lobe start as C shape ventrally → rotate to the right → retroperitoneal ..Epithelial proliferation →temporarily obliterated lumen →degeneration of epithelial → lumen recanalization 	<ul style="list-style-type: none"> ..Preherniation : ..physiological umbilical hernia.: As a result of rapidly grow of abdominal components and small abdominal cavity →Midgut loop projects into the umbilical cord .. rotation of midgut loop. around the superior mesenteric artery total rotation is 270 degrees (90 in the stage of physiological hernia and 180 in the reduction of the physiological herniation stage) .. reduction of umbilical hernia. due to regression of liver & kidneys + expansion of abdominal cavity Caecum location change and descends from below the live to the right iliac fossa. .. fixation of various parts of intestine. mesentery of ascending colon fuses with the posterior abdominal wall lead the fan-shape of the mesentery of small intestine +duodenum and pancreas fixed on the posterior abdominal wall and retro peritoneum 	<ul style="list-style-type: none"> ..main duct→ ventral bud duct + distal part of dorsal bud duct ..accessory duct →Proximal part of dorsal bud duct ..Pancreatic parenchyma → buds endoderm ..Pancreatic islets → parenchymatous tissue. 	
Congenital anomalies	Duodenal stenosis; incomplete recanalization Duodenal atresia; failure of recanalization (autosomal recessive inheritance).	Congenital Omphalocele <ul style="list-style-type: none"> .. failure of reduction of physiological hernia .. small abdominal cavity. .. Cover by epithelium of the umbilical cord(amnion) .. Need immediate surgical repair Congenital Umbilical Hernia <ul style="list-style-type: none"> ..imperfectly closed umbilicus(with normal in reduction) .. Contain greater omentum & small intestine.. .. Cover by skin & subcutaneous tissue .. Surgery at age of 3-5 Y 	Ileal (Meckel's) Diverticulum <ul style="list-style-type: none"> .. most common anomalies of GIT ,< males ..small pouch from the ileum(anti mesenteric border) ..Couse by non obliterated part of yolk stalk (or vitelline duct) ..inflammed and causes symptoms that mimic appendicitis. ..may be connected to the umbilucus by a fibrous cord, cyst or fistula 	Accessory pancreatic tissue; located in the wall of the stomach or duodenum. Anular pancreas; band of pancreatic tissue causing duodenal obstruction



1. Most of pancreas is derived from :

- A-the main pancreatic duct
- B-the ventral pancreatic duct
- C-the dorsal pancreatic duct

2. the development of duodenum and pancreas starts at :

- A-in the fifth week
- B-in the middle of the 4th week
- C-early in 4th week

3. incomplete recanalization of duodenum is called :

- A-duodenal atresia
- B-duodenal stenosis
- C-umbilical hernia

4. In the Congenital anomalies Accessory pancreatic tissue located in the wall of the

- A-stomach
- B-liver
- C-duodenum
- D-A&C

5. Distal part of duodenum is developed from caudal part of foregut :

- A-True
- B-False

6. The cranial limb of midgut loop gives rise to:

- A-The liver.
- B-The pancreas.
- C-The stomach.
- D-The jejunum & ileum

7. During 10th week :

- A-duodenal obstruction.
- B-duodenum develops from the endoderm
- C-reduction of physiological midgut hernia.
- D-the lumen of the duodenum is temporarily obliterated

8. Derived from the caudal part of midgut loop : Lower portion of ileum.

- A-True
- B-False

ANSWERS:

- 1.C
- 2.C
- 3.B
- 4.D
- 5.B
- 6.D
- 7.C
- 8.A



9. 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.

10. Which artery the midgut loop rotates around its axis ?

- a.Splenic artery.
- b.Inferior mesenteric artery.
- c.Superior mesenteric artery.
- d.Celiac trunk.

11. 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.

12. 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.

13. 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.

ANSWERS:

- 9.B
- 10.C
- 11.B
- 12.B
- 13.C



❖ Mention three congenital anomalies of the small intestine?

- 1- omphalocele
- 2- umbilical hernia
- 3- Ileal diverticulum

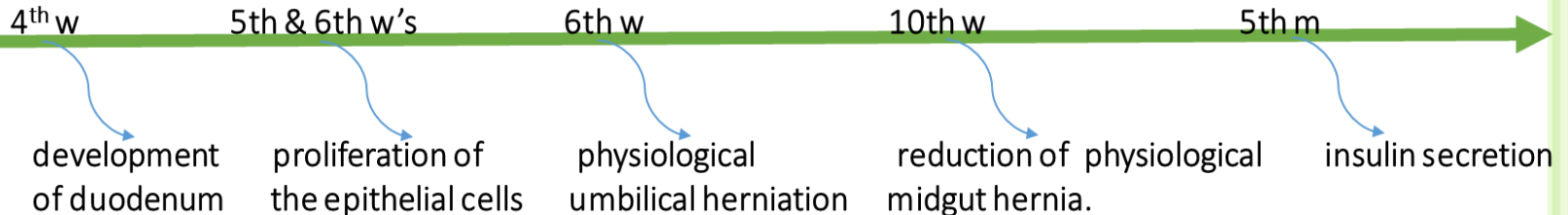
❖ What does duodenal atresia mean?

it means congenital occlusion of the duodenal lumen results from failure of recanalization

❖ Cranial part of the midgut gives rise to?

- 1-Distal part of the duodenum
- 2- Jejunum
- 3- Upper part of the ileum

❖ TIME LINE : of all events in this lecture:





DONE BY

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Thank you for checking our team
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