Development Of Pancreas And Small Intestine

Embryology 436

(إِنَّا خَلَقْنَا الإنسان مِنْ نُطْفَةٍ أَمْشَاجٍ نَبْتَلِيهِ فَجَعَلْنَاهُ سَمِيعًا بَصِيرًا)

تمت المراجعة
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436
MEDICINE
KING SAUD UNIVERSITY

- Important
- Dr. notes
- Explanation

- We recommend you to study anatomy of pancreas and small intestine.

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:

Useful video

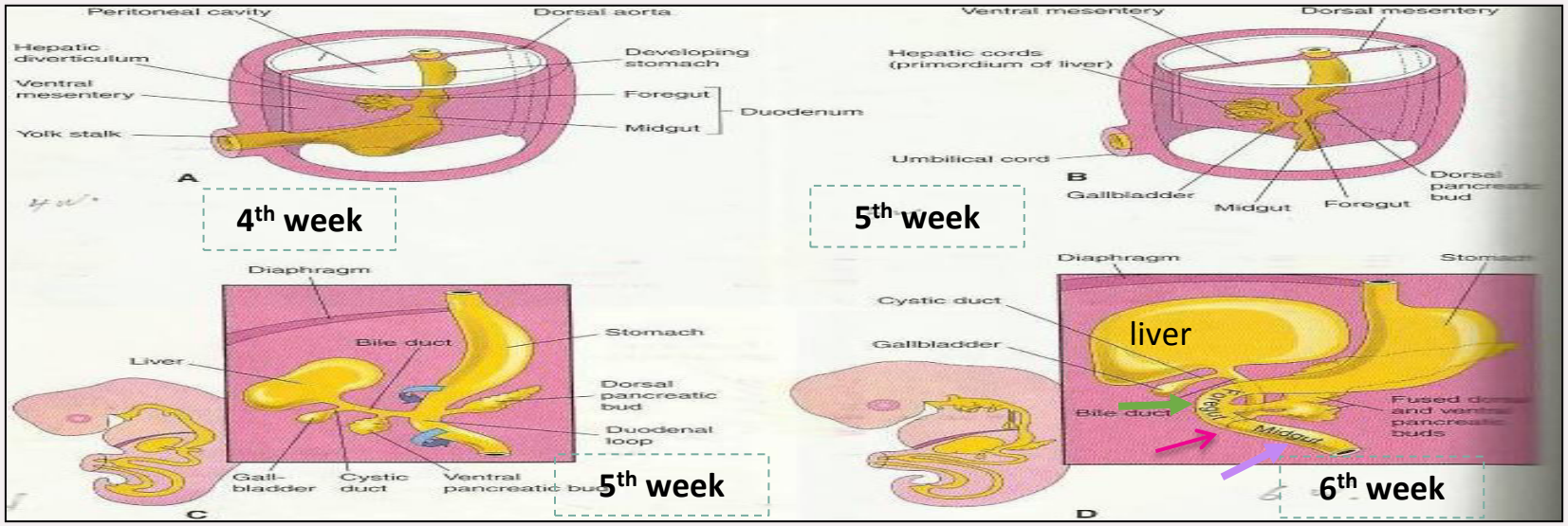
- Stages in the development of duodenum, liver, biliary ducts and pancreas (pic.A-D).

- Early in **the 4th week**, the duodenum develops from the endoderm of primordial gut* of :

1-**Caudal** (تحت)**part of foregut** 2-**Cranial**(فوق) **part of midgut** **3-Splanchnic mesoderm****.

Forgut is(Proximal part) Midgut is (Distal part)

-The junction*** of the 2 parts of the gut lies just below or distal to the origin of bile duct (pic,C -D).



*It's an intra-embryonic endoderm That Divided into: Foregut, midgut, hindgut

**give smooth muscle

***it's the junction between the two part of duodenum

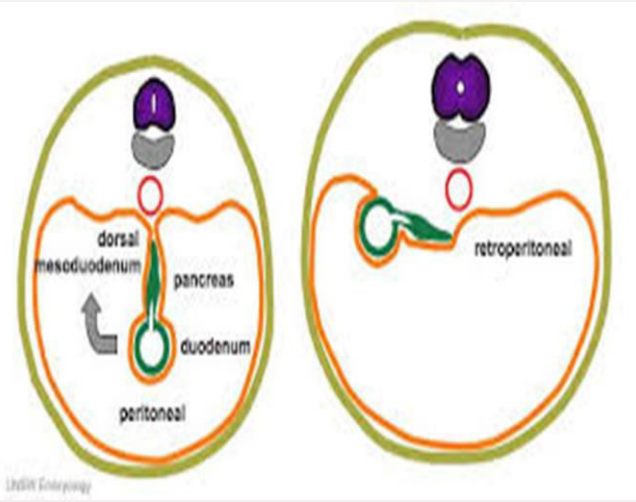
Cont..

-The duodenal loop:

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

2-The duodenal loop is rotated with the stomach to the right. (90) degrees

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

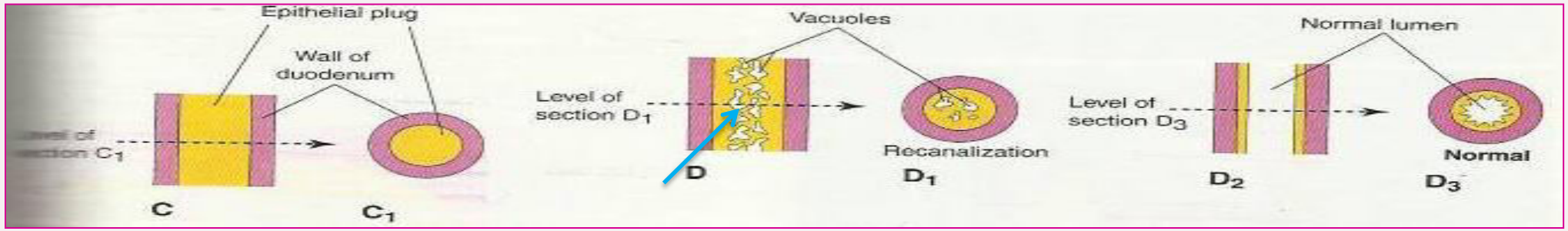


*except the first small part of duodenum.

During **5 th and6 th 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*** (**end of 8th week**)



** the period from fertilization to the end of 8th week

- Fetal period: from 9th week to birth

-الخلاصة: الديودينم عبارة عن أنبوب؛ لذلك في الأسبوع الخامس والسادس الأنبوب يتسد ويتقفل من الوسط موقتا بسبب تكاثر الإبيثيليال سلز، بعدين الخلايا تبدأ تتآكل ومع نهاية الأسبوع الثامن يرجع الأنبوب يفتح من جديد

Development Of Pancreas:

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

1- **ventral pancreatic bud** : which develops from the proximal end of **hepatic diverticulum** (forms the liver and gall bladder).

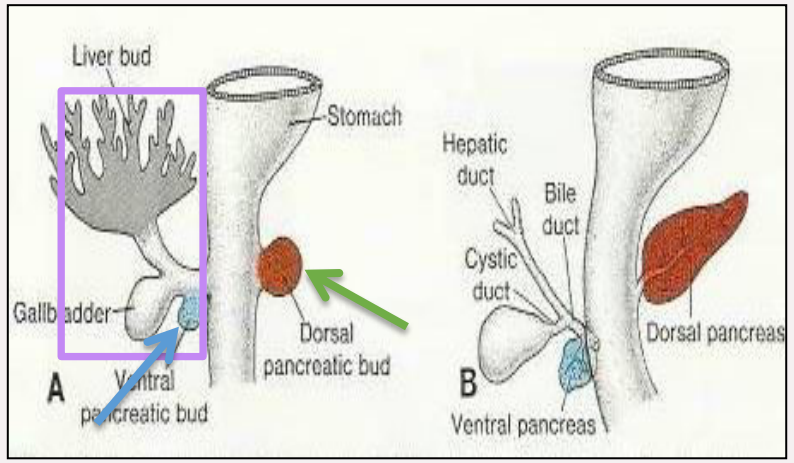
2- dorsal pancreatic bud : which develops from **dorsal wall of duodenum** slightly cranial to the ventral bud.

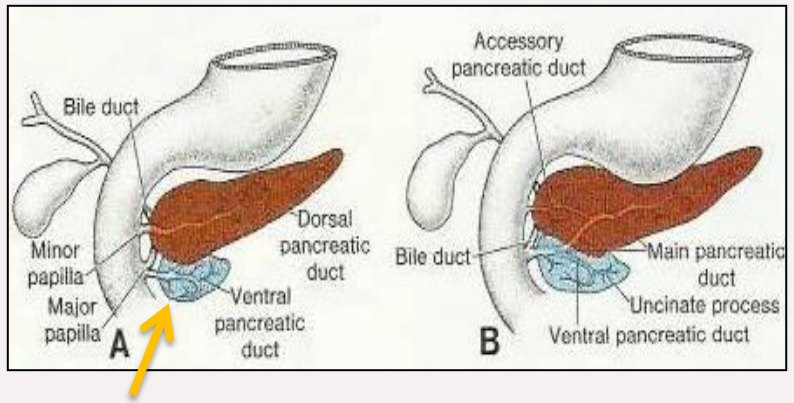
- But Most of pancreas is derived from the dorsal pancreatic bud.(لانها الاكبر)

- 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.



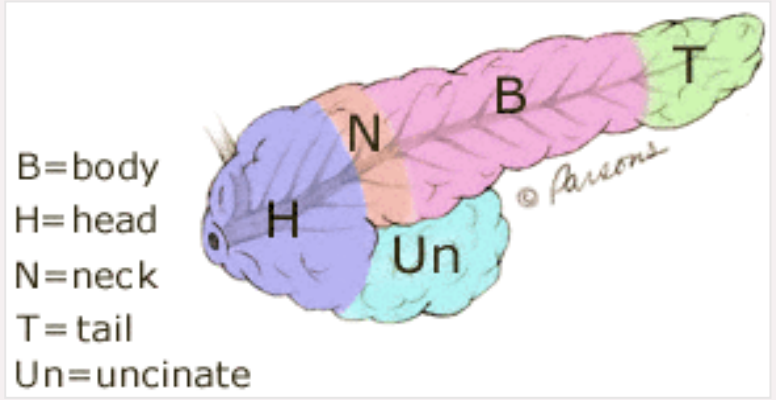


*

Development Of Pancreas:

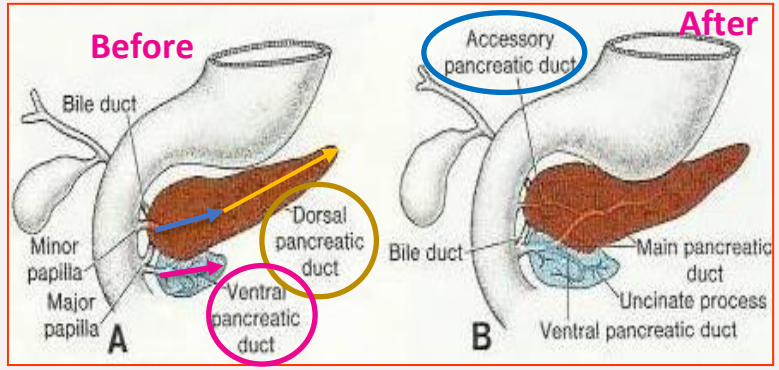
This slide is very important ☺

	A ventral pancreatic bud	A dorsal pancreatic bud (larger)
develops from:	Proximal end of hepatic diverticulum (forms the liver and gall bladder).	dorsal wall of duodenum slightly cranial to the ventral bud
the bud forms:	**1-Uncinate process**. 2-(Inferior part of head of pancreas). (so, ventral bud give us small part)	Upper part of head, Neck, Body and Tail of pancreas. (so, dorsal bud give us a lot of parts)

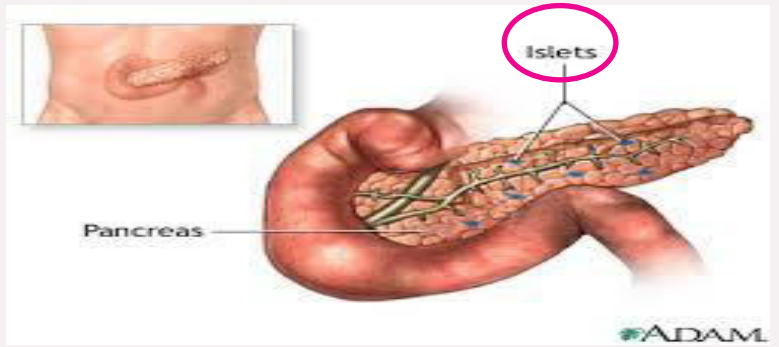


pancreatic ducts: They are two ducts open in duodenum

The main pancreatic duct (is derived from) السهمين الاصفر و الزهري يندمجوا مع بعض ويعطونا المين بينكرياتك دكت	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.



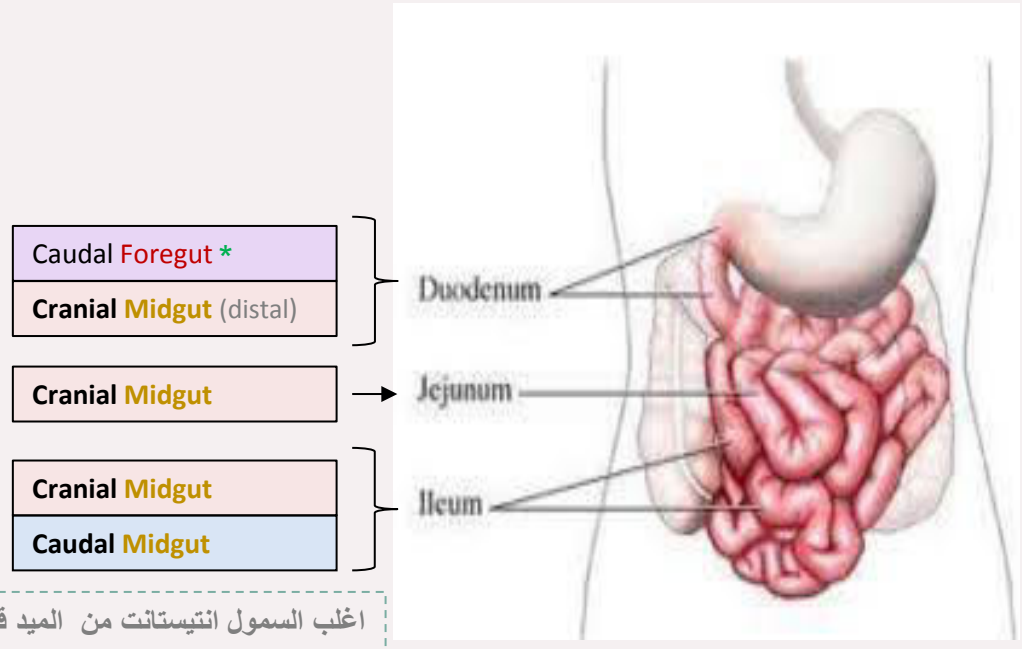
- **The parenchyma** of pancreas is derived from the **endoderm of pancreatic buds.**
- Pancreatic islets* develops from **parenchmatous pancreatic tissue**
- Insulin secretion begins at **5th month** of pregnancy *important*



*its function is to secrete insulin
And we can found islet a lot in the tail part of pancreatic tissue

Development Of Small Intestine:

Derivatives of cranial part of the midgut loop :	**1. Distal part of the duodenum** **2. Jejunum** **3. Upper part of the ileum.** لو تخيلنا الأمعاء واعتبرناه تسلسل يسهل (حفظها)
the caudal part of midgut loop:	**1. Lower portion of ileum.** 2. Cecum and appendix. 3. Ascending colon 4. proximal 2/3 of transverse colon.** مو مرة تهمنا في هذه المحاضرة
Derivatives of caudal part of foregut :	**1. proximal part of duodenum**



اغلب السمول انتيستانت من الميد قت

Very helpful summarizing pic

- So, the small intestine is developed from :

1. Caudal part of foregut.
2. All midgut.

- Midgut is supplied by superior mesenteric artey (artery of midgut).***

* Don't forget that also from caudal foregut (proximal part)

** 2,3,4 are parts of large intestine,
The rest 1/3 of transvers colon developed from **hindgut.**

***very important; SMA sometimes called artery of midgut.

- Stages of development of small intestine :

1. Preherniation stage.
2. Stage of physiological umbilical hernia****.
3. stage of rotation of midgut loop.
4. Stage of reduction of umbilical hernia.
5. Stage of fixation of various parts of intestine

**** Hernia is a condition in which part of an organ is displaced and protrudes through the wall of the cavity containing it.

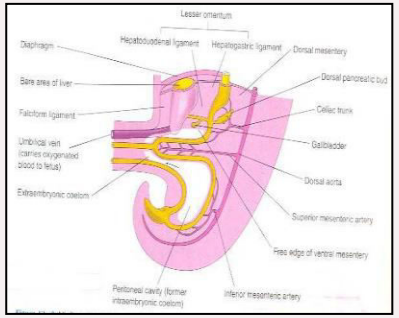
Development Of Midgut Loop

Useful video

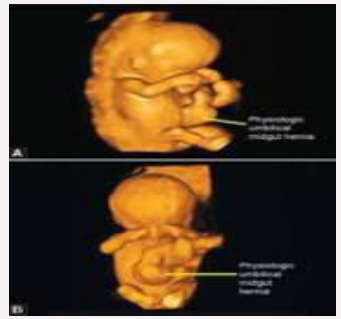
1- Preherniation stage:

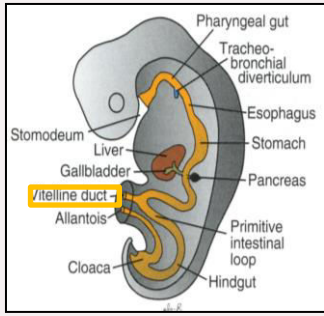
- At the biginning of 6th week, the midgut elongates to form a venteral U-shaped midgut loop
- Midgut loop communicates with the yolk sac by vitelline duct or yolk stalk.
- As a result of rapidly growing liver, kidneys and gut ,the abdominal cavity is temporarily too small to contain the developing rapidly growing intestinal loop.

1-Preherniation Stage



2-Physiological umbilical hernia.





2- physiological umbilical herniation

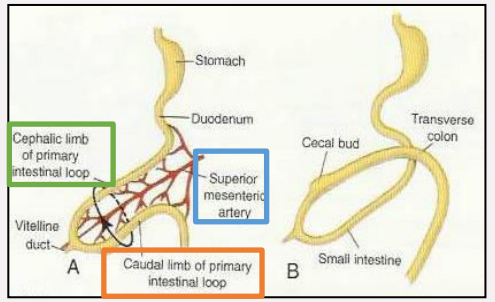
- So ,Midgut loop projects into the umbilical cord .. this is called physiological umbilical herniation **(begins at 6th w.).**

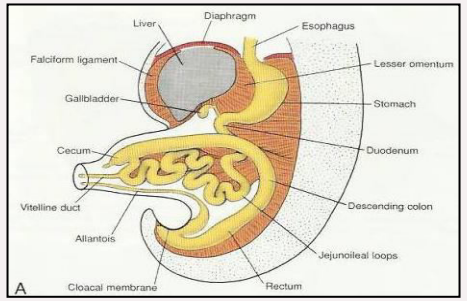
- الفكرة هنا ان الميدقت يطول ويلتحم مع يولك ساك وهذي المرحلة «preherniation»، بعدين بسبب ان الأعضاء الأخرى الموجودة في ال abdominal cavity زي الكبد والكلية تنمو بسرعة وأصلا المساحة صغيرة داخل الجنين فتضغط على الميدقت بالتالي يطلع على برى من فتحة الصرة بشكل مؤقت وينتج شيء اسمه herniation ومعناه فتق وهوا شيء فسيولوجي طبيعي في الجنين لانه يرجع في الأسبوع العاشر (physiological umbilical herniation)

3-Rotation of the midgut loop

ضروري تشوفوا الفيديو

- Midgut loop has a cranial limb (cephalic limb) and a caudal limb.
- Midgut loop rotates around the axis of the superior mesenteric artery.
- Midgut loop rotates first 90 degrees (عكس عقارب الساعة) 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 and ileum).

- so after reduction of physiological hernia it rotates to about 180 degrees
- This rotation is counterclockwise and it is completed to 270 degrees,

.

ركزوا معانا: (الي ماشاف الفيديو او مافهم)

تخيلوا عندنا (عمود=الميدقت لوب) الجزء العلوي هو كرينيال ليمب والجزء السفلي هو الكودال ليمب والمحور حق العمود هو سوبيريور ميزنترك ارتري طيب بعدين؟

حيلف العمود 90 درجة عكس عقارب الساعة (طبعا عكس الساعة في الامبريو هي نفس اتجاه عقارب الساعة عندنا)

المهم الكرينيال تصير في اليمين (يبدا يكبر ويكون الجيوجينم والاليم) والكودال ف اليسار وهذا يصير خلال **مرحلة الفيسولوجيكال هيرنيا**

بعدين تلف 180 درجة وبكذا يصير التوتال 270 درجة

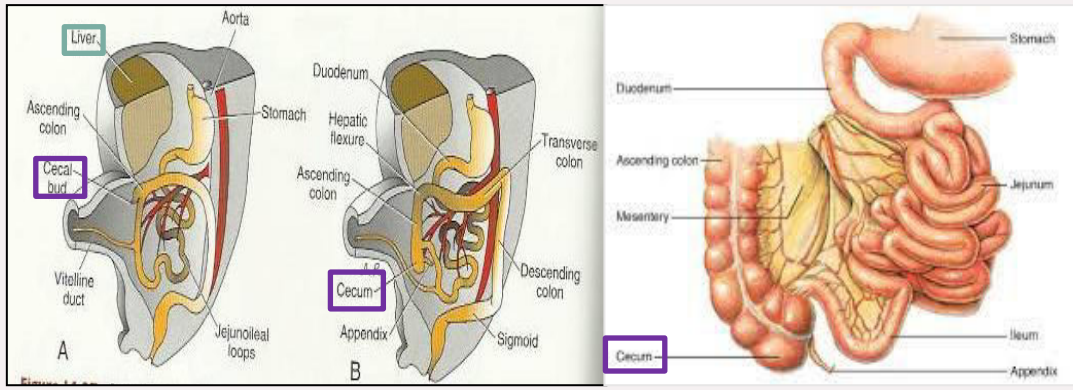
Cont..

4-Return of the midgut to abdomen

- During 10th week, the intestines return to the abdomen due to regression of liver and kidneys + expansion of abdominal cavity.
It is called **reduction of physiological midgut hernia**. In 10th week !! مهم هذا الوقت

- 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 (A), but later it descends to lie in the right iliac fossa (B)



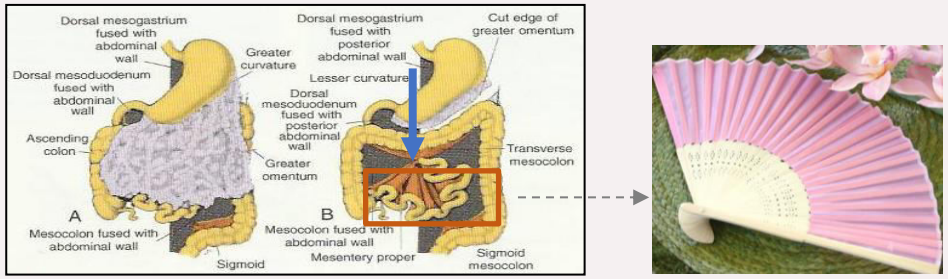
5- Fixation of various parts of intestine

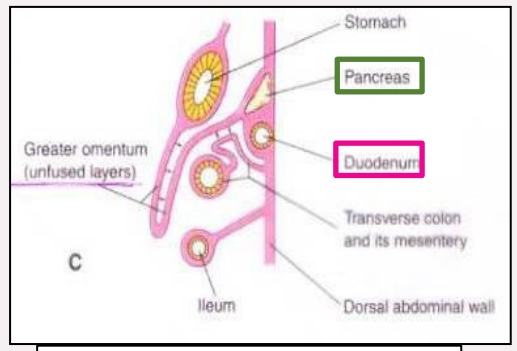
- The mesentry of jejunoileal loops is at **first continuous with that** of the **ascending colon.**

- 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.

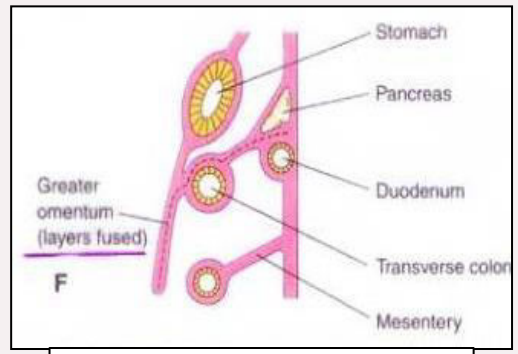
➢The enlarged colon presses the duodenum and pancreas against the posterior abdominal wall.(**C & F)**

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





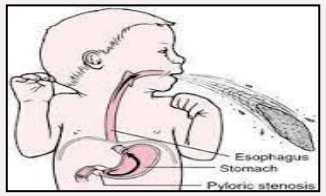
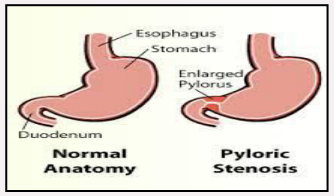
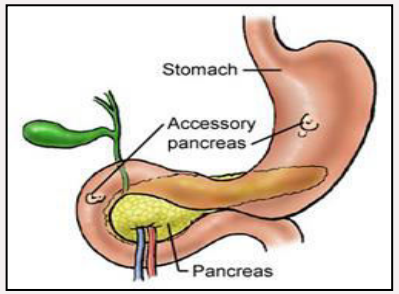
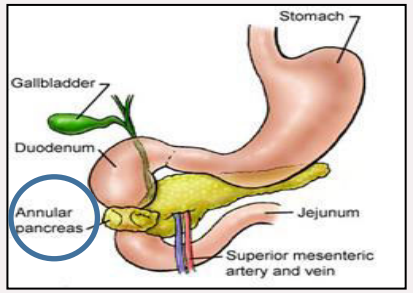
Intestine prior fixation



Intestine after fixation

Congenital Anomalies :

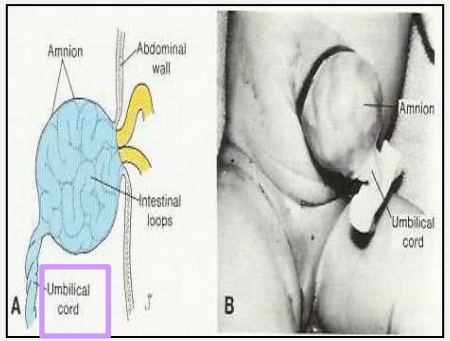
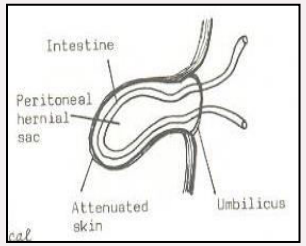
Duodenal stenosis and atresia

Organ :	Details :
قلنا ان الديودينم في بداية فترة الجنين طبيعي يتقفل وفي الأسبوع 8 يرجع يفتح؛ لذلك في حال حصلت مشكلة وما فتح سواءً جزئيا أو كليا تطلع هذه الأنوميلس. **Duodenum :** **A. Duodenal stenosis** يصير تضيق في الديودينم **B. Duodenal atresia** جز ء من الديودينم يقفل بشكل كامل وعشان نعالجه يتم استئصال الجزء المقفل وتوصيل باقي الأمعاء مع بعض	**A.** results from incomplete recanalization of duodenum   **B.** results from failure of recanalization leading to complete occlusion of the duodenal lumen, (autosomal recessive inheritance). 
Pancreas: **A. Accessory pancreatic tissue** جزء من البنكرياس يخترق ويدخل داخل الديودينم او المعدة **B. Anular pancreas** انسجة البنكرياس تلف حول السكند بارت اوف الديودينم وتسوي اوبستركشنز	**A.** located in the wall of the stomach or duodenum. **B.** A thin flat band of pancreatic tissue surrounding the second part of the duodenum, causing duodenal obstruction.  

Congenital Anomalies :

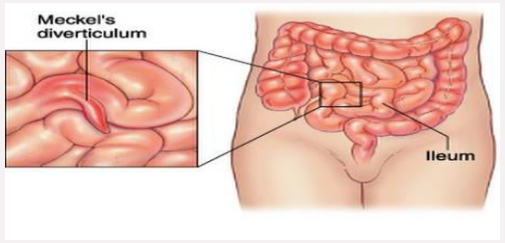
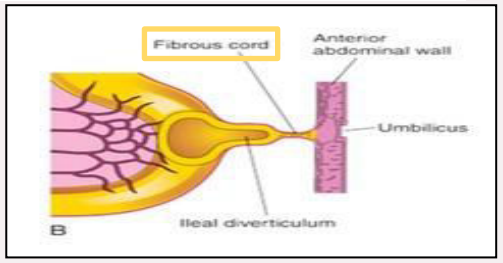
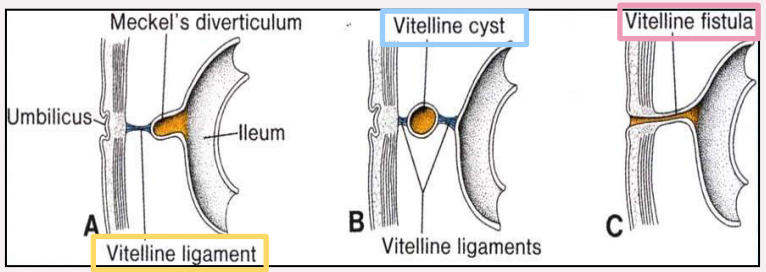
This slide is very important ☺

Congenital Omphalocele

Organ :	Details :
Small intestine : important to know **The hernial sac is covered by** (in every anomalies) **A. 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.** • It is accompanied by small abdominal cavity. مارجع اللوب في الأسبوع العاشر وعشان الابدومنال كافتي صغير ماكبر • Herniation of **intestines** occurs in 1 of 5000 births – herniation of **liver and intestines** occurs in 1 of 10,000 births. • The hernial sac is covered by **the epithelium of the umbilical cord or the amnion.** • **Immediate surgical repair is required** ←عكس الانوميليس الي بعدها.
B. Congenital Umbilical Hernia    	• The intestines return to abdominal cavity **at 10th week,** but herniate through an imperfectly closed umbilicus. الانتستانت رجعت مكانها بس الفتحة ماتقفلت • It is a **common type** of hernia. • The herniated contents are usually **the greater omentum and small intestine**. • The hernial sac is covered by **skin and subcutaneous tissue.** • It protrudes during crying , straining or coughing and **can be easily reduced through fibrous ring at umbilicus.** اذا ضغطنا على مكان الفتاق تدخل الأمعاء جوا بدون مايتألم الطفل لكن ترجع تطلع اذا الطفل بكى او كح او بذل جهد • Surgery is performed at age of 3-5 years. So it's not an emergency as the one above

Congenital Anomalies :

This slide is very important ☺

Organ :	Details :
C. 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 and pancreatic tissues causing ulceration, bleeding or even perforation. • **It is the remnant of proximal part non-obliterated part of yolk stalk (or vitelline duct).** Normally, viteline obliterate and disappear , but in this anomalie will not disappear • It arises from antimesenteric border of ileum, 1/2 meter from ileocecal junction. • It is sometimes becomes inflammed and causes symptoms that mimic appendicitis. لما تلتهب تسوي نفس اعراض التهاب الزائدة • 1- It may be connected to the umbilucus by a fibrous cord (vetline ligament), 2- or the middle portion forms a cyst 3- or may remain patent forming the fistula - so, faecal matter is carried through the duct into umbilicus. والخطورة هنا انو ممكن الfeces يخرج من الumbilicus

- **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**. **(girls slids only)**

Summary

Organ	Period	Event
Duodenum	4th week	- Develops from the endoderm of primordial gut
	5th & 6th week	- The lumen of the duodenum is temporarily obliterated. - Degeneration of epithelial cells occurs.
	End of 8th week	- Duodenum normally becomes recanalized.
Pancreas	5th month	- Insulin secretion begins.
Midgut loop	6th week	- Elongates to form a venteral U-shaped midgut loop. - Communicates with the yolk sac by vitelline duct or yolk stalk. - Projects into the umbilical cord (physiological umbilical herniation).
	10th week	- Return to the abdomen (reduction of physiological midgut hernia).

Summary

Congenital Anomaly	Cause And Details
Duodenal stenosis	Incomplete recanalization of duodenum.
Duodenal atresia	Failure of recanalization of duodenum.
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.
Congenital Omphalocele	Failure of reduction of physiological hernia to abdominal cavity at 10th week.
Congenital Umbilical Hernia	Imperfectly closed umbilicus.
Ileal (Meckel's) Diverticulum	Remnant of proximal part non-obliterated part of yolk stalk (or vitelline duct). Sometimes become inflamed and can produce pain.

MCQ's

1. 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

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 and 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- 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.

1- B
2- C
3- D
4- B
5- B
6- C

ANY SUGGESTIONS OR ISSUES

Editing file

References

- Dr.slides (male and female).
- Embryology team 435 .

USEFUL VIDEOS

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