

Gastrointestinal block

DEVELOPMENT OF PANCREAS & SMALL INTESTINE

يعتبر العمل مصدر للمذاكرة والمراجعة

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.

Resources

- ★ 435 embryology (males & females) lectures.
- ★ BRS embryology Book.
- ★ Langman embryology book.

Color Index

- ★ IMPORTANT
- ★ Day, Week, Month
- ★ Doctor notes and extra information.

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❖ **INTRODUCTION** (the Extra information for better understanding) : [Overview](#)

- ★ The primitive gut tube is formed from the incorporation of the dorsal part of the yolk sac into the embryo due to the craniocaudal folding and lateral folding of the embryo.
- ★ The **primitive gut tube** extends from the oropharyngeal membrane to the cloacal membrane and is **divided** into the **foregut**, **midgut**, and **hindgut**.
- ★ Arterial supply:
 - Foregut derivatives are supplied by the celiac trunk. The exception to this is the esophagus(not all of the esophagus).
 - **Derivatives of the midgut are supplied by the superior mesenteric artery.**
 - Derivatives of the hindgut are supplied by the inferior mesenteric artery.

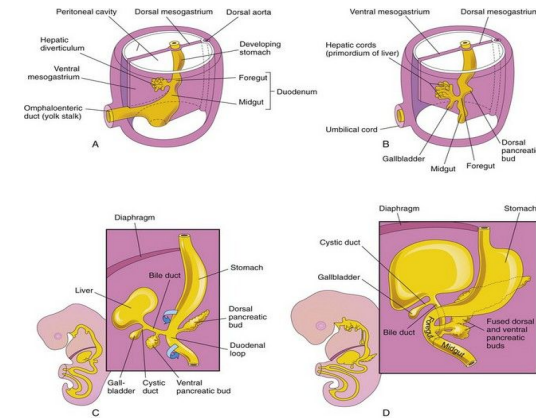
★ Stages in the development of duodenum, liver, biliary ducts and pancreas (pic.A-D).

★ pic A > 4th week , pic B and C > 5th week , pic D > 6th week

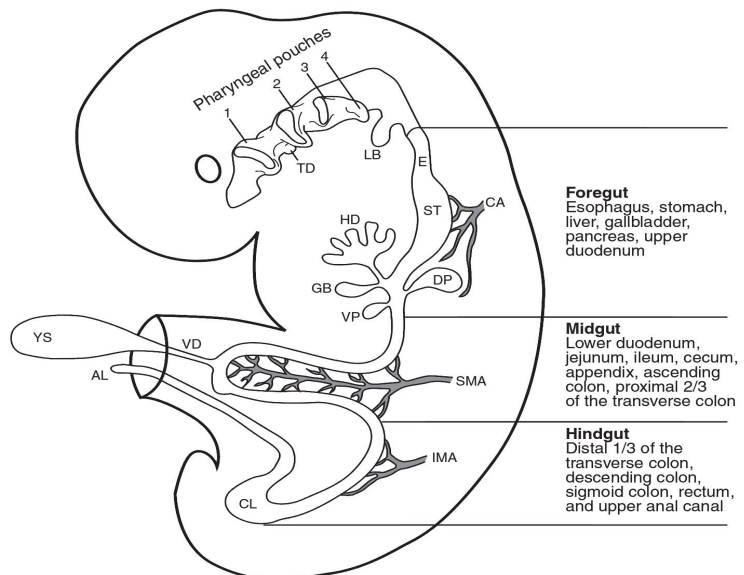
★ Early in the 4th week , the duodenum develops from the endoderm of primordial gut of : Caudal part of foregut , Cranial part of midgut & Splanchnic mesoderm.

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

★ Midgut (development of small intestine) :



Derivatives of cranial part of the midgut loop.	Derivatives of the caudal part of midgut loop.	Derivative of the caudal part of foregut .
<ul style="list-style-type: none"> ● Distal part of the duodenum ● Jejunum ● Upper part of the ileum. 	<ul style="list-style-type: none"> ● Lower portion of ileum. ● Cecum , appendix, ascending colon + proximal 2/3 of transverse colon (Large intestine) 	<p>proximal part of duodenum.</p>
<p>So, the small intestine (duodenum , Jejunum & ileum) is developed from : Caudal part of foregut. All midgut.</p>		



❖ DEVELOPMENT OF PANCREAS

- ★ The pancreas develops from 2 buds (**ventral & dorsal** pancreatic buds) arising from the **endoderm** of the **caudal part of foregut**. But Most of pancreas is derived from the **dorsal pancreatic bud**. (see the pic. Below)
- ★ 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. (see the pic. Below) Later the 2 buds **fused together** and lying in the dorsal mesentery. (see the pic B at the beginning)

	A ventral pancreatic bud	A dorsal pancreatic bud (larger)
develops from	Proximal end of hepatic diverticulum (forms the liver & gall bladder). Formation is induced by hepatic mesoderm.	dorsal wall of duodenum slightly cranial to the ventral bud. Formation is induced by the notochord.
the bud forms	Uncinate process. Inferior part of head of pancreas.	Upper part of head. Neck. Body Tail of pancreas.
pancreatic ducts		
The main pancreatic duct (is derived 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 (tissue) of pancreas is derived from the endoderm of pancreatic buds.
- ★ Pancreatic islets (of Langerhans) more potent in the tail develops from > parenchymatous pancreatic tissue.
- ★ **Insuline secretion begins at 5th month of pregnancy.**

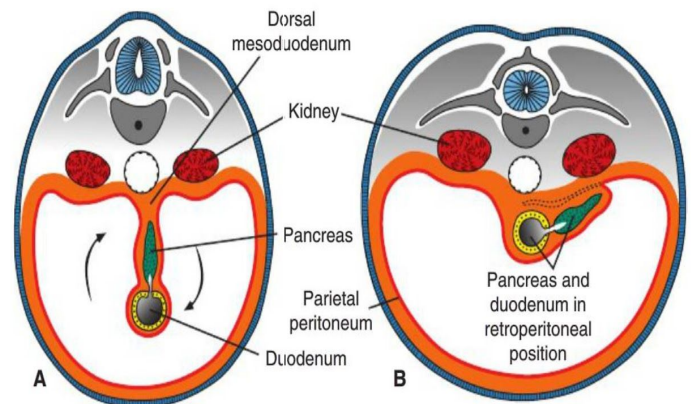
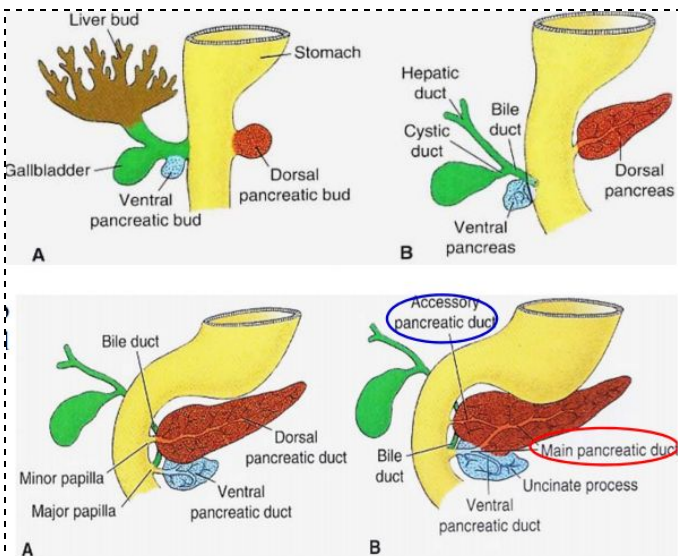


FIGURE 15.17 Transverse sections through the region of the duodenum at various stages of development. At first, the duodenum and head of the pancreas are located in the median plane (A), but later, they swing to the right and acquire a retroperitoneal position (B).

★ **Congenital anomalies:**

Accessory pancreatic tissue	Anular pancreas
located in the wall of the stomach or duodenum . Removed by surgery	a thin flat band of pancreatic tissue <u>surrounding</u> the second part of the duodenum , causing duodenal obstruction .

★ this Picture is Extra

Clinical Correlates

Pancreatic Abnormalities

The ventral pancreatic bud consists of two components that normally fuse and rotate around the duodenum so that they come to lie below the dorsal pancreatic bud. Occasionally, however, the right portion of the ventral bud migrates along its normal route, but the left migrates in the opposite direction. In this manner, the duodenum is surrounded by pancreatic tissue, and an **annular pancreas** is formed

[Fig. 15.23]. The malformation sometimes constricts the duodenum and causes complete obstruction.

Accessory pancreatic tissue may be anywhere from the distal end of the esophagus to the tip of the primary intestinal loop. Most frequently, it lies in the mucosa of the stomach and in Meckel diverticulum, where it may show all of the histological characteristics of the pancreas itself.

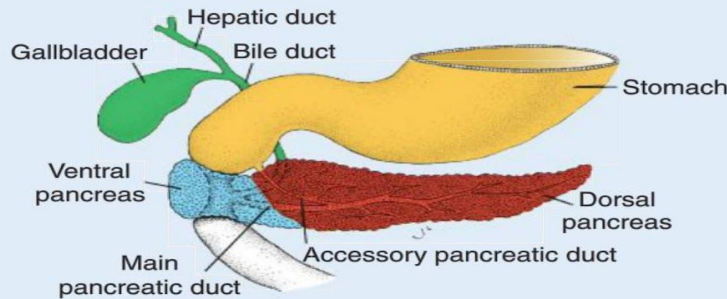


FIGURE 15.23 Annular pancreas. The ventral pancreas splits and forms a ring around the duodenum, occasionally resulting in duodenal stenosis.

❖ **DEVELOPMENT OF THE DUODENUM**

- ★ The duodenal loop is formed and projected ventrally, forming a **C-shaped loop**.
- ★ 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**.
الدوران هنا مع عقارب الساعة شوفو الصورة بالصفحة السابقة نفس الكلام اللي في البنكرياس
- ★ 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 (the end of 8th w.)**.
طبيعي انه يبصير لها تفرغ من الداخل لانه هو انبوب بمجرد اي خلل في هذا التجويف يبصير مشكلة للجنين وينشوفها تحت مع الكونجنتال

❖ DEVELOPMENT OF SMALL INTESTINE

→ 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: ([helpful video](#) for better understanding of this part and the next part)

- 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 ,so 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.**).
لما بدأت تنمو الأمعاء كان البطن صغير عليها فهي قاعدة تنمو بسرعة ومالقت مساحة تروح لها فتروح لجهة الامبيلكال كورد عند اليولك ساك كانها تتخبي بهذا المكان لما يتوسع البطن اكثر بترجع لمكانها الطبيعي.

★ ROTATION of 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 & upper ileum).
- This rotation is **counterclockwise** and it is completed to **270 degrees**, so after **reduction of physiological hernia it rotates to about 180 degrees**.
باختصار الدوران سيكون عكس عقارب الساعة وبيكون اول شيء تسعين درجة بعدين بيلف مئة وثمانين درجة يعني المجموع 270 عشان يطلع لنا الصورة الطبيعية للأمعاء للإنسان وكل هذا الكلام موجود في الفيديو انصحكم بمشاهدته لتوسيع الخيال وتعميق الفهم.

★ 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**.
- 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**.

❖ **CONGENITAL ANOMALIES:**
★ DUODENUM

Duodenal stenosis	Duodenal atresia
results from incomplete recanalization of duodenum.	<ul style="list-style-type: none"> - autosomal recessive inheritance - results from failure of recanalization leading to complete occlusion of the duodenal lumen.
Atresias and stenoses may occur anywhere along the intestine. Most occur in the duodenum, fewest occur in the colon, and equal numbers occur in the jejunum and ileum.	

★ SMALL INTESTINE

<p>Congenital Omphalocele</p> 	<ul style="list-style-type: none"> - It is a <u>persistence</u> of herniation of abdominal contents into <u>proximal part</u> 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 & the amnion. - Immediate surgical repair is required.
<p>Congenital Umbilical Hernia</p> 	<ul style="list-style-type: none"> - 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 <u>crying</u>, <u>straining</u> or <u>coughing</u> and can be easily reduced through fibrous ring at umbilicus. - Surgery is performed at age of 3-5 years. - هذا المرض له حالتين يا اما بيختفي الانتفاخ هذا بمجرد ما تدخله باصبعك بيدخل للداخل ، او بيدخل لكن بمجرد ما يبكي الطفل او يكح بيرجع يطلع بهذي الحالة نخليه لما يكبر شوي تقريبا ثلاث الى خمس سنوات ونصلح العملية.
<p>Ileal (Meckel's) Diverticulum</p> 	<ul style="list-style-type: none"> - 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 <u>remnant of proximal part nonobliterated part of yolk stalk (or vitelline duct).</u> - 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 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.

Summary & MCQ's

The foregut gives rise to :	The midgut gives rise to :
<ul style="list-style-type: none"> - Duodenum (proximal to the opening of the bile duct). - Pancreas. & Biliary apparatus. 	Small intestine : Duodenum (distal to bile duct) , Jejunum & ileum.

★ Pancreas:

- The pancreas develops from : Dorsal & ventral pancreatic buds that develop from the endodermal lining of the caudal part of foregut.

★ Small intestines:

- DUODENUM develops early in 4th week.
- physiological umbilical hernia : The midgut forms a U-shaped intestinal loop that herniates into the umbilical cord during 6th week.
- Midgut loop rotates around the axis of the superior mesenteric artery. This rotation is counterclockwise and it is completed to 270 degrees, so after reduction of physiological hernia(90 degree) it rotates to about 180 degrees.
- 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.

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.
Duodenal stenosis	incomplete recanalization of duodenum
Duodenal atresia	failure of recanalization of duodenum
Congenital Omphalocele	<ul style="list-style-type: none"> - due to failure of reduction of physiological hernia to abdominal cavity at 10th week. - accompanied by small abdominal cavity. - The hernial sac is covered by the epithelium of the umbilical cord & the amnion.
Congenital Umbilical Hernia	<ul style="list-style-type: none"> - imperfectly closed umbilicus - It is a common type of hernia. - The hernial sac is covered by skin & subcutaneous tissue.
Ileal (Meckel's) Diverticulum	<ul style="list-style-type: none"> - small pouch from the ileum. - are common anomalies of GI ; however, only a few of them become inflamed and produce pain.

1. Pancreatic islets consist of alpha, beta, and delta cells, which secrete glucagon, insulin, and somatostatin, respectively. These cells are derived from
 - a. mesoderm
 - b. endoderm
 - c. ectoderm
 - d. neuroectoderm
 - e. neural crest cells
2. Which of the following arteries supplies midgut derivatives of the digestive system?
 - a. Celiac trunk
 - b. Superior mesenteric artery
 - c. Inferior mesenteric artery
 - d. Right umbilical artery
 - e. Intercostal artery
3. A baby born to a young woman whose pregnancy was complicated by polyhydramnios was placed in the intensive care unit because of repeated vomiting containing bile. The stomach was markedly distended, and only small amounts of meconium had passed through the anus. What is the most likely diagnosis?
 - a. Esophageal stenosis
 - b. Annular pancreas
 - c. Hypertrophic pyloric stenosis
 - d. Extrahepatic biliary atresia
 - e. Duodenal atresia
4. Mainly the small intestine developed from :
 - a. Midgut
 - b. Foregut
 - c. Hindgut
 - d. All
5. physiological umbilical herniation occur at
 - a. 6th month
 - b. 10th month
 - c. 10th week
 - d. 6th week
6. reduction of physiological midgut hernia. (RETURN OF MIDGUT TO ABDOMEN) occur during :
 - a. 6th month
 - b. 10th month
 - c. 10th week
 - d. 6th week
7. The duodenal..... results from failure of recanalization , but duodenal..... results from incomplete recanalization.
 - a. atresia - stenosis
 - b. Stenosis- atresia
 - c. Omphalocele - Umbilical Hernia
 - d. Umbilical Hernia - Omphalocele
8. A dorsal pancreatic bud form :
 - a. Neck & body of pancreas
 - b. Upper part of of head & tail of pancreas
 - c. Uncinate process. & Inferior part of head of pancreas.
 - d. A & b
9. Insuline secretion begins atof pregnancy ?
 - a. 5th week
 - b. 6th week
 - c. 5th month
 - d. 10 week
10. it is due to failure of reduction of physiological hernia to abdominal cavity at 10th week.
 - a. Omphalocele
 - b. Umbilical Hernia
 - c. Ileal (Meckel's) Diverticulum
 - d. Anular pancreas
11. is a small pouch from the ileum, the remnant of proximal part nonobliterated part of yolk stalk and the most common anomalies of the digestive tract
 - a. Omphalocele
 - b. Umbilical Hernia
 - c. Ileal (Meckel's) Diverticulum
 - d. Anular pancreas
12. 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.
13. Which artery the midgut loop rotates around its axis ?
 - a. Splenic artery.
 - b. Inferior mesenteric artery.
 - c. Superior mesenteric artery.
 - d. Celiac trunk.
14. 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.

1	2	3	4	5	6	7	8	9	10	11	12	13	14
b	b	e	a	d	c	a	d	c	a	c	b	c	b