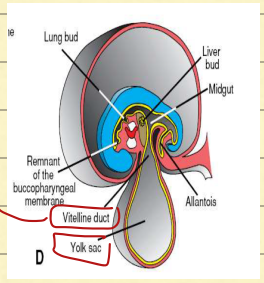
* Midgut

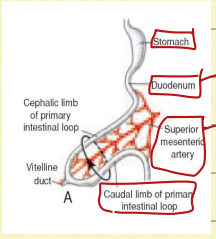
* the midgut starts after the liver bud
* in development → rapid elongation of jejunum & ileum (6m in length)

While the large intestine = 2m ← (so part of the large intestine will develop slowly)
(while it's very rapid in small intestine)



links the yolk sac to the ileum (midgut)

* We call this elongation: primary intestinal loop (rapid elongation especially in the small intestine)
  ↳ the apex of the loop → opened to the yolk sac by: vitelline duct



→ has 2 parts → Before the liver bud → foregut
→ after the liver bud → midgut

→ supplied (the sup. mesenteric a.)

part above sup. mesenteric → called: cephalic part of the intestinal loop
part below the sup. mesenteric → Caudal part of intestinal loop

→ So: development of midgut is devided into → cephalic part
→ caudal part

first elongation of the caudal part

cephalic part will form
- jejunum
- most of the ileum

forms:
- cecum
- appendix
- ascending colon
- proximal 2/3 of transverse colon

* Development of the intestinal loop consists of 2 processes → ① physiological herniation
→ ② Rotation of intestinal loop

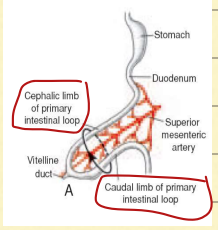
① Physiological herniation
↳ rapid elongation especially: cephalic limb (cephalic part of intestinal loop)
(in the umbilical cord)
↳ So the midgut enters the umbilical cord → elongation
↳ in the 6th week of development → to 10th week of development

* Why does it enter the umbilical cord?
- bc the liver enlarges → diaphragm descends downwards → so abd. cavity gets smaller

So: the intestinal loop enters the umbilical cord

* on the 10th week → the midgut returns to the abd. cavity (90°)
Why? bc the abd. cavity enlarges → ① By regression of mesonephric kidney
② the liver grows upwards
(so it leaves a space in the abd. cavity)

② Rotation around the sup. mesenteric artery (270°)



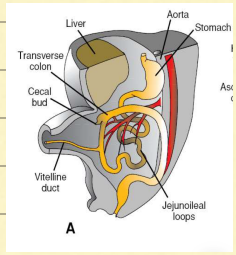
* cephalic & caudal part → rotation
↳ their apex is called: vitelline duct

→ 90° anti-clockwise / counter clockwise → during physiological herniation
→ 180° anti-clockwise → starts at the 10th week when the midgut returns to abd. cavity

* the first part that returns from the midgut is the jejunum (الصائم)
↳ Returns upwards & to the left

* the last parts to return are → cecum
→ appendix
(return to be below the liver & on the left side)

But I think it's the right side



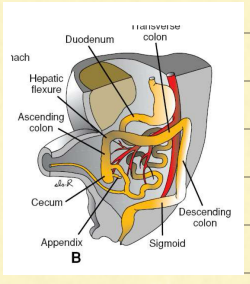
* When does the cecum bud start to appear?
around the 6th week
↳ and when it returns back during the 10th week → it undergoes enlargement
↙
to form cecum + appendicular diverticulum
↙
then descend downwards to the right iliac fossa
↙
When it descends downwards it forms the ascending colon

* So the proximal part of jejunum is the 1st part that re-enters the abd. cavity & goes to the left side.

* Later, returning loops (return to the right side) → mainly: cecum → below the liver

* The cecal bud appears on the 6th week → but returns on the 10th week to the abd. cavity below the liver

appendix ← appendicular bud ← diverticulum
right colic flexure + ascending colon ← right loop ← downward



* So: in the right upper quadrant → cecal bud
↓
then descends below the right lobe of the liver to the right iliac fossa → ascending
- hepatic flexure

* common position of appendix → retrocecal (cecum خلف)

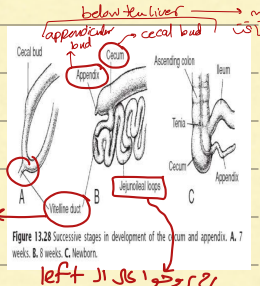


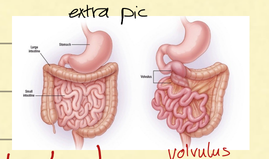
Figure 13.28 Successive stages in development of the cecum and appendix. A, 7 weeks. B, 8 weeks. C, Newborn.

* Mesentery of the intestine
(e.g.) → jejunum + ileum + transverse colon + sigmoid colon (mesocolon) → so they're attached to post. abd. wall

* Organs that don't have a mesentery: ascending + descending colon
↳ the mesentery disappears posteriorly + fixation of lateral wall of ascending + descending
* So mesentery proper undergoes elongation → elongation to post. abd. wall
Why?
Because the mesentery is attached to post. abd. wall

* at the end, the descending + descending → fixed to post. abd. wall
  ↳ the peritoneum (or mesentery) surrounds them from → anterior → both sides (rt & lt)

* appendix is retroperitoneal
* mesentery of jejunum + ileum loops → first is continuous with the ascending colon
  ↳ but mesentery of the ascending mesocolon fuses with the post. abd. wall (disappears)
  ↳ and is now fixed to post. abd. wall
  While the jejunoileal stays attached to post. abd. wall with a mesentery



* **Gut rotation defect** → the 270° → 90° + 180°
  ↳ abnormal rotation of intestinal loop —results in→ twisting of the intestine (volvulus) (mainly in jejunum + ileum)

① volvulus يعني انه الفة وحدة ← وألفة طويلة بحيث زيادة ←
  بسبب ↳ cut of blood supply —so→ degeneration of part of the small intestine (الجزء اللي صار فيه الالتفاف)
  ↳ treatment: cut of the degenerated part then linking the 2 healthy parts with each others

② intestinal loop (mal rotation) rotates 90° instead of 270° (partial rotation)
  ↳ so: cecum & appendix are found on the left side (instead of right)
  ↳ & all other parts of the intestine are also inverted

③ Reversed rotation of the intestinal loop → when the primary loop rotates 90° clockwise

④ Duplication of intestinal loop → & cysts may occur anywhere along the length of the gut
  ↳ could happen in jejunum + ileum

* **Gut atresia & stenoses**
  ↳ can happen in any part of the small intestine BUT common in the duodenum (duodenal atresia) → نسبتها $\left(\frac{1}{1500 \text{ births}}\right)$
  ↳ the cause of atresia: lack of recanalization
  normally (the duodenum is filled with cells → then: recanalization) ← هون هاي الخطوة ما صارت
  ↓
  So: atresia or intestinal stenosis

* **Omphalocele**  → نسبته $\left(\frac{2.5}{10{,}000 \text{ births}}\right)$ → (rare)
  ↳ treatment ↳ if tissues are healthy → abd نرجعهم لل + نعمل تصليح
  ↳ if there's gangrene / degeneration → cut + linking
  ↳ unreturned physiological hernia (physiological hernia but didn't returned on the 10th week) ← ظلت موجودة بال umbilical cord
  ↳ So it is: herniation of abd viscera through enlarged umbilical ring
  ↳ إذا هي بتطلع umbilical cord → through the umbilical ring
  ↳ here the viscera is usually covered by the amniotic fluid
  ↳ يؤدي لموت high rate of mortality (in 25%) + sever malformation + chromosomal abnormalities بنسبة كبيرة
  (especially cardiac anomalies) (50% neural defects)

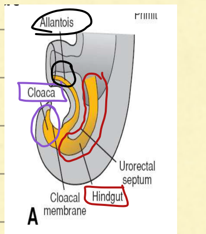
*Gastroschisis → another type of hernia

↳ herniation of abd. contents through the body wall directly into amniotic cavity

↳ happens especially in the right side of umbilicus

side ال جنب ← umbilical cord ال بنشوف ↩

↳ the treatment is the same as omphalocele



* Hindgut

↳ Hindgut is connected to cloaca → (pelvic structure & in embryo it's attached to hindgut + allontois)

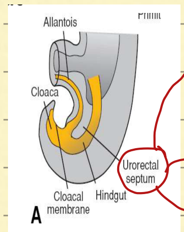
↳ (between cloaca + umbilicus)

part of the cloaca will : تكمل ↙

continue the formation of the hindgut (بتشكل جزء منه)

↳ the posterior part of it will participate in the formation of the hindgut

& the anterior part of it will participate in the formation of the urogenital system (lower half)



→ participates in the formation of - anal canal

- urogenital system (especially the urinary bladder)

→ its location: between the hindgut + allantois

→ mesenchymal structure

*So :- the terminal portion of the hindgut enters the posterior region of the cloaca

primitive anorectal canal وبعطي ال ↩

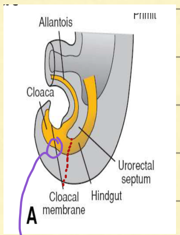
&

- allantois enters the anterior portion of the cloaca

urogenital sinus بعطي ↩

*Cloaca itself is endodermal in origin but the outer surface (ventrally الي برا)

ectodermal يكون ↩



ال urorectal بتعطي

perineal body بعطي

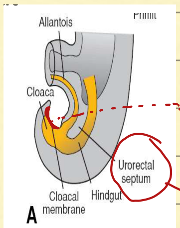
* the urorectal septum (is mesenchymal) → undergoes growth → so

it will separate the hindgut from the urogenital tract

perineal body ← وبنهاية بعطي ↩

anal canal

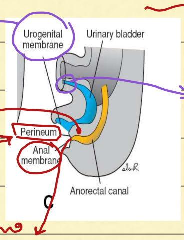
urinary bladder & urethra > بفصل بين ↩



→ the cloacal membrane → its outer surface → is ectodermal in origin → and is called: proctodeum

lower 1/2 of anal canal ال بتشكل جزء من ↩

urethra ← rupture



→ allantois

→ separates the anterior & posterior part

Urethra + allantois + urinary bladder

ano-rectal canal

تتكون بعد rupture of urogenital membrane

perineal body + perineum ↩

anal canal ال 1/2 السفلي proctodeum ال يكون من ال

*So: - the tip of urorectal septum → perineal body

- proliferation of ectodermal → closes the caudal region of anal canal (lower half of anal canal)

during the 9th week : this region canalizes ← proctodeum

thus the caudal part of anal canal originates from ectoderm → and is supplied by inferior rectal artery → branch of internal pudendal a.

sensation + L.N + innervation

* the junction between the endodermal and the ectodermal of anal canal → pectinate line

simple columnar epi ← (upper 1/2 & lower 1/2) — lower part of عند ال anal columns

① upper 1cm [stratified squamous non-keratinized

② lower 1cm → stratified squamous keratinized

* Abnormalities/malformation of anorectal part: (birth defect between anus & rectum) → النسبة (1/4000 births)

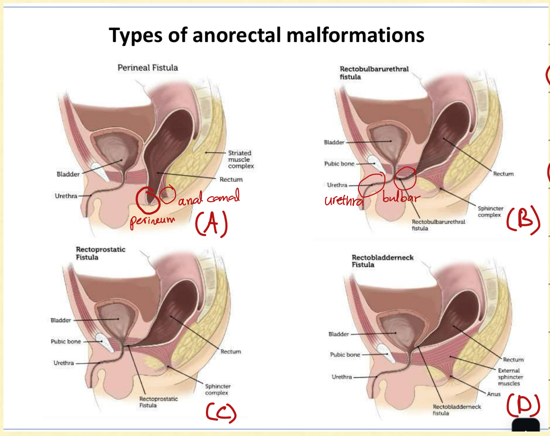
(دائماً الأجزاء الي بتكون فيها اختلاف بال embryology بصير فيها abnormalities)

- like when the rectum & upper half of anal canal (endodermal) meet the lower half of anal canal (ectodermal) → هون: abnormalities بصير

(like) → fistula, imperforated anus, no formation of lower 1/2, abnormal position

* anorectal malformation:
- the anal passage maybe narrow
- a membrane maybe present over the anal opening → (ما بيصير لها rupture & disappearance)
- rectum is not connected with the anus (imperforated anus) → بيصير → male / female
- rectum maybe connected to a part of urinary tract (بيلاصق الأعضاء التناسلية) → fistula وبالتالي

with differences بال → due to differences in their genital structure
- in females: - rectovaginal fistula
- in males: - rectoprostatic fistula



(A) perineal fistula → the rectum is opened to the perineum in front of the anal canal (بيفتح عند مكان تكون ال perineal body)

(B) Rectobulbarurethral fistula → the rectum is opened to the urethra & to bulbar membrane (بدل ما يوصل لل anal canal)

(C) Rectoprostatic fistula → the rectum is opened on the prostate

(D) Rectobladder neck fistula → the rectum is opened to the neck of urinary bladder

* and also there's rectovaginal in females