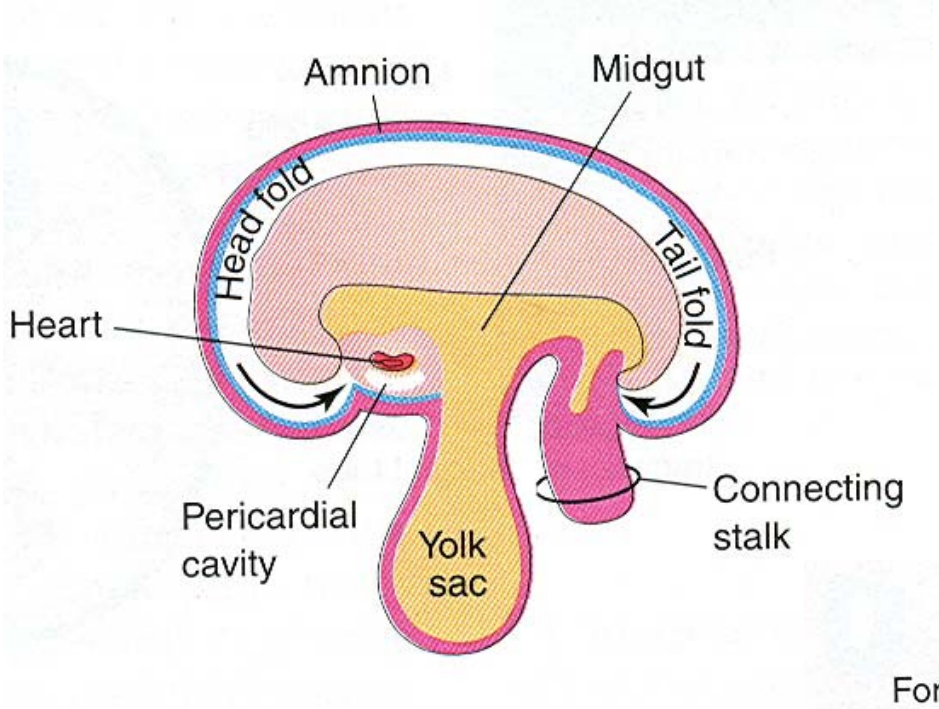
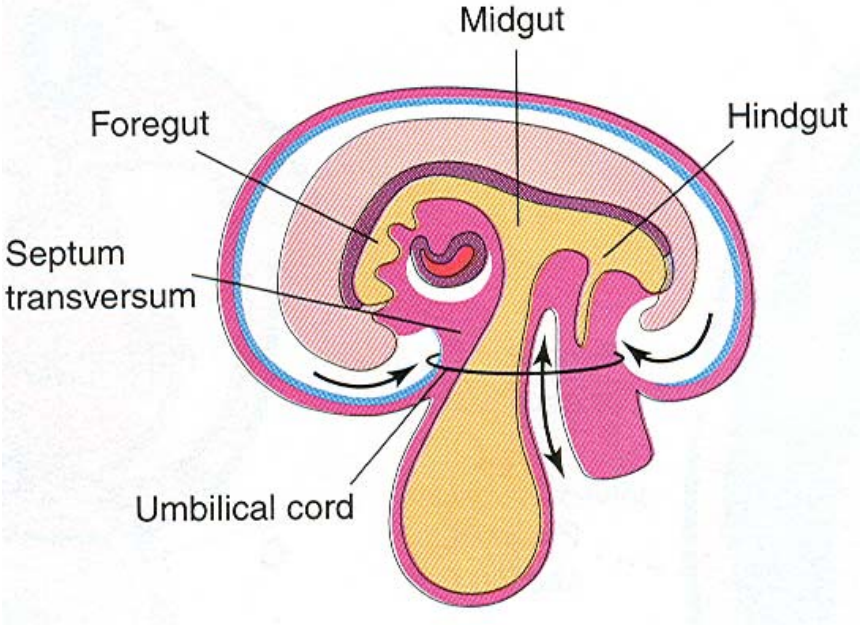
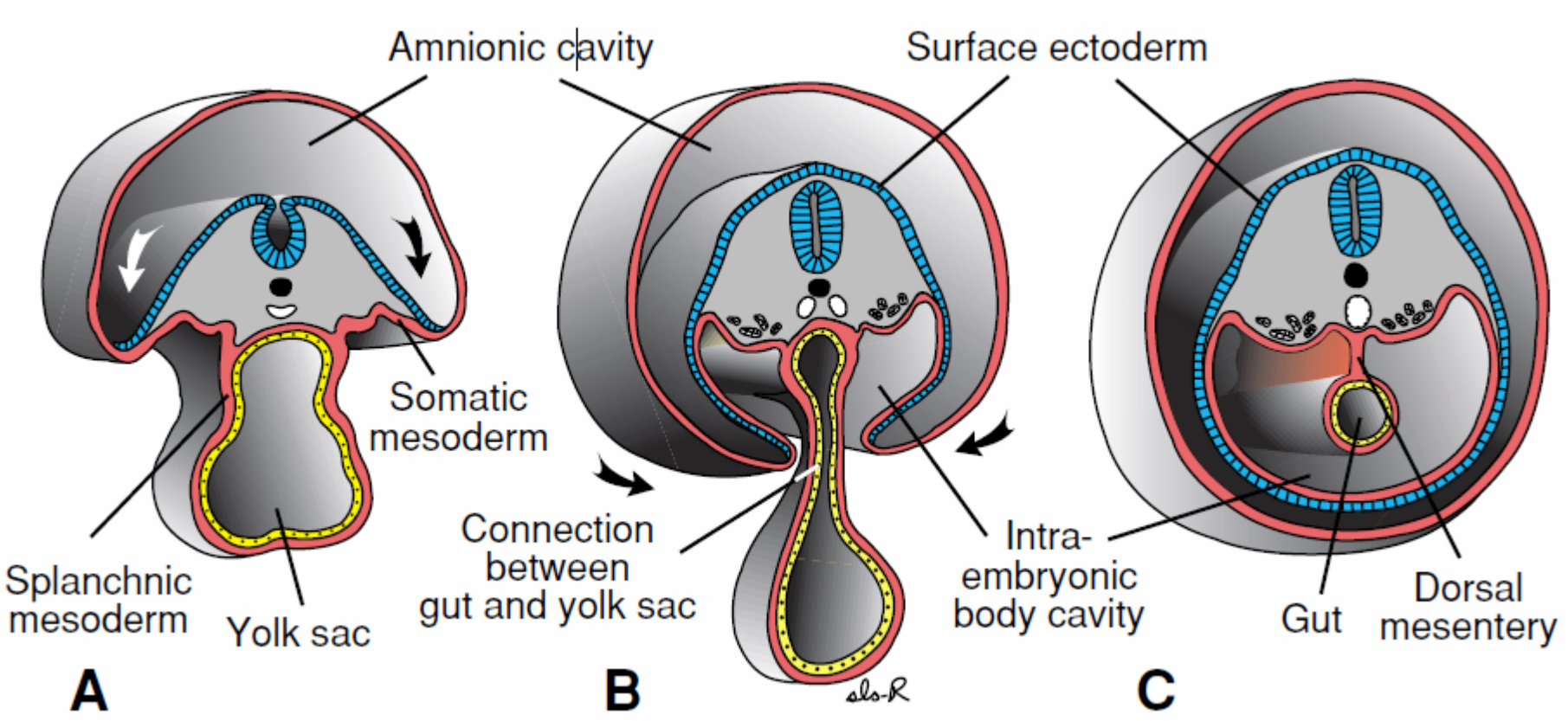
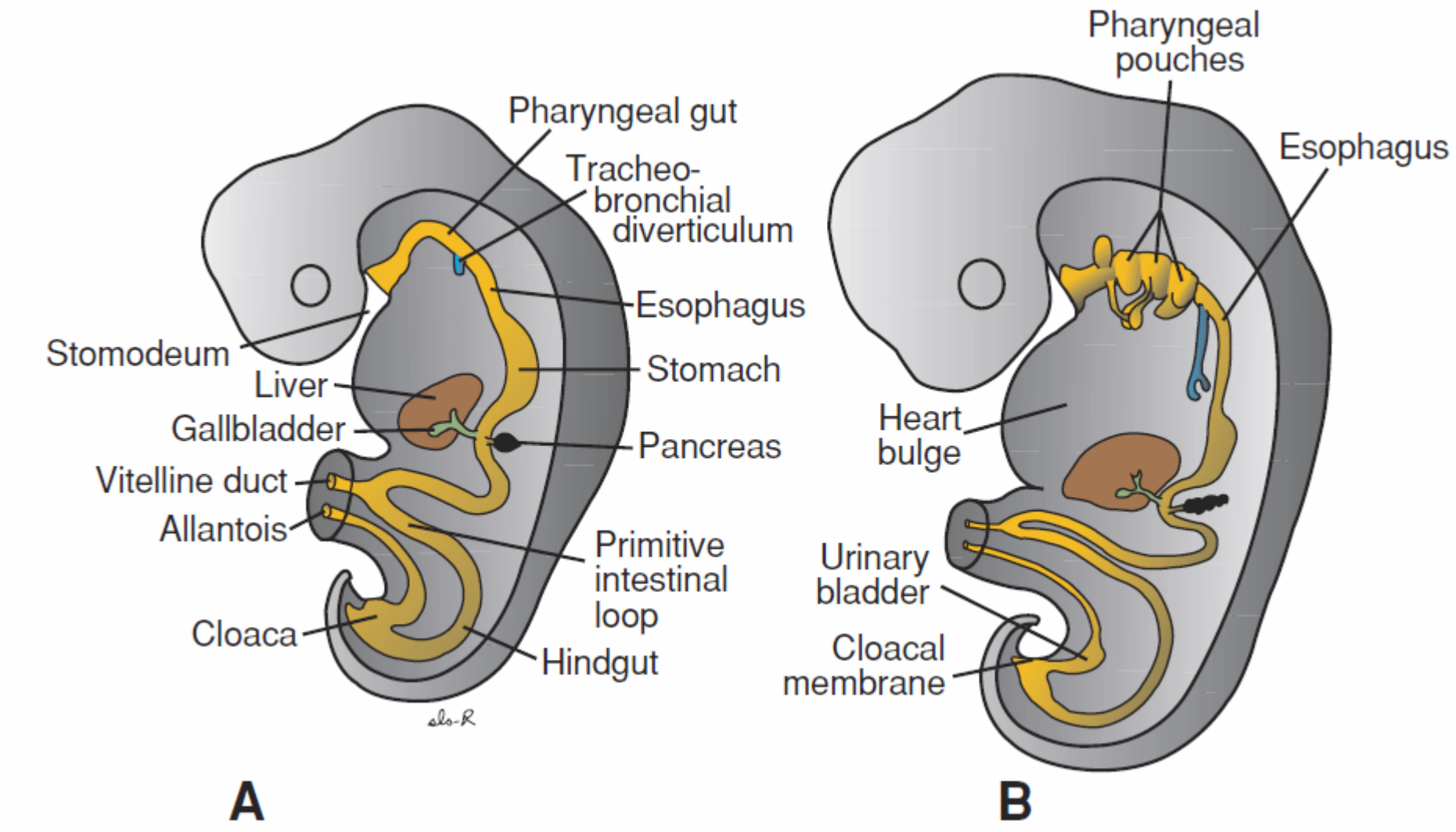
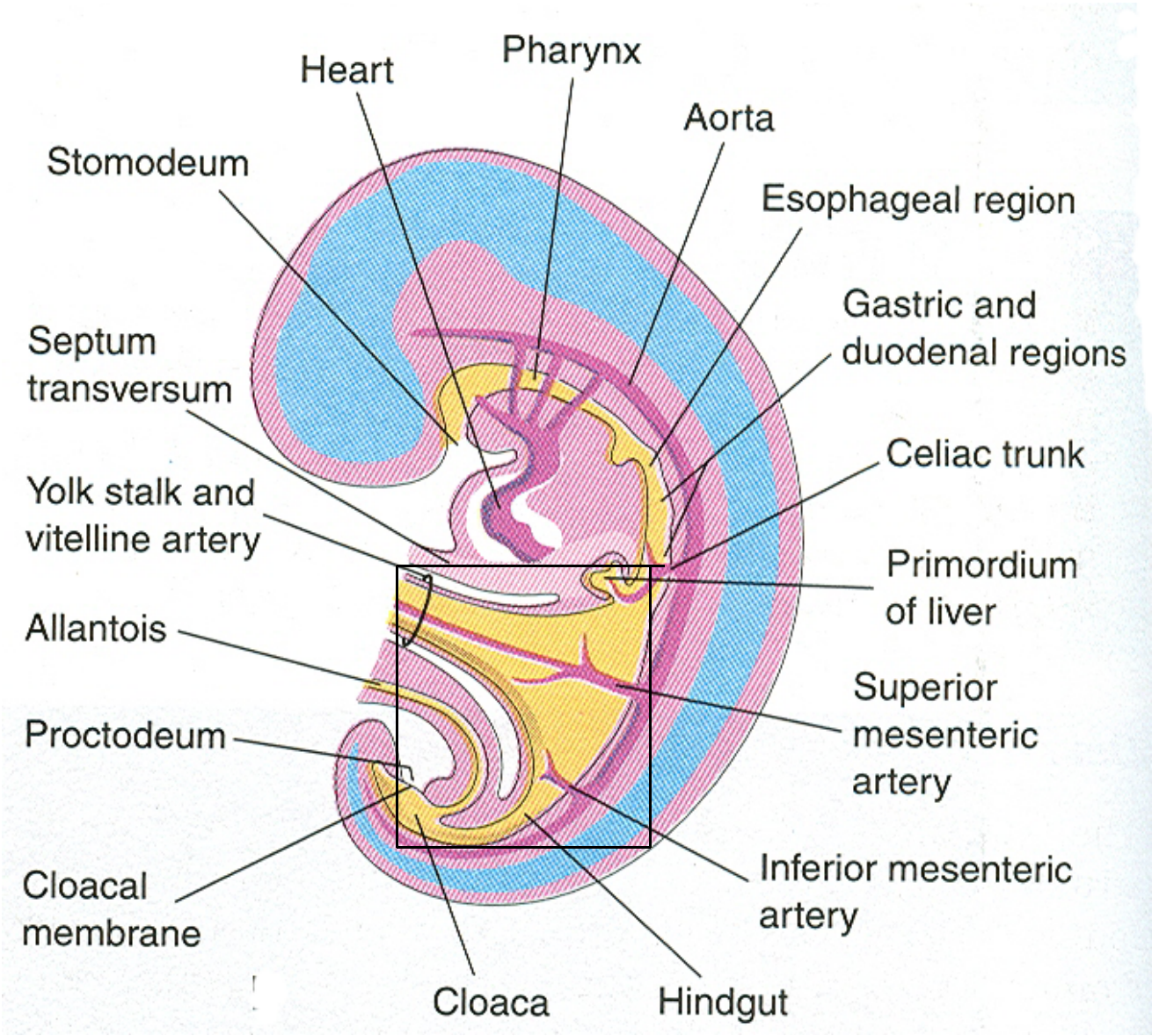
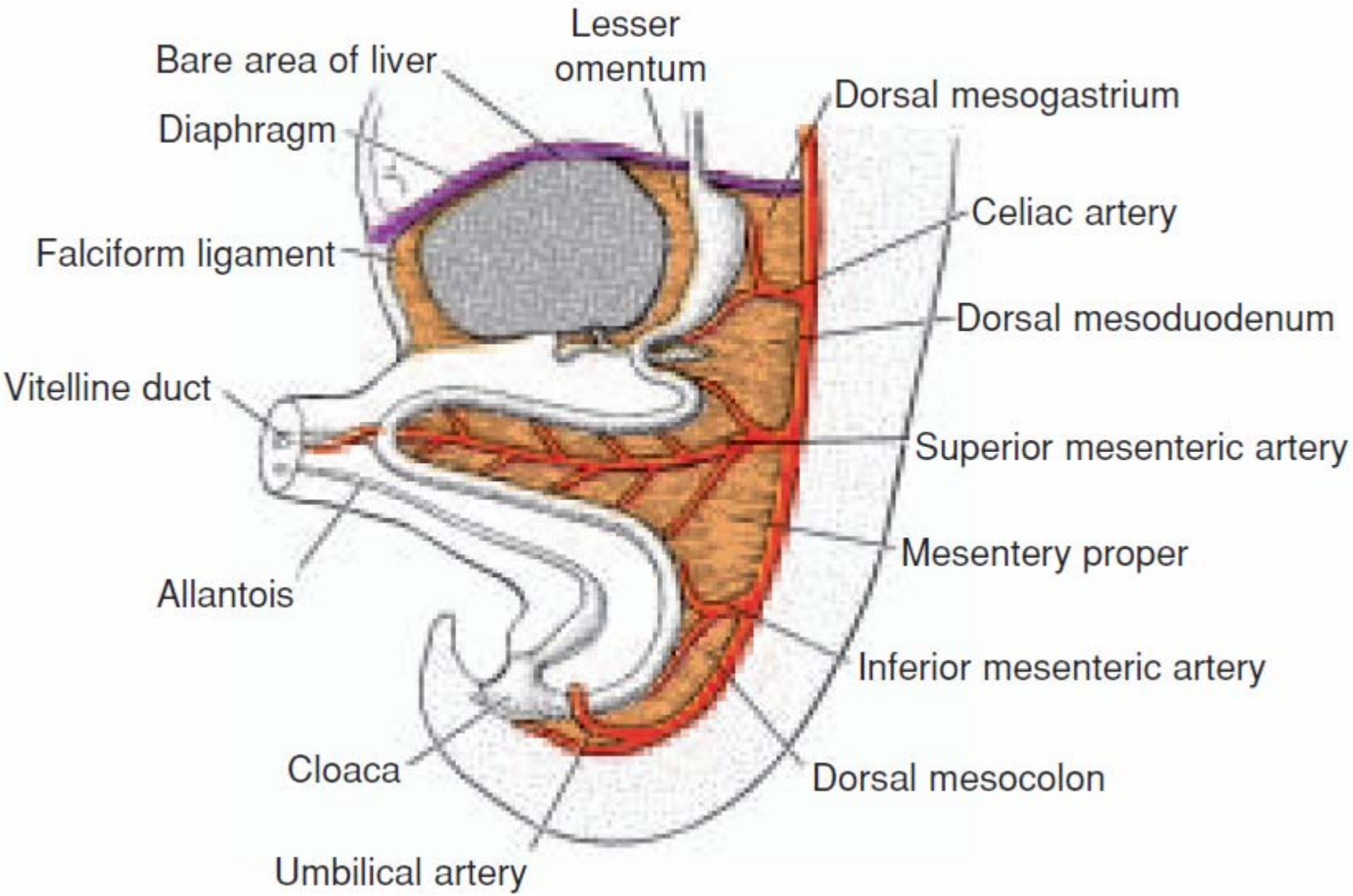

Amnion
Midgut
Head fold
Tail fold
Heart
Pericardial cavity
Yolk sac
Connecting stalk

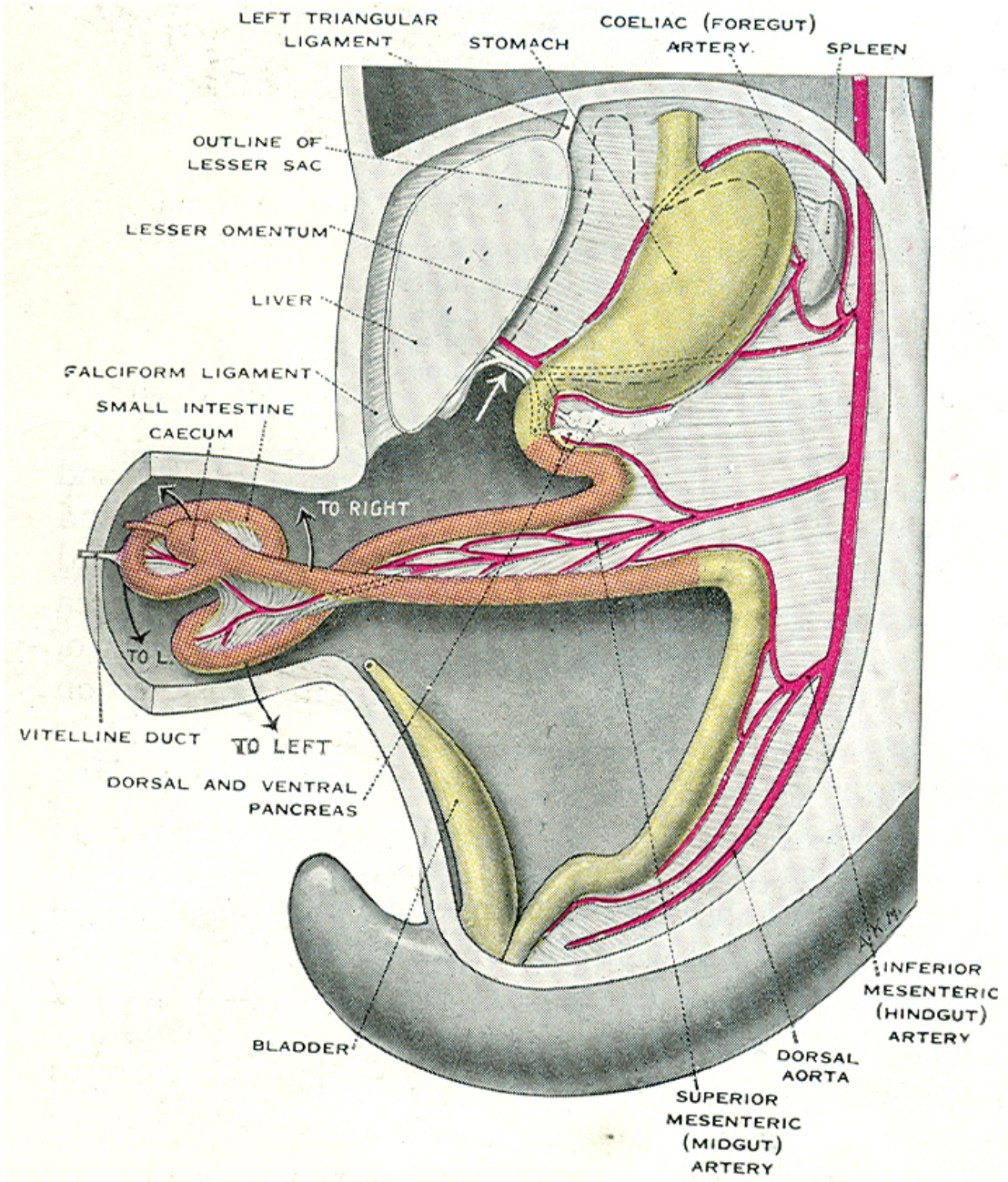

Midgut
Foregut
Hindgut
Septum transversum
Umbilical cord

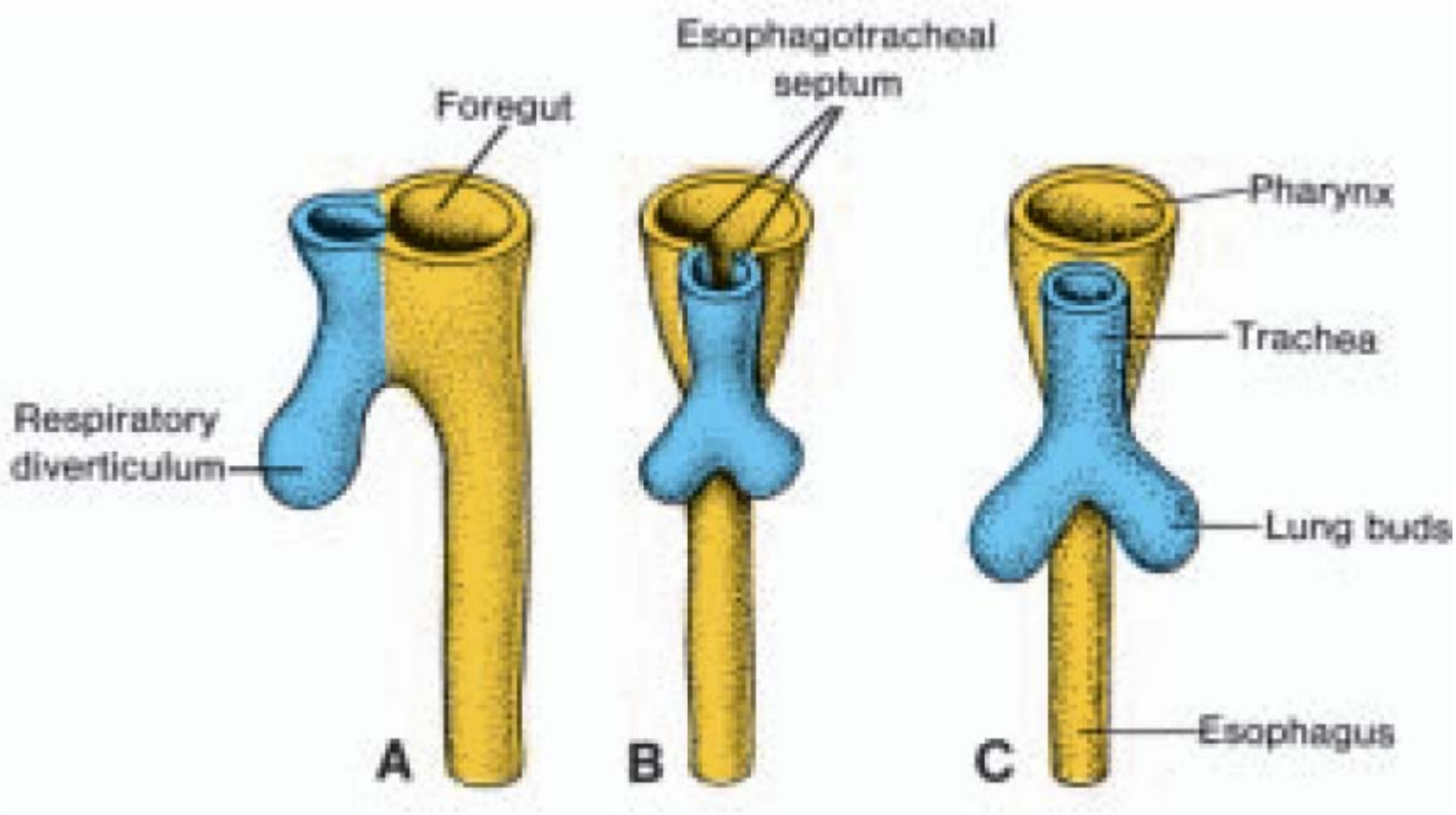

Amnionic cavity
Surface ectoderm
Somatic mesoderm
Splanchnic mesoderm
Yolk sac
Connection between gut and yolk sac
Intra-embryonic body cavity
Gut
Dorsal mesentery
A
B
C

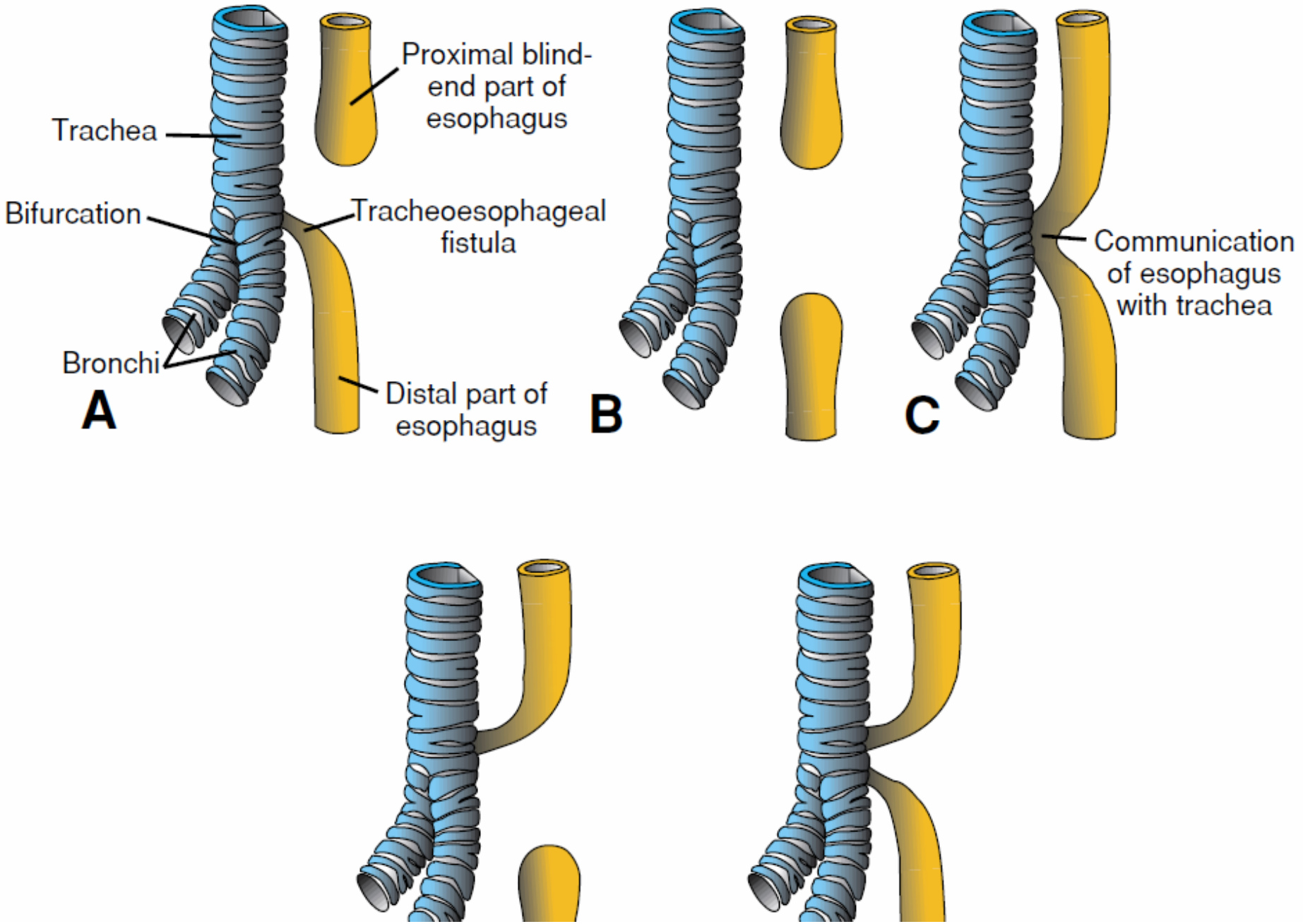

Pharyngeal gut
Tracheo-
bronchial
diverticulum
Esophagus
Stomodeum
Liver
Stomach
Gallbladder
Pancreas
Vitelline duct
Allantois
Primitive
intestinal
loop
Cloaca
Hindgut
A
Pharyngeal
pouches
Esophagus
Heart
bulge
Urinary
bladder
Cloacal
membrane
B

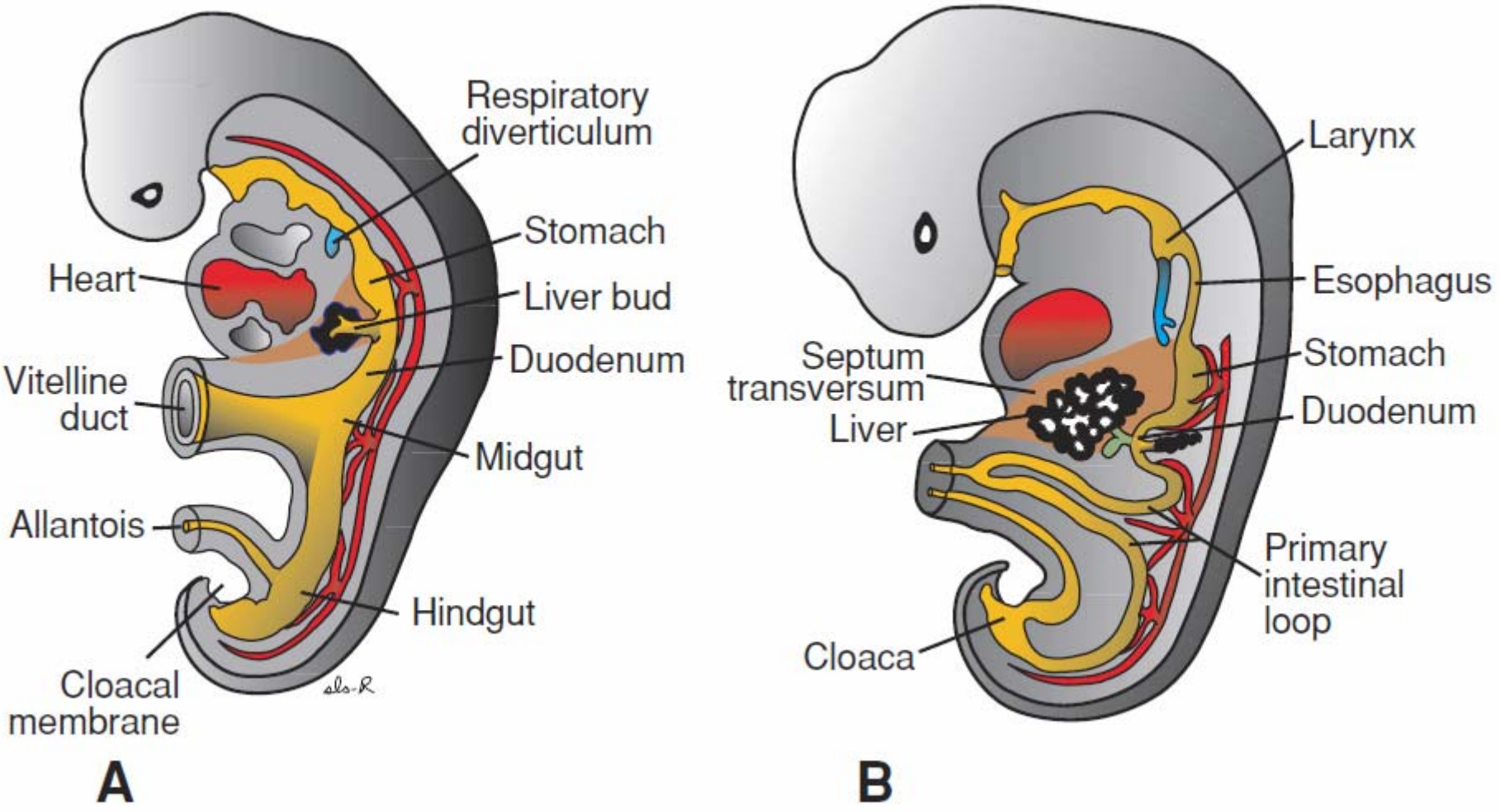

Heart
Pharynx
Aorta
Stomodeum
Esophageal region
Gastric and
duodenal regions
Septum
transversum
Celiac trunk
Yolk stalk and
vitelline artery
Primordium
of liver
Allantois
Superior
mesenteric
artery
Proctodeum
Inferior mesenteric
artery
Cloacal
membrane
Cloaca
Hindgut

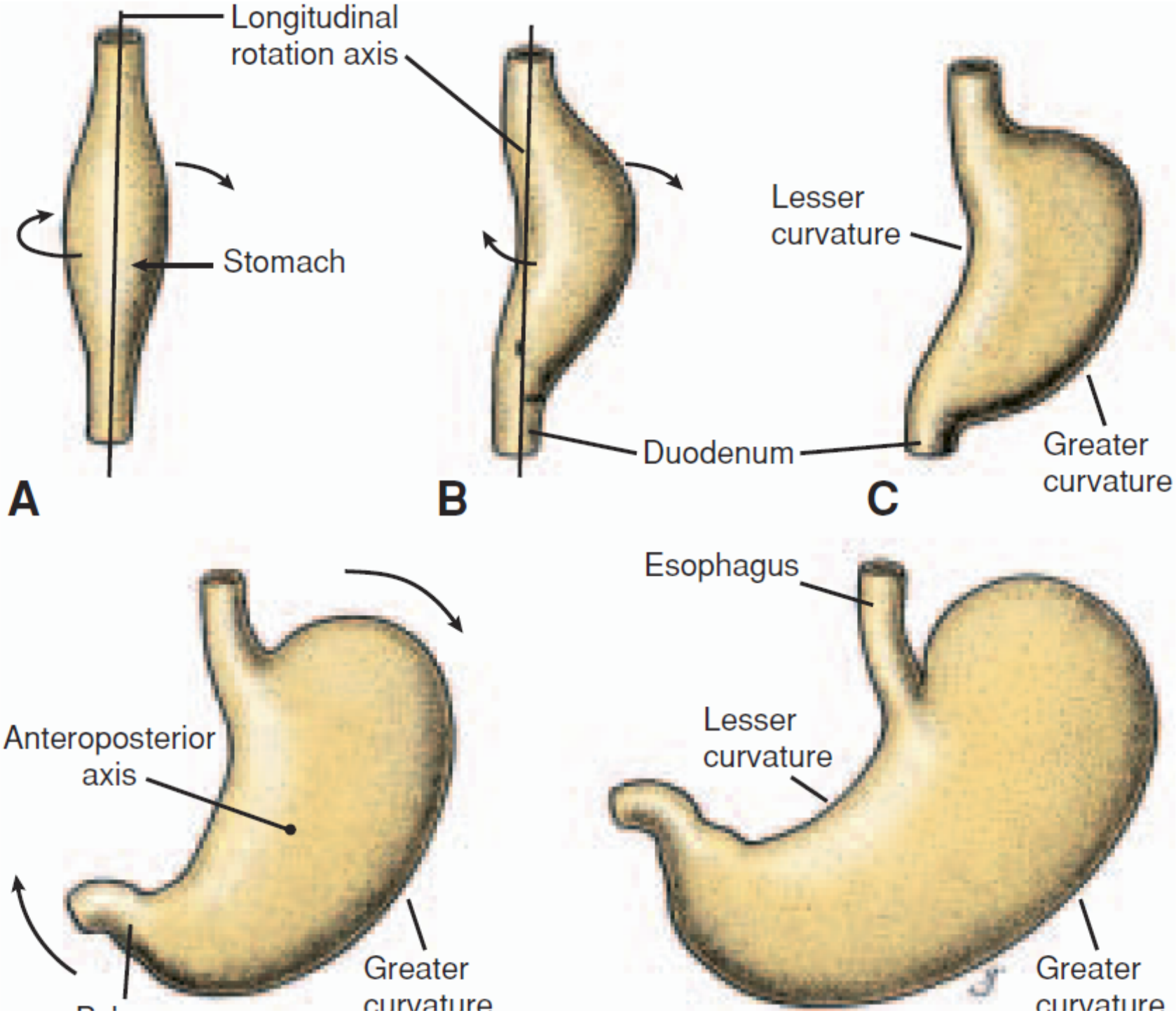

Lesser
omentum
Bare area of liver
Diaphragm
Dorsal mesogastrium
Celiac artery
Falciform ligament
Dorsal mesoduodenum
Vitelline duct
Superior mesenteric artery
Mesentery proper
Allantois
Inferior mesenteric artery
Cloaca
Dorsal mesocolon
Umbilical artery

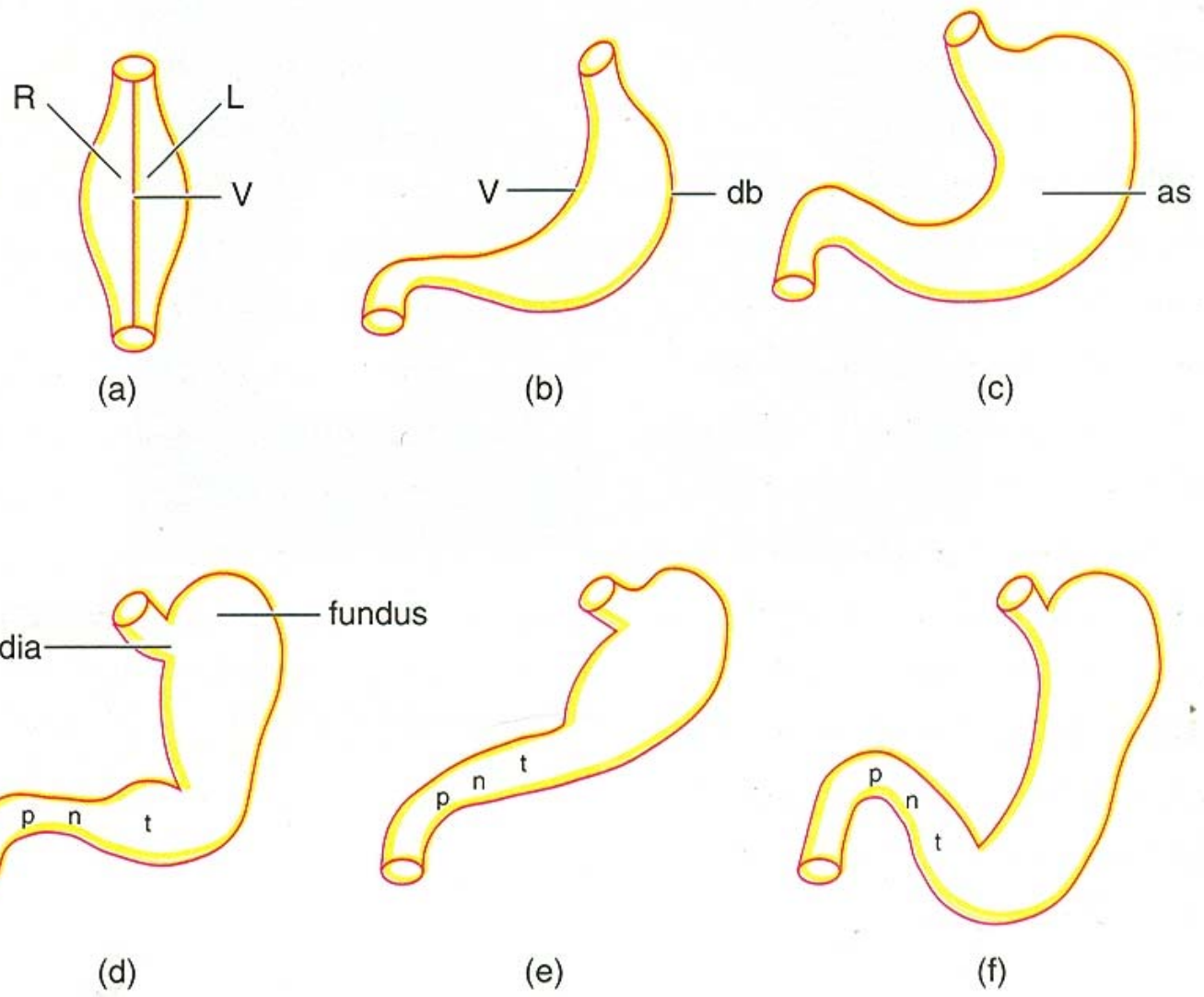

LEFT TRIANGULAR LIGAMENT
STOMACH
COELIAC (FOREGUT) ARTERY.
SPLEEN
OUTLINE OF LESSER SAC
LESSER OMENTUM
LIVER
FALCIFORM LIGAMENT
SMALL INTESTINE
CAECUM
TO RIGHT
TO L.
VITELLINE DUCT
TO LEFT
DORSAL AND VENTRAL PANCREAS
INFERIOR MESENTERIC (HINDGUT) ARTERY
BLADDER
DORSAL AORTA
SUPERIOR MESENTERIC (MIDGUT) ARTERY

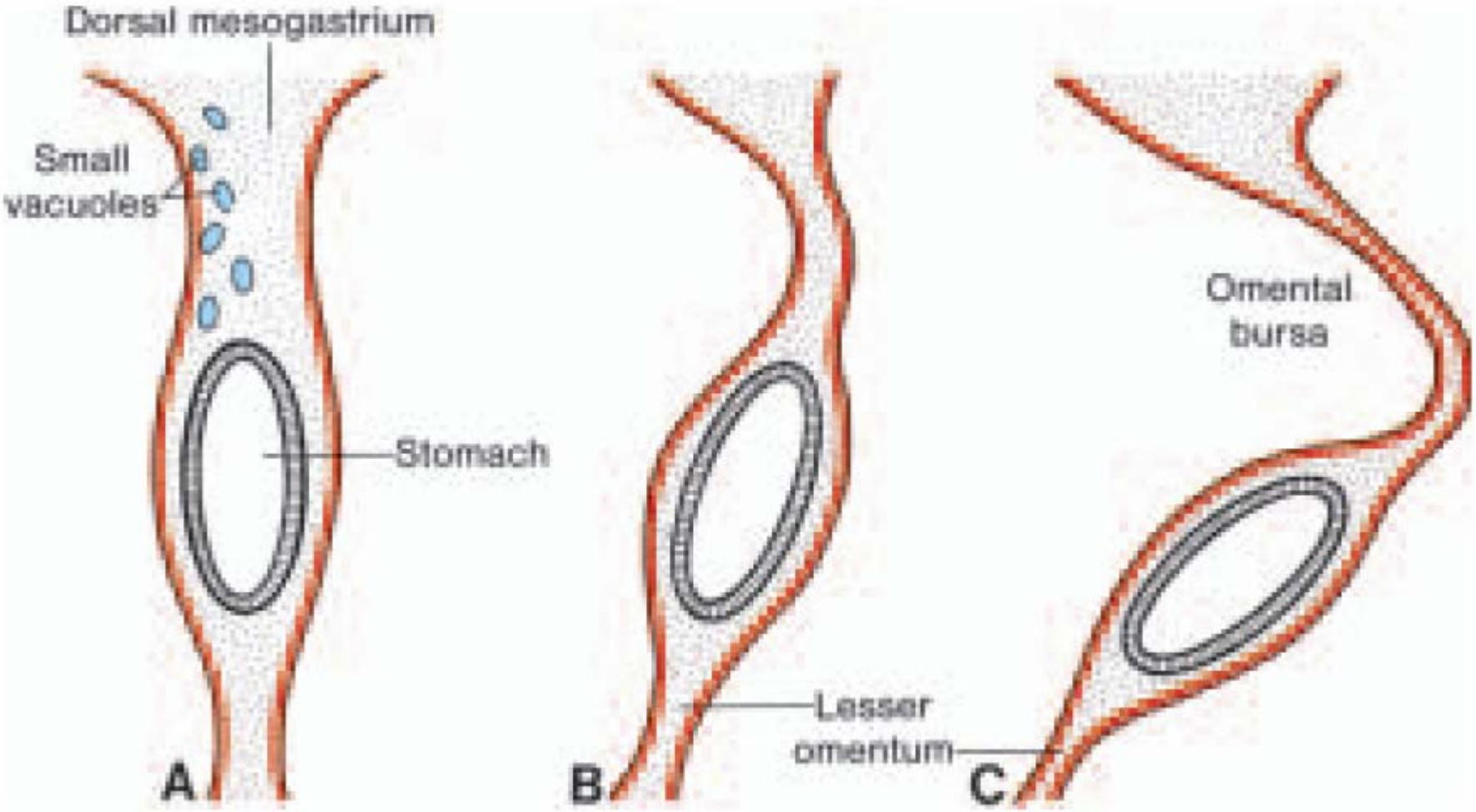

Esophagotracheal
septum
Foregut
Pharynx
Trachea
Respiratory
diverticulum
Lung buds
Esophagus
A
B
C

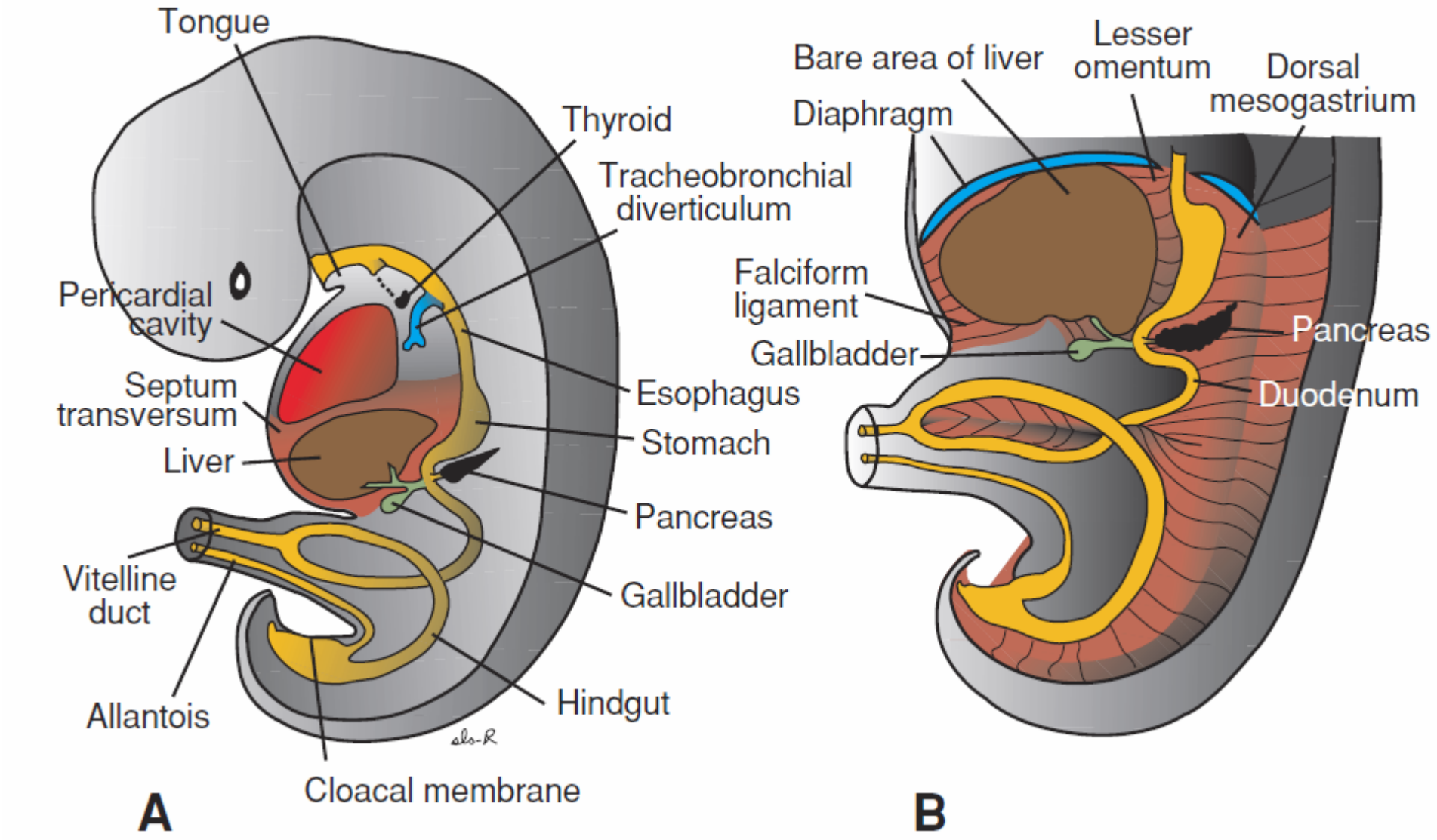

Proximal blind-end part of esophagus
Trachea
Bifurcation
Tracheoesophageal fistula
Bronchi
Distal part of esophagus
A
B
C
Communication of esophagus with trachea

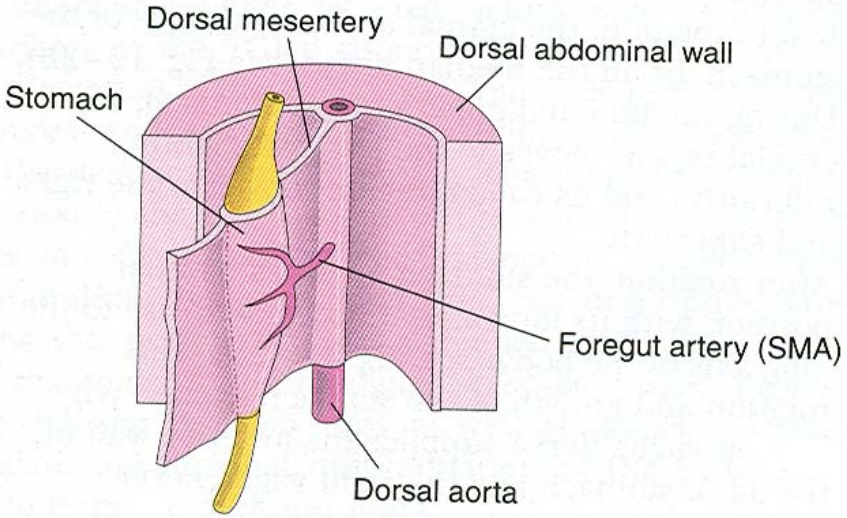

Respiratory diverticulum
Stomach
Heart
Liver bud
Duodenum
Vitelline duct
Midgut
Allantois
Hindgut
Cloacal membrane
A
Larynx
Esophagus
Septum transversum
Stomach
Liver
Duodenum
Primary intestinal loop
Cloaca
B

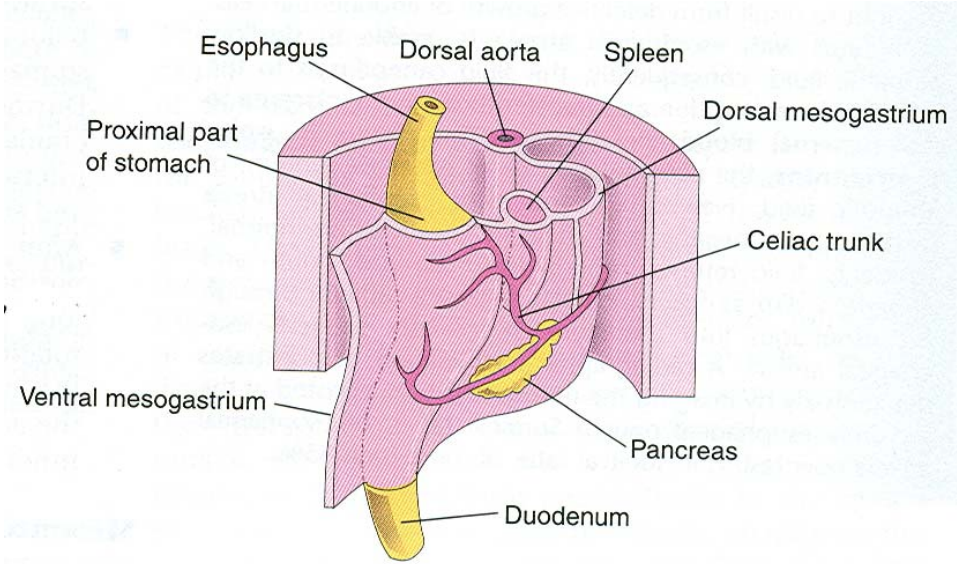

Longitudinal
rotation axis
Stomach
A
B
Lesser
curvature
Duodenum
Greater
curvature
C
Anteroposterior
axis
Greater
curvature
Esophagus
Lesser
curvature
Greater
curvature

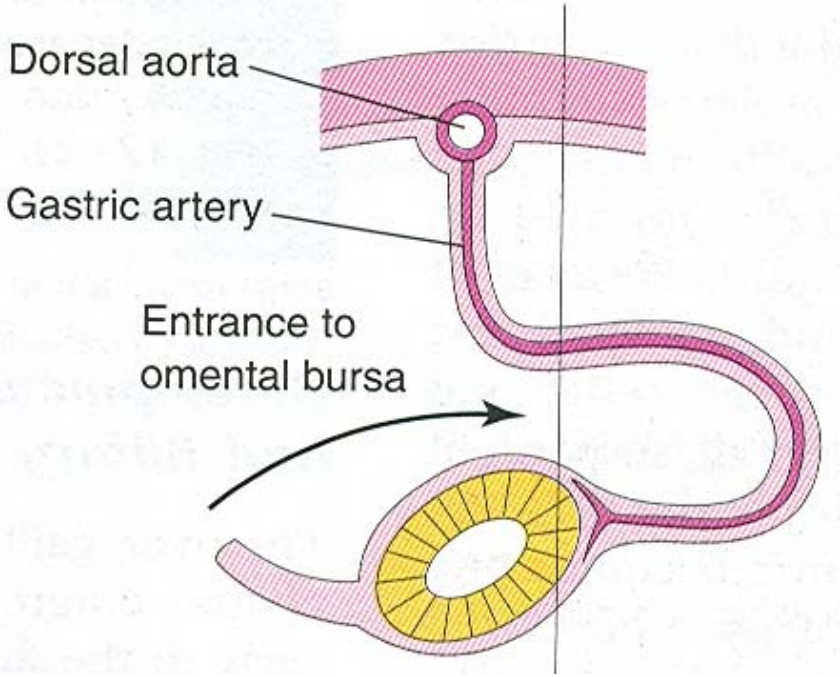

R
L
V
(a)
V
db
(b)
as
(c)
cardia
fundus
p
n
t
(d)
p
n
t
(e)
p
n
t
(f)

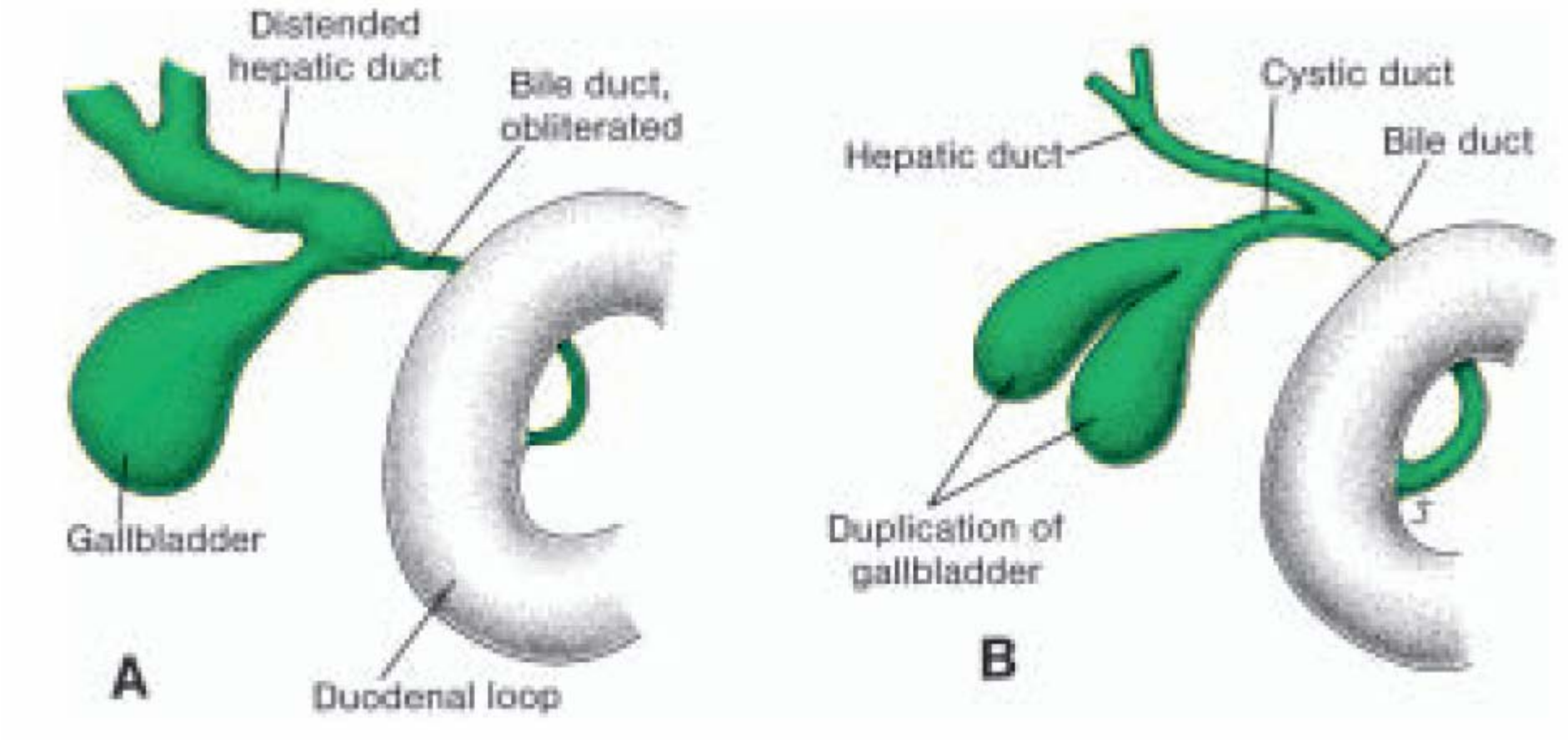

Dorsal mesogastrium
Small vacuoles
Stomach
A
B
Lesser omentum
Omental bursa
C

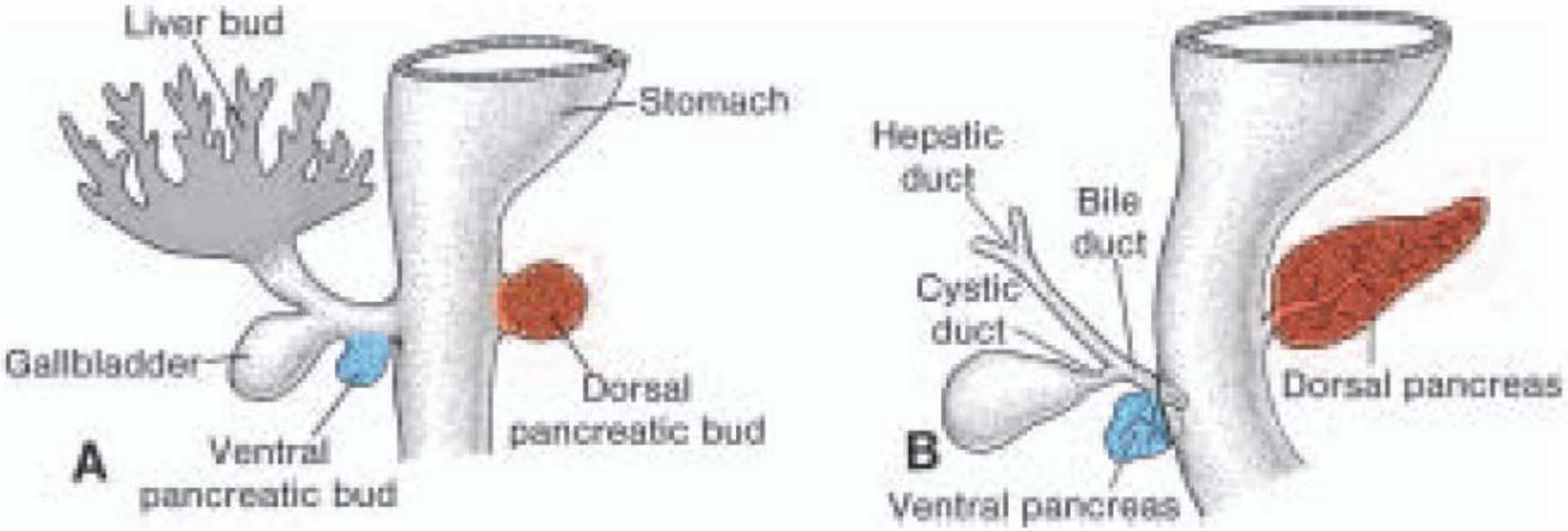

Tongue
Thyroid
Tracheobronchial diverticulum
Pericardial cavity
Septum transversum
Liver
Esophagus
Stomach
Pancreas
Gallbladder
Vitelline duct
Allantois
Hindgut
Cloacal membrane
A
Bare area of liver
Lesser omentum
Dorsal mesogastrium
Diaphragm
Falciform ligament
Gallbladder
Pancreas
Duodenum
B

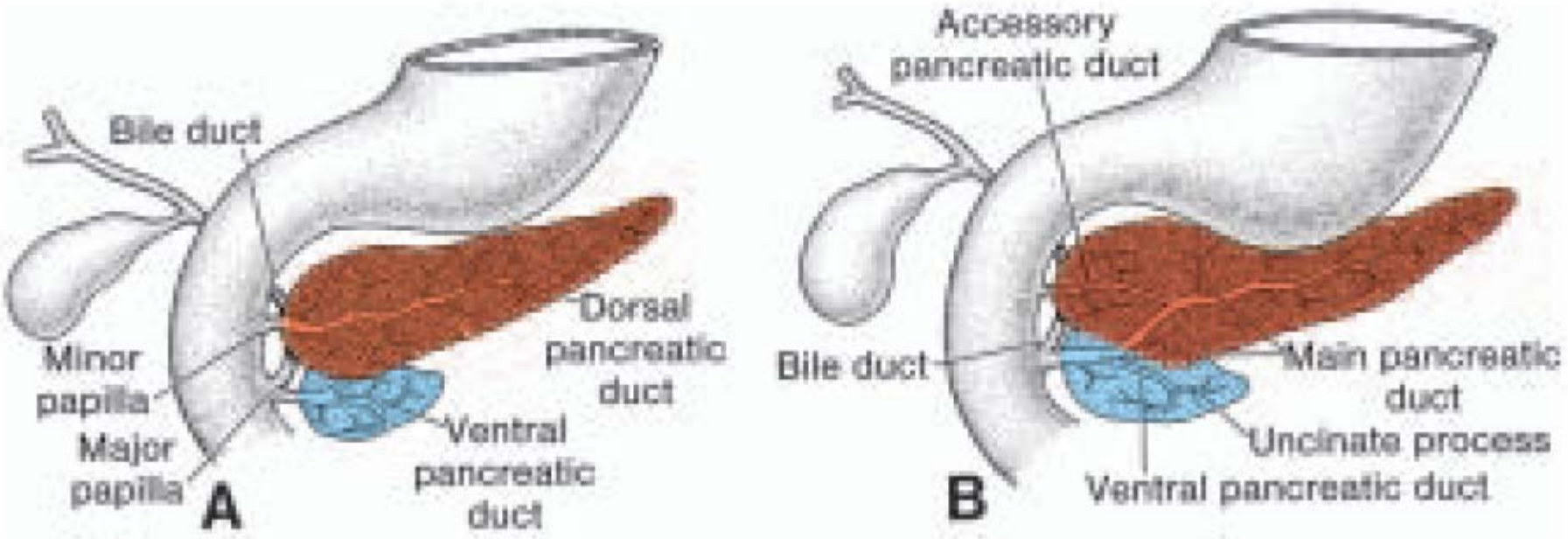

Dorsal mesentery
Dorsal abdominal wall
Stomach
Foregut artery (SMA)
Dorsal aorta

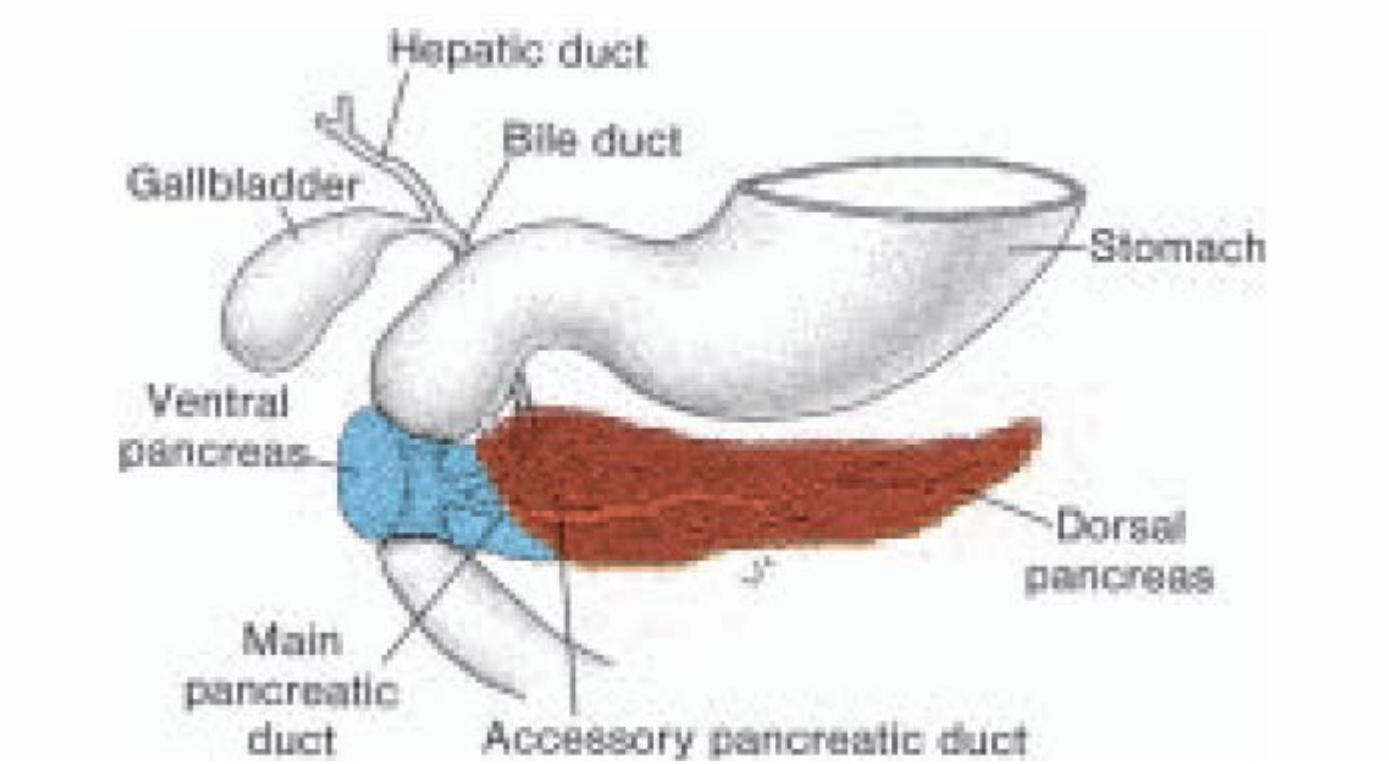

Esophagus
Dorsal aorta
Spleen
Dorsal mesogastrium
Proximal part
of stomach
Celiac trunk
Ventral mesogastrium
Pancreas
Duodenum

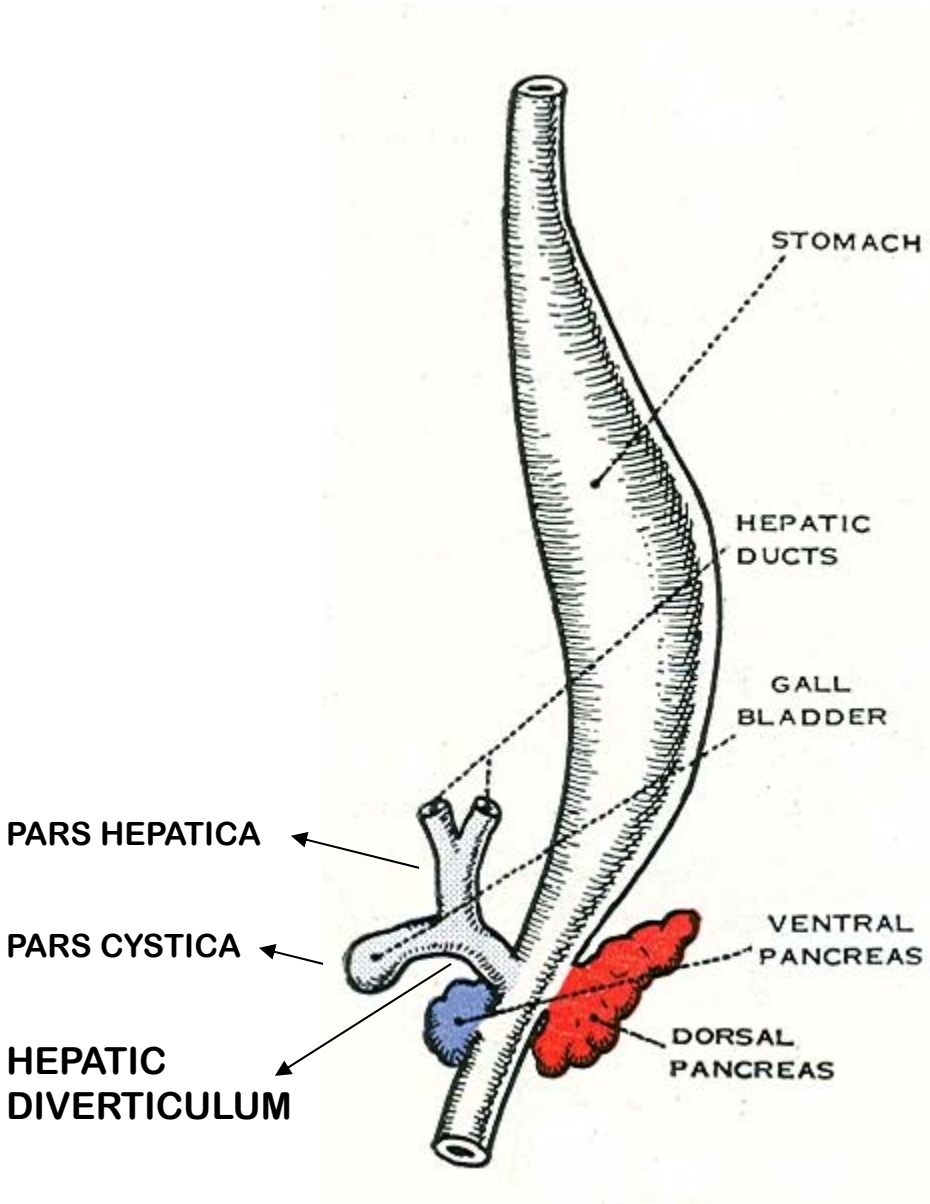

Dorsal aorta
Gastric artery
Entrance to
omental bursa

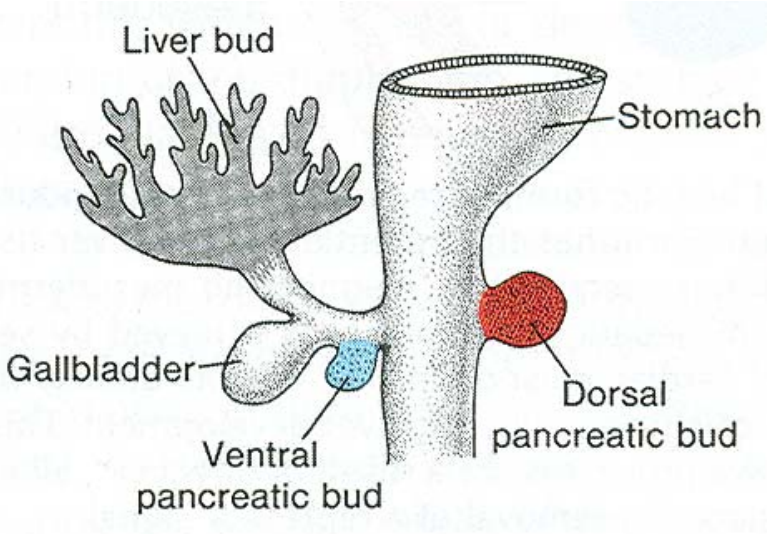

Distended hepatic duct
Bile duct, obliterated
Gallbladder
Duodenal loop
A
Cystic duct
Hepatic duct
Bile duct
Duplication of gallbladder
B

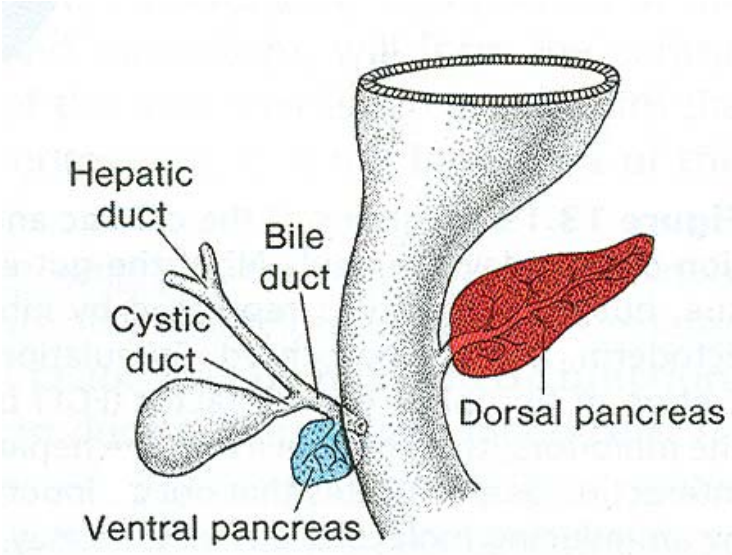

Liver bud
Stomach
Gallbladder
Dorsal pancreatic bud
A
Ventral pancreatic bud
Hepatic duct
Bile duct
Cystic duct
Dorsal pancreas
B
Ventral pancreas

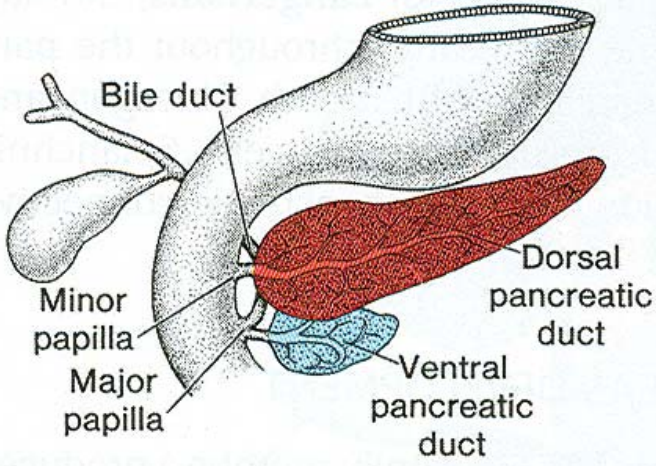

Bile duct
Minor papilla
Major papilla
A
Dorsal pancreatic duct
Ventral pancreatic duct
Accessory pancreatic duct
Bile duct
B
Main pancreatic duct
Uncinate process
Ventral pancreatic duct

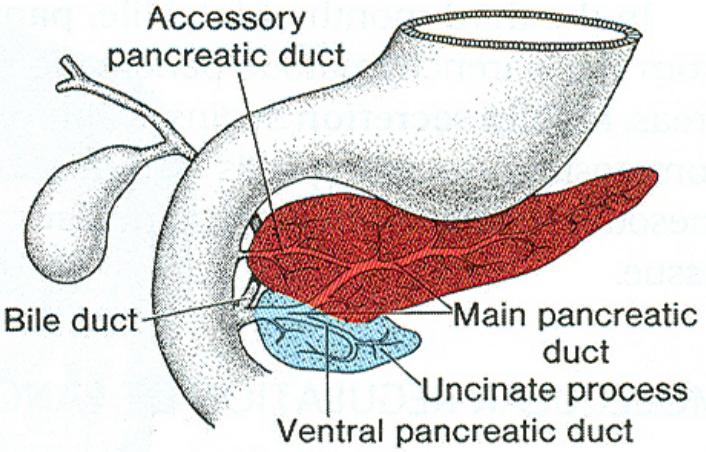

Hepatic duct
Bile duct
Gallbladder
Stomach
Ventral pancreas
Dorsal pancreas
Main pancreatic duct
Accessory pancreatic duct

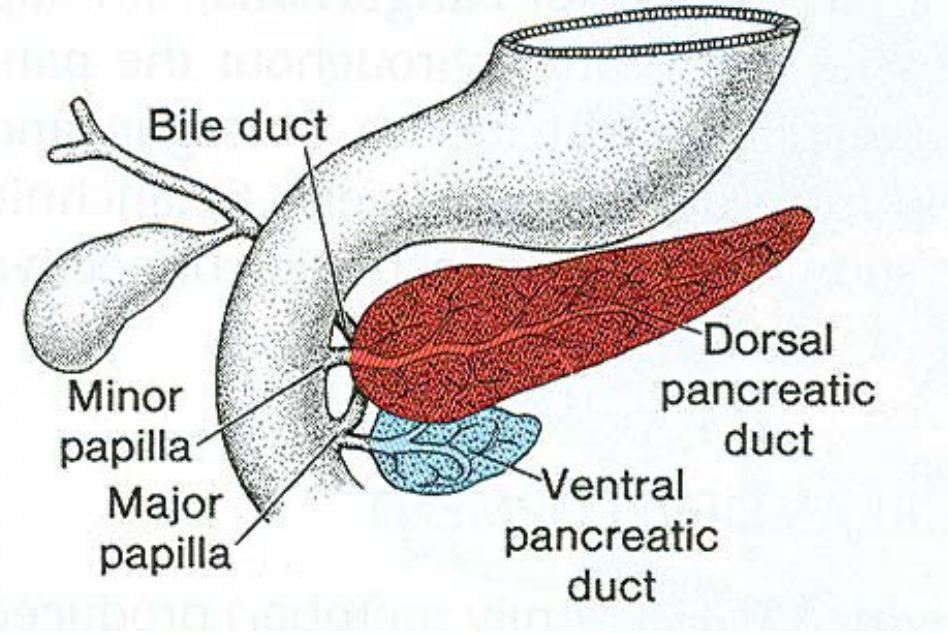

STOMACH
HEPATIC DUCTS
GALL BLADDER
PARS HEPATICA
PARS CYSTICA
HEPATIC DIVERTICULUM
VENTRAL PANCREAS
DORSAL PANCREAS

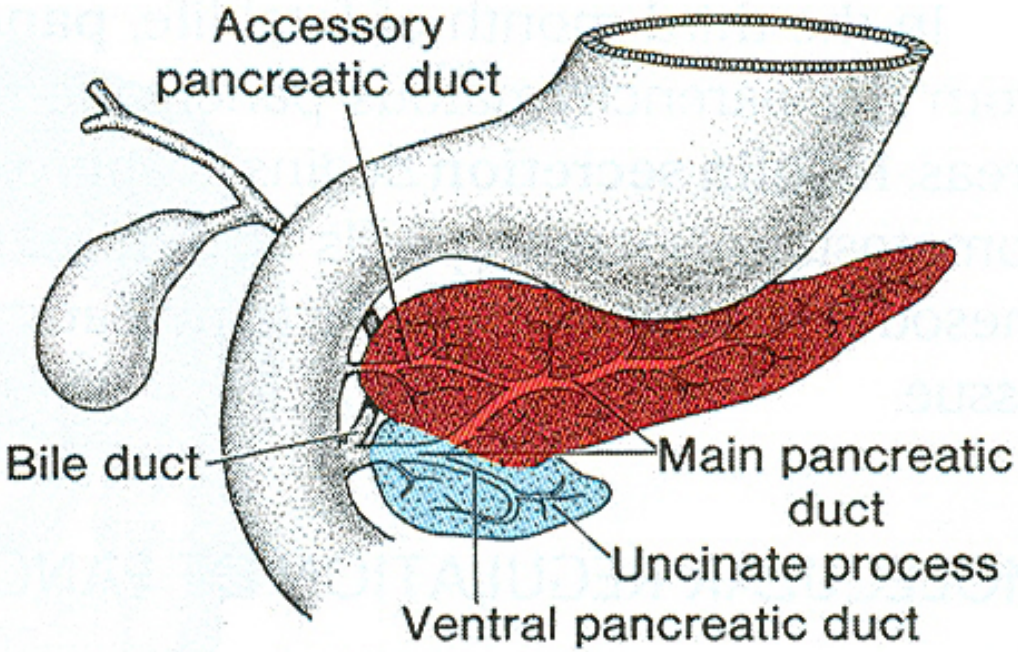

Liver bud
Stomach
Gallbladder
Dorsal
pancreatic bud
Ventral
pancreatic bud

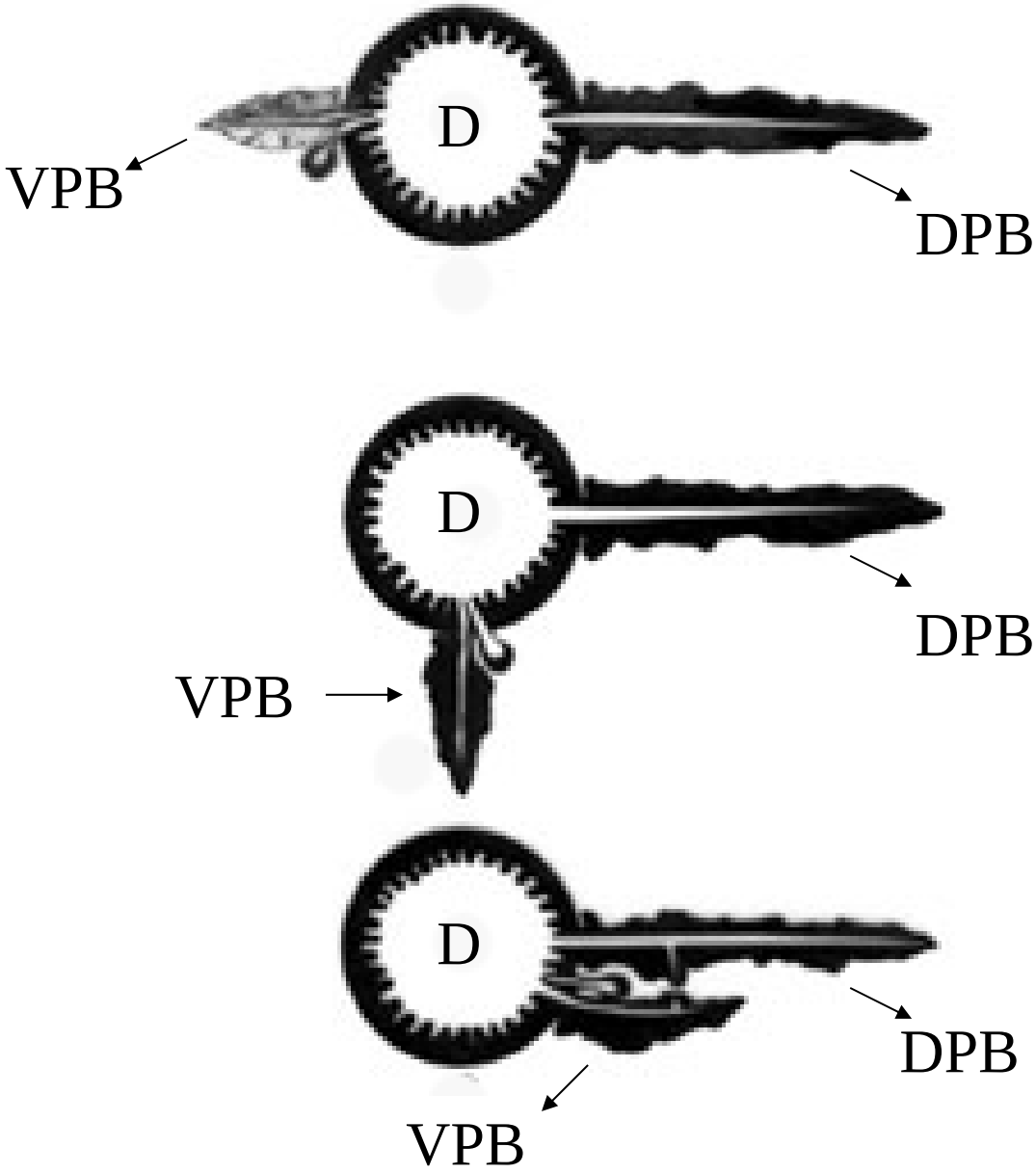

Hepatic
duct
Bile
duct
Cystic
duct
Dorsal pancreas
Ventral pancreas

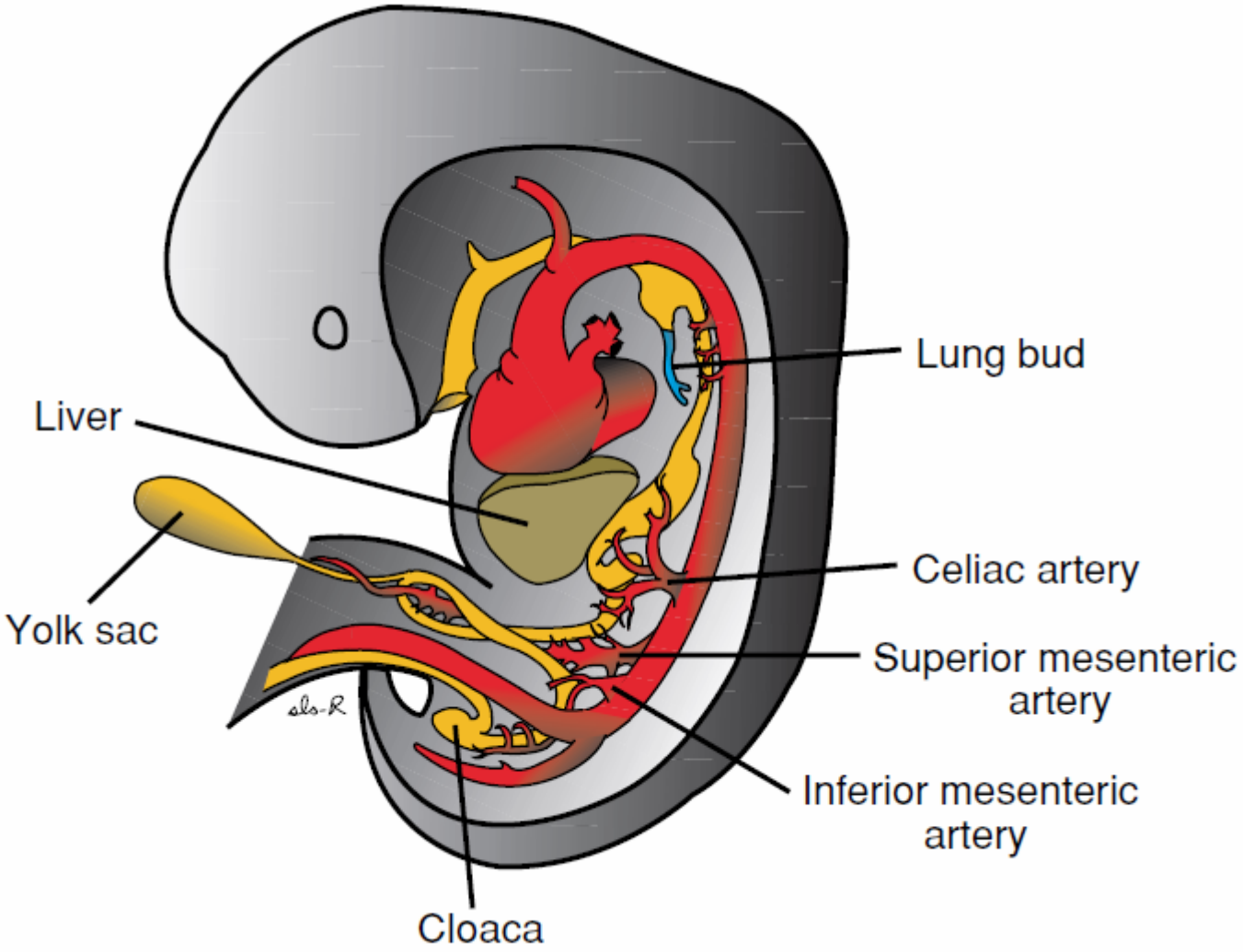

Bile duct
Dorsal
pancreatic
duct
Minor
papilla
Major
papilla
Ventral
pancreatic
duct


Accessory
pancreatic duct
Bile duct
Main pancreatic
duct
Uncinate process
Ventral pancreatic duct


Bile duct
Dorsal pancreatic duct
Minor papilla
Major papilla
Ventral pancreatic duct

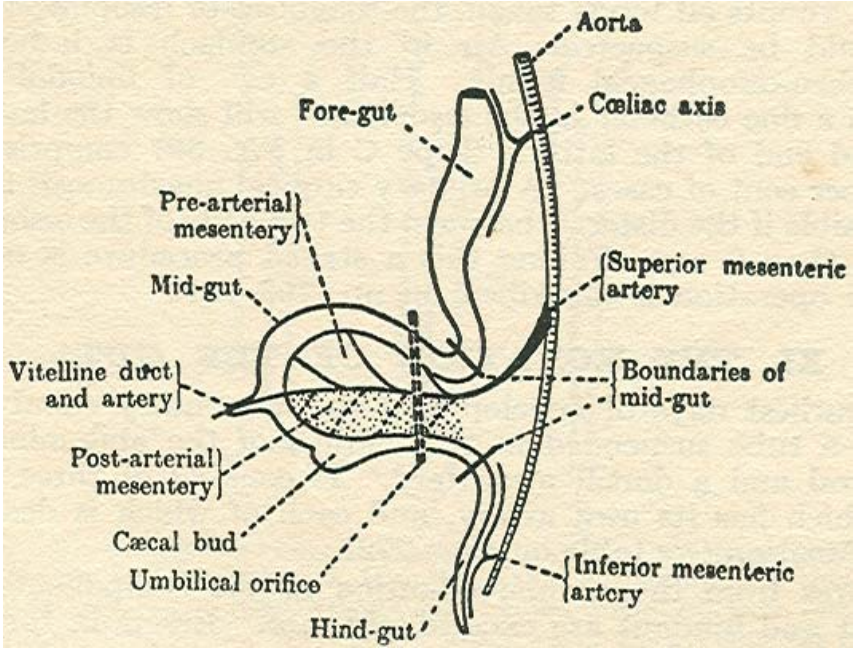

Accessory pancreatic duct
Bile duct
Main pancreatic duct
Uncinate process
Ventral pancreatic duct

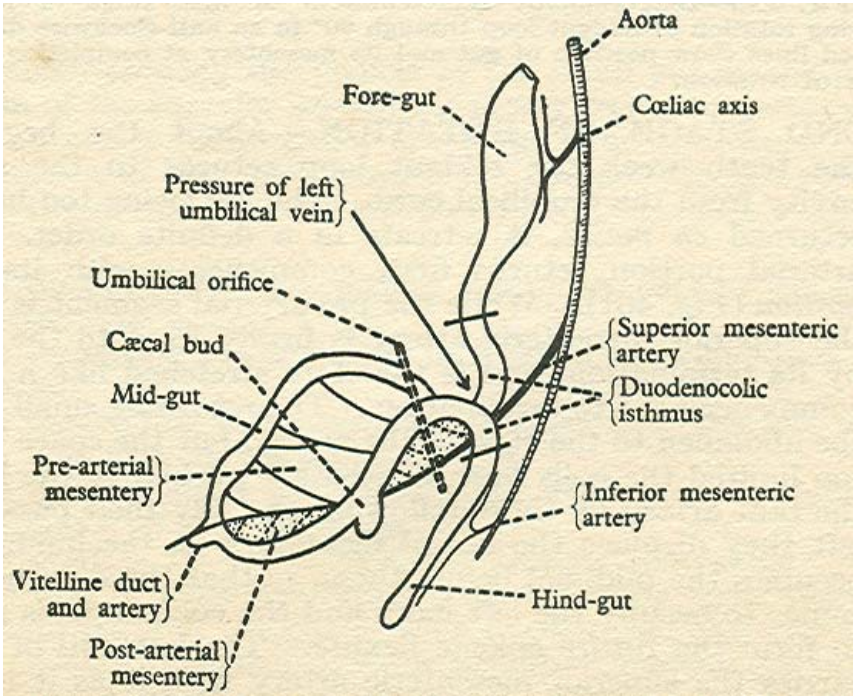

D
VPB
DPB
D
DPB
VPB
D
DPB
VPB

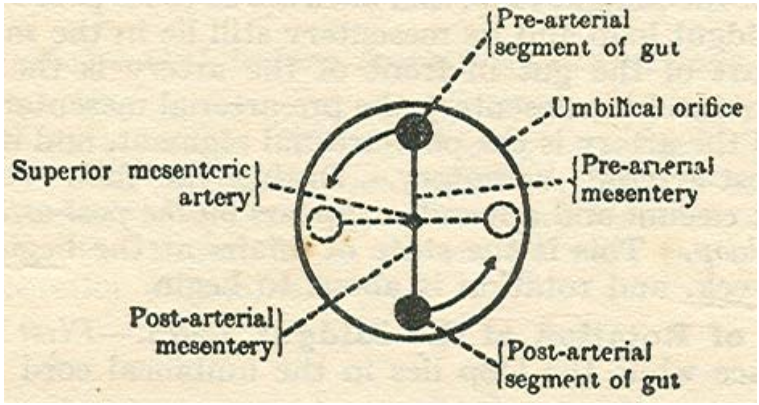

Lung bud
Liver
Celiac artery
Yolk sac
Superior mesenteric artery
Inferior mesenteric artery
Cloaca

Factors causing physiological hernia:

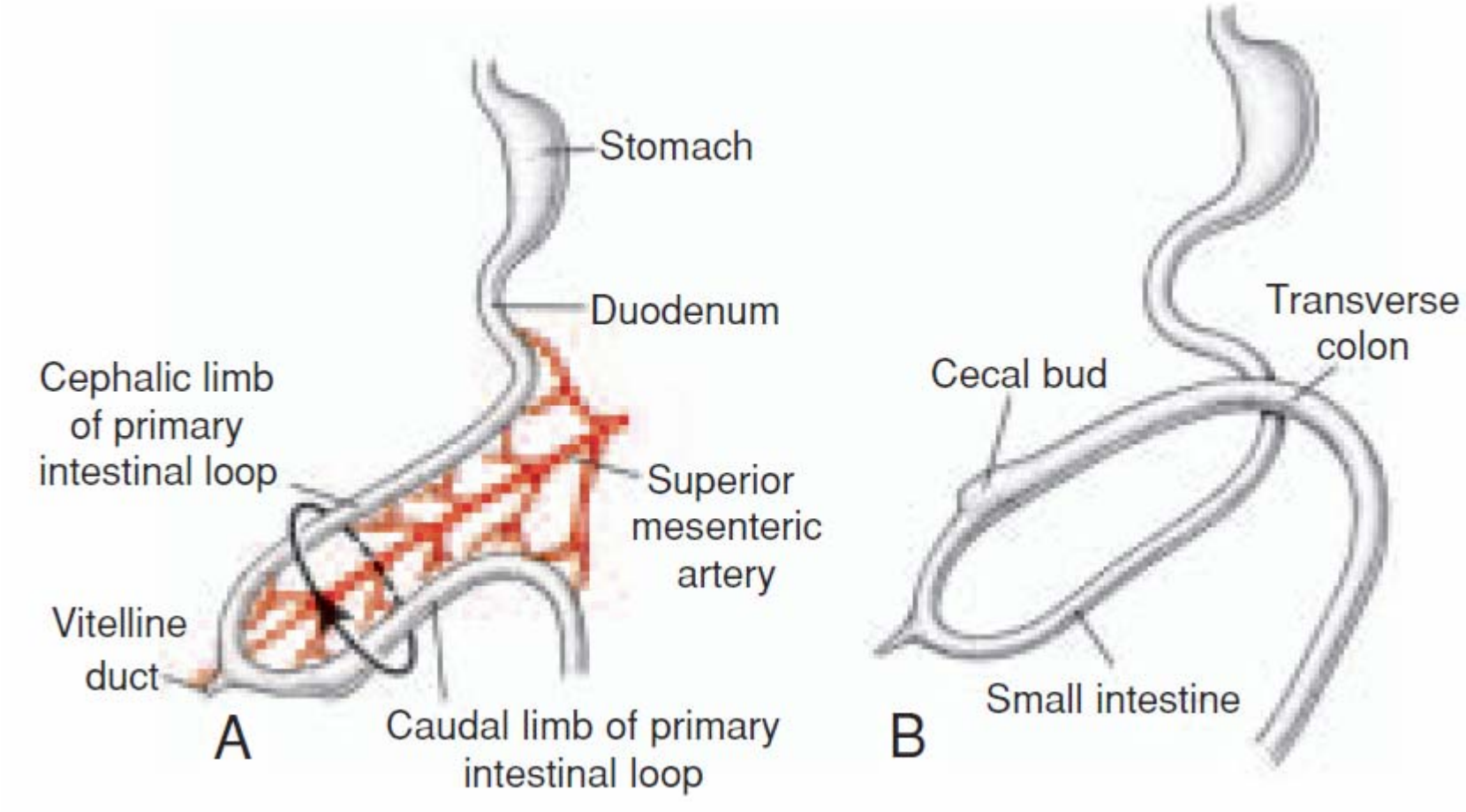
1. Rapid growth & large size of liver which occupies a large area of abdominal cavity.
2. Small size of abdominal cavity because the lumbar segment is not yet formed.
3. Mid gut is growing at a fast pace.

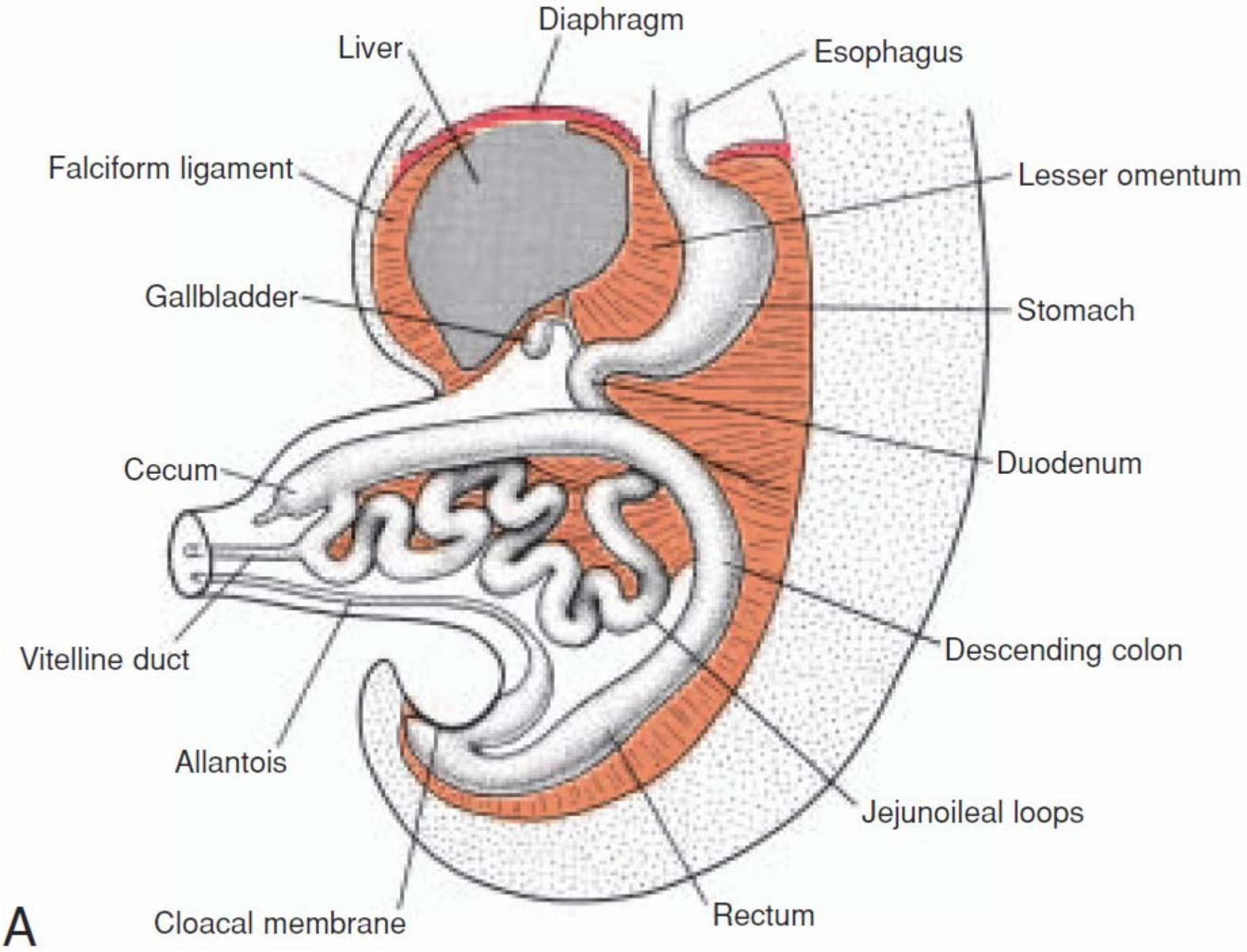


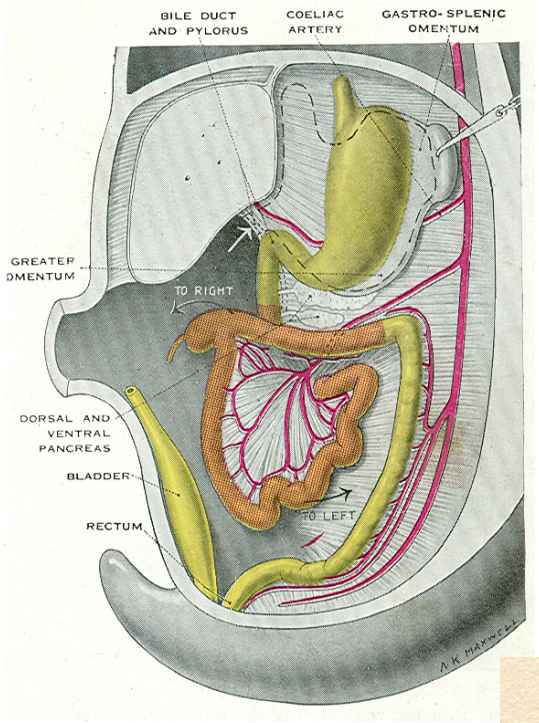




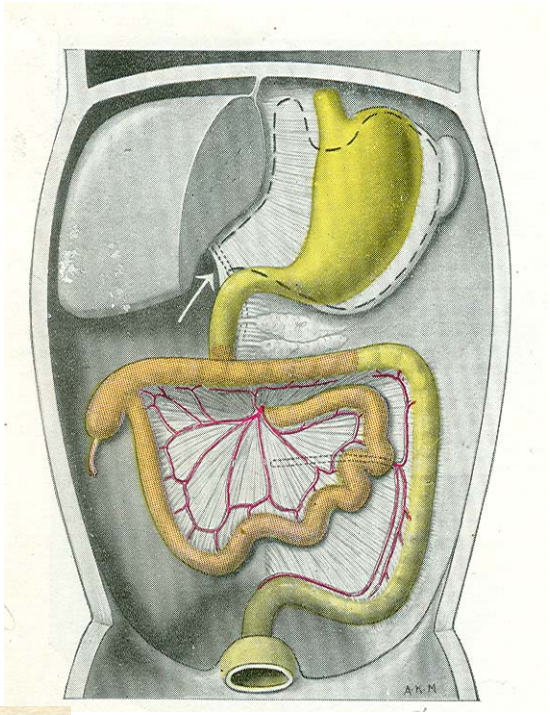
1st stage: Stage of physiological hernia;
90^0 anticlockwise rotation;
5-10th wks of IUL.

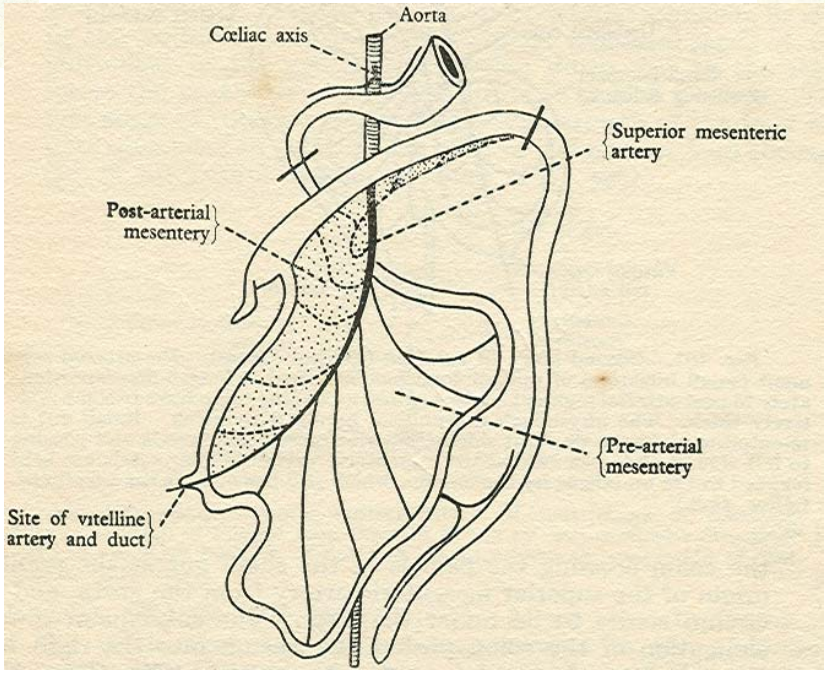

Stomach
Duodenum
Cephalic limb of primary intestinal loop
Superior mesenteric artery
Vitelline duct
A
Caudal limb of primary intestinal loop
Transverse colon
Cecal bud
Small intestine
B


Diaphragm
Liver
Esophagus
Falciform ligament
Lesser omentum
Gallbladder
Stomach
Cecum
Duodenum
Vitelline duct
Descending colon
Allantois
Jejunoileal loops
Cloacal membrane
Rectum
A



2nd stage: Reduction of hernia;
180^0 anticlockwise rotation;
10-11th wks of IUL.

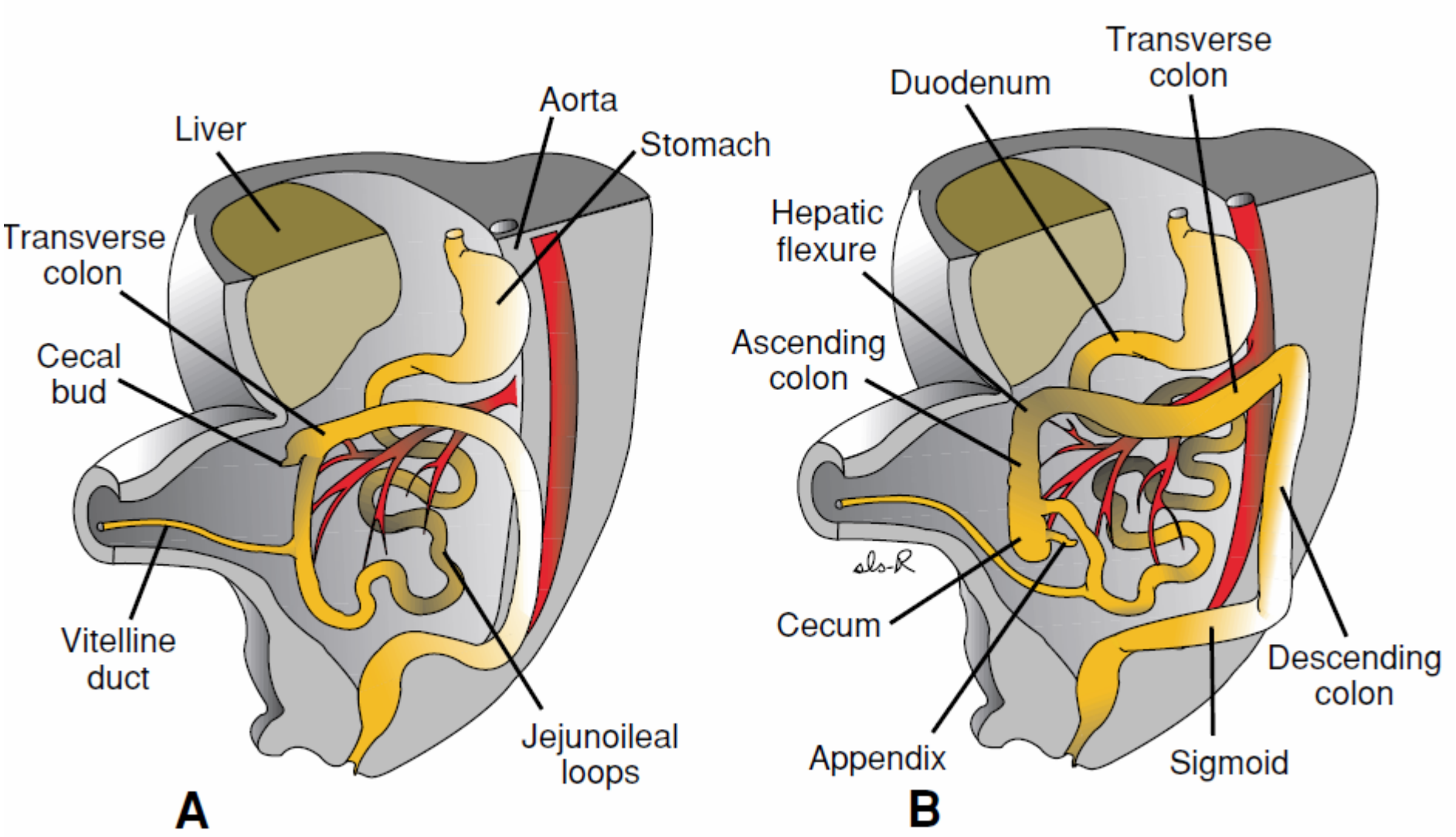




Factors causing reduction of physiological hernia:

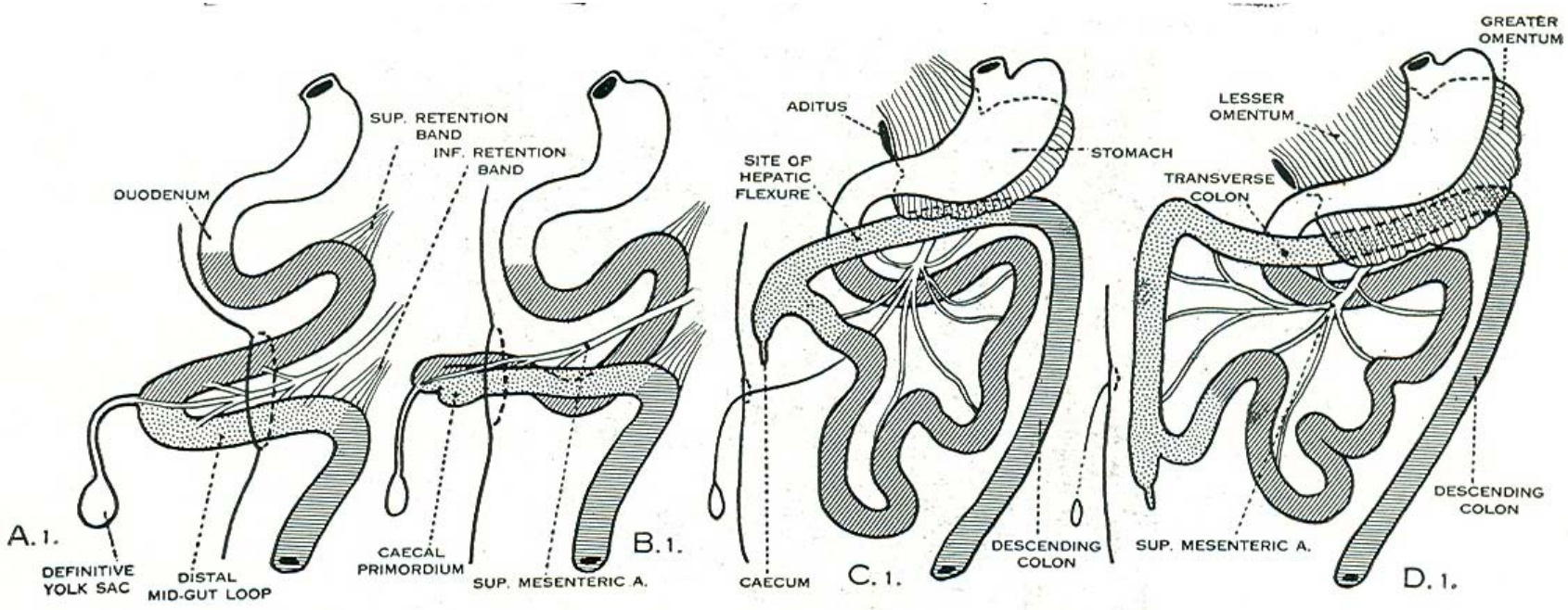
1. Liver occupies relatively less space (its haemopoietic function is over)
2. Abdominal cavity is larger now as the lumbar segment is formed.
3. Contraction of some fibromuscular bands in the mesentery helps in reduction of the herniated loop.
4. Contraction of longitudinal muscles of mid gut may also be of some help in reduction.

Because of the caecal bud, the post arterial segment can not reduce first. Pre arterial segment reduces first and occupies upper left part of abdominal cavity. Subsequent loops progressively settle towards the right lower segment of abdominal cavity.


Liver
Aorta
Stomach
Transverse colon
Cecal bud
Vitelline duct
Jejunoileal loops
A
Duodenum
Transverse colon
Hepatic flexure
Ascending colon
Cecum
Appendix
Descending colon
Sigmoid
B

Rotation of midgut

- Ist Stage: Herniation. Prearterial and postarterial segments. Caecal bud
- IInd stage: Reduction. Duodenum crosses behind artery; transverse colon in front; caecum in the right side; intestine from left upper to right lower segments of abdomen.
- IIIrd stage: Fixation. Caecum reaches right illiac fossa. Zygosis occurs in some parts. Mesentry becomes adherent to post. Abdominal wall. Transverse mesocolon.



1st stage

Physiological hernia; 90^0 of acw rotation.
5-10th wks of IUL.

2nd stage

Reduction of hernia; 180^0 of acw rotation.
10-11th wks of IUL.

3rd stage

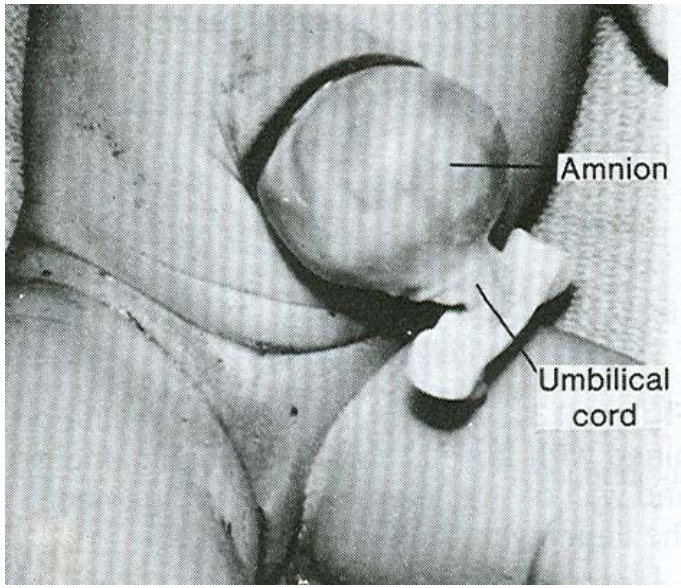
Fixation

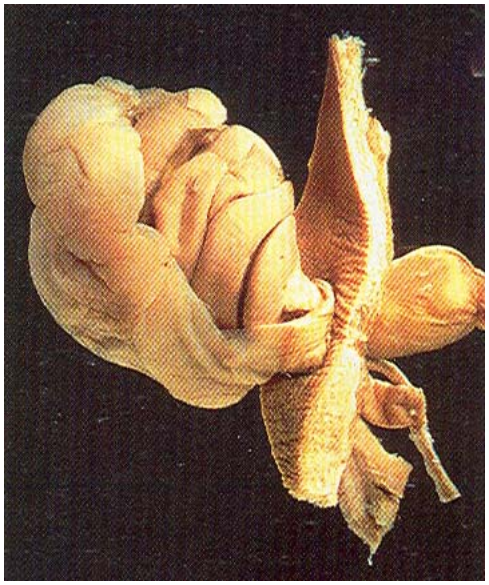
11th wk to after birth.

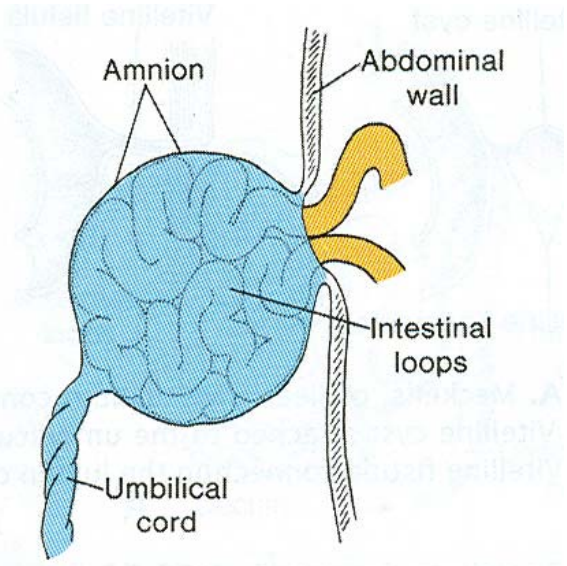
Errors of Rotation

A. 1st Stage:

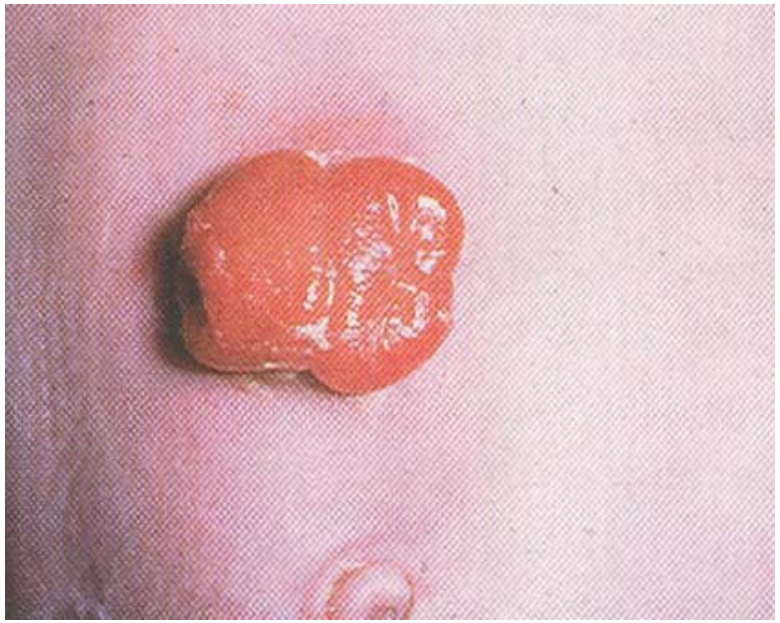
Examphalos (congenital omphalocoele)

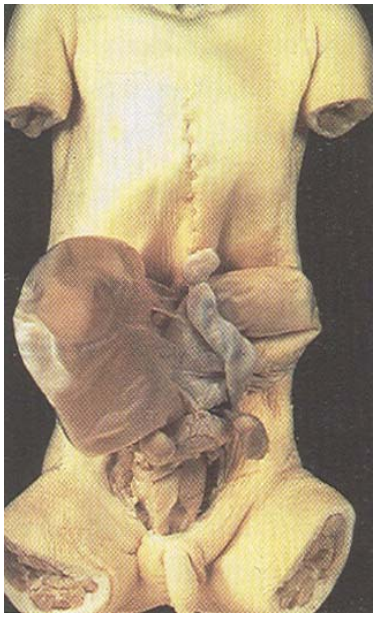






Gastroschisis: Defect in the ant. Abdominal wall; permits extrusion of viscera; present lateral to umbilicus.

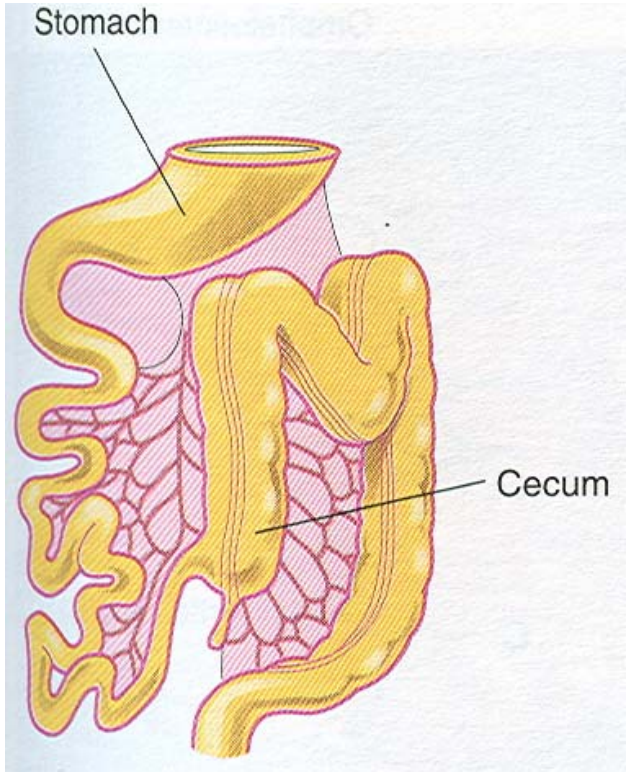




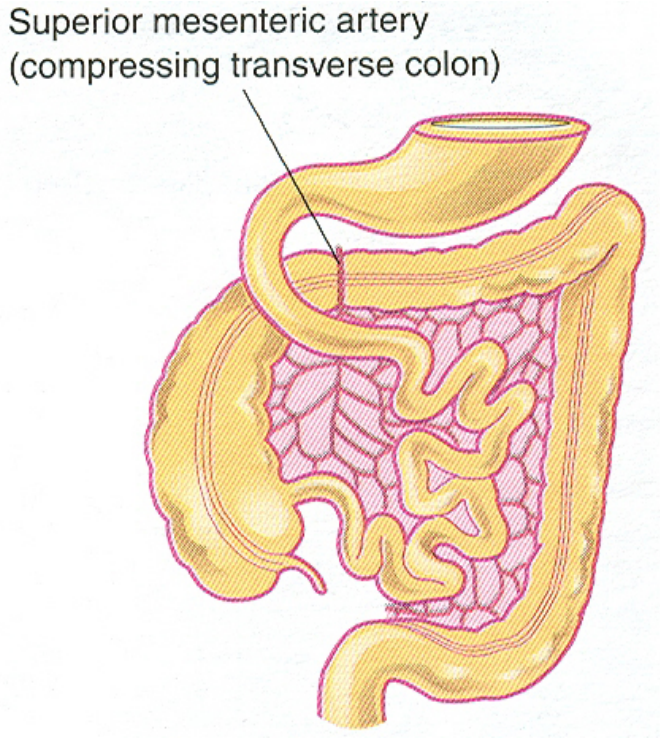
Errors of Rotation

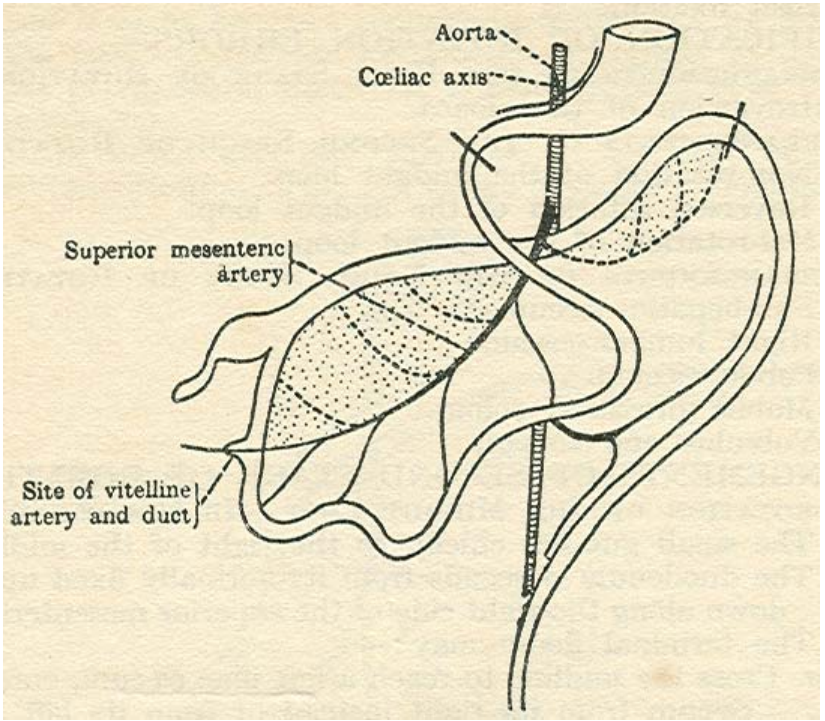
B. 2nd Stage:

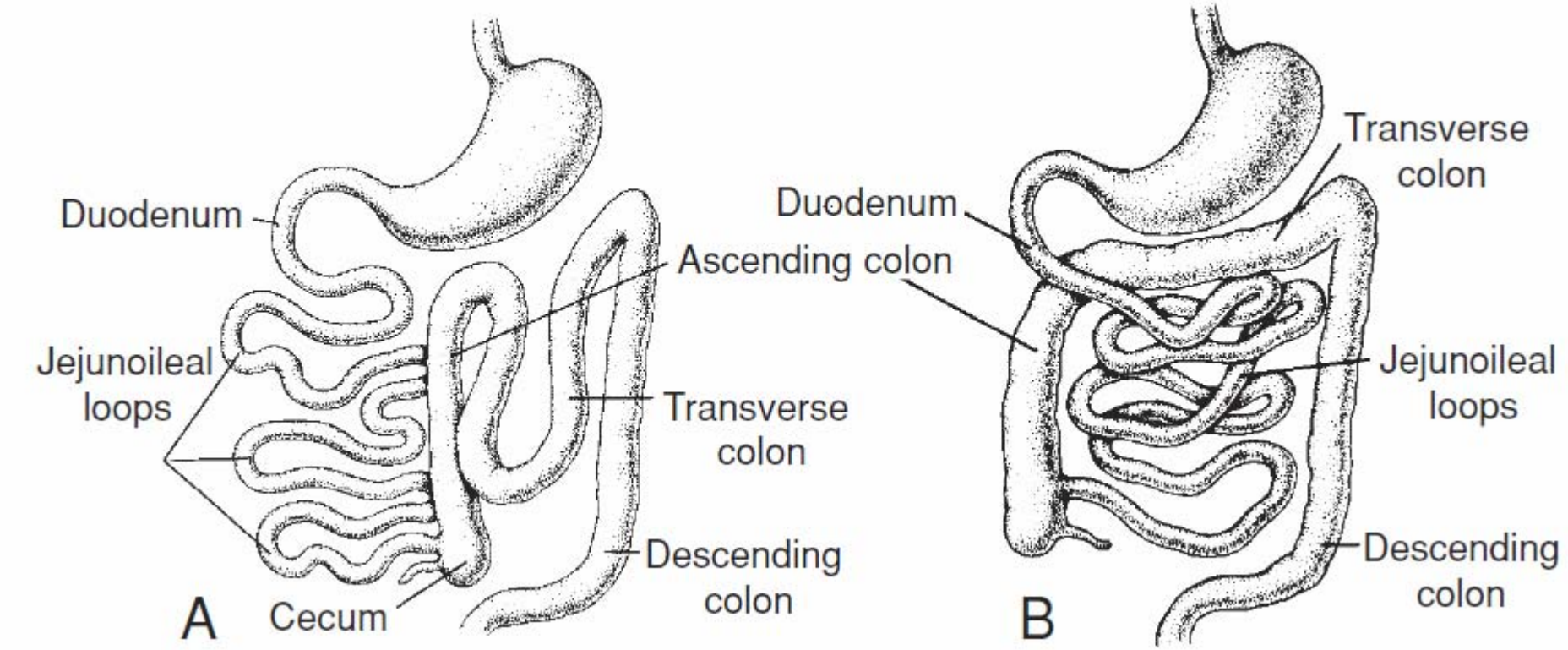
1. Nonrotation



2. Reversed rotation






Duodenum
Jejunoileal loops
Ascending colon
Transverse colon
Descending colon
Cecum
A
Duodenum
Transverse colon
Jejunoileal loops
Descending colon
B

Errors of Rotation

C. 3rd Stage:

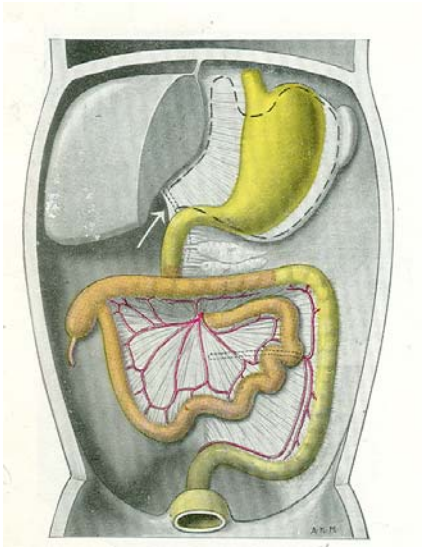
1. Abnormal positons of caecum

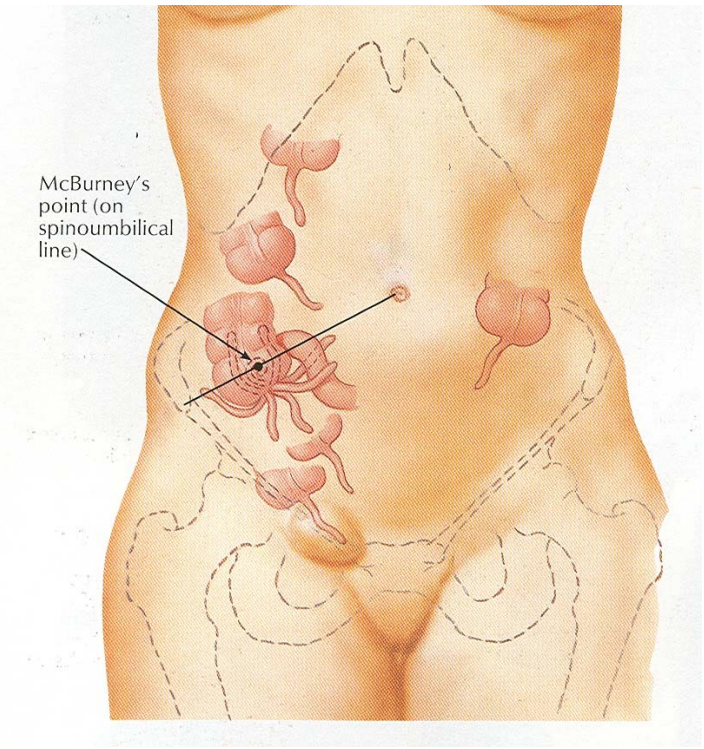
   a. Subhepatic

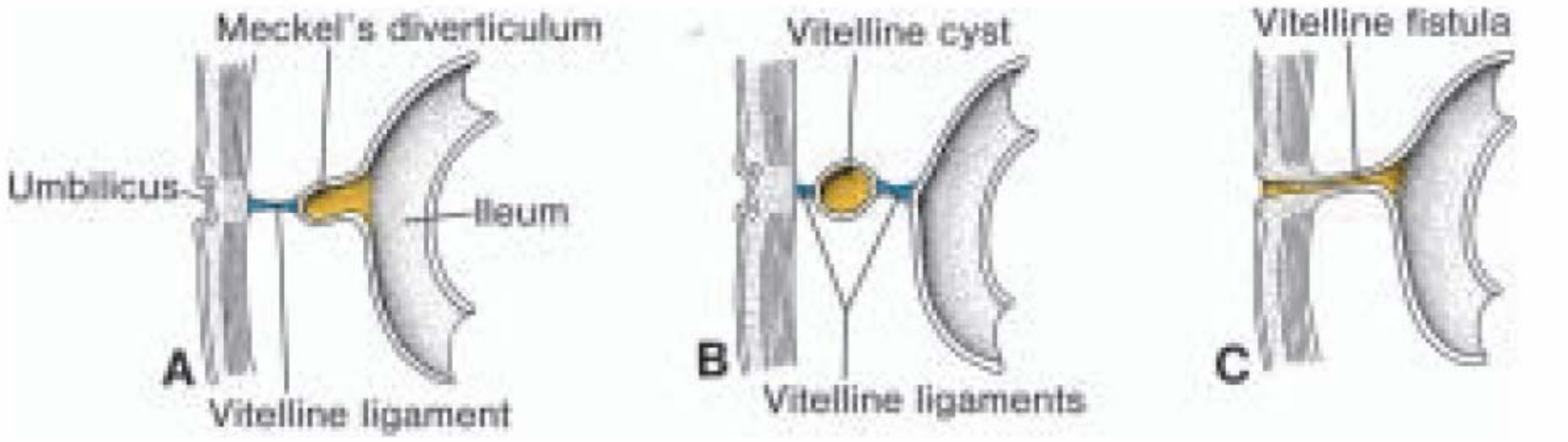
   b. Right lumbar

   c. Pelvic

   d. Mobile caecum





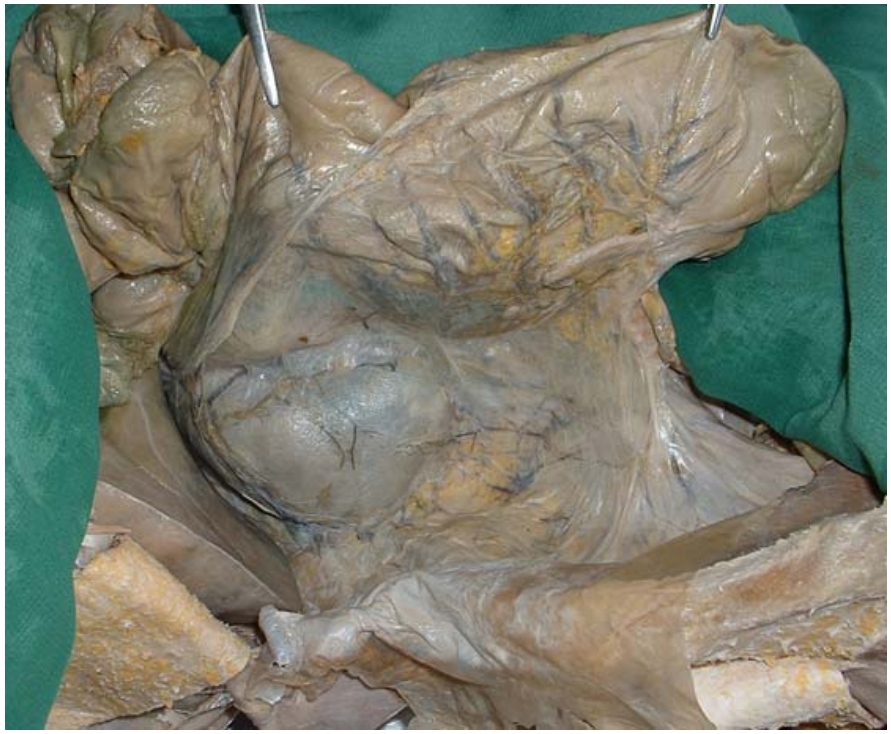


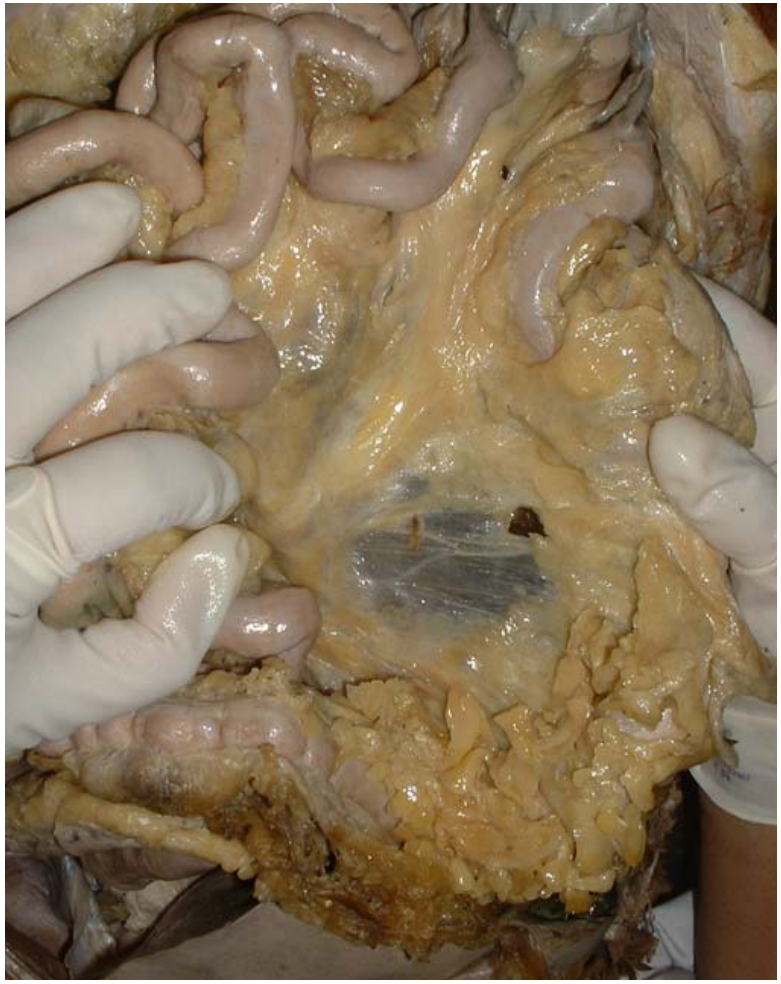
Meckel's diverticulum: remanant of vitello-intestinal duct, in 2% cases, 40-50 cm from ileocaecal junction, from antimesenteric border of ileum.

2. Persistent mesenteries

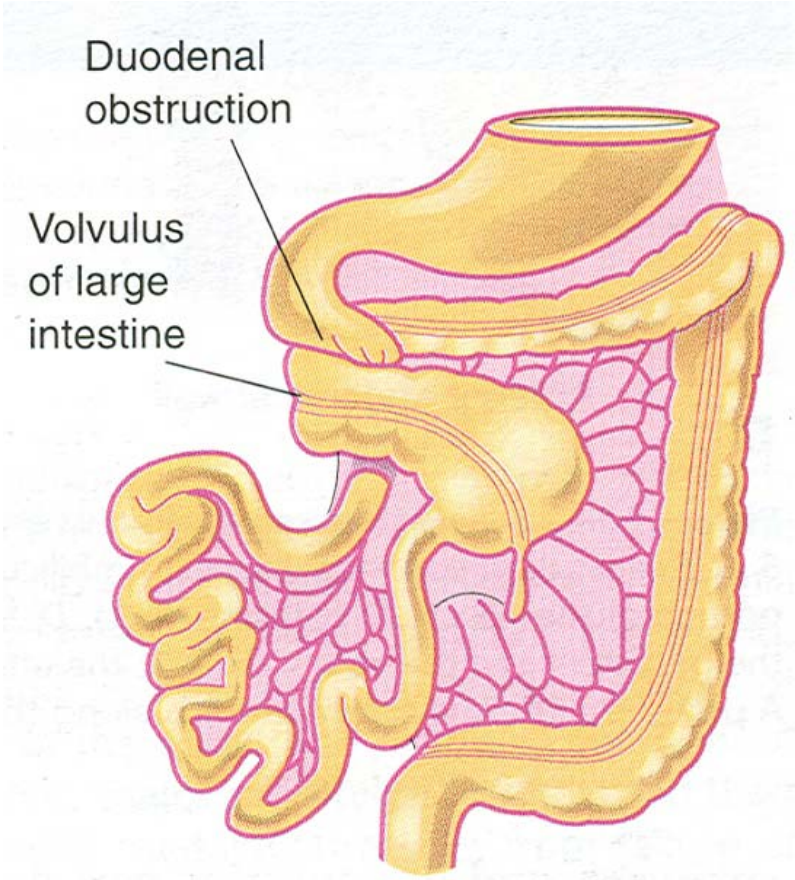
of ascending/descending colon;

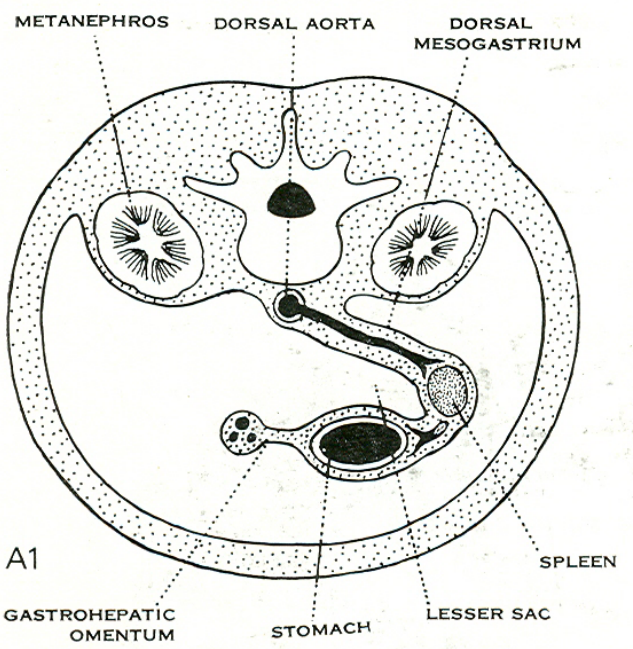
duodenum

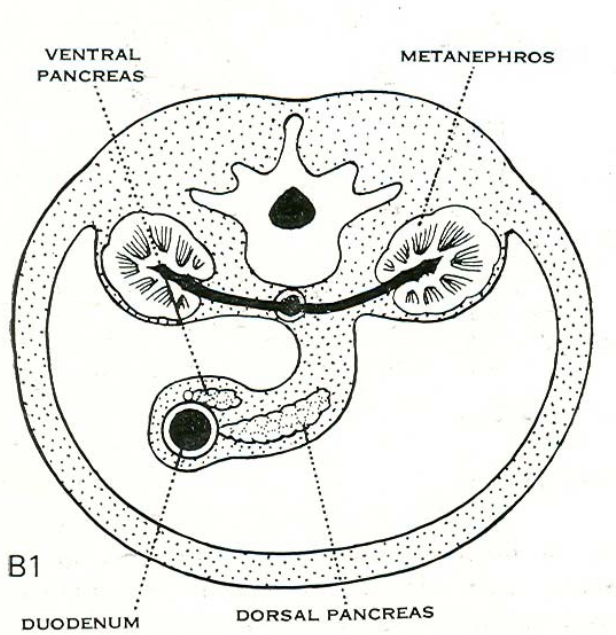




3. Volvulus




METANEPHROS
DORSAL AORTA
DORSAL MESOGASTRIUM
A1
SPLEEN
GASTROHEPATIC OMENTUM
STOMACH
LESSER SAC


VENTRAL PANCREAS
METANEPHROS
B1
DUODENUM
DORSAL PANCREAS

Development of Abdominal Digestive System

Oesophagus, stomach and duodenum up to the hepatopancreatic ampulla, liver, gall bladder and most of pancreas develop from the fore gut. These structures are supplied by branches of coeliac artery.

Lower part of duodenum, lower part head & uncinate process of pancreas, jejunum, ileum, appendix, caecum, ascending colon and right two thirds of transverse colon develop from mid gut. These structures are supplied by branches of superior mesenteric artery.

Left 1/3 of transverse colon, descending colon, sigmoid colon, rectum and upper anal canal develop from hind gut. These structures are supplied by branches of inferior mesenteric artery.

Stomach

develops as a fusiform dilatation of fore gut.

Spleen

develops by fusion of thickenings of mesodermal tissue (splenules) in the dorsal mesogastrium.

Duodenum:

a) proximal part of duodenum (up to the hepatopancreatic ampulla) develops from the caudal part of fore gut and

b) the remaining lower part of duodenum develops from the cranial part of mid gut.

Caecum

develops from a conical caecal bud which arises from the post arterial segment of mid gut.

The apical part of the caecal bud forms the appendix.

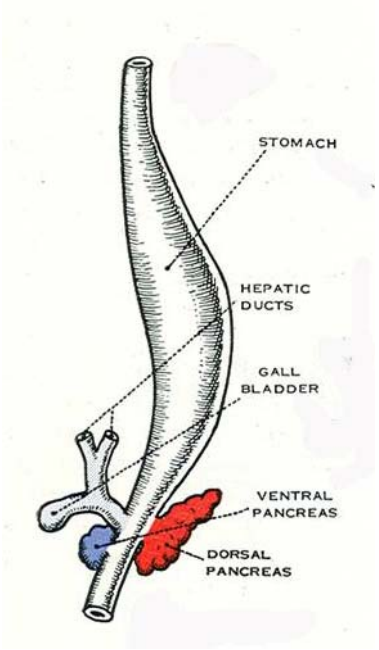
Liver

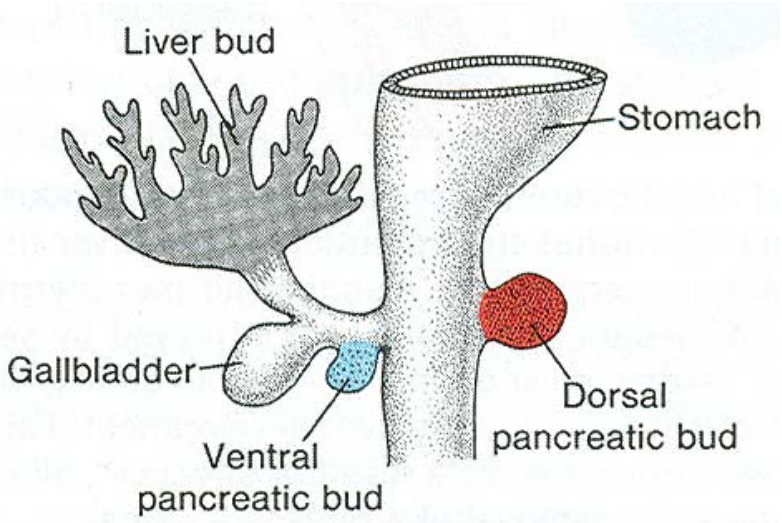
develops from the pars hepatica of endodermal hepatic diverticulum (which develops from the ventral wall of fore gut near its caudal end).

Glisson's capsule develops from the surrounding mesoderm of septum tranversum.

Gall bladder and cystic duct

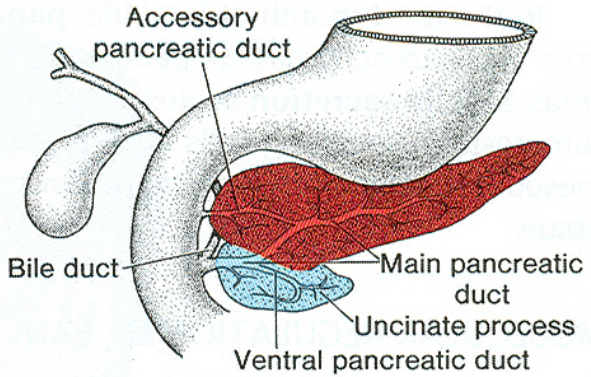
develop from the pars cystica of hepatic diverticulum.





Pancreas:

a) upper part of head, neck, body and tail of pancreas develop from dorsal pancreatic bud (which arises from end of fore gut) &



b) lower part of head and uncinate process develop from ventral pancreatic bud (which arises from beginning of mid gut).

c) duct of VPB and distal part of duct of DPB form the main pancreatic duct.

d) proximal part of duct of DPB forms the accessory pancreatic duct.

e) some terminal acini from the pancreatic ducts get separated to form the islets of Langerhans.

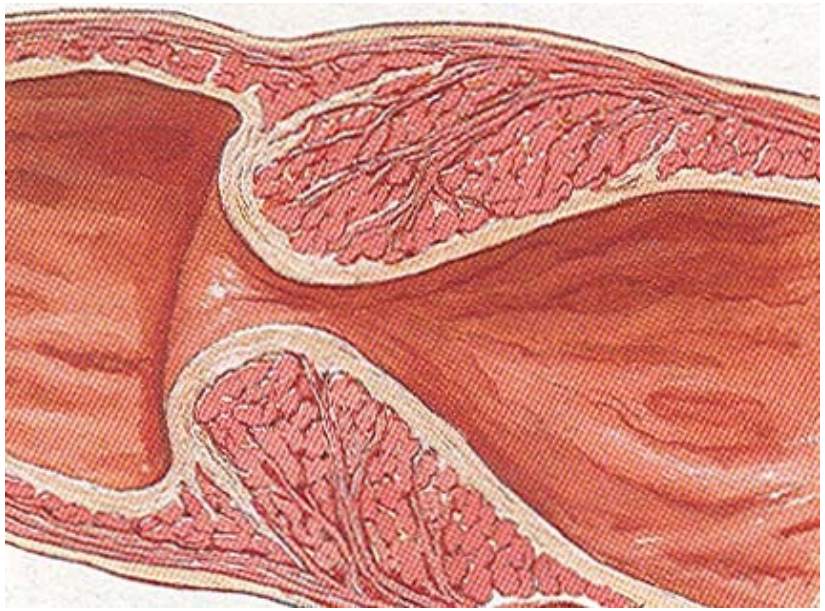
Congenital anomalies

1. Foregut:

   a) Tracheo-oesophageal fistula

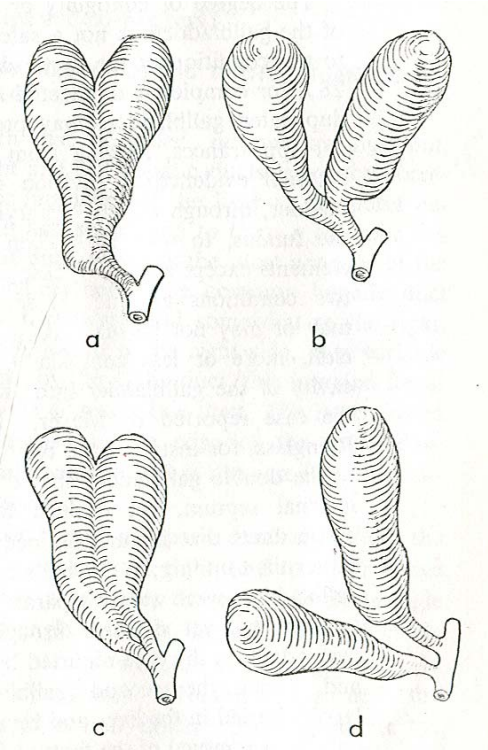
   b) Stomach:

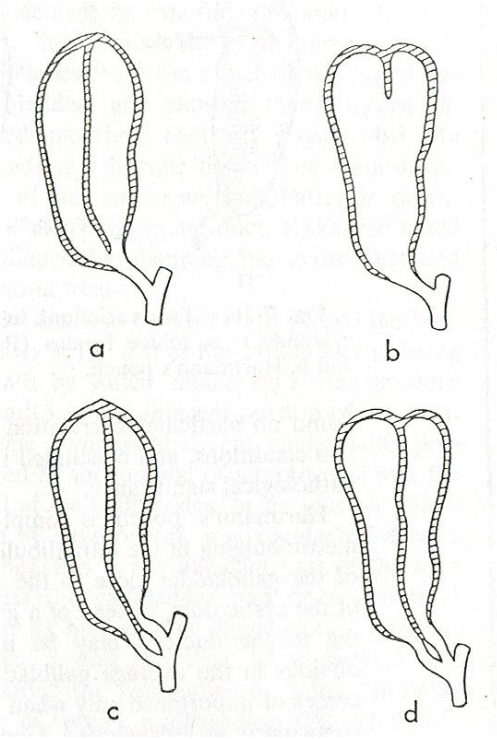
   Congenital pyloric stenosis – Marked muscular thickening; projectile vomiting; surgery (pyloromytomy)

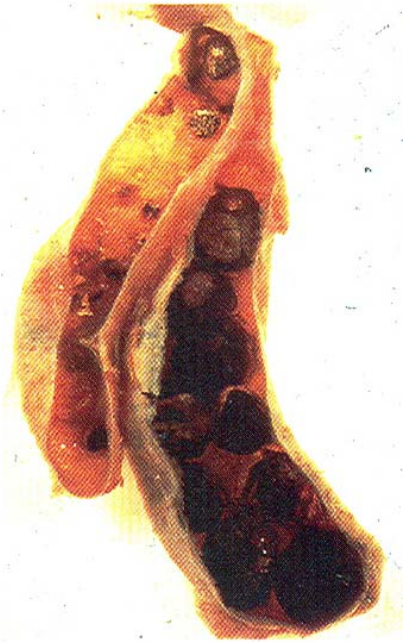


b) Gall bladder:

i) Absence of cystic duct (Sessile Bladder)
ii) Double gall bladder/ septate
iii) Persistence of mesentery



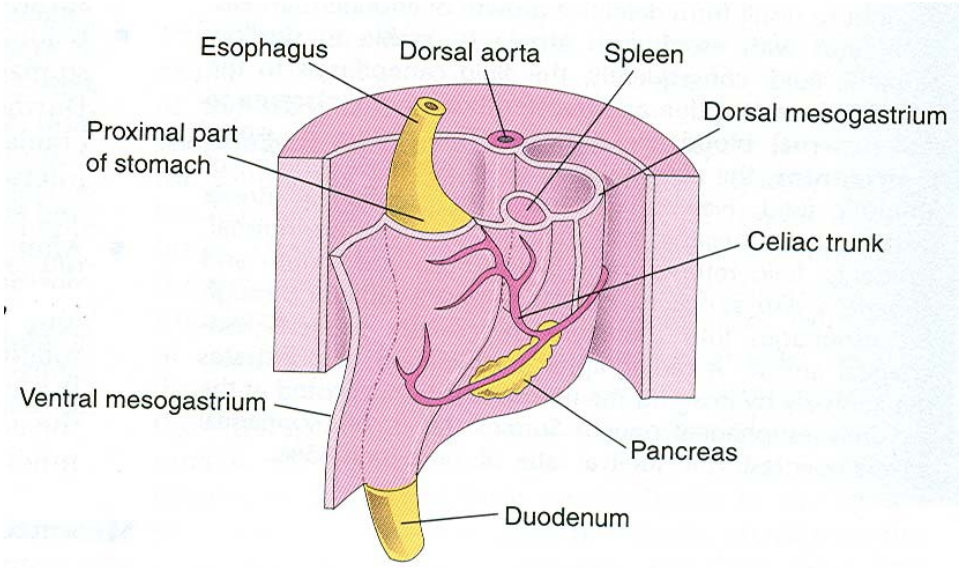




c) Spleen:

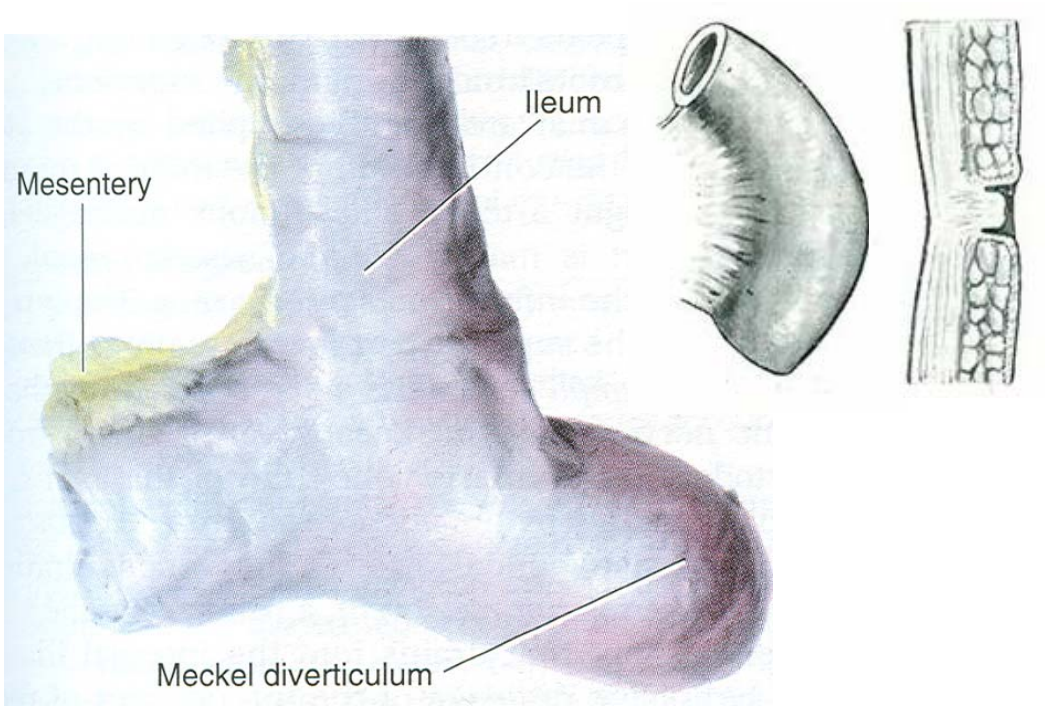
i) Lobulated

ii) Accessory



Midgut:

i) Errors of rotation
ii) Duodenal atresia/ stenosis
iii) Meckel's diverticulum



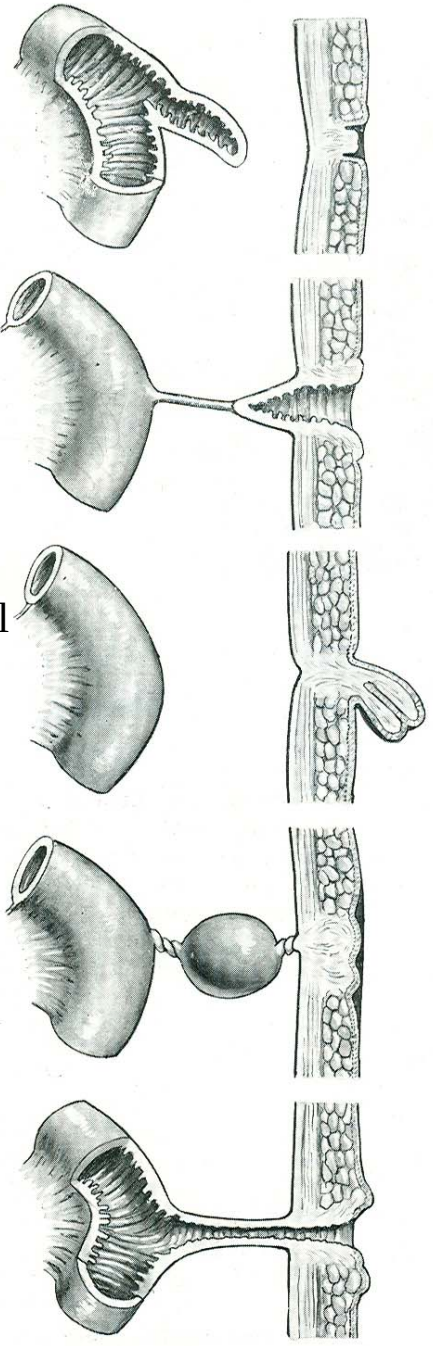
a) Meckel's divericulum

b) Vitelline cord with umbilical sinus

c) Umbilical sinus

d) Vitelline cyst

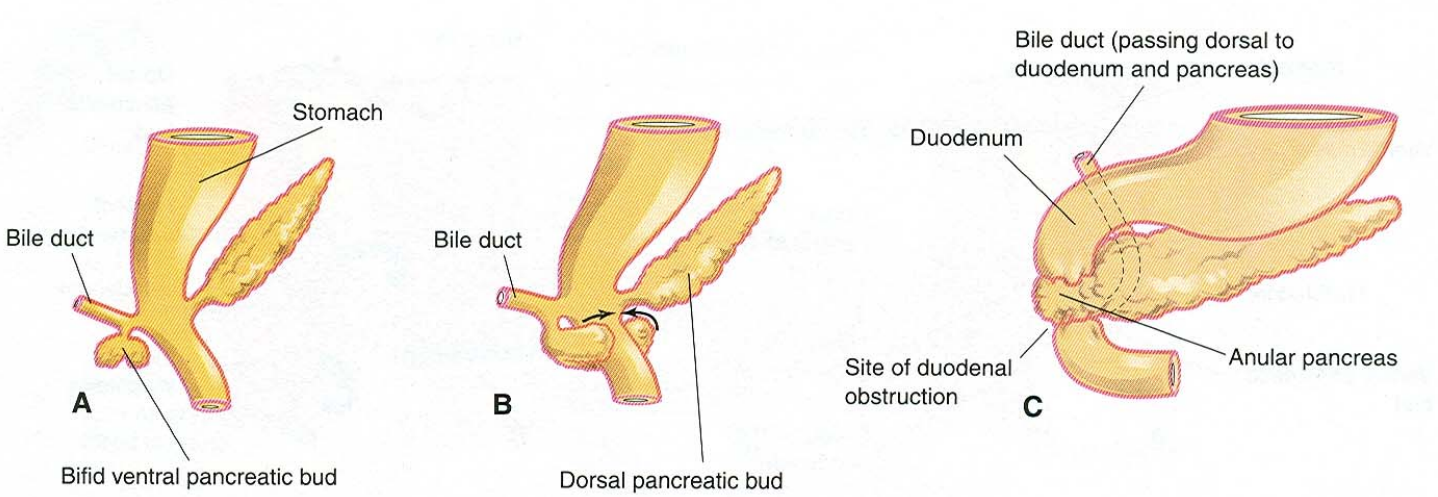
e) Vitelline fistula

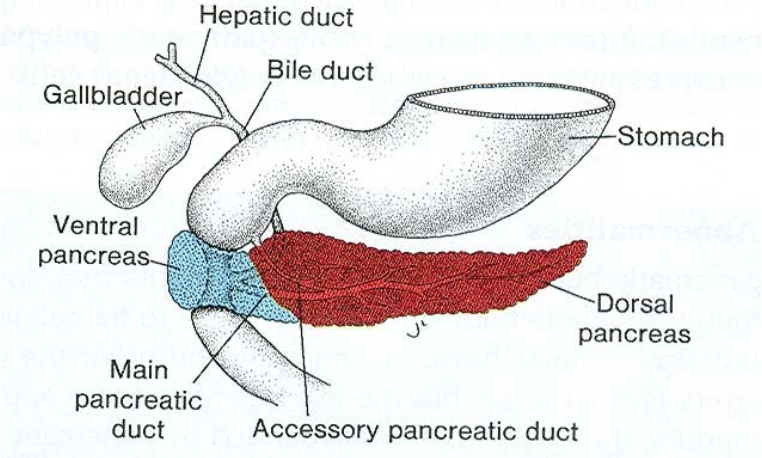


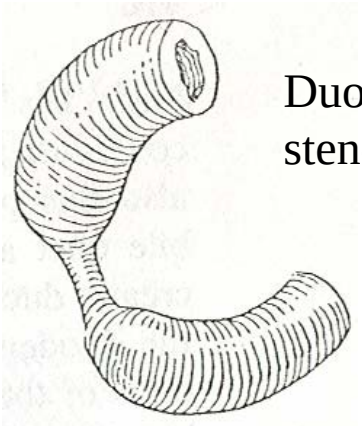
iv) Pancreas:

a) Annular

b) Divided

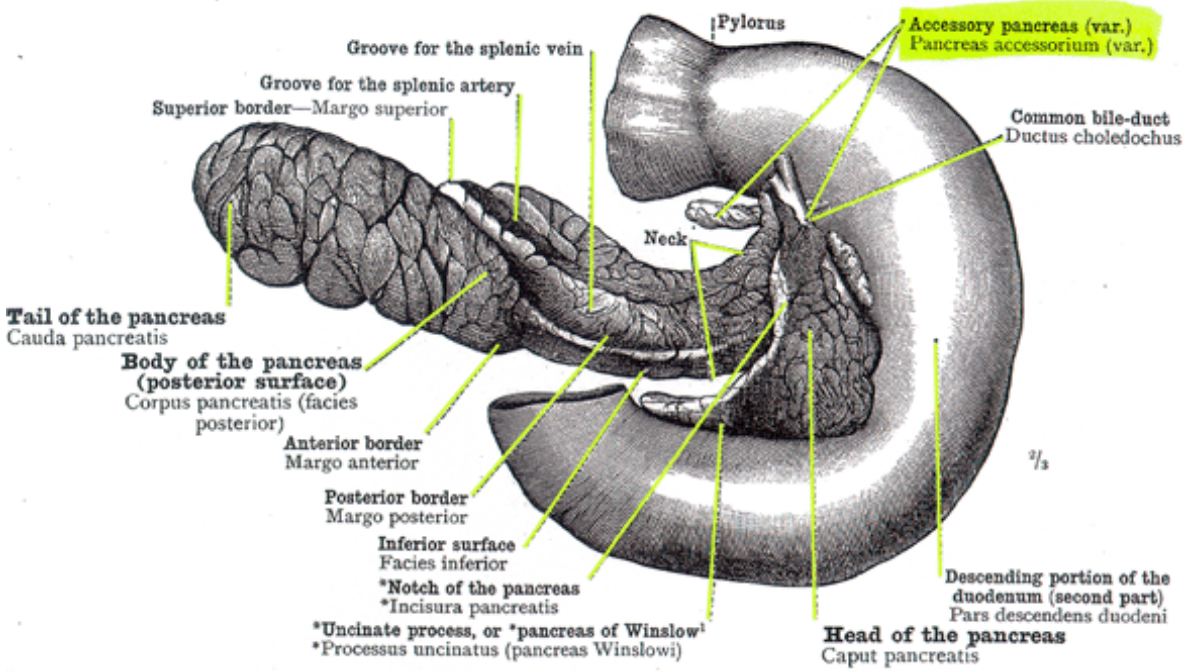






Duodenal stenosis

c) Accessory pancreas



v. Caecum

a) Anomalies of shape

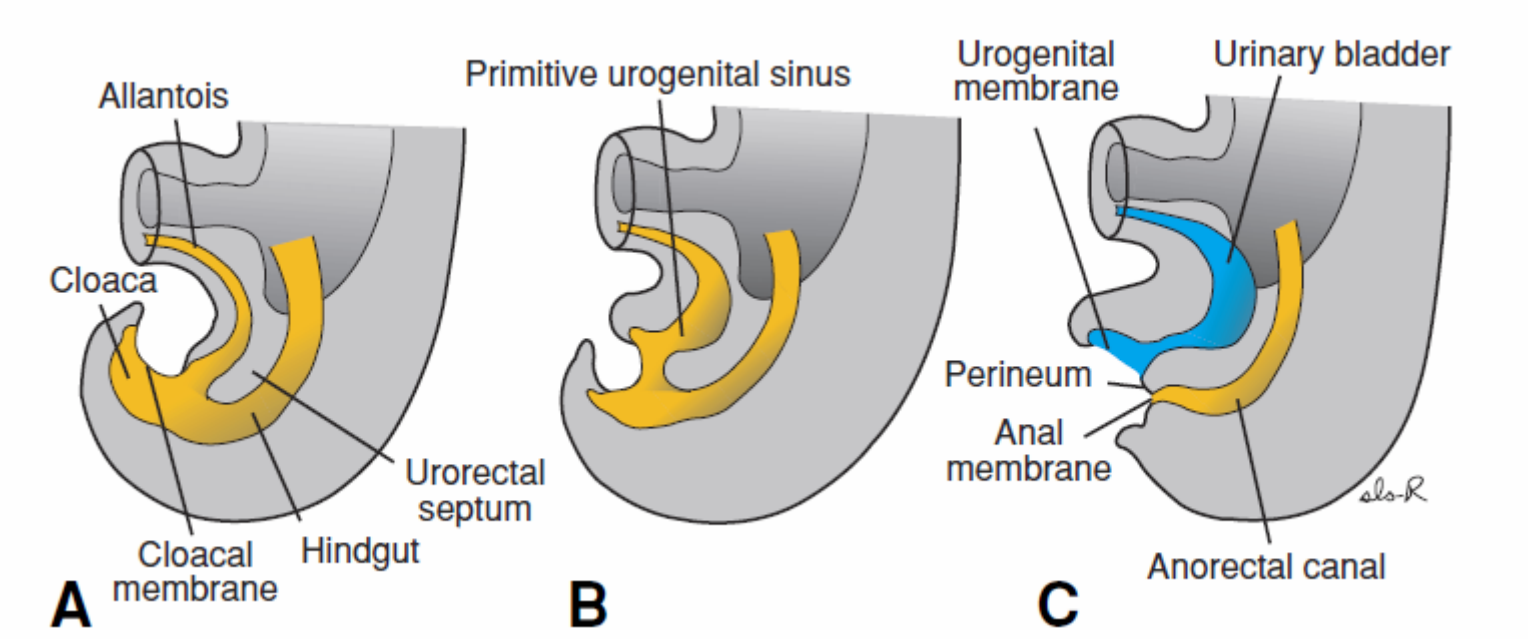
i) Conical (Infantile: 2%)

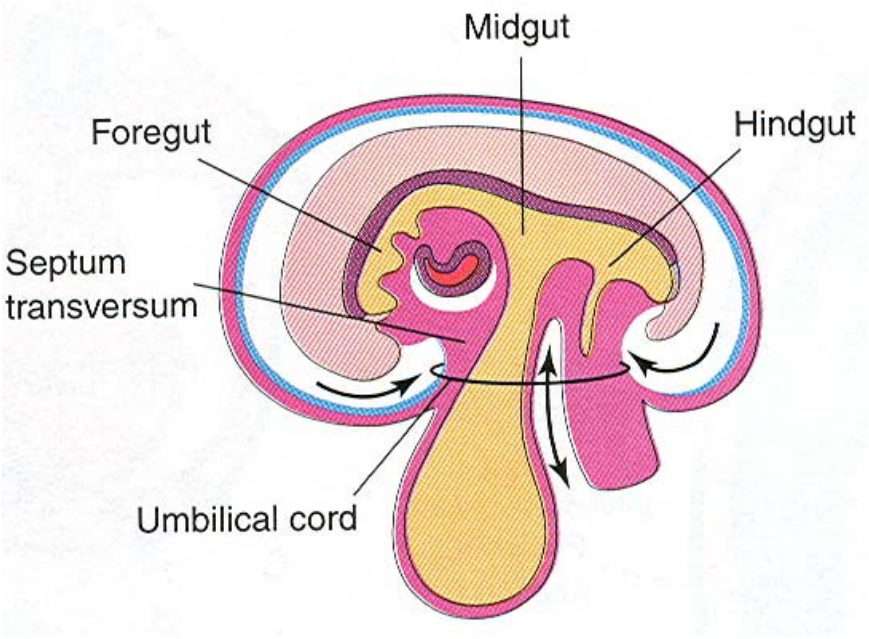
ii) Quadrate (3%)

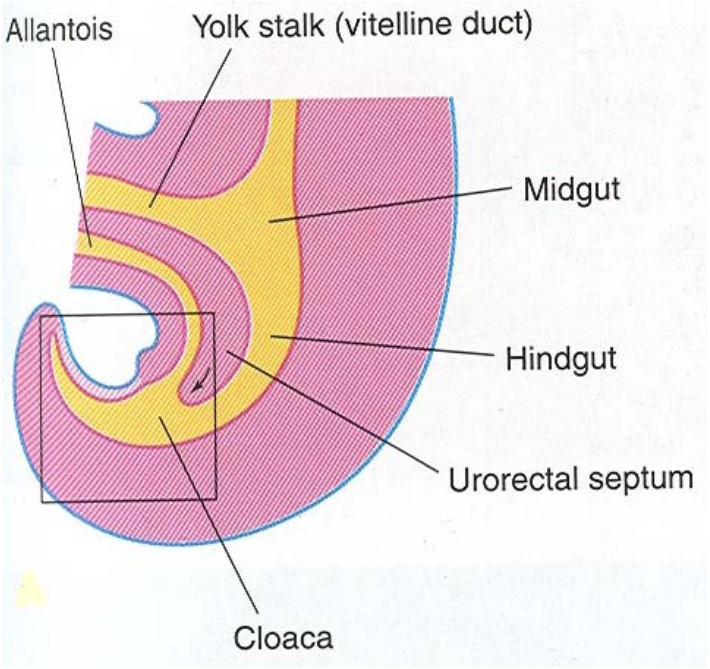
iii) Hyper position of appendix (4-5%)

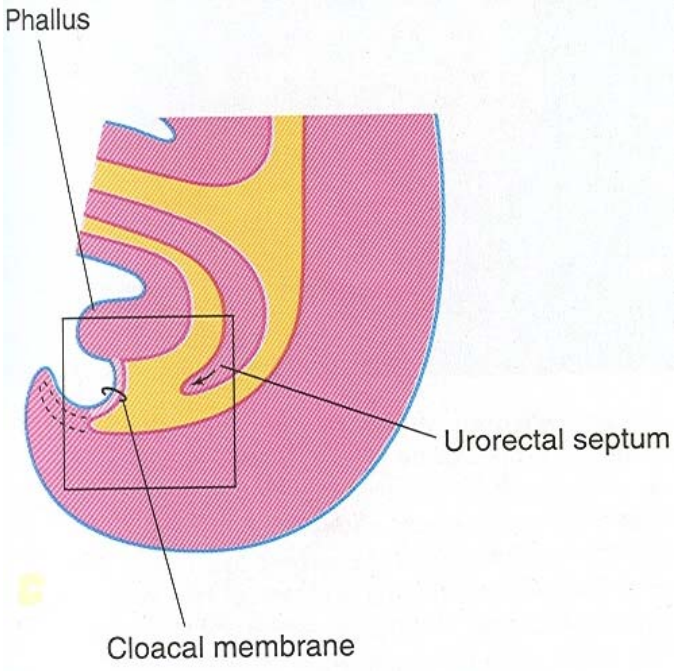
b) Anomalies of position

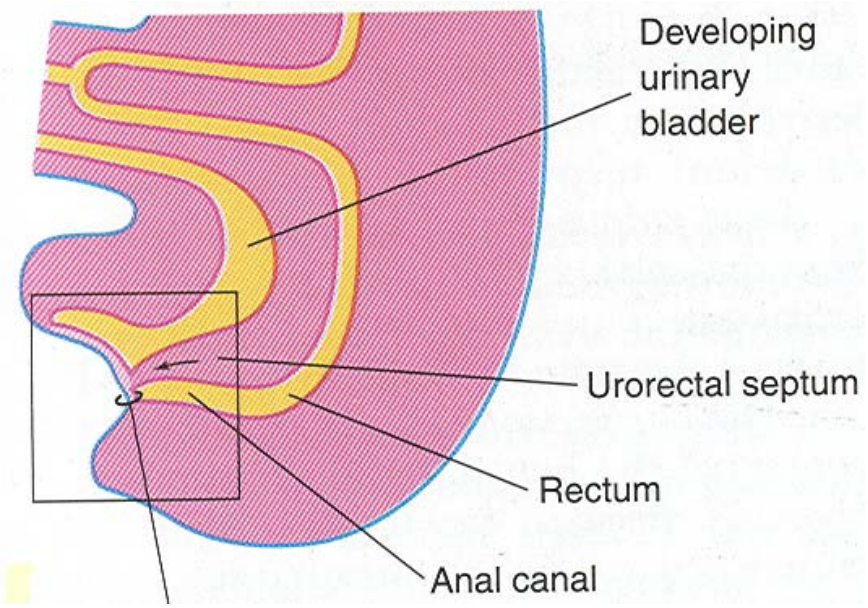
(errors of rotation)

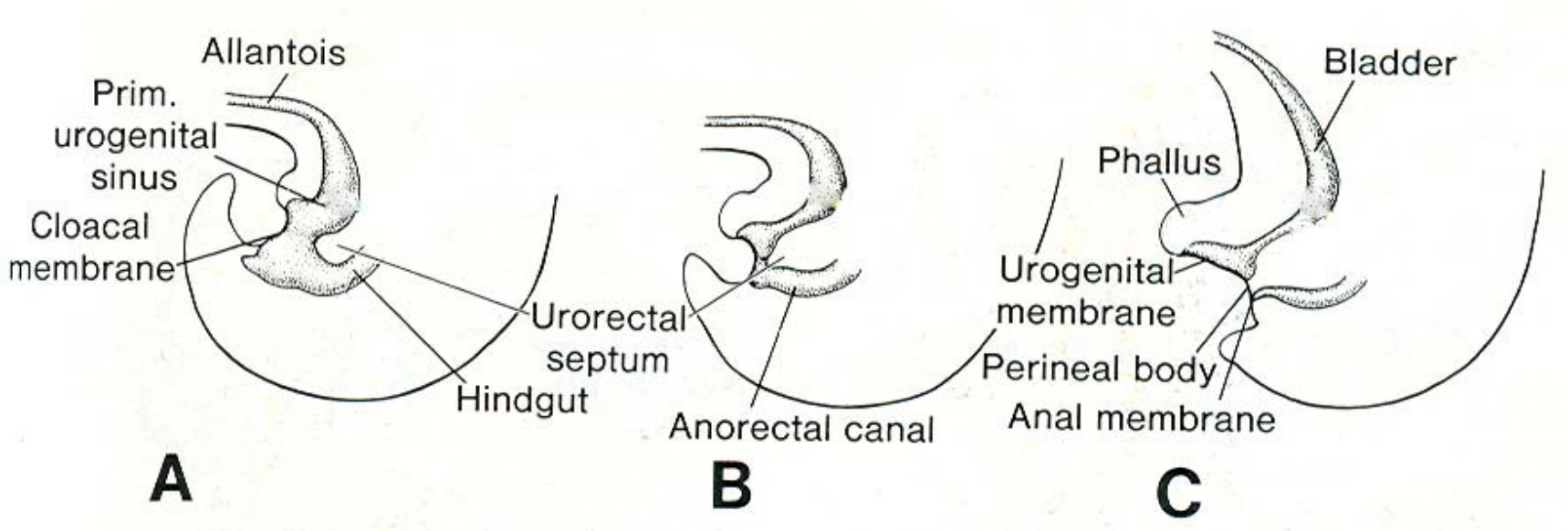

Allantois
Cloaca
Urorectal septum
Cloacal membrane
Hindgut
A
Primitive urogenital sinus
B
Urogenital membrane
Urinary bladder
Perineum
Anal membrane
Anorectal canal
C

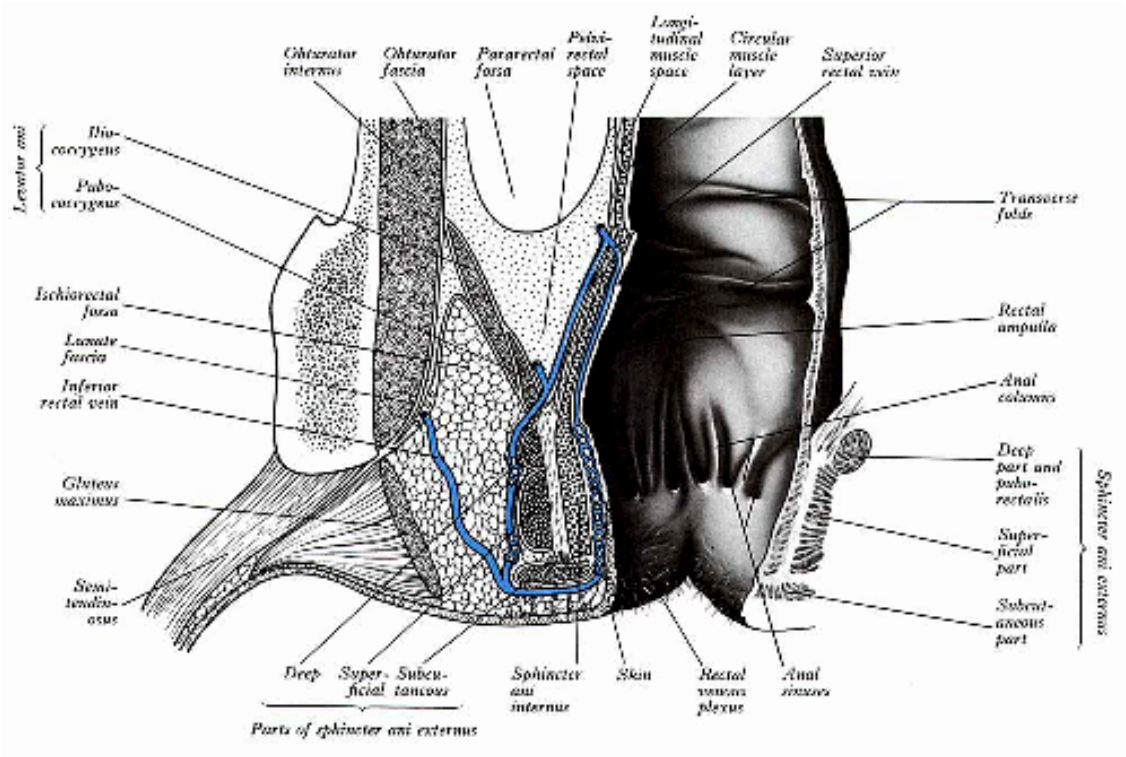

Midgut
Foregut
Hindgut
Septum transversum
Umbilical cord


Allantois
Yolk stalk (vitelline duct)
Midgut
Hindgut
Urorectal septum
Cloaca


Phallus
Urorectal septum
Cloacal membrane


Developing urinary bladder
Urorectal septum
Rectum
Anal canal

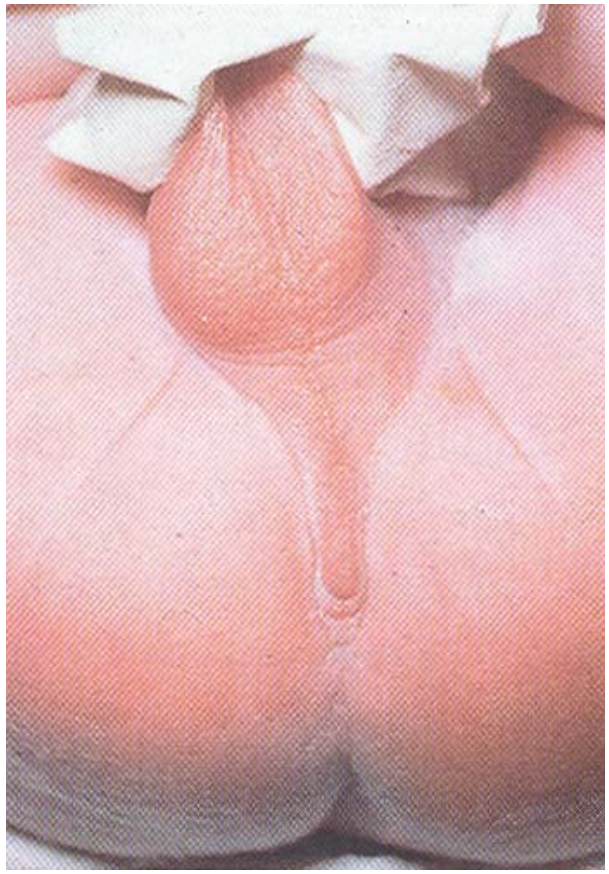

Allantois
Prim.
urogenital
sinus
Cloacal
membrane
Urorectal
septum
Hindgut
Anorectal canal
Bladder
Phallus
Urogenital
membrane
Perineal body
Anal membrane
A
B
C

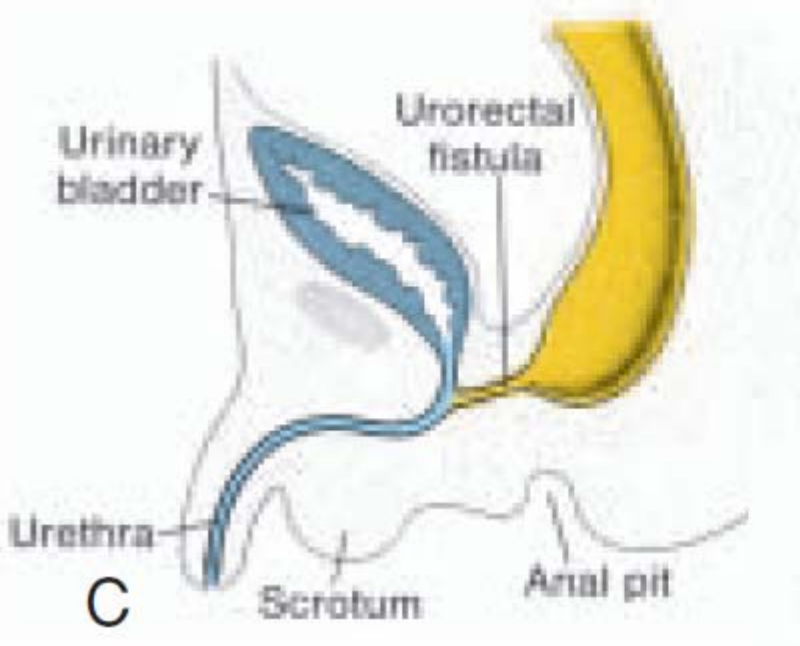

Obturator internus
Obturator fascia
Pararectal fossa
Pelvi-rectal space
Longi-tudinal muscle layer
Circular muscle layer
Superior rectal vein
Levator ani
Ilio-coccygeus
Pubo-coccygeus
Transverse folds
Ischiorectal fossa
Rectal ampulla
Lunate fascia
Inferior rectal vein
Anal columns
Deep part and pubo-rectalis
Sphincter ani externus
Gluteus maximus
Super-ficial part
Semi-tendino-sus
Subcut-aneous part
Deep
Super-ficial
Subcu-taneous
Sphincter ani internus
Skin
Rectal venous plexus
Anal sinuses
Parts of sphincter ani externus

Congenital anomalies of hindgut:

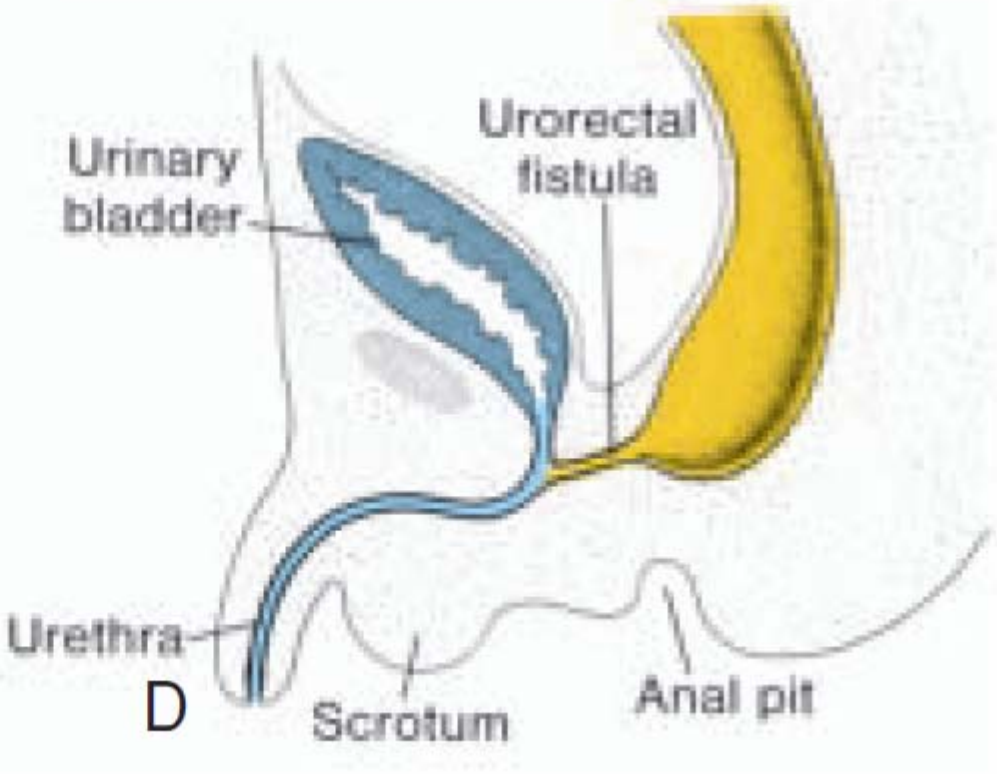
1. Imperforate anus
2. Fistulae:
    a. Rectovesical
    b. Rectourethral
    c. Rectovaginal
    3. Congenital megacolon(Hirschsprung disease).
    4. **Rectoanal atresia**

Imperforate anus




Urinary bladder
Urorectal fistula
Urethra
Scrotum
Anal pit

C


Urinary bladder
Urorectal fistula
Urethra
Scrotum
Anal pit

D