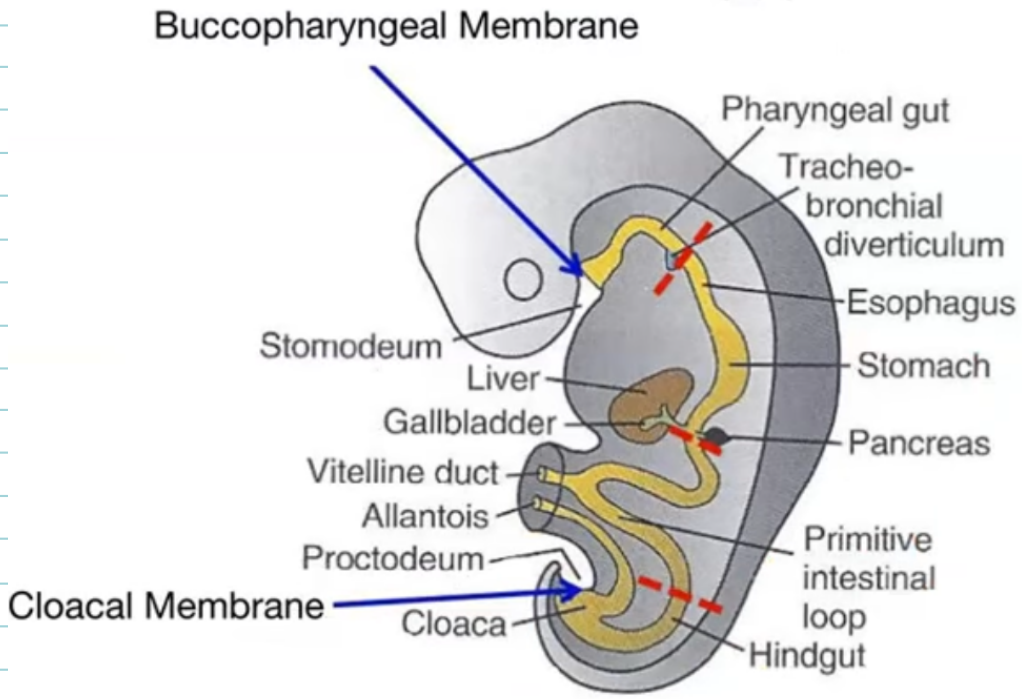
Revision



Buccopharyngeal membrane
A temporary membrane between the stomodeum and the foregut. It later breaks down to form the opening of the mouth.

Stomodeum
The primitive mouth.

Pharyngeal gut
The upper part of the foregut that forms parts of the pharynx.

Tracheobronchial diverticulum
A respiratory bud from the foregut. It forms the trachea, bronchi, and lungs.

Vitelline duct
Connects the midgut to the yolk sac.
Persistence can cause Meckel's diverticulum.

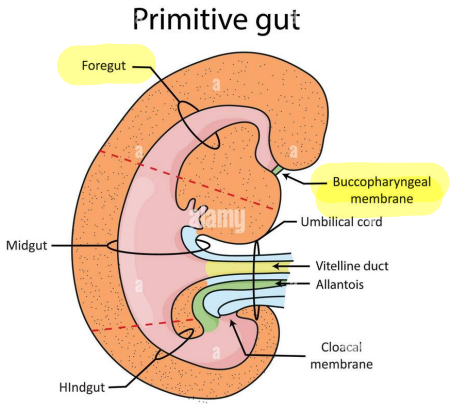
Primitive intestinal loop
The main structure of the midgut.
It forms jejunum, ileum, cecum, appendix, ascending colon, and proximal part of transverse colon.

Cloaca
A common cavity at the end of the hindgut.
It later divides into the urogenital sinus and anorectal canal.

Cloacal membrane
A temporary membrane that closes the cloaca. It later breaks down.

Proctodeum
The primitive anal pit forms the lower part of the anal canal.

Allantois
An embryonic structure related to the future bladder.
It becomes the urachus, then the median umbilical ligament.



1. Development of the Oral Cavity

Sources:

Stomodeum depression (ectoderm)

Cephalic foregut end (endoderm)

Buccopharyngeal membrane separates the two; disappears in the 3rd week.

Anterior structures (hard palate, lips, enamel)

→ectodermal origin.

Posterior structures (tongue, soft palate, palatoglossal/palatopharyngeal folds, floor of mouth) → endodermal origin.

2. Development of Salivary Glands

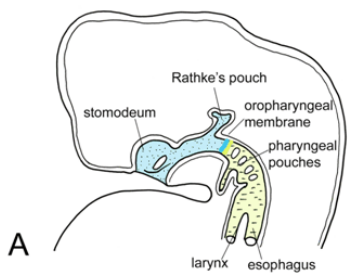
1) Begins around 7th week as solid outgrowths from oral epithelium.

2)Cells grow into mesenchyme, undergo branching, forming ducts and acini.

3)Exocrine glands retain duct connection; endocrine glands lose contact with surface.

4)Parotid gland → ectoderm

submandibular and sublingual glands → endoderm.

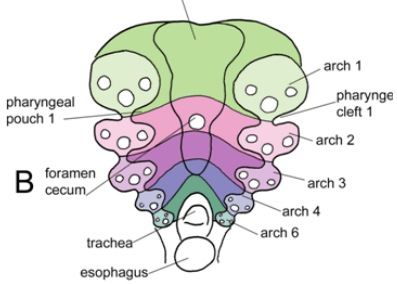


3. Tongue Development

Appears ~4 weeks as two lateral lingual swellings + tuberculum impar (1st pharyngeal arch).

Copula/hypobranchial eminence → 2nd–4th arches.

Epiglottis → posterior 4th arch.



Anterior 2/3 (body) from lateral lingual swellings; innervated by mandibular branch of trigeminal nerve.

Posterior 1/3 (root) from 2nd–4th arches; innervated by glossopharyngeal nerve; epiglottis by superior laryngeal nerve.

Muscles from myoblasts of occipital somites; innervated by hypoglossal nerve.

Taste: anterior 2/3 by chorda tympani (facial nerve); posterior 1/3 by glossopharyngeal nerve.

4. Development of the Pharynx

1)Derived from foregut **endoderm**, separated from surface **ectoderm** by mesenchyme.

2) Pharyngeal arches → swellings.

3)Pharyngeal clefts (external) and pharyngeal pouches (internal) form as grooves between arches.

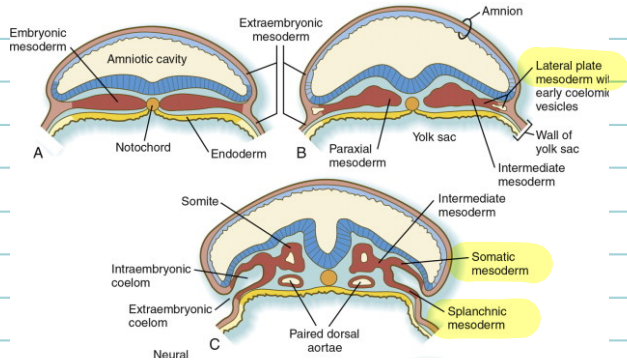
5. Development of Anterior Abdominal Wall

1)Lateral mesoderm divides into somatic and splanchnic layers.

2)Anterior wall derived from somatopleuric mesoderm; innervation from ventral rami.

3) Somatopleuric mesoderm forms external oblique, internal oblique, transversus abdominis.

4)Rectus abdominis retains segmental origin; linea alba forms at ~3 months.

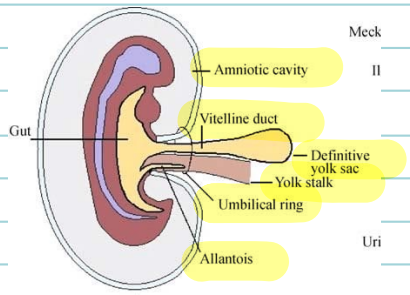


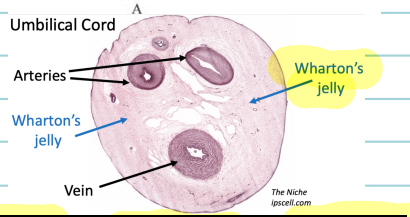
6. Development of Umbilicus and Umbilical Cord

1)Amnion + chorion fusion encloses body stalk + yolk sac.

2)Wharton's jelly → connective tissue embedding:

remnants of yolk sac
vitelline duct
allantois
umbilical vessels (2 arteries(deoxygenated), 2 veins(oxygenated) ; right vein disappears)



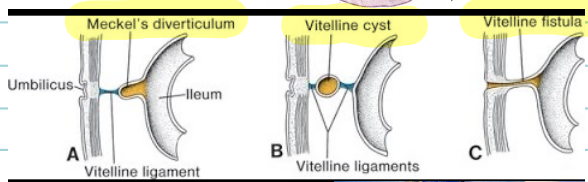


7. Vitelline Duct Abnormalities

1)Meckel's diverticulum: 2–4% of people; proximal vitelline duct persists.

2)Enterocystoma/vitelline cyst: middle portion persists; both ends fibrose.

3)Clinical issues: heterotopic pancreatic/ gastric tissue → ulceration, bleeding, perforation.



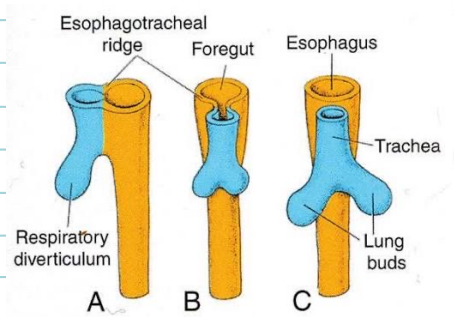
8. Formation of Lung Buds

1)~4 weeks: respiratory diverticulum arises from ventral foregut.

2)Endoderm → epithelium of larynx, trachea, bronchi, lungs.

3)Splanchnic mesoderm → cartilaginous, muscular, connective tissues.

4)Tracheoesophageal ridges fuse → tracheoesophageal septum, separating esophagus (dorsal) and trachea/ lungs (ventral).

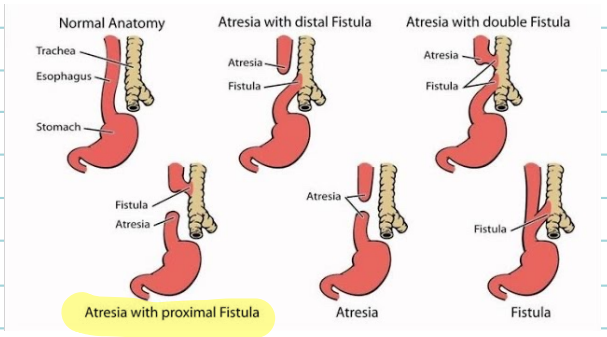


9.Esophagus

The esophagus develops from the foregut. At first, it is short, but it lengthens rapidly because of the descent of the heart and lungs.

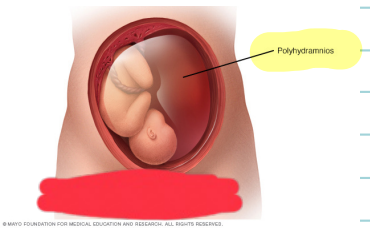
The muscular coat of the esophagus develops from the surrounding splanchnic mesenchyme.

Part of esophagus	Muscle type	Innervation
Upper two-thirds	Striated muscle	Vagus nerve
Lower one-third	Smooth muscle	Splanchnic plexus

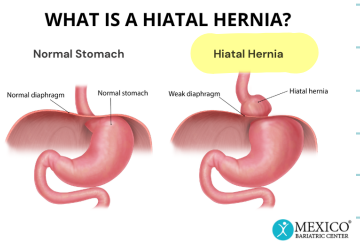


Esophageal abnormalities:

The most important abnormality is esophageal atresia with or without tracheoesophageal fistula.
The common form:
1)The proximal esophagus ends blindly.
2)The distal esophagus connects to the trachea by a fistula.
3)This prevents normal passage of amniotic fluid into the intestine.
4)It may cause polyhydramnios, which means excess amniotic fluid.



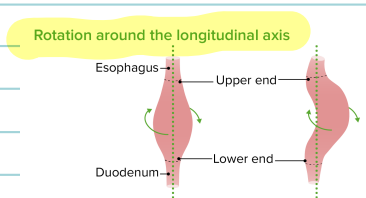
Other abnormalities include:
Esophageal stenosis: narrowing of the esophageal lumen.
Congenital hiatal hernia: stomach is pulled upward through the esophageal hiatus.



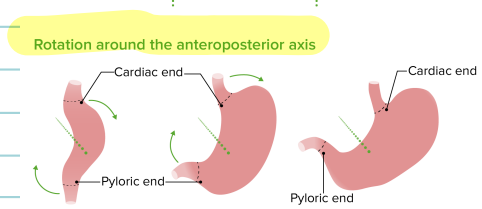
10.Stomach Development

The stomach appears in the 4th week as a fusiform dilation of the foregut.
Its final shape and position happen because of two main rotations:

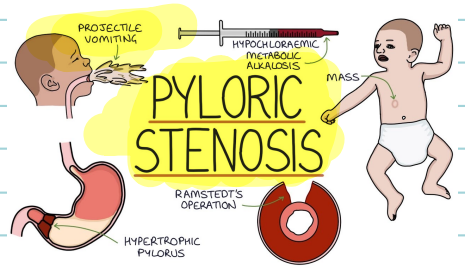
A. Rotation around the longitudinal axis



The stomach rotates 90° clockwise around its longitudinal axis.
Results:
1)Left side becomes anterior.
2)Right side becomes posterior.
3) Left vagus nerve supplies anterior wall.
4)Right vagus nerve supplies posterior wall.
5) Posterior wall grows faster than anterior wall.
6)This forms:
-Greater curvature
-Lesser curvature



B. Rotation around the anteroposterior axis



The stomach also rotates around the anteroposterior axis.

Results:

1)Pyloric part moves to the right and upward.

2) Cardiac part moves to the left and slightly downward.

3)Stomach becomes positioned from upper left to lower right.

Pyloric Stenosis

Definition:Hypertrophy and hyperplasia of the pyloric sphincter muscle(circular muscle) , leading to gastric outlet obstruction in infants.

Pathophysiology:

1)Thickened pyloric muscle narrows the lumen.

2)Delayed gastric emptying → forceful, projectile vomiting.

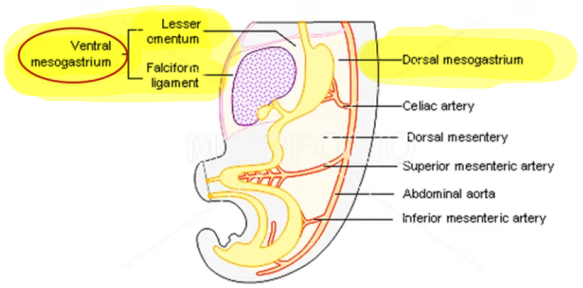
Clinical Features:

Projectile vomiting after feeding.

Mesenteries of the stomach:

The stomach is attached by two mesenteries:

Mesentery	Attachment	Derivatives
Dorsal mesogastrium	Stomach to posterior body wall	Greater omentum, gastrosplenic ligament, lienorenal ligament
Ventral mesogastrium	Stomach to liver/anterior body wall	Lesser omentum, falciform ligament



Notice the ventral mesentery:

-It is derived from septum transversum.
-It is called ventral mesogastrium.
-It connects the stomach and cranial part of the duodenum to the anterior abdominal wall.

During stomach rotation:

The dorsal mesogastrium moves to the left A space forms behind the stomach called the omental bursa or lesser sac.

The dorsal mesogastrium grows downward like an apron and forms the greater omentum.

The spleen develops in the dorsal mesogastrium during the 5th week.

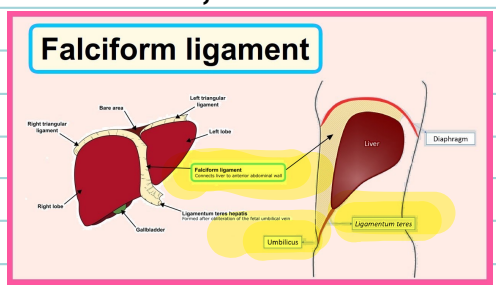
Spleen ligaments:

1)Gastrolienal / gastrosplenic ligament: connects spleen to stomach.

2)Lienorenal / splenorenal ligament: connects spleen to posterior abdominal wall near the left kidney.

Important point:

The free margin of the falciform ligament contains the umbilical vein, which becomes after birth the round ligament of the liver / ligamentum teres hepatis.



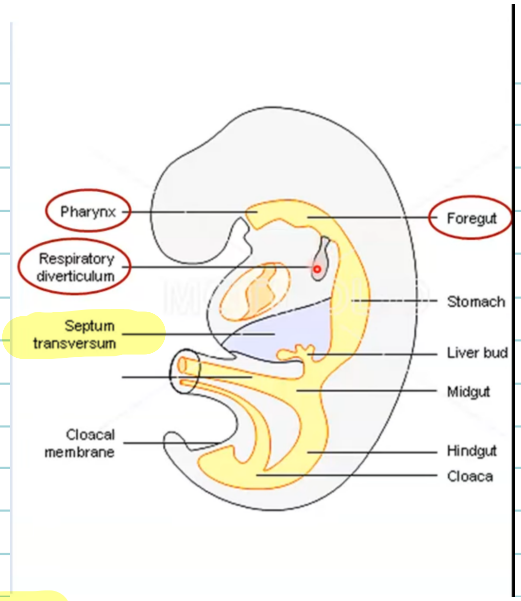
The free margin of the lesser omentum is the hepatoduodenal ligament.

It contains the portal triad:Bile duct,Portal vein,Hepatic artery

11)Liver and Gallbladder Development

The liver primordium appears in the middle of the 3rd week.

It develops as an outgrowth from the endodermal epithelium of the distal foregut This outgrowth is called: Hepatic diverticulum(Liver bud) ,The liver bud grows into the septum transversum.



Common abnormalities include:

1)Variations in liver lobulation.

2) Accessory hepatic ducts.

3) Duplication of gallbladder.

Important clinical abnormality:

1)Extrahepatic biliary atresia:This happens when bile ducts fail to recanalize.

2)Intrahepatic biliary duct atresia or hypoplasia

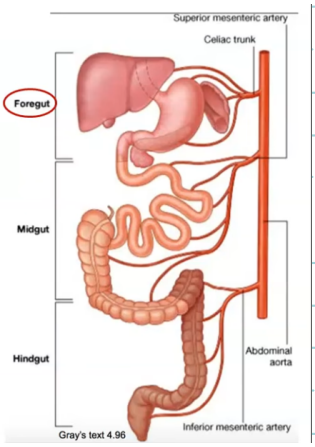
Derivatives	
Structure	**Origin**
Liver cells / hepatocytes	Endoderm of hepatic diverticulum
Biliary duct lining	Endoderm
Gallbladder	Small ventral outgrowth from bile duct
Cystic duct	Same ventral outgrowth
Kupffer cells	Mesoderm of septum transversum
Connective tissue	Mesoderm of septum transversum
Hematopoietic cells	Mesoderm of septum transversum

12. Duodenum Development:

The duodenum develops from two parts:

Part	Origin
Proximal duodenum	Terminal foregut → celiac A
Distal duodenum	Cephalic midgut → superior mesenteric A

The junction is just distal to the origin of the liver bud.



As the stomach rotates, the duodenum:

1) Forms a C-shaped loop,Rotates to the right,Moves from midline to the left side of the abdominal cavity because of growth of the pancreatic head.

2) The duodenum and head of pancreas become pressed against the posterior abdominal wall.

3)Then, the mesoduodenum fuses with the posterior peritoneum

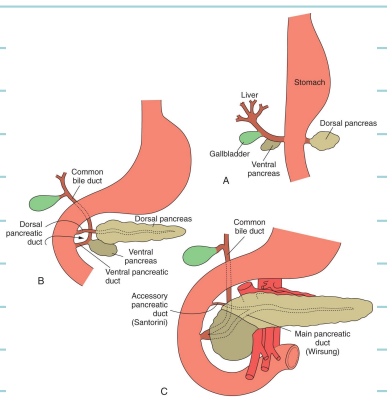
Result:

1)Most of the duodenum becomes retroperitoneal.

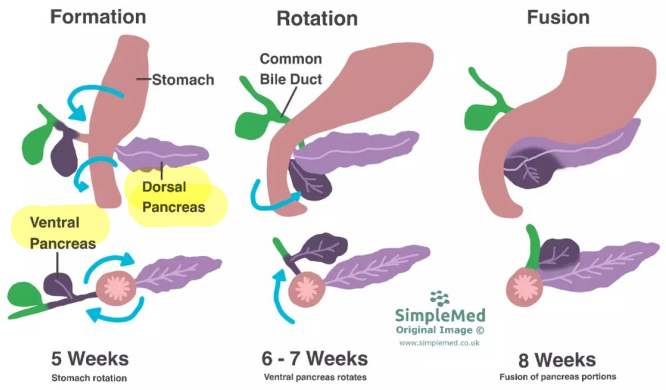
2) The duodenal cap near the pylorus remains intraperitoneal.

Duodenal lumen During the second month:

The lumen of the duodenum is temporarily obliterated by epithelial proliferation, Then it is recanalized.



13.Pancreas Development



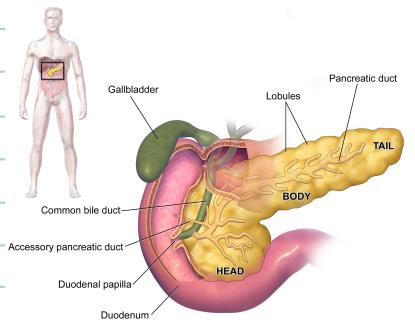
The pancreas develops from two endodermal buds from the duodenum:

1. Dorsal pancreatic bud
2. Ventral pancreatic bud

The dorsal bud is located in the dorsal mesentery.

The ventral bud is close to the bile duct.

When the duodenum rotates to the right, the ventral pancreatic bud moves dorsally and comes to lie behind and below the dorsal bud.



Pancreatic ducts:

1)The main pancreatic duct / duct of Wirsung is formed from:

Entire ventral pancreatic duct

Distal part of dorsal pancreatic duct

2)The accessory pancreatic duct / duct of Santorini comes from the proximal part of the dorsal pancreatic duct if it persists.

Pancreatic Endocrine Development

Pancreatic islets of Langerhans develop during the 3rd month.

Insulin secretion begins around the 5th month.

Other endocrine cells also develop: Glucagon-secreting cells,Somatostatin-secreting cells

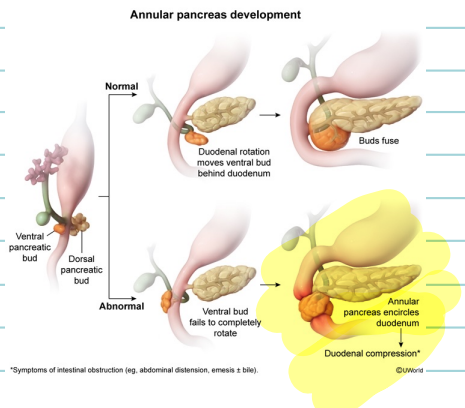
-**The surrounding splanchnic mesoderm forms the connective tissue of the pancreas.**

Pancreatic Abnormalities:

A. Annular pancreas

Normally, the ventral pancreatic bud rotates around the duodenum.

In annular pancreas, part of the ventral bud migrates in the wrong direction.



Result:

-Pancreatic tissue surrounds the duodenum.

- It may constrict the duodenum.

-It can cause complete duodenal obstruction.

B. Accessory / ectopic pancreatic tissue

Accessory pancreatic tissue may be found anywhere from:

Distal end of esophagus To the tip of the primary intestinal loop

Most common sites:

-Mucosa of stomach ,Meckel's diverticulum