

Clinical

# GI EMBRYOLOGY 1



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# Outline

*Clinical*

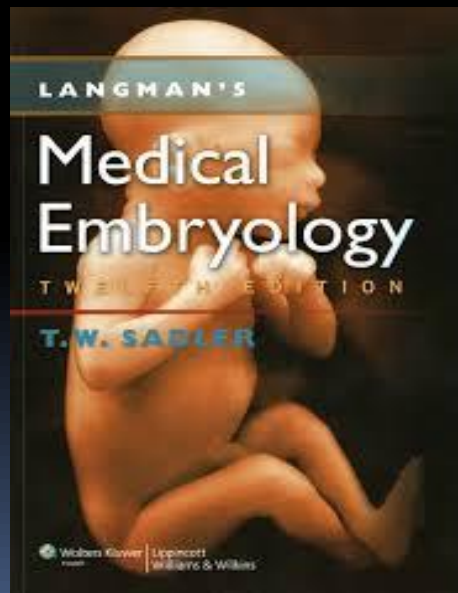
- Lecture one :
  - Gut formation
  - Foregut:
    - esophagus, stomach, Duodenum
    - Liver , gall bladder and pancreas
    - Spleen
- Lecture Two :
  - Mid gut : duodenum . Jejuno-ileum, colon
  - Hind gut : distal transverse colon – anal canal

# Clinical correlation

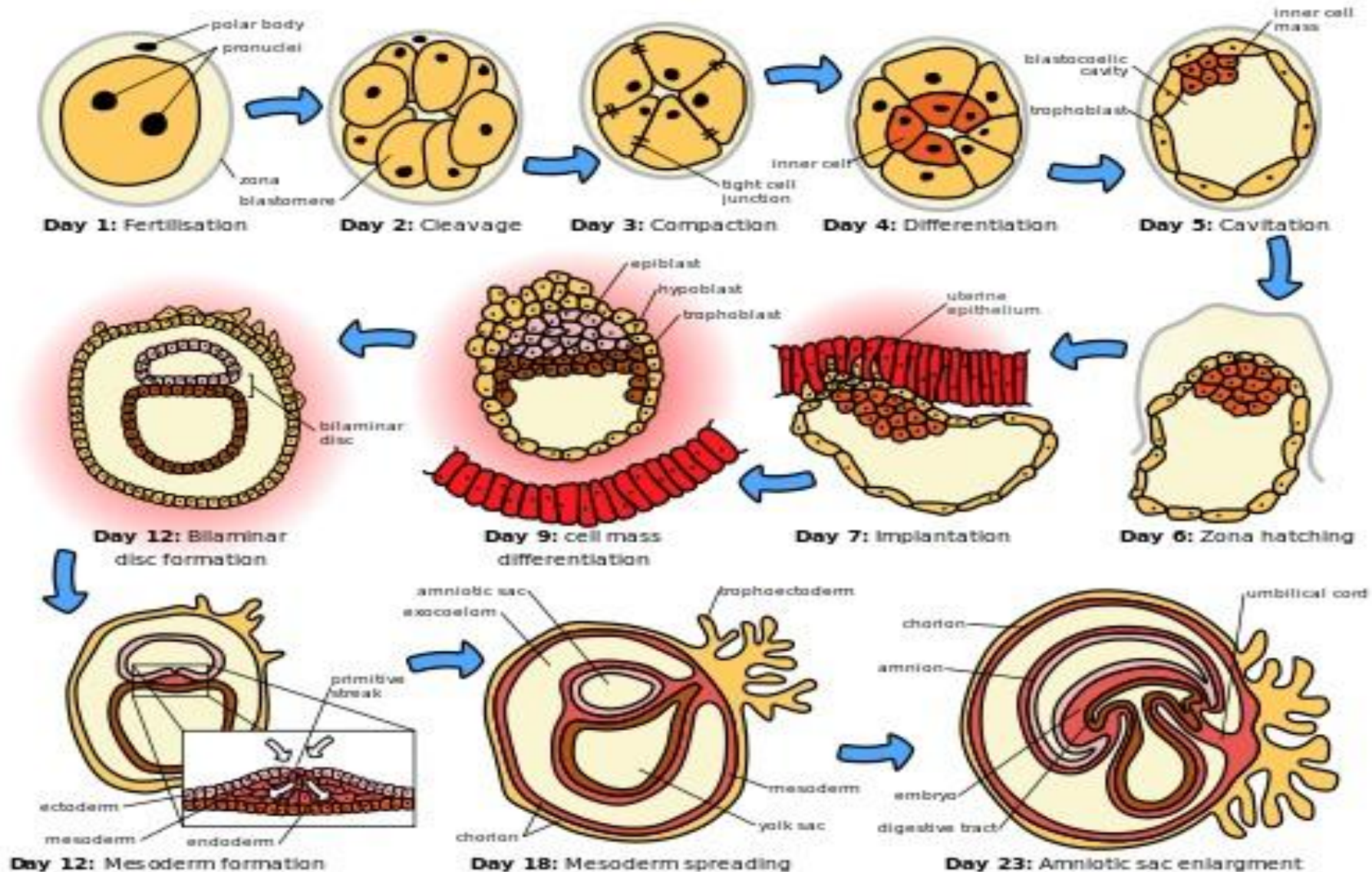
- Symptoms related to GI tract development:
  - Vomiting
  - Jaundice
  - Abdominal distension
  - constipation

# References

- Lecture slides
- Langman medical embryology
  - Chap 15

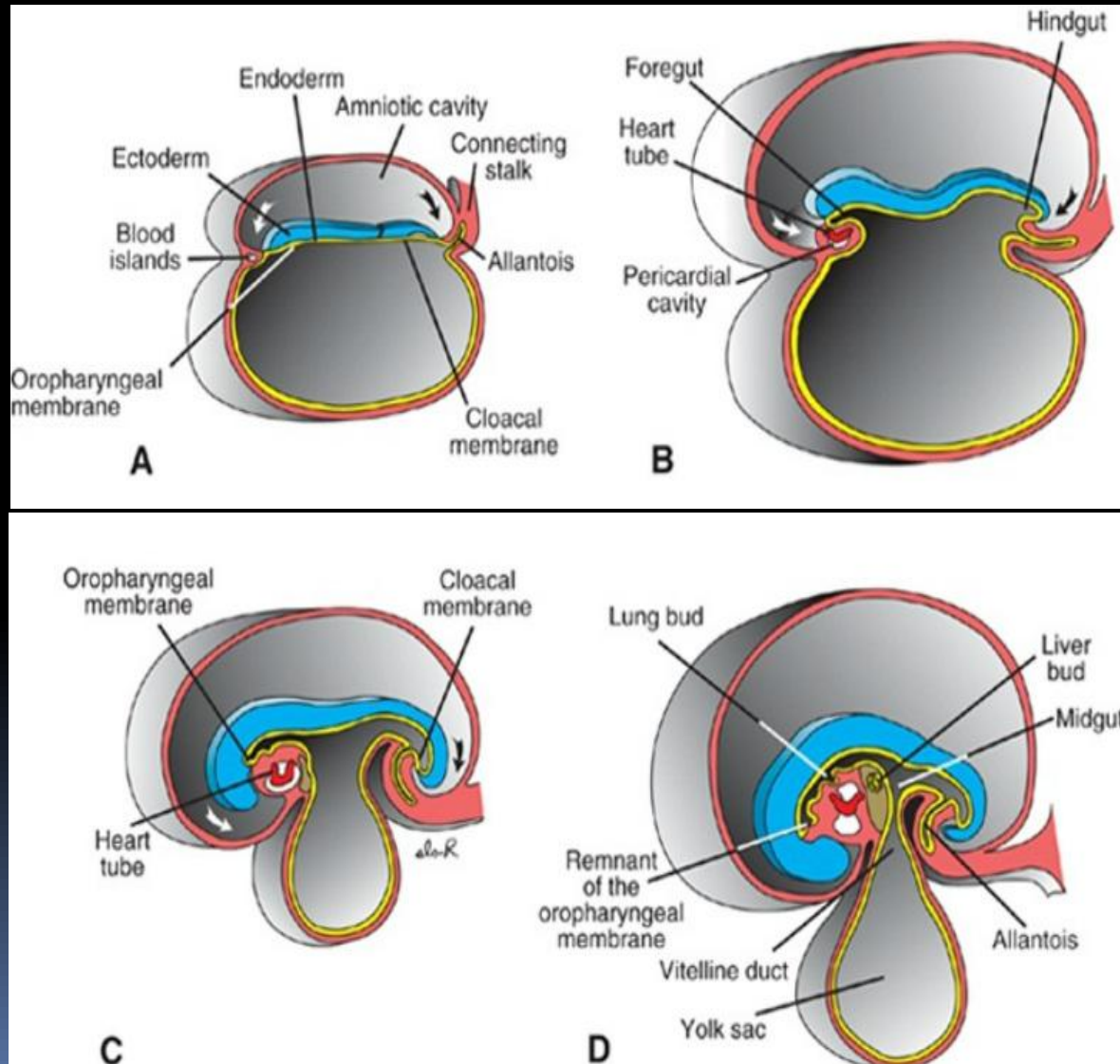


# Quick review



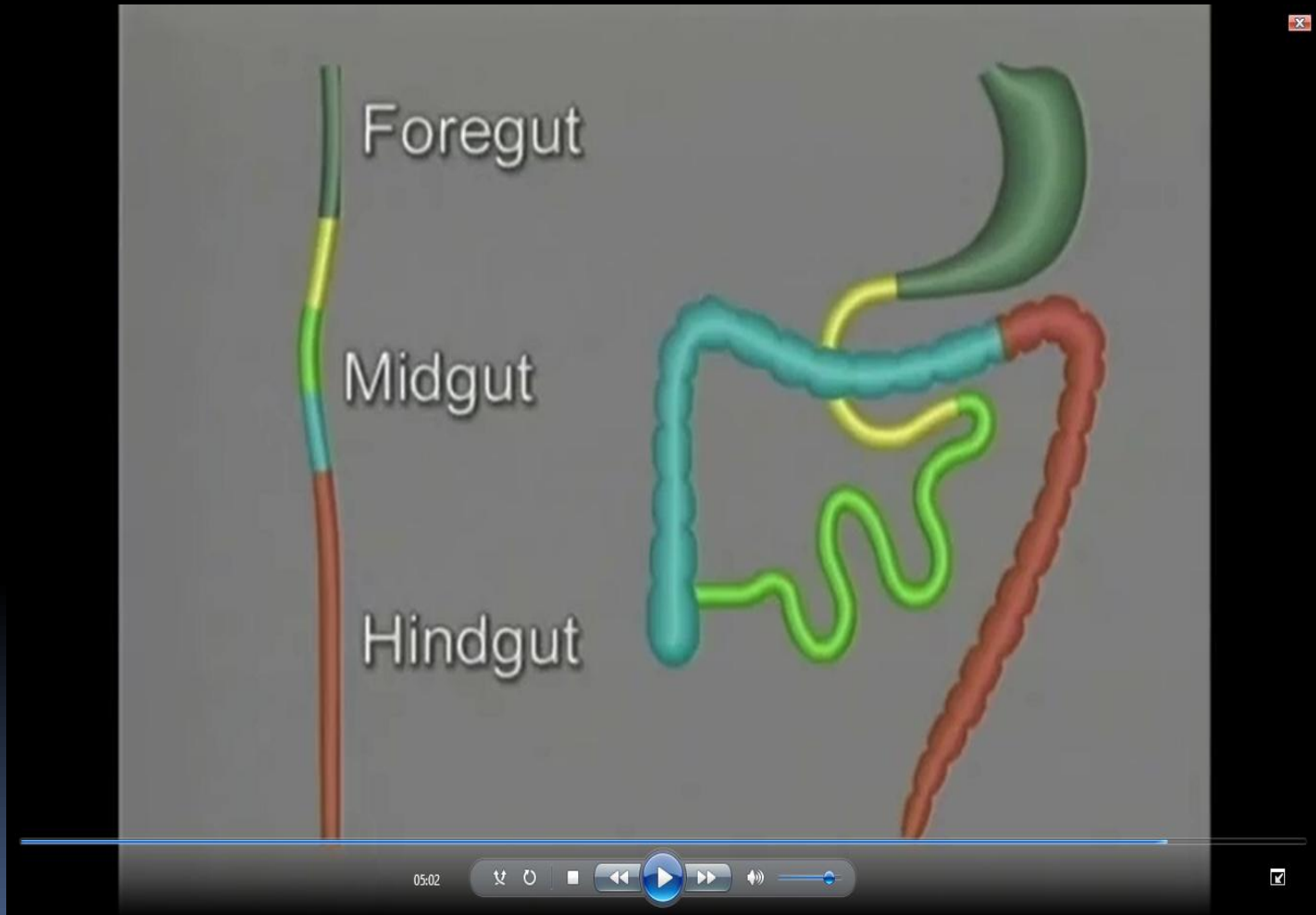


# Embryo folding

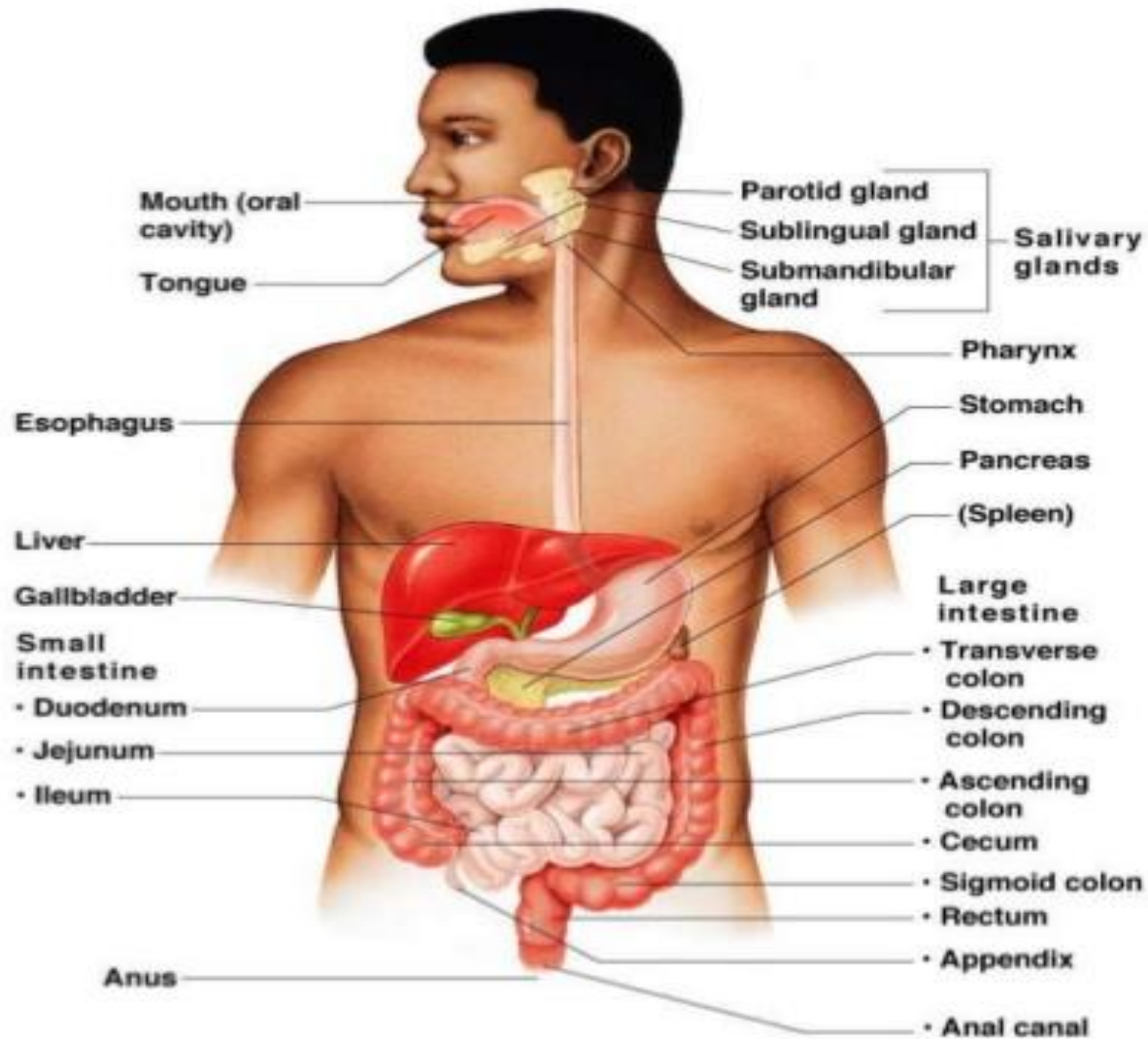


One  
month

# GI embryology



# GI Tract

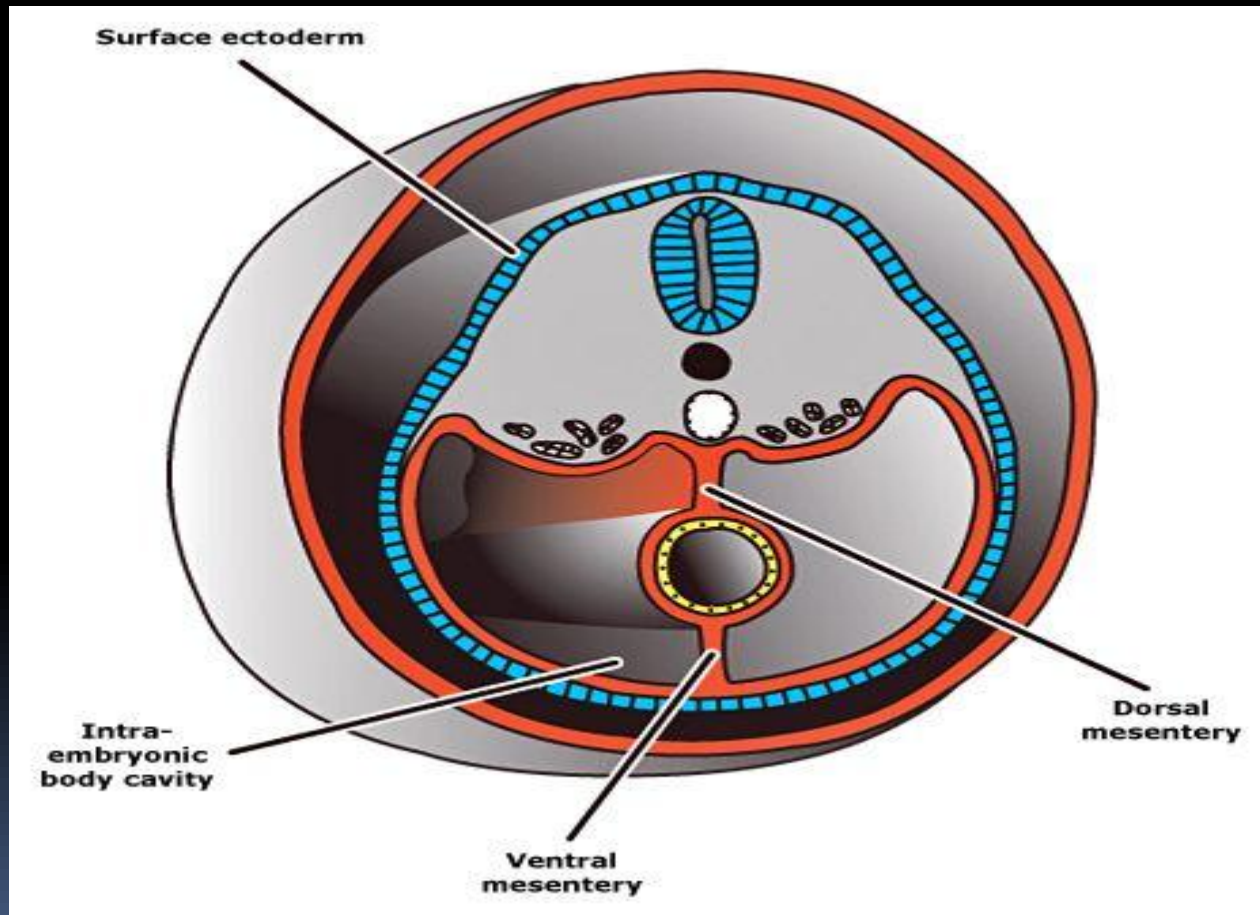




# GI tract origin

- Endoerm :
  - Epithelial lining of GI tract
  - Organ parenchyma : hepatocytes and pancreas glands
- Mesoderm :
  - Stroma ( connective tissue) of the GI glands
  - Muscles, CT tissue, and gut peritoneum
  - spleen

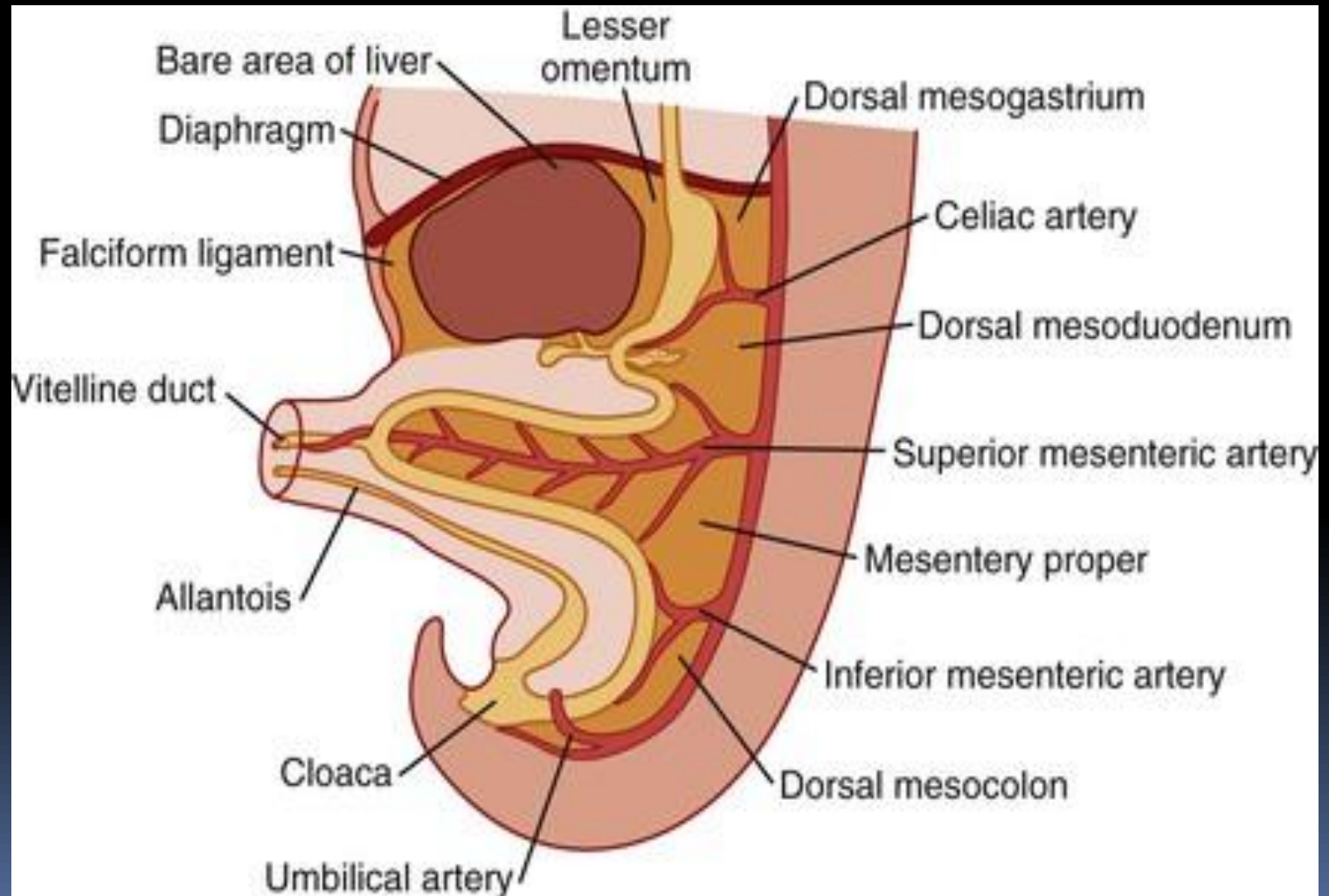
# mesenteries



# Mesenteries

- Double layer of peritoneum
- Suspend the gut tube in abdominal cavity
- provide pathway for nerves , blood vessels , and lymphatics to pass to the organs
- **Dorsal mesentery** : from esophagus to lower hind gut
- **Ventral mesentery** : esophagus to upper duodenum . Called **septum transversum**

# Dorsal and ventral mesentery





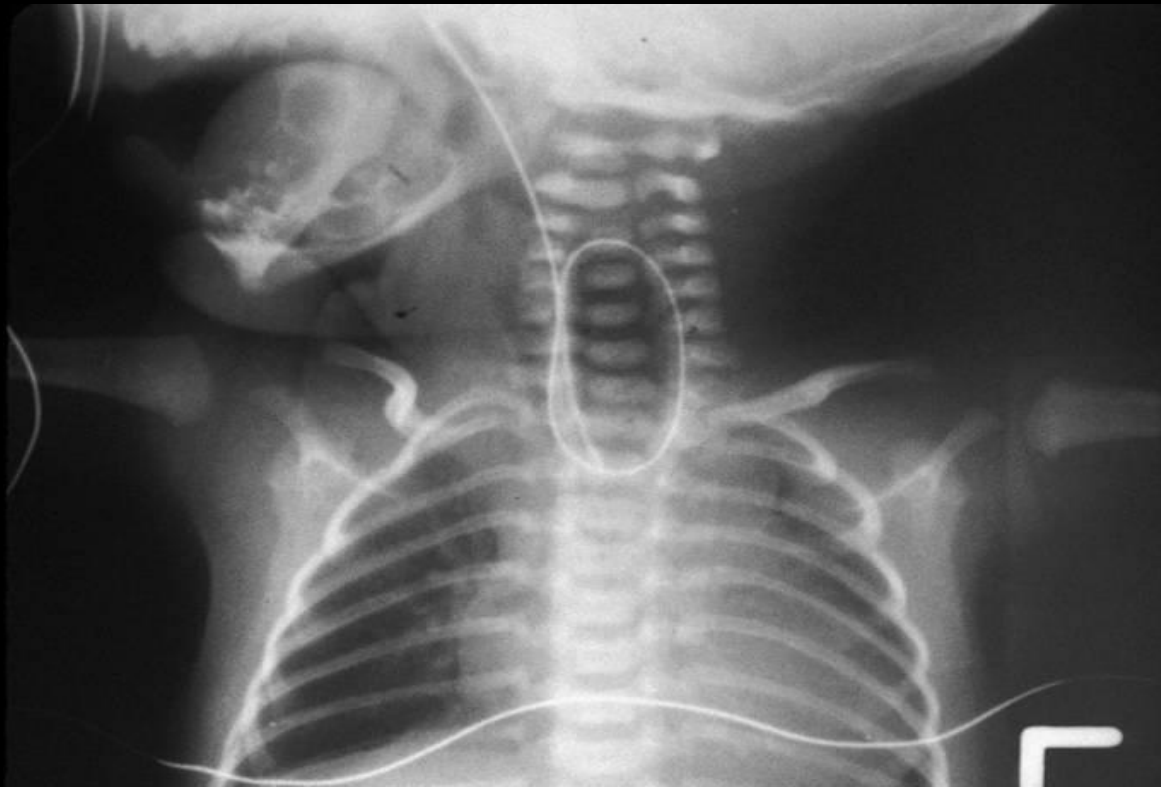
# Clinical GI embryology



# Case 1



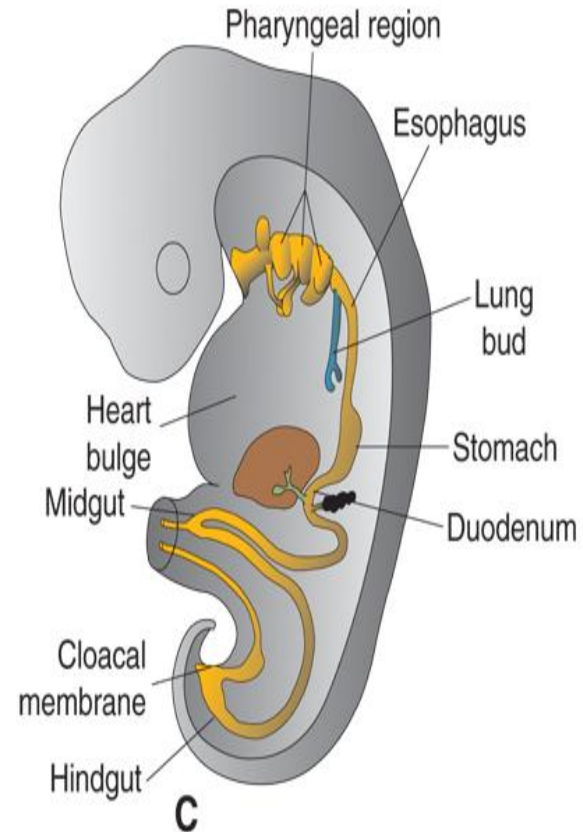
## Vomiting



**Esophageal atresia**

# embryology of esophagus

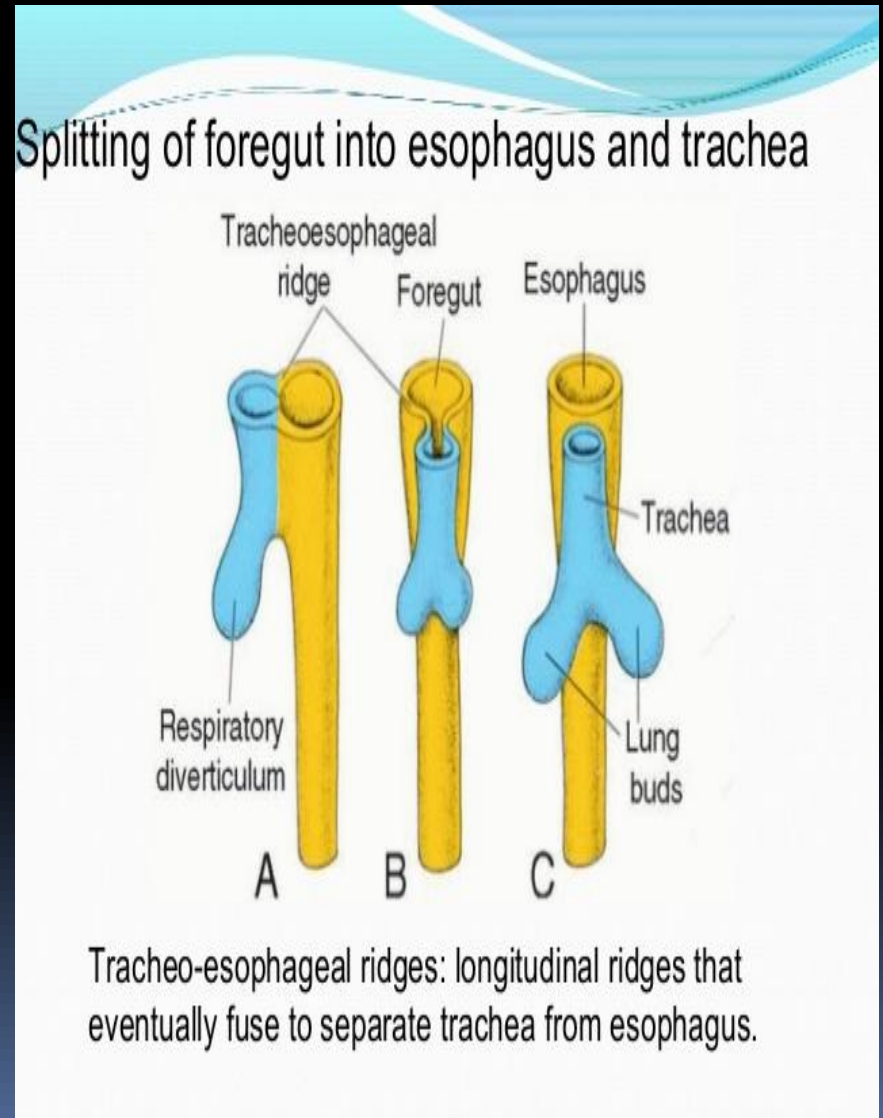
- 4 weeks old embryo
- **respiratory diverticulum (lung bud)** : an **outgrowth** from the ventral wall of the foregut



6-1C Lung bud initiation and branching


# Stages of development

1. the lung bud is in **open communication** with the foregut
  2. diverticulum expands caudally
  3. the **tracheoesophageal ridges**, separate it from the foregut
  4. The 2 ridges fuse : **tracheoesophageal septum**
  5. the foregut is divided into :
    - dorsal portion: the esophagus
    - ventral portion: the trachea and lung buds
- The respiratory primordium maintains its communication with the pharynx through the **laryngeal orifice**.





# Stages of development

- At first the esophagus is short
  - but with descent of the heart and lungs it lengthens rapidly
- 





# Esophageal Abnormalities



# Esophageal atresia tracheoesophageal fistula

# Surgery

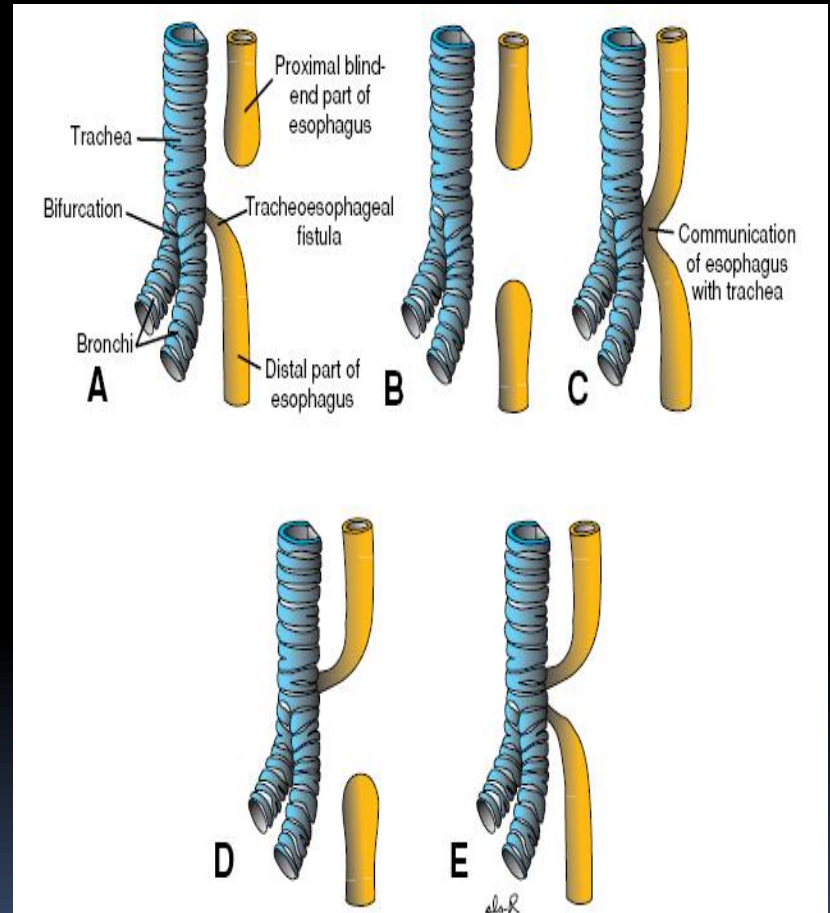
results either from:

- spontaneous posterior deviation of the **tracheoesophageal septum**.
- or from some mechanical factor pushing the dorsal wall of the foregut anteriorly

**most common form :**

the proximal part of the esophagus ends as a blind sac, and the distal part is connected to the trachea by a narrow canal just above the bifurcation

- Atresia of the esophagus prevents normal passage of amniotic fluid into the intestinal tract : **polyhydramnios**

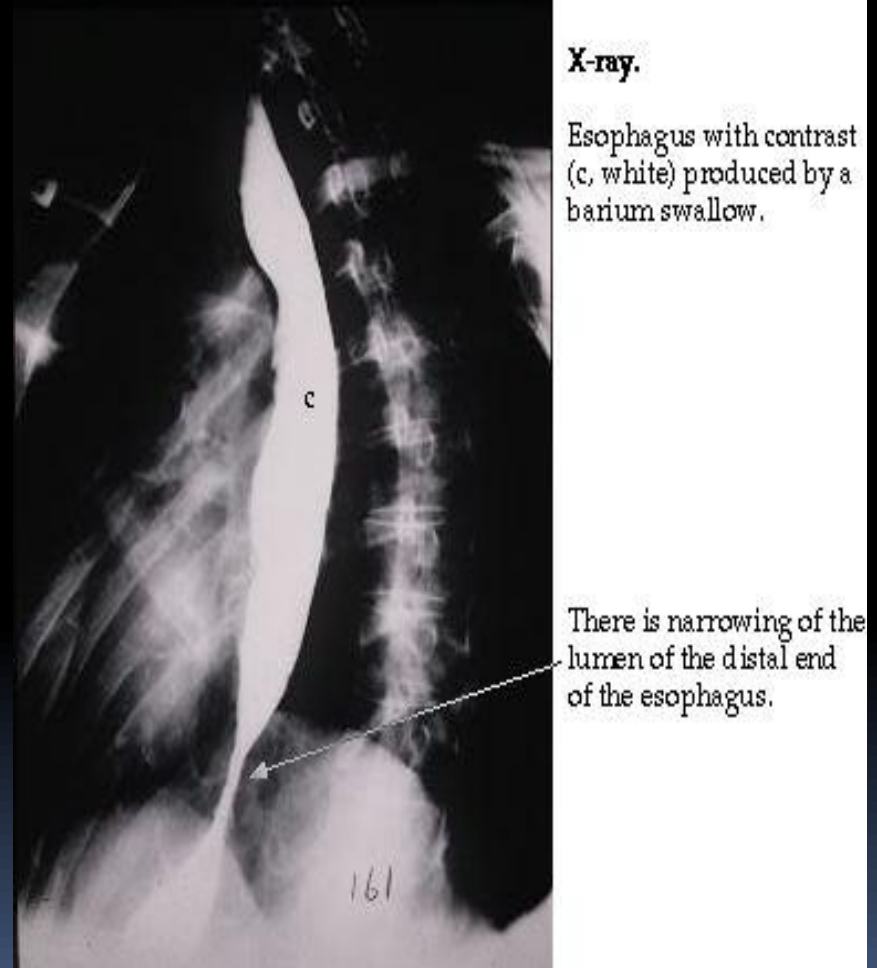


**Figure 13.7** Variations of esophageal atresia and/or tracheoesophageal fistula in order of their frequency of appearance: A, 90%; B, 4%; C, 4%; D, 1%; and E, 1%.

# Other causes for vomiting

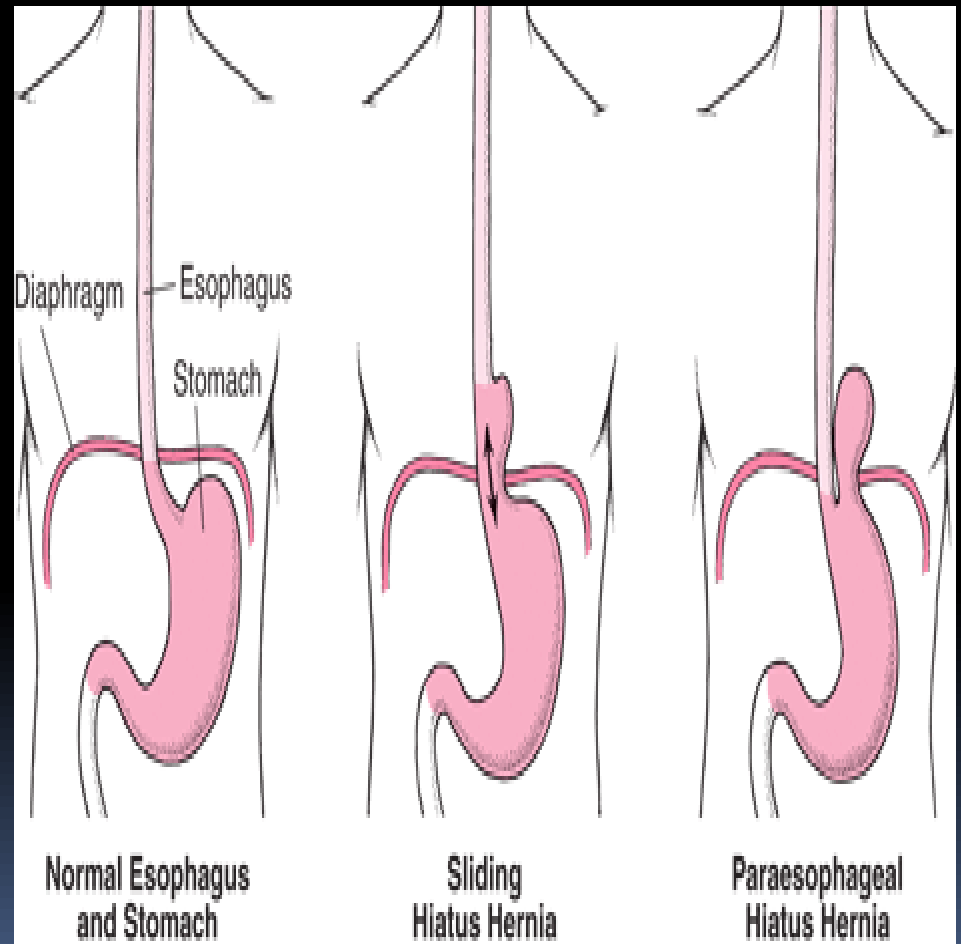
## esophageal stenosis

- usually in the lower third
- caused by :
  - incomplete recanalization
  - vascular abnormalities
- /accidents : compromise blood flow



# congenital hiatal hernia

- the esophagus fails to lengthen sufficiently
- the stomach is pulled up into the esophageal hiatus through the diaphragm.



# Esophagus muscle layers

- formed by surrounding splanchnic mesenchyme.
- Upper 2/3: **striated** and innervated by the **vagus**
- lower third : **smooth** and is innervated by the **splanchnic plexus**

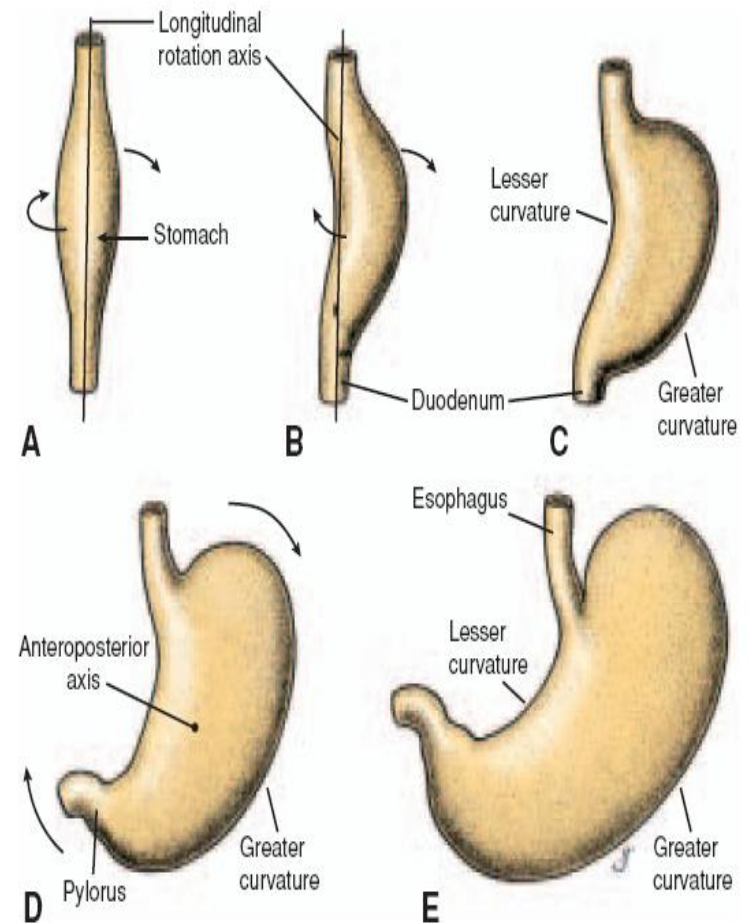




# STOMACH

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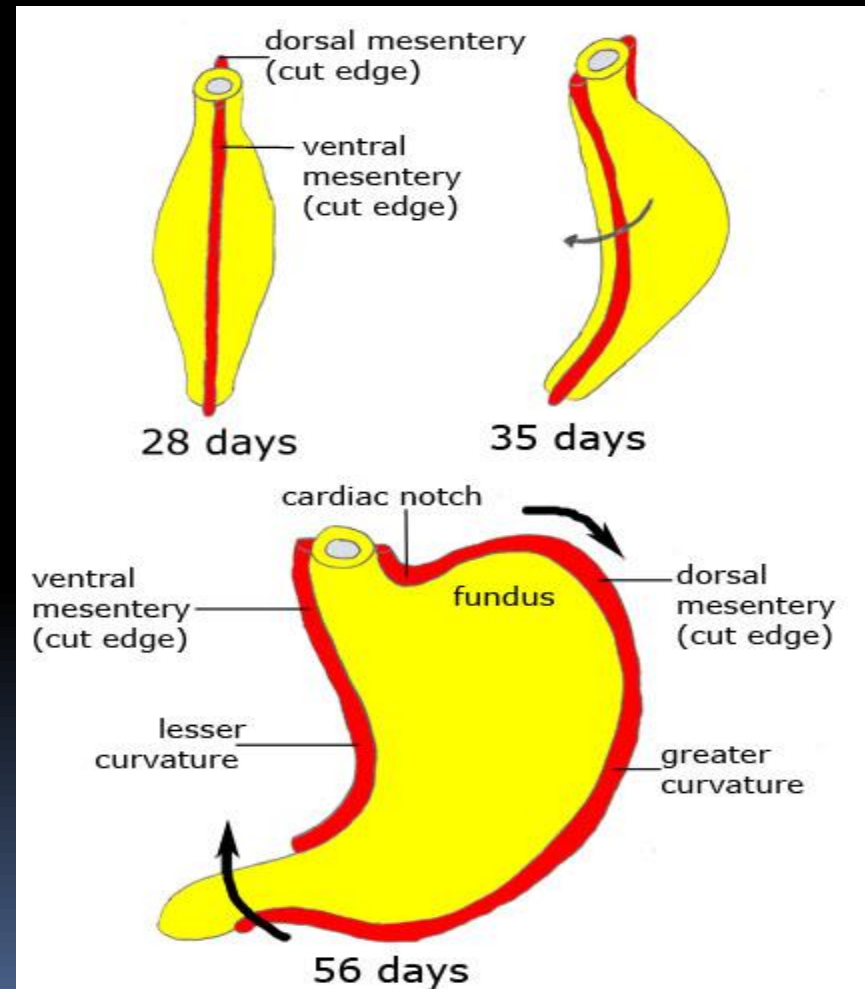
- **fourth week** of development
- fusiform dilation of the foregut
- appearance and position change
- growth in **various regions** of its wall



**Figure 13.8** A, B, and C. Rotation of the stomach along its longitudinal axis as seen anteriorly. D and E. Rotation of the stomach around the anteroposterior axis. Note the change in position of the pylorus and cardia.

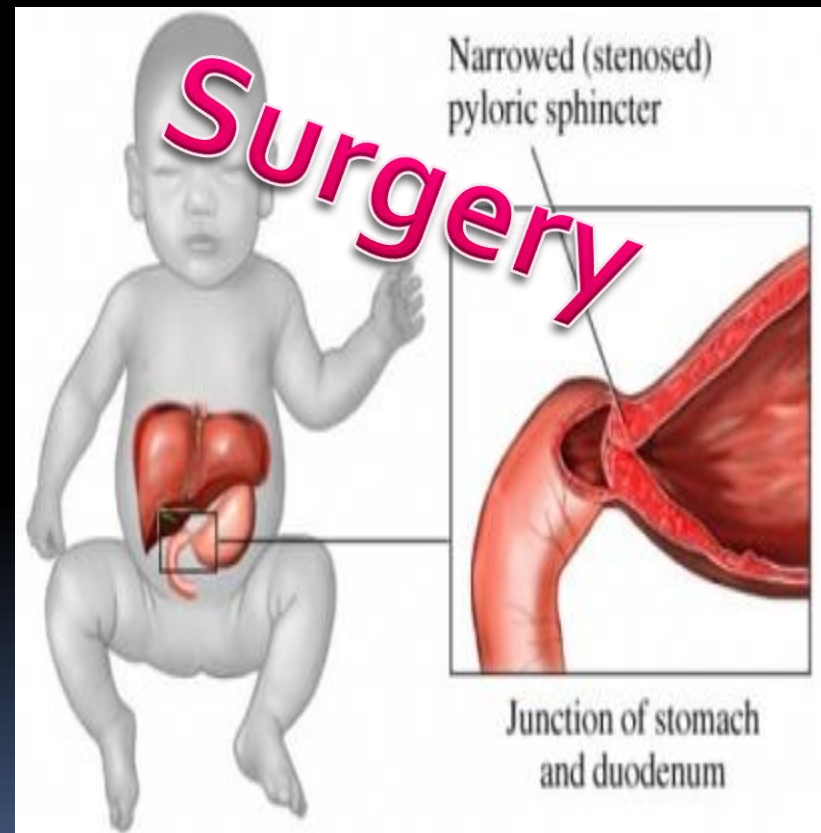
# Stomach development

- rotates 90° clockwise around its longitudinal axis :
- left side to face anteriorly and its right side to face posteriorly
- the left vagus nerve :innervates the anterior wall
- the right vagus nerve innervates the posterior wall
- During this rotation the original posterior wall of the stomach grows faster than the anterior portion, forming the greater and lesser curvatures



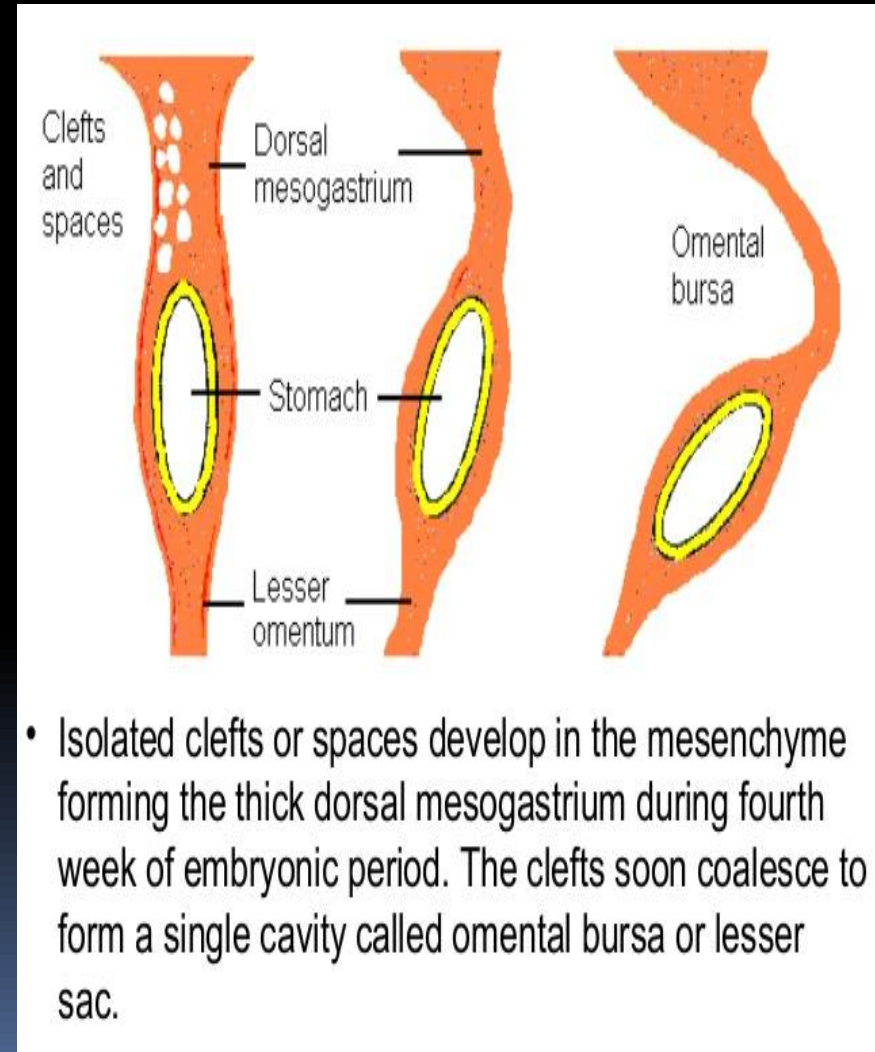
# Another cause of vomiting

- **Pyloric stenosis**
- Due to hypertrophy of the pylorus muscles
- One of the most common abnormalities of the stomach in infants.
- develops during fetal life (3-6) weeks



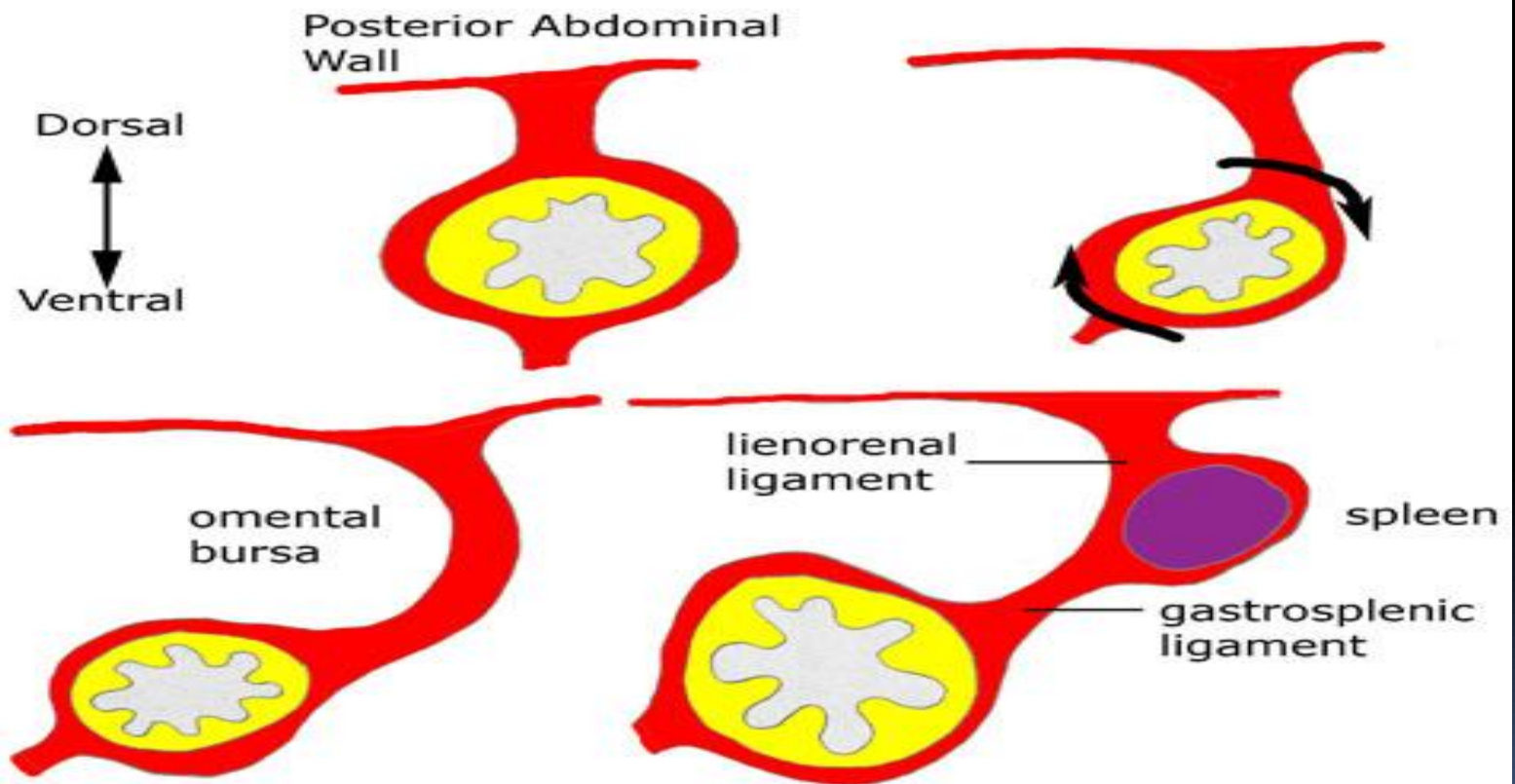
# Stomach attachments

- to the dorsal body wall by the **dorsal mesogastrium** .
- to the ventral body wall by the **ventral mesogastrium**
- its rotation and disproportionate growth alter the position of these mesenteries.
- Rotation about the longitudinal axis pulls the dorsal mesogastrium to the left, creating a space behind the stomach called the omental bursa (lesser peritoneal sac)
- This rotation also pulls the ventral mesogastrium to the right.



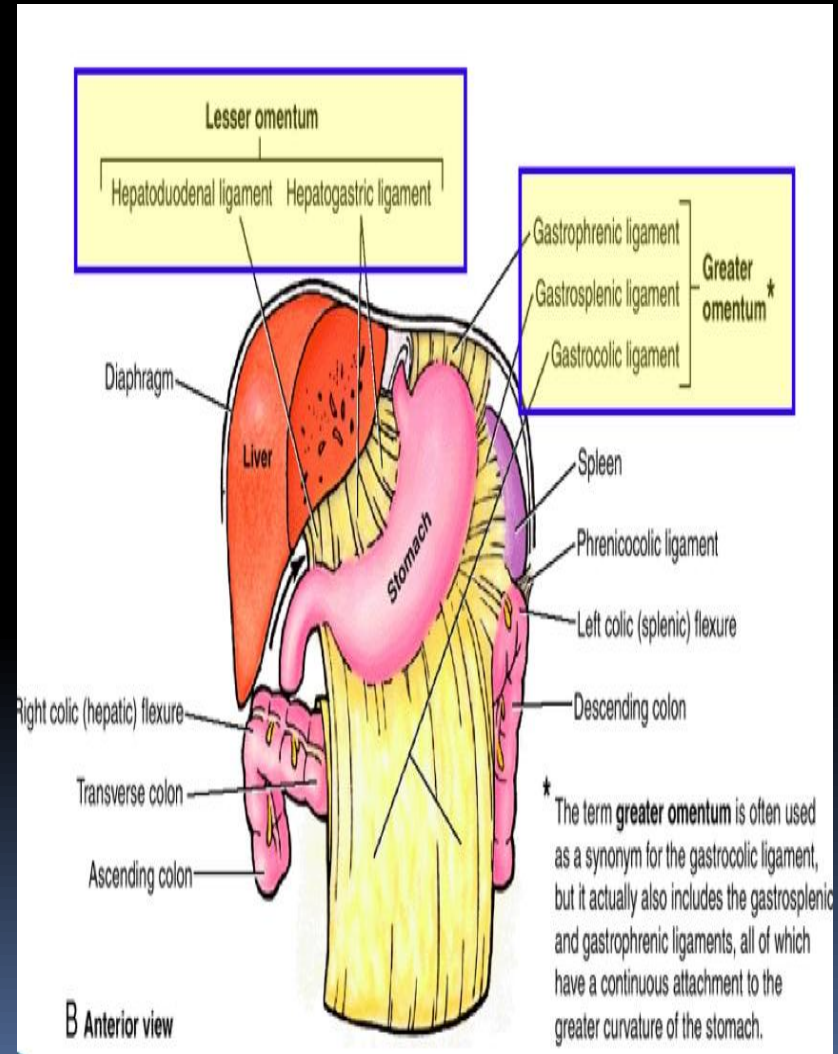


## Transverse Section Stomach



# With stomach rotation

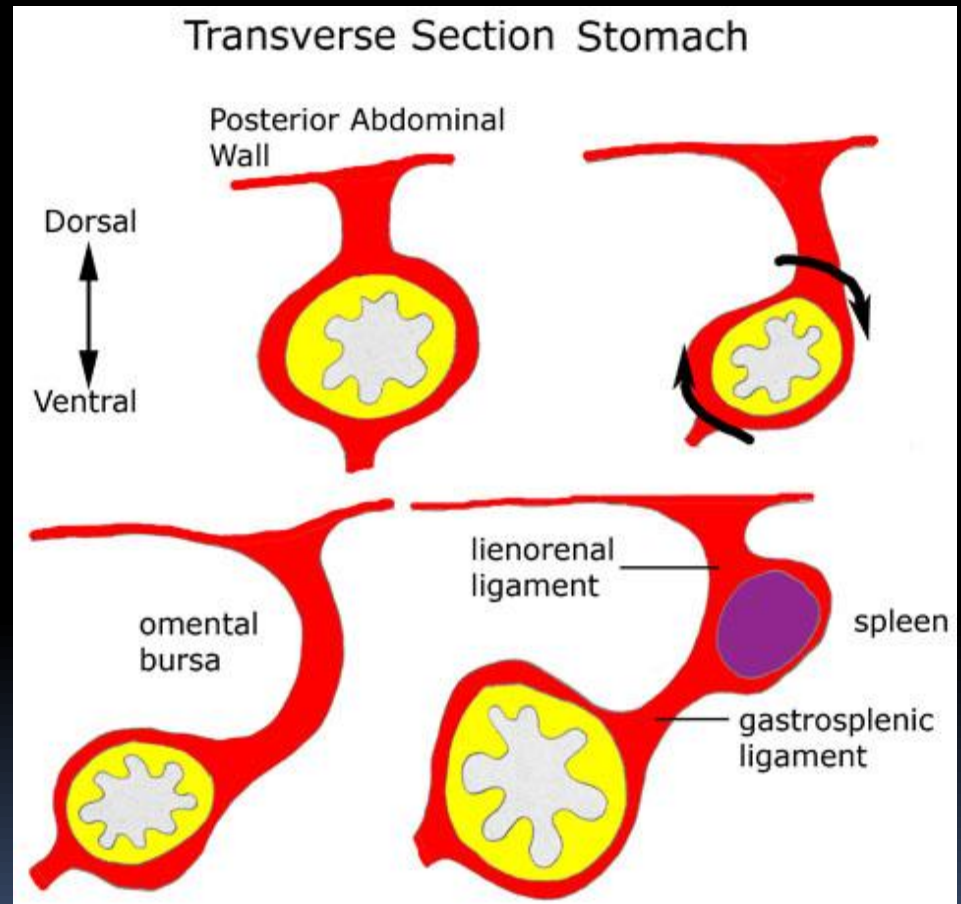
- the **dorsal mesogastrium** bulges down
- It continues to grow down and forms a double-layered sac over the transverse colon and small intestinal loops
- **greater omentum**



# SPLEEN

# Spleen

- fifth week
- spleen primordium appears .
- Mesenchyme
- between the two leaves of the dorsal mesogastrium
- Intraperitoneal structure



## Case 2!



**Jaundice**

**Biliary  
Atresia**





# LIVER & GALL BLADDER

# Liver and gall bladder

- middle of the third week
- **hepatic diverticulum, or liver bud**
- Outgrowth of foregut
- penetrates **the septum transversum**  
(**ventral mesentery**)
- connection between the hepatic diverticulum and the foregut (duodenum) narrows, forming the **bile duct**
- A small ventral outgrowth is formed by the bile duct to give : **gallbladder** and the **cystic duct**

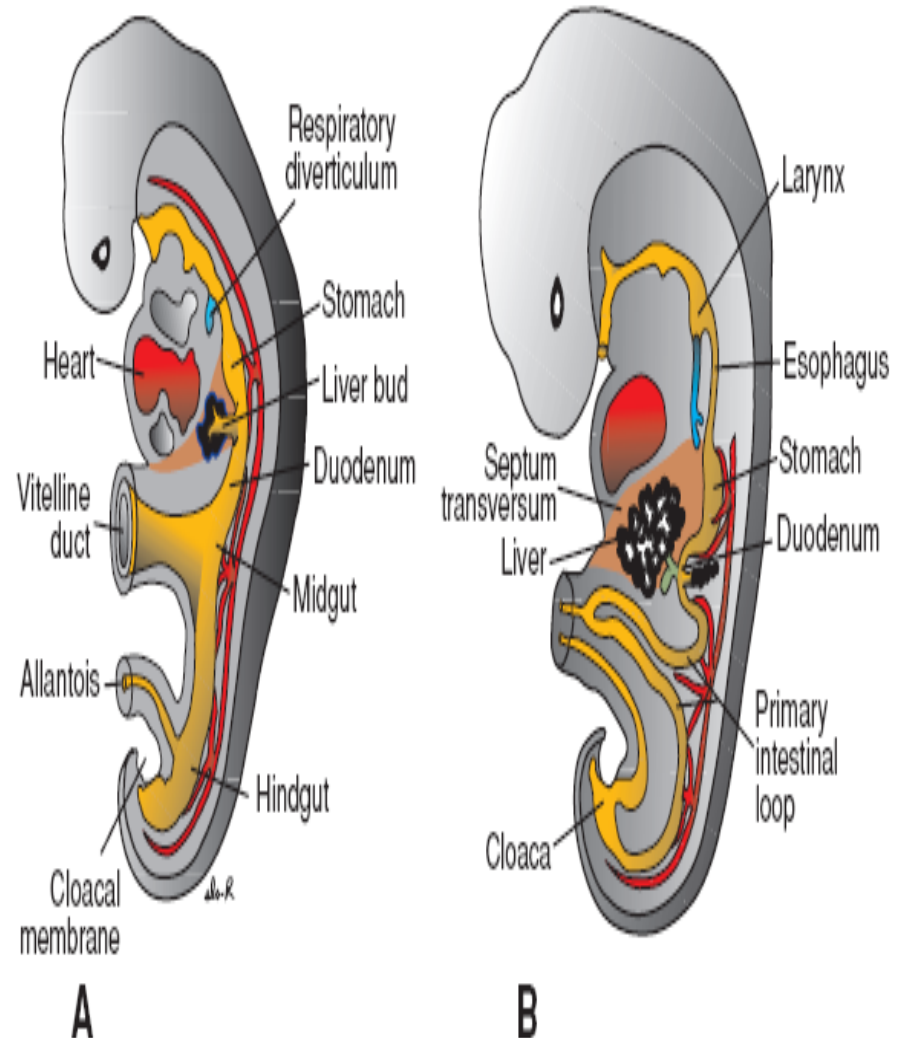
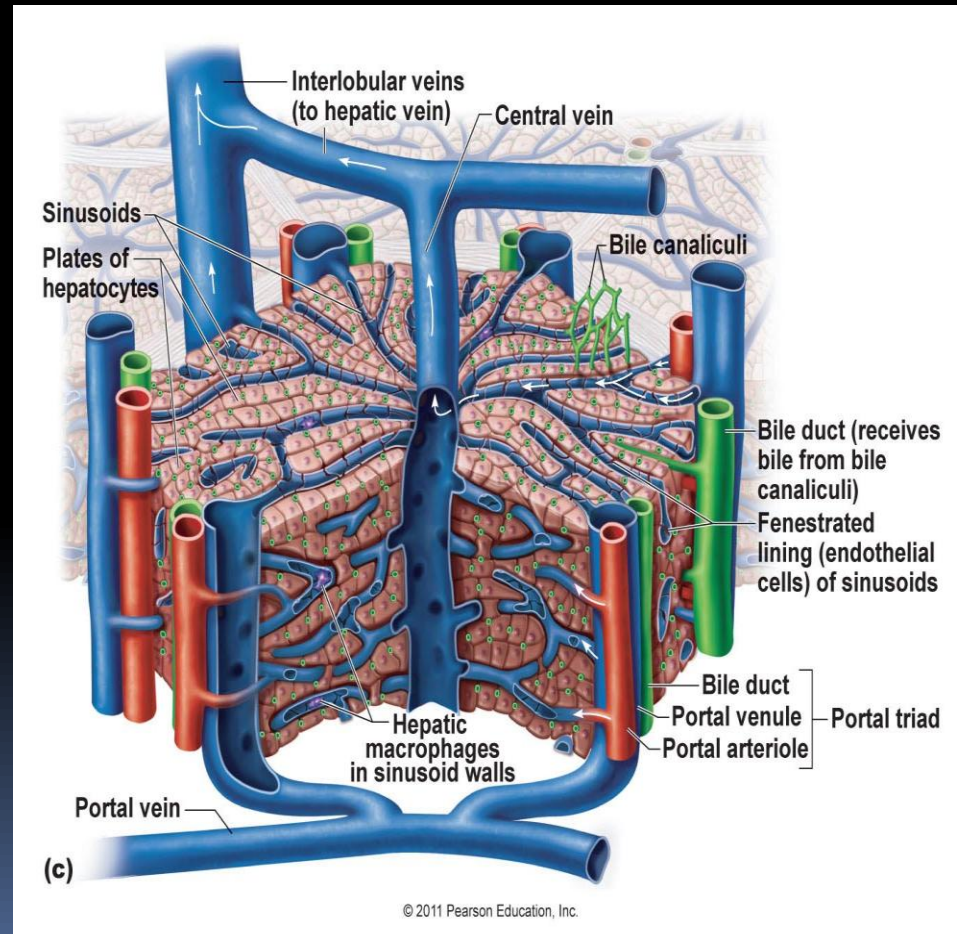


Figure 13.14 A. A 3-mm embryo (approximately 25 days) showing the primitive gas-

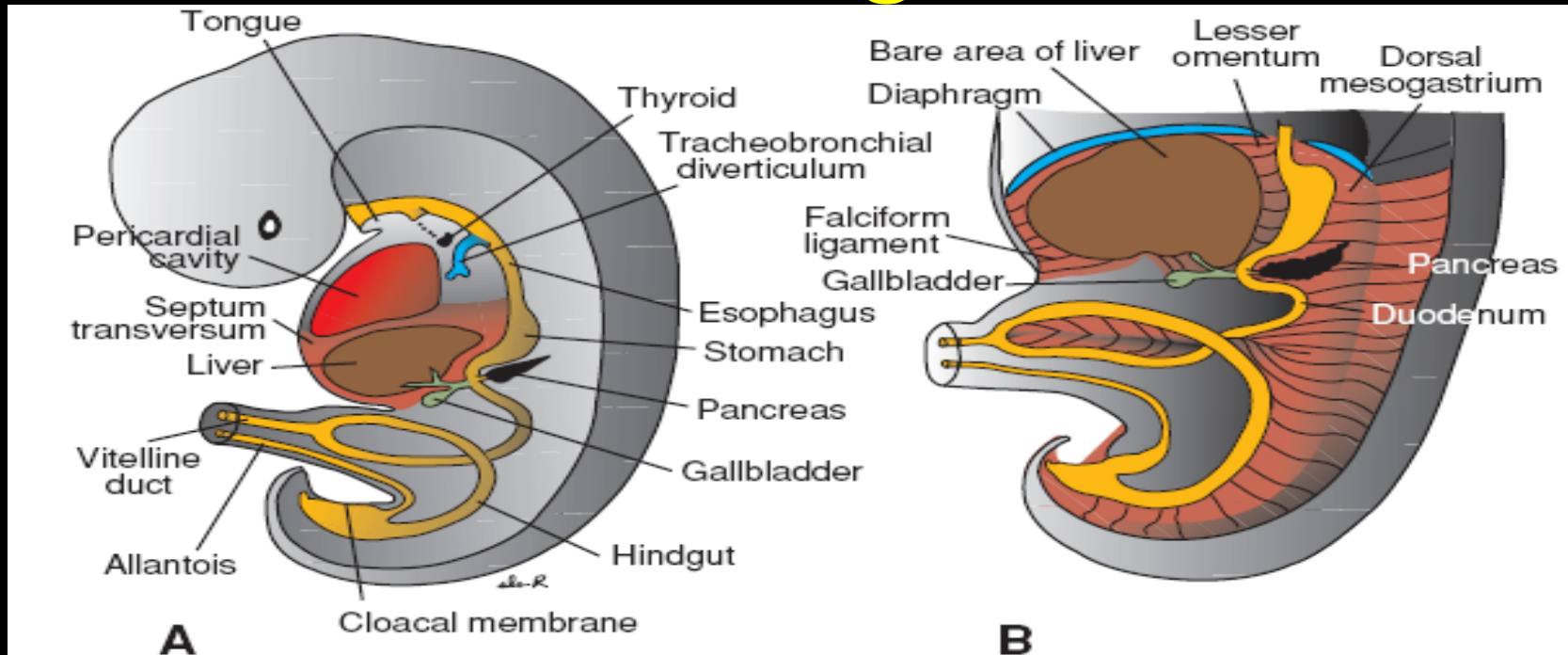


# Liver parenchyma

- **Hepatocytes** and **bile ducts** lining : from epithelial liver cords
- **Hepatic sinusoids**: combination from epithelial liver cords and umbilical veins and viteline ducts
- **Hematopoietic cells**, Kupffer cells, and connective tissue cells are derived from mesoderm of the septum transversum



# Liver ligaments

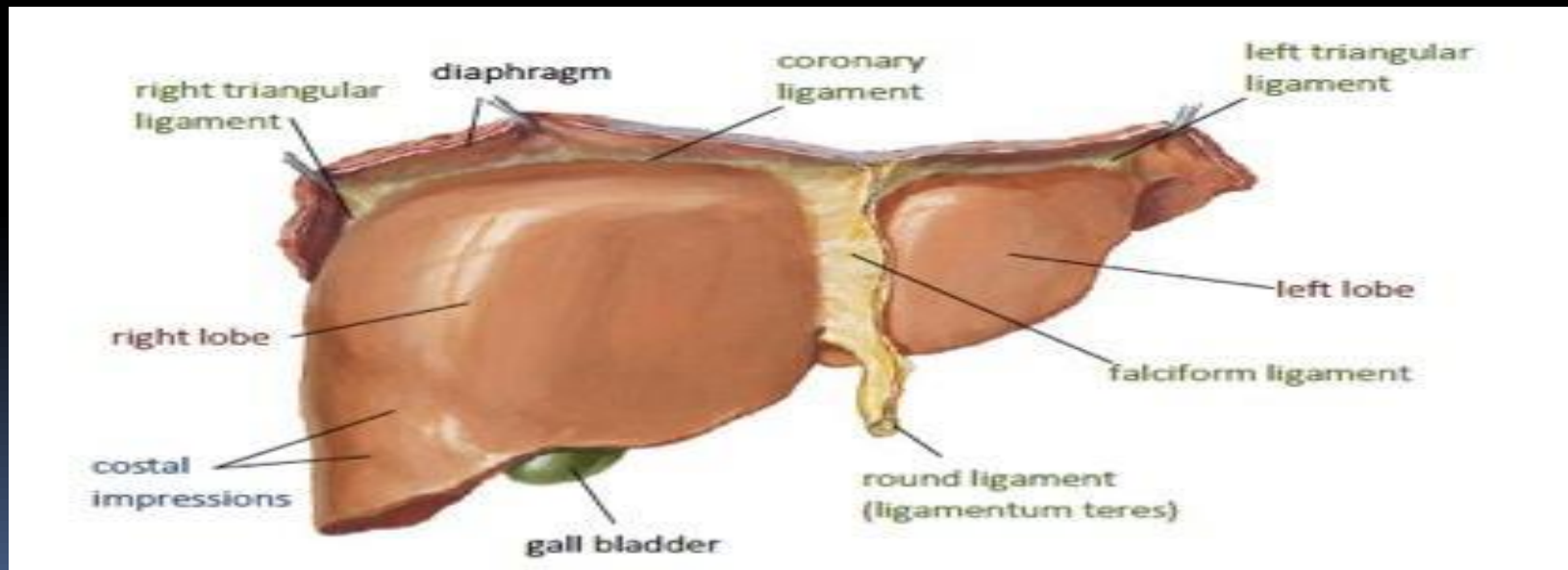


Septum transversum :

falciform ligament + lesser omentum

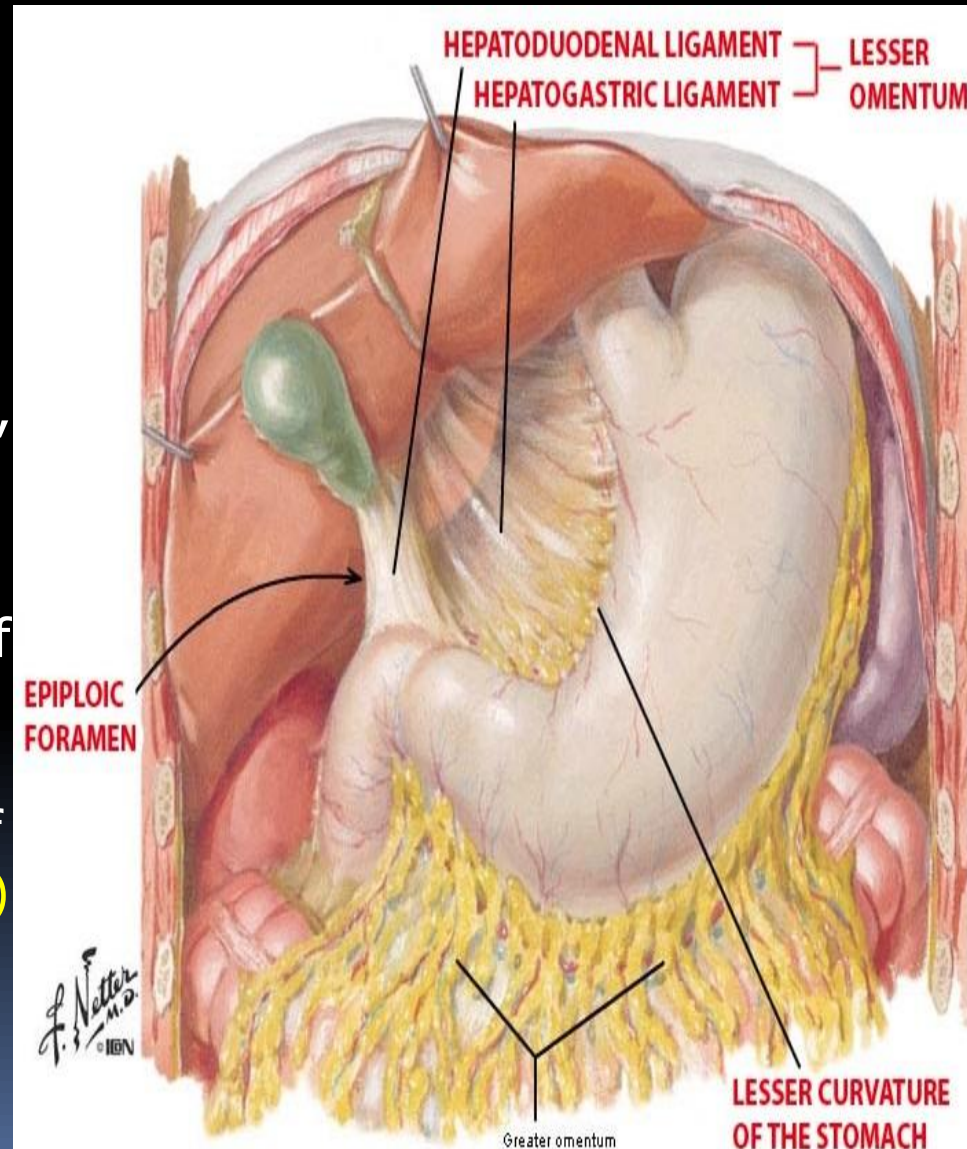
# Liver ligaments

- The free margin of the falciform ligament contains the **umbilical vein**
- Umbilical vein is obliterated after birth to form the **round ligament** of the liver : Ligamentum teres hepatis



# Lesser omentum

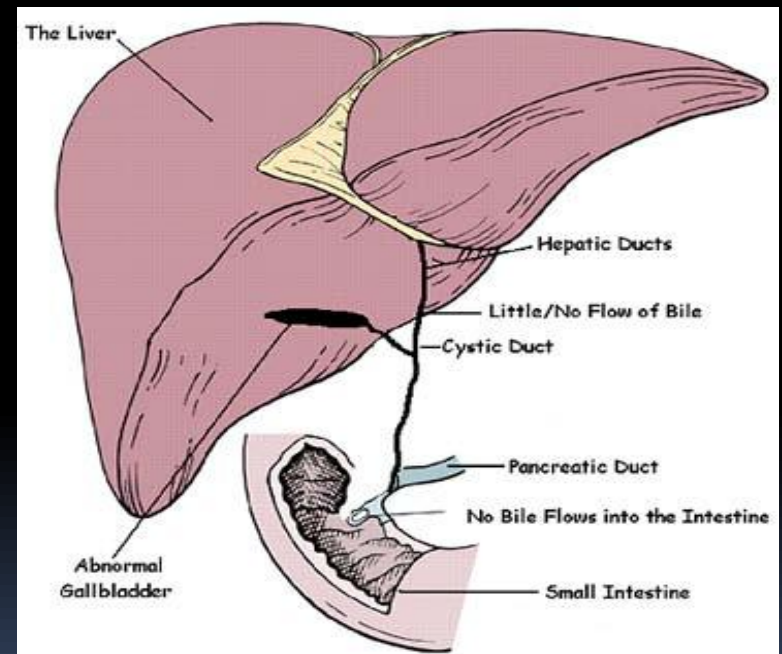
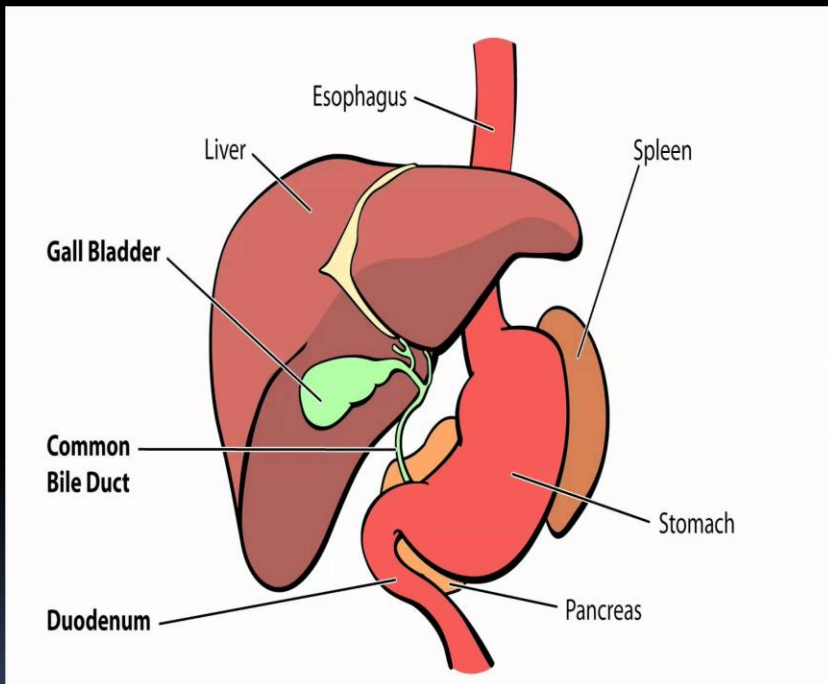
- The free margin of the lesser omentum connects duodenum and liver (hepatoduodenal ligament)
- contains the bile duct, portal vein, and hepatic artery (**portal triad**).
- This free margin forms the roof of the **epiploic foramen of Winslow**: opening connecting the omental bursa (**lesser sac**) with the rest of the peritoneal cavity (**greater sac**)





# Liver and Gallbladder Abnormalities

- Biliary atresia



Unknown etiology

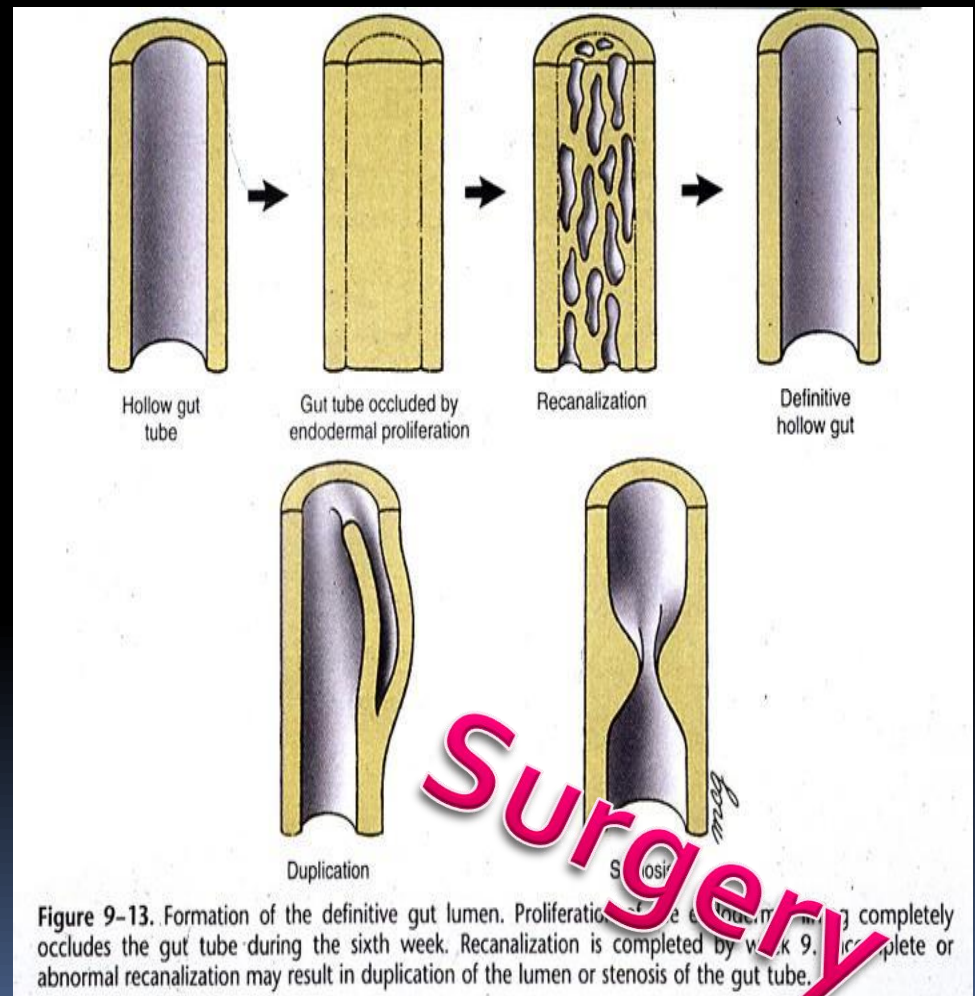
# Surgery

# Duodenum

- From : terminal part of the foregut and the cephalic part of the midgut .
- The junction of the two parts is distal to the origin of the liver bud
- As the stomach rotates, the duodenum takes on the form of a **C-shaped** loop and rotates to the right
- Retroperitoneal except : duodenal cap

# Duodenum

- During the **second month**, the lumen of the duodenum is obliterated by proliferation of cells in its walls.
- It is recanalized shortly thereafter
- Failure to recanalize : **duodenal atresia**
- **Bilious vomiting**



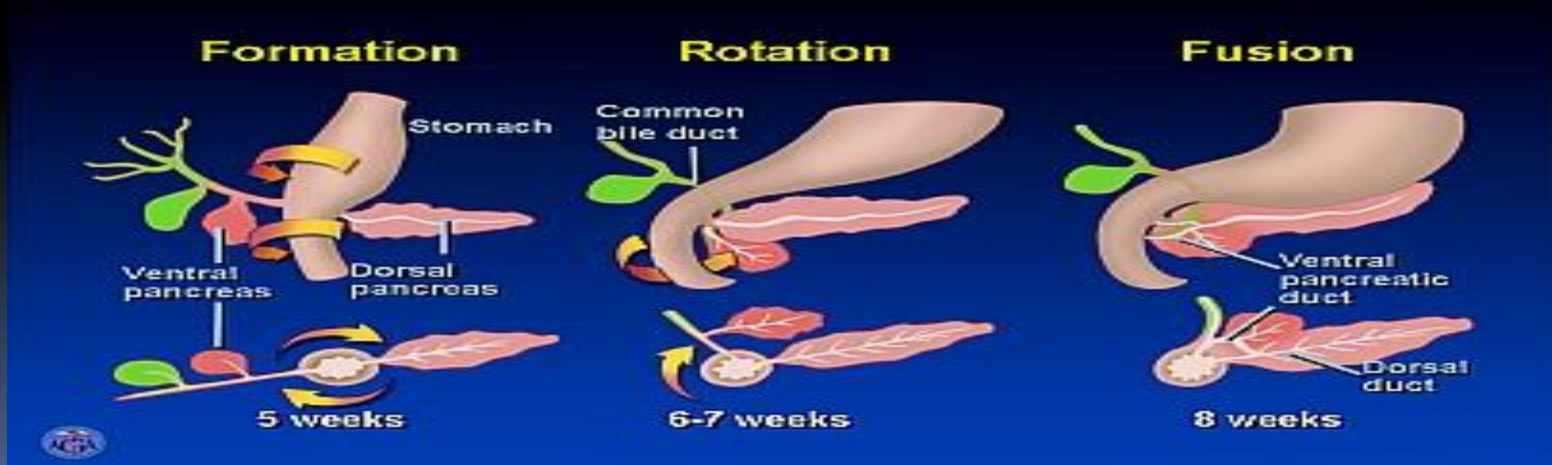


# PANCREAS

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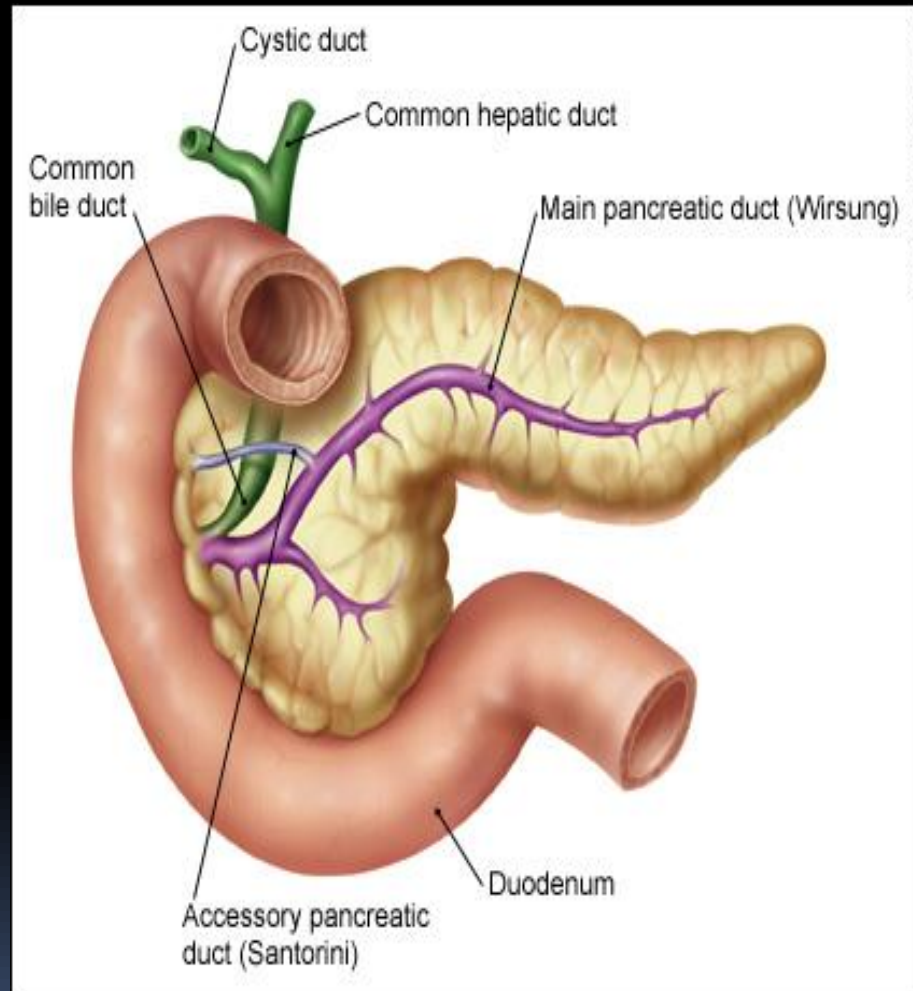
- formed by two buds from the endodermal lining of the duodenum
- dorsal pancreatic bud in dorsal mesentery & ventral pancreatic bud is close to the bile duct
- When the duodenum rotates to the right and becomes C-shaped, the ventral pancreatic bud rotates dorsally along with the bile duct
- the ventral bud fuses with the dorsal bud

## Pancreas - Embryology



# Pancreas

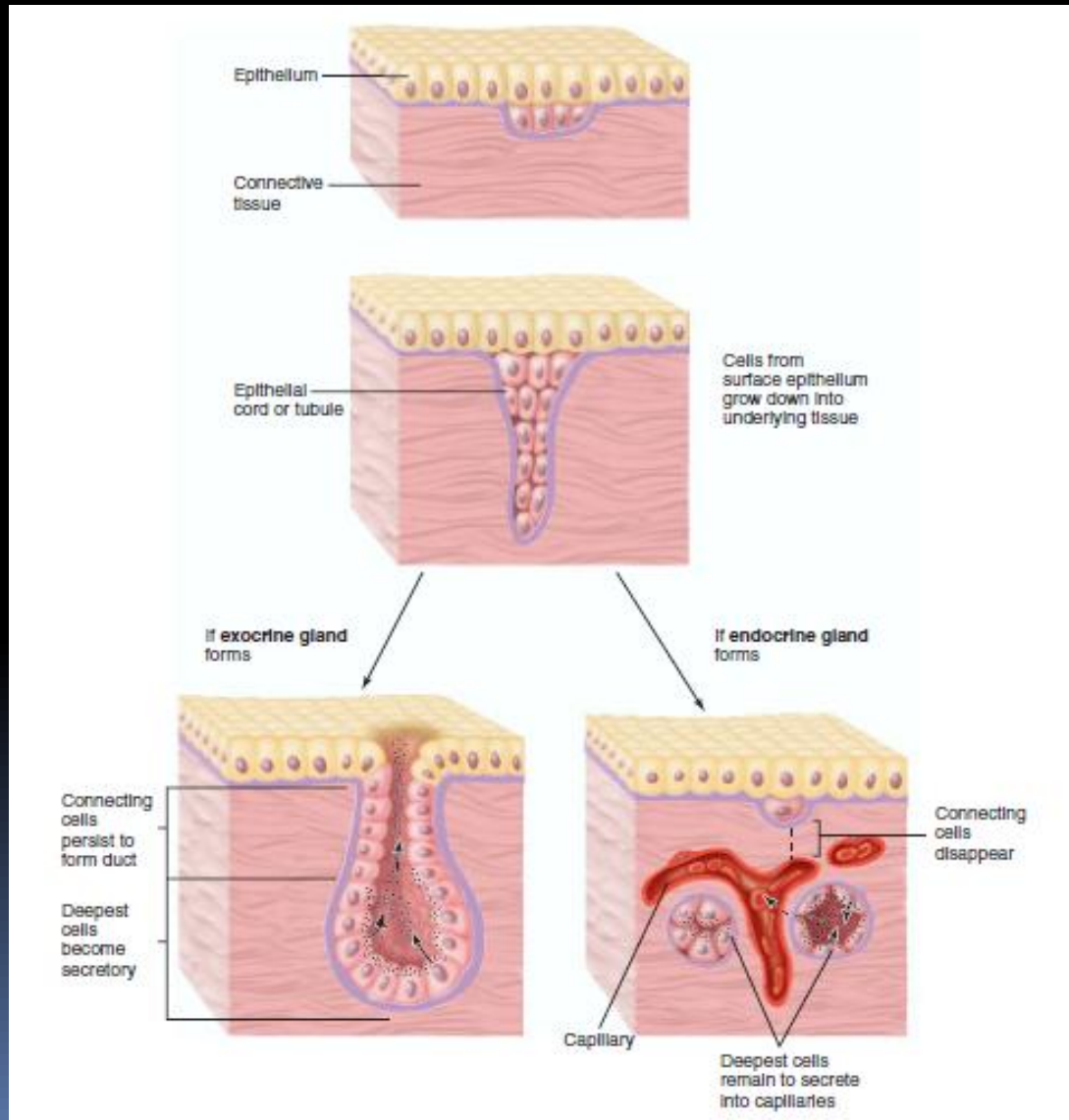
- The **ventral bud** forms the **uncinate process** and inferior part of the head of the pancreas
- The remaining part of the gland is derived from the **dorsal bud**.
- The **main pancreatic duct** (of **Wirsung**) is formed by the distal part of the dorsal pancreatic bud and the entire ventral pancreatic bud
- The proximal part of the dorsal pancreatic bud either is obliterated or persists as a small channel, the **accessory pancreatic duct** (of **Santorini**).



# Development of the glands

proliferation of epithelial cells to project into the underlying connective tissue

- **EXOCRINE GLANDS**
- retain their continuity with the surface via a **duct**
- **ENDOCRINE glands**
- lose direct continuity with the surface (ducts degenerate)
- Endocrine glands are either arranged in cords or follicles



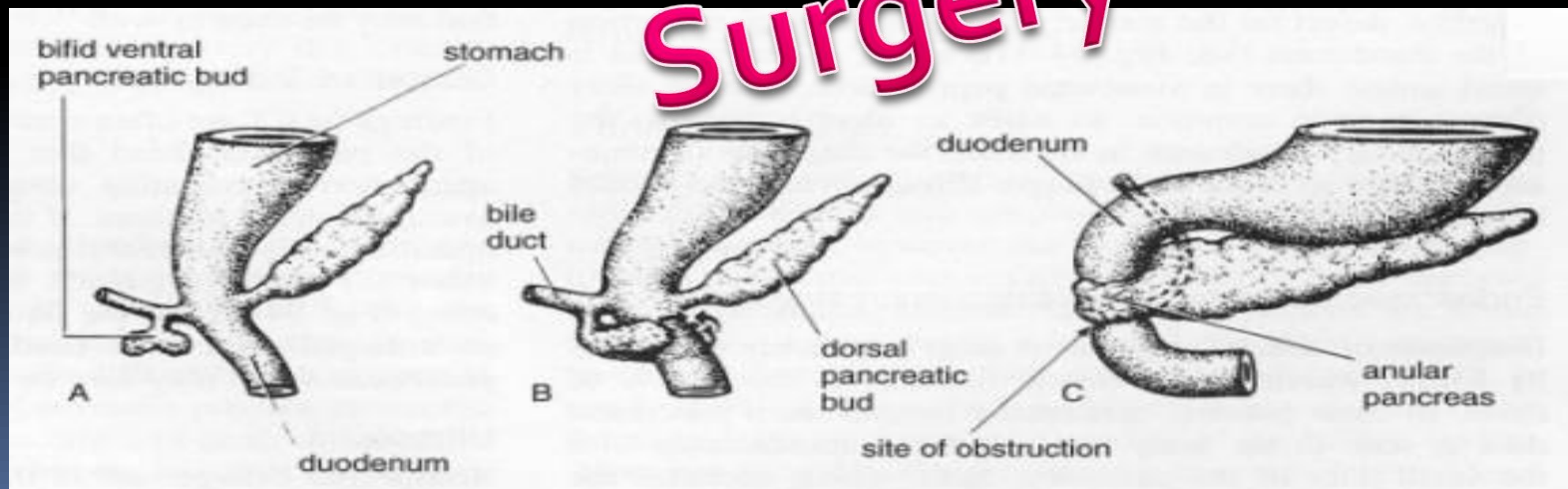
# Pancreas hormones

- **Insulin** secretion begins at approximately the fifth month
- **Glucagon**- and **somatostatin**-secreting cells also develop from parenchymal cells.
- Splanchnic mesoderm surrounding the pancreatic buds forms the pancreatic connective tissue

# Pancreatic Abnormalities

## Annular pancreas

- the right portion of the ventral bud migrates along its normal route, but the left migrates in the opposite direction.
- the duodenum is surrounded by pancreatic tissue, and an is formed
- constricts the duodenum and causes complete obstruction
- **Bilious vomiting**





THE END







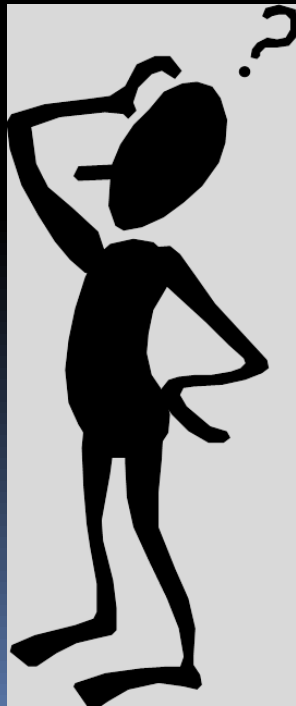
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# QUESTIONS?



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