

# Anatomy & Embryology - GIS

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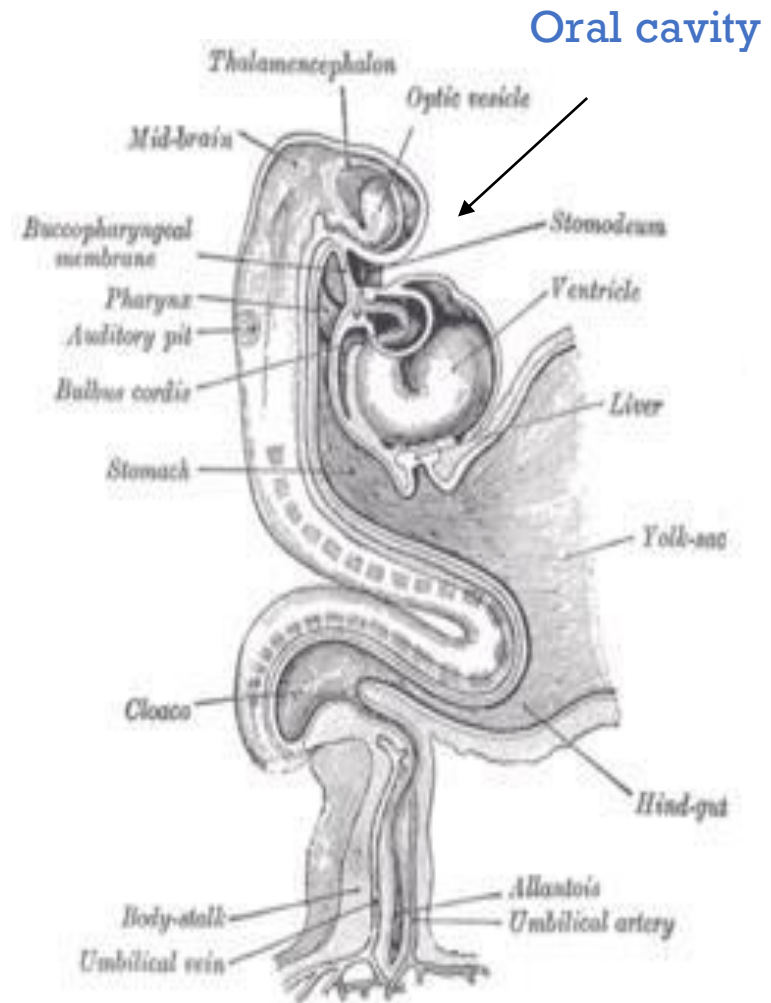


# Gi tract embryology 1

# Development of the oral cavity

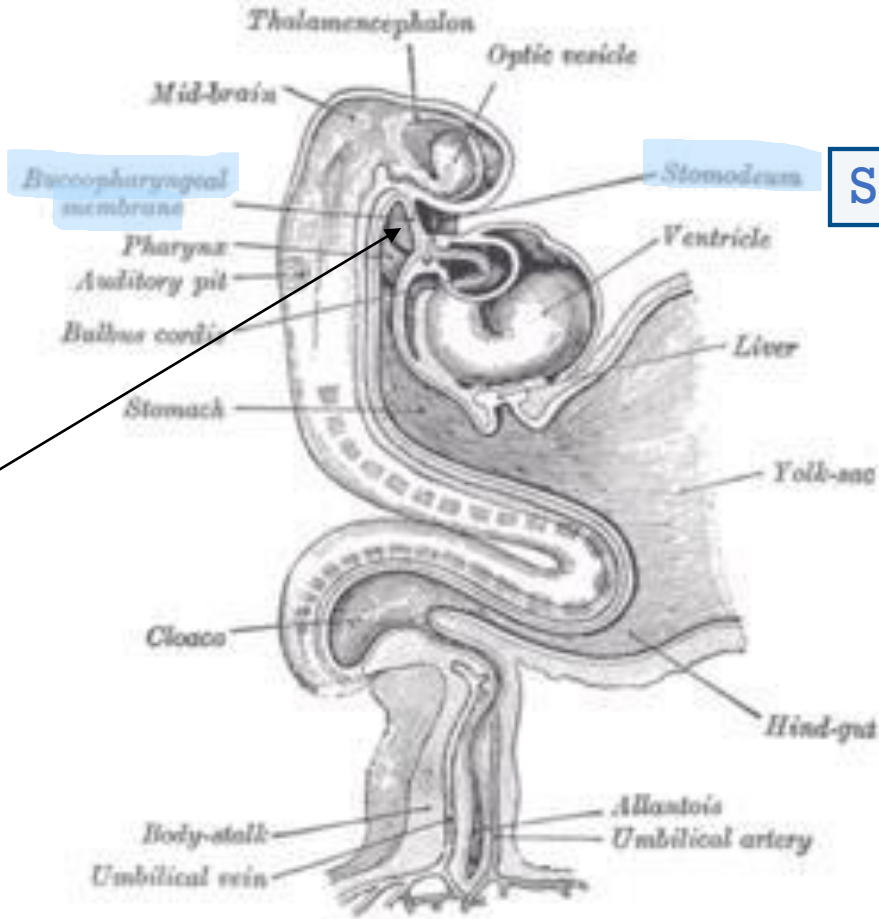
- The mouth has 2 sources of development:
- 1. depression in the stomodeum (lined with ectoderm) (Ectodermal origin)
- 2. cephalic(upper) end of the foregut(lined with endoderm) (Endodermal origin)
- These two points are separated by the buccopharyngeal membrane
- During the 3<sup>rd</sup> week of development the membrane disappears

Hence the oral cavities become one cavity



Buccopharyngeal membrane

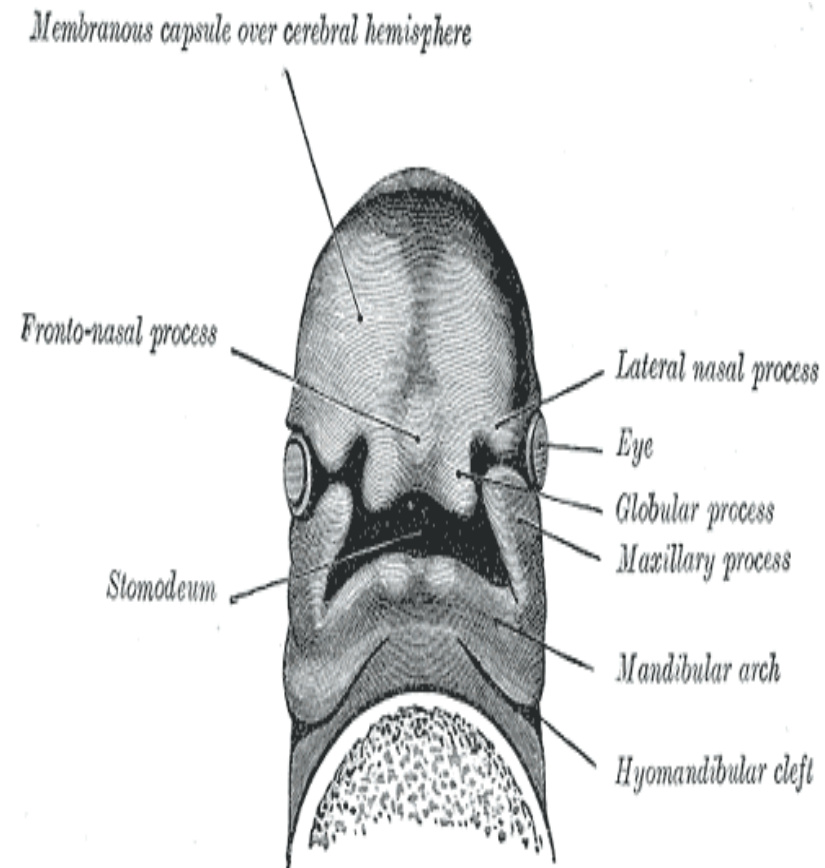
Cephalic end of the foregut



Stomodeum

## To differentiate between structures of the ectoderm and endoderm( their origin) we create an imaginary line

- If the membrane persists (we create an imaginary line), it will extend to:
  - Body of sphenoid
  - Soft palate
  - Inner surface of the mandible, inferior to the incisor teeth
- Structures that are anterior to this plane are ectodermic in origin(epithelium) like:
  - Hard palate
  - Sides of the mouth
  - Lips
  - Enamel of the teeth



- Structures situated posterior to this plane are derived from endoderm:
- Tongue
- Soft palate
- Palatoglossus and palatopharyngeal folds
- Floor of the mouth

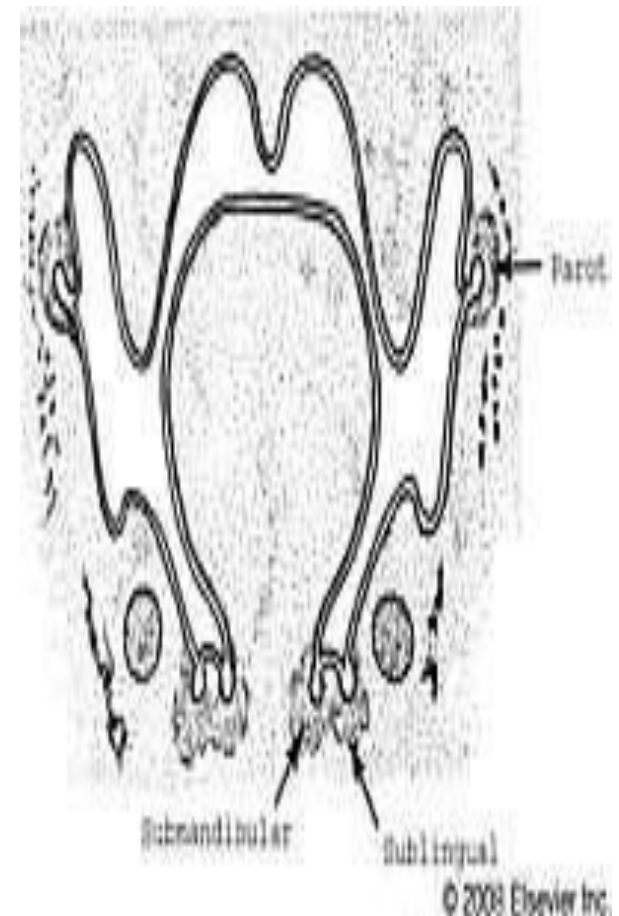
## Note on previous slides:

We already know that the mucosa of the oral cavity is composed of epithelial tissue adding to what was discussed now this epithelium is either ectodermal in origin or endodermal in origin

# Development of the salivary glands

- During the 7<sup>th</sup> week it arises as a solid outgrowth of cells from the walls (endoderm or epithelial tissue) of the developing mouth  
(Epithelial tissue inside, connective tissue outside (mesenchymal tissue))
- These cells will grow into the underlying mesenchyme (through the connective tissue)
- The epithelial buds will go through repeated branching to form solid ducts (filled with cells)
- The ends of these ducts will form the secretory acini, and they will both go through canalization thus opening the ducts (by the removal of cells)

Glands that open in the oral cavity like; parotid, submandibular, sublingual





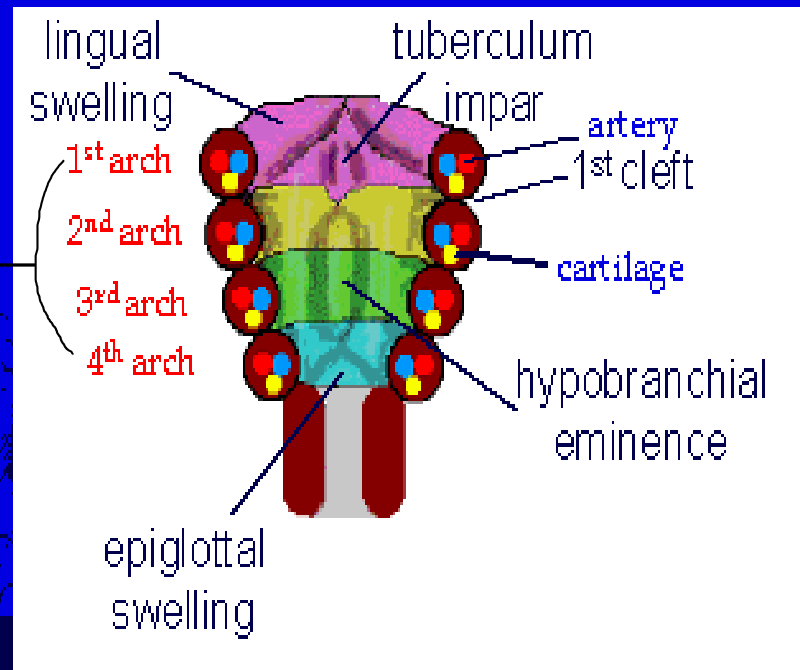
- The surrounding mesenchyme will condense to form:
- The capsule of the gland
- Septa that divide the gland into different lobes and lobules
  
- The ducts and acini of the parotid gland are both derived from the ectoderm
  
- Submandibular and sublingual glands are derived from the endoderm

# Tongue

- The tongue appears in embryos of approximately 4 weeks in the form of two **lateral lingual swellings** and **one medial swelling, the tuberculum impar** (these three will form the anterior two third of the tongue)
- These three swellings originate from the first pharyngeal arch.
- A second median swelling, the **copula, or hypobranchial eminence**, is formed by mesoderm of the second, third, and part of the fourth arch ( will form the posterior third of the tongue)
- Finally, a third median swelling, formed by the posterior part of the fourth arch, marks development of the epiglottis.

# Development of the Tongue

- Tongue develops where the stomodeum and pharynx meet.

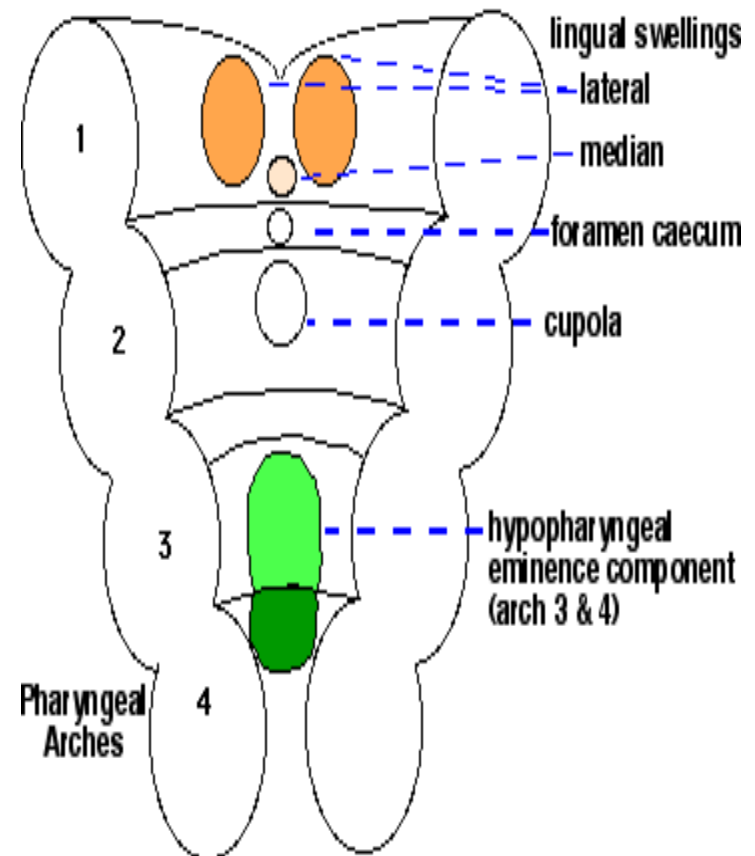


Pharyngeal arches

Each arch from the outside is ectodermal while from the inside is endodermal and between the ectoderm and the endoderm it contains mesenchyme

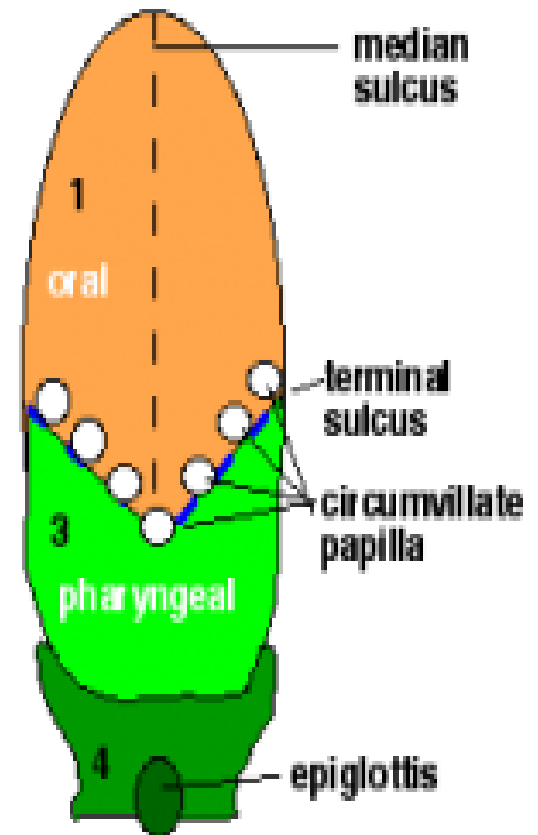
- Immediately behind this swelling is the **laryngeal orifice** (connect the pharynx with the larynx) which is flanked by the **arytenoids swellings**
- As the lateral lingual swellings increase in size, they overgrow the tuberculum impar and merge, forming the anterior two-thirds, or body, of the tongue
- Since the mucosa covering the body of the tongue originates from the first pharyngeal arch, **sensory innervation to this area is by the mandibular branch (lingual branch) of the trigeminal nerve** since the trigeminal branch originate from the first arch
- The body of the tongue is separated from the posterior third by a V-shaped groove, the **terminal sulcus** since two parts have different origin

Development of the Tongue (part 1)



- The posterior part, or root, of the tongue originates from the second, third, and part of the fourth pharyngeal arch.
- The fact that **sensory innervation to this part of the tongue is supplied by the glossopharyngeal nerve indicates that tissue of the third arch overgrows that of the second (the third arch overlies the second arch).**
- The epiglottis and the extreme posterior part of the tongue are innervated by the **superior laryngeal nerve (from the vagus nerve since it originate in the fourth arch), reflecting their development from the fourth arch.**

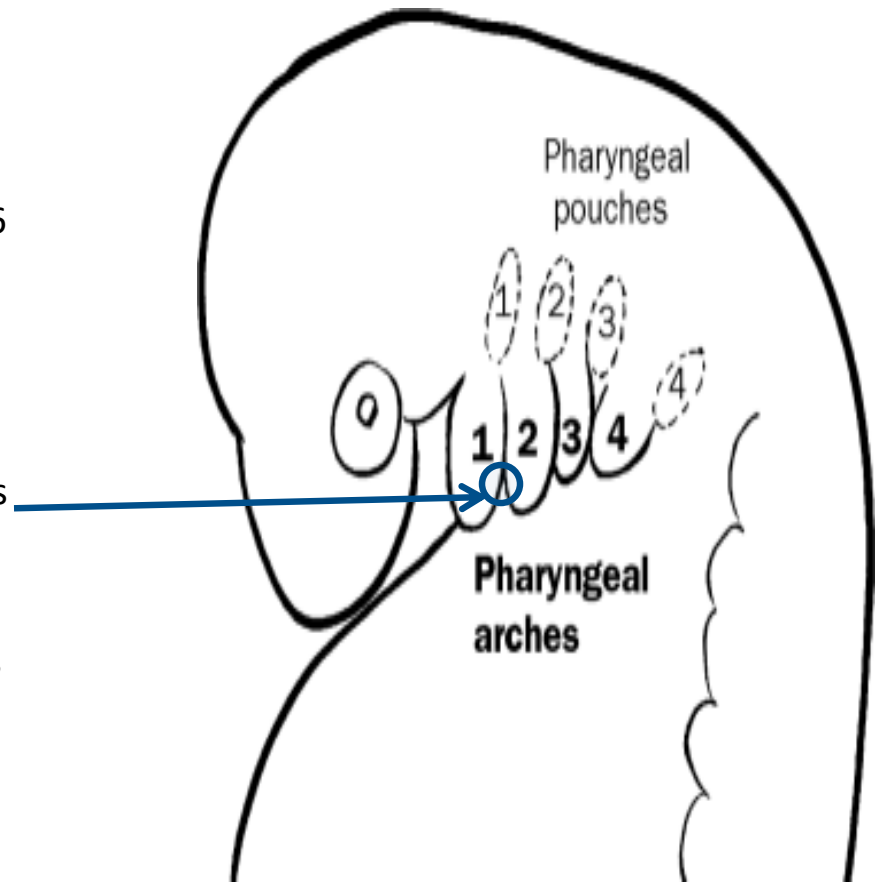
### Development of the Tongue (part 3)



- Some of the tongue muscles probably differentiate in situ, but most are derived from myoblasts originating in **occipital somites**.(formed by myotome migrating from the occipital somites to the tongue)
- Thus, tongue musculature is innervated by the **hypoglossal nerve**.
- **Special sensory innervation (taste)** to the anterior two thirds of the tongue is provided by the **chorda tympani**
- **branch of the facial nerve, while the posterior third is supplied by the glossopharyngeal nerve.**

# Development of the pharynx

- The pharynx develops in the neck from the endoderm of the foregut
- The endoderm is separate from the surface ectoderm by mesenchyme
- The mesenchyme in each side splits up to 5-6 arches
- Each arch forms a swelling on the surface of the walls of the foregut
- As a result of these swellings a series of clefts are seen between the arches....pharyngeal clefts
- Similar grooves are found on the lateral walls of the foregut.....pharyngeal pouches
- The foregut on this level is known as the pharynx



# Development of the anterior abdominal wall

- Following the segmentation of the mesoderm, the lateral mesoderm divides into:
  - Somatic (on the wall) layer related to ectoderm
  - Splanchnic (on the viscera) layer related to endoderm
  - Both lined by endo and ectoderm
- The ant. Abdominal wall is derived from the somatopleuric mesoderm (muscles) and they retain their innervation from the ventral rami of the thoracic spinal nerves
- The somatopleuric mesoderm then tangentially divides into three layers:
  - Ext. oblique
  - Int. oblique
  - Trans. abdominus



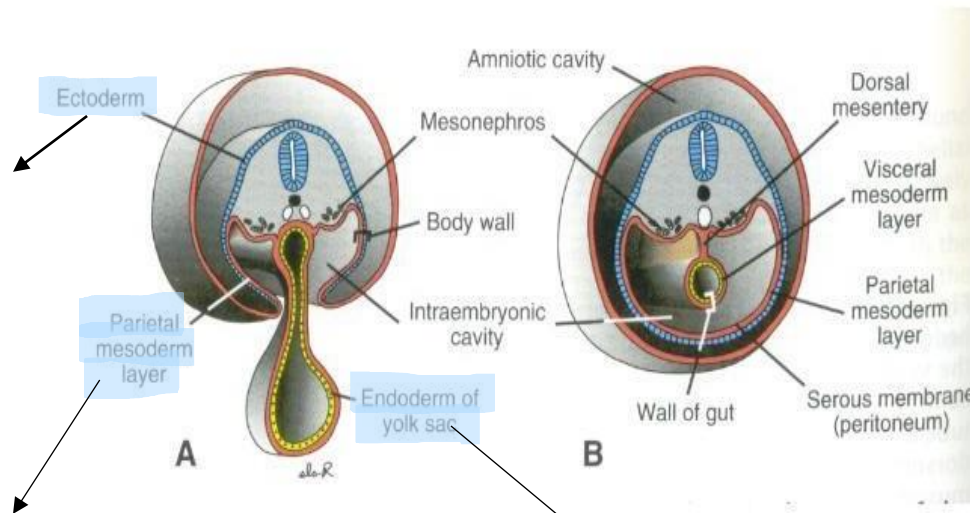
# Lateral Plate Mesoderm Further Divides into Somatopleuric mesoderm and Splanchnopleuric mesoderm.

Somatopleuric mesoderm becomes parietal mesoderm which form serous membranes that line the peritoneal, pleural, and pericardial cavities.

Splanchnopleuric mesoderm becomes visceral mesoderm which form serous membranes that line each organ.

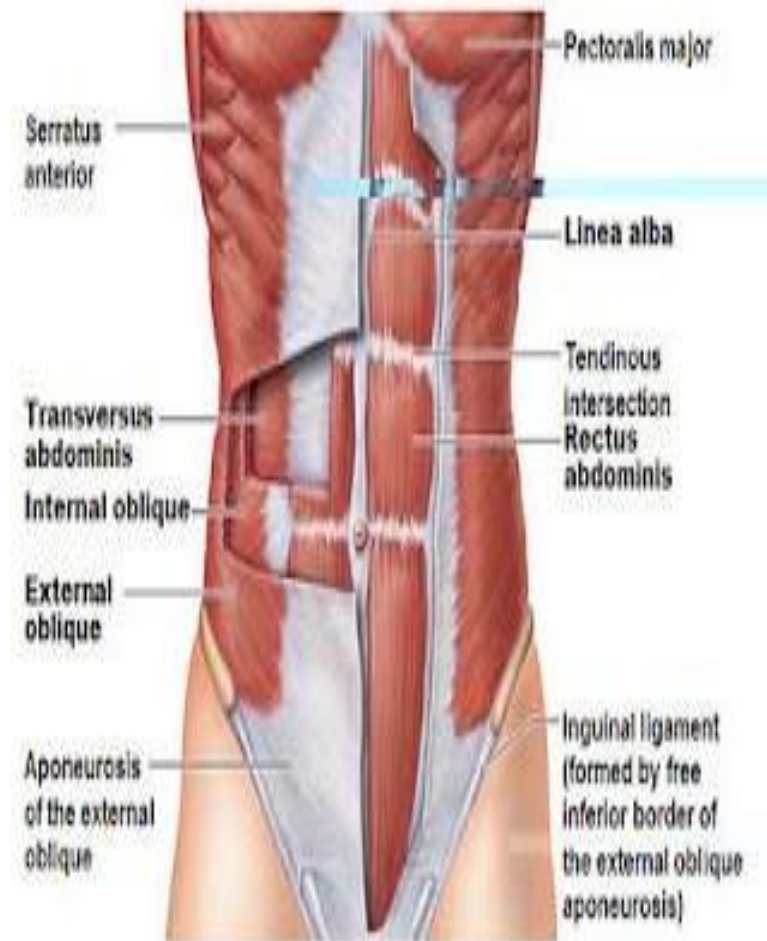
Differentiate into the skin and the nervous system

Important for the connective tissue and structures like bones, cartilages and muscles



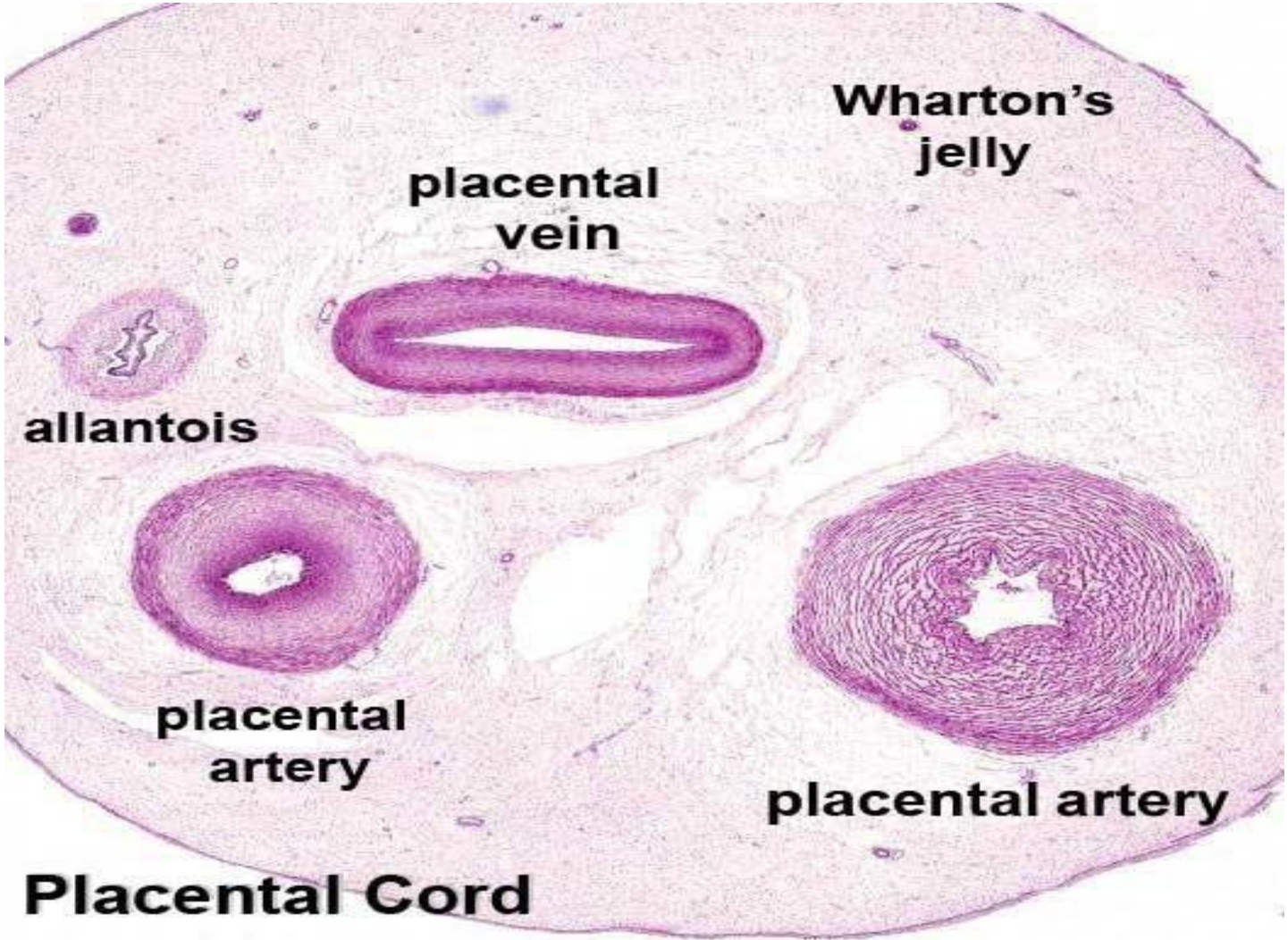
Differentiate to the GI tract

- The rectus abdominus muscle retains the indications of the segmental origin **due to the myotome positioning in the rectus sheath** and the presence of tendinous intersections
- Finally the abd. Wall right and left sides of mesenchyme fuses together at 3 months into the midline to form the linea alba.
- On either side of the linea alba the rectus muscles lie within their rectus sheaths



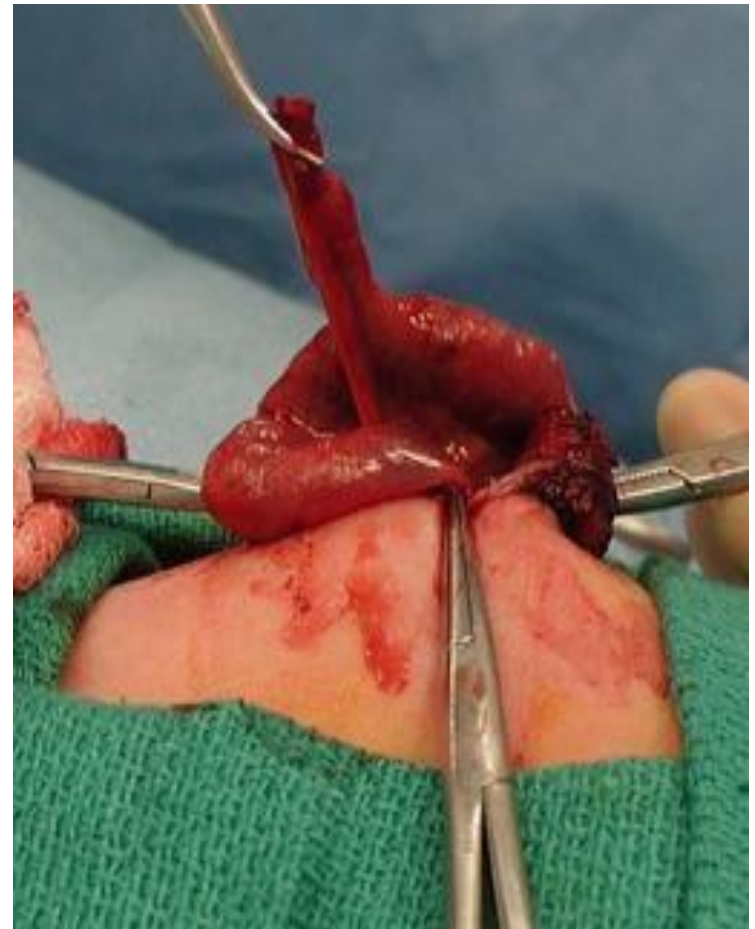
# Development of the umbilicus and the umbilical cord

- The amnion (gives the amniotic sac filled with the amniotic fluid) and the chorion (gives the placenta) fuse together
- The amnion encloses the body stalk and the yolk sac with their blood vessels to form the tubular umbilical cord (kept after birth these days due to being rich with mesenchymal stem cells)
- The mesenchyme core of the cord (whartons jelly (mucoïd tissue)) form a loose connective tissue which embed the following:
  - Remains of yolk sac
  - Vitelline duct (connection between the umbilicus and midgut/ need to be obliterated and obstruction if not it'll form a fistula where fecal material will come out from the umbilicus)
  - Remains of allantois (connection between the urinary bladder and umbilicus/ also needs obliteration if not it'll form a tract or fistula between the urinary bladder and umbilicus)
  - Umbilical blood vessels
- We have 2 arteries that carries deoxygenated blood from the fetus to the chorion (placenta)
- 2 veins carry oxygenated blood from the Placenta to the fetus , but the right vein will soon disappear



# Vitelline Duct Abnormalities

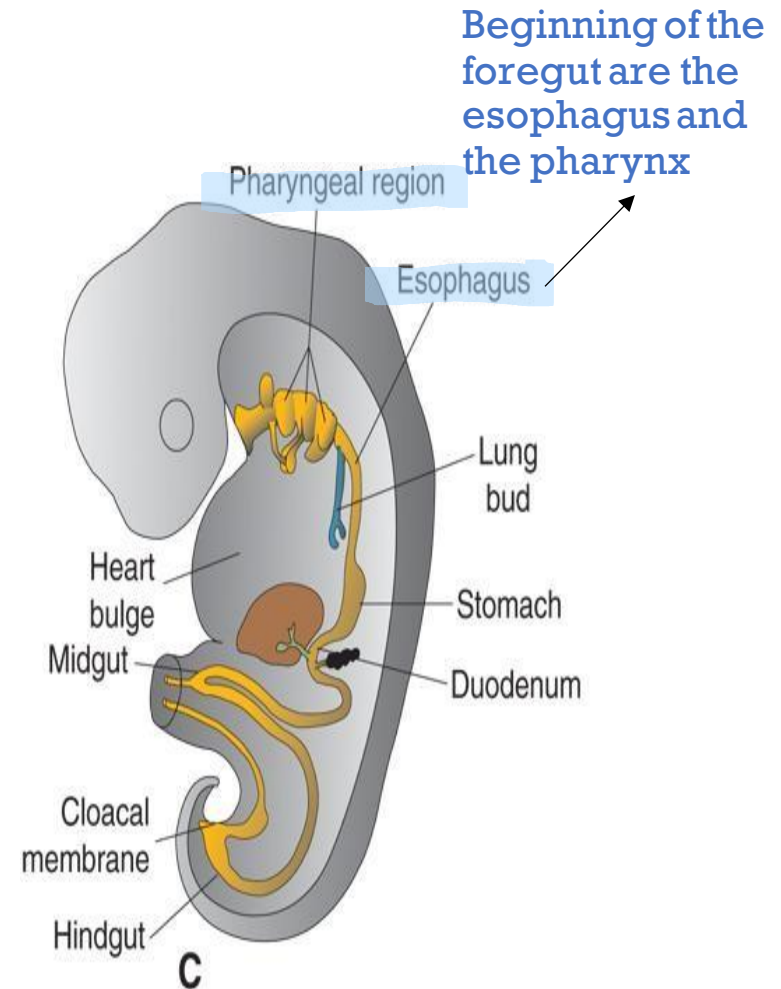
- In 2 to 4% of people, a small portion of the **vitelline duct persists, forming** an outpocketing of the ileum, **Meckel's diverticulum or ileal diverticulum**
- In the adult, this diverticulum (2 in pouch), approximately 40 to 60 cm from the ileocecal valve on the antimesenteric border of the ileum, does not usually cause any symptoms.
- However, when it contains heterotopic pancreatic tissue or gastric mucosa, it may cause ulceration, bleeding, or even perforation.



- Sometimes both ends of the vitelline duct transform into fibrous cords, and the middle portion forms a large cyst, an **enterocystoma**, or **vitelline cyst**

# Formation of the Lung Buds

- When the embryo is approximately 4 weeks old, the **respiratory diverticulum (lung bud)** appears as an outgrowth from the ventral wall of the foregut
- The location of the bud along the gut tube is determined by signals from the surrounding mesenchyme, including fibroblast growth factors (FGFs) that “instruct” the endoderm.
- Hence **epithelium of the** internal lining of the larynx, trachea, and bronchi, as well as that of the lungs, is entirely of **endodermal origin**.
- The **cartilaginous, muscular, and connective tissue components** of the trachea and lungs are derived from **splanchnic mesoderm** surrounding the foregut



6-1C Lung bud initiation and branching

- Initially the lung bud is in open communication with the foregut
- When the diverticulum expands caudally, however, two longitudinal ridges, the **tracheoesophageal ridges**, separate it from the foregut
- Subsequently, when these ridges fuse to form the **tracheoesophageal septum**, **the foregut is divided into a dorsal portion, the esophagus, and a ventral portion, the trachea and lung buds (that will give origin to the respiratory tract)**
- The respiratory primordium maintains its communication with the pharynx through the **laryngeal orifice**

