



Anatomy team
med 438



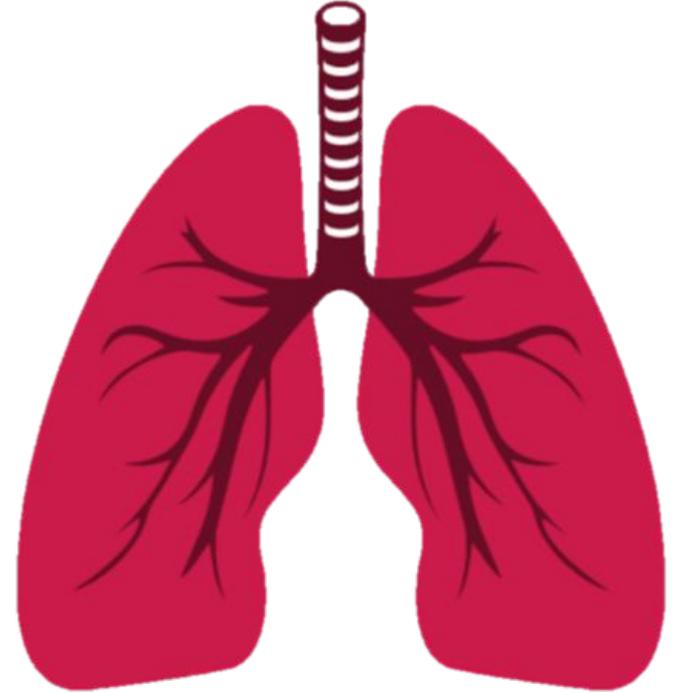
MED 438
KING SAUD UNIVERSITY



Development of respiratory system

Respiratory block-Anatomy-Lecture 5

Editing file



Objectives

- Identify the development of the laryngotracheal (respiratory) diverticulum.
- Identify the development of the larynx.
- Identify the development of the trachea.
- Identify the development of the bronchi & Lungs.
- Describe the periods of the maturation of the lung.
- Identify the most congenital anomaly

Color guide :

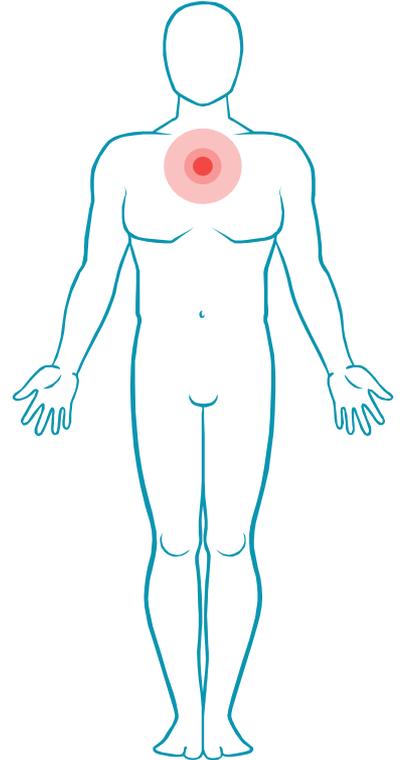
Only in boys slides in **Green**

Only in girls slides in **Purple**

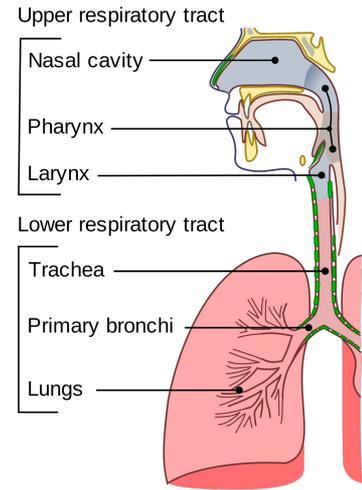
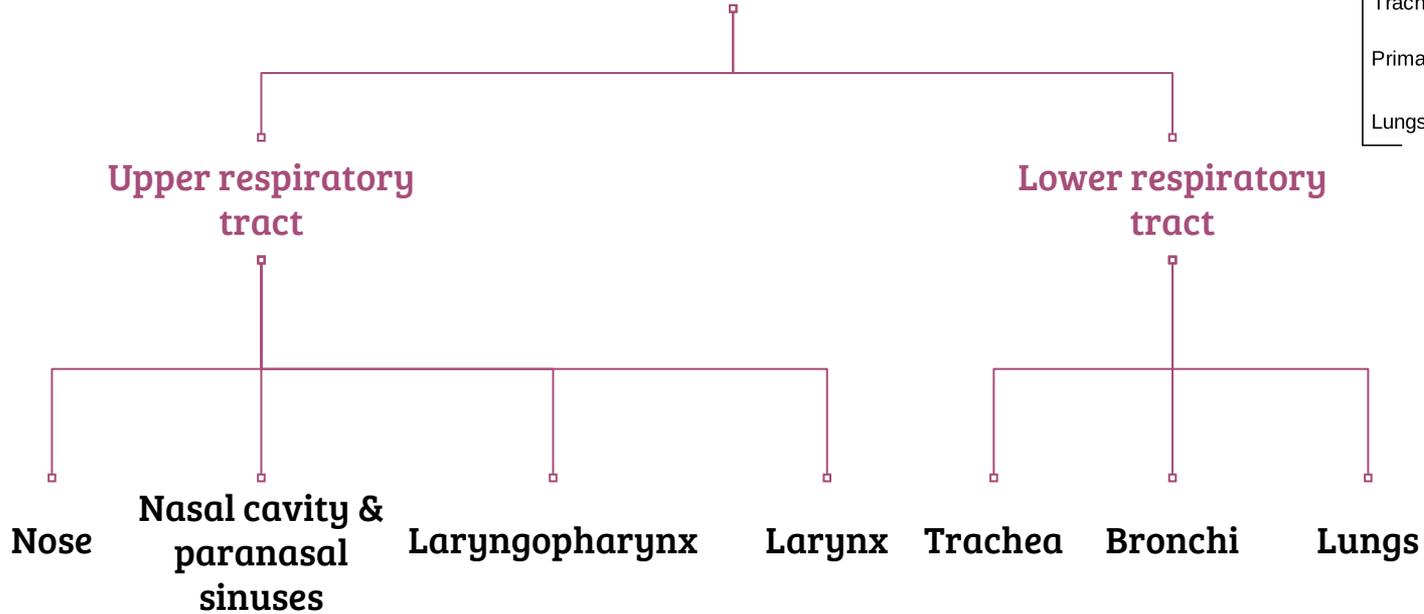
important in **Red**

Doctor note in **Blue**

Extra information in **Grey**



Respiratory system



Development of the respiratory tract

Begins during the 4th week of development

Development of **longitudinal tracheoesophageal septum**

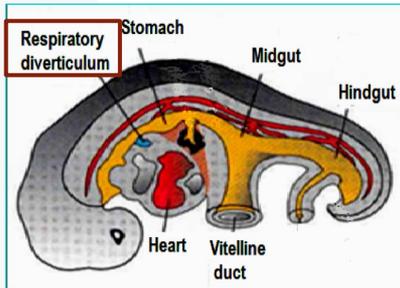
Proximal & distal parts of the respiratory diverticulum

The endoderm & surrounding splanchnic mesoderm

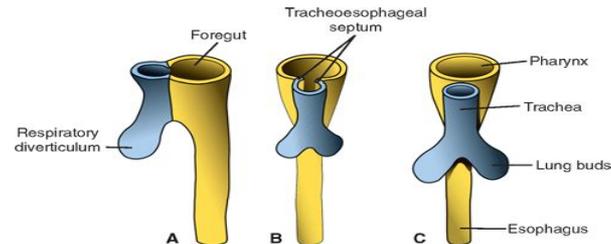
- ▶ **Begins** as a median outgrowth (**laryngotracheal groove**) from the **caudal part** of the **ventral wall** of the primitive pharynx (foregut).
- ▶ The groove **invaginates** (fold within itself) and **forms laryngotracheal (respiratory) diverticulum**.

- ▶ **Divides** the diverticulum into:
 - ▶ **Dorsal portion***: primordium (in the earliest stage of development) of the oropharynx & esophagus.
 - ▶ **Ventral portion***: primordium (=give rise) of larynx, trachea, bronchi & lungs.

* Remember that the larynx, trachea, bronchi & lungs lie anteriorly while the oropharynx & esophagus lie posteriorly. Hence, the ventral and dorsal portions.



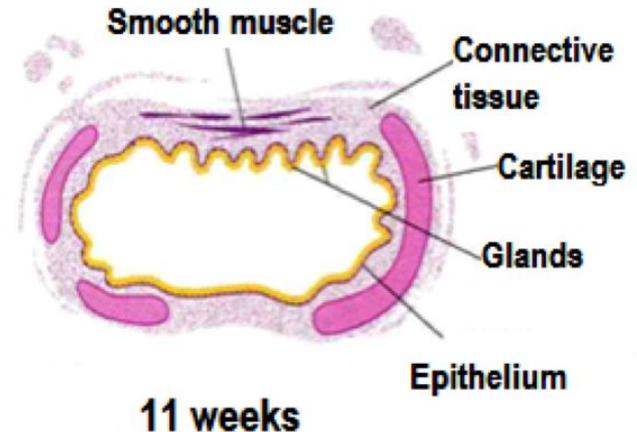
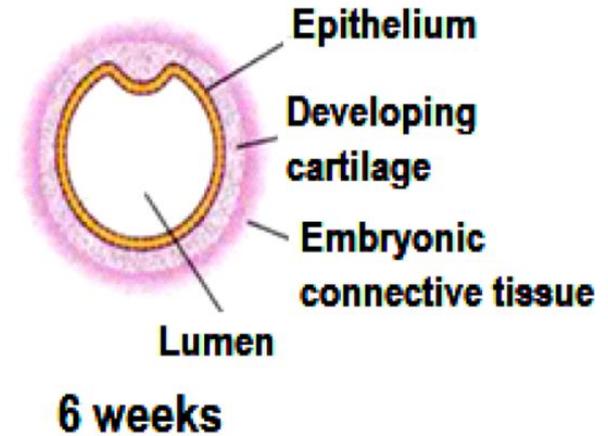
- ▶ *The proximal part* of the respiratory diverticulum remains tubular and **forms larynx & trachea**.
- ▶ *The distal end* of the diverticulum dilates to **form lung bud**, which divides to give rise to 2 lung buds (**primary bronchial buds**).



- ▶ The **endoderm** lining the laryngotracheal diverticulum (**respiratory diverticulum**) gives rise to the:
 - ▶ **Epithelium & glands** of the respiratory tract.
- ▶ The **surrounding splanchnic mesoderm** gives rise to the:
 - ▶ **Connective tissue, cartilage & smooth muscles** of the respiratory tract.

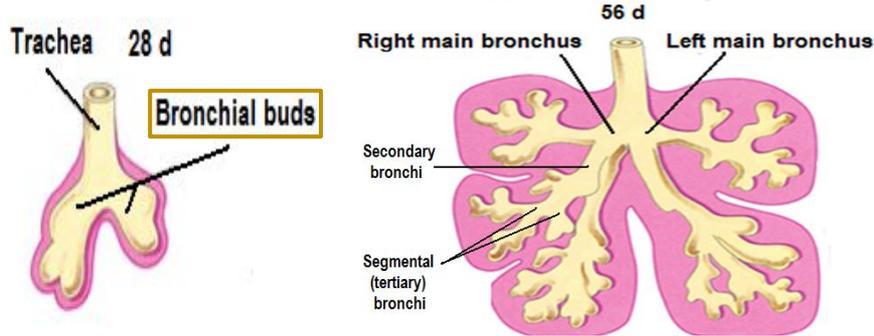
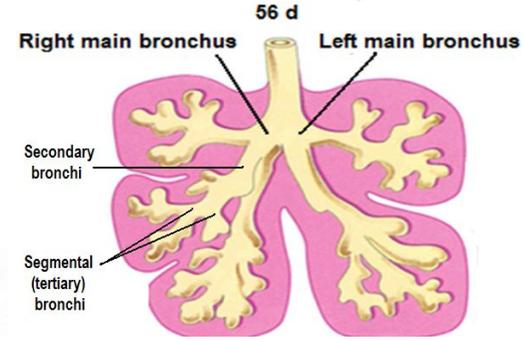
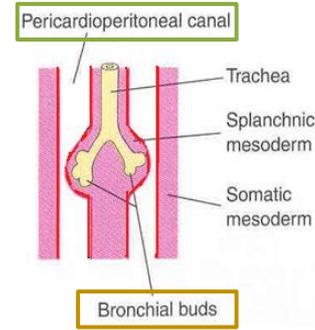
Development of the trachea

- The **endodermal** lining of the **laryngotracheal tube** (distal to the larynx) differentiates into the **epithelium and glands** of the trachea and pulmonary epithelium.
- The cartilages, connective tissue, and muscles of the trachea are derived from the mesoderm.



Development of the Bronchi & Lungs

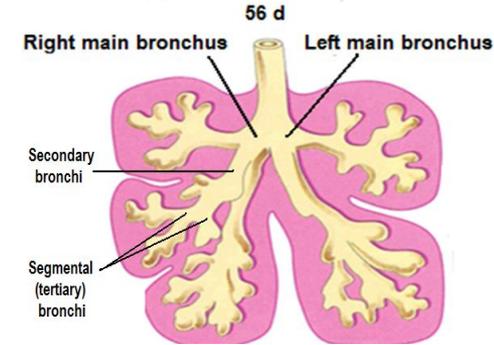
- ▶ The 2 primary **bronchial buds** grow **laterally** into the **pericardio-peritoneal canals** (part of *intra-embryonic celome*), which is the primordia of pleural cavities.
- ▶ Bronchial buds divide and re-divide to give the bronchial tree.



- ▶ The **right** main bronchus is slightly **larger** (wider) than the left one and is **oriented more vertically**.
- ▶ This embryonic relationship **persists** in the adult.
- ▶ The main bronchi subdivide into secondary & tertiary (segmental) bronchi which give rise to further branches.

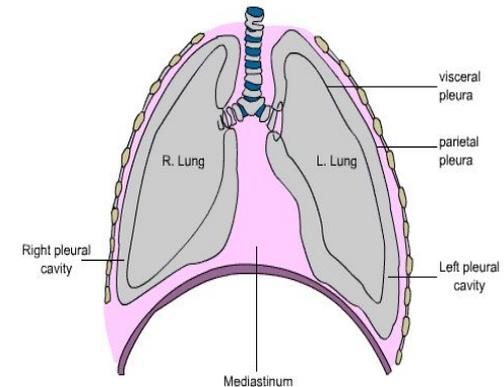
Development of the Bronchi & Lungs

- ▷ The segmental bronchi, 10 in the **right** lung and 8 or 9 in the **left** lung, begin to form by the **7th week**.
- ▷ The surrounding mesenchyme also divides.
- ▷ Each segmental bronchus with its **surrounding mass of mesenchyme** is the primordium of a **bronchopulmonary segment**.



Development of the pleura

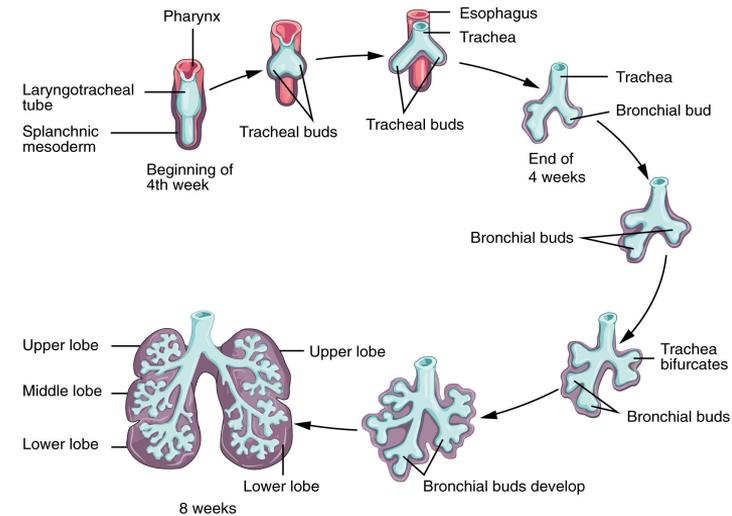
- ▷ As the lungs develop they acquire a layer of **visceral pleura** from the **splanchnic mesenchyme**.
- ▷ The thoracic body wall becomes lined by a layer of **parietal pleura** derived from the **somatic mesoderm**.



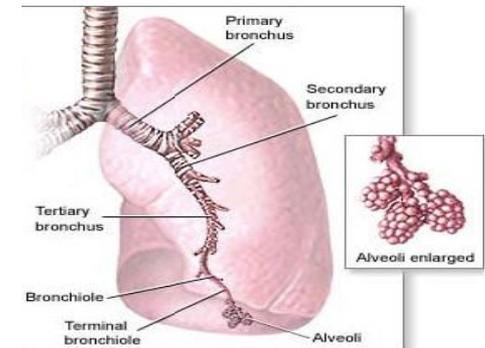
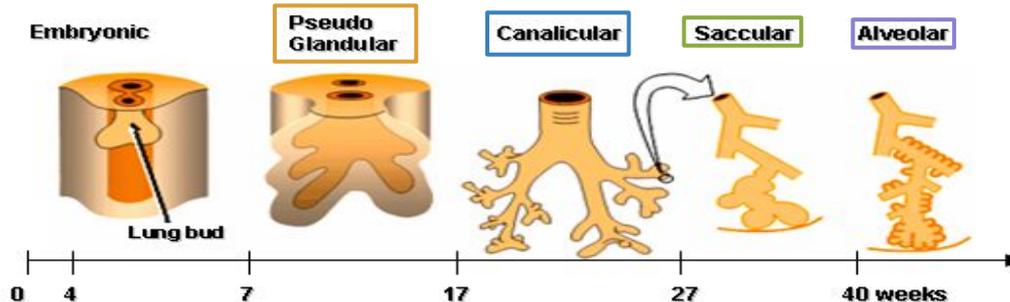
Maturation of the Lungs

Maturation of lung is divided into 4 periods:

- ▶ **Pseudoglandular** (6 - 16 weeks) .
- ▶ **Canalicular** (16 - 26 weeks).
- ▶ **Terminal sac** (26 weeks - birth).
- ▶ **Alveolar** (late fetal period - childhood) (32w to 8y)

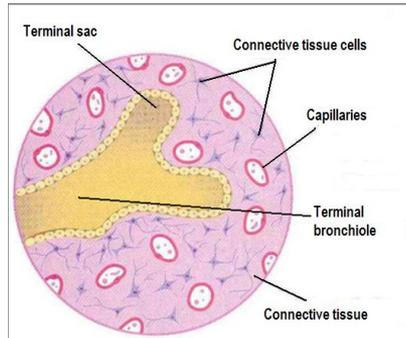


These periods overlap each other because the **cranial** segments of the lungs mature **faster** than the **caudal** ones.



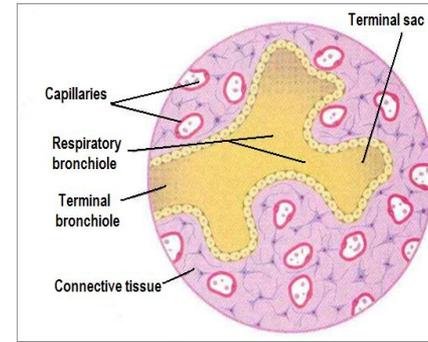
Pseudoglandular Period (5-16 weeks)

- ❑ Developing lungs somewhat resembles an exocrine gland during this period.
- ❑ By **16 weeks** all major elements of the lung have formed **except** those involved with **gas exchange (alveoli)**.
- ❑ **Respiration is NOT possible.**
- ❑ **Fetuses** born during this period are **unable to survive.**



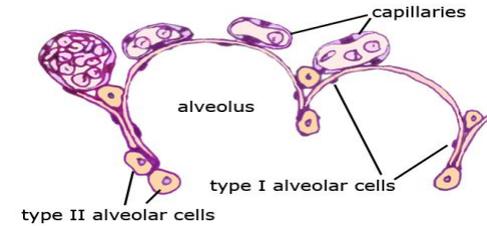
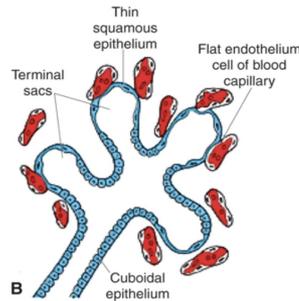
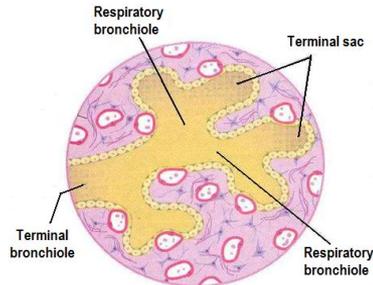
Canalicular Period (16-26 weeks)

- ❖ Lung tissue becomes highly vascular.
- ❖ Lumina of **bronchi** and **terminal bronchioles** become **larger**.
- ❖ By **24 weeks** each terminal bronchiole has given rise to **two** or more respiratory bronchioles.
- ❖ The respiratory bronchioles divide into **3 to 6** tubular passages called **alveolar ducts**.
- ❖ Some thin-walled **terminal sacs** (primordial alveoli) develop at the end of respiratory bronchioles.
- ❖ **Respiration is possible** at the end of this period.
- ❖ **Fetus** born at the end of this period **may survive** if given intensive care (but usually die because of the immaturity of respiratory as well as other systems).



Terminal Sac Period (26 weeks - birth)

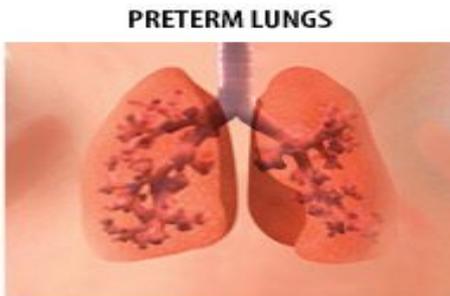
- ▶ Many more terminal sacs develop.
- ▶ Their epithelium becomes very thin.
- ▶ **Capillaries** begin to bulge into developing alveoli.
- ▶ The **epithelial** cells of the alveoli and the **endothelial** cells of the capillaries come in intimate contact and establish the **blood-air barrier**.
- ▶ Adequate gas exchange can occur which allows the prematurely born fetus to survive.



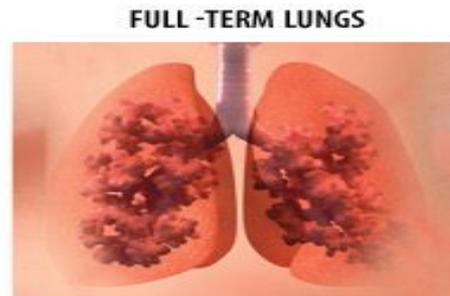
- ▶ By **26 weeks**, the terminal sacs are lined by: squamous **type I pneumocytes** and & rounded secretory **type II pneumocytes**, that secrete a mixture of phospholipids called **surfactant**.
- ▶ **Surfactant** production begins by **20 weeks** and increases during the **terminal** stages of pregnancy.
- ▶ Sufficient terminal sacs, pulmonary vasculature & surfactant are present to permit survival of a prematurely born infants.
- ▶ Fetuses born prematurely at **24-26 weeks** may suffer from **respiratory distress** due to **surfactant deficiency** but may survive if given intensive care.

Alveolar Period (32 weeks – 8 years)

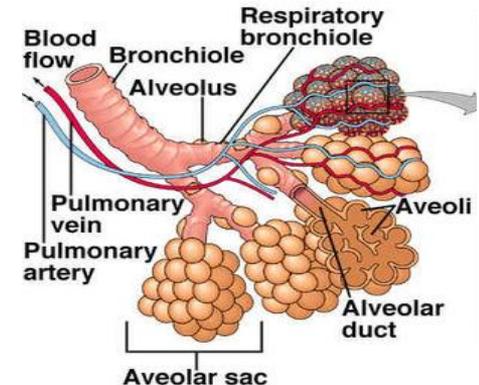
- ▶ At the beginning of the **alveolar period**, each respiratory bronchiole terminates in a cluster of thin-walled **terminal saccules** separated from one another by loose connective tissue.
- ▶ These **terminal saccules** represent future alveolar sacs.
- ▶ Characteristic mature alveoli do not form until **after birth**, so; 95% of alveoli develop **postnatally**.
- ▶ About *50 million* alveoli, one sixth of the adult number are present in the lungs of a **full-term newborn infant**.
- ▶ From **3-8 year** or so, the number of alveoli continues to increase, forming additional primordial alveoli. By about the **eighth year**, the adult complement of 300 million alveoli is present.



32 WEEKS GESTATIONAL AGE

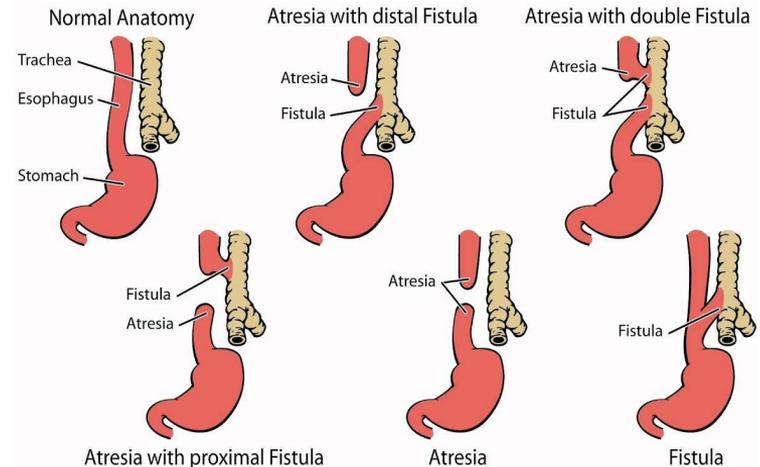
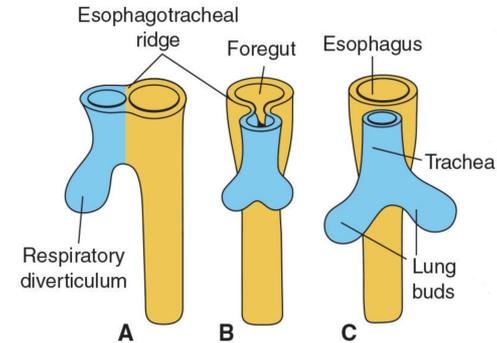


40 WEEKS GESTATIONAL AGE



Developmental anomalies: Tracheo-esophageal Fistula

- ▶ An abnormal passage between the **trachea** and **esophagus**.
- ▶ Results from incomplete division of the **cranial** part of the **foregut** into respiratory and esophageal parts by the **tracheo-esophageal septum**.
- ▶ Occurs once in 3000 to 4500 live births.
- ▶ Most affected **infants are males**.
- ▶ In more than 85% of cases, the fistula is associated with **esophageal atresia** (esophagus ends in a blind-ended pouch rather than connecting normally to the stomach).



MCQs

Question 1: The vestibular folds develop during which phase?

- A. recanalization of the larynx
- B. proliferation of the mesoderm in the floor of the pharynx
- C. development of the trachea
- D. differentiation of the endodermal lining of the laryngotracheal tube

Question 2: Which one of the following is derived from the endoderm?

- A. connective tissue of the trachea
- B. glands of the trachea
- C. cartilage of the trachea
- D. laryngeal muscles

Question 3: Which portion of the respiratory diverticulum the larynx arises from?

- A. cranial
- B. caudal
- C. ventral
- D. dorsal

Question 4: At which week does the development of the respiratory tract begins ?

- A. 10th
- B. 4th
- C. 5th
- D. 7th

Question 5: By 17 weeks all major elements of the lung have formed except:

- A. alveoli
- B. bronchioles
- C. trachea
- D. esophagus

Question 6: The parietal pleura is derived from:

- A. thoracic body wall
- B. somatic mesoderm
- C. visceral pleura
- D. splanchnic mesenchyme

Question 7: segments of the lungs mature faster than the ones.

- A. cranial, caudal
- B. caudal, cranial
- C. dorsal, ventral
- D. ventral, dorsal

Question 8: Surfactant production begins by:

- A. 22 weeks
- B. 20 weeks
- C. 18 weeks
- D. 21 weeks

Best wishes



Anatomy team
med 438

**Don't forget to leave
your feedback:**



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- Rahaf Al Shabri
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- Maha Al Nahdi
- Ghaida Al Braithen