

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ



Larynx, Trachea, and Bronchi

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Color Code

- **Important**
- **Doctors Notes**
- **Notes/Extra explanation**

Objectives

By the end of the lecture, you should be able to:

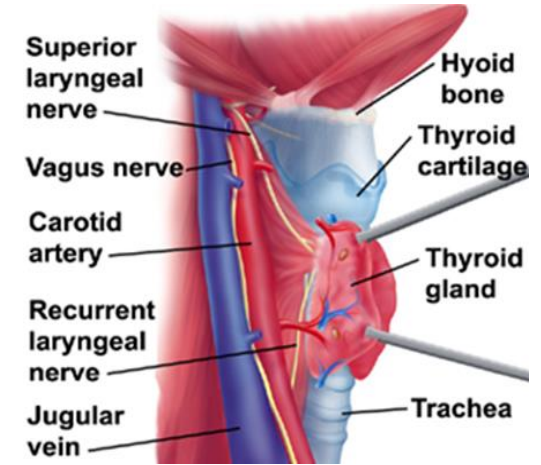
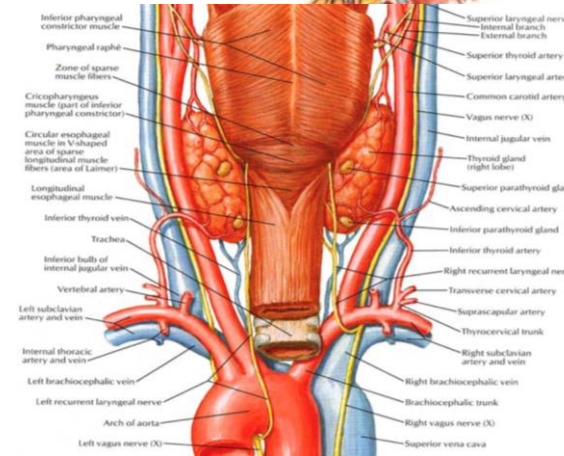
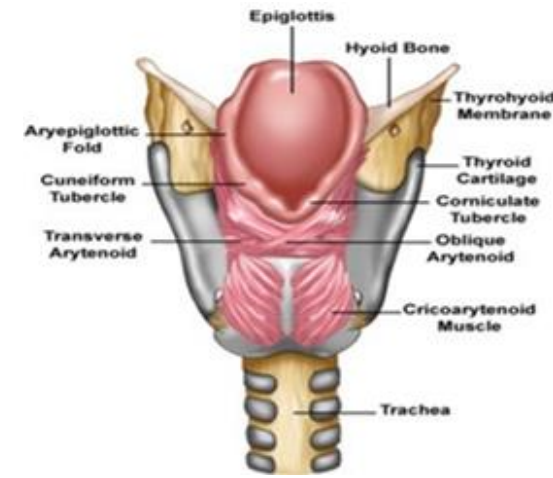
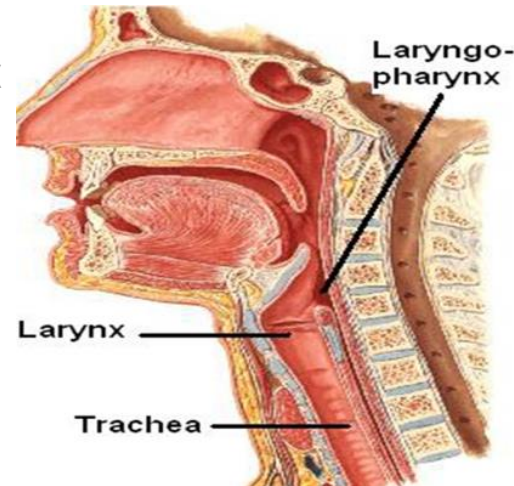
- ✓ Describe the Extent, structure and functions of the **larynx**.
- ✓ Describe the Extent, structure and functions of the **trachea**.
- ✓ Describe the **bronchi** and branching of the **bronchial tree**.
- ✓ Describe the **functions of bronchi and their divisions**.

Larynx

NOTE: PHARYNX EXTENDS FROM C1 TO C6 WHILE LARYNX EXTENDS FROM C3 TO C6
*C6 AT THE LEVEL OF CRICOID CARTILAGE.



- The larynx is the part of the respiratory tract which contains the vocal cords.
- In adult it is a **2-inch-long** tube.
- It opens above into the laryngeal part of the **pharynx**.
- Below, it is continuous with the trachea
- The larynx has functions in:
 - Respiration (breathing).
 - Phonation (voice production).
 - Deglutition (swallowing).
- The larynx is related to major **critical** structures in the neck.



Arteries

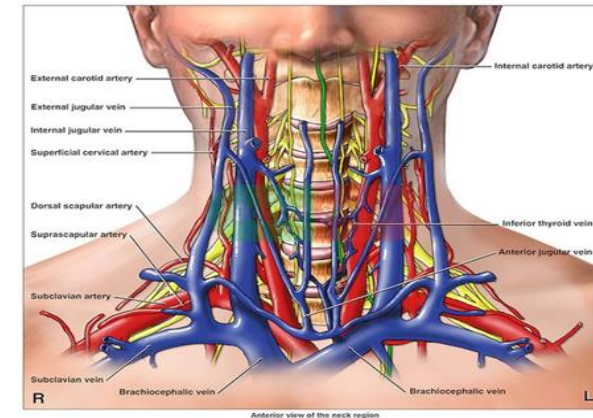
Carotid arteries:
(common, external and internal).
Thyroid arteries:
(superior & inferior thyroid arteries).

Veins

Jugular veins,
(external & internal)

Nerves

Laryngeal nerves:
(Superior laryngeal & recurrent laryngeal).
Vagus nerve.

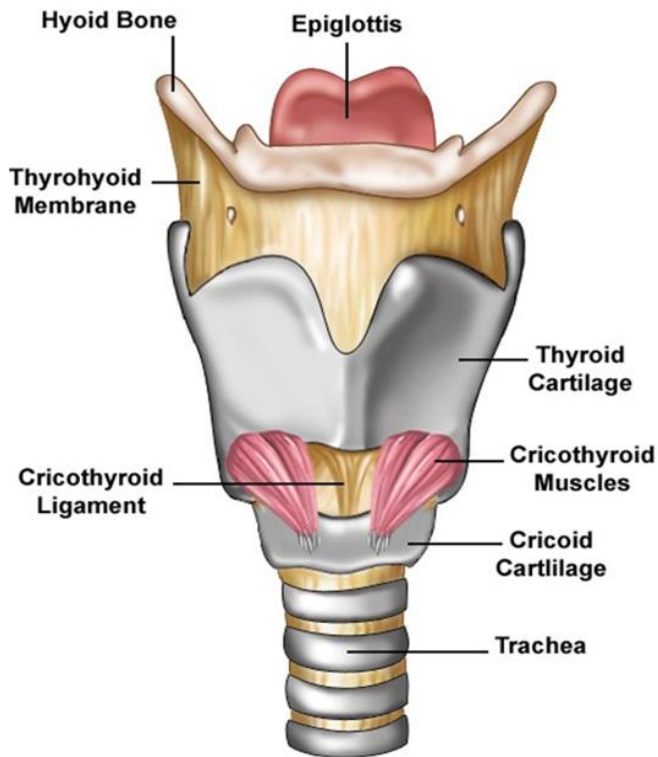


Larynx



The larynx consists of four basic components:

- 1- Cartilaginous skeleton.
- 2- Membranes and ligaments.
- 3- Mucosal lining.
- 4- Muscles (Intrinsic & extrinsic muscles).



1- Cartilaginous skeleton

○ The cartilaginous skeleton is composed of 9 cartilages:

3 Single:

1. Thyroid
2. Cricoid
3. Epiglottis

-Arytenoid lies in the back of larynx.

3 Paired:

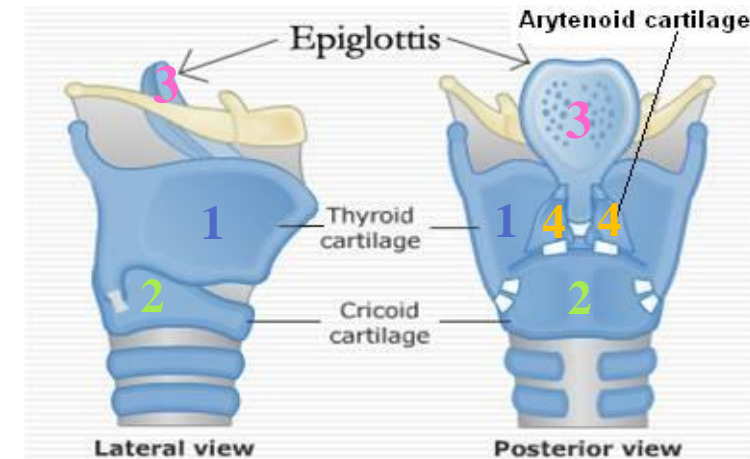
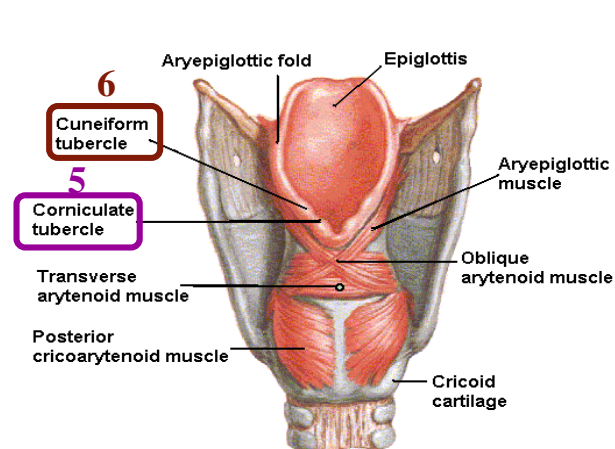
4. Arytenoid
5. Corniculate
6. Cuneiform

-Corniculate and Cuneiform are in the Aryepiglottic fold.

○ All the cartilages, are **hyaline** except the **epiglottis** which is **Elastic** cartilage.

○ The cartilages are:

- Connected by joints, membranes & ligaments.
- Moved by muscles.

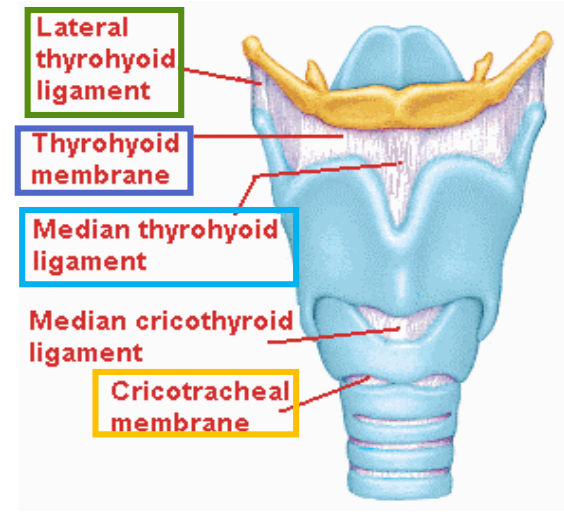
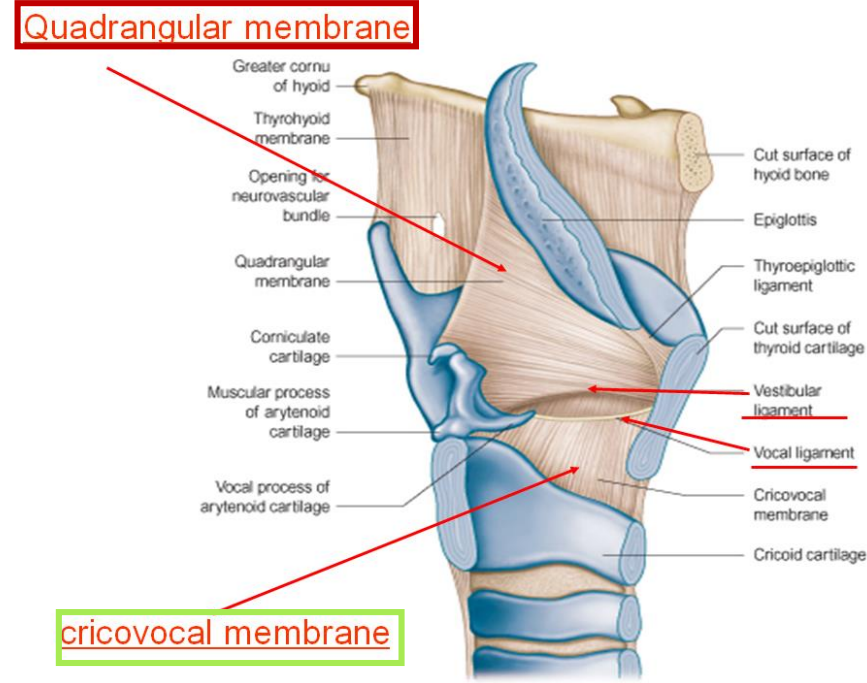


Larynx

2- Membranes & Ligaments

- Thyrohyoid membrane
- Cricothyroid membrane
- Cricotracheal membrane
- Hyoepiglottic ligament
- Thyroepiglottic ligament

The **thyrohyoid membrane** is thickened in the median plane to form **median thyrohyoid ligament** and on both sides to form **lateral thyrohyoid ligaments**.

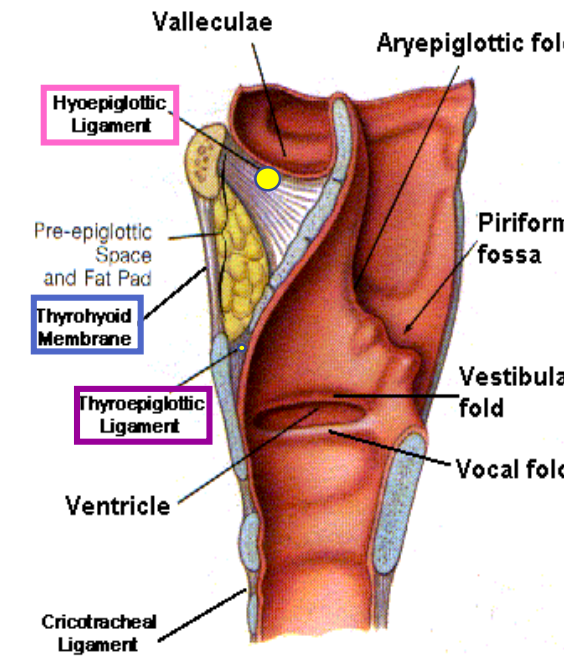
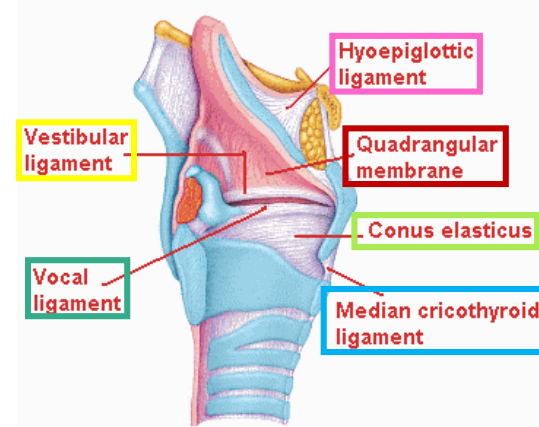


- Quadrangular membrane or (aryepiglottic membrane) :

- It extends between the arytenoid and epiglottis.
- Its **lower free margin** forms the **vestibular ligament** which forms the **vestibular fold (false vocal cord)**.

- Cricothyroid membrane (conus elasticus):

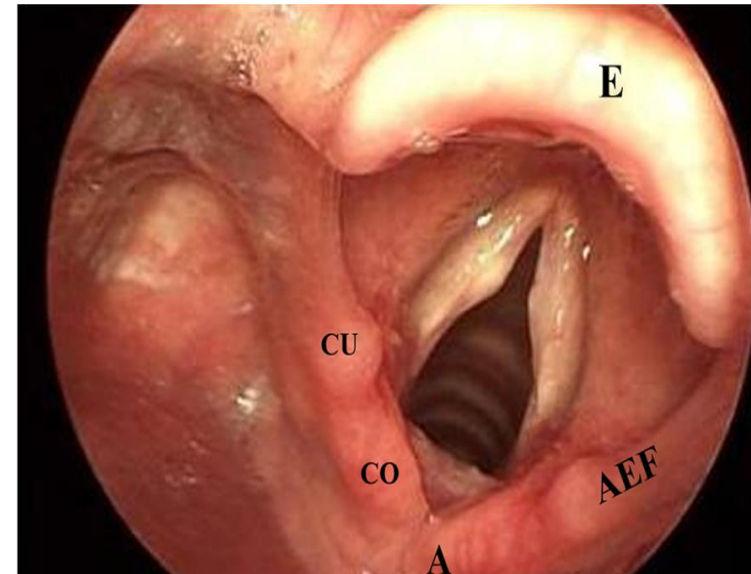
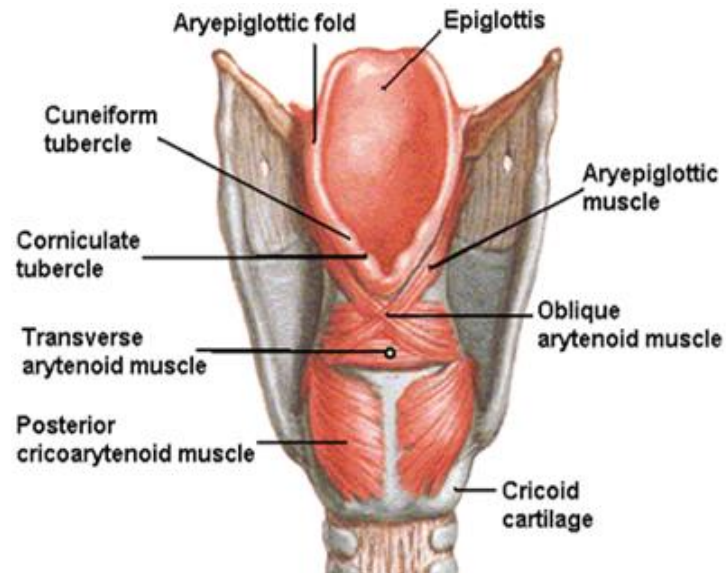
- Its lower margin is attached to the upper border of cricoid cartilage.
- **Upper free margin** forms **Vocal ligament** which forms the **(true vocal cord)**



Larynx

Laryngeal Inlet

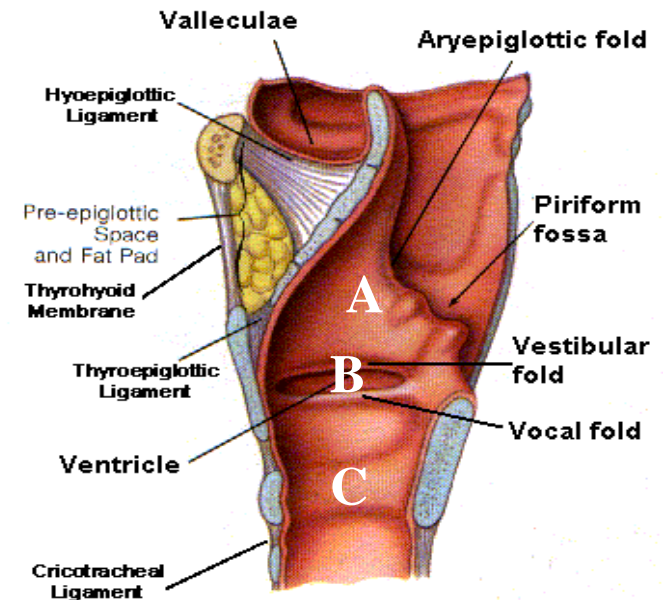
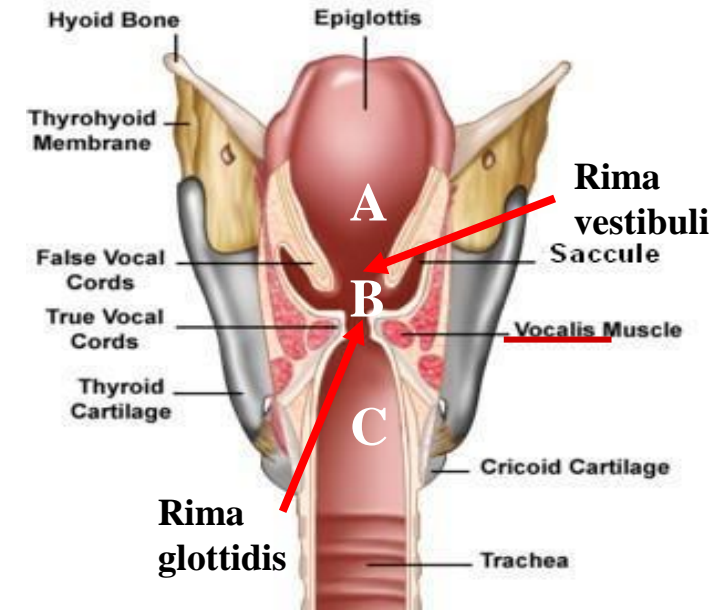
- It is the upper opening of the larynx.
- It faces **upward** and **backward** and opens into the laryngeal part of the pharynx (**laryngopharynx**).
- **Bounded by :**
 - Anteriorly: by the upper margin of epiglottis (E)
 - Posteriorly & below by arytenoid cartilages (A)
 - Laterally by the Aryepiglottic folds (AEF)



Larynx

Laryngeal Cavity

- Extends from **laryngeal inlet** to **lower border of the cricoid cartilage**
- Narrow in the region of the vestibular folds (**rima vestibuli**)
- **Narrowest** in the region of the vocal folds (**rima glottidis**)
- Divided into three parts:
 - Supraglottic part or vestibule:** it is the part above the vestibular folds.
 - Ventricle:** it is the part between the vestibular folds & the vocal folds. The ventricle has an upward invagination called **saccule** which is rich in goblet cells.
 - Infraglottic part:** the part below the vocal folds.



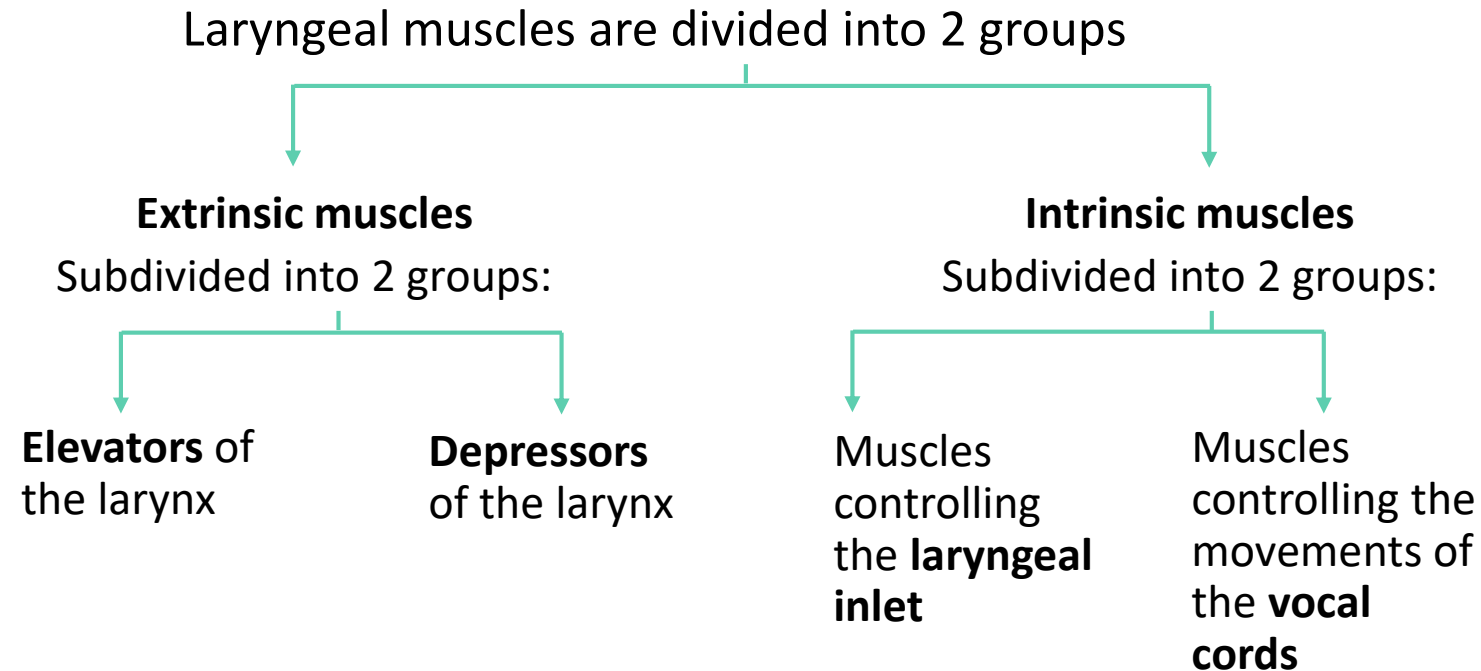
Larynx

3- Mucosal Lining

Mucous Membrane

- The cavity is lined with **ciliated columnar epithelium** **except** the surface of the vocal cords.
- The surface of **vocal folds**, is covered with **stratified squamous epithelium** **because of exposure to continuous trauma during phonation.**
- It contains many **mucous glands**, **more numerous** in the region of the **saccul**e (for lubrication of vocal folds).

4- Muscles



Larynx

4- Muscles (Extrinsic)

Elevators of the Larynx:

A- Suprahyoid muscles (MSGD)

1. Mylohyoid.
2. Stylohyoid.
3. Geniohyoid.
4. Digastric.

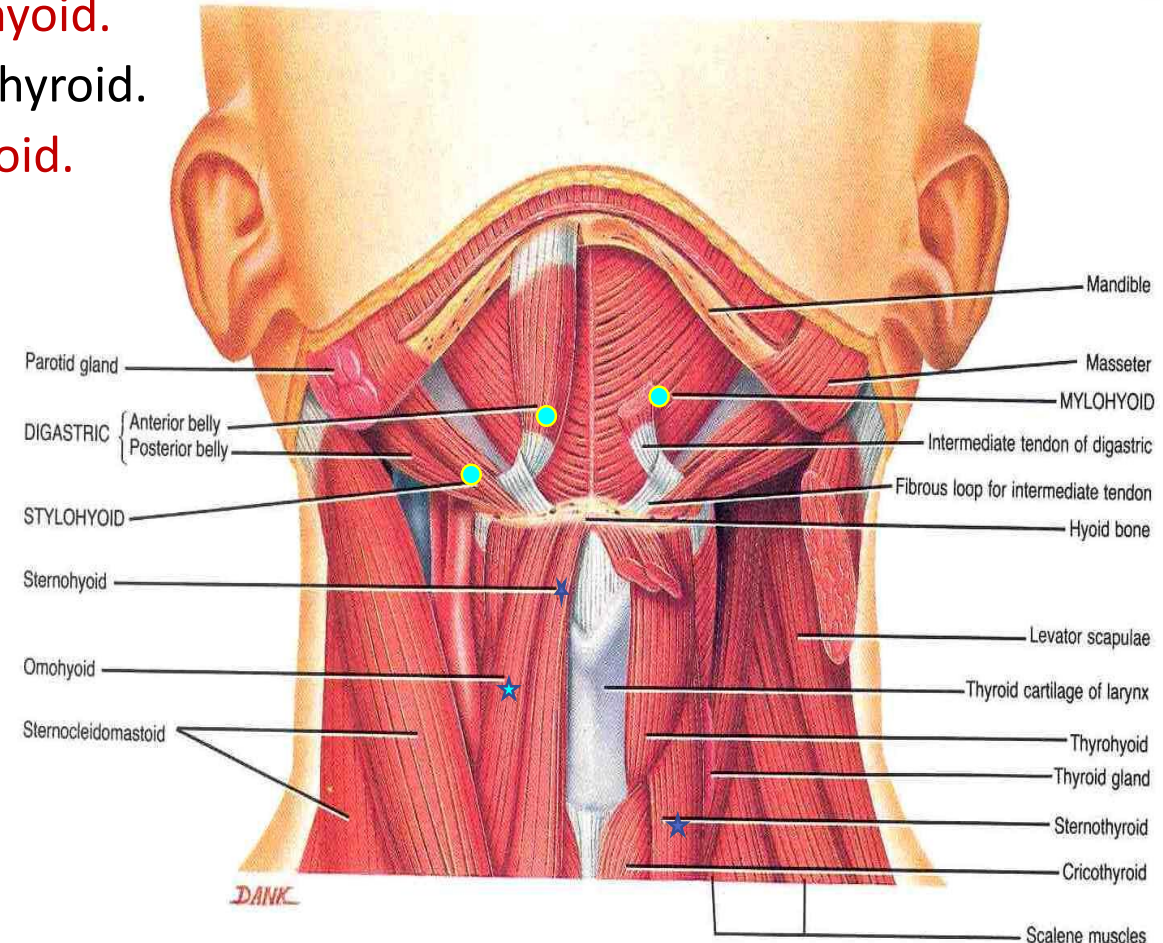
B- The longitudinal muscles of the pharynx

- Stylopharyngeus.
- Salpingopharyngeus.
- Palatopharyngeus.

Depressors of the Larynx:

The Infrahyoid Muscles:

- Sternohyoid.
- Sternothyroid.
- Omohyoid.

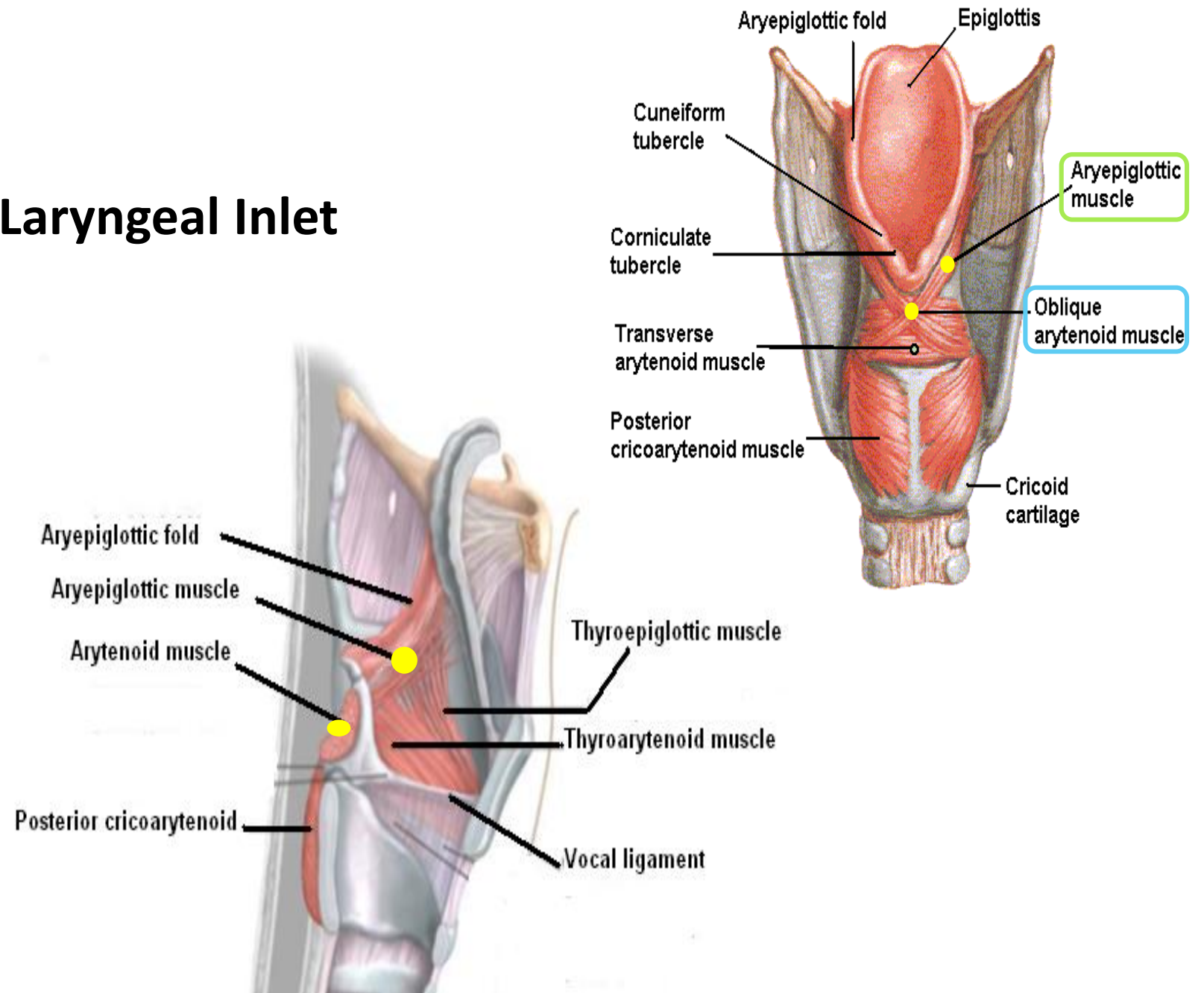


Larynx

4- Muscles (Intrinsic)

Muscles controlling the **Laryngeal Inlet**

1. Oblique arytenoid
2. Aryepiglottic muscle



Larynx

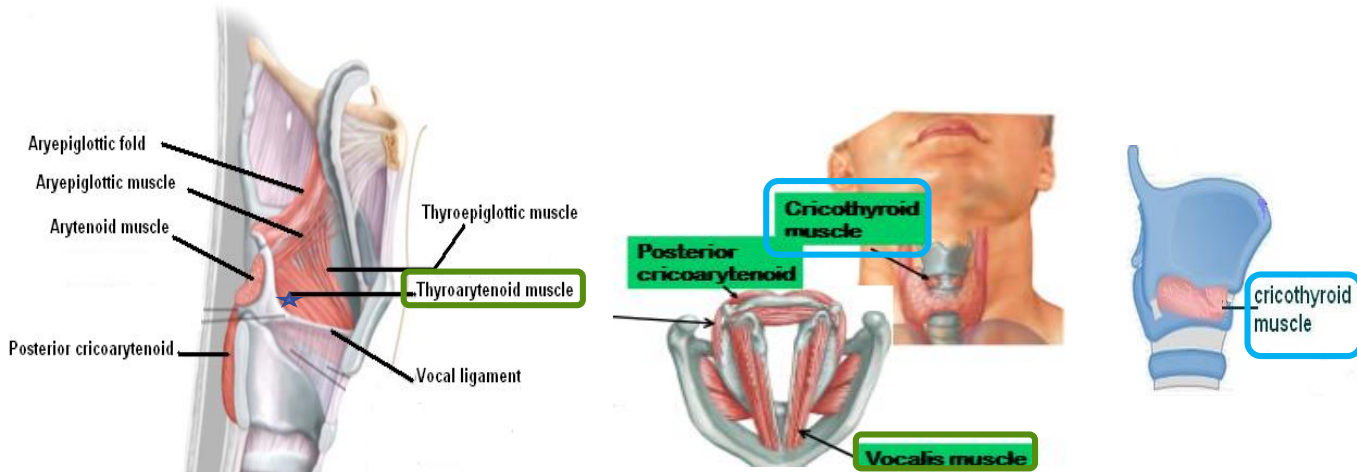
4- Muscles (Intrinsic)

Muscles controlling vocal cords:

LENGTH AND TENSION

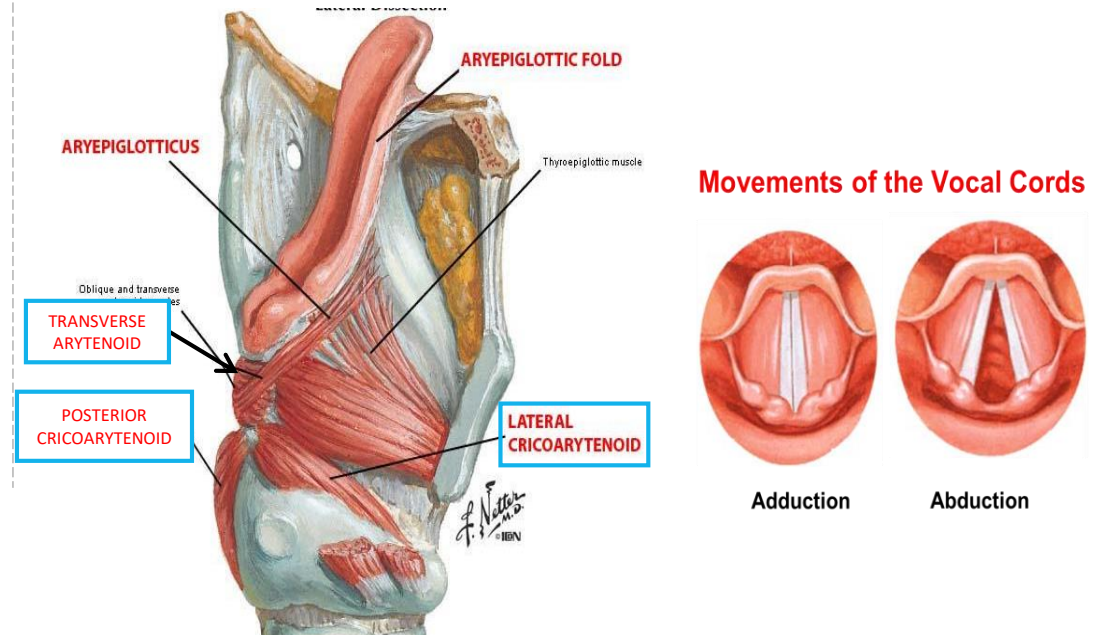
1. Thyroarytenoid (vocalis) muscle:
 - Relax vocal cords
 - Decrease both length and tension of vocal cords
2. Cricothyroid muscle:
 - increase both length and tension of vocal cords

Remember: Cricothyroid is the only intrinsic muscle which found outside the larynx



ADDUCTION AND ABDUCTION

1. Adductors (**close rima glottis**)
 - Lateral cricoarytenoid.
 - Transverse arytenoid.
2. Abductor (**open rima glottis**)
 - Posterior cricoarytenoid



Larynx

Nerve Supply (very important):

Sensory:

Above the vocal cords:

- **Internal laryngeal nerve**
- branch of the **superior laryngeal** of the vagus nerve.

Below the vocal cords:

- **Recurrent laryngeal nerve** of the **vagus nerve**.

Motor:

All intrinsic muscles supplied by the **recurrent laryngeal nerve** **except the cricothyroid**

The **cricothyroid*** is supplied by the **external laryngeal nerve** of **superior laryngeal of vagus**.

* للحفظ: cross the rule

Blood Supply And Lymphatics:

Arteries:

Upper half:

- **Superior laryngeal artery**
- branch of **superior thyroid artery**

Lower half:

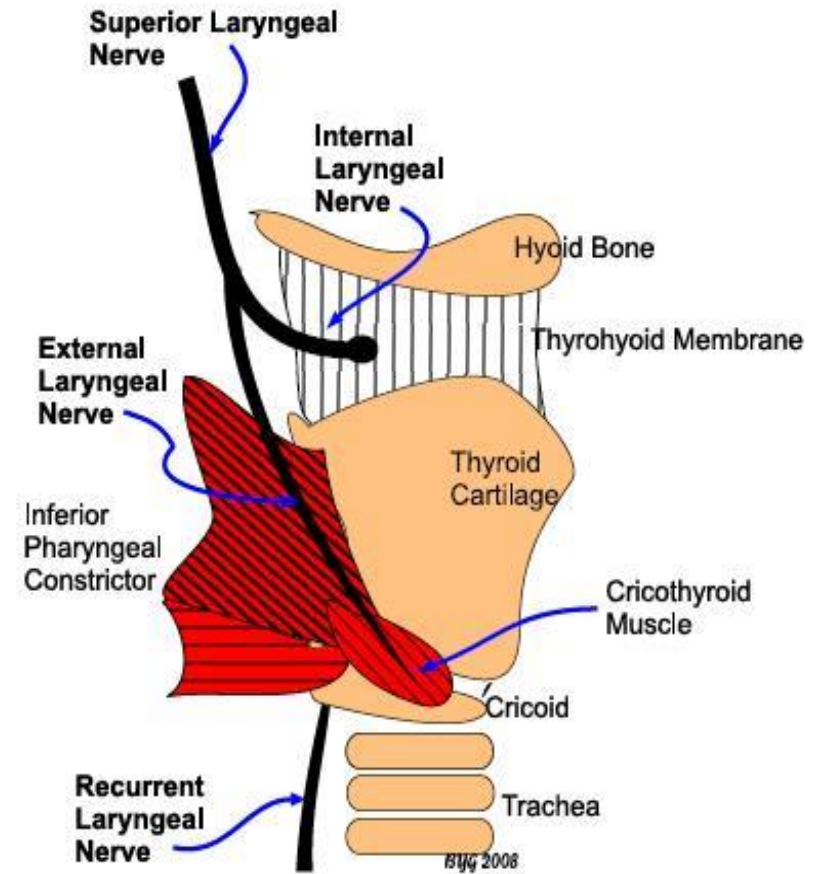
- **Inferior laryngeal artery**
- branch of **inferior thyroid artery**

Veins:

Accompany the corresponding arteries.

Lymphatics:

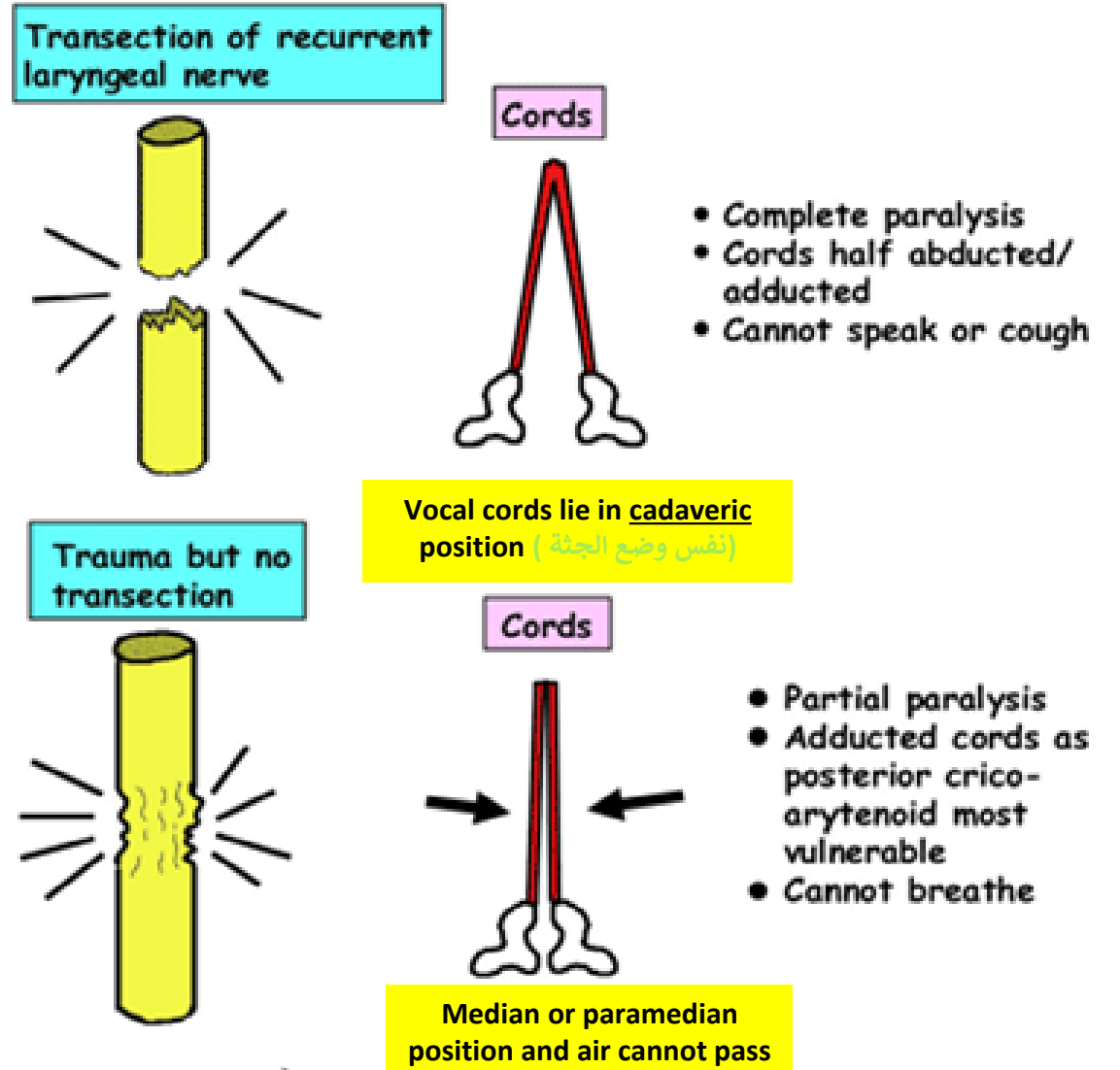
The lymph vessels drain into the **deep cervical lymph nodes**.



للحفظ: بما أن سالفه arteries معقدة شوي في اللارنكس لأن فيها نصف علوي و نصف سفلي نقدر نقول: لا ذا !
(laryngeal & thyroidal)

SEMON'S LAW or damage of the RECURRENT LARYNGEAL NERVE

Semon's Law indicates the different effect between **damage** (surgical trauma) and **transection** (قطع) of the **recurrent laryngeal nerve** due to surgery in region of the neck (e.g. thyroidectomy or parathyroidectomy).

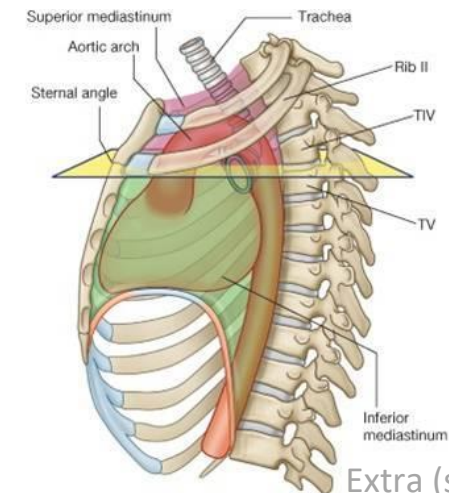
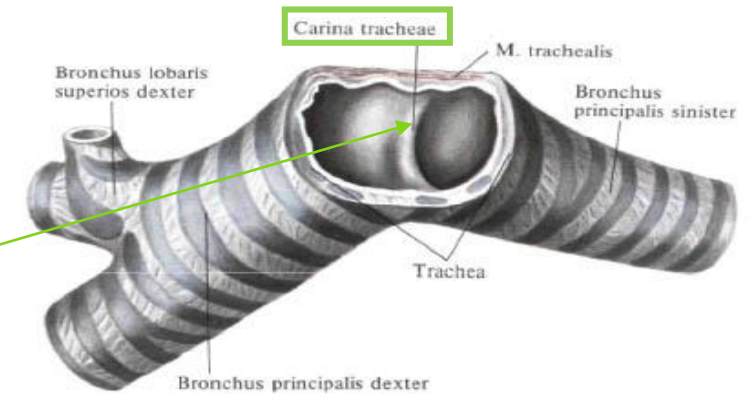
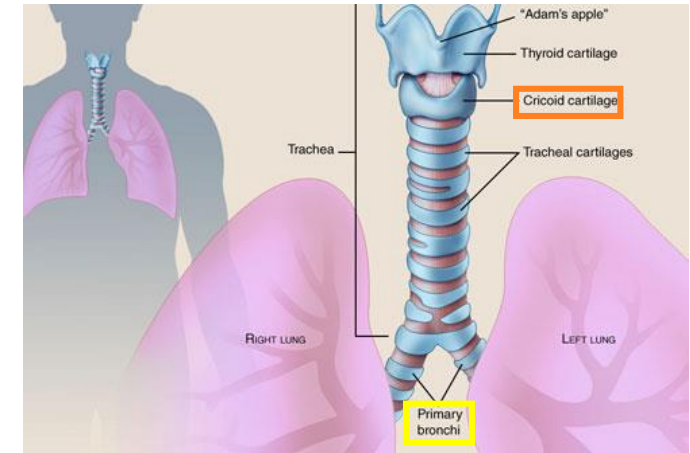


Damage occurs to both sides of the nerve → patient may die ← **BILATERAL** → **DISASTER**

Damage occurs to one side only → can be repaired incompletely ← **UNILATERAL** → **CAN PARTIALLY COMPENSATE**

Trachea (windpipe)

- Mobile متحركة ,fibro cartilaginous tube, **5 inches long***, and 1 inch in diameter.
- *Begins:* In the neck below the **cricoid cartilage** of the larynx (at lower border of cricoid cartilage at **C6**).
- *Ends:* In the thorax at the level of **sternal angle** (lower border of **T4**), by dividing into **right and left principal (main,primary) bronchi**.
- The ridge at the bifurcation **from inside** is called **carina**. زاوية الانقسام
- It is the most **sensitive** part of the respiratory tract and is associated with the **cough reflex**.



*Note:

Trachea = 5 inches

Larynx = 2 inches

Extra (sternal angle)

Anterior:

1. Sternum
2. Thymus,(remains of thymus gland).
3. Left brachiocephalic vein.
4. Arch of aorta.
5. Origin of: Brachiocephalic artery and left common carotid artery.

Left side:

1. Arch of aorta.
2. Left common Carotid artery
3. Left subclavian artery
4. Left vagus nerve
5. Left phrenic nerve
6. Pleura

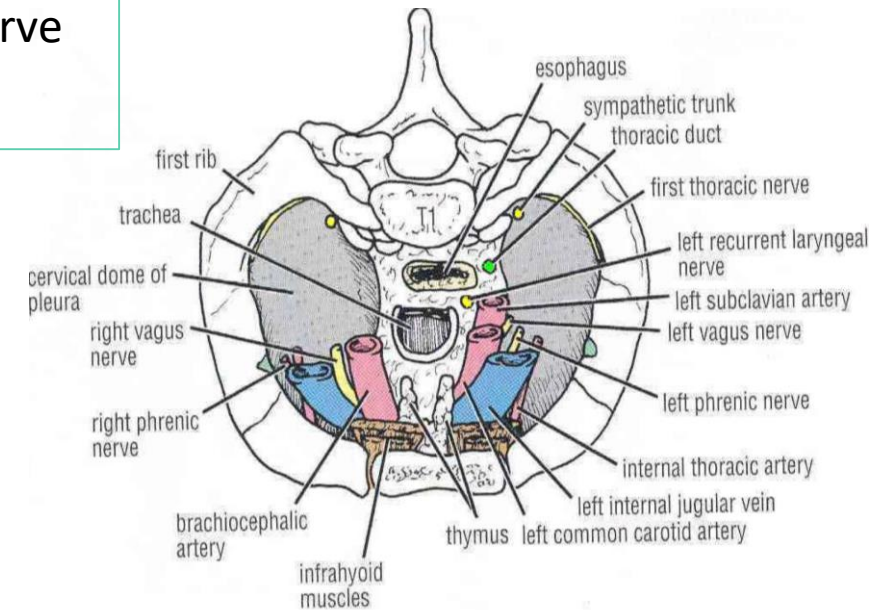
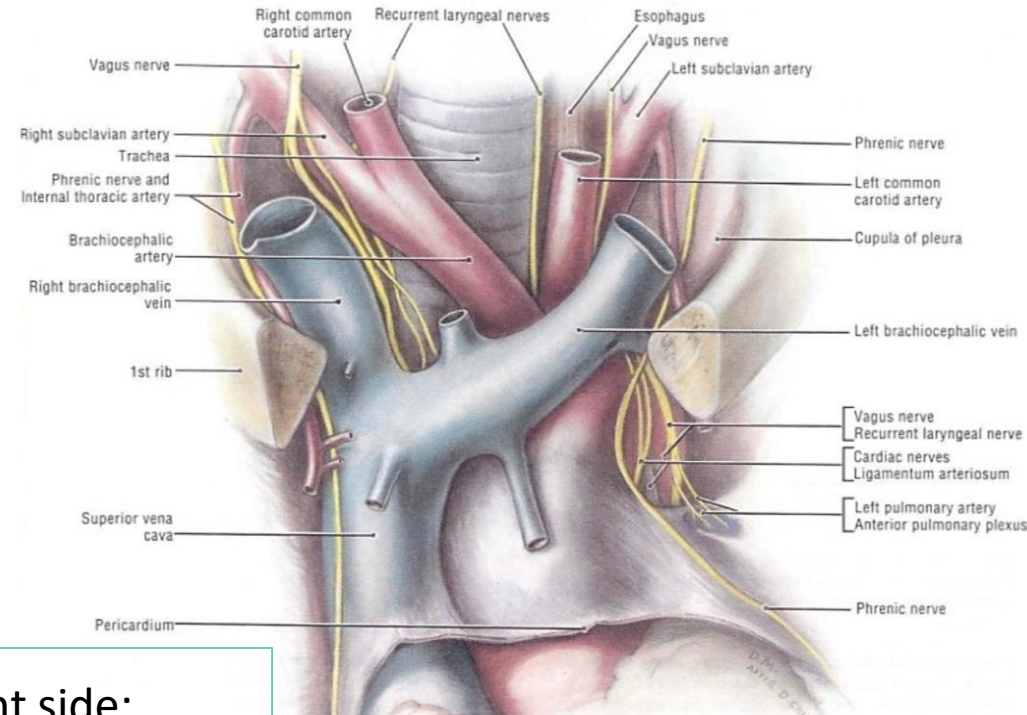
Relations in the **Superior Mediastinum**

Right side:

1. Azygos vein
2. Right vagus nerve
3. Pleura

Posterior:

1. Esophagus
2. Left recurrent laryngeal nerve.



Trachea

Nerve Supply:

- Branches of the **vagus nerve** and **recurrent laryngeal** nerve give sensory fibers to supply the mucous membrane
- Branches from the **Sympathetic trunks** supply the **trachealis muscle** and the **Blood vessels**.

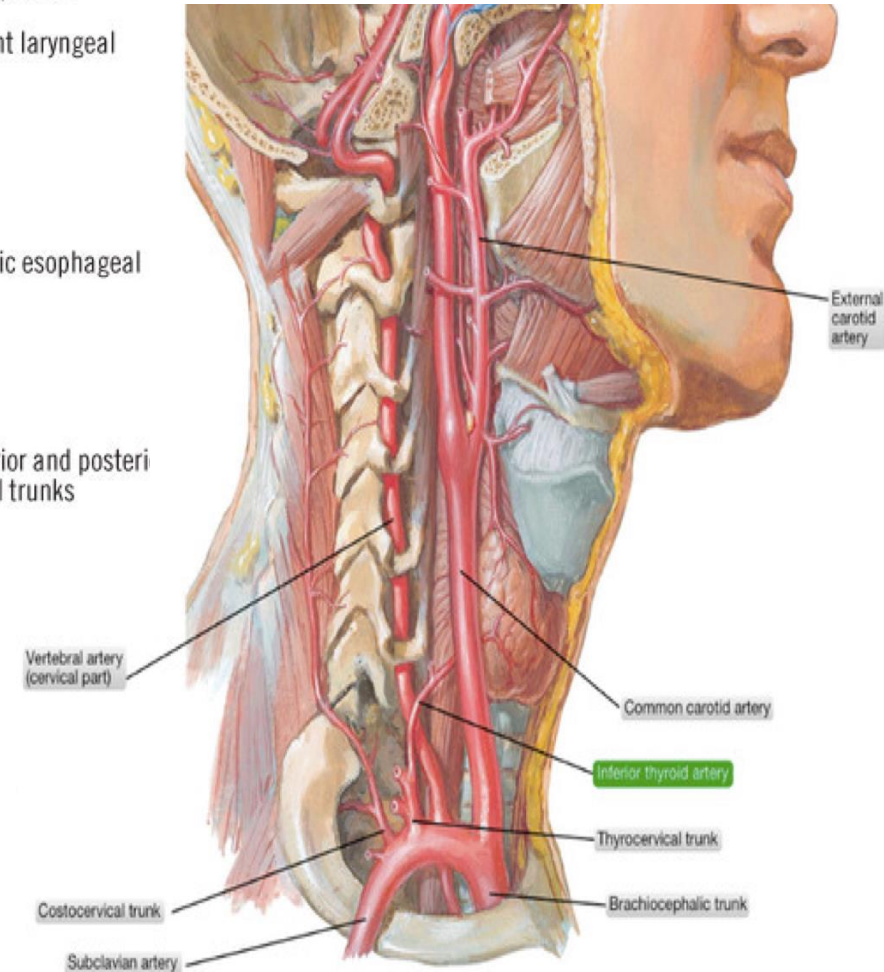
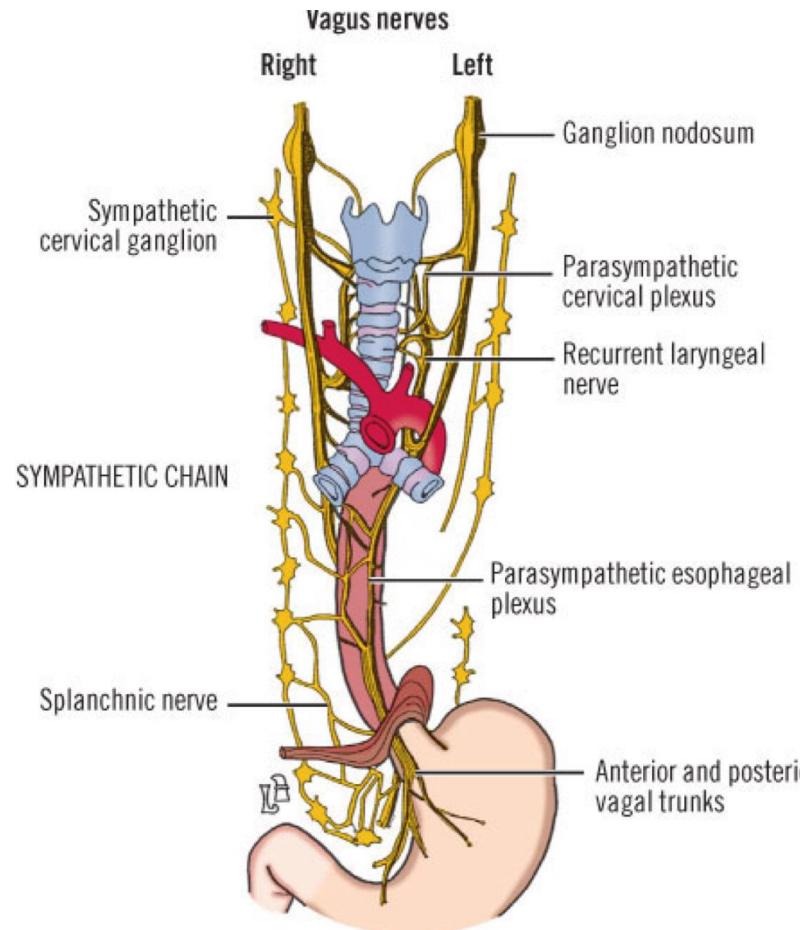
Blood Supply:

Arteries: Branches from the **inferior thyroid** and **bronchial arteries** (from descending thoracic aorta)

Veins: Drain to **inferior thyroid** veins.

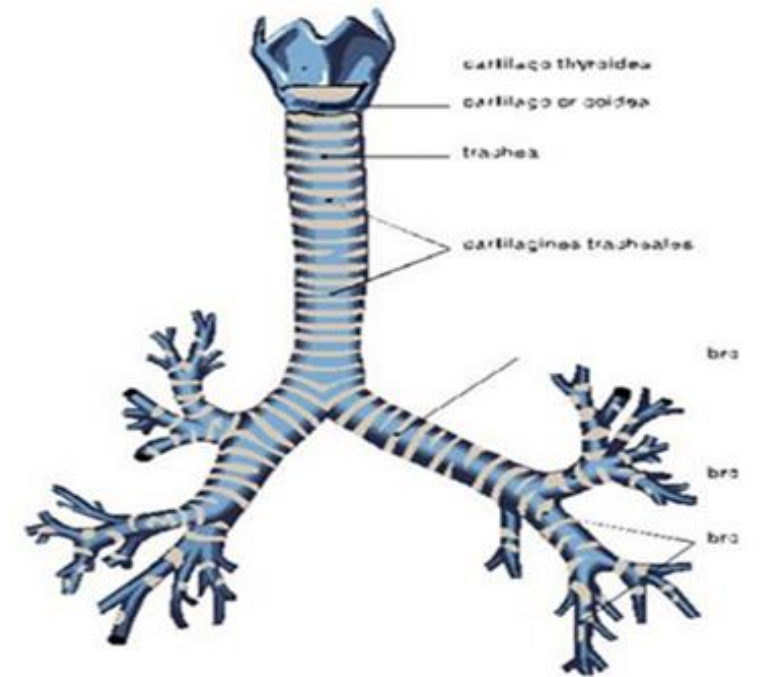
Lymphatic Drainage:

Into the **pretracheal** and **paratracheal** lymph nodes.



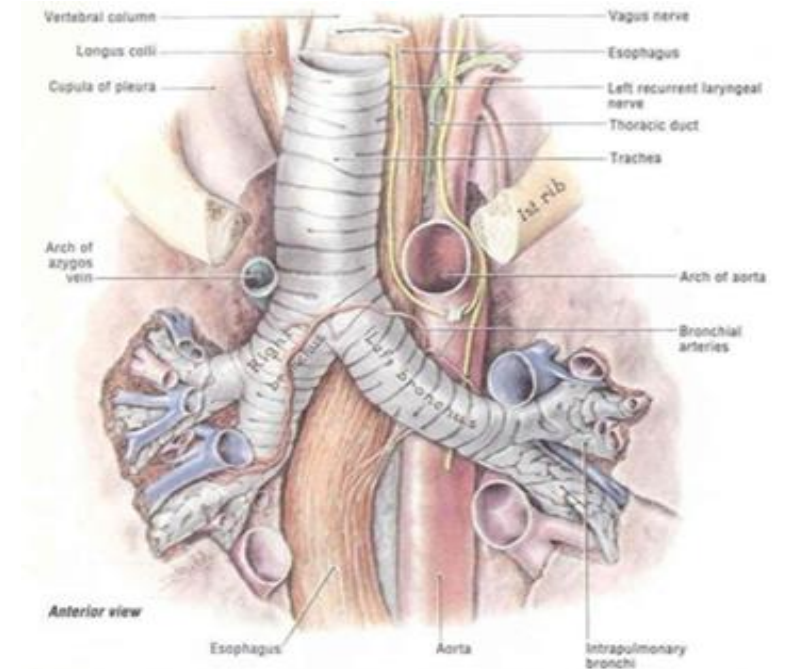
Right Principal Bronchus

- About **one inch** long.
- **Wider, shorter** and **more vertical** than the left.
- Gives **superior lobar bronchus** before entering the hilum of the right lung.
- On entering the hilum it divides into **middle** and **inferior lobar bronchi**.



Left Principal Bronchus

- About **two inches** long.
- **Narrower, longer** and **more horizontal** than the right.
- Passes to the left below the aortic arch and in front of esophagus.
- On entering the hilum of the left lung it divides into **superior** and **inferior lobar bronchi**.



Bronchial Divisions (VERY IMPORTANT SLIDE)

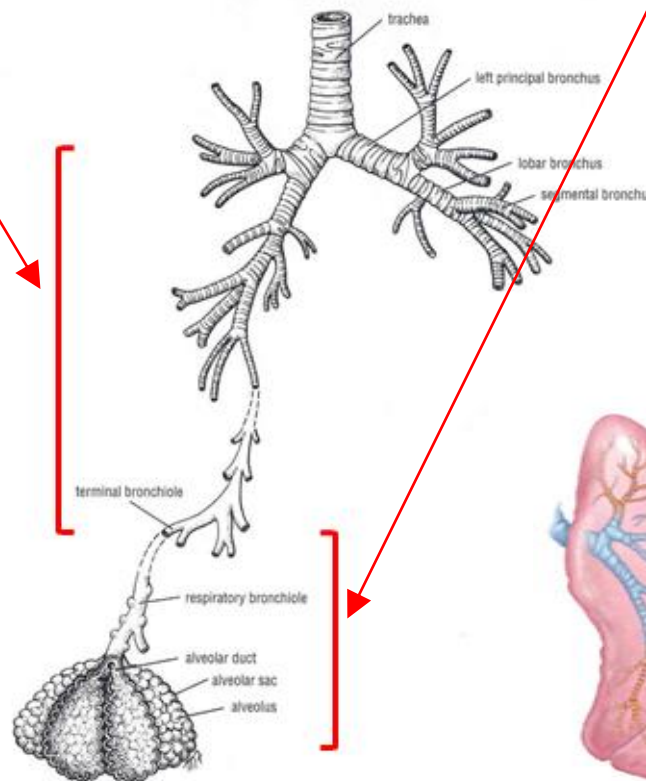
Within the lung, each bronchus divides and redivides into number of branches that can be divided into two groups:

Conduction zone branches

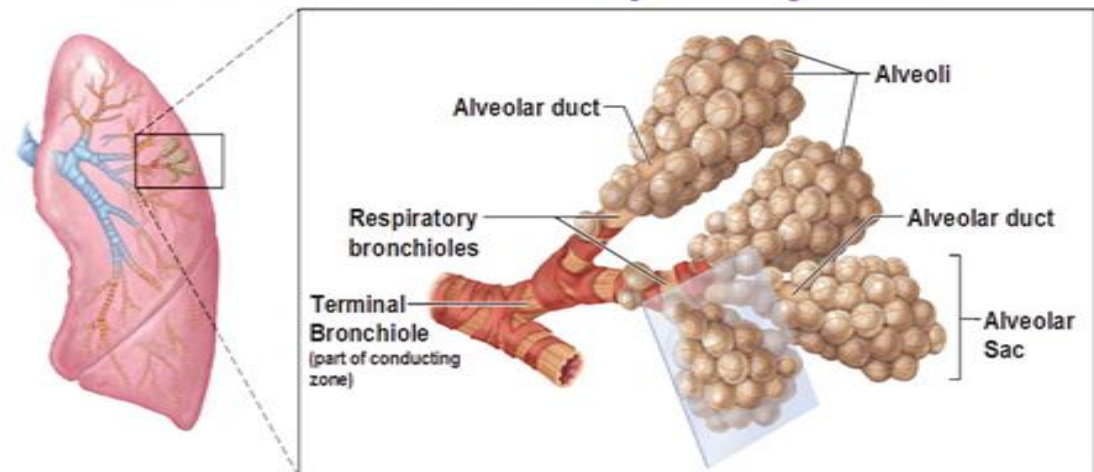
1. Primary (main) bronchi.
2. Secondary (lobar) bronchi.
3. Tertiary (segmental) bronchi.
(supply the bronchopulmonary segment).
4. Smaller bronchi.
5. Bronchioles.
6. Terminal bronchioles.

Respiratory zone branches

1. Respiratory bronchioles.
2. Alveolar ducts.
3. Alveolar sacs.
4. Alveoli.



Structures of the Respiratory Zone



Questions

1. Which of the following muscles controls the laryngeal inlet?
- a. Omohyoid
 - b. Digastric
 - c. Palatopharyngeus
 - d. Aryepiglottic muscle

Answer: D

2. Which of the following muscles relaxes and shortens the vocal cords?
- a. Cricothyroid
 - b. Oblique arytenoid
 - c. Thyroarytenoid
 - d. Sternothyroid

Answer: C

3. The laryngeal muscle most responsible for stretching the vocal cords is the:
- a. Cricothyroid
 - b. Oblique arytenoid
 - c. Thyroarytenoid
 - d. Sternothyroid

Answer: A

4. Which muscle is responsible for opening the rima glottidis?
- a. Lateral cricoarytenoid
 - b. Posterior cricoarytenoid
 - c. Transverse arytenoid
 - d. Both a and c

Answer: B

5. All intrinsic muscles of the larynx are innervated by the recurrent laryngeal nerve except:
- a. Thyroarytenoid
 - b. Cricothyroid
 - c. Lateral cricoarytenoid
 - d. Posterior cricoarytenoid

Answer: B

6. In continuation of the previous question: which nerve is it supplied by?

Answer: External laryngeal nerve of the superior laryngeal branch of the vagus nerve.

7. Recurrent laryngeal nerves are sensory to:
- a. Laryngeal cavity below the level of vocal cords
 - b. Laryngopharynx
 - c. All intrinsic muscles of the larynx
 - d. Both a and c

Answer: A

8. According to Semon's Law, the result of transection of the recurrent laryngeal nerve can cause:
- a. Adducted cords
 - b. Inability to breath
 - c. Inability to speak
 - d. Partial paralysis

Answer: C

9. Following thyroid surgery, it was noted that a patient frequently aspirated fluid into her lungs. Upon examination it was determined that the area above the vocal fold of the larynx was numb. What nerve may have been injured?
- a. External branch of the superior laryngeal nerve
 - b. Internal branch of the superior laryngeal nerve
 - c. Recurrent branch of vagus nerve
 - d. None of the above

Answer: B

10. The mucous membrane of the trachea is innervated by:
- a. Recurrent laryngeal nerve
 - b. Internal laryngeal nerve
 - c. External laryngeal nerve
 - d. Sympathetic nerve fibers

Answer: A

11. What happens to the trachea, or windpipe, before it reaches the lungs?
- a. It branches in two directions
 - b. It branches in three directions
 - c. It vibrates and creates a sound
 - d. It closes up so that no oxygen can escape

Answer: A

12. Which of the following statements is NOT true regarding the trachea?
- a. Trachea rings are C-shaped
 - b. It splits into the right and left bronchi to supply air to the lungs
 - c. Opening to the trachea is covered by epiglottis
 - d. It lies posterior to the esophagus

Answer: D

13. Bronchi branch into tubes of smaller diameter that are known as:

- A) Microtrachea
- B) Bronchioles
- C) Alveolar sacs
- D) Respiratory bronchioles

Answer: B

14. All the larynx cartilages are hyaline cartilage EXCEPT :

- A) cricoid.
- B) epiglottis.
- C) thyroid.
- D) Arytenoid

Answer: B

15. How long is the larynx :

- A) 2cm.
- B) 2.5 inches.
- C) 2inches.
- D) 4cm

Answer: C

16. Laryngeal Inlet is bounded anteriorly by:

- A) upper margin of epiglottis.
- B) arytenoid cartilage.
- C) Aryepiglottic folds.
- D) all of them

Answer: A

17. Quadrangular membrane forms :

- A) vocal ligament.
- B) lateral thyrohyoid ligament.
- C) median thyrohyoid ligament.
- D) vestibular ligament.

Answer: D

18. Laryngeal Cavity Extends from laryngeal inlet to upper border of the cricoid cartilage

A\ true. B\ false

Answer: B, correct is: until lower border of crocoid cartilage

19. Epithelium lining of vocal folds is :

- A) ciliated columnar epithelium.
- B) simple squamous epi.
- C) stratified squamous epi.
- D) simple cuboidal epi.

Answer: C

20. Extrinsic muscles of Larynx subdivide into:

- A) Elevators & depressors
- B) Controlling laryngeal inlet & vocal cavity
- C) none of the above
- D) all of the above.

Answer: A

