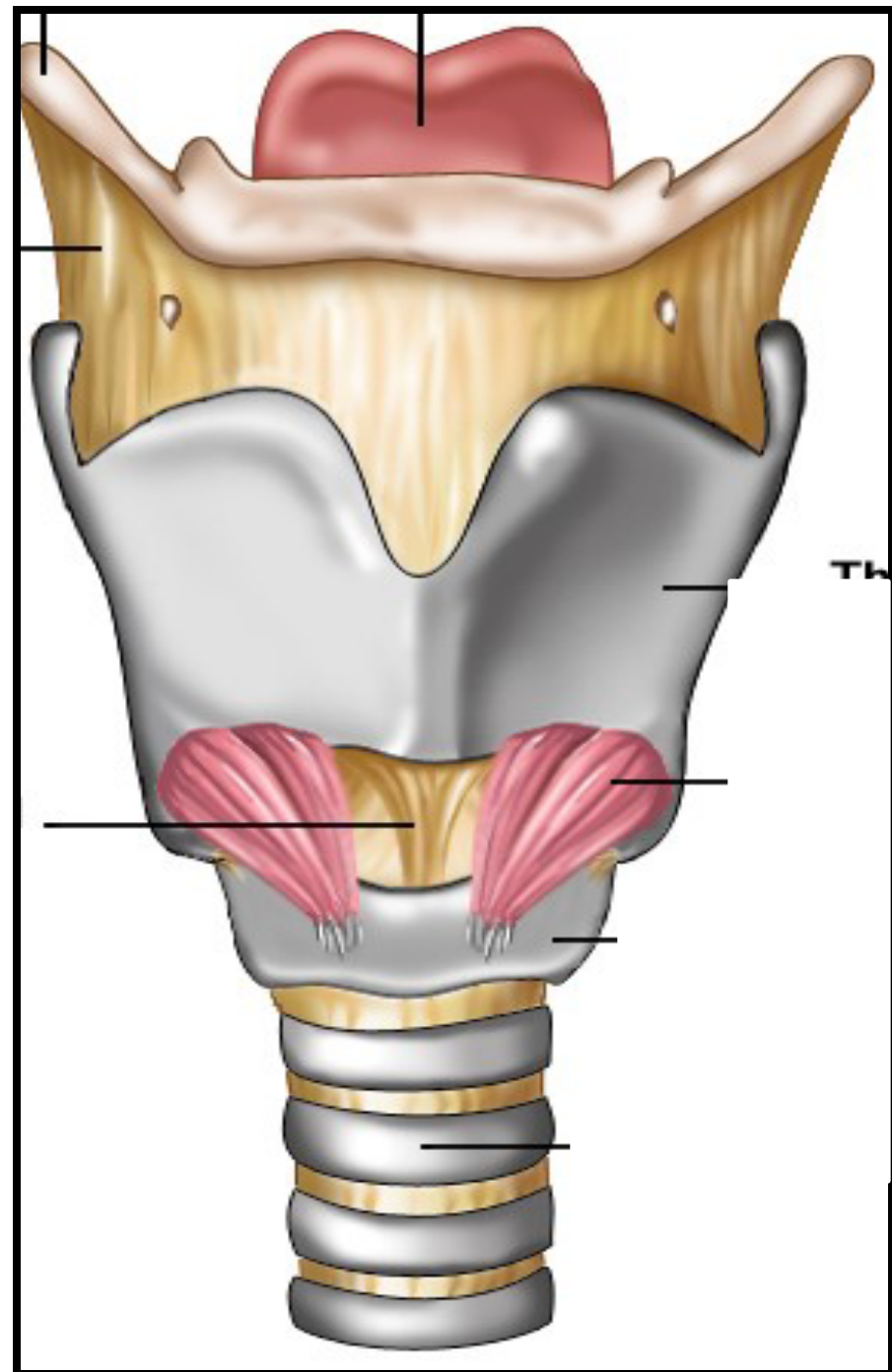


# LARYNX & TRACHEA & BRONCHI

Dr. Sameerah Shaheen  
Anatomy Department

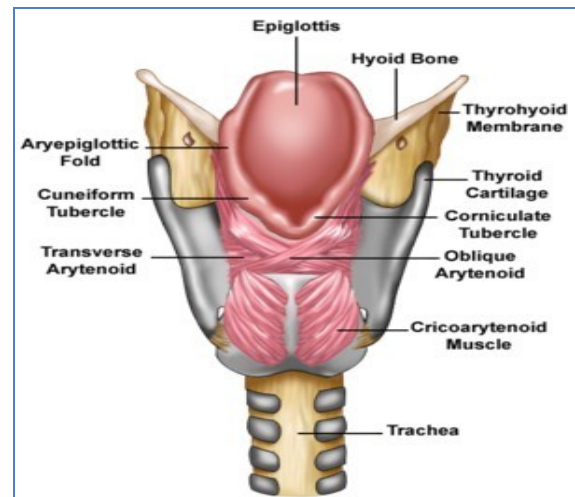
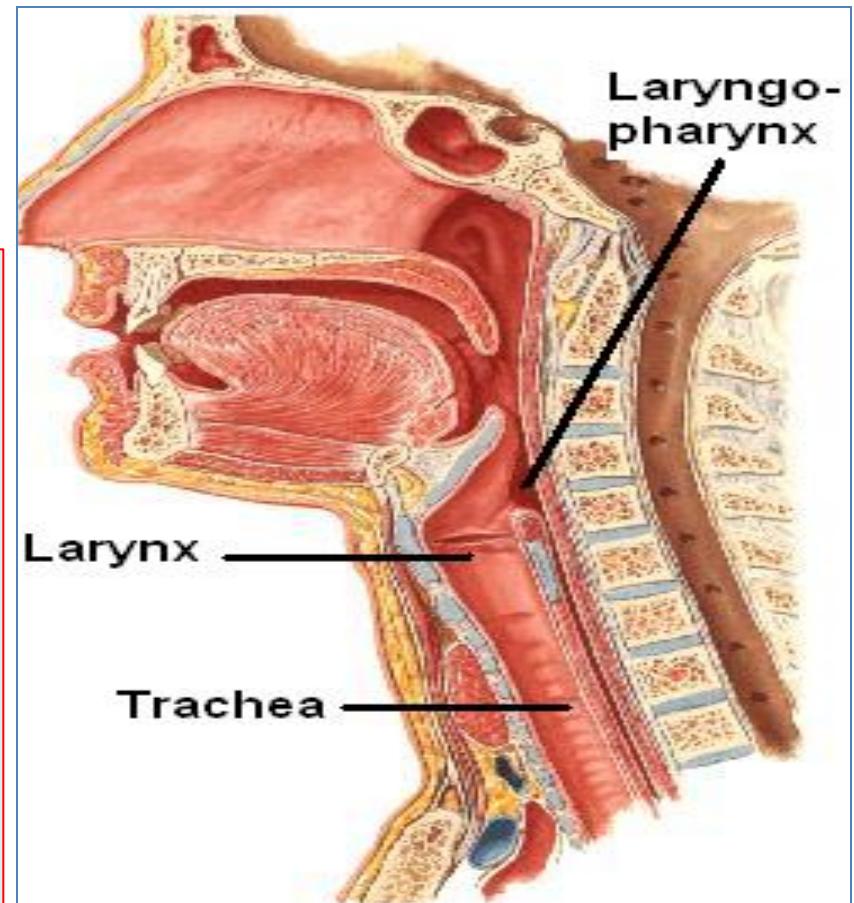


# Objectives

- *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**.

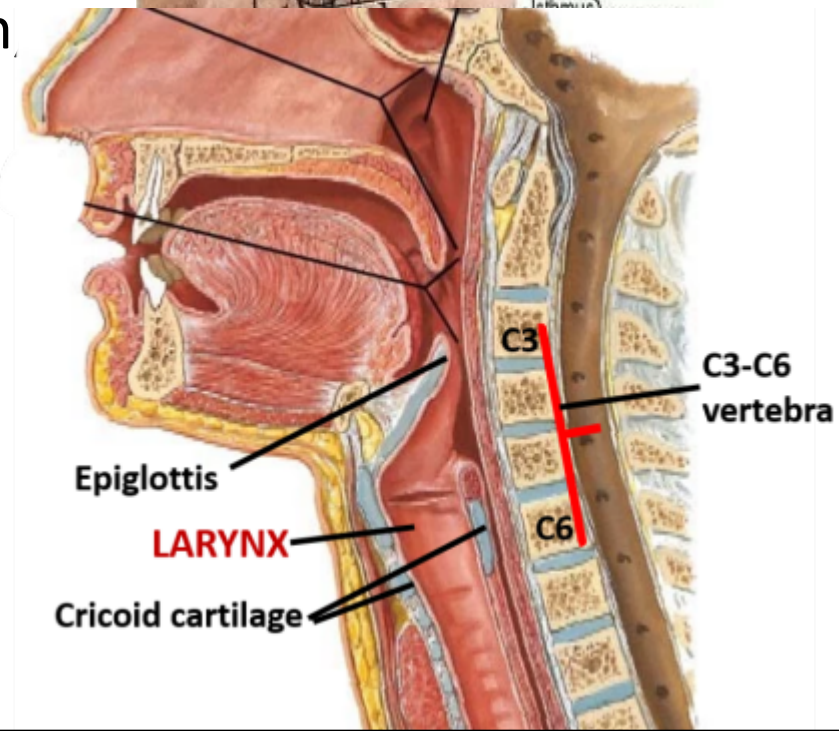
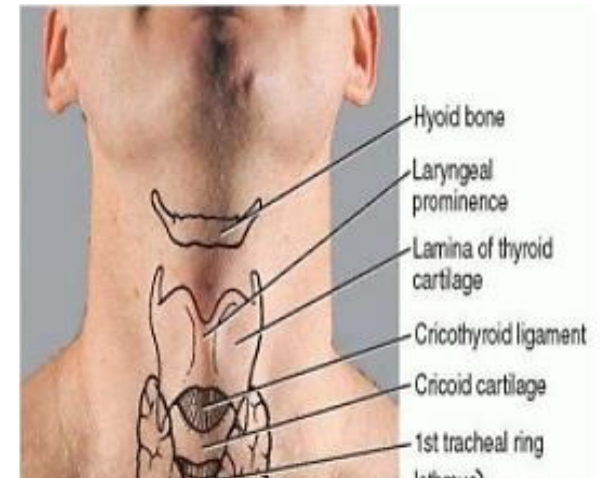
# LARYNX

- The larynx is the part **of the respiratory tract** **which** contains the vocal cords.
- In adult it is **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).



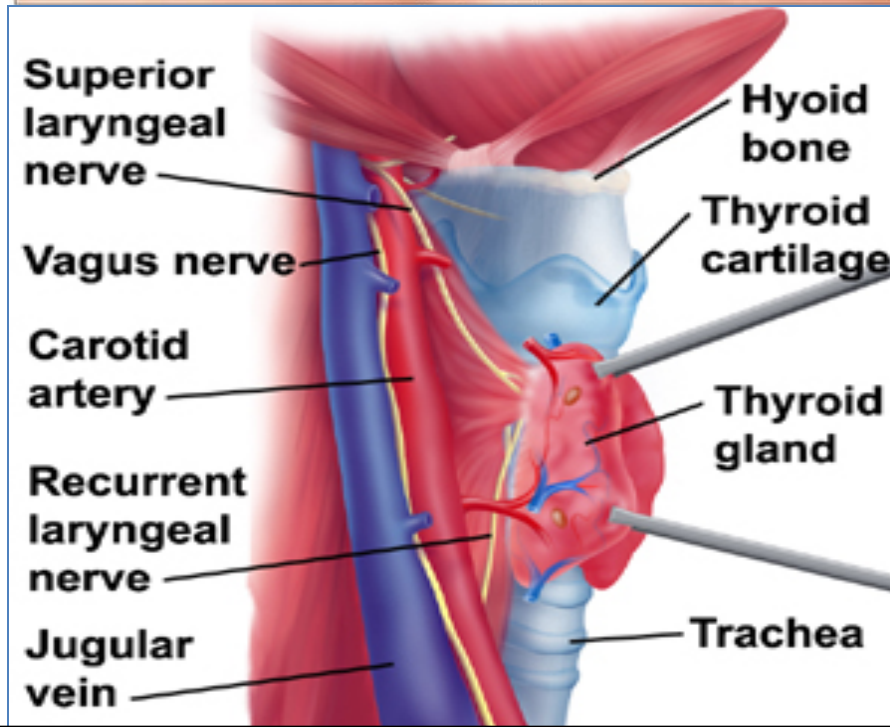
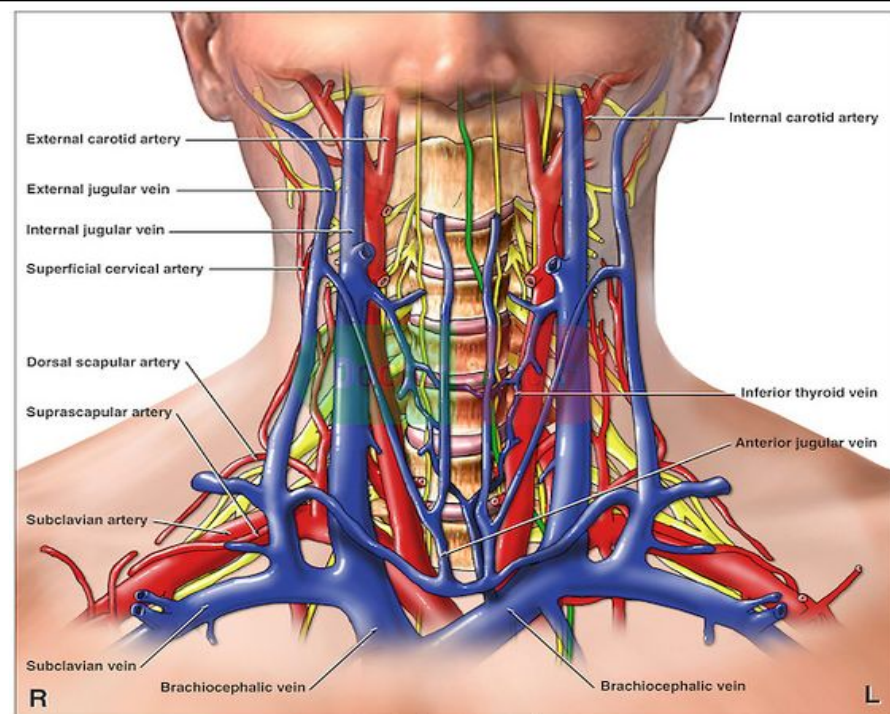
# Situation & Extent

- Lies in the anterior midline of the neck.
- From root of **tongue to trachea**, from **laryngeal inlet up** to lower border of **cricoid cartilage**.
- Opposite to **C3-C6** vertebrae in men.
- Slightly higher in female & children.
- In male, after puberty thyroid cartilage become prominent- **Adam's Apple**.



# Relations

- 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.**



# Structure

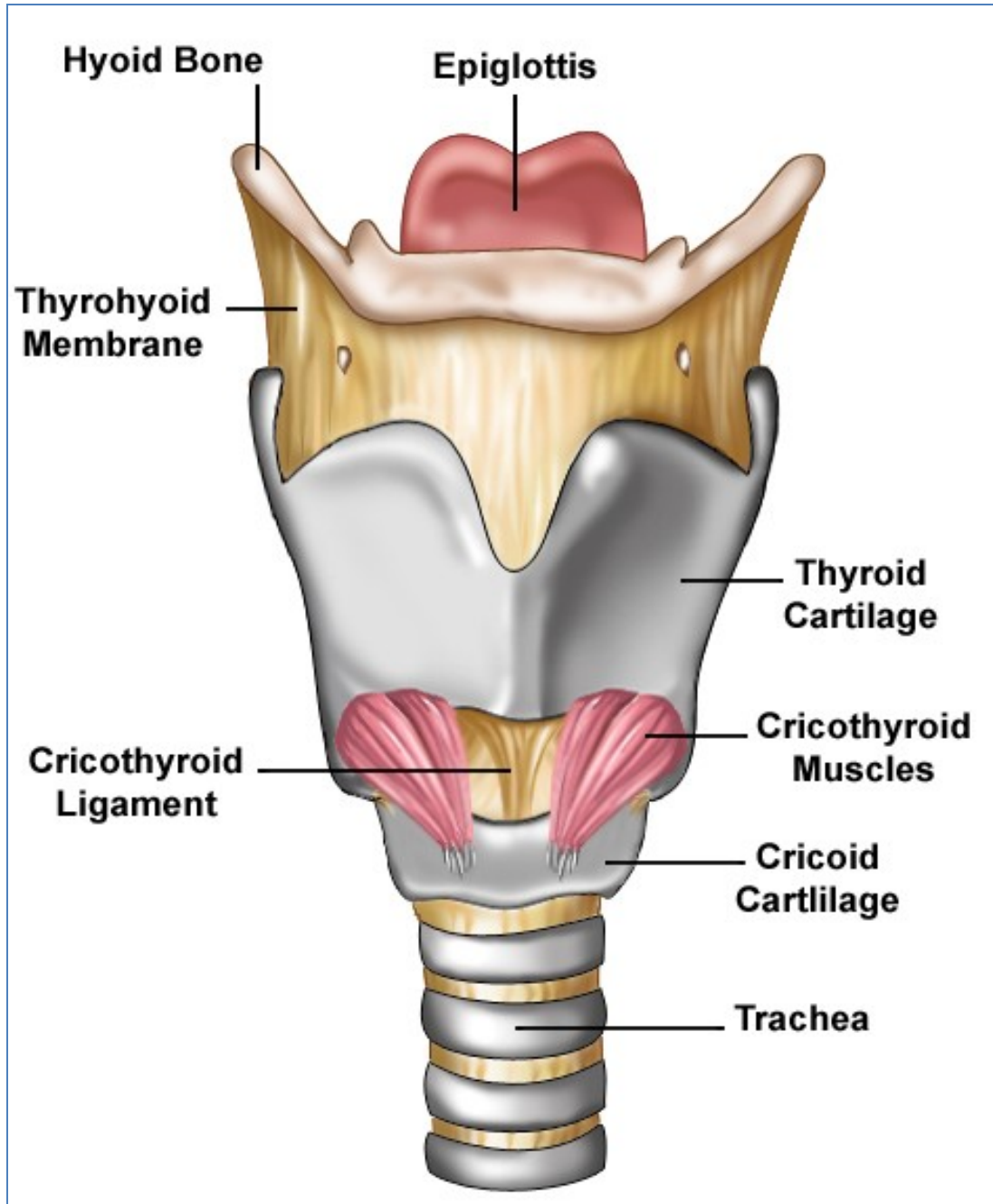
- The larynx consists of four basic components:

**1- Cartilaginous skeleton.**

**2- Membranes and ligaments.**

**3- Muscles (Intrinsic & extrinsic muscles).**

**4- Mucosal lining.**



# The Cartilages

- The cartilaginous skeleton is composed of:

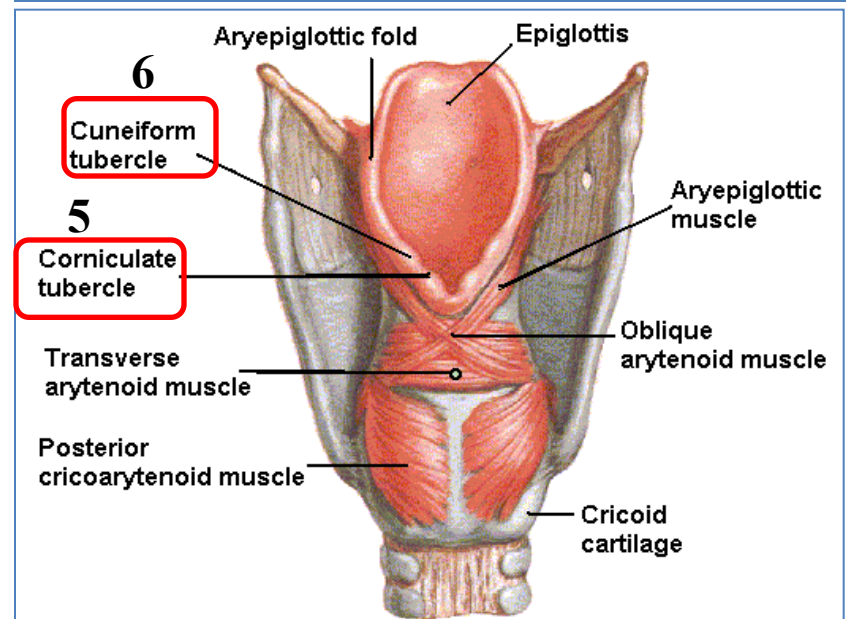
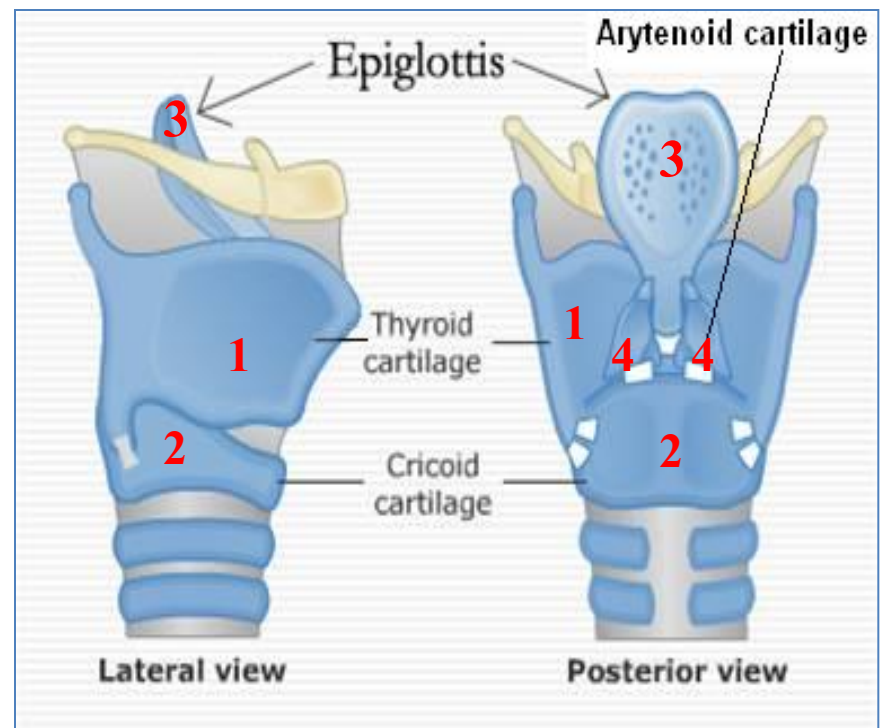
1. Thyroid
  2. Cricoid
  3. Epiglottis
- 3 Single

- 
4. Arytenoid
  5. Corniculate
  6. Cuneiform
- 3 Paired

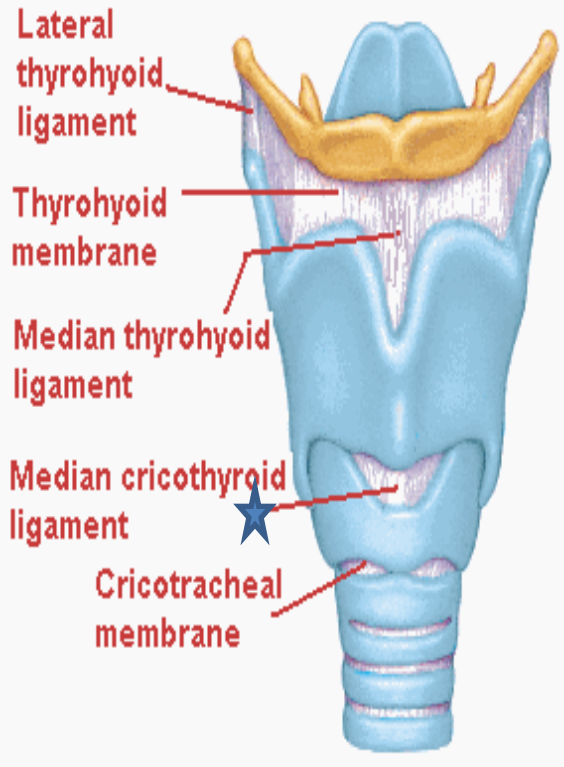
- All the cartilages, are **hyaline** except the **epiglottis** which is **Elastic** cartilage.

- The cartilages are:

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

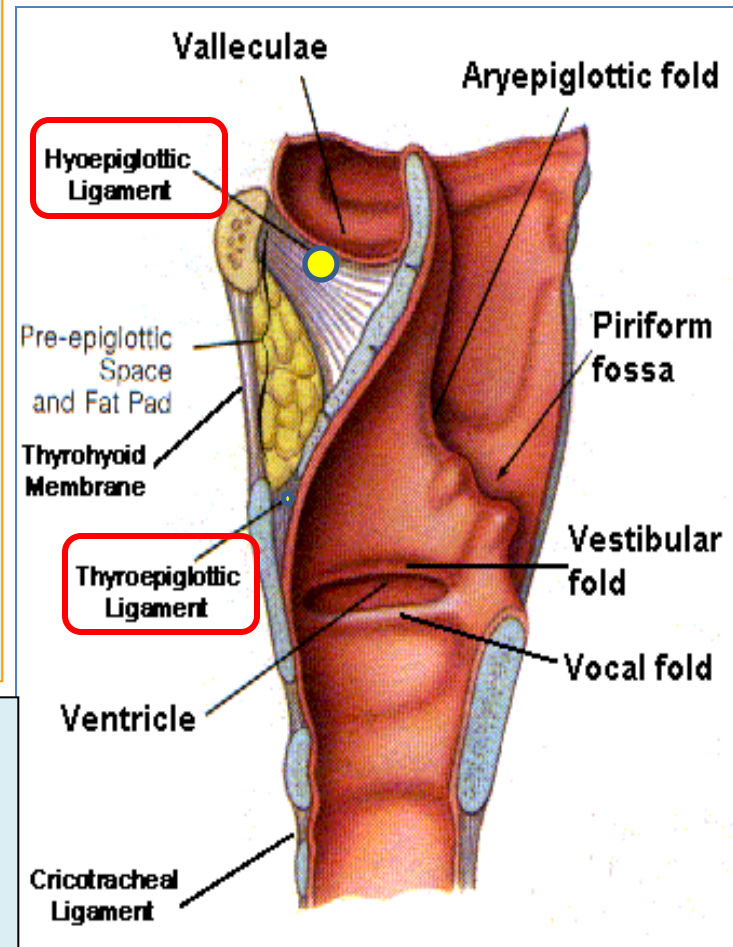


# MEMBRANES & LIGAMENTS



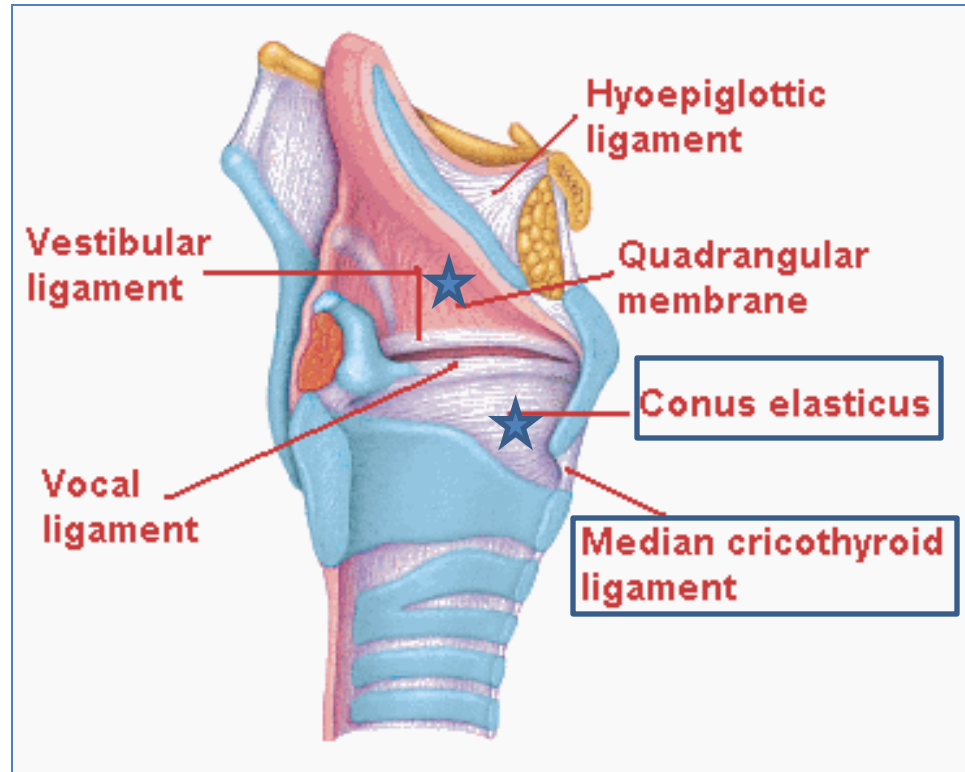
- Thyrohyoid membrane.
- Cricothyroid membrane. ★
- Cricotracheal membrane
- **Hyoepiglottic ligament.**
- **Thyroepiglottic ligament**

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





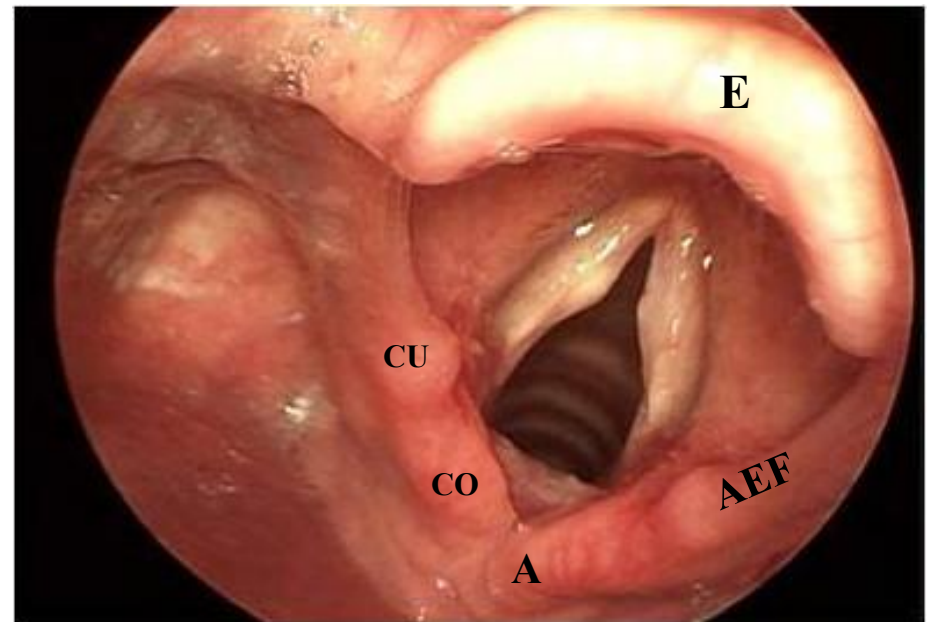
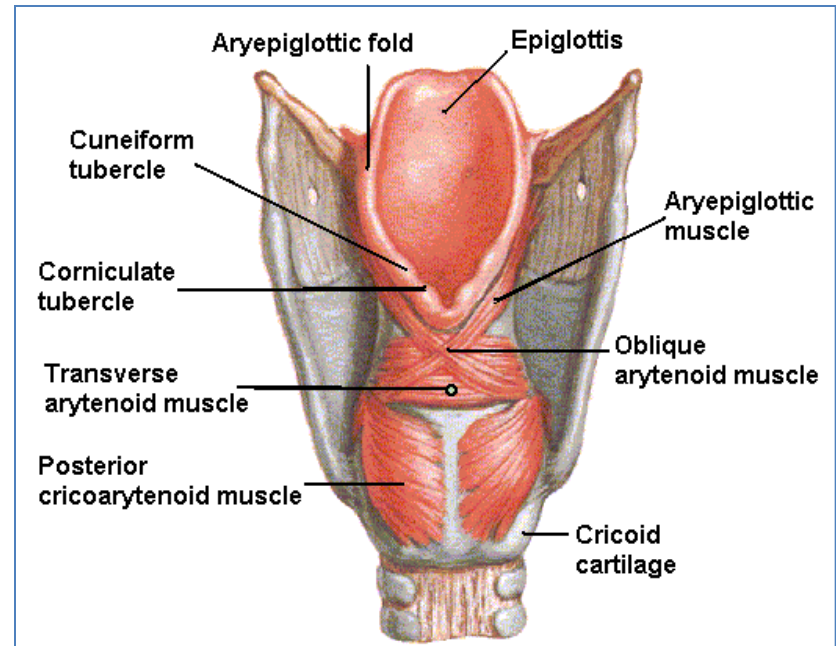
- **Quadrangular membrane:**
  - Or **aryepiglottic**★  
**membrane,**
  - It extends between the **arytenoid** and **epiglottis**.
  - Its lower free margin forms the **vestibular ligament** which forms the vestibular fold (false vocal cord).
- **Cricothyroid membrane (conus elasticus):**★
  - Its lower margin is attached to the upper border of cricoid cartilage.
  - Upper free margin forms Vocal ligament which forms the true vocal cord



**The arytenoid cartilage** has two processes: the vocal process where the **vocal ligament** is attached and the muscular process where the cricoarytenoid dorsalis muscle (the laryngeal abductor muscle) inserts

# Laryngeal Inlet

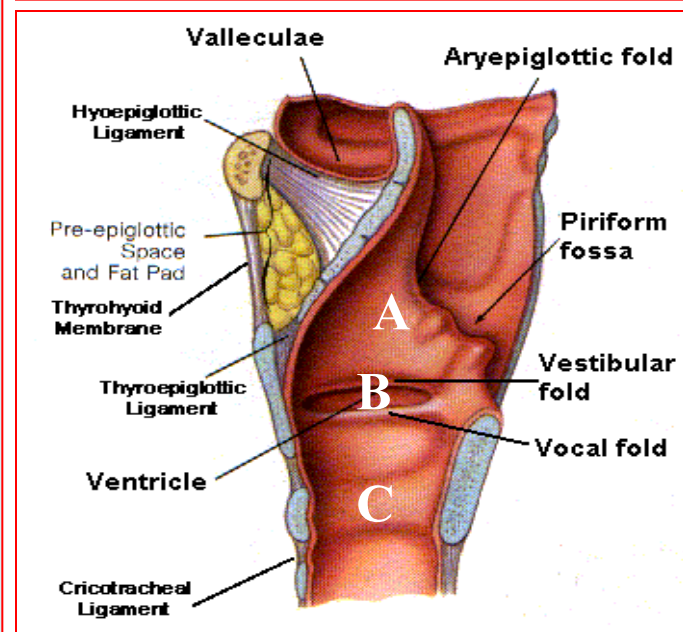
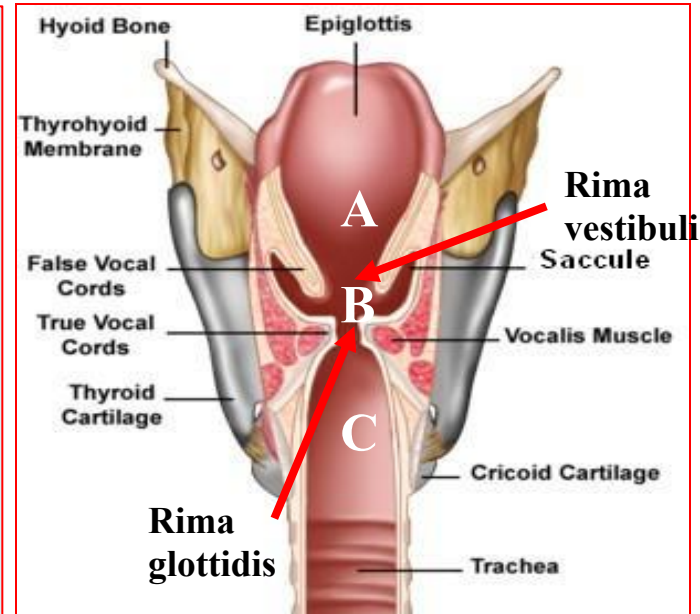
- It is the upper opening of the larynx.
- It faces upward and backward and opens into the laryngeal part of the pharynx, (**laryngopharynx**).
- **Bounded by:**
  - **Anteriorly:** by the **upper margin of epiglottis (E)**
  - **Posteriorly & below** by **arytenoid cartilages (A)**
  - **Laterally**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



# 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**:
  - A. Supraglottic part or vestibule**: it is the part above the vestibular folds.
  - B. Ventricle**: it is the part between the vestibular folds & the vocal folds.
  - C. Infraglottic part**, the part below the vocal folds.

NB. The ventricle has an upward invagination called **saccul** which is rich in goblet cells.



## 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 **sacule** (for lubrication of vocal folds).

## Muscles

Laryngeal muscles are divided into two groups:

- **Extrinsic muscles:** subdivided into two groups:
  - **Elevators** of the larynx.
  - **Depressors** of the larynx.
- **Intrinsic muscles:** subdivided into two groups:
  - Muscles **controlling the laryngeal inlet.**
  - Muscles **controlling the movements of the vocal cords.**

# Extrinsic muscles of Larynx

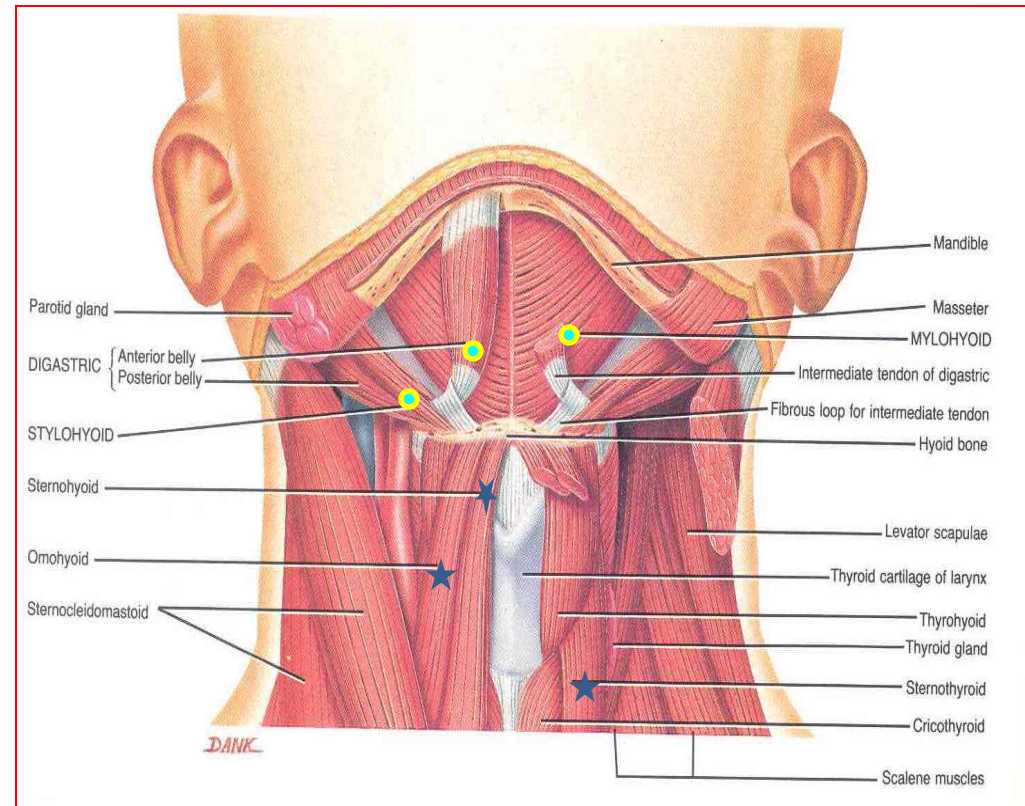
## Elevators of the Larynx

- **A- The 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.**
- **Omothyroid.**

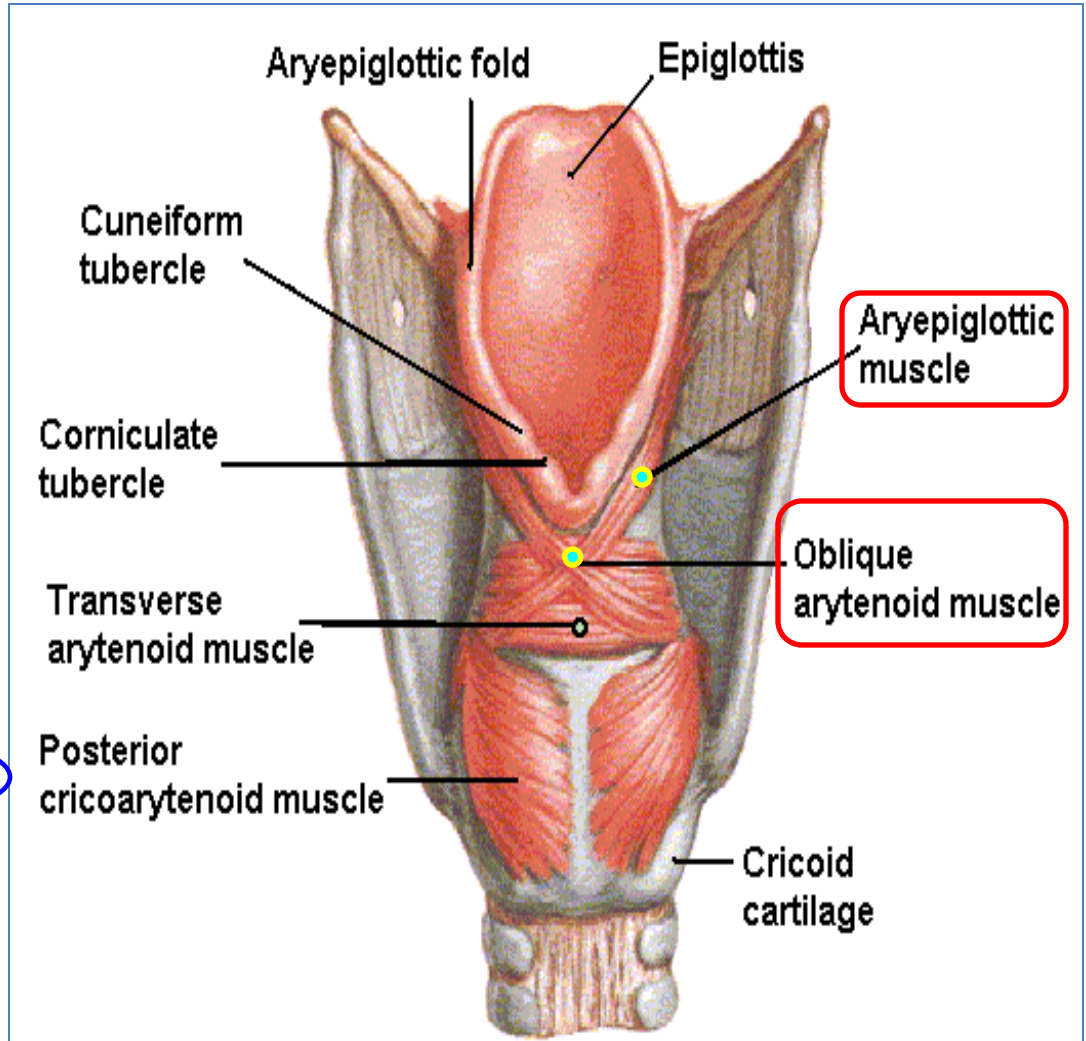
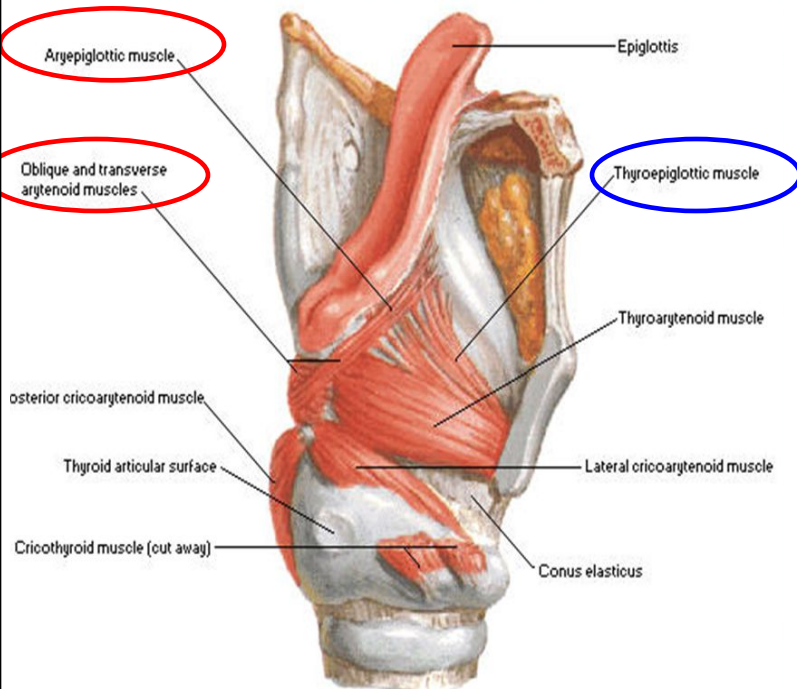
# Intrinsic muscles of Larynx

## Muscles Controlling the Laryngeal Inlet

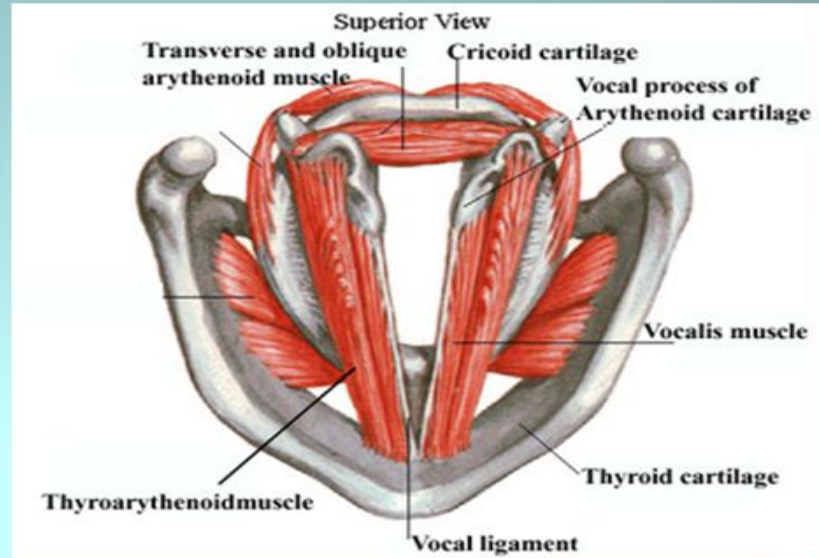
### ➤ Muscles which close inlet of larynx :

- Oblique arytenoid.
- Aryepiglottic muscle.

### Intrinsic Laryngeal Muscles



### ➤ Muscles which open inlet of larynx : Thyro-epiglottics

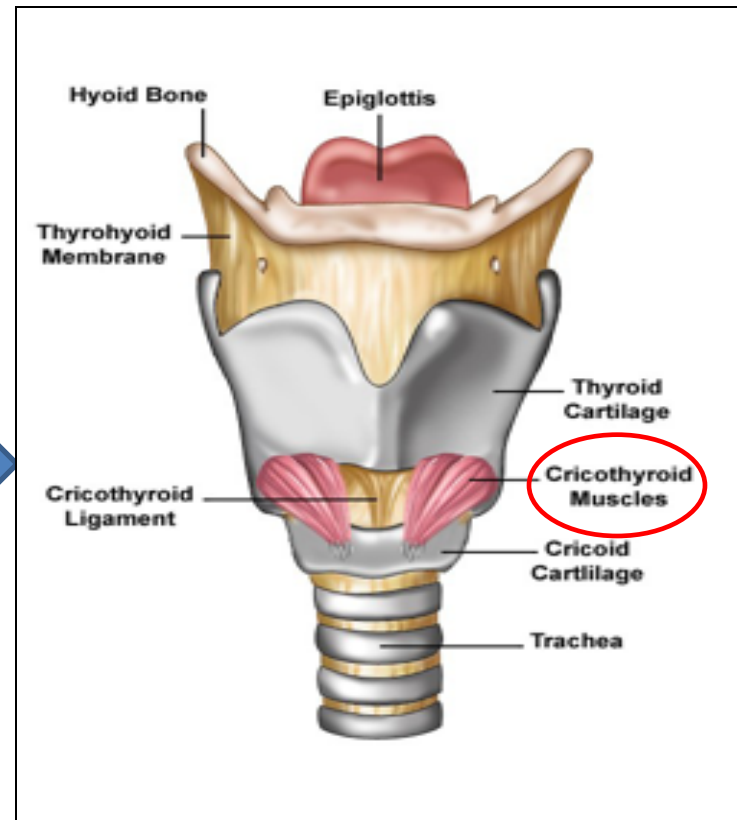


- **Muscle decreasing the Length & Tension of Vocal Cords** (relax vocal cords).

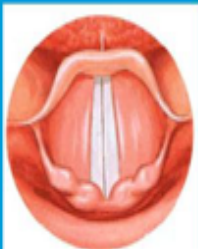
- Thyro-arytenoid
- Vocalis (the lower fibres of thyro-arytenoid muscle.)

- **Muscle increasing the Length & Tension of Vocal Cords.**

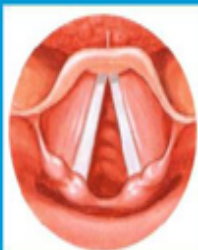
- Cricothyroid.
- NB. It is the **only intrinsic muscle which found outside the larynx.**



## Movements of the Vocal Cords



Adduction



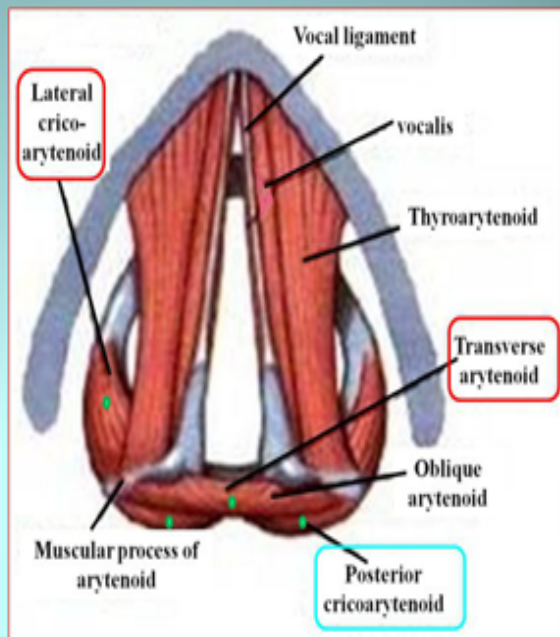
Abduction

### Adductors

- Lateral cricoarytenoid
- Transverse arytenoid

### Abductor

- Posterior cricoarytenoid

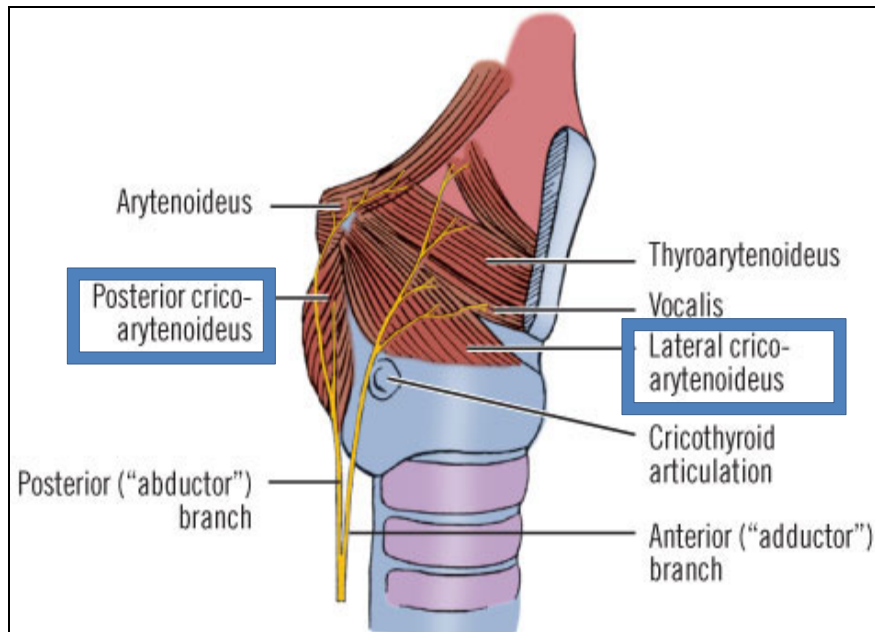


## Adductors (close rima glottis) :

- Lateral crico-arytenoid.
- Transverse arytenoid.

## Abductor (open rima glottis) :

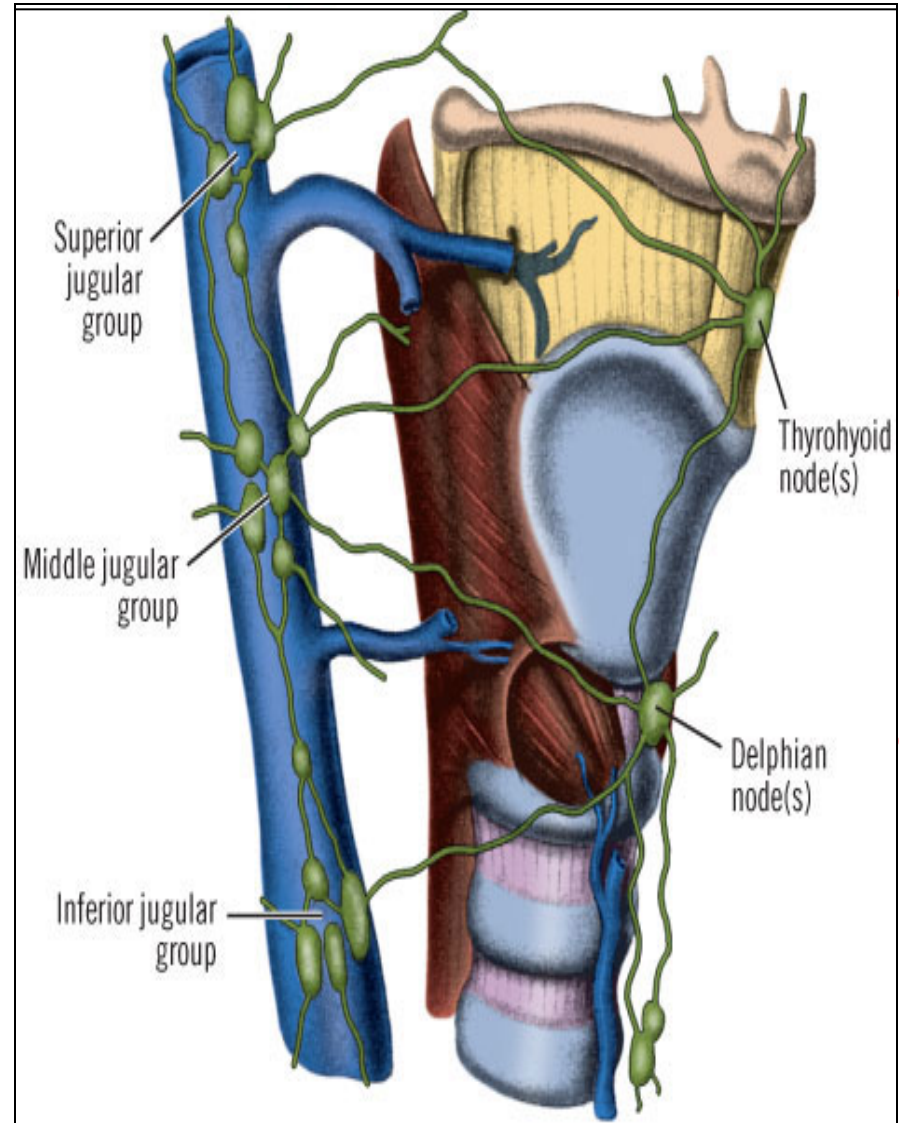
- Posterior crico-arytenoid.





# Blood Supply

- **Arteries:**
  - **Upper half: Superior laryngeal artery**, branch of **superior thyroid artery**.
  - **Lower half: Inferior laryngeal artery**, branch of **inferior thyroid artery** from **thyrocervical trunk** of **subclavian artery**.
- **Veins:**
  - Accompany the corresponding arteries.
- **Lymphatics:**
  - The lymph vessels drain into the **deep cervical lymph nodes**.



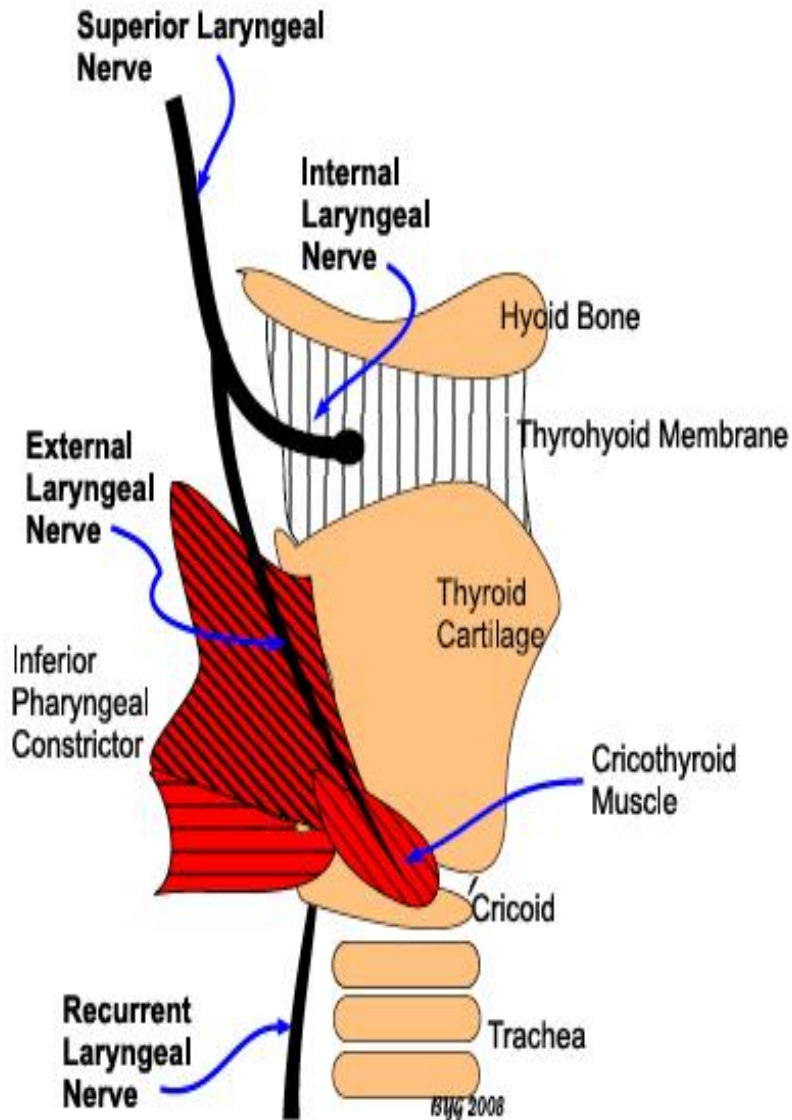
## Nerve Supply (very important)

- 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, **are** supplied by the **recurrent laryngeal nerve** except the cricothyroid.
- The cricothyroid is supplied by the **external laryngeal nerve** of **superior laryngeal** of **vagus**.



## NERVE SUPPLY

### Internal Laryngeal Nerve :

Only sensory – Above VC

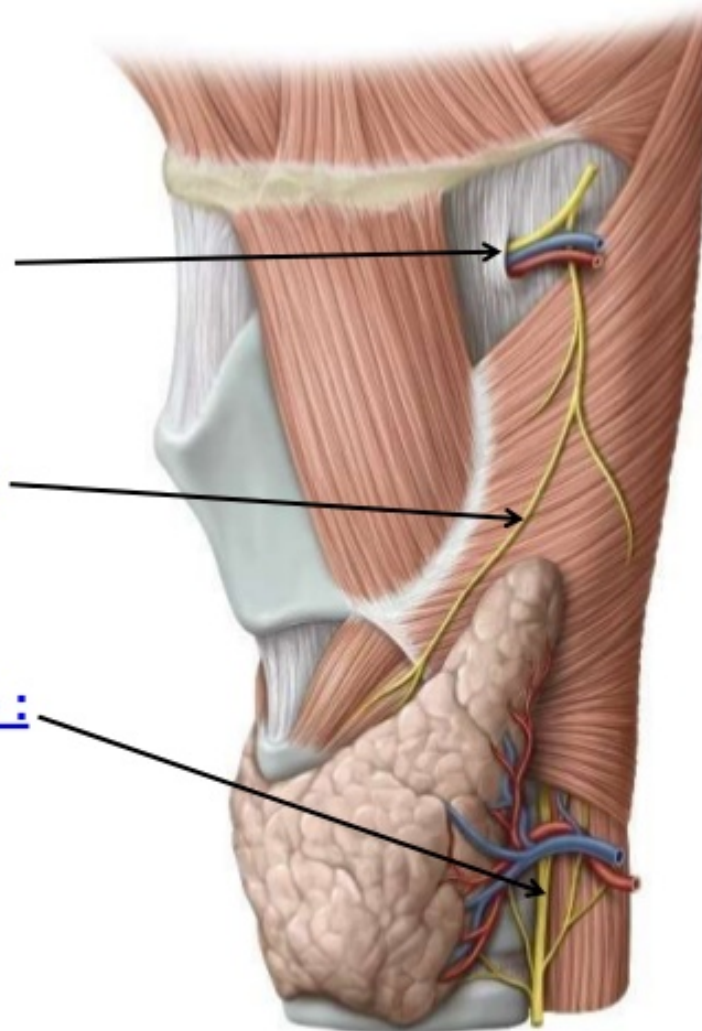
### External Laryngeal Nerve :

Only motor - Cricothyroid

### Recurrent Laryngeal Nerve :

Sensory – Below VC

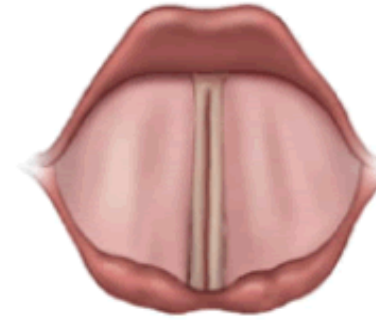
Motor – All other muscles



# Clinical Notes



Inspiri



Movement of Vocal cord during  
inspiration & expiration

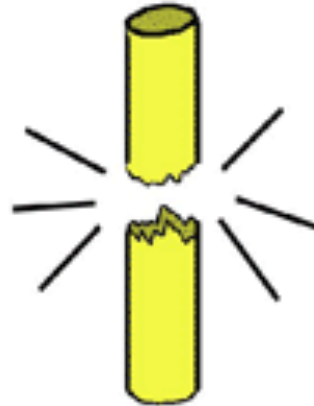
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MD Anderson Cancer Center



**SEMON'S LAW OR  
DAMAGE OF THE  
recurrent  
LARYNGEAL Nerve**

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

Transection of recurrent laryngeal nerve



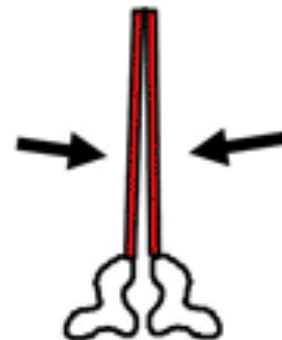
- Complete paralysis
- Cords half abducted/ adducted
- Cannot speak or cough

Vocal cords lie in cadaveric position.

Trauma but no transection



Cords



- Partial paralysis
- Adducted cords as posterior crico-arytenoid most vulnerable
- Cannot breathe

Median position and air cannot pass.

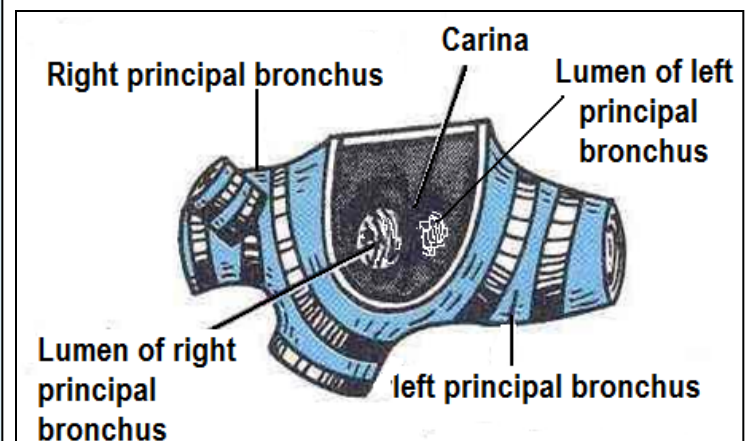
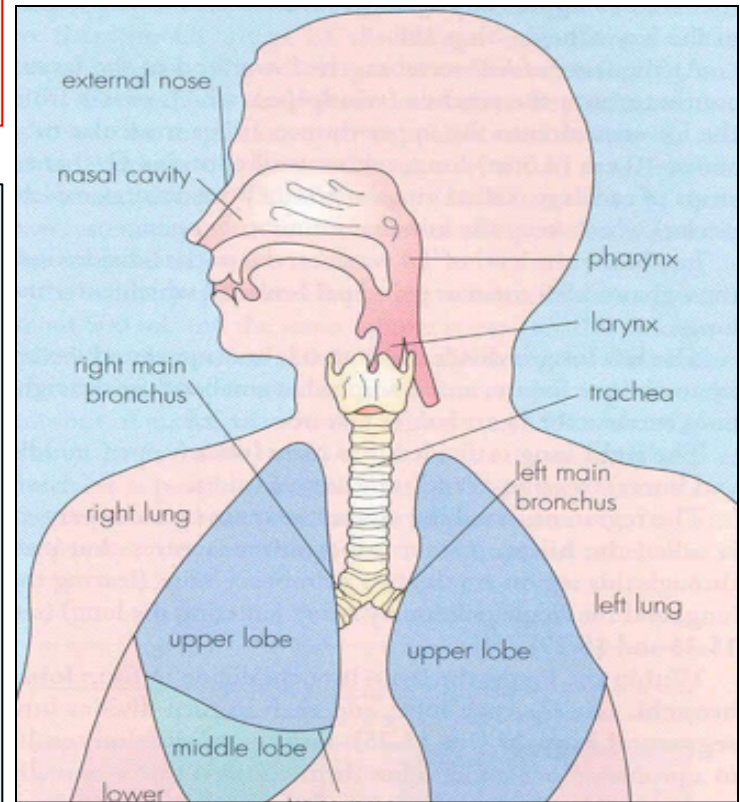
BILATERAL → DISASTER

UNILATERAL → CAN PARTIALLY COMPENSATE

**N.B :** The nerve fibers supplying the abductors of the vocal folds lie in the periphery of the recurrent laryngeal nerve and any progressive lesion involves these fibers first before involving the deeper fibers that supply the adductors.

# TRACHEA (windpipe)

- Mobile, fibrocartiliginous tube, **5** inches long, 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**.
- It is **the most sensitive part** of the respiratory tract and is associated with the **cough reflex**.



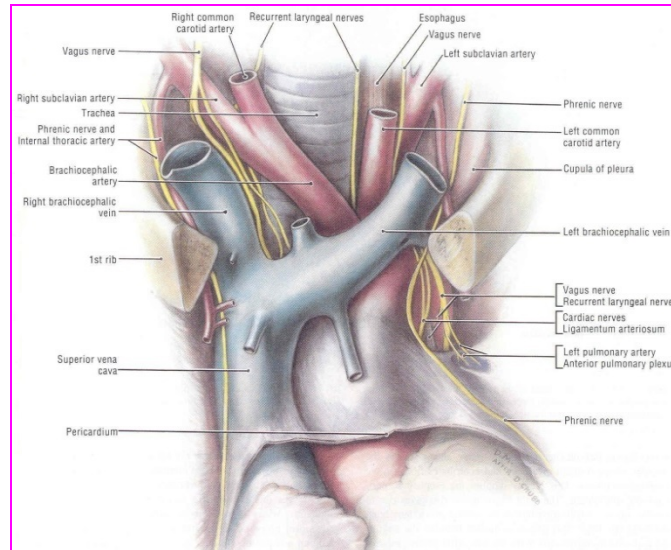
# Relations in the Superior Mediastinum

## Anterior

- Sternum.
- Thymus, (remains of thymus gland).
- Left brachiocephalic vein.
- **Arch of aorta.**
- Origin of:
- Brachiocephalic artery.
- left common carotid artery.

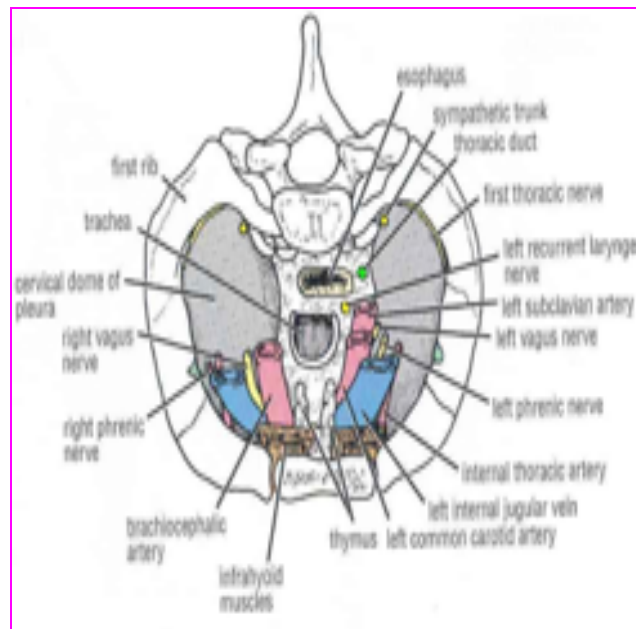
## Posterior

- Esophagus.
- **Left** recurrent laryngeal nerve.



## Left side

- **Arch of aorta.**
- **Left common carotid artery.**
- **left subclavian artery.**
- Left vagus nerve.
- Left phrenic nerve.
- Pleura.



## Right side

- Azygos vein
- Right vagus nerve.
- Pleura

## Nerve Supply

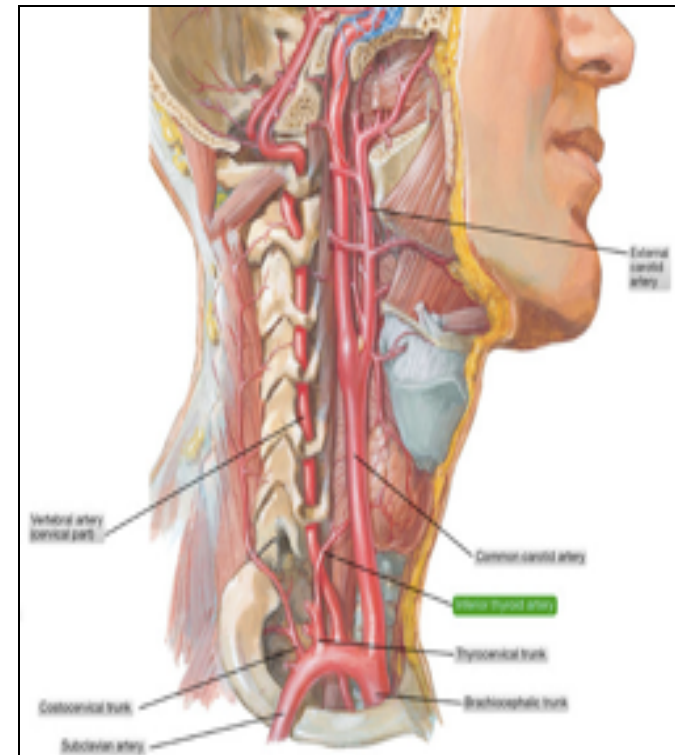
- Branches of the **vagus nerve** and **recurrent laryngeal nerve** give **sensory fibers** to supply the **mucous membrane**.
- Branches from the **sympathetic trunks** supply the **trachealis muscle** and the **blood vessels**.

## Lymphatic Drainage

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

## Blood Supply

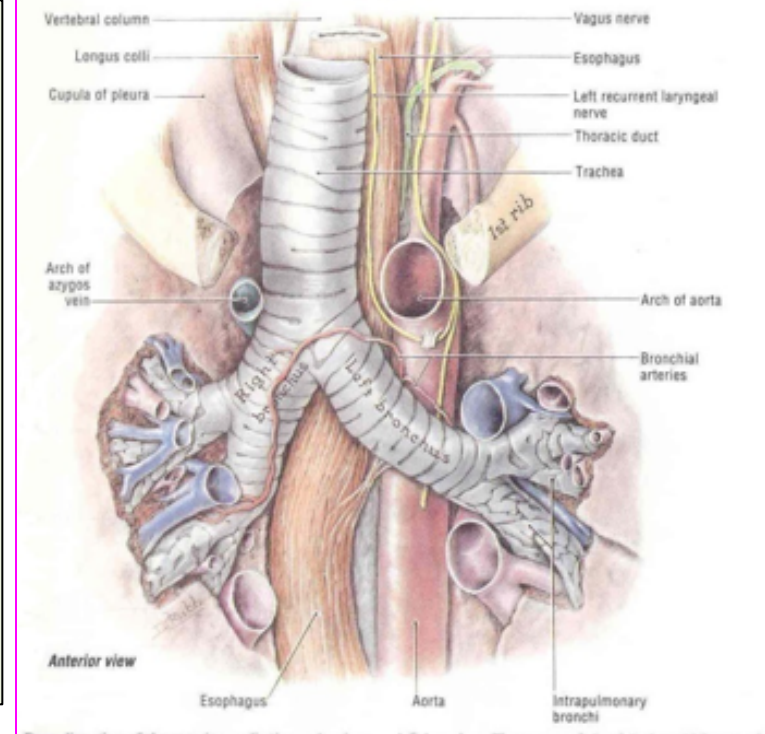
- **Arteries:** Branches from the **inferior thyroid** and **bronchial arteries** (from descending thoracic aorta)
- **Veins:** Drain to **inferior thyroid veins**.





## 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**.

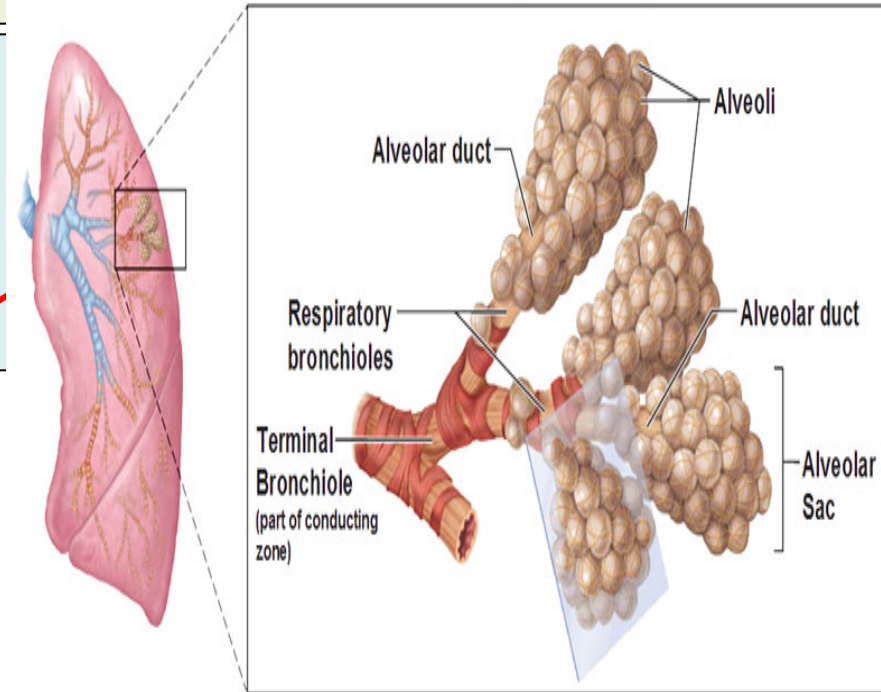
# Bronchial Divisions

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

## Conduction zone branches

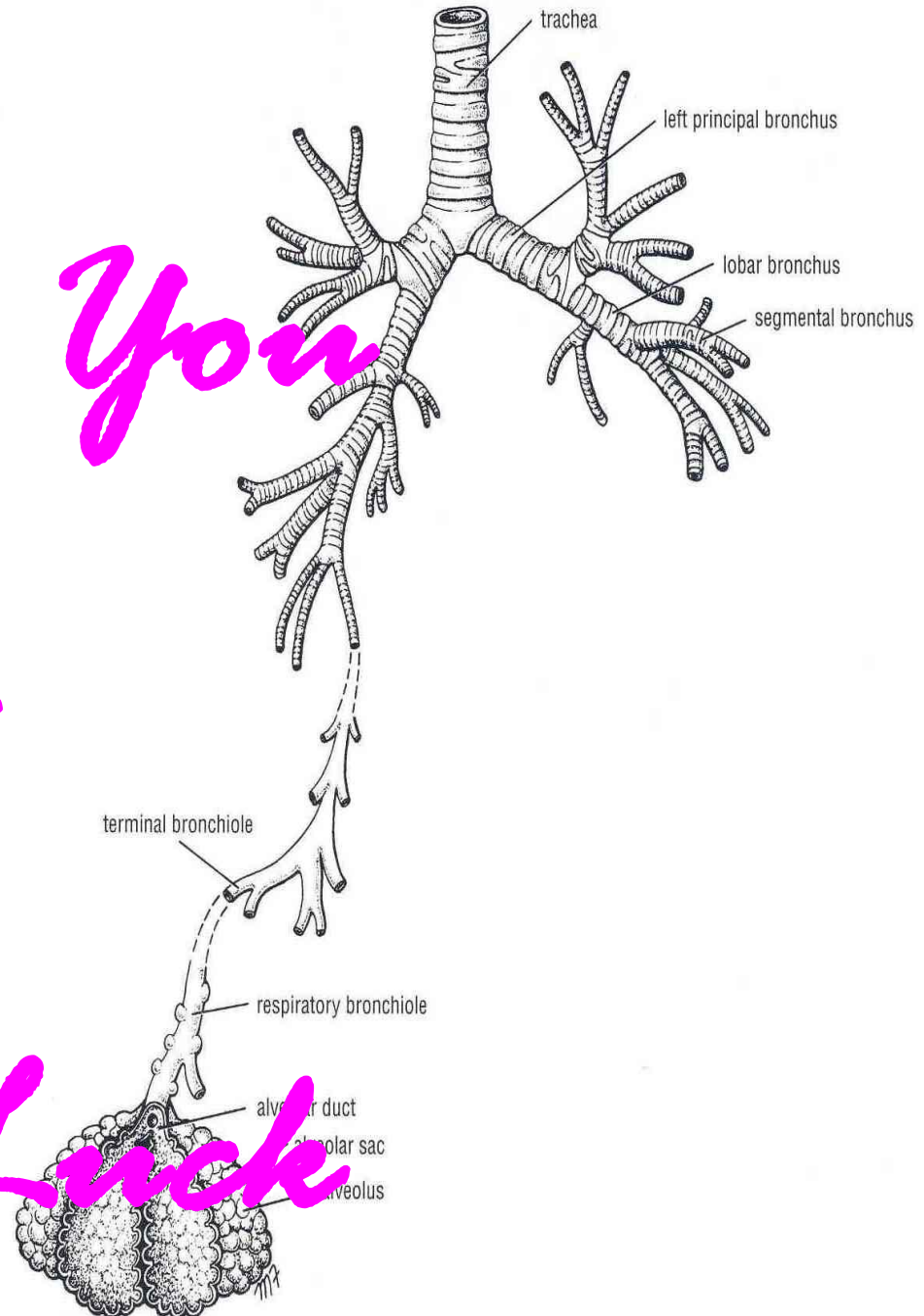
1. Primary (main) bronchi.
2. Secondary (lobar) bronchi.
3. Tertiary (segmental) bronchi.  
(supply the bronchopulmonary segment).
4. Smaller bronchi.
5. Bronchioles.
6. Terminal bronchioles.

## Structures of the Respiratory Zone



## Respiratory zone branches

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



# Clinical Notes

## ➤ Recurrent laryngeal nerve (RLN) injury

- **Unilateral:**
- Results in ipsilateral paralysis of all intrinsic muscles of larynx except the cricothyroid.
- The vocal cords lie in **median** or **paramedian** position & **doesn't move laterally** on deep respiration.
- Change in voice.
- No treatment required.
- The voice gradually improve due to compensation by healthy cord which crosses the midline to meet paralysed one.

## ➤ **Recurrent laryngeal nerve (RLN) injury**

- **Bilateral:**
- All **intrinsic muscles** of larynx are **paralysed**.
- The vocal cords lie in **median** or **paramedian** position due to unopposed action of cricothyroid muscle.
- **Dyspnea/stridor.**