**ANATOMY OF RESPIRETORY SYSTEM (RS)**

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Respiratory system (RS) is one of the vital systems in the body. It is responsible for gaseous exchange between lung and bloody supplying the body with oxygen and removing the carbon dioxide. RS involve the following structures: **nose, pharynx, epiglottis, larynx (glottis), trachea, bronchi and lungs.** They can be divided to:

1. **Upper respiratory system** includes nose, nasal cavity, pharynx, epiglottis and larynx.
2. **Lower respiratory system** includes trachea, bronchi, alveoli and lungs.

**Upper Respiratory System (URS)**

1. **NOSE AND NASAL CAVITY:**

The nose is the externally visible part of the respiratory system. It is formed by bone, hyaline cartilage that covered by connective tissue and skin. The external openings of the nose (also called **nostrils** or **external (anterior) nares**) opened into the **nasal cavity**. The nasal cavity extends from the nostrils to the **posterior nares or internal nares** which are the openings to the **pharynx**. The nasal cavity is divided into the right and left **nasal fossae or cavity** by the **nasal septum**. The septum is composed of bone and hyaline cartilage. The hard palate forms the floor of the nasal cavity that separating it from the oral cavity. **Three folds of tissue** project from the lateral walls of the nasal cavity towards the septum. These are the superior, middle and inferior **nasal conchae (turbinate)**. Below each conchae there is superior, middle and inferior nasal meatus. Nasal conchae areresponsible for air moisturization and filtering. **Nasal meatuses** drain paranasal sinuses.

Sensory receptors for the sense of smell are found in the **olfactory mucosa**. The olfactory mucosa is a small patch of specialized epithelium that covers the roof of the nasal fossae and parts of the septum and superior conchae. The rest of the nasal cavity is lined with pseudostratied ciliated columnar epithelial cells containing cilia and goblet cells.

Anatomical boundaries of the nasal cavity:

Superiorly:

1. Nasal bone
2. Frontal bone
3. Cribriform plate of ethmoid bone
4. Sphenoid bone

Laterally:

1. Lacrimal Bone
2. Ethmoid Bone
3. Maxilla Bone

Medially:

1. Cartilaginous and Bony parts of nasal septum

Inferiorly:

1. Horizontal plate of palatine bone
2. Palatine process of maxilla

**Paranasal Sinuses:** The paranasal sinuses are air-filled spaces located within the bones of the skull and facial bones. They are centered on the nasal cavity and have various functions, including lightening the weight of the head, humidifying and heating inhaled air, increasing the resonance of speech. Four sets of paired sinuses are recognized: **maxillary, frontal, sphenoid, and ethmoid**

1. The maxillary sinus is the largest paranasal sinus and lies inferior to the eyes in the maxillary bone.
2. The frontal sinus in the frontal bone superior to the eyes in the forehead.
3. The sphenoid sinus originates in the sphenoid bone at the center of the head.
4. The ethmoid sinuses arise in the ethmoid bone, forming several distinct air cells between the eyes.

Paranasal sinuses drainage:

1. Superior Nasal Meatus Opening drain the posterior ethmoidal air cells
2. Middle Nasal Meatus Opening drain the followings:
3. Frontal sinus
4. Anterior and middle ethmoidal air cell of ethmoid sinus
5. Maxillary sinus
6. Inferior Nasal Meatus Openings drains the nasolacrimal duct
7. Sphenoethmoidal recess drain the sphenoidal sinus
8. **PHARYNX**

The pharynx is a common passageway for the respiratory and digestive systems. It is a muscular funnel extending **from the internal nares to the larynx**. It receives air from the nasal cavity and air, food and water from the oral cavity. Inferiorly it opens into the larynx and the esophagus. The pharynx has three regions **nasopharynx, oropharynx and laryngopharynx**.

**The nasopharynx** is the superior part of the pharynx that connects to the nasal cavity. It extends from the **internal nares** to the level of the **uvula**. **The uvula is a soft process extending from the posterior end of the soft palate**. The soft palate forms part of the floor of the nasopharynx. The soft palate and uvula are elevated during swallowing to prevent food from passing through the nasopharynx into the nasal cavity.

**The oropharynx** is the middle part of the pharynx that connects to the oral cavity. It extends from the uvula superiorly to the epiglottis inferiorly. **The epiglottis is a flap of tissue covering the superior opening of the larynx**. During swallowing, **larynx cover the trachea**. The airway is thus closed and, food and drinks are directed into the esophagus.

**The laryngopharynx** is the inferior part of the pharynx. Extends superiorly from the epiglottis to the larynx and esophagus inferiorly.

1. **LARYNX**

The larynx is composed of 3 large, unpaired cartilages (cricoid, thyroid, epiglottis); 3 pairs of smaller cartilages (arytenoids, corniculate, cuneiform); and a number of intrinsic muscles. The hyoid bone, while technically not part of the larynx, provides muscular attachments from above that aid in laryngeal motion. The laryngeal muscles act to move the components of the larynx for phonation and breathing. It is extends from the root of the tongue and the hyoid bone superiorly to the trachea inferiorly. The thyroid cartilage, epiglottis and cricoid cartilage are connected as single piece. The thyroid prominence and thyroid notch can be palpated at the anterior aspect of the neck. The thyroid cartilage connected to the hyoid bone by the thyrohyoid membrane and to the cricoid cartilage by cricothyroid muscle and membrane. The larynx divided to the following regions

* **Supraglottis**– From the inferior surface of the epiglottis to the vestibular folds (false vocal cords).
* **Glottis**– at level of vocal cords and 1cm below them. The opening between the vocal cords is known as rima glottidis, the size of which is altered by the muscles of phonation.
* **Subglottis**– From inferior border of the glottis to the inferior border of the cricoid cartilage.

**Lower Respiratory System**

* + 1. **TRACHEA**

The trachea is flexible 2.5 cm diameter and about 9 to 15 cm in length membranous tube consisting of connective tissue and smooth muscle, reinforced with 16 to 20 C-shaped cartilages. They protect the trachea and keep it always open for passage of air. The posterior wall of the trachea consists of smooth muscle which can alter the diameter of the trachea by contracting or relaxing. The trachea begins immediately inferior to the larynx, runs anterior to the esophagus in the neck and ends by dividing into the **right and left primary** **bronchi** in the mediastinum at the level of fifth thoracic vertebrae T5.

The left primary bronchus is more horizontal than the right primary bronchus due to the position of the heart. The primary bronchi further divided to **two** **secondary bronchi** on the left side and **three** secondary bronchi on the right side according to the number of the lobes of the lung in each side.

After entering the lung, each primary bronchus branches into secondary bronchus, then the secondary bronchus divide many times to form tertiary bronchus then the alveoli. The bronchial tree is a highly branched system of air tubes extending from the primary bronchus to the alveoli.

* + 1. **LUNGS**

The lungs are the principal organs of respiration. They are located the thoracic cavity. Each lung is a cone-shaped organ, with its base resting on the diaphragm while its apex extends superiorly to a point slightly above the clavicle. The surface of the lung is covered by two membranes called pleurae that are continuous with each other. The inner membrane is the visceral pleura while the outer membrane is the parietal pleura. The space between the parietal and visceral pleurae is called the pleural cavity. The pleural cavity contains serous fluid called the pleural fluid. This fluid lubricates the surfaces of the pleurae, so that expansion and contraction of the lung can occur with minimal friction. The right lung is shorter than the left lung because of the high position of the liver in the abdominal cavity below. The left lung is narrower than the right lung because the heart in the mediastinum. The right lung has two fissures (horizontal and oblique) on its surface which divide it into the superior, middle and inferior lobes, while the left lung has a single oblique fissure which divides it into the superior and inferior lobes. The point of entry of the primary bronchus, blood vessels and nerves into each lung is called the **hilum**. The hilum and its structure considered the root of the lung.

MUSCLES OF RESPIRATION

* Inspiration:
1. the diaphragm contracts & moves downward, increasing the vertical diameter of the chest,
2. The external intercostal muscles elevate the ribs laterally, increasing the lateral diameter of the chest,
3. The accessory inspiratory muscles (sternocleidomastoid & scalene muscles) assist forceful inspiration.

All that leads to decrease intrathoracic pressure than atmospheric pressure, air will enter the lung through respiratory airways.

* Expiration:
1. The diaphragm relaxes, moving upward, reducing the vertical diameter of the chest,
2. The internal intercostal muscles depress the ribs laterally, decreasing the lateral diameter of the chest,
3. The accessory expiratory muscles (abdominal muscles) assist forceful expiration.

All that leads to increase intrathoracic pressure than atmospheric pressure, pushing air out of the lung through airways.

