The Respiratory System

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Respiratory System

- Consists of a conducting zone and respiratory zone
  - Conducting zone (Upper):
    - Is part of the respiratory system lying outside of the thorax or above the sternal angle
    - Provides tube-like conduction system for air
    - Facilitate the air to reach the sites of gas exchange.
    - Includes all other respiratory structures (e.g., nose, nasal cavity, pharynx, and the upper part of the trachea).
  - Respiratory zone (Lower)
    - The lung
    - Site of gas exchange
    - Consists of bronchioles, alveolar ducts, and alveoli
    - Prime respiratory muscles – diaphragm and other inter-costal muscles that promote ventilation
Respiratory System

- Nasal cavity
- Nostril
- Oral cavity
- Pharynx
- Larynx
- Right primary bronchus
- Right lung
- Site of carina
- Left lung
- Diaphragm

Upper respiratory tract:
- Nasal cavity
- Pharynx
- Larynx

Lower respiratory tract:
- Trachea
- Primary bronchi
- Lungs
Function of the Nose:

- The only externally visible part of the respiratory system that functions by:
  - Providing an airway for respiration
  - Moistening and warming the entering air
  - Filtering inspired air and cleaning it of foreign matter
  - Serving as a resonating chamber for speech
  - Housing the olfactory receptors
Structure of the Nose

- The nose is divided into two regions
  - The external nose, including the root, bridge, dorsum nasi, and apex
  - The internal nasal cavity
- Philtrum – a shallow vertical groove inferior to the apex
- The external nares (nostrils) are bounded laterally by the alae
Structure of the Nose Cartilages and bones

- Frontal bone
- Nasal bone
- Septal cartilage
- Maxillary bone (frontal process)
- Lateral cartilage
- Lesser alar cartilages
- Greater alar cartilages
- Dense fibrous connective tissue
Nasal Cavity

- Frontal sinus
- Cribiform plate of ethmoidal bone
- Probe passing from semilunar hiatus into frontal sinus via frontonasal duct
- Probe in opening of sphenoidal sinus
- Sphenoidal sinus
- Superior nasal meatus with opening of posterior ethmoidal cells
- Basilar part of occipital bone
- Torus tubarius
- Opening of auditory (pharyngotympanic, eustachian) tube
- Middle nasal concha (cut surface)
- Ethmoidal bulla
- Openings of middle ethmoidal cells
- Semilunar hiatus (osteomeatal unit) with opening of anterior ethmoidal air cells
- Uncinate process
- Inferior nasal concha (cut surface)
- Opening of nasolacrimal duct
- Inferior nasal meatus
- Opening of maxillary sinus
Opening of the para-nasal sinuses
The Pharynx

- Funnel-shaped tube of skeletal muscle that connects to the:
  - Nasal cavity and mouth superiorly
  - Larynx and esophagus inferiorly
- Extends from the base of the skull to the level of the sixth cervical vertebra
- It is divided into three regions:
  - Nasopharynx
  - Oropharynx
  - Laryngopharynx
Nasopharynx

- Lies posterior to the nasal cavity, inferior to the sphenoid, and superior to the level of the soft palate
- Strictly an air passageway
- Lined with *pseudo-stratified columnar epithelium*
- The pharyngeal tonsil lies high on the posterior wall
- Pharyngotympanic (auditory) tubes open into the lateral walls
Oropharynx

- Extends inferiorly from the level of the soft palate to the epiglottis
- Opens to the oral cavity via an archway called the fauces
- Serves as a common passageway for food and air
- The epithelial lining is a protective epithelium:
  - *stratified Squamous epithelium*
- Palatine tonsils lie in the lateral walls of the fauces
- Lingual tonsil covers the base of the tongue
Laryngopharynx

- Serves as a common passageway for food and air
- Lies posterior to the upright epiglottis
- Extends to the larynx, where the respiratory and digestive pathways diverge
The Larynx (Voice Box)

- Attaches to the hyoid bone and opens into the laryngo-pharynx superiorly
- Continue inferior with the trachea
- The **three functions** of the larynx are:
  - To provide a patent airway
  - To act as a switching mechanism to route air and food into the proper channels
  - To function in voice production
Framework of the Larynx

- Cartilages (hyaline cartilage) of the larynx are:
  - Unpaired
    - Shield-shaped antero-superior is the
      - Thyroid cartilage with a midline laryngeal prominence (Adam’s apple)
    - Signet ring–shaped anteroinferior
      - Cricoid cartilage
  - The Unpaired Epiglottis is made of elastic cartilage
    - Covers the laryngeal inlet during swallowing
  - Paired
    - Three pairs of cartilages of small diameters:
      - Arytenoid
      - Cuneiform
      - Corniculate
Framework of the Larynx

- Epiglottis
- Thyrohyoid membrane
- Cuneiform cartilage
- Corniculate cartilage
- Arytenoid cartilage
- Arytenoid muscle
- Cricoid cartilage
- Cricothyroid ligament
- Cricotracheal ligament
- Tracheal cartilages
- Body of hyoid bone
- Thyrohyoid membrane
- Fatty pad
- Vestibular fold (false vocal cord)
- Thyroid cartilage
- Vocal fold (true vocal cord)
- Cricothyroid ligament
- Cricotracheal ligament

(a)

(b)
**FIGURE 23-4** Anatomy of the Larynx. (a) Anterior view of the intact larynx. (b) Posterior view of the intact larynx. (c) Sagittal section through the larynx.
Lower Respiratory Tract

- **Functions:**
  - Larynx: maintains an open airway, routes food and air appropriately, assists in sound production
  - Trachea: transports air to and from lungs
  - Bronchi: branch into lungs
  - Lungs: transport air to alveoli for gas exchange
The Trachea

- Flexible and mobile tube extending from the larynx into the mediastinum
- Composed of three layers
  - **Mucosa:**
    - Pseudo-stratified ciliated epithelium.
    - Goblet cells
  - **Submucosa:**
    - Connective tissue deep to the mucosa
  - **Adventitia:**
    - Outermost layer made of C-shaped rings of hyaline cartilage.
    - Covered with dense irregular CT
Coverings of the Lungs: The Pleurae

- Thin, double-layered serosa
- Parietal pleura
  - Covers the thoracic wall and superior face of the diaphragm
  - Continues around heart and between lungs
- Visceral, or pulmonary, pleura
  - Covers the external lung surface
  - Divides the thoracic cavity into three chambers
    - The central mediastinum
    - Two lateral compartments, each containing a lung
Pleural cavity
Lung Anatomy

- **External features:**
  - Cardiac notch (impression) – cavity that accommodates the heart
  - Left lung – separated into upper and lower lobes by the oblique fissure
  - Right lung – separated into three lobes by the oblique and horizontal fissures
Lobes and Fissures of the Right Lung

Oblique fissure

SUPERIOR LOBE

INFERIOR LOBE

MIDDLE LOBE

Horizontal fissure
Left Lung medial surface Hillum of the lung
Blood Supply to Lungs

- Lungs are perfused by two circulations: pulmonary and bronchial
- Pulmonary arteries – supply systemic venous blood to be oxygenated
  - Branch profusely, along with bronchi
  - Ultimately feed into the pulmonary capillary network surrounding the alveoli
- Pulmonary veins – carry oxygenated blood from respiratory zones to the heart
- Bronchial arteries – provide systemic blood to the lung tissue
  - Arise from aorta and enter the lungs at the hilus
  - Supply all lung tissue except the alveoli
- Bronchial veins anastomose with pulmonary veins
- Pulmonary veins carry most venous blood back to the heart
Components of the Lower Respiratory Tract
Bronchial Tree

- Cartilage support structures change
- Epithelium types change
- Amount of smooth muscle increases

Wall layers are mucosa, submucosa and muscularis

- **Trachea**
  - The lining (mucosa) is pseudostratified ciliated columnar
  - "C" shaped hyaline cartilage rings keeps tracea open
- **As conducting tubes become smaller, the names of the tubes are changing**
  - **Bronchi**
  - **Bronchioles**
Primary Bronchi

• At the site of tracheal division “The carina”
  • marks the end of the trachea

• Two in number:
  • right and left bronchi

• Air reaching the bronchi is:
  • Warm and cleansed of impurities
  • Saturated with water vapor

• Bronchi (primary) are subdivide into secondary bronchi, each supplying one lobe of the lungs
Respiratory Zone

- Defined by the presence of alveoli.
- Begins as terminal bronchioles became Respiratory bronchioles.
- Respiratory bronchioles continue as Alveolar ducts, then to terminal clusters of alveolar sacs which is composed of alveoli.
- Approximately 300 million alveoli:
  - Gas exchange accure.
Respiratory Zone

- Smooth muscle
- Alveolus
- Capillaries
- Elastic fibers
Blood supply: Gas Exchange Between the Blood and Alveoli
Respiratory Membrane: Alveolar walls:

- Are a single layer of type I epithelial cells
- Permit gas exchange by simple diffusion
- Type II cells secrete surfactant