

The Islamic University, Najaf
College of Medical Techniques
Department of Radiology Techniques



Medical Physiology

First stage

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Lecture (5)

Respiratory System

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Lecture Objectives

By the end of this lecture, the students should be able to:

- 1) Describe the respiratory system and classify its parts.
- 2) Understand the mechanics of pulmonary ventilation.

Lecture Contents

- What is the respiratory system?
- How do we breathe?
- Mechanics of pulmonary ventilation.



Respiratory System

What is the respiratory system?

The respiratory system is the organs and other parts of the body involved in breathing, when exchange oxygen and carbon dioxide. The respiratory system consists of the nose, pharynx (throat), larynx (voice box), trachea (windpipe), bronchi, and lungs (Figure 1). Its parts can be classified according to either structure or function. Structurally, the respiratory system consists of two parts: (1) The **upper respiratory system** includes the nose, nasal cavity, pharynx, and associated structures; (2) the **lower respiratory system** includes the larynx, trachea, bronchi, and lungs. Functionally, the respiratory system also consists of two parts. (1) The **conducting zone** consists of a series of inter-connecting cavities and tubes both outside and within the lungs. These include the nose, nasal cavity, pharynx, larynx, trachea, bronchi, bronchioles, and terminal bronchioles; their function is to filter, warm, and moisten air and

conduct it into the lungs. (2) The **respiratory zone** consists of tubes and tissues within the lungs where gas exchange occurs. These include the respiratory bronchioles, alveolar ducts, alveolar sacs, and alveoli and are the main sites of gas exchange between air and blood.

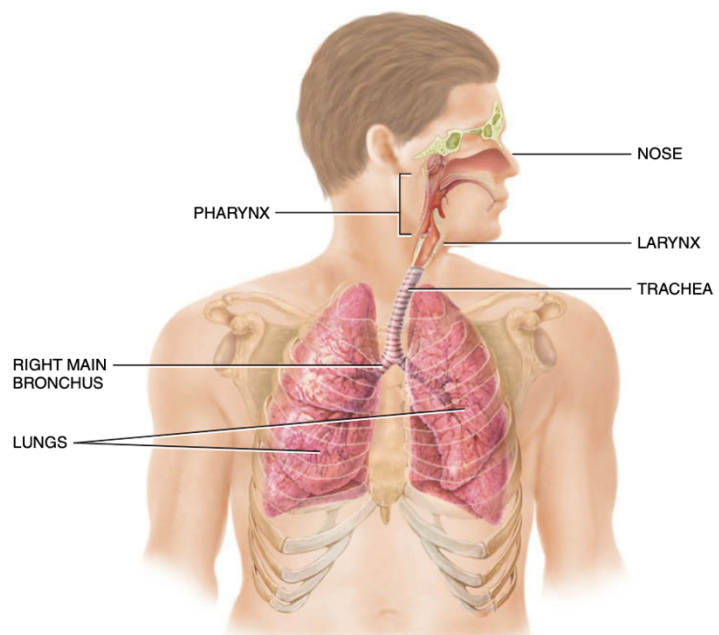


Figure 1: Respiratory system



How do we breathe?

Breathing starts when the person inhale air into the nose or mouth. It travels down the back of the throat and into the trachea, which is divided into air passages called **bronchial tubes**. As the bronchial tubes pass through the lungs, they divide into smaller air passages called **bronchioles**.

The bronchioles end in tiny balloon-like air sacs called **alveoli**. The human body has about 600 million alveoli. The alveoli are surrounded by a mesh of tiny blood vessels called **capillaries**. Here, oxygen from inhaled air passes into the blood.

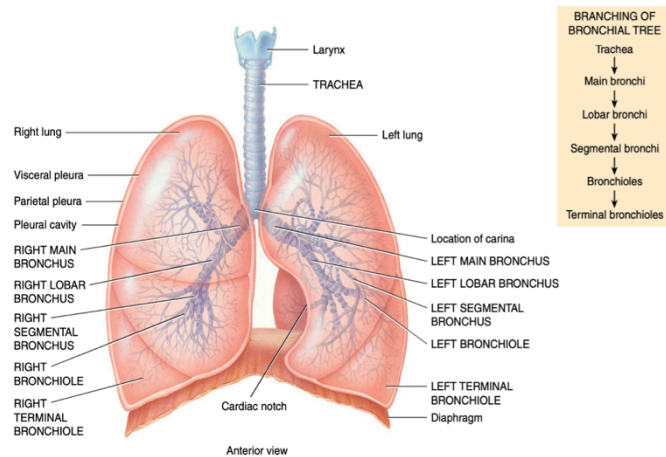
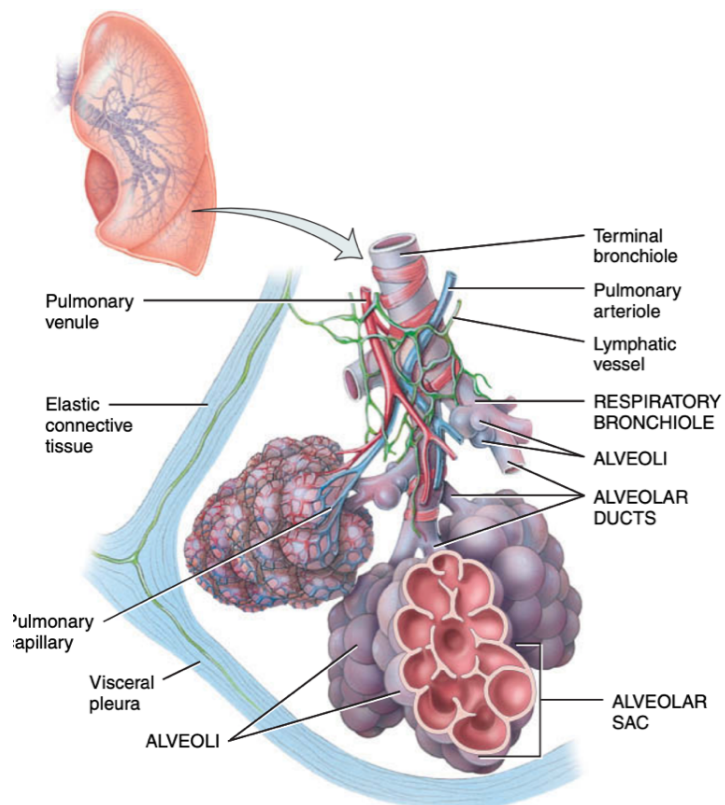


Figure 2: Branching of airways from the trachea: the bronchial tree



(a) Diagram of portion of lobule of lung

Figure 3: Microscopic anatomy of a lobule of the lungs



Mechanics of pulmonary ventilation

The lungs can be expanded and contracted in two ways: (1) by downward and upward movement of the diaphragm to lengthen or shorten the chest cavity, and (2) by elevation and depression of the ribs to increase and decrease the anteroposterior diameter of the chest cavity. **Figure 4** shows these two methods.

Normal quiet breathing is accomplished almost entirely by the first method, that is, by movement of the diaphragm. During inspiration, contraction of the diaphragm pulls the lower surfaces of the lungs downward. Then, during expiration, the diaphragm simply relaxes, and the **elastic recoil** of the lungs, chest wall, and abdominal structures compresses the lungs and expels the air. During heavy breathing, however, the elastic forces are not powerful enough to cause the necessary rapid expiration, so extra force is achieved mainly by contraction of the **abdominal muscles**, which pushes the abdominal contents upward against the bottom of the diaphragm, thereby compressing the lungs.

The second method for expanding the lungs is to raise the rib cage. Raising the rib cage expands the lungs because, in the natural resting position, the ribs slant downward, as shown on the left side of Figure 4, thus allowing the sternum to fall backward toward the vertebral column. When the rib cage is elevated, however, the ribs project almost directly forward, so the sternum also moves forward, away from the spine, making the anteroposterior thickness of the chest about 20 percent greater during maximum inspiration than during expiration. Therefore, *all the muscles that elevate the chest cage are classified as muscles of inspiration, and the muscles that depress the chest cage are classified as muscles of expiration.*

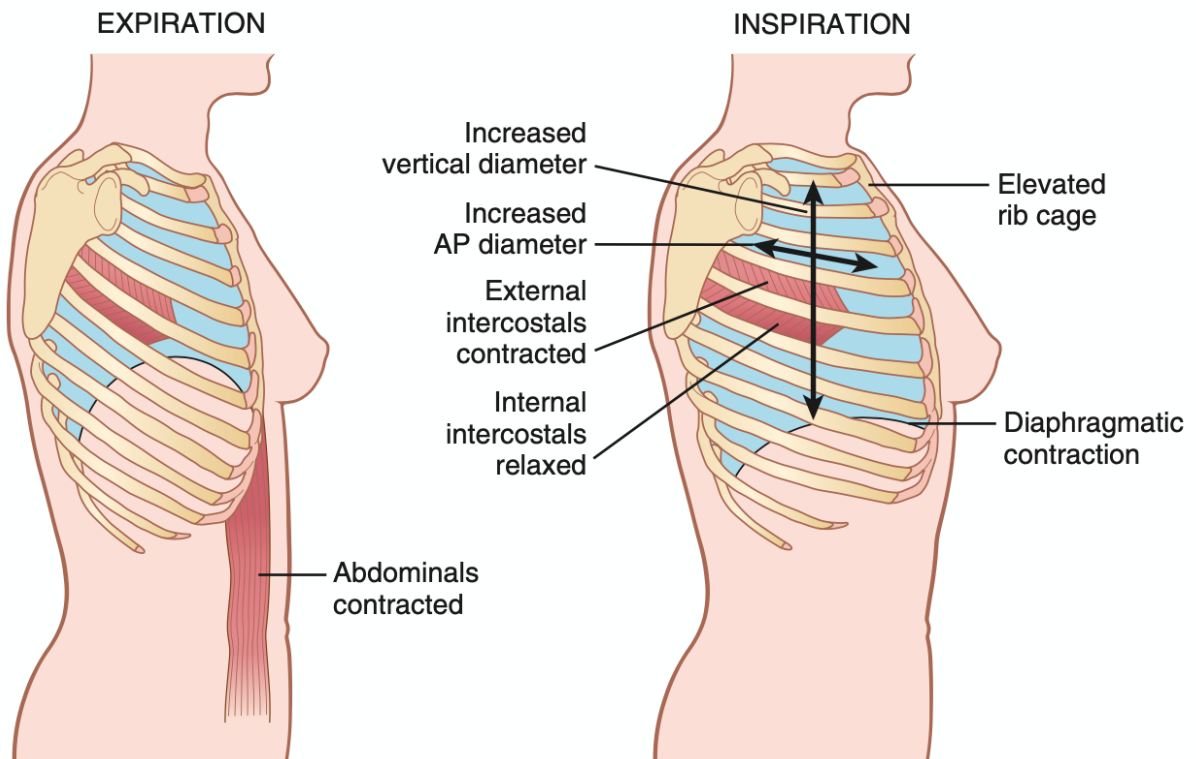


Figure 4: Contraction and expansion of the thoracic cage during expiration and inspiration