HUMAN PHYSIOLOGY AND CLINICAL BIOCHEMISTRY

Topic: Respiration

Lecture 1

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REFERENCE: OPEN ACCESS

PHYSIOLOGY OF RESPIRATION

Respiration includes 2 processes:

1) **External respiration** – is the uptake of O2 and excretion of CO2 in the lungs
2) **Internal respiration**

means the O2 and CO2 exchange between the cells and capillary blood. The quality of these respiration processes depends on:

a) **pulmonary ventilation** – it means the inflow and outflow of air between the atmosphere and the lung alveoli
b) **diffusion of gases** oxygen and CO2 between the alveoli and the blood
c) **perfusion** – of lungs with blood
d) **transport** of O2 and CO2 in the blood
e) **regulation of respiration**

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Upper airways - nose, nasopharynynx - borderline - larynx

Lower airways - trachea, bronchi, bronchioles.

Alveoli - Tiny air sacs at the end of the bronchioles (tiny branches of air tubes in the lungs).

Alveoli are lined by a fluid called surfactant. This fluid maintains the shape of the air sac and helps keep it open so that oxygen and CO2 can pass.

The alveoli are made up of two different types of cells. Each type has different functions:

Type I pneumocytes. These are the cells responsible for the exchange of oxygen and CO2.

Type II pneumocytes. These cells perform two important functions. They produce surfactant, the fluid inside the alveoli that helps keep the balloon shape from collapsing. They can also turn into type I cells in order to repair damage.

Alveoli also contain immune cells called alveolar macrophages.

Macrophages clean up any particles that are breathed in and make it to the alveoli. They also remove dead cells and bacteria.

300 milion - total surface area 70 m^2, lined pneumocytes

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Inspiration - an active process - contraction of the inspiratory muscles: - Diaphragm, External intercostal muscles, Auxiliary-accessory-inspiratory muscles: Scalene and sternocleidomasoid m.m.

Expiration - passive process - given by elasticity of the chest and lungs

Muscles That Cause Lung Expansion and Contraction

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 antero posterior diameter of the chest cavity.

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.

REFERENCE: OPEN ACCESS

The most important muscles that raise the rib cage are the external intercostals, but others that help are the

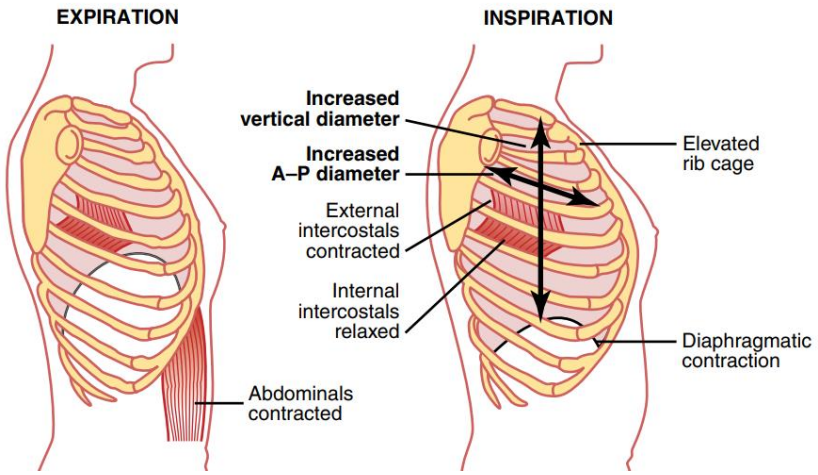
(1) sternocleidomastoid muscles, which lift upward on the sternum;

(2) anterior serrati, which lift many of the ribs; and

(3) scaleni, which lift the first two ribs.

The muscles that pull the rib cage downward during expiration are mainly the

(1) **abdominal recti,** which have the powerful effect of pulling downward on the lower ribs at the same time that they and other abdominal muscles also compress the abdominal contents upward against the diaphragm, and (2) internal intercostals.



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Pressures That Cause the Movement of Air In and Out of the Lungs

Lung is an elastic structure that collapses like a balloon and expels all its air through the trachea

There are no attachments between the lung and the walls of the chest cage, except its hilum from the mediastinum, the middle section of the chest cavity.

Lungs are held to the thoracic wall as if glued there, except that they are well lubricated and can slide freely as the chest expands and contracts

Pleural pressure

is the pressure of the fluid in the thin space between the lung pleura and the chest wall pleura.

The normal pleural pressure at the beginning of inspiration is about −5 centimeters of water, which is the amount of suction required to hold the lungs open to their resting level. Then, during normal inspiration, expansion of the chest cage pulls outward on the lungs with greater force and creates more negative pressure, to an average of about −7.5 centimeters of water.

REFERENCE: OPEN ACCESS

The increasing negativity of the pleural pressure from −5 to −7.5 during inspiration and in the upper panel an increase in lung volume of 0.5 liter.

during expiration, the events are essentially reversed.

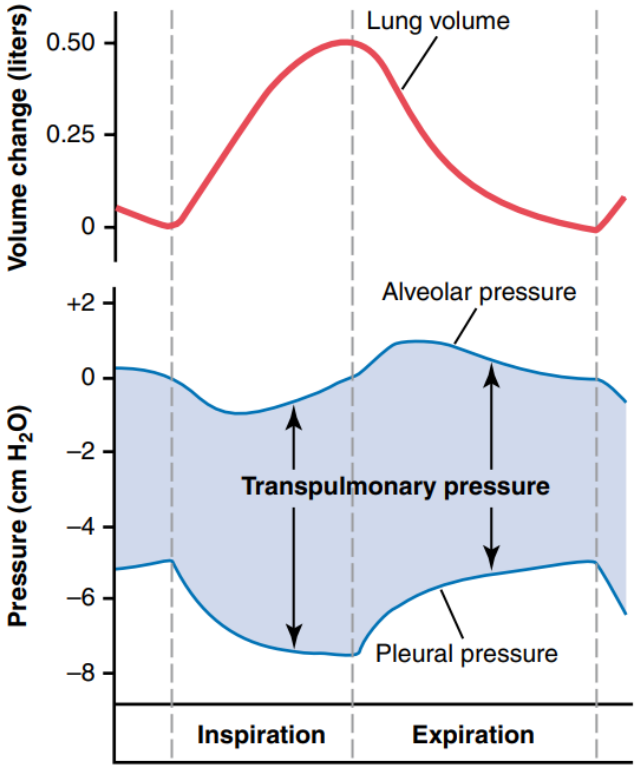
Alveolar Pressure Alveolar pressure is the pressure of the air inside the lung alveoli.

To cause inward flow of air into the alveoli during inspiration, the pressure in the alveoli must fall to a value slightly below atmospheric pressure (below 0).

The second curve (labeled “alveolar pressure”) demonstrates that during normal inspiration, alveolar pressure decreases to about −1 centimeters of water.

This slight negative pressure is enough to pull 0.5 liter of air into the lungs in the 2 seconds required for normal quiet inspiration

During expiration, opposite pressures occur: The alveolar pressure rises to about +1 centimeter of water, and this forces the 0.5 liter of inspired air out of the lungs during the 2 to 3 seconds of expiration.



Transpulmonary Pressure

difference between the alveolar pressure and the pleural pressure. This is called the transpulmonary pressure. It is the pressure difference between that in the alveoli and that on the outer surfaces of the lungs, and it is a mea sure of the elastic forces in the lungs that tend to collapse the lungs at each instant of respiration, called the recoil pressure

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