UNIVERSITY OF BUEA

FACULTY OF SCIENCE
DEPARTMENT OF PLANT AND ANIMAL SCIENCES

COURSE CODE: ZOO 612

COURSE TITLE: SYSTEMIC PHYSIOLOGY of MAMMALS

LUNG MECHANISMS

By
KAGA SCHOLASTICA MUAH
B.Sc. (Hons.), Zoology
(SC09B746)

Supervised by
Dr. SALAH / Dr. BOBDA.,
Lecturers of Zoology.

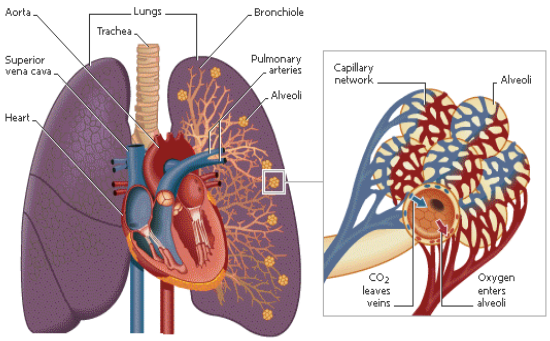
June, 2010.

OUTLINE

- The thorax and respiratory muscles
- Mechanisms of ventilation
- Lung volumes
- Lung-related pressures
- Elastic properties of the lung
- Resistance to airflow
- Pressure and volume during the breathing cycle

Introduction

- The lungs are paired organs lying within thoracic cavity. The lungs and chest wall are lined by the visceral pleural membrane and the partial pleural membrane respectively
- Air enters the lungs from the oral-nasal passages through the trachea and the bronchi and eventually reaches the alveoli



Human Lungs

•In humans the lungs occupy a large portion of the chest cavity from the collarbone down to the diaphragm.

•The right lung is divided into three sections, or lobes. The left lung, with a cleft to accommodate the heart, has only two lobes. The two branches of the trachea, called bronchi, subdivide within the lobes into smaller and smaller air vessels known as bronchioles. Bronchioles terminate in alveoli, tiny air sacs surrounded by capillaries.

•When the alveoli inflate with inhaled air, oxygen diffuses into the blood in the capillaries to be pumped by the heart to the tissues of the body. At the same time carbon dioxide diffuses out of the blood into the lungs, where it is exhaled.

The thorax and respiratory muscles

- The thorax is a sealed compartment lined inside by the partial pleural membrane and the outer surface of the lungs is covered by the pulmonary pleural membrane.
- Air is drawn into the lungs by the action of inspiratory muscles .i.e. the diaphragm, external intercostals and the neck and back muscles.
- Expiration at rest is by elastic recoil of the lungs, force expiration is by contraction of the abdominal and internal intercostals muscles.

Mechanisms of Pulmonary ventilation

The lungs can be expanded and contracted in two ways:

- By downward and upward movement of the diaphragm to lengthen or shorten chest cavity.
- By elevation and depression of the ribs to decrease or to increase the antero-posterior diameter of the chest cavity.

- All the muscles that elevate the rib cage are classified as inspiratory muscles and those that depress the rib cage are classified as expiratory muscles.
- The most important muscles that raise the rib cage are the external intercostals muscles but others are also involve i.e., sternocleidomastiod, anterior serratiand scaleni

Lung volumes and capacities

- The events of pulmonary ventilation can be described with ease by dividing the air in the lungs into four volumes and capacities
- These pulmonary volumes are as follows:
- The tidal volume;
- The inspiratory reserve volume;
- The expiratory reserve volume;
- The residual volume;

Lung capacities

- There are four lung capacities and these include;
- 1. **Inspiratory capacity:** It is the maximum volume of air which can be inspired after normal expiration.
- 2. **Functional Residual capacity:** It is the volume of air remaining in the lung after normal expiration.
- 3. **Total lung capacity:** It is the volume of air contained in the lungs after deepest inspiration.
- 4. **Vital capacity:** It is the volume of air given out by maximal expiration after maximal inspiration.

Lung -related pressure

- There three lung- related pressures and these include the following:
- *Pleural pressure*: It is the pressure of the fluid in the thin space between the lug pleural and the chest wall pleural.
- *Alveolar pressure:* It is the pressure of the air inside the lung alveoli.
- *Transpulmonary pressure*: It is the pressure difference between that in the alveoli and that on the outer surface of the lungs

Elastic properties of the lungs

1) *Compliance of the lungs;* it is the measurement of the distensibility of the lungs. It is express as a change in volume divided by a change in pressure. The normal lung plus thorax compliance of an adult is about 0.1 L/cm of water.

2) Principle of surface tension and surfactant

The surface tension of the alveoli increases as the radius of the alveolus gets smaller.

Surfactant is a surface active agent with a detergent-like properties and it substantially lowers the surface tension to about one-sixth, surfactant is secreted by special epithelial cells called type ll alveolar epithelial cells and its secretion is stimulated by alveolar expansion and B-adrenergic mechanism.

Resistance to airflow

- Resistance to airflow into and out of the lungs is due mainly to friction in the airway.
- Airflow in the lungs requires a pressure gradient between the atmosphere and the alveoli

Energy require for respiration

During normal quiet respiration, only 3 to 5 per cent of the total energy expended by the body is required for pulmonary ventilation. But during heavy exercise, the amount of energy required can increase as much as 50-fold, especially if the person has any degree of increased airway resistance or decreased pulmonary compliance.

Therefore, one of the major limitations on the intensity of exercise that can be performed is the person's ability to provide enough muscle energy for the respiratory process.

Pressure and volume during the normal breathing cycle

The pleural pressure during the breathing cycle is due to two forces i.e., one due to elastic recoil which is proportional to the degree of inflation and the other is due to inspiration and expiration alveoli pressures generated to overcome airflow resistance. As air is flowing, the pressure volume relationship is referred to as dynamic and is seen to be a loop.

- The width of the loop is an estimate of airflow resistance. With slow deep breaths, most of the extra work is against the elasticity of the alveoli and for rapid shallow breaths, most of the extra work is against the airway resistance. Maximum respiratory muscle forces can be estimated from the mouth pressure generated during maximum inspiration and expiratory effort against an obstructed mouth.
- In reality, the duration of inspiration is shorter than expiration.
- In reality, the duration of inspiration is shorter than expiration


Thank you for
Listening to
this talk