

Chapter - 23

Respiratory System of Human

Energy is required for the operation of all vital activities in the body of living beings. This energy is obtained from the oxidation of food. So, respiration is a biochemical process in which energy, water and carbon dioxide are obtained due to oxidation of food present in living cells. This energy is stored as chemical energy in form of ATP and carbon dioxide is released out side.

Type of Respiration

Respiration is of two types –

1. External respiration
2. Internal/Cellular respiration

1. External Respiration – The process related to the absorption of oxygen from the environment and the removal of CO_2 by the cells of the animal is called **External respiration**. In this, Exchange of O_2 and CO_2 takes place between environment and the cells. It is also called **breathing** or **ventilation**. It is physical process.

2. Internal or Cellular Respiration– The process related to the use of oxygen and production of carbon dioxide and ATP by the living beings is called **internal or cellular respiration**. Internal or cellular respiration is of two types :-

- (i) When cellular respiration takes place in the presence of oxygen then it is called **aerobic respiration**.
- (ii) When cellular respiration takes place in the absence of oxygen then it is called **anaerobic respiration**.

Respiratory Organ and Respiratory System of Human

In human, well developed respiratory organ and respiratory system is found for the gaseous exchange. Respiratory system consist external nares or nostril, nasal cavity, naso pharyngeal cavity, larynx, trachea, bronchi and lungs. Lungs are the main respiratory organ in human, rest of the structures make respiratory tract.

Alveoli present in lungs work as respiratory surface. One pair of external nares are the external aperture of respiratory system in human. The hairs found in nostril and spiral bones of nasal passage which are covered by mucous membrane filter the entering air. Air is hot and moist in the nasal cavity. Microscopic particles present in the air blocked by mucous and prevents them from going into the lungs. Nasal passage is made up of nasal, premaxilla maxilla and ethmoid bones. Nasal cavity open into nasopharynx through internal nares. The incoming air goes back to the laryngopharynx. Laryngopharynx joins trachea through larynx. Larynx is a structure like triangular chamber. The cartilages give support to wall of larynx.

In this, the main cartilages are thyroid, cricoid, arytenoids and epiglottis. The vocal cords also found in larynx which generate sound. The aperture of larynx is called glottis, this aperture open into trachea.

Trachea is about 12 cm long tube. It stops from the larynx to thoracic cavity. Where it divides into

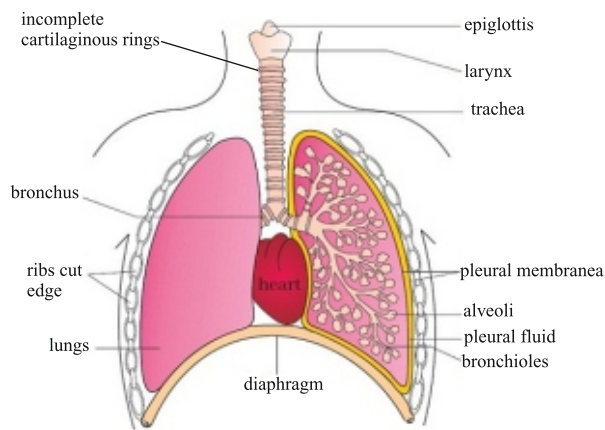


Fig. 23.1 Diagram of human respiratory system.
Transverse section of a lung

two bronchi. 'C' shaped cartilages give support to the wall of trachea and bronchi. Mucous cells and ciliated cells are found at the wall of respiratory tract. Bacteria and micro particles entrapped in mucous, are taken into pharynx by cilia and mucous is swallowed.

In human, two lungs are situated in thoracic cavity near the heart. Right lung is made up of three lobes and left lung is made up of two lobes. Lungs are covered by two pleura. Pleural fluid is filled between pleura. The pleural cavity which is found between both pleura has no air. This cavity prevents the lungs from shrinking. The cavity of both lungs are separated. If air enters into pleural cavity due to an accident then lungs become shrunk. Rib cage covers the lungs and protects them. Dome-shaped muscular diaphragm separates the thoracic cavity from the abdominal cavity.

In human, single bronchus enters each lung and in the lungs continuously divides to form secondary and tertiary bronchi, bronchioles, terminal bronchioles, and respiratory bronchioles. Respiratory bronchioles subdivide into alveolar ducts which open into alveolar sac or atrium. In each atrium, a group of small alveoli is connected. Both lungs have about sixty crores alveoli. Respiratory bronchioles, alveolar ducts, atrium, and alveoli make a respiratory unit. Alveoli are the main surface of gaseous exchange.

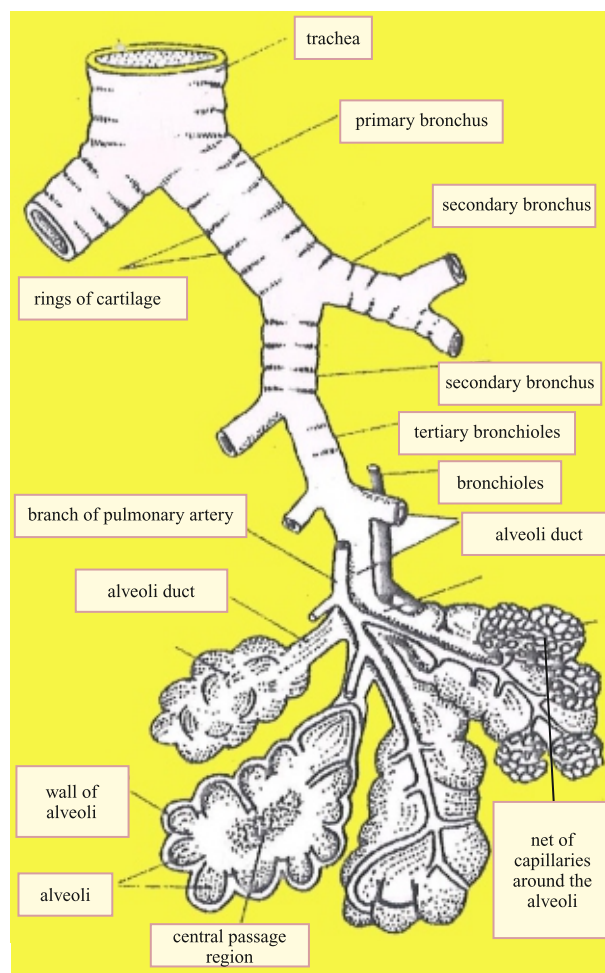


Fig. 23.2 Diagram of respiratory tree of lungs in human

Each alveolus is a minute micro cup-shaped structure having 0.2 mm diameter. The network of blood capillaries is found in its extremely thin wall, in which blood flows as a continuous layer. The respiratory membrane or surface formed by alveoli for gaseous exchange is extremely thin, about 0.2 μm . The respiratory membrane is formed by the alveolar epithelium, inner membrane of cells, and basement membrane present in the middle. The wall of alveoli is made up of squamous epithelium. Bronchi and bronchioles are lined by ciliated epithelium.

Mechanism of Respiration

The mechanism of human respiration is completed in two steps –

- (i) Inspiration
- (ii) Expiration

(i) Inspiration – Entry of air (O_2) into body is called **inspiration**. It is also known as **inhalation**.

Inspiration is a active phase which starts with the contraction of diaphragm and intercostal muscles. When the diaphragm contracts it become flat. At the time of contraction, diaphragm falls down in the abdomen, this increases the volume of thoracic cavity. Along with external intercostal muscle also contract. From their contraction, the ribs are pulled out and upwards. Due to both activities volume of thoracic cavity increases. Due to this, air pressure in thoracic cavity and lungs reduces than the atmospheric pressure. Because of this difference in air pressure, the air rushes into alveoli rapidly from atmosphere through respiratory tract until the air pressure of alveoli become equals to atmospheric pressure.

The passage of air is –

Nostril → nasal cavity → internal nares → pharynx → glottis → trachea → bronchi → bronchiole → alveolar duct → atrium → alveoli

(ii) Expiration – Getting out of the body of the air from the lungs is called **expiration**. This is also known as **exhalation**.

It is inactive phase in resting stage. After inspiration, expiration takes place. When external inter costal muscles and muscles of diaphragm get relax then the ribs come down due to their own weight and the diaphragm rises up in thoracic cavity. There fore, due to the volume of the thoracic cavity decreasing, its air pressure rises more than atmospheric pressure. The lungs are compressed and pressure increases in them. Air goes out side into atmosphere from alveoli through respiratory tract.

At the time of exercise and physical labour, expiration become active phase. Intercostal muscles contract rapidly and pull the ribs downward, for this volume of thoracic cavity decreases. Abdominal muscles also contract quickly which increase pressure upon abdominal cavity. Due to this pressure, diaphragm moves upward more actively into thoracic cavity.

The lungs are compressed rapidly by contracting these two muscles and the air gets out

forcibly. In human, the respiration rate (breathing rate) in adult is 16-20 per minute in resting stage.

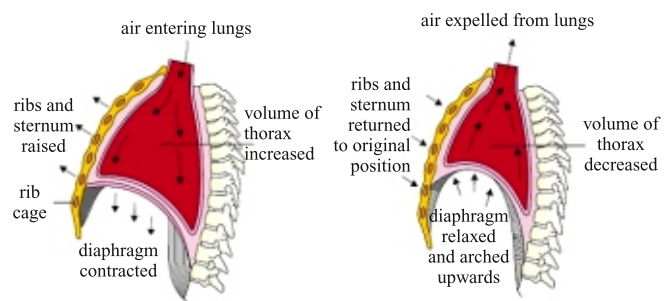


Fig. 23.3 Mechanism of Breathing (a) Inspiration (b) Expiration

Volume Related Respiration

1. Tidal volume (TV)– The volume of air taken in lungs in inspiration or expired volume of air in expiration during normal breathing is called **tidal volume**. In each breath, the measurement of tidal inspiration or tidal expiration is 500 mL.

A healthy man can inspire or expire at he rate of 6000 to 8000 mL air per minute.

2. Inspiratory Reserve Volume (IRV) – The extra quantity of air volume can be inspired forcefully by a person. This is average 2500 mL to 300 mL.

3. Expiratory Reserve Volume (ERV) – The extra quantity of air volume that can be expired force fully by a person. This is average 1000 mL to 1100 mL.

4. Residual Volume (RV) – The volume of air which remains in the lungs after a force full expiration. That is called **residual volume**. It is average 1100 ml to 1200 ml.

Capacities Related to Respiration –

1. Inspiratory Capacity (IC)– The maximum quantity of air which can be taken during inspiration. It is equal to the sum of tidal volume and inspiratory reserve volume. It measures 3500 mL.

2. Expiratory Capacity (EC) – The maximum quantity of air which can be exhale during expiration. It includes tidal volume and expiratory reserve volume (TV+ERV)

3. Functional Residual Capacity (FRC) – The amount of air which remain in lungs after

normal breathing. It includes expiratory reserve volume and residual volume (ERV + RV). Its value is 2300 mL.

4. Vital Capacity – It is maximum inhaled and maximum exhaled air in the lungs. It is the sum total of IRV, TV and ERV ($VC = IRV + TV + ERV$). Its value is 4600 mL

5. Total Lung Capacity (TLC)– The maximum amount of air that can be filled in the lungs after maximum efforts is called the **total lung capacity**. Its value is equal to $TLC = VC + RV$. It measure about 5800 mL.

Artificial Respiration

When a person stops breathing in an accident such as drowning, carbon mono oxide or other gaseous toxicity electrical trauma or other condition, but if heart beating remain continued then human life can be saved by giving artificial respiration.

Generally, it is possible to retrieve normal respiration by activating respiratory centers with the help of artificial respiration.

Many artificial respiration methods are known but mouth to mouth respiration method is more effective. Following are main points to give artificial respiration by this method –

- (I) Laying down the patient flat up right, put one hand on his fore head and the other hand under his neck, lift the neck so that the neck get pulled and tongue separates from the back portion.
- (ii) Close the nose of patient by the hand keeping on the forehead by the person giving artificial respiration and he should keep his face on the patient in such a way that there is no air gap or should be air tight condition.
- (iii) In the mouth of patient double quantity of tidal air should be filled for 12 times per minute.
- (iv) Open the mouth and nose of patient and observe expiration. In this way the patient can get rejuvenation by artificial respiration.

Respiratory Disorders

1. Asthma – This disease is caused due to

allergy from pollen grains, dust particles, food stuffs, smoke, cold, smoking etc. The symptoms of this disease may be coughing and difficulty in breathing. At the time of asthma attack the sound whistling turns out during expiration. In this disease, breathing difficulties arise due to the formation of excess mucous in bronchioles, inflammation and narrowing of these. The best way of avoiding this disease is to stay away and avoid the allergy causing factors. For the treatment of this disease broncho-dilator and antibiotic medicine should be taken that decrease the inflammation.

2. Bronchitis – The main symptoms of this disease are continuous cough, excess mucous, green-yellow cough and problem in breathing causes due to the inflammation in inner surface of bronchus. This disease is caused by smoking. Due to the chemicals present in cigarette smoke, excessive mucous is formed which causes inflammation in bronchus and cilia are destroyed. Staying away from smoking can prevent this disease.

3. Emphysema – This disease is also caused by excess smoking. Smoking causes continuous stimulation of the lungs by which alveolar wall is gradually destroy. Air space in lungs spread and the area of respiratory surface decreases. Due to the increase in the amount of connective tissue, the flexibility of the lungs also decreases, resulting the hard expiration. Inflammation excess cough and narrowing of bronchus causes breathing hard. Staying away from smoking, antibiotics and broncho-dilator medicine gives relief.

4. Pneumonia – This disease is caused by the infection of **Streptococcus pneumonia** bacteria. Due to infection alveolar sac is occupied by the dead WBC and fluid which causes inflammation in lungs. The patient has difficulty in breathing. This disease occurs mostly in the elderly and in the childrens. Antibiotics and broncho-dilator medicines are useful in the treatment.

5. Cancer of lungs – Its main reason is smoking. Chemicals present in cigarette smoke are cancer causing. Un controlled cell division begins in the epithelium of bronchus due to the stimulation of smoke, which gradually become cancer through out

the lungs.

6. Silicosis and Asbestosis – This disease is caused due to air pollution such labour who works in silica and asbestos mines or factories, they may possibly suffered by this disease.

The particles of these material enter into lungs through breathing and cause fibrosis (growth of fibrous tissue) in the upper part of the lungs and produce inflammation. Both disease are incurable, so should avoid them.

Important Points

1. Respiration is a bio chemical process in which the food present in the living cell is oxidised and as a result energy, water and CO_2 are produced.
 2. Types of respiration – (i) External respiration (ii) Internal or Cellular respiration
 3. Human respiratory system consist – nostril, nasal cavity, pharynx, larynx, trache, bronchi and lungs. Alveoli are found in the lungs, which make the respiratory surface.
 4. Mechanism of respiration in human is completed in two steps – (I) Inspiration (ii) Expiration
 5. Entry of air (O_2) into body is called inspiration
 6. External intercostal muscles and diaphragm contraction occurs during inspiration.
 7. Exhaling the air (CO_2) from body is called expiration.
 8. External inter costal muscles and muscles of diaphragm get relaxed during expiration.
 9. Mouth to mouth respiration method is more effective in artificial respiration.
 10. Smoking causes the respiration related disease such as asthma, bronchitis, emphysema and lung cancer.
- (c) Kinetic energy
 - (d) Electrical energy
 2. Diaphragm occurs while taking air
(a) Oblique (b) Dome shaped
(c) Normal (d) Flattened
 3. What happens during inspiration?
(a) Contraction of diaphragm and external intercostal muscles.
(b) Relaxation of diaphragm and external intercostal muscles.
(c) Contraction of only diaphragm.
(d) Relaxation of only external intercostal muscles.
 4. What happens during expiration?
(a) Contraction of diaphragm and external inter costal muscles.
(b) Relaxation of diaphragm and external inter costal muscles.
(c) Relaxation of diaphragm only.
(d) Contraction of external intercostal muscles only.
 5. The rate of breathing in adult during resting condition is –
(a) 20-22 per minute (b) 18-20 per minute
(c) 16-20 per minute (d) 14-16 per minute
 6. Tidal volume found in a normal man during resting phase -
(a) 1.2 litre (b) 2.5 litre
(c) 0.5 litre (d) 4.5 litre
 7. End part of trachea in lungs is –
(a) Bronchiols (b) Alveoli
(c) Bronchi (d) Air sac
 8. Whistle sound during expiration is symptom of the disease -
(a) Emphysema (b) Asthma
(c) Bronchitis (d) Silicosis
 9. Labour, working in the mines and factories are possible to more suffer from the disease -
(a) Pneumonia (b) Bronchitis

Practice Questions

Multiple Choice Questions

1. Energy used in respiration is –
(a) Physical energy
(b) Chemical energy

- (c) Emphysema (d) Silicosis
10. Total capacity of lung is –
- (a) 4600 mL (b) 3500 mL
- (c) 5800 mL (d) 2300 mL

Very Short Answer Questions

1. What is external respiration?
2. What is respiratory surface?
3. Where is diaphragm situated?
4. Write the name of inspiration muscle?
5. Write the name of two disease caused by smoking?
6. What is expiratory reserve volume?
7. What is inspiratory reserve volume?
8. What is residual volume?
9. What is inspiratory capacity?
10. What is functional residual capacity?
11. What is the importance of artificial respiration?

Short Answer Questions

1. Explain the mechanism of inspiration.

2. Explain the mechanism of expiration.
3. Explain the method of artificial respiration.
4. What is emphysema disease? How it is treated?
5. What is respiration? Define the external and internal respiration.

Essay Type Questions

1. Describe human respiratory system with labelled diagram.
2. Explain the mechanism of respiration and importance of respiration in human.
3. Write short notes on –
 - (a) Artificial respiration
 - (b) Respiratory disorders
 - (c) Volume related respiration

Answer Key

1. (b) 2. (d) 3. (a) 4. (b) 5. (c)
6. (c) 7. (b) 8. (b) 9. (d) 10. (c)