VENTILATION
MECHANICAL VENTILATION(MV)
INVASIVE VENTILATION
NON-INVASIVE VENTILATION(NIV)

BY

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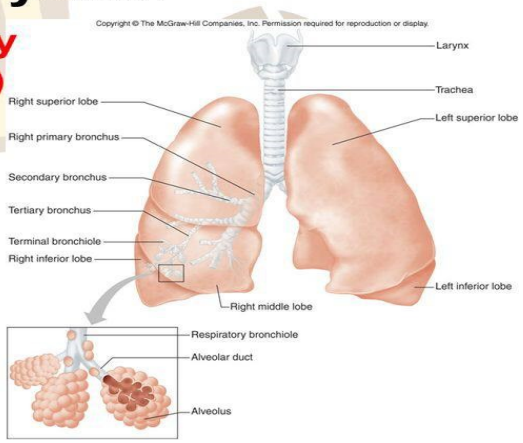
Review

ANATOMY AND PHYSIOLOGY OF RESPIRATORY SYSTEM

Divisions of the Respiratory System

2. Lower respiratory tract (within thorax)

- Trachea
- Bronchial Tree
- Lungs



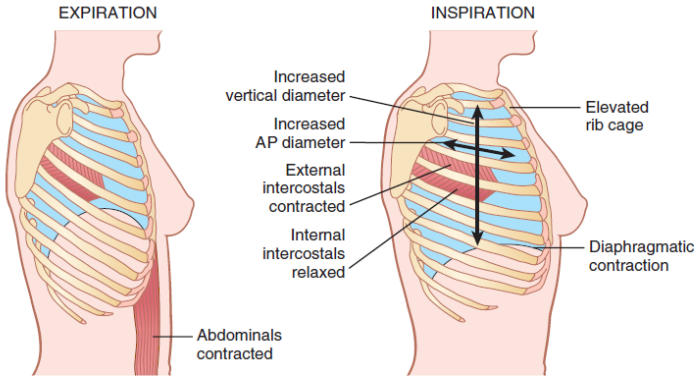
RESPIRATORY SYSTEM

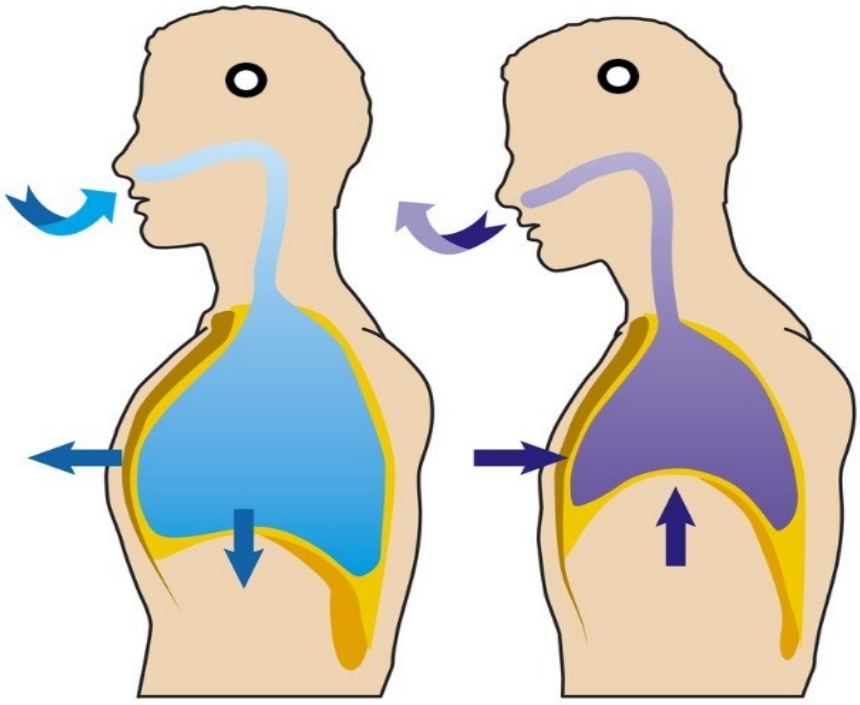
The main functions of respiration are to provide oxygen to the tissues and remove carbon dioxide. The four major components of respiration are

1. Pulmonary ventilation, which means the inflow and outflow of air between the atmosphere and the lung alveoli
2. Diffusion of oxygen (O2) and carbon dioxide (CO2) between the alveoli and the blood
3. Transport of oxygen and carbon dioxide in the blood and body fluids to and from the body's tissue cells
4. Regulation of ventilation and other facets of respiration.

LUNGS 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 anteroposterior diameter of the chest cavity





❖ IMPORTANT INFORMATION

Pleural pressure is the pressure of the fluid in the thin space between the lung pleura and the chest wall pleura. As noted earlier, this pressure is normally a slight suction, which means a slightly negative pressure. 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. 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.

Respiration is defined as movement of gas molecules across a membrane

External respiration is movement of O2 from the lungs into bloodstream and of CO2 from bloodstream into alveoli.

Internal respiration is movement of CO2 from the cells into the blood and movement of O2 from the blood into cells.

❖ Important information

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, alveolar pressure rises to about +1 centimeter of water, which forces the 0.5 liter of inspired air out of the lungs during the 2 to 3 seconds of expiration.

Alveolar ventilation

The ultimate importance of pulmonary ventilation is to continually renew the air in the gas exchange areas of the lungs, where air is in proximity to the pulmonary blood. These areas include the alveoli, alveolar sacs, alveolar ducts, and respiratory bronchioles. The rate at which new air reaches these areas is called alveolar ventilation

	Generation		Diameter, cm	Length, cm	Number	Total cross sectional area, cm^2
Conducting zone	Trachea	0	1.80	12.0	1	2.54
	Bronchi	1	1.22	4.8	2	2.33
		2	0.83	1.9	4	2.13
		3	0.56	0.8	8	2.00
	Bronchioles	4	0.45	1.3	16	2.48
	Terminal bronchioles	5 ↓ 16	0.35 ↓ 0.06	1.07 ↓ 0.17	32 ↓ 6×10^4	3.11 ↓ 180.0
Transitional and respiratory zones	Respiratory bronchioles	17	↓	↓	↓	↓
		18				
		19	0.05	0.10	5×10^5	10^3
	Alveolar ducts	T_3 20	↓	↓	↓	↓
		T_2 21				
		T_1 22				
	Alveolar sacs	T 23	0.04	0.05	8×10^6	10^4

WHAT ARE THE CAUSES OF ABNORMAL $\dot{V}/\dot{Q}$ RATIO?

There are many pathological causes of $\dot{V}/\dot{Q}$ mismatch. These are broadly grouped into:

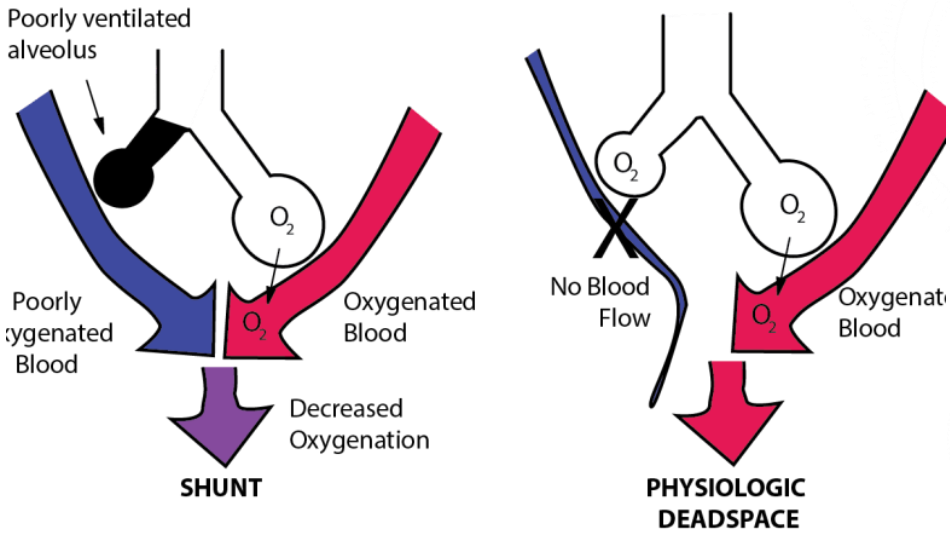
Problems with lung ventilation, resulting in low $\dot{V}/\dot{Q}$ ratio. This is the most common cause of hypoxemia. Causes include:

- Upper airway obstruction
- Foreign body aspiration
- Pneumonia
- Pneumothorax
- Atelectasis
- ARDS
- Emphysema
- One-lung ventilation
- Normal ageing
- Increased closing capacity associated with obesity.

- PROBLEMS WITH LUNG PERFUSION, RESULTING IN HIGH $\dot{V}/\dot{Q}$ RATIO. CAUSES INCLUDE:

PE

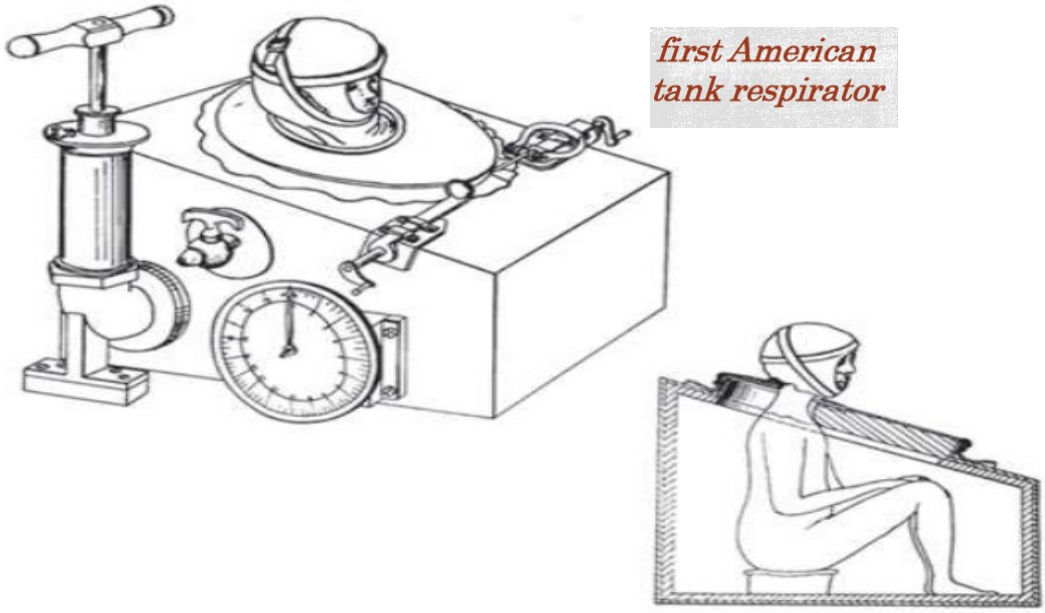
Reduced right ventricular stroke volume (SV), due to hypovolemia, right ventricular infarction or pericardial tamponade.



HISTORY OF MECHANICAL VENTILATION

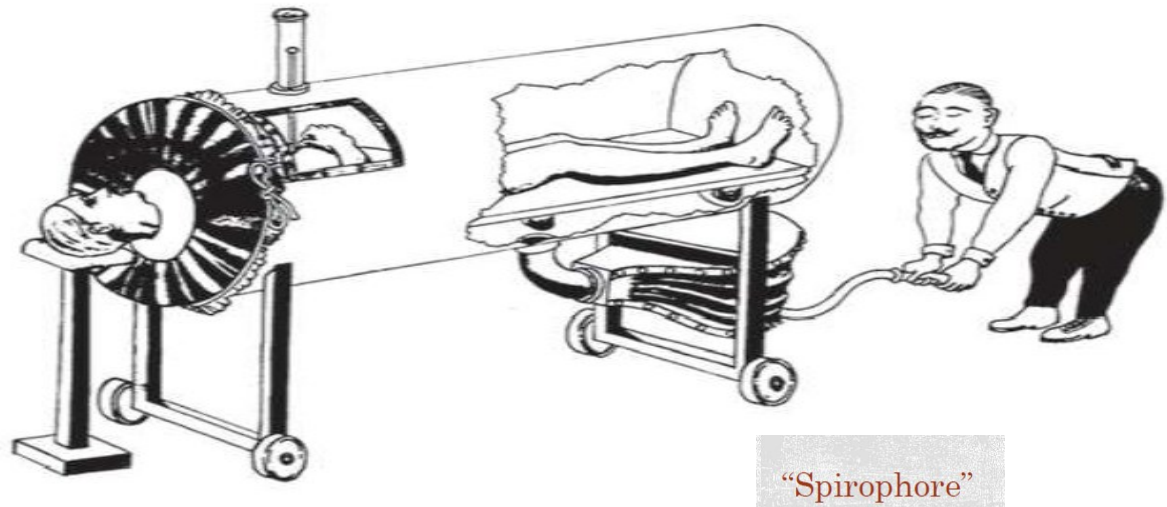
An unknown philosopher stated “The lungs are the center of the universe and the seat of the soul”.

The earliest reference for attempts to restore breathing was about 3150 BC when Egyptian physicians tried to save drowned victims by placing a reed in the throat and blowing into the lungs . The Chinese in 2000 BC described lien ch’i, as a transfer of inspired air into the “soul” (life): mouth positive pressure.



first American tank respirator

1864 NO. 1 – EMERSON EXHIBIT JONES



"Spirophore"

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Introduction About Mechanical Ventilation

Mechanical ventilation is typically used after an invasive intubation, a procedure wherein an endotracheal or tracheostomy tube is inserted into the airway. It is used in acute settings such as in the ICU for a short period of time during a serious illness. It may be used at home or in a nursing or rehabilitation institution if patients have chronic illnesses that require long-term ventilation assistance

Meaning of Mechanical Ventilation

In medicine, mechanical ventilation is a method to mechanically assist or replace spontaneous breathing

Main goal of mechanical ventilation

Reduce the work of breathing to allow for respiratory muscle rest and recovery

Indication of mechanical ventilation

- Respiratory failure: An inability of the heart and lungs to provide adequate tissue oxygenation or removal of carbon dioxide.
- Hypoxemic respiratory failure - lung failure just decrease in PaO2
- Hypercapnic respiratory failure - pump failure decrease in PaO2 and PaCO2
- Neuromuscular diseases: Myasthenia Gravis, Guillain-Barre Syndrome, and Poliomyelitis (failure of the normal respiratory neuromuscular system)
- Musculoskeletal abnormalities Such as chest wall trauma.
- Infectious diseases of the lung such as pneumonia, tuberculosis

- Obstructive lung disease in the form of asthma, chronic bronchitis or emphysema.
- Conditions such as pulmonary edema, atelectasis, pulmonary fibrosis.
- Patients who has received general anesthesia as well as post cardiac arrest patients requires ventilatory support until they have recovered from the effects of the anesthesia or out from a Dange

EFFECTS OF POSITIVE PRESSURE VENTILATION

System	Effect
Respiratory / Pulmonary	↑ mPaw, alveolar and pleural pressures
Cardiovascular	• ↑ intrathoracic pressure - ↓ venous return - ↓ CO and SV • CVP is increased with PEEP • Effects are more pronounced with use of PEEP
Renal	Decreased CO – Decreased GFR – Reduced filtration and urine output
Hepatic	Reduced hepatic blood flow with PEEP (32% decrease with PEEP of 20 cm H2O
Gastrointestinal/ Abdominal	•Increase in Intra abdominal pressure – impaired circulation •Erosive oesophagitis, stress related mucosal damage

Basic information mechanical ventilation

Respiratory rate (R.R) or frequency (F): is a number of breath per minute or 60 seconds.

Tidal Volume (Vt): the volume of air that enter the lung in each breath for example 0.5 L or 500 ml.

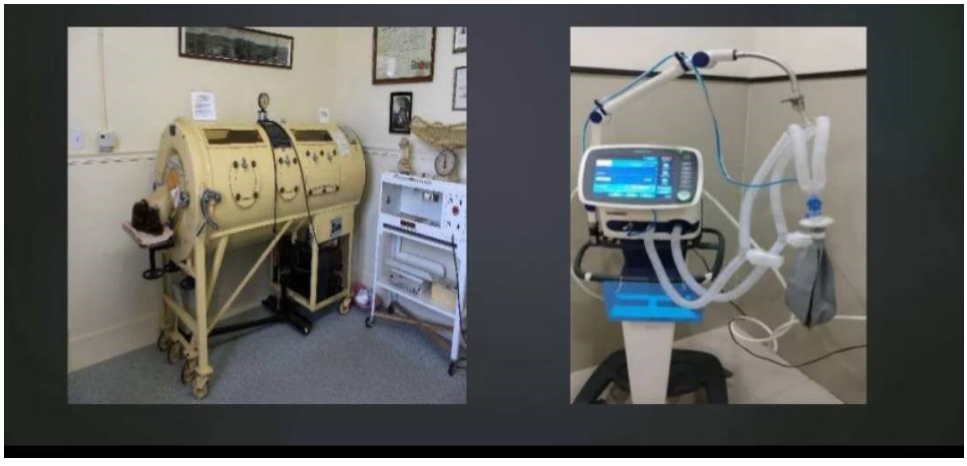
If we give 10 breath/min (60 second) that mean each breath will take (6 second).

If we give 20 breath/min (60 second) that mean each breath will take (? Second).

Minute ventilation (MV) = R.R * Tv

Types or forms of mechanical ventilation

Negative pressure ventilator positive pressure ventilator



Thank you