



Department of Anesthesia Techniques
Title of the lecture:- Respiratory physiology and
anesthesia

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Respiratory cycle

The respiratory centers contain many different types of inspiratory and expiratory neurons that fire during the three phases of the respiratory cycle:

- 1- **Inspiratory phase:** is the first stage of the breathing cycle. It begins with the contraction of the diaphragm and the external intercostal muscles. This contraction increases the volume of the thoracic cavity, which, in turn, decreases the pressure in the lungs causing the air entrance into the lung (inhalation)
- 2- **Post-inspiratory phase:** It is characterized by a temporary short pause of breathing, during which the respiratory muscles, such as the diaphragm and intercostal muscles start to relax.
- 3- **Expiratory phase:**
 - It can be a **passive** process during quiet breathing (**rest**): the the diaphragm and intercostal muscles, **relax**, causing a decrease in the volume of the chest cavity. This results in an increase in pressure within the chest, which pushes air out of the lungs (exhalation)
 - it can become **active** during forced expiration (**exercise**) by the **contraction** of specific expiratory muscles.

Anaesthesia affects all aspects of respiratory system function.

1. The control of breathing
2. Chemoreceptors
3. Upper airway
4. Respiratory muscles
5. Lung mechanics (lung volume & airway resistance).



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The impact of these factors on:

- a. Ventilation.
- b. Perfusion.

Effect of Anaesthesia on Control of Breathing

1. Neural Control of Respiration

2. Chemical Control of Respiration

1. Neural Control of Respiration

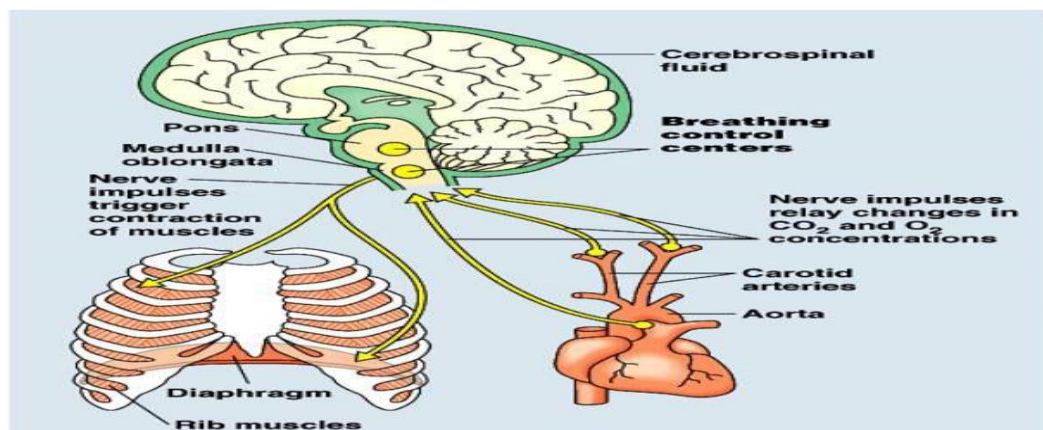
Normal respiratory movements are involuntary. The movement is transported automatically in the form of nervous impulse from centers in the brain.

Respiratory centers which are located in the pons and the medulla receive input

from the following afferents such as Chemoreceptors, Cortex, Hypothalamus and mechanoreceptors in airways .

A-Control of Inspiration Process:

Group of cells from the **inspiratory centers** sends impulses down the spinal cord then using **phrenic nerves to Diaphragm**, and using the **Intercostal nerves to the intercostal muscles**. This will lead to the contraction of the inspiratory muscles and to the expansion of the thorax cage volume allowing air to enter the lungs.





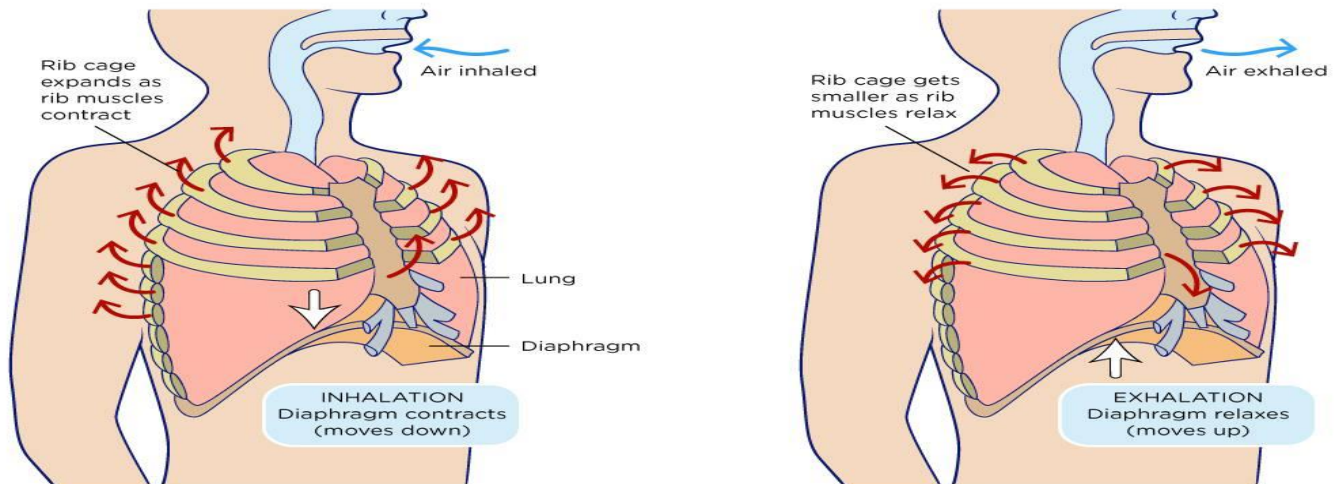
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B. Control of Expiration Process:

When inspiration, reach its maximum it will stimulate the **pneumotaxic centers** (Respiratory movements centers) at the **Pons** which supply excitation to the **expiratory centers** at the upper part of the **Medulla oblongata**. They, in turn, send **inhibitory impulses to the inspiratory centers** cause relaxation of the **inspiratory muscles** and **tighten the thorax cage** forcing air to leave out the lungs.



Jack Westin

C. Reflexes Controlling Respiration:

I- Respiratory chemoreceptor Reflexes:

Respiratory reflexes from the Carotid and Aorta when stimulated by increase CO₂ or acidosis will cause increase in respiration.

II. Respiratory Protective Reflexes:

Reflexes that protect the respiratory passage ways and lungs from **food or foreign particles** by **sneezing and coughing** to remove these particles from nasal cavity, larynx and bronchi.

III. Muscular Exercises:

Movement stimulates proprioceptors in muscles and joints causing increase respiratory rate with increase activity



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Chemical Control of Respiration

A-Direct effect on respiratory centers: Activity of respiratory centers are affected by the blood chemistry & temperature.

- 1- Effect of CO₂:** Increase CO₂ lead to increased **acidity** which stimulates the neurons at the centers and increase respiratory **depth and rate**. Reduced CO₂ in blood will inhabit respiration.
- 2- Effect of changes in O₂ amount:** Sever lack of O₂ depresses these centers lead to **reduction** or even ceases of **respiration** in sever causes.
- 3- Effect of Temperature:** Increased temperature accelerate the **rate** but not the depth. Reduced temperature slow the rate of respiration.

B. Indirect effects by means of Chemoreceptors:

Deficiency of O₂, Increased CO₂ , Low pH Stimulates chemoreceptors and sends impulses to respiratory centers that cause the reflex increase of respiration.

Effect of Anaesthesia on Control of Breathing

Anaesthetic agents influence breathing and respiratory centers by :

- 1. Rate of Respiration:** decrease rate of respiration
- 2. Rhythm of Respiration:** can cause irregular slow respiration with deep general anesthesia
- 3. Pattern of Breathing:** alternating periods of deep breathing followed by shallow or absent breathing.