* REGULATION OF RESPIRATION
-NERVOUS REGULATION
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* Objectives

***By the end of this session, the student should be able to:***

* Identify CNS regions (respiratory centers) that share in the generation and control of cyclic breathing.
* Describe receptors and neural pathways of the reflexes involved in regulation of respiration
* The spontaneous respiration is regulated by two mechanisms
* Nervous Regulatory Mechanism
* Chemical Regulatory Mechanism
* Nervous Regulatory Mechanism
* Automatic Control of Respiration
* Brainstem
* Voluntary Control of Respiration
* Cerebral cortex
* Automatic Control Of Respiration

It is brought about by two centre located in the brainstem

* Medullary respiratory center
* Pontine respiratory center
* **Medullary respiratory center**
* It consists of two types of neurons – **I** neurons and **E** neurons that are active during inspiration and expiration only respectively.
* These neurons are located in two groups in the medulla
* Dorsal respiratory group
* Ventral respiratory group
* **Dorsal Respiratory Group-**
* Near Nucleus Tractus Solitarius
* Consists of primarily inspiratory(I) neurons
* Basic rhythm of respiration is generated here in the form *inspiratory ramp signals.*
* Receive afferents from airways and chemoreceptors
* **Ventral Respiratory Group-**
* Near nucleus ambigous and retroambigous.
* Inactive during normal quiet breathing
* Contributes to the extra respiratory drive.

Inspiratory(I) and Expiratory(E) neurons have *reciprocal innervations.*

Inspiratory Ramp Signal:

* It begins weakly and then increases steadily in a ramp manner for about 2 seconds ,ceases abruptly for approx. 3 seconds which allows elastic recoil of the lungs and chest wall to cause expiration, and then another cycle begins.
* The advantage of the ramp signal is that it causes a steady increase in the volume of the lungs during inspiration., rather than inspiratory gasps.
* **Pontine Respiratory Center**
* It is subdivided into two groups
* **Lower Pons**-
* Called apneustic center
* Tonically active and activates the *I neurons*
* Inhibited by the afferents from the vagus nerve from airway and the lungs.
* **Upper Pons-**
* Called Pneumotaxic center
* Contains *both I and E neurons*
* Active in both phases of respiration
* Inhibits neurons in lower pons.
* Thus rhytmicity of the neurons in the medullary respiratory center is spontaneous but it is modified by
* Neurons in the Pons
* Afferents in the vagus nerve from receptors in the lungs and airways.
* **Voluntary control of respiration**
* Acts through *the corticospinal tract* which originates from the cerebral cortex to end on the spinal motor neurons innervating the respiratory group of muscles. Thus this pathway bypasses the medullary respiratory neurons.
* Factors affecting respiratory center

**Hering-Breuer Inflation Reflex:**

* Steady inflation of the lungs stimulates *the stretch receptors* in the walls of bronchi and bronchioles, this in turn stimulates the vagus nerve. The vagus nerve then inhibits the apneustic centre thus switching off the inspiration .
* This is a protective mechanism preventing excess inflation of the lungs. The threshold for this reflex is tidal volume more than 1.5 litres(T.V.≥1.5l)

**Afferent from pharynx trachea and bronchi**-from trachea to bronchioles there are myelinated nerve endings of vagal fibres that function as *Irritant Receptors.*

* **Cough reflex-**deepinspiration followed by a forced expiration against a closed glottis. The glottis is then suddenly opened producing an explosive outflow of air.
* **Sneezing reflex-**it is a similar expiratory effort with a continuously open glottis.
* **Swallowing or deglutition reflex-** During swallowing movement respiration is inhibited(*deglutition apnea)*. Afferent from glossopharyngeal nerve(IX) inhibits the respiration. This reflex is protective in nature and prevents aspiration of food particles into the respiratory tract.
* **Hiccup –**spasmodic contraction of diaphragm producing an inspiration during which glottis suddenly closes producing a sound.

**Afferent from Baroreceptors and Chemoreceptors:**

* **Baroreceptors**- Baroreceptors in carotid and aortic sinus get stimulated by high blood pressure and cause inhibition of respiration by inhibiting respiratory center.
* **Chemoreceptors-** Chemoreceptors in aortic and carotid bodies get stimulated by low oxygen and high carbon dioxide. These impulses through vagus and glossopharyngeal nerve increase rate and depth of respiration.
* Summary
* Identify CNS regions (respiratory centers) that share in the generation and control of cyclic breathing.
* Describe receptors and neural pathways of the reflexes involved in regulation of respiration

***Thanks ……..***