

Chemical Regulation of Breathing

Chemical regulation of breathing is part of the involuntary (autonomic) control of breathing. This mechanism is part of the body's homeostasis to maintain an appropriate balance and concentration of CO₂, O₂, HCO₂⁻ and pH. There are two types of chemoreceptors that react strongly to a change in the blood gases: **central** and **peripheral** chemoreceptors.

Chemoreceptors

- detects arterial pCO₂ and pH
- increase in alveolar pCO₂ causes an increase in breathing rate
- pO₂ normally stimulates ventilation when it falls below ~8kPa (60 mmHg). When the fall is accompanied by an increase in PCO₂, the increase in ventilation is greater

Central Chemoreceptors

Central chemoreceptors are located on the ventrolateral surface of the medulla oblongata. They respond indirectly to blood pCO₂ but not to pO₂. CO₂ diffuses across the blood-brain barrier from blood to cerebral spinal fluid (CSF) while H⁺ and HCO₃⁻ are unable to.

As the blood CO₂ readily passes the blood-brain barrier into the CSF it will react with H₂O to make H₂CO₃, that will split into HCO₃⁻ and H⁺.



An increase in H⁺ concentration will directly stimulate the chemoreceptor neurons in the medulla oblongata. They will relay this information and cause an increase in ventilation which will lead to a decrease in CO₂.

The central chemoreceptors are responsible for ~80% of the response to CO₂ concentration.

Peripheral Chemoreceptors

Peripheral chemoreceptors are located in carotid and aortic bodies that have neuro-epithelial cells that contact with sensory nerve terminals. They respond to changes in pO₂, pCO₂ and pH. When they are stimulated, K⁺ channels close and Ca²⁺ channels open. This causes an increase in initiation of dopamine, impulses to respiratory center via the glossopharyngeal nerves (N IX) and an increase in ventilation.

The peripheral chemoreceptors are responsible for ~20% of the response to an increase in pCO₂.

Links

Bibliography

- GUYTON, Arthur – HALL, John. *Textbook of Medical Physiology*. 11. edition. Saunders, 2005. 1104 pp. ISBN 978-0721602400.
- WARD, Jeremy, et al. *Physiology at a glance*. 2. edition. Wiley-Blackwell, 2008. 160 pp. ISBN 978-1405177238.
- KAPIT, Wynn, et al. *Physiology Coloring Book*. 2. edition. Benjamin Cummings, 1999. 320 pp. ISBN 978-0321036636.

External Links

- Regulation of Respiration Brain Stem Centre (<http://ak47boyz90.wordpress.com/2009/08/06/13-regulation-of-respiration-brain-stem-centre/>)
- Mechanics of Breathing and Gas Exchange-Transport (<http://www.colorado.edu/intphys/Class/IPHY3430-200/015breathing.htm>)
- Breathing oxygen level (<http://www.tutornext.com/help/breathing-oxygen-level>)