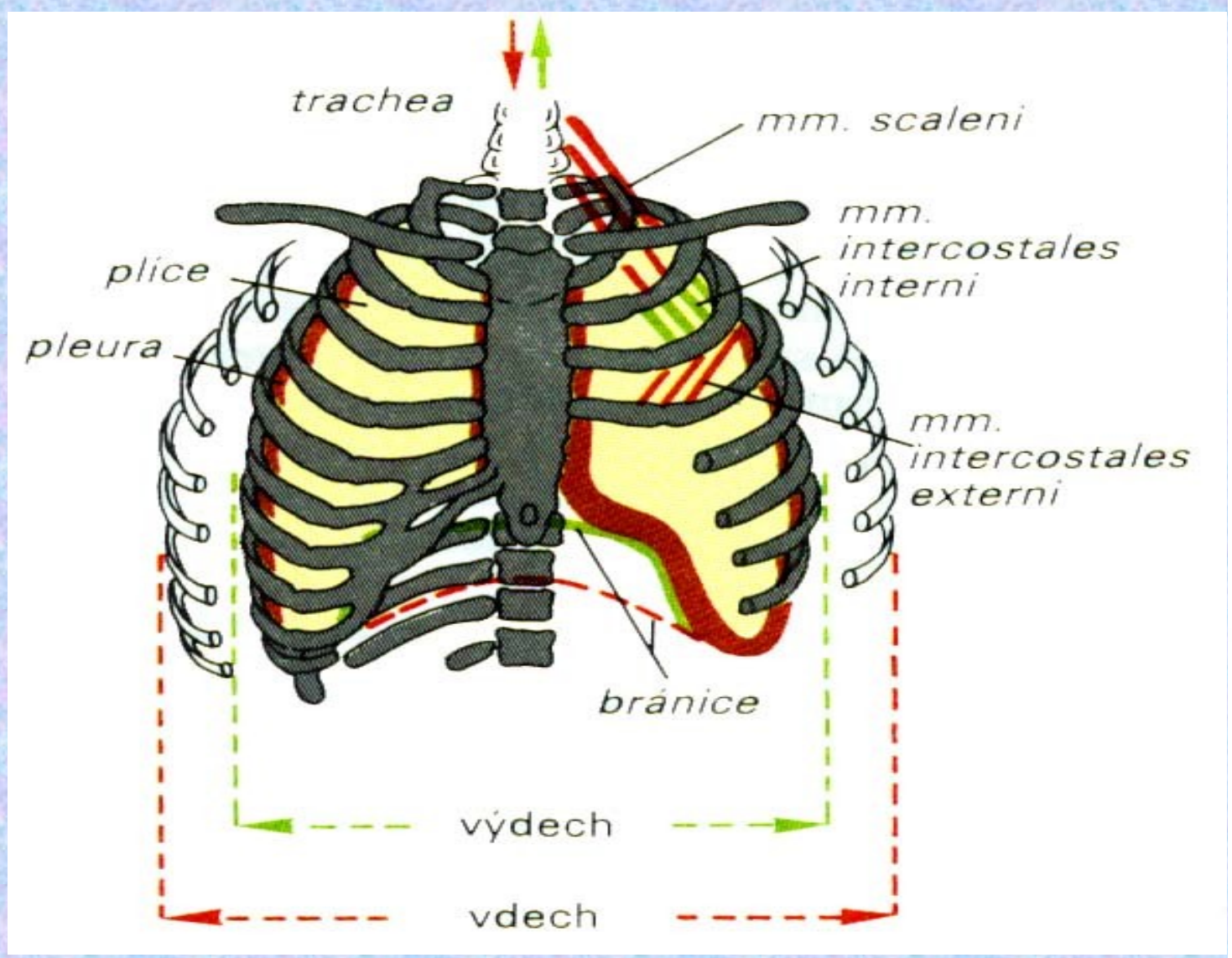
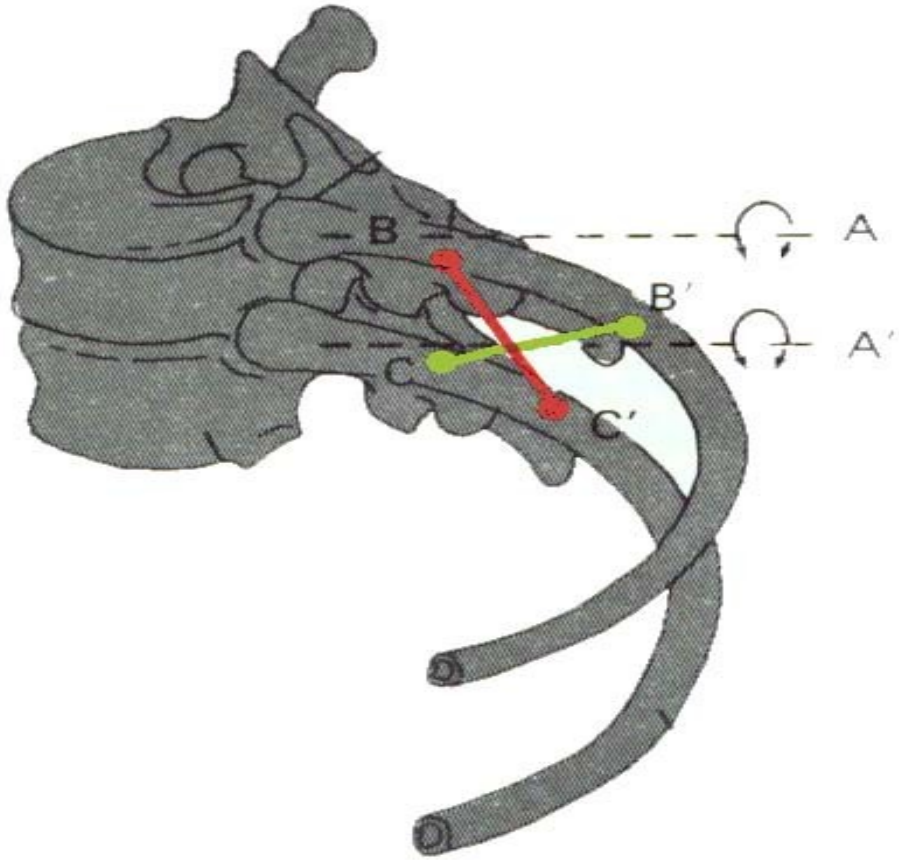
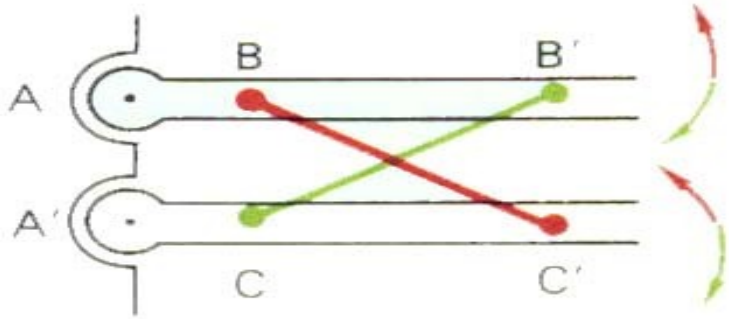
Respiratory system

Bucket-handle and water-pump handle effects





páka A – B < A′ – C′ → zvedání žeber

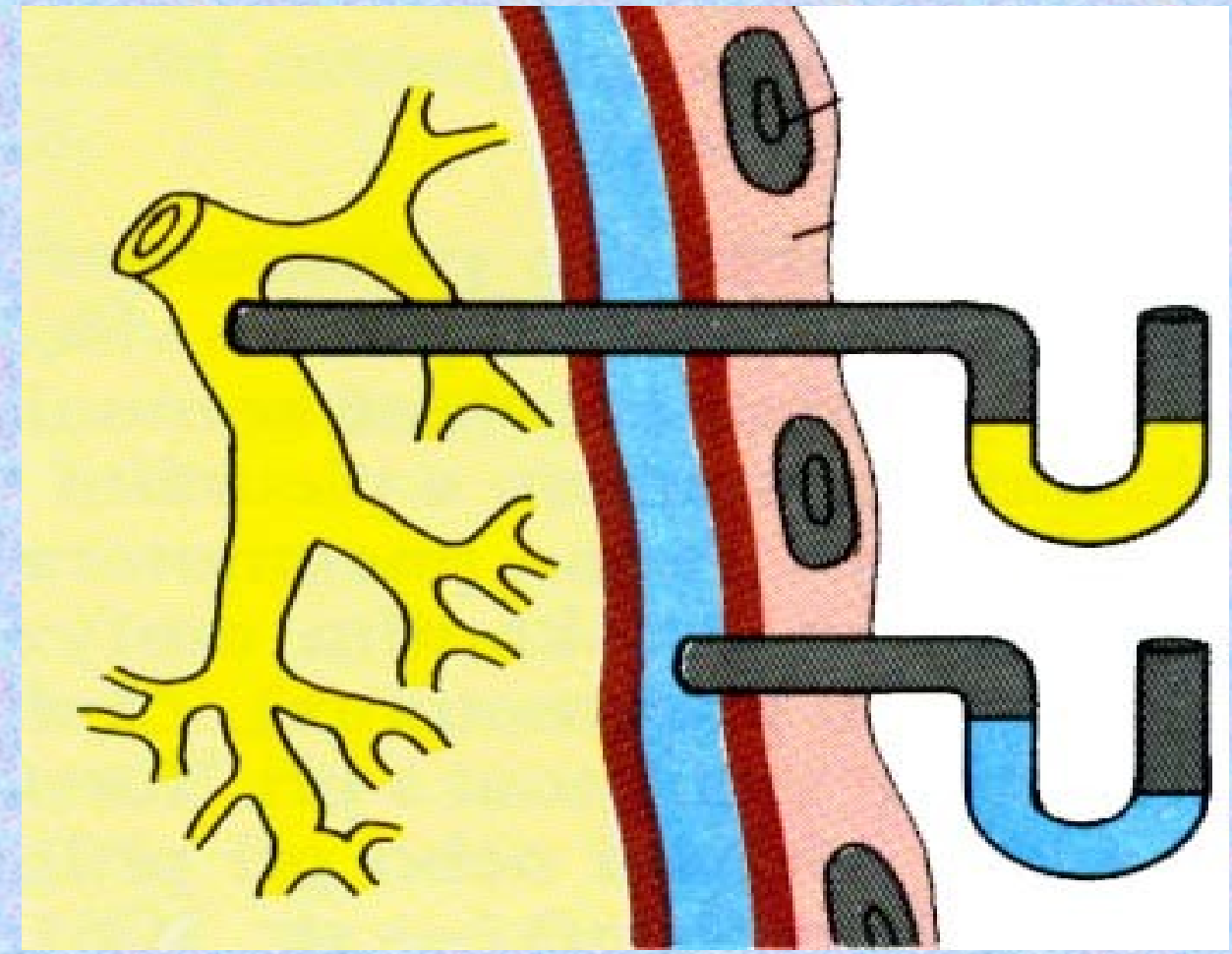


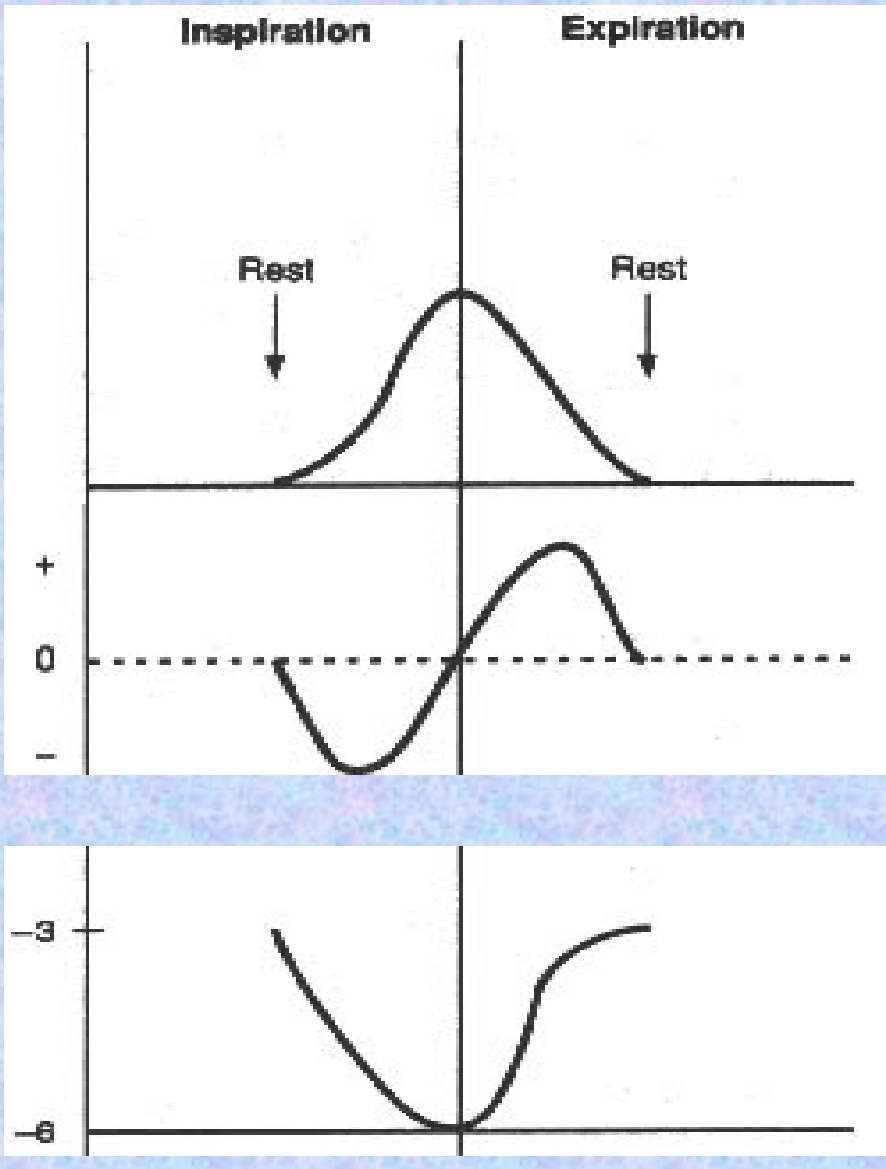
páka A – B′ > A′ – C → klesání žeber

PLEURA

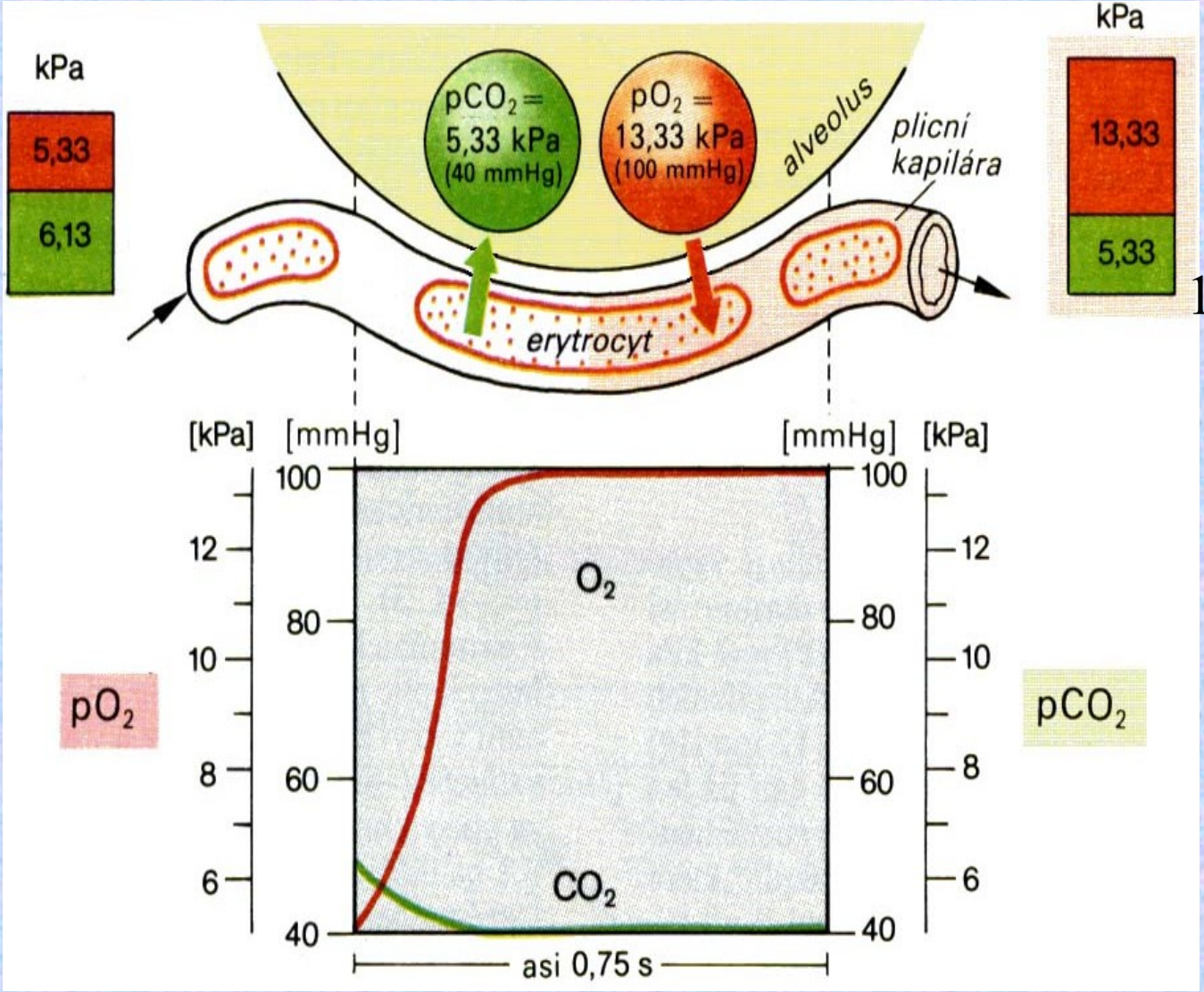
pulmonalis

parietalis



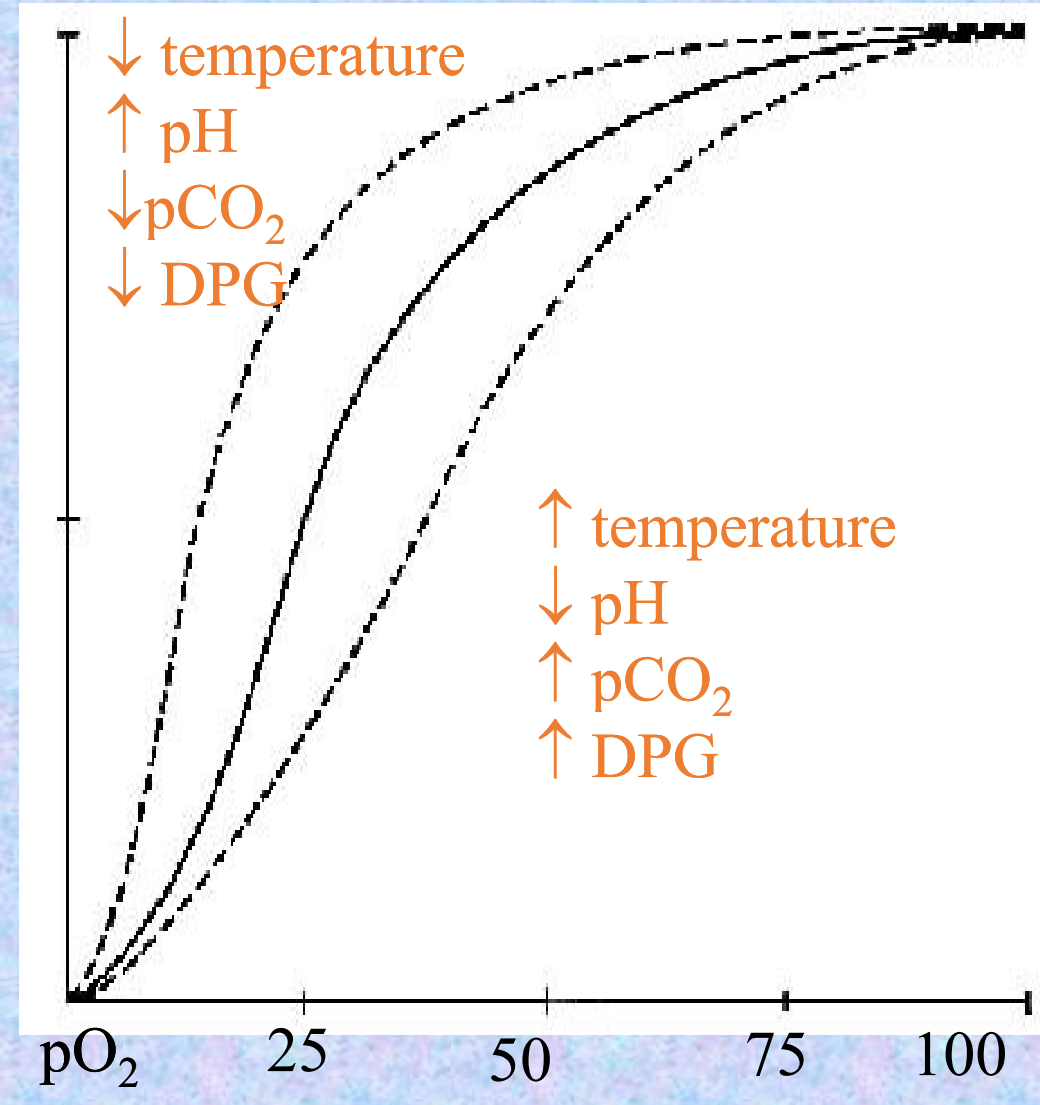


TRANSPORT O_2



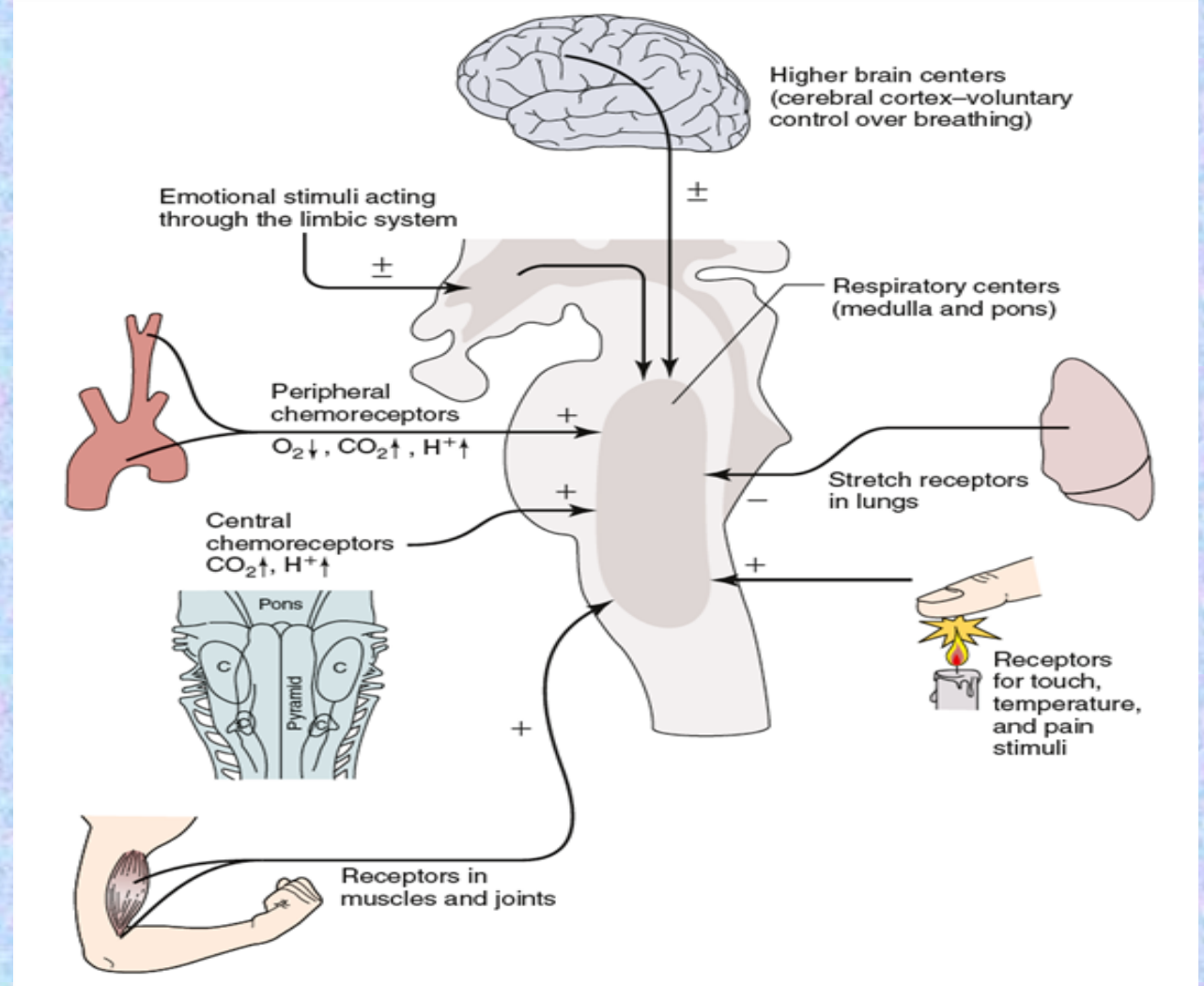
100%

50%



Regulation of breathing

Control of ventilation



https://sleep.sharepoint.com/siteimages/Chapter%203.png

- Breathing is an automatic process that takes place unconsciously. Automaticity of breathing comes from regular (rhythmic) activity of groups of neurons anatomically localized in the medulla and its vicinity. They can be divided into three main groups:

  - *dorsal respiratory group* – placed bilaterally on the dorsal side of the medulla oblongata, only inspiratory neurons, sending axons to motoneurons of inspiratory muscles (diaphragm, external intercostal muscles; their activation=inspiration, their relaxation=expiration; participates on inspiration at rest and forced inspiration

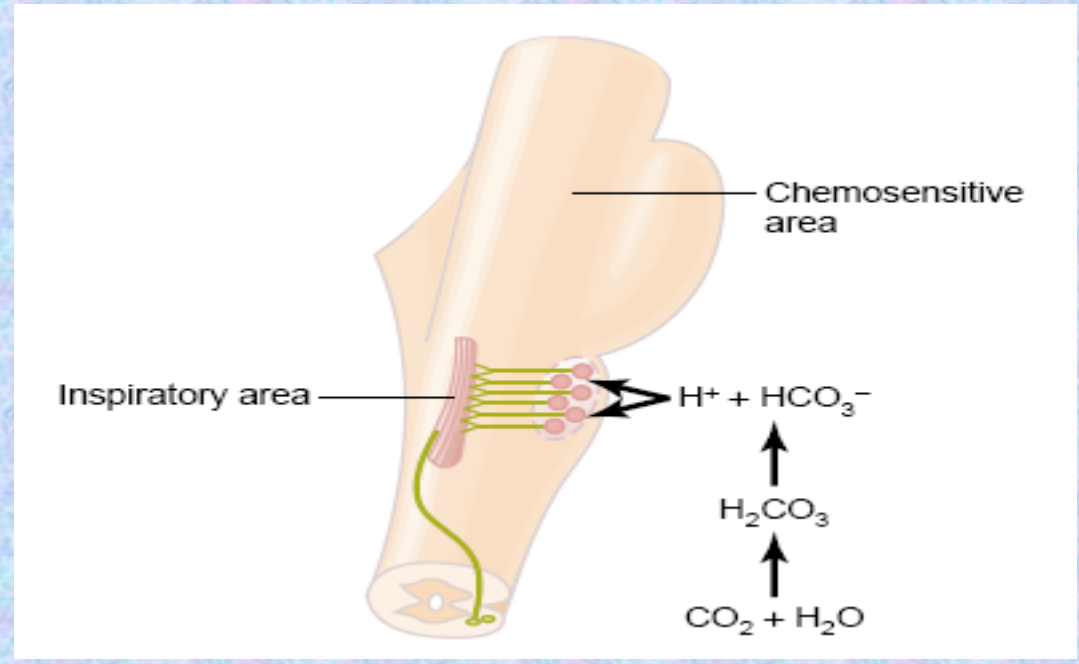
  - *ventral respiratory group* - located on the ventrolateral part of the medulla oblongata, the upper part: neurons whose axons of motor neurons activate the main and auxiliary inspiratory muscles; the lower part: expiratory neurons which innervate expiratory muscles (internal intercostal muscles). Neurons in this group operate only during forced inspiration and forced expiration.

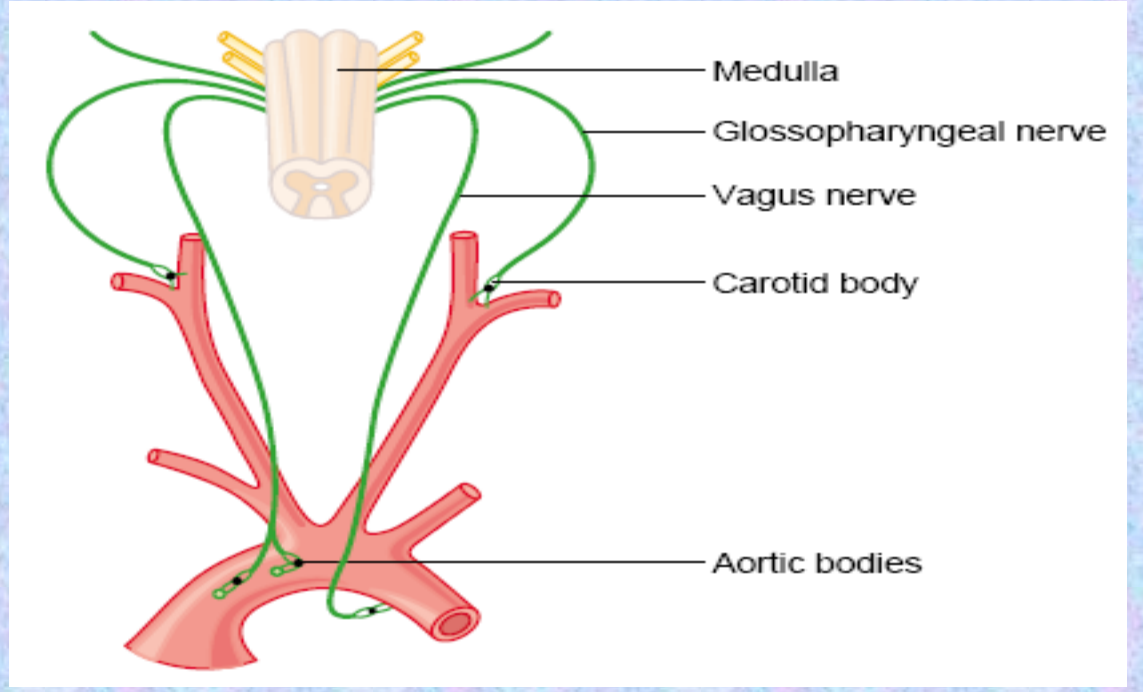
  - *Pontine respiratory group* - *pneumotaxic center* - dorsally placed on top of the pont, contributes to the frequency and depth of breathing; affects the activity of respiratory neurons in the medulla oblongata.

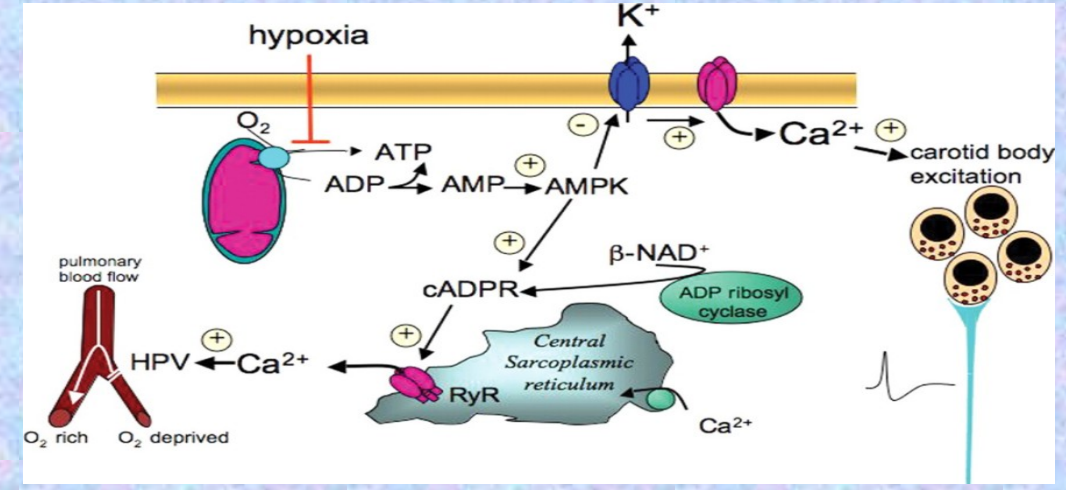
Chemical factors affecting the respiratory center:

Central chemoreceptors

- on the front side of the medulla
- sensitive only to increase of arterial pCO_2 (by increasing H^+)
- central chemoreceptor are stimulated by other types of acidosis (lactate acidosis, ketoacidosis)







Peripheral chemoreceptors

– located in the aortic and carotid bodies

-primarily sensitive to decrease in arterial pO_2, particularly to decrease of O_2 under 10-13 kPa in the arterial blood.

They convey their sensory information to the medulla via the vagus nerve and glossopharyngeal nerve.

Mechanism of action: Decreased ATP production in mitochondria leads to depolarization of receptors membrane and to excitation of chemoreceptor

http://www.medicine.mcgill.ca/physio/resp-web/sect8.htm,

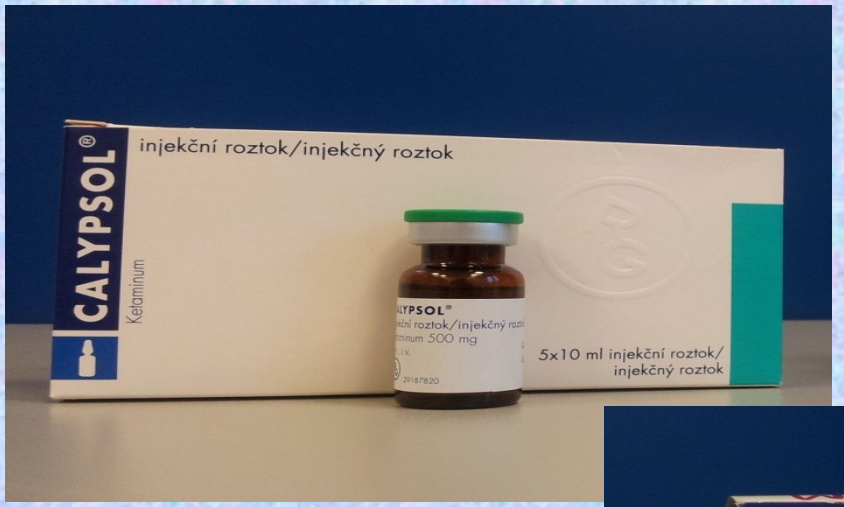
Non-chemical influences

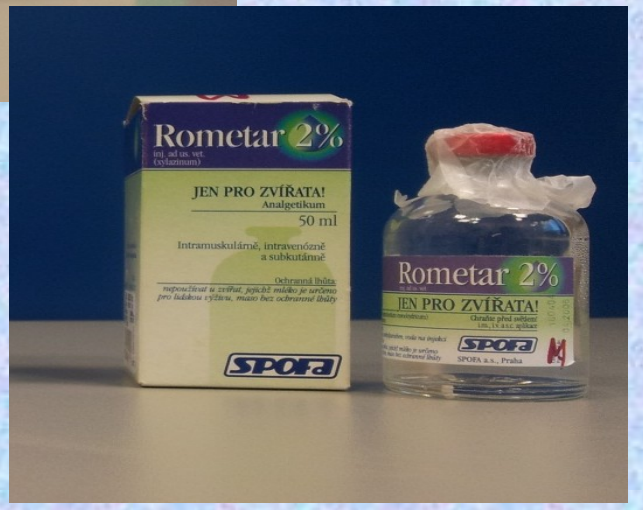
More types of receptors in respiratory system

Irritants receptors on mucose of respiratory system – quickly adaptated,
Stimulus: chemical substances (histamin, serotonin, cigarette smoke).
Respons: increase mucus secretion, constriction of larynx and brochus

C-receptors (=J receptors)– free nerve ending of n.vagus (type C) in intersticium of bronchus and alveolus;
Mechanical irritans (pulmonary hypertension, pulmonary oedema)
Response: hypopnoe, bronchoconstriction, cough

Stretch receptors slowly adaptation, in smooth muscle trachea and bronchus; its irritants triggered decrese activity of respiratory centre – **Hering-Breuer´s reflexes**.

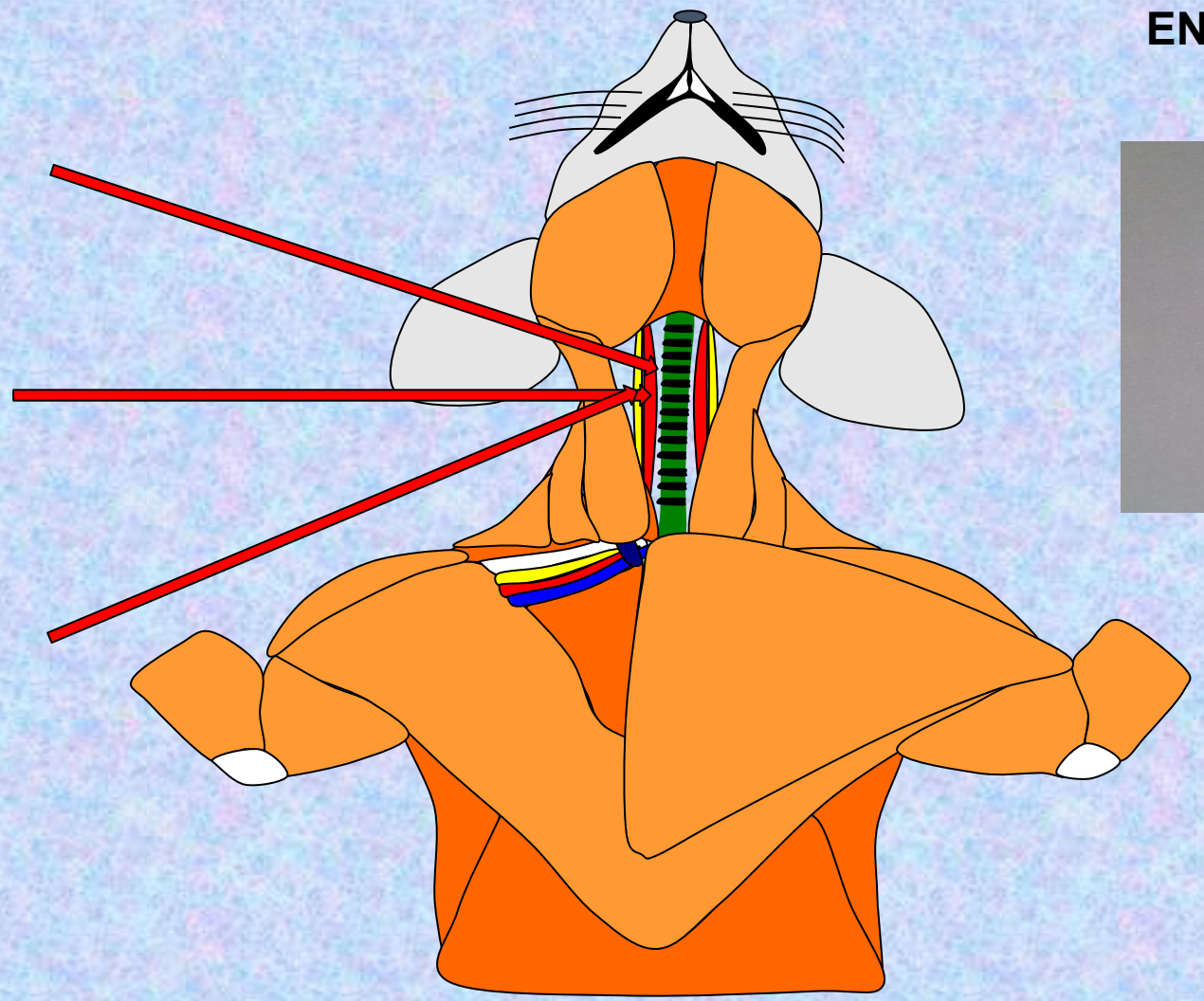

CALYPSOL®
injekční roztok/injekčný roztok
Ketaminum
5x10 ml injekční roztok/
injekčný roztok


Rometar 2%
JEN PRO ZVÍŘATA!
Analgetikum
50 ml
Intramuskulárně, intravenózně
a subkutánně
SPOFA
Rometar 2%
JEN PRO ZVÍŘATA!
SPOFA

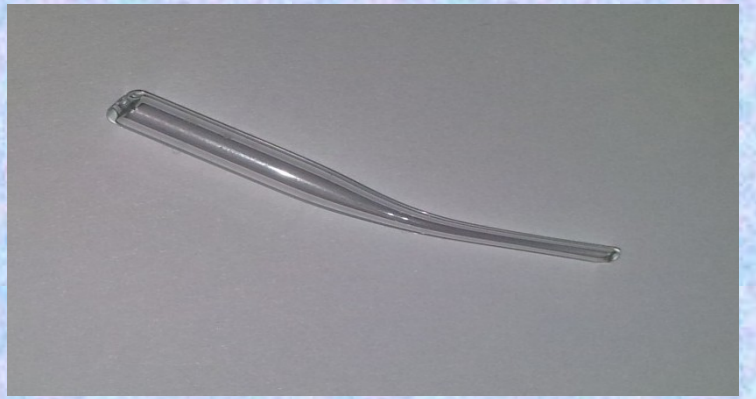
TRACHEA

A. CAROTIS

N. VAGUS

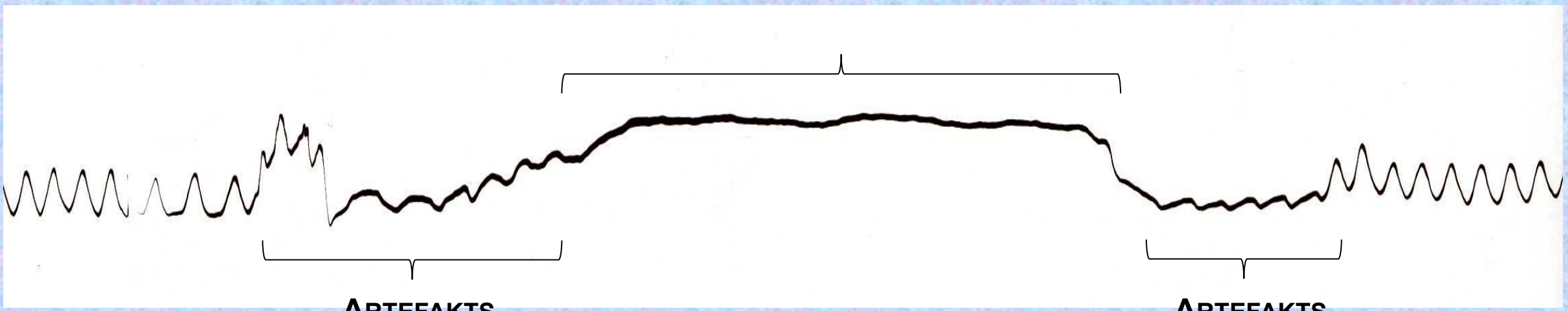


ENDOTRACHEAL CANNULA



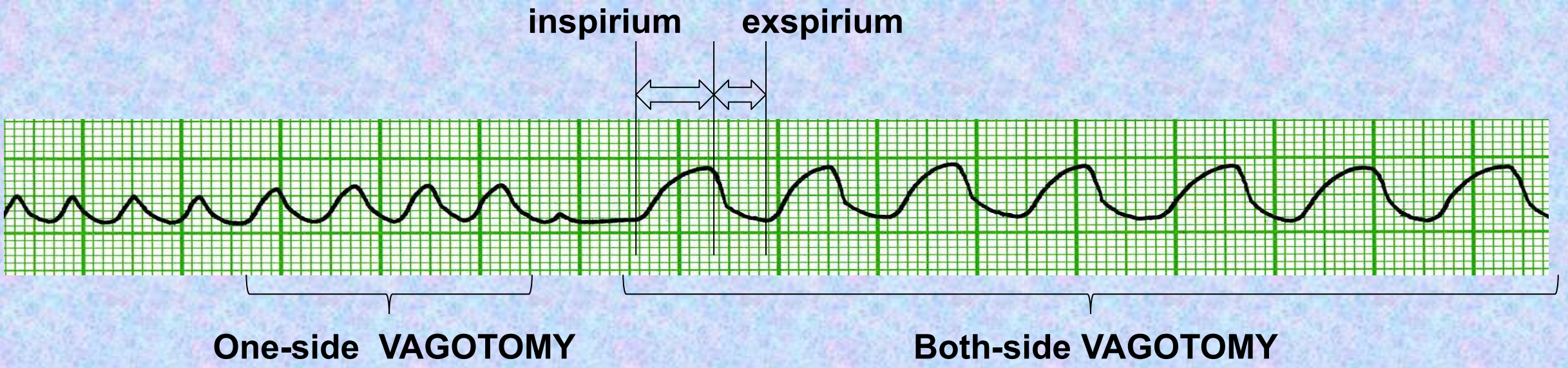
HERING-BREUER REFLEX

REFLEX STOP BREATHING



ARTEFAKTS **ARTEFAKTS**

VAGOTOMY



Baroreceptors – suppresses activity of respiratory centre

Irritants of **proprioreceptors of muscles, tendons** during active and pasive movements of limbs
Influenced activity of respiratory neurons (increase minute ventilation during work load)

Limbic system, hypothalamus – strong pain, emotion
Tractus corticospinalis =cortex – activated RC during work load

temperature

Periodic breathing

- Non regulary, non rhythmic, respirátory coming in „periods“ e.g. – period with respiration folows period without respiration.

- **CHEYNE-STOKES –** e.g. sleeping babies
- **BIOT‘S –** brain injury, encephalitis
- „gasping“ – newborn
- KUSSMAUL – during coma in diabetic patients (ketoacidosis)

Hypoxia, hypoxemia

- Hypoxia is a general name for a lack of oxygen in the body or individual tissues.
- Hypoxemia is lack of oxygen in arterial blood.
- Complete lack of oxygen is known as anoxia.

The most common types of hypoxia:

1. Hypoxic - physiological: stay at higher altitudes, pathological: hypoventilation during lung or neuromuscular diseases
2. Transport (anemic) - reduced transport capacity of blood for oxygen (anemia, blood loss, CO poisoning)
3. Ischemic (stagnation) - restricted blood flow to tissue (heart failure, shock states, obstruction of an artery)
4. Histotoxic - cells are unable to utilize oxygen (cyanide poisoning - damage to the respiratory chain)

Hypercapnia

- Hypercapnia - increase of concentration of carbon dioxide in the blood or in tissues that is caused by retention of CO_2 in the body
- possible causes: total alveolar hypoventilation (decreased respiration or extension of dead space)
- mild hypercapnia (5 -7 kPa) causes stimulation of the respiratory center (therapeutic use: pneumoxid = mixture of oxygen + 2-5% CO_2)
- hypercapnia around 10 kPa - CO_2 narcosis - respiratory depression (preceded by headache, confusion, disorientation, a feeling of breathlessness)
- hypercapnia over 12 kPa - significant respiratory depression - coma and death.

Travelling by aircraft

(On board aicraft is pressure as on 2000 m above see level)

<u>High risk for patients with:</u>

- ***concentration of hemoglobin lower than 60 %***
- ***severe step of atherosclerosis***
- ***cardial insuficiency***
- ***Respiratory insuficiency***
- ***non-treated hypertension (BP ower 200/100mmHg)***

Toxicity of oxygen

The toxicity seems to be due to the production of the superoxid anion and H_2O_2 + increase pCO2 in body (all hemoglobin is bound with oxygen)

Symptoms are dependent on time of exposure:

Exposure – 8 hours:- respiratory passages became irritated

- Substernal distress

- Nasal congestion

- Sore throat

- Cough

- 24-48 hours:

- damage of lungs – decrease production of surfactant

Recommendation:

100 % - give discontinuosly + together with air

HYPERVENTILATION

- **Definition: Both, accelerated and deep breathing**
  - In humans, hyperventilation coming as combination of anxiety and pain
  - During hyperventilation is expired CO_2 (hypocapnia) and the increase of pO_2 (hyperoxia) ---> <u>vasoconstriction of cerebral vessels</u>
  - Symptoms: tingling in the ears, feeling light in the head, headache etc.
  - Removing symptoms - by increasing pCO_2 in the body – e.g.: by breathing into and out of the bag (re-breathing)