Monitoring the respiratory system

Monitoring the functions of the respiratory system[1][2][3] is an important area of intensive care medicine , which is used in patients with respiratory failure, , in patients who are at risk of respiratory failure (unconsciousness, etc.), in securing airways, etc. Monitoring can be performed clinically, but it is also advantageous to use instrumentation.

Clinical monitoring

Common methods used in internal medicine are used for clinical monitoring: look , listen , feel , tap . Breathing movements can be observed by looking, especially their frequency (DF), their symmetry, possible objective signs of shortness of breath (retraction of the jugular, hypochondria), possible orthopnea. It is also important to evaluate the color of the skin (cyanotic, gray and marbled - centralization of circulation, etc.). Breathing intensity and secondary associated listening phenomena can be evaluated by listening.

The respiratory rate can be further monitored by analyzing the ECG signal - we filter only respiratory muscle signals according to the frequency, thus allowing the respiratory rate to be displayed on the monitor. However, this information is significantly disturbed by the patient's movements. Another variant is sensing the respiratory rate during UPV.

Instrument monitoring

Gas exchange, lung volumes, lung mechanics, circulation/lung interaction and the degree of inflammation of the lung tissue can be monitored mainly by instrumentation .

Pulse oximetry

Pulse oximetry is an essential method of non-invasive continuous measurement of hemoglobin oxygen saturation. A decrease below 90% clearly indicates a decrease in pO_2 . More accurate data will be supplemented by a blood gas examination. In clinical practice, it is essential to distinguish a normal signal from artefacts or sensing disorders, both in the case of certain pathologies (arrhythmia, impaired perfusion, icterus, ...) and in the case of technical difficulties (movement, artificial light, colored nails, persons with a high amount of skin pigment, ...).

🔎 *For more information see Pulse Oximetry.*

Capnometry and capnography

The most common use of measuring end -tidal CO 2 (end-tidal CO_2, normal values **35–45 mm Hg** or 4,6–6 kPa) in intensive care is:

- non-invasive monitoring of the alveolar tension of CO 2 and therefore also its arterial tension,
  - with knowledge of P and CO 2 (after measurement from arterial blood), it enables calculation of the ratio between dead space and respiratory volume,
- esophageal intubation detection,
- detection of recovery of heart activity during resuscitation.[4]

🔎 *For more information see Capnometry.*

UPV progress monitoring

During artificial pulmonary ventilation , the following parameters can be monitored in particular:

- respiratory rate,
- tidal volumes,
- minute ventilation,
- peak pressures and plateau pressure,
- concentration of oxygen in the inhaled mixture.

Furthermore, it is necessary to monitor **dyssynchrony** between the patient and the set mode.

Further monitoring depends on the ventilation methods used and allows an ideal compromise between sufficient aggressiveness of the ventilation regime to allow adequate ventilation and, on the other hand, minimizing the risk of lung damage related to UPV.

Blood gas examination

The basic examination is the examination of blood gases from arterial blood, its basic indications are:

- detection of hypoxemia or hyperoxemia (assessment **oxygenation**);

- detection of hypocapnemia or hypercapnemia (assessment of **ventilation**);
- determination of the type of acid-base balance disorder.[4]

This method also enables a clear diagnosis of respiratory insufficiency (pO_2 < 8,0 kPa) and its classification according to pCO_2:

- respiratory insufficiency of type 1, i.e. partial, respiratory insufficiency with impaired oxygenation (hypoxemia and normocapnia, or even hypocapnia caused by a compensatory increased respiratory rate),
- type 2 respiratory insufficiency, i.e. global, respiratory insufficiency with an associated ventilation disorder (hypoxemia and hypercapnia at the same time).

The examination can be sent to the laboratory, some workplaces are equipped with an analyzer directly in the department [1].

This method is usually **intermittent** . There are also expensive special sensors for continuous measurement of P and CO 2 that are not routinely used. Continuous measurement of oxygen tension in the jugular bulb is sometimes used in the therapy of intracranial hypertension. . For continuous monitoring, it is very advantageous to use **arterial blood oxygen saturation** (s and O 2), e.g. using pulse oximetry, and **the partial pressure of carbon dioxide in exhaled air** (EtCO 2) using **capnometry** or **capnography** .

🔎 *For more information see laboratory examination of acid-base balance.*

Other methods

New, so far more research methods are finding their place in clinical practice. The benefit of most techniques lies primarily in optimizing the setting of artificial lung ventilation and minimizing the risks associated with it.

These new methods include transcutaneous CO 2 monitoring , volumetric capnography and dead space calculation, monitoring of extravascular lung water, monitoring of lung mechanics, electrical bioimpedance tomography, vibration response imaging or respiratory inductive plethysmography.[4]

Links

Related Articles

- Respiratory insufficiency
- Laboratory examination of acid-base balance

Reference

1. SCHINDLER, Ivo. *Monitorace v intenzivní medicíně – stáž u lůžka* [lecture for subject Anesteziologie a neodkladná medicína, specialization Všeobecné lékařství, 1. lékařská fakulta Univerzita Karlova]. Praha. 26.3.2014.
2. ZAZULA, Roman, et al. *Praktikum intenzivní medicíny : učební text pro posluchače LF.* 1. edition. Praha : Anesteziologicko-resuscitační klinika 1. LF UK a FTN, 2007. 104 pp. pp. 30–55. ISBN 978-80-239-9474-2.
3. KASAL, Eduard, et al. *Základy anesteziologie, resuscitace, neodkladné medicíny a intenzivní péče : pro lékařské fakulty.* 1. edition. Praha : Karolinum, 2004. 197 pp. pp. 62–63. ISBN 80-246-0556-2.
4. ŠEVČÍK, Pavel, et al. *Intenzivní medicína.* 3. edition. Galén, 2014. 1195 pp. pp. 179–183. ISBN 978-80-7492-066-0.