CEREBRAL OXIMETRY MONITORING WITH INVOS 5100 IN CAROTID SURGERY

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Abstract: *The authors present a new method of monitoring the cerebral perfusion by infrared spectroscopy (NIRS), transcranial (which measures the brain level of O_2) using the INVOS 5100 cerebral oximetry monitoring. Cerebral oximetry is a simple method to identify the lower limit of cerebral vascular self-regulation, where the cerebral blood flow and cerebral tissue oxygenation become dependent on pressure. The research could create a risk score for us to predict: cognitive decline, prolonged hospitalization after surgery and perioperative stroke.*

Cuvinte cheie: *oximetria cerebrală, trombendarterectomia carotidiană (TEA), spectroscopia în infraroşu (NIRS) transcraniană*

Rezumat: *Autorii prezintă o nouă metodă de monitorizare a perfuziei cerebrale, prin spectroscopia în infraroşu (NIRS) transcraniană (care măsoară nivelul O2 cerebral) folosind monitorizarea oximetriei cerebrale cu INVOS 5100. Oximetria cerebrală reprezintă o metodă simplă de identificare a limitei inferioare a autoreglării vasculare cerebrale, punct la care fluxul sanguin cerebral şi oxigenarea cerebrală tisulară devin dependente de presiune. In urma studiilor s-a putut realiza un scor de risc cu ajutorul căruia putem anticipa: declin cognitiv, spitalizarea prelungită postoperator şi AVC perioperator.*

Oximetry is a common method for the analysis of O_2 saturation and fractional blood components. Noninvasive cerebral oximetry uses the infrared spectroscopy (NIRS) for O_2 saturation in a small region of the cerebral cortical vasculature.(6,7,13,17).

JOBIS described for the first time, more than 25 years ago, the infrared spectroscopy technology (NIRS, near infrared spectroscopy) for measuring O_2 level.

Cerebral oximetry differs from other types: it is nonivasive, is pulse indendent, includes arterial and venous values of the measurements in capillaries (75% and 25% arterial vein in adults and 70% and 30% venous artery in children), reflects peripheral oxygenation and perfusion of organs and measures the balance between the supply and the demand of O_2 in the brain.(13,4,2)

As for the measurement of systemic arterial blood O_2 saturation, pulse oximetry is used, cerebral oximetry measures the changes in haemoglobin absorption proportionally with cerebral oxygenation.(6,7,8,18). Oxihemoglobin fraction can be determined by tow infrared wavelengths. Selective measurement of brain tissue oximetry is possible due to infrared rays. Intracranial penetration depth of photons, the electrodes mounted on the skin is influenced by the distance to the nearest sensor. By using a pair of sensors with a source different from the infrared, the reflecting surface may be reduced for the deep vascular areas.(1,15)

Theoretically, the absolute concentration of oxy- and deoxyhemoglobin at the level of the brain can be determined by this method that uses the optical density of chromophore concentration.(9,16,22).

Cerebral oximetry / somatic INVOS has the following characteristics: continuous monitoring, immediate alarm, it is a simple technique, it improves the postoperative outcomes by continuous intraoperative monitoring, it is the only regional oximeter providing simultaneous cerebral and somatic oximetry, it is noninvasive, quick to install, it provides immediate feedback and may indicate oxygen saturation regional values (rSO_2) continuously at the brain level and other parts of the body simultaneously.(3,12,15,17)

Functioning principles:

INVOS system technology is based on infrared light spectroscopy. Infrared light passes through the skin, cranial bones and dura mater, reaching the gray matter of the cortex. Then, NIRS light is spread and a portion of light is reflected by red blood cells passing through capillary flow, measured at 30-40 mm LED. Most commonly, the measurement surface in cerebral oximetry is the cerebral cortex.

The monitored blood is the arterial and venous one, thus being able to reflect the balance between O_2 intake and consumption in real time and noninvasively, representing the amount of oxyhemoglobin of the tissue. Intraoperative desaturation was associated with impaired neurological disorientation of the frontal lobe. Intraoperative desaturation is predictive for: prolonged intubation, prolonged monitoring in the ATI, long term hospitalization and increased costs.(6,7)

It is considered that brain oxygen saturation values are those when the patient is in dorsal decubitus, at rest, but not anesthetized. The normal values range between 58 and 82 + / -0.2, with an average of 70 + / -0.6 and in cardiac patients, of 47-83 65, on average.

rSO_2 decrease with 20% from the baseline values or below 50 are a cause for concern. Following the studies, a risk score has been produced, with the help of which we can

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anticipate the cognitive decline, which was obtained by multiplying the units below 50 to the time spent below 50, measured in seconds. Any combination of values for rSO_2 and more than 300% seconds increases the risk of cognitive decline.

The main factors that may affect cerebral O_2 consumption are:

- factors influencing the intake of O_2: systolic blood pressure, CO_2 (increased CO_2 causes cerebral vasodilatation with increased blood flow to the brain), cardiac flow pump and cardiac index and heart, figurative elements of blood, neck position,

- factors influencing the consumption of O_2: depth of anaesthesia, anaesthetic agents, temperature.

The methods to improve brain oxygenation are the following: blood pressure increase, arterial oxygenation increase (red blood cell mass and increased partial pressure of O_2), reducing cerebrovascular resistance (increase of the partial arterial O_2 pressure), reducing the cerebral metabolic rate (prevention of hyperthermia and sedation)

O_2's core values are set per patient before surgery, which is the standard of the intraoperative monitoring, without the existence of an exact protocol of the universally accepted normal values.

The INVOS system may reflect the patient's response to any event during surgery, helping the anaesthesiologist to determine the optimal treatment

Older patients are more prone to cerebral desaturation than the younger patients, due to reduced physiological reserves that come with age.

The decision to intraluminally place a shunt was based on a unilateral decrease with 34% from the baseline values during the internal carotid clamping. The appropriate shunt function is indicated by rSO_2 values of 60 during carotid clamping.(11)

INVOS 4100 oximetre (for adults) and 5100 (for adults and children) is a continuous wave spectrometer that measures the regionally changes of the regional cerebral oxygenation (rSO_2).

Cerebral oximetry is a simple way to identify the lower limit of self-regulation, point in which the cerebral blood flow and tissue oxygenation are dependent on pressure.(8,14)

The independence of the mean arterial pressure and rSO_2 stabilizes cerebral self-regulation during the critical postoperative period of time for each patient. Brain self-regulation principle states that on an interval of the arterial pressure between 50-150mmHg, cerebral blood flow remains uninfluenced by the perfusion pressure.

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