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TARGETED CEREBRAL PERFUSION IN NEONATAL INTENSIVE CARE

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ТАРГЕТНА ПЕРФУЗІЯ МОЗКУ В ІНТЕНСИВНОЇ ТЕРАПІЇ НОВОНАРОДЖЕНИХ

Сурков Д.

Зниження сигналу NIRS відображає низьку доставку кисню до тканини мозку, але не може відповісти, чи пов'язано це з гіпоксією або ішемією. Допплерівська оцінка мозкового кровотоку в передній мозковій артерії на додаток до моніторингу NIRS має бути методом, який дозволить розпізнати власне ішемію та допомогти неонатологу вирішити, що робити для підтримки гемодинаміки та/або постачання кисню. Були оцінені зв'язки між NIRS, допплерівським мозковим кровотоком та параметрами гемодинаміки у шести доношених дітей з тяжким HIE. Враховуючи, що rSO_2 більше залежить від циркуляторної достатності, ніж FiO_2, доцільно використовувати таке визначення, як «киснева ціна сатурації». У цьому випадку використання допплерівської оцінки мозкового кровотоку дозволяє розрізняти змішану гіпоксію та ішемію головного мозку з метою вибору оптимальних шляхів інтенсивної терапії.

Ключові слова: перфузія головного мозку, новонароджені, інтенсивна терапія.

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NIRS signal decreasing reflects low oxygen delivery to the brain tissue but can't answer if it been related to hypoxia or ischemia. Doppler evaluation of cerebral blood flow in anterior cerebral artery in addition to NIRS monitoring should be the method which will distinguish proper ischemia and help neonatologist to decide what to do aiming hemodynamic support and/or oxygen supply. Relations between NIRS, Doppler cerebral blood flow and hemodynamic parameters in six term babies with severe HIE were evaluated. Considering rSO_2 more depends on circulatory sufficiency then FiO_2 it is expedient to use such a definition as "oxygen price of saturation". In that case using of Doppler estimation of cerebral blood flow pattern allows differing mixed hypoxia and cerebral ischemia aiming to choose proper ways of intensive care.

Key words: cerebral perfusion, newborns, intensive care.

Objective. Target goals of hemodynamic support in critically ill newborns still remain unclear. A circle of problems delineates both term and preterm babies including HIE, PPHN and septic shock in term newborns as well as pathology in preterm neonates related with left-to-right PDA shunting such as IVH, PVL, NEC, sepsis and BPD [5].

Accepted methods for estimation of hemodynamics include capillary refill time, BP measurement, urine output, SVC blood flow, cardiac index, saturation of mixed venous blood and Masimo perfusion index [2]. All of them have some imperfection. CRT and urine output are indirect and depend on not only hemodynamic reasons for example acidosis. Normal levels of BP are not finally determined according to different gestation ages. $ScvO_2$ and $SvmixO_2$ monitoring is too invasive in infants comparing to adults. Cardiac index is unpredictable in case of significant PDA shunting. SVC blood flow is acknowledged as gold standard for cardiac output estimation but requires sophisticated ultrasound operator, sometime is difficult to be evaluated and in fact it is not a kind of monitoring because of discreet not continuous measurement [1].

Recently NIRS attracts attention of many investigators as a basic for neonatal intensive care. It is fully non-invasive continuous monitoring of saturation of mixed blood in the brain. The principles of NIRS applying were published in SafeBoosC – a Phase II Trial [4]. Nevertheless, a one but very important question remains unresolved. NIRS signal decreasing reflects low oxygen delivery to the brain tissue but can't answer if it been related to hypoxia or ischemia [3]. So transfontanel Doppler evaluation of cerebral blood flow in anterior cerebral artery in addition to NIRS monitoring should be the method which will distinguish proper ischemia and help neonatologist to decide what to do aiming hemodynamic support and/or oxygen supply.

Methods. To evaluate relations between NIRS, Doppler cerebral blood flow and hemodynamic parameters we have proceeded parallel recording of all these measuring in six term babies with severe HIE and signs of brain edema and hypoperfusion. Obtained trends were analyzed.

Results. The records of trends for one of babies are exemplified. Respiratory support values were stable and SpO_2 was 99–100% using room air during all the period of observation.

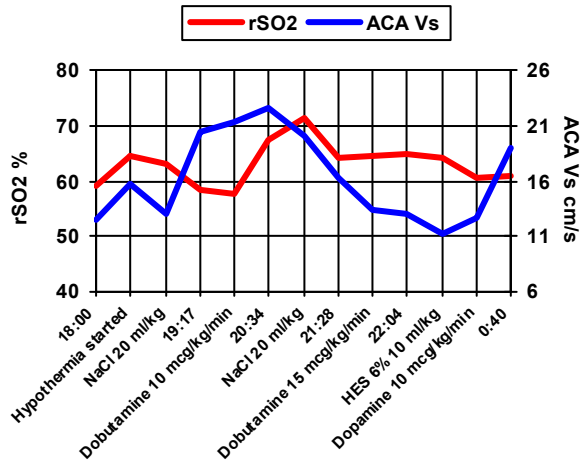

Fig. 1. Trends of brain regional oxygen saturation and systolic velocity of blood flow in anterior cerebral artery

rSO_2 – regional oxygen saturation; ACA Vs – systolic velocity of blood flow in anterior cerebral artery, cm/s

Figure shows non-linear correlation of regional oxygen saturation and systolic velocity of blood flow in anterior cerebral artery.

Figure shows lack of correlation of mean blood pressure and cerebral blood flow upon hypovolemia. After reaching of normovolemia by fluid resuscitation we can see that cerebral blood flow becomes interrelated with MBP and inotropic support.

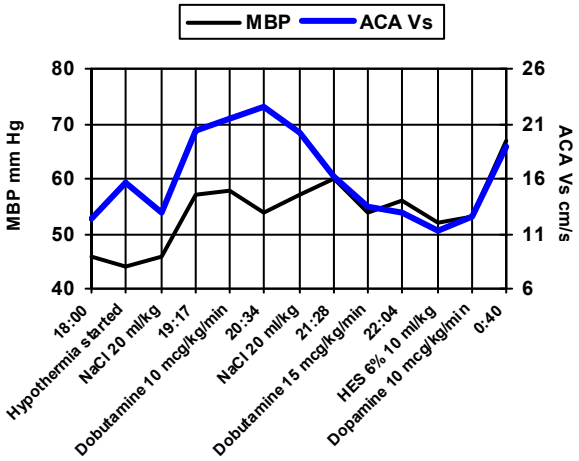

Fig. 2. Trends of mean arterial pressure and systolic velocity of blood flow in anterior cerebral artery.
MBP – mean blood pressure, mm Hg; ACA Vs – systolic velocity of blood flow in anterior cerebral artery, cm/s

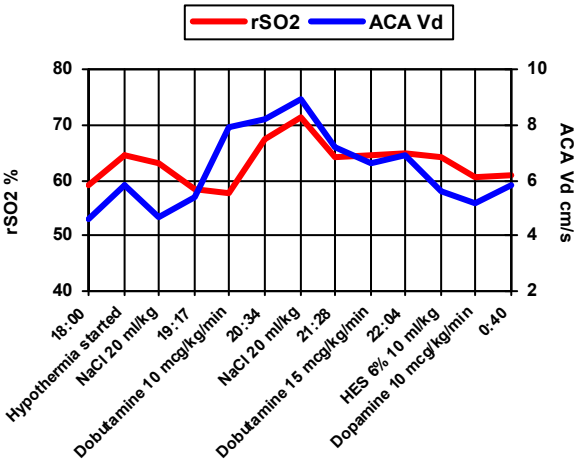

Fig. 3. Trends of brain regional oxygen saturation and diastolic velocity of blood flow in anterior cerebral artery
rSO_2 – regional oxygen saturation; ACA Vd – diastolic velocity of blood flow in anterior cerebral artery, cm/s

Figure shows lack of correlation of mean blood pressure and cerebral blood flow upon hypovolemia. After reaching of normovolemia by fluid resuscitation we can see that cerebral blood flow becomes interrelated with MBP and inotropic support.

Conclusions:

1. A combination of NIRS monitoring and Doppler evaluation of cerebral blood flow is highly sensitive and predicable for estimation of circulatory sufficiency and oxygen delivery in term newborns definitely with severe HIE and could be used as a targeted parameter for neonatal intensive care.
2. NIRS values are correlated with cerebral blood flow partially with diastolic velocity.
3. Cerebral blood flow correlates with mean blood pressure just after reaching of normovolemia not during hypovolemia reflecting preservation of cerebral autoregulation and mostly depends on inotropic support.
4. Considering rSO_2 more depends on circulatory sufficiency then FiO_2 it is expedient to use such a definition as "oxygen price of saturation". In that case using of Doppler estimation of cerebral blood flow pattern allows differing mixed hypoxia and cerebral ischemia aiming to choose proper ways of intensive care.

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