CAN CEREBRAL OXYGENATION REFLECT BLOOD LOSS? - A CASE SERIES IN TOTAL HIP REPLACEMENT SURGERY

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Background: Cerebral oximetry estimates the oxygenation of cerebral cortex by a non-invasive transcutaneous measurement using near-infrared spectroscopy (NIRS). Although it has been used to detect cerebral ischemia, its utility to monitor blood loss is yet to be confirmed.

Goal: to study if cerebral oxygenation (cerebral rSO₂) changes induced by the normoxic challenges (↓FiO₂ from 50% to 21% in ventilated patients) can reflect the amount of blood lost.

Materials and methods:
- ASA 1-2 patients undergoing general anesthesia for total hip replacement surgery were prospectively studied.
- Patients were monitored by ASA standards.
- Depth of anesthesia was monitored by BIS and cerebral oxygenation (rSO₂) by INVOS.
- Every 30 minutes a normoxic challenge was performed (decrease of FiO₂ from 50% to 21%) and an arterial blood sample was obtained to measure Hgb and blood gases. Heart rate (HR), mean arterial pressure (MAP), SpO₂, EtCO₂, BIS, rSO₂ (cerebral and thenar eminence) and estimated blood loss were also recorded every 30 minutes.
- Statistic analysis used Friedman test, Spearman correlation and linear regression (SPSS Statistic 23).

Results and discussion:
10 patients were studied but only 9 had at least three normoxic challenges (total of 29). Median values of HR, MAP, Bis, EtCO₂, SpO₂, rSO₂ (cerebral and thenar) are presented in Table 1. There were no correlations between HR, MAP, EtCO₂ and BIS and the challenges neither with Hgb and blood gases.

We found a correlation between consecutive challenges and the fall of cerebral rSO₂ (p=0.01) and a trend towards an increase of that fall over time (Graph 1). SpO₂ showed no correlations with other variables. Estimated blood loss increased with the length of the surgery (p<0.001) (Graph2) and there was a correlation with cerebral the rSO₂ variation (p=0.002) (Graph 3). Cerebral rSO₂ with 50% FiO₂ did not change during surgery. Hemoglobin value did not correlate with any parameter.

Conclusions: Performing normoxic challenges provided additional clinically useful information as it showed the cerebral perfusion state without the contaminant factor of the high FiO₂. We found a correlation between the amount of blood loss and the decrease of cerebral rSO₂, although there was no decrease in hemoglobin measurements. This lack of correlation with Hgb can be explained by the fact that hipoxia is caused by a mismatch between oxygen delivery and demand in tissues, not always translated into immediate hemoglobin values. So, we hypothesize that it was caused by blood loss.

References: ¹Ferari M, Principles, techniques and limitations of near-infrared spectroscopy, Can J Appl Physiol. 2004; 29, ²Murkin JM, Near-infrared spectroscopy as an index of brain and tissue oxygenation, BJA, 2009;103, ³Torella F, Cerebral and peripheral oxygen saturation during red cell transfusion, J Surgical Research, 2003;110