Intraoperative cerebral autorregulation: Non-Invasive Monitoring and retrospective calculation of optimal arterial blood pressure in neurosurgical patients.

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Background and objective

- Different indices permit the evaluation of the integrity of cerebral autorregulation including Pressure Reactivity index (PRx), mean velocity index (Mx).
- These indices correlate surrogate markers of CBF with the mean arterial blood pressure (mABP) and/or Cerebral perfusion pressure
- The invasiveness and technical challenges of these techniques limit their use in the operating room.
- Cerebral autoregulation (CA) may be assessed with the cerebral oximetry index (COx) by correlating regional saturation of oxygen, rSO₂ with either cerebral perfusion pressure (CPP) or arterial blood pressure (ABP) ¹.
- An automated curve fitting method with specific software (ICM+®) calculates the “optimal ABP” (ABP_{OPT}), defined as the ABP level where COx reaches its lowest value in an individual patient².
- Besides the technical challenges, we hypothesized that on-line monitoring of the COx index in patients undergoing long neurosurgical procedures allows a retrospective definition of their intraoperative ABP_{OPT}.

Measurements and Main Results

- Retrospective analysis of prospectively collected data in the neurosurgical theatre at Hospital Clinic de Barcelona.
- 66 patients with continuous (> 2 hours) intraoperative monitoring of invasive ABP and rSO₂ with ICM+® software were included.
- COx was calculated online as the correlation between 10-second averaged values of rSO₂ and mABP over a 300 s period (30 values).
- CA was considered intact for COx < 0.3 and impaired for COx ≥ 0.3.
- The average ABP_{OPT} in the studied population was 85.5 ± 21.03 mmHg and the average ABP_R was 76.6 ± 9 mmHg.
- We were able to obtain ABP opt in 49 (74%) of the 66 patients analyzed.
- In these patients we studied the relationship between the baseline ABP value at admission (ABP_{BV}), ABP_{OPT} and the averaged “real” intraoperative ABP (ABP_R).
- Ten patients (20.41%) kept their average ABP_R below 20% of their ABP_{BV}.
- 30 patients (61.22%) had averaged ABP_R lower than the ABP_{OPT}.
- The ABP_{BV} was lower than ABP_{OPT} in 18 patients with a mean difference of 16.3 mmHg.

Conclusions

- On-line CA monitoring with non-invasive COx index is feasible and allows a retrospective calculation of the ABP_{OPT} values in most of the patients of the study.
- The fact that ABP_R was lower than calculated ABP_{OPT} in a significant number of patients, and the differences found between ABP_{BV} and ABP_{OPT}, deserves further analysis to evaluate the impact of these findings in our practice.

References

- 1.- Zweifel, C et al. Continuous assessment of cerebral autoregulation with near-infrared spectroscopy in adults after subarachnoid hemorrhage. Stroke, 2010; 41:1963-8
- 2.- Aries, MJH et al. Continuous determination of optimal cerebral perfusion pressure in traumatic brain injury. Critical Care Medicine, 2012; 40:2456-63

Figure 1. Curve Assessing optimal ABP Using ICM+® software

Figure 2. Example using ICM+ for Intraoperative CA monitoring in a patient undergoing an acoustic neuroma resection. Lower pannel showing COx < 0.3 (green bars) and COx > 0.3 (red bars) COx.

Figure 3. Box and whisker plot relating ABPs