Continuous cerebral autoregulation measurement and outcomes in aneurysmal subarachnoid hemorrhage

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Background:
Impaired cerebral autoregulation has been associated with worse outcomes in patients with aneurysmal subarachnoid hemorrhage (aSAH). Recent data demonstrated that oxygen reactivity measured by either parenchymal probes or near infrared spectroscopy (NIRS) may be associated with worse clinical outcomes and occurrence of spreading depolarization events.

Methods:
We prospectively collected continuous multimodality monitoring recordings in patients with aneurysmal treated at our institution between 2011 and 2021. Physiologic data were linked using the Moberg Component Neuromonitoring system (CNS) and clinical data were obtained by chart review. Continuous autoregulation indices were calculated using the CNS Envision software retrospectively for all available data sources (intracranial pressure either from ventriculostomy tranducer or parenchymal monitor of Hummingbird bolt, PbtO2 from Licox, cerebral blood flow from Bowman probe, or cerebral oximetry from NIRS). These led respectively to the following autoregulation indices available for analysis: PRx (ventriculostomy), PRx (Hummingbird), CBFRx, ORx, and OSRx (right, left, and mean). Outcome was assessed by discharge modified Rankin Score as good (0-2) or poor (3-6). Descriptive statistics and logistic regression were used to estimate the association of various impaired autoregulation indices and functional clinical outcomes, controlling for admission variables.

Results:
We identified 332 subjects with at least one multimodality of physiologic monitoring. Age, Admission GCS, Admission WFNS, and impaired ORx and OSRx were strongly associated with worse clinical outcomes ($p<0.0001$). On multivariable analysis, age (OR=1.043, 95%CI 1.020-1.067) and OSRx (OR=112.516, 95%CI= 4.188- >999) were the only variables that remained significant in the model.

Conclusion:
Cerebral autoregulation as calculated from continuous measurement of brain oxygenation parameters appears to have the strongest association with clinical outcomes. These may offer targeted approaches to individualize blood pressure management to avoid secondary injury in aSAH patients and such strategies should be incorporated into clinical trials.