

Title: Temporal changes in dynamic cerebral autoregulation of critically ill patients

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Structured Abstract:

Introduction: Cerebral autoregulation (CA) protects the brain from ischemic or hyperemic injuries via modulation of cerebral blood flow (CBF). CA may be impaired in critically ill patients, possibly contributing to high incidence of delirium and long-term cognitive impairment in this population. Prior studies showed both normal and impaired CA in critically ill patients, but both static and dynamic measures are often done over limited observation periods, potentially missing changes in CA status over the course of a typical ICU day. In this study, we monitored dynamic CA over 8 continuous hours in cohort of critically ill patients using Mx, the moving correlation coefficient between CBF and mean arterial pressure (MAP). The objective of this study was to assess the status of dynamic CA over 8 hours of continuous observation in a cohort of critically ill patients admitted with sepsis or cardiac arrest.

Methods: We recorded middle cerebral artery blood flow velocity (MCAv) using transcranial Doppler and MAP over 8 hours in a cohort of mechanically ventilated patients. We then examined the data offline and removed sections with poor MCAv or MAP signal, as well as any artefacts (e.g. movement resulting in loss of Doppler signal), and calculated Mx as the moving correlation coefficient between remaining MCAv and MAP data using 300 second intervals. We plotted Mx data vs. time for each patient to determine the status of CA. Mx value > 0.3 was used as a cut-off to determine impaired autoregulation.

Results: We completed measurements in 12 patients (8 septic, 9 male). Mx vs. time profile varied considerably within and between patients. All patients displayed multiple transient spontaneous excursion of Mx above 0.3, suggesting temporary loss of CA capacity. The frequency and duration of these excursions varied between patients. Excursions lasting more than 20 minutes were observed in only 6 patients, potentially rendering them vulnerable to ischemic or hyperemic injuries.

Discussion: In our cohort, all patients experienced multiple episodes of impaired CA of varying frequency and duration, with half of them losing CA for an extended and potentially dangerous time period. Further research is needed to determine whether frequency and/or duration of observed excursions correlate with delirium or long-term cognitive impairment.