Multimodality monitoring and cerebral autoregulation: Dynamic Relationships Between Intracranial Pressure, Cerebral Blood Flow and Brain Tissue Oxygenation

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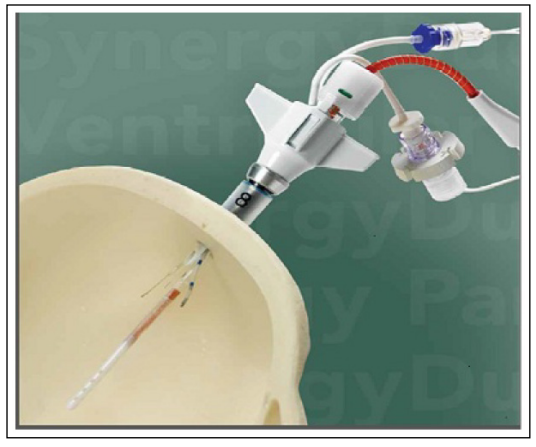
Introduction

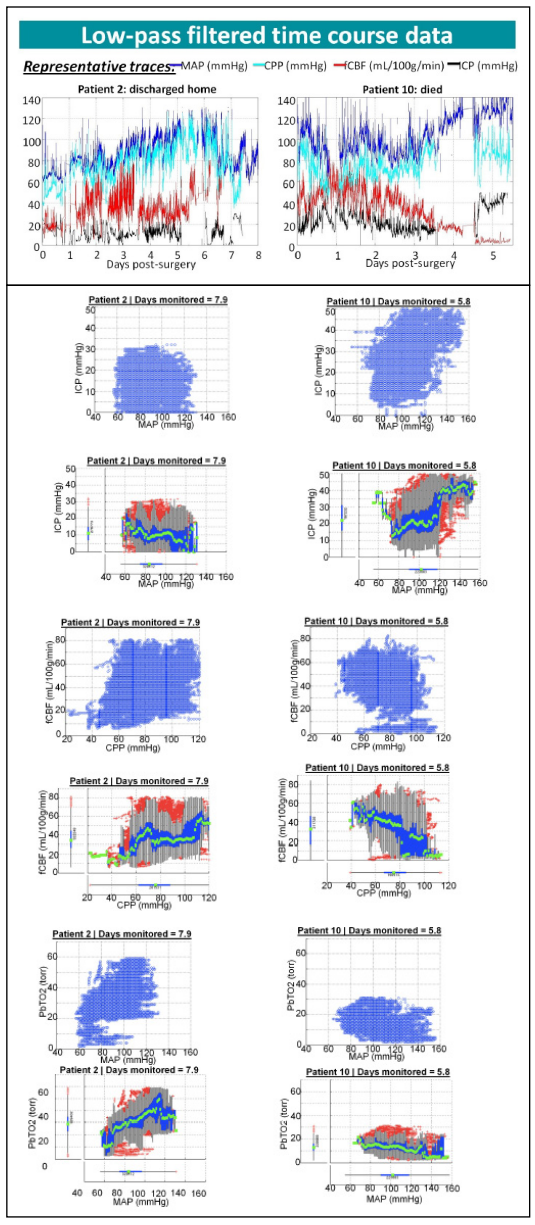
Characterizing cerebral autoregulation has been an ongoing challenge in management of patients with aneurysmal subarachnoid hemorrhage(SAH). New technologies available for continuous monitoring hold promise to correlate this information with outcome and provide an algorithm for clinical management.

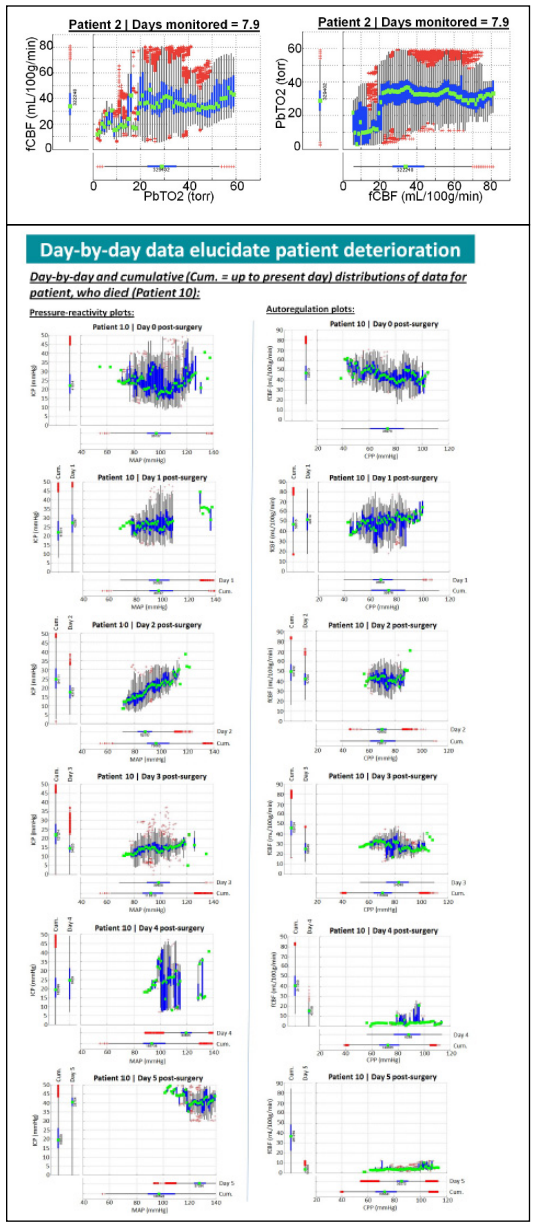
Methods

13 SAH patients were included in this study with intracerebral monitoring via the Hummingbird SynergyDuo (Innerspace) bolt system with continuous capture of data via the CNS system(Component Neuromonitoring System, CNS Technologies LLC) for at least 5 days. Intracranial data include ventricular intracranial pressure (ICP), parenchymal ICP, focal brain tissue oxygen(tO2) (Licox, Integra) and thermodilution cerebral blood flow(CBF) (Bowman Perfusion, Hemedex). O2 and perfusion probes have a fixed spatial relationship between them, with placement into the deep frontal white matter adjacent to the ventriculostomy.



Non-parametric statistics incorporate frequency distribution of data.





Results

Use of the Hummingbird system has provided a consistent data acquisition which is automatically captured via the CNS system. Dynamic analysis of individual data streams indicates that despite a spatially fixed relationship between CBF and tO2 there is not necessarily a correlation between the two except in clinical extremis. However, ICP responsiveness to changes in blood pressure mirrored a similar responsiveness by CBF to changes in blood pressure which we did not observe in changes in tO2.

Conclusions

The fixed positions between monitors for ICP, CBF and tO2 provides reliable access to physiological information that warrants further examination. Focal cerebral blood flow probe demonstrates previously understood global cerebral autoregulation phenomenon via non-parametric statistics to capture the frequency distribution of data.

Learning Objectives

By the conclusion of this session, participants should be able to: 1) Describe and understand available monitoring technologies 2) Discuss issues that are challenging in management of aneurysmal subarachnoid hemorrhage and how monitoring may be useful 3. Identify how to incorporate treatment strategies into their own clinical practice