Hands-on Course 1

Monitoring and multimodal neuromonitoring - Level 1

Oxygen Monitoring

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Essential Knowledge

Maintenance of adequate oxygenation is paramount in neurocritical care. Hypoxia is defined as the reduction of tissue oxygenation to levels insufficient to maintain cellular function and metabolism. Hypoxia may result from ischemia - either macro-vascular (reduced/absent cerebral blood flow [CBF] - e.g. vascular thrombosis, vasospasm, reduced carbon dioxide [PaCO2]) or micro-vascular (perivascular edema, blood-brain barrier disruption, endothelial dysfunction) - anemia and hypoxemia. Cytopathic hypoxia is primarily from failure of the cell to extract oxygen (e.g. oxygen diffusion barriers and/or mitochondrial dysfunction). High-quality data on the safety, accuracy, and the potential clinical utility of invasive and non-invasive tools to monitor brain and systemic oxygenation in neurocritical care are scarce. This workshop aims to provide an up-to-date account on basic bedside brain and systemic oxygen monitoring in neurocritical care as far as current literature, guideline and consensus allow for. Several methods of oxygen monitoring will be presented in pragmatic, interactive fashion, and an exemplary method of non-invasive cerebral oximetry demonstrated hands-on.
Summary of current evidence and recommendations: All tools for oxygen monitoring are sufficiently safe. Parenchymal brain oxygen (PbtO2) monitoring is accurate to detect brain hypoxia, and is recommended to titrate individual targets of cerebral perfusion pressure (CPP), ventilator parameters (PaCO2, PaO2), transfusion, and to manage intracranial hypertension, in combination with ICP monitoring. Jugular oxygen saturation (SjvO2) is less accurate than PbtO2. Near-infrared-spectroscopy (NIRS) cannot yet be routinely recommended for oxygen monitoring in neurocritical care alone, but holds considerable potential as part of multimodality neuromonitoring. Systemic monitoring of oxygen (PaO2, SaO2, SpO2) and CO2 (PaCO2, end-tidal CO2) is recommended in patients who require neurocritical care.

**Key Learning-objectives**

1. What are the indications for brain and systemic oxygenation in neurocritical care?

2. What are the principal methods of safe, reliable and accurate brain oxygen monitoring?

3. What is the utility of brain oxygen monitoring to direct medical and surgical therapy and possibly to improve neurological outcome?
References for further reading


Disclosure
The author has served on the NCS 2013/2014 guideline committee for a consensus statement on multimodality monitoring. Otherwise, the author has no conflict of interest in relation to this manuscript.