Multimodal Neuromonitoring Indications

- Traumatic brain injury management in the intensive care unit: standard of care and knowledge gaps
- Evaluating the predictive value of multimodal intraoperative neuromonitoring in anterior cervical discectomy and fusion: a retrospective cohort study on 442 patients
- Next-Generation Neuromonitoring in Minimally Invasive Spine Surgery: Indications, Techniques, and Clinical Outcomes
- Intracranial multimodal monitoring in neurocritical care (Neurocore-iMMM): an open, decentralized consensus
- Neurosurgical Spreading Depolarization Monitoring: Why, How, and What to Do About It
- Neuromonitoring in neonatal intensive care units-an important need towards individualized neuroprotective care
- Accuracy of Intraoperative Neuromonitoring in the Diagnosis of Intraoperative Neurological Decline in the Setting of Spinal Surgery-A Systematic Review and Meta-Analysis
- From Pansinusitis to Cerebritis Due to Eikenella corrodens

 Indications for Multimodal Neuromonitoring 1. Complex Spine Surgery Procedures:

Intramedullary spinal cord tumor resection

Spinal deformity correction (scoliosis, kyphosis)

Thoracic or cervical corpectomy

Tethered cord release

Modalities used:

SSEPs (sensory pathway)

MEPs (motor pathway)

Free-running and triggered EMG (nerve roots)

Rationale: Detect both motor and sensory pathway compromise; reduce risk of postoperative paresis or sensory deficits.

2. Intra-axial Brain Tumor Resection Location: Near motor cortex, corticospinal tract, or language areas.

Modalities used:

Direct cortical stimulation (motor/language mapping)

MEPs (continuous motor monitoring)

Subcortical stimulation (mapping white matter tracts)

Rationale: Maximize extent of resection while preserving function (e.g., prevent hemiparesis or aphasia).

3. Brainstem or Posterior Fossa Surgery Procedures:

Resection of vestibular schwannomas

Cavernomas in the brainstem

Fourth ventricle tumors

Modalities used:

BAEPs (auditory pathway)

EMG (facial, lower cranial nerves)

MEPs (long motor tracts)

SSEPs

Rationale: Protect cranial nerves and brainstem functions (speech, swallowing, hearing, motor control).

4. Epilepsy Surgery / Functional Neurosurgery Procedures:

Lesionectomy

Temporal lobectomy

Deep brain stimulation (DBS)

Modalities used:

EEG / electrocorticography (ECoG)

Cortical mapping

Rationale: Identify epileptogenic focus and avoid functional cortex.

5. Carotid Endarterectomy / Vascular Neurosurgery Modalities used:

EEG (cortical ischemia detection)

SSEPs

Transcranial Doppler or cerebral oximetry (optional)

Rationale: Monitor for hypoperfusion during carotid clamping or aneurysm clipping.

6. Aortic or Cardiac Surgery with Circulatory Arrest Modalities used:

EEG

NIRS (near-infrared spectroscopy)

SSEPs

Rationale: Detect cerebral ischemia during low-flow or no-flow states.

7. Pediatric Neurosurgery Especially in spinal dysraphism, tumor resection, or complex craniovertebral junction procedures.

MMN helps due to the developing nervous system’s vulnerability.

 General Benefits of MMN: Increases sensitivity and specificity (one modality can compensate for another)

Cross-validation of findings

Real-time feedback for safer surgery

Better outcomes in high-risk procedures

Collaboration among institutions is necessary to establish practice guidelines for the choice and placement of multimodal monitors. Further advancement in device technology is needed to improve insertion techniques, inter-device compatibility, and device durability. Multimodality data needs to be analyzed to determine the preferable device location [1)].

Obviously, brain tissue oxygen tension monitoring requires insertion of a probe into the brain parenchyma through a single multiple lumen bolt, or in a subcutaneously tunneled fashion. As those patients often require early magnetic resonance imaging(MRI), typically used bolts are disadvantageous due to massive metal artifact. Similarly, subcutaneous tunneling is often problematic as suture fixation can loosen over time. We hereby report a new method of fixation of the LICOX brain tissue oxygenation probe with one or two three-way taps that are attached to standard plastic cannula, resulting in a stable connection with no need for further direct sutures around the probe and above all with no metal artifacts in MRI. The extended fixation system was first tested in a porcine model of brain injury in CPR and thereafter adopted in our daily clinical practice [2)].

Used for the management of secondary brain injury (SBI).

Integration of monitored data using new informatics tools may help optimize therapy of brain-injured patients and quality of care [3)].

Multimodal neuromonitoring for traumatic brain injury management

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1)
Stuart RM, Schmidt M, Kurtz P, Waziri A, Helbok R, Mayer SA, Lee K, Badjatia N, Hirsch LJ, Connolly ES, Claassen J. Intracranial multimodal monitoring for acute brain injury: a single institution review of current practices. Neurocrit Care. 2010 Apr;12(2):188-98. doi: 10.1007/s12028-010-9330-9. PubMed PMID: 20107926.
2)
Pinggera D, Petr O, Putzer G, Thomé C. How I do it/Technical note: Adjustable and Rigid Fixation of Brain Tissue Oxygenation Probe (LICOX) in Neurosurgery - from bench to bedside. World Neurosurg. 2018 May 30. pii: S1878-8750(18)31108-2. doi: 10.1016/j.wneu.2018.05.154. [Epub ahead of print] PubMed PMID: 29859358.
3)
Oddo M, Villa F, Citerio G. Brain multimodality monitoring: an update. Curr Opin Crit Care. 2012 Apr;18(2):111-8. doi: 10.1097/MCC.0b013e32835132a5. Review. PubMed PMID: 22322259.