Pitfalls of INM for brain tumor surgery

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Background

Despite advances in instrumentation and the use of microsurgical and stereotactic techniques, postoperative motor deficits can still result after brain tumor resection. Neurological complication rates after brain tumor surgery vary from 23 to 44%. Motor complications are more frequent with surgery to treat tumors located near the primary motor cortex or the motor pathway. Intraoperative evoked potential monitoring is valuable for minimizing neural injury during many neurosurgical procedures. Somatosensory evoked potential monitoring has been widely used for brain and spinal surgery. However, somatosensory evoked potential monitoring cannot provide direct information regarding the integrity of the motor pathway. In addition, time is required for averaging of somatosensory evoked potential data, and injury can occur during this data reconstruction period. Recently, electrical and magnetic motor evoked potential (MEP) monitoring has been demonstrated to improve the detection of intraoperative spinal cord injuries during spinal surgery and thoracoabdominal aneurysmectomy. In nonsurgical settings, MEP recordings (87-89%) were well correlated with clinical examination results for patients with brain tumors, acute trauma, stroke, or other neurological diseases. However, intraoperative MEP monitoring during brain surgery has not been well studied, and it is not yet clear whether MEP monitoring is safe and feasible for brain surgery.

A potential risk of MEP monitoring for brain surgery is stimulation below lesions or subcortical regions, which may produce muscle responses and false-normal MEPs. Whenever supratentorial surgeries are performed, MEPs should ideally be elicited by direct cortical stimulation rather than via transcranial stimulation. The size of the craniotomy typically poses significant limitations on stimulation electrode placement. Suboptimally placed (often laterally or posteriorly placed) stimulation electrodes will activate the corticospinal tracts more caudally. Thus the monitored pathways will not include the motor cortex and the immediate subcortical area - or in other words, the surgical field. Careful direct cortical stimulation will yield much better results. However, direct cortical stimulation may not be straightforward and requires collaboration between the surgeon, the anesthetists and the INM team. Responses have to be obtained at several stimulation intensities until a threshold is found. This threshold may vary depending on the anesthetic conditions, which have to be taken into account. Direct cortical stimulation is typically reserved for the initial intraoperative mapping of the motor cortex, but not necessarily for continuous monitoring during the remainder of the surgery.

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