STUDENTS CORNER

The Science Behind TCeMEPs: Transcranial Electrical Motor Evoked Potentials. Part 1

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INTRODUCTION

In the Intraoperative Neurophysiological Monitoring (IONM) world, few tools are as crucial to providing real-time motor function assessment as Transcranial Motor Evoked Potentials (TCeMEPs). They provide neurophysiological assessment of the motor fibers to assist clinicians in monitoring the integrity of the descending motor pathways, namely the corticospinal tract responsible for voluntary motor sequences. TCeMEPs are used throughout various procedures, such as during complex spine surgeries, brain tumor resections, brainstem surgeries, and any procedure involving the potential for motor function integrity loss.

The benefit of monitoring TCeMEPs is that they provide real-time feedback. During surgeries involving the spine (scoliosis corrections, spinal tumor resections, spine fractures) or intracranial surgeries located near the motor cortex, there is always concern regarding injuries to the descending motor pathway (via the corticospinal tract). The TCeMEPs will sound alarm bells and warn the surgical team of any compromise to these signals, typically before neurological destruction moments occur.

While somatosensory evoked potentials (SSEPs) monitor sensory tracts (the dorsal columns of the spinal cord), transcranial electrical motor evoked potentials (TCeMEPs) emphasize the anterior aspect of the spinal cord, the location of the motor pathways. Understanding, the TCeMEP provides complementary information about the patient's overall neurofunction. The SSEPs could remain stable, while the TCeMEPs show, for example, immediate deterioration should the motor system suffer, compromising surgical positioning.

Various factors can lead to inconsistent quality in TCeMEP signals during surgery. One of the most significant factors is the depth of anesthesia. It is important to note that inhalational anesthetics can suppress motor responses, which is why total intravenous anesthesia (TIVA) is often preferred. Additionally, since TCeMEPs depend on recording actual muscle contractions, using muscle relaxants must be carefully managed. Excessive neuromuscular blockades can eliminate the signal.

Blood pressure and cerebrospinal fluid perfusion are also critical factors; any reduction in perfusion can result in a sudden loss or degradation of TCeMEP quality. Patients' positioning can also affect the SSEP and TCeMEP signals during compression of the blood vessels or nerves. Given these

variables, anesthesiologists, neuromonitoring technologists, and surgeons must maintain ongoing communication to create an optimal environment for accurate TCeMEP interpretations.

TCeMEP provides the surgical team with a crucial real-time view of the integrity of motor pathways, enabling immediate surgical interventions that significantly enhance outcomes. This versatile tool has been effectively utilized across various surgical procedures, from detecting spinal cord ischemia in other areas to facilitating avoidance of the motor cortex. TCeMEPs have proven to be an indispensable element in modern operating theatres, particularly in neurosurgery and orthopedics, firmly establishing their importance in advancing patient care.

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