Intraoperative Monitoring

Recent Advances in Motor Evoked Potentials

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KEYWORDS

• Intraoperative electrophysiological monitoring • Somatosensory evoked potentials
• Motor evoked potentials • Electroencephalography • Electromyography

KEY POINTS

- Advances in transcranial and direct cortical stimulation have allowed a wider application of motor evoked potentials for mapping and monitoring during procedures on the central nervous system.
- The D-wave amplitude has minimal variability allowing it to be used as a measure of neural injury with mapping and monitoring cortical tumor resection near the motor cortex, and monitoring of surgery on intramedullary spinal cord tumors.
- Stimulation techniques have been developed to measure the proximity of the cortical spinal tract in subcortical and brainstem surgery.
- Conditioning stimuli have been developed to enhance the tcMEP when it is difficult to record.

INTRODUCTION

Advances in electrophysiological monitoring have improved the ability of surgeons to make procedural decisions and reduce complications during surgery and interventional procedures when the central nervous system (CNS) is at risk. Monitoring continues to be done using a multimodality approach using several techniques; each modality provides key aspects for identifying or mapping the location and pathway of critical neural structures or to monitor the progress of procedures so as to reduce the risk of CNS injury. Advances in our understanding of the

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electrophysiology of the neural tracts involved have allowed advances in the use of these techniques so that they can evolve to match the needs of complex procedures. Perhaps the most rapidly advancing technique of electrophysiological monitoring is using motor evoked potentials (MEPs).

MOTOR EVOKED POTENTIAL TECHNIQUES

MEPs are produced by stimulation of the motor cortex with recording of responses from the cortical spinal tract (CST) and from the muscles activated by the motor stimulation (Fig. 1). The motor cortex can be stimulated by several means. The most

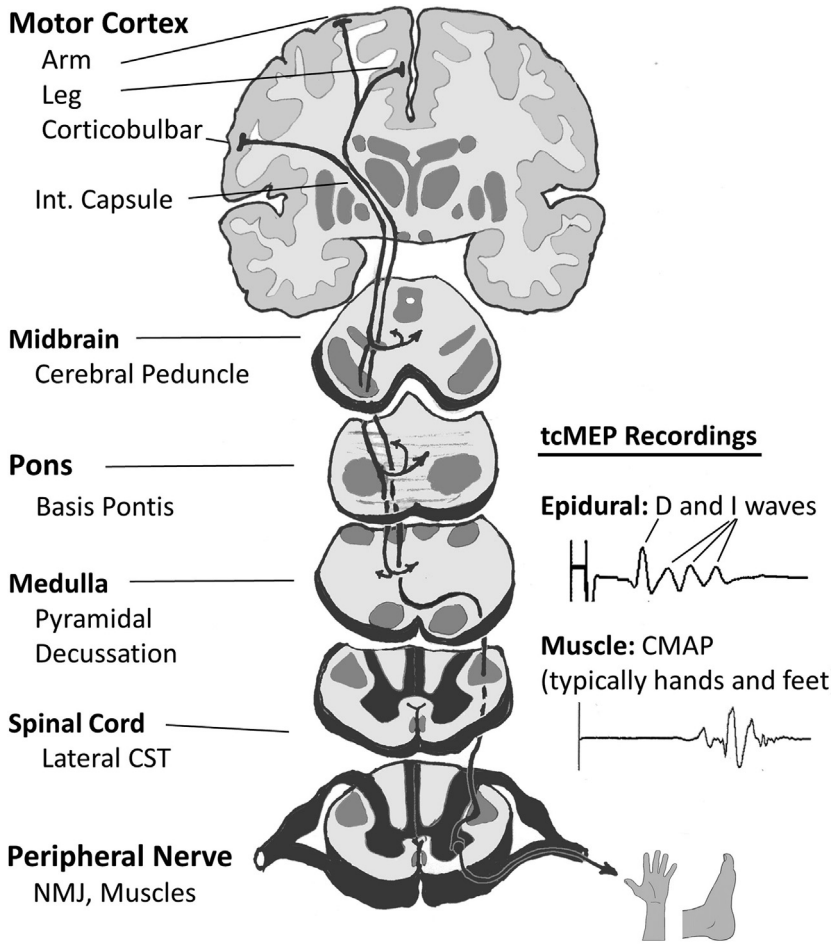

Fig. 1. Stimulation of the motor cortex initiates a traveling wave that descends via cortico-spinal pathway through the brainstem and through the lateral cortico-spinal pathway to the anterior horn cells in the spinal cord, which results in a muscle contraction through lower motor neurons. The response can be recorded in the epidural space as a D wave and I waves and as a CMAP in the periphery. Stimulation of the corticobulbar motor cortex initiates a traveling wave through the corticobulbar pathway to the brainstem and can be recorded as CMAP in muscles innervated by motor cranial nerves. Int, internal, NMJ, neuromuscular junction.