

Evoked Potential Monitoring during Spine Surgery

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Editorial

Intraoperative electrophysiological monitoring is used in a variety of procedures. Various techniques are thought to be useful for the detection and prevention of neurological deficits [1,2]. Mechanisms of thoraco-lumbar spinal cord injury during scoliosis surgery include ischemia and over-distraction of vertebral column. This injury can be potentially detected by standard tibial somatosensory evoked potentials (SSEPs) thus reducing the risk of permanent paraplegia [3-5]. However, SSEPs only detect sensory tracts dysfunction and motor deficits can occur without any SSEP changes [6,7]. Motor evoked potentials (MEP), obtained by transcranial cortical stimulation, can provide an early detection of motor disturbance [8-10]. The combined methods can improve the sensitivity and specificity of the monitoring [11].

SSEPs (Somatosensory Evoked Potentials)

Somatosensory evoked potentials (SSEPs) monitoring serves as an early warning system to detect injury intraoperatively. SSEP monitoring is performed to assess the functional status of peripheral nerves and sensory tracts in the spinal cord. SSEP is elicited by stimulating either a sensory or mixed peripheral nerve. The neuronal response to the electrical stimulation can be recorded from various locations along the neural pathway.

SSEPs can be significantly affected by the halogenated anesthetics. Inhalation anesthetics such as sevoflurane, desflurane, and isoflurane are most often used. All anesthetics affect cortical responses [12,13].

Intraoperative monitoring equipment consists of three systems: stimulus, recording, and data storage. The last component of the monitoring system is the signal averager. Signals that are time-locked to the presentation of the stimulus are converted to a digital signal. The computer captures a set of samples and computes the mean of each data point which is displayed on the monitor as a waveform.

Neurogenic Motor Evoked Potentials (NMEPs)

Stimulation is applied to the spinal cord and the descending sensory volley is recorded from the nerves in the extremities [14,15].

Transcranial Cortical Motor Evoked Potentials (TcMEP)

Typically, a large current is required for adequate motor cortex stimulation. The resultant response can be recorded from spinal cord or target muscles. MEPs are extremely sensitive to inhalation anesthetics. Intravenous propofol/narcotic based anesthesia with or without nitrous oxide can provide favorable anesthesia to perform TcMEPs [16]. Currently, all patients with a history of epilepsy, skull fracture, craniotomy, cardiac pacemaker, or cochlear implant are excluded from the TcMEP use. Intraoperatively, since cortical stimulation, in non-paralyzed patient, can cause severe jaw musculature contraction, adequate measures should be taken to prevent tongue and teeth damage.

Spinal Nerve Root Monitoring

Pedicle screw instrumentation systems for spinal arthrodesis are in widespread use. Malpositioned screws can induce loss of fixation,

neuronal injury, and pain syndromes. Intraoperative evoked EMG monitoring of pedicle screws has proven to be a simple, safe, and efficacious technique in accurate placement of pedicle screws [17]. A positive EMG response at or below the constant-current of ≤ 8 mA requires either inspection, redirection, or removal of the instrument or implant. Normal free-run EMG response is predictive of the lack of nerve root injury or irritation. An abnormal EMG response during a spine procedure may or may not be associated with a clinical injury.

Dermatome Sensory Evoked Potential Monitoring

Dermatome somatosensory evoked potentials (DSEP) are a more specific mean for nerve root monitoring than SSEP monitoring [18,19]. DSEP has been used to assess adequacy of root decompression. Data does not support the use of DSEP for improvement of outcome following lumbar decompression and fusion.

Neuromonitoring During Decompression

There is no medical evidence to support the hypothesis that intraoperative monitoring improves long term outcome following decompression procedures for degenerative diseases. Changes in SSEP/DSEP monitoring appear to be sensitive to nerve root injury during surgery. There is no tangible evidence to indicate that the use of monitoring provides useful information in assessing the adequacy of nerve root decompression.

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