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Editorial

Conducting Neurospinal Surgery Using Neurophysiological Monitoring (IONPM), as Safe Guard against Possible Neuronal Damage and Prevent Morbidity and Mortality

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Intraoperative neurophysiological monitoring (IOM) in Neuro spinal surgery may reduces the incidence of postoperative neurological complications, at all neurological level. Many techniques are available and motor and somatosensory evoked potentials are thought to be essential for better results of IONPM. Spinal cord evoked potentials (SEP) are observed and recorded over cord. Electrical stimulation is given on the dorsal of spinal cord by an epidural electrode. Somatosensory evoked potentials (SSEP) provide the functional continuity of sensory pathways. That's so from the terminal nerve through the dorsal column going up till the sensory cortex.

Motor evoked potentials (MEPs) consist of spinal, neural and muscular MEPs. MEPs perform selective and specific examination of the working intactness of descending motor pathways, starting from the motor cortex to the terminal muscles. Neurological surgeons must understand the monitoring techniques and read monitoring records properly to understand use IONPM for the proper decision making during the neurosurgery for safe spinal neurosurgery and better surgical Results.

"Somatosensory evoked potentials (SSEP):

SEPs were first utilized in the 1970s to assess and monitor the spinal cord function during spinal surgery for scoliosis treatment. After stimulating terminal nerves, SEPs are measured both from the spinal cord, epidural electrode and/or simultaneously from the sensory cortex of the brain [1]. Normally, the posterior tibial nerve is used for taking SSEP traces.

Used data are stimulation, 0.2ms duration; at, -3 Hz frequency; with intensity -25mA. This is given for one minute and averaging gives SSEP result [2]. Latency and amplitude are measured and determined. Latency measures the time and measures distance. Amplitude measures the power and is more variable vis a vis latency. Monitoring of dorsal column intactness by SSEP is the commonest form in neuro spinal surgery.

Subdermal needle electrodes, used are made of Platinum. It is used for stimulation and recording. Normally, following is considered

(a) 50% decrease in amplitude (b) along with 10% increase in latency in comparison to baseline values of the patients, makes a warning signal. False negative SSEP monitoring happening during spinal surgery in 0.063% [3]. Multicenter, very vast, research has concluded the result in reduction of postoperative paraplegia by more than 50%-60% with modality [4]. SSEP signals are good indicators of spinal cord function. But much better information about function of nerve root are provided by use of MOTOR EVOKED POTENTIALS.

Direct waves MEP (or spinal motor evoked potentials) these waves are compound corticospinal action potentials started by the direct activation of axons and velocity (conduction) of nearly 50m/s [1], thus making it useful for monitoring the motor pathways up from the motor cortex up to level of the spinal electrode placement. This is gained by single transcranial electrical stimulation of the intensity by, 80-100mA, and the total stimulus duration of 0.5-1ms, using normal frequency of 0.5-2 Hz. Recording of which done from the epidural/ subdural space of cord [2]. This is directly generated electrical pulse. And thus called "single stimulus technique "of MEP or "spinal motor evoked potentials (MEPs)". This does not require an averaging, but if few averages are taken it improves quality of MEP. This is also good because it provides real-time reading clinically. Warning sign are the decrease in wave amplitude by or more than 50 percent of original baseline value. Or when they cannot be detectable. This may indicate happening of or high probability of severe neurological deficits which may include injuries such as permanent paraplegia.

Other measurements can be used

Neurogenic MEP

(1) "Muscle MEP (or myogenic MEP)

(2) "Spontaneous electromyography

Spontaneous or free-running electromyography (EMG) is used to see or observe selective nerve root functioning undergoing neuro spinal- cord spinal surgery. SEP and SSEP data are not real time. but EMG is truly "real-time" data observed from terminal muscles. Spontaneous EMG thus may eliminate operative radiculopathy while spinal instrumentation procedure is being done. This also may include pedicle screw putting. Here no stimulation is required, this can be recorded continuously from particular peripheral muscle or muscle groups supplied by particular nerve roots which are at risk during operation [5-10].

Method of triggered EMG for observation of the intactness of lumbar pedicles while doing screw placement surgery and the accuracy screw putting was described in 1922 by Calancie *et al* [11].

There is a decrease in electric threshold leading to immediate appearance of CMAPs of the muscles under consideration by the irritated or damaged nerve root that muscle group due to stimulation using the screw [12].

Spinal Cord Evoked Potentials: SCEP technique was first described in Japan during 1970s. Electrical stimulation was put on the dorsal spinal cord by epidural electrodes during procedure [13] and evoked potentials are recorded over the spinal cord. The SCEP correspond to total of neural activities that originating from the up going and down coming tracts and neurons at the site of recording. The potentials so recorded are quite vigorous. They in reality shows all activity of the tracts of the spinal cord, including dorsal columns and the corticospinal tracts along with others [14]. Therefore practically, SCEP cannot provide accurate inputs regarding motor activities. It's so because of presence of sensory-related potentials as well. These sensory potentials, are large in amplitude, and mask motor potentials. We have used utilizing neurophysiological monitoring, for lumbosacral discectomy and decompression for canal stenosis and destabilization by immediate fixation using MRI compatible titanium pedicle rods and screw and also cervical spinal surgery for disc and intra and extra spinal neuro spinal surgery using somatosensory evoked potential and motor evoked potential, which helped immensely in preventing damage. Under intraoperative Neurophysiological monitoring using somatosensory evoked potential and motor evoked potential. This helped immensely in detecting encroachment of neural structures and thus alerting the neuro spinal surgeon and preventing damage to neural structure. By preventing intra-operative neural structure damage, it helps patients and decrease their mortality and morbidity. It also help the neuro spinal surgeon during surgery so he is more confident and objectively able to avert damage [15]. Therefore, it's the recommendation of the authors that during neuro-spinal surgeries and spinal fixation the Methodologies should be utilized if available. It is also preferable to use this preventive measure in extraspinal cord and intra spinal cord surgeries to neural structure and decreasing the chances of mortality and morbidity for patients and confidence and reliable method for neuro-spinal surgeons [16,17].

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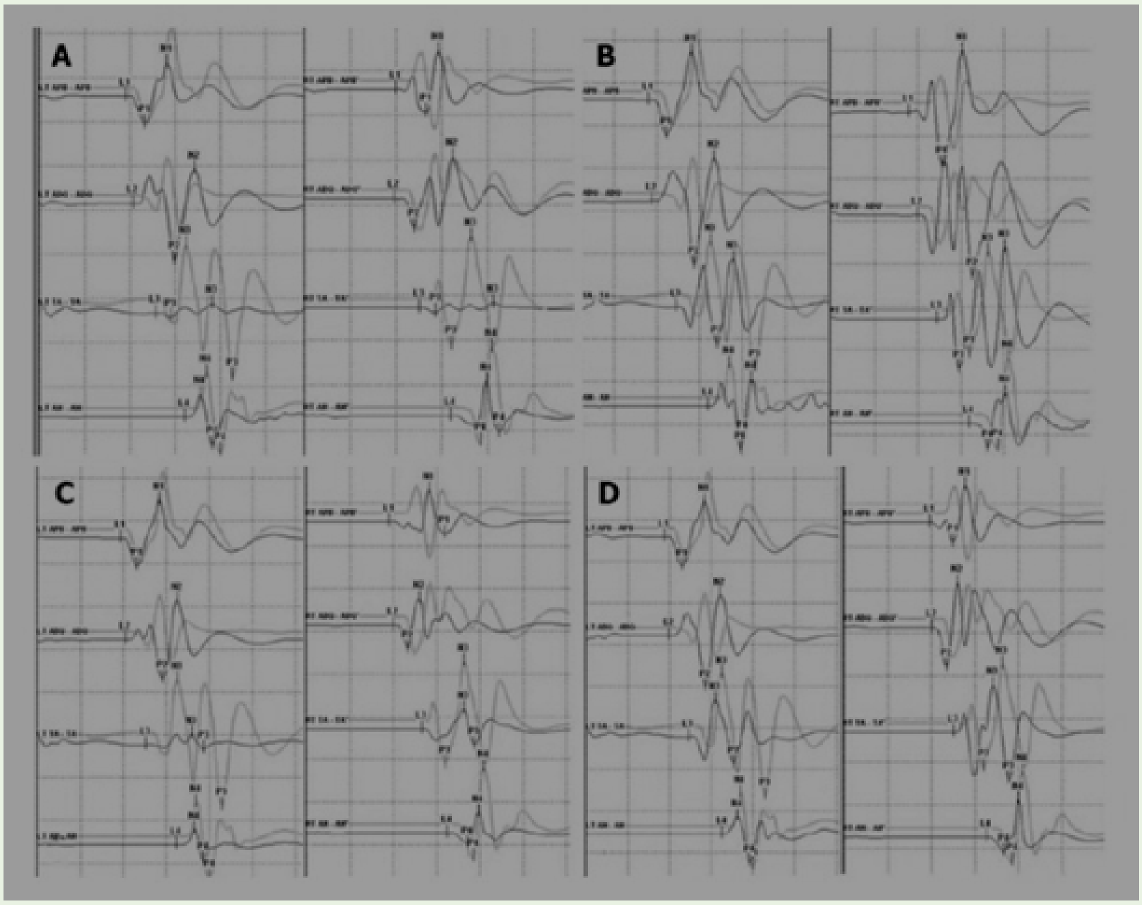
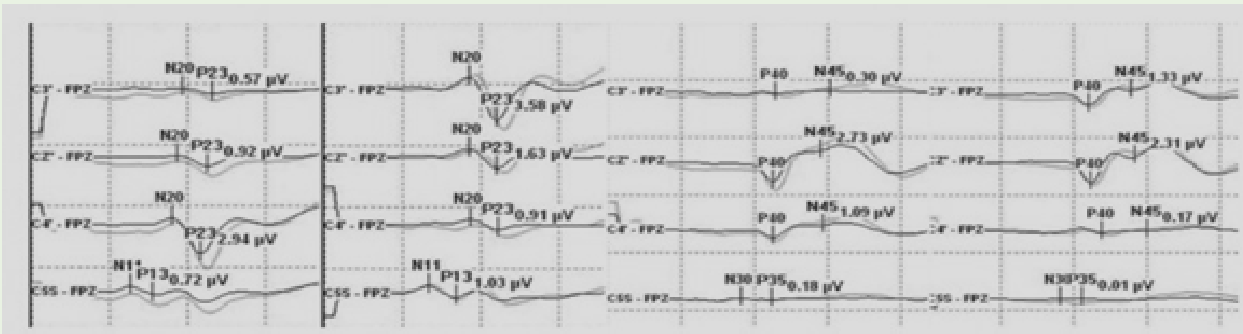
Neurophysiological intra operative graph have been shown as graph 1 and 2.



Graph 1: *Recording of Neurophysiological monitoring (intra operative) Representative case demonstrating clinical usefulness of intraoperative neuromonitoring in spinal surgery. A: MEP after applying rod to the screw heads using derotation maneuver and cantilever maneuver. The amplitude of MEP (black line) at both lower more than 50% compared with the baseline amplitude (green line); B: The amplitude of MEP recovered after correction release by removal of the rods and set screws; C: The amplitude of MEP re-deteriorated extremities decreased after reassembly of the implants; D: The amplitude of MEP recovered finally after raising MAP and administration of dexamethasone. APB: Abductor pollicis brevis; ADQ: Abductor digiti quinti; TA: Tibialis anterior; AH: Abductor halluces; MEP: Motor evoked potential; MAP: Mean arterial pressure.*



Graph 2: *SSEP showing no change in comparison to base line*

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