

Postoperative Changes and Outcomes in Intraoperative Neurophysiological Monitoring in Scoliosis Surgery

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ABSTRACT

Objective: To evaluate the advantages of combined motor and sensory evoked potential monitoring during scoliosis surgery.

Methods: We performed and analyzed the records of 107 (83 Female (77.5%) and 24 male (22.4%) Scoliosis surgery patients with Transcranial electric motor evoked potential and somatosensory evoked potential performed at spine surgery center, Ghurki Trust Teaching Hospital Lahore. Mean age was 14.7 years. Patients who showed significant up to (45%) in baseline signals loss unilateral or bilateral limbs during surgical intervention in scoliosis surgery under total intravenous anesthesia is included.

Results: Motor Evoked Potentials (MEPs) and Somato-Sensory Evoked Potentials (SSEPs) of 107 patients in intraoperative neurophysiological monitoring were performed jointly. 21 (19.6%) patients have mark or significant changes in baseline signals on transcranial motor evoked potentials. Seventeen 17 (15.8%) Patients have complete return of baseline signals after surgical intervention by surgeon, whereas 04 (3.73%) patients have return of motor signals after 14 hours of surgery. Transcranial electric motor evoked potentials monitoring was 100% specific and 100% sensitive, however Somatosensory evoked potential was 100% specific and 84% sensitive.

Conclusions: MEPs and SSEPs, in combination gives accurate and correct information of any surgical insult and neurology in real time during Scoliosis surgery.

Keywords: Scoliosis, Transcranial electric motor evoked potentials, Somatosensory evoked potentials.

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INTRODUCTION

Intraoperative neurophysiological monitoring (IONM) becoming the essential part of spine surgery, Neurosurgery, Vascular surgery, Otolologic Surgery and in many other surgical procedures with the advancement of postoperative patient care and functional outcomes.¹ Utilization of Intraoperative neurophysiological monitoring increases the safety of patient's nervous system during advanced surgical interventions.²

With the advancement of medical field, nowadays there are many different modalities being used in

intraoperative neurophysiological monitoring, each modality has different parameters, merits and limitations.³ Nowadays more frequently used modalities in Intraoperative Neurophysiological Monitoring are Transcranial Electric Motor Evoked Potentials (TCeMEPs) and Somatosensory Evoked Potentials (SSEPs).⁴ In order to get efficient and proper results, there should be team work of Surgeons, Electrophysiologist and anesthesiologist.⁵

Transcranial electric motor evoked potentials (TCeMEPs) is advanced technique and more accurate to detect the ischemic changes and function of motor tracts during surgical intervention by surgeons.⁶ Somatosensory evoked potentials (SSEPs) are more effective and sensitive for detecting any change in sensory tracts.⁷ Multimodality Intraoperative Neurophysiological Monitoring technique gives more sensitive and specific information to surgeons during

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surgery, facilitate to reduced postoperative deficits due to surgical intervention.⁸

We are trying to analyze the variations and outcomes of Transcranial electrical motor evoked potentials (TCeMEPs) and Somatosensory evoked potentials (SSEPs) to identify the intraoperative neurological insult during Scoliosis Surgery.⁴ The main aim of this study was to exhibit the advantages of Transcranial electric motor evoked potentials (TCeMEPs) and Somatosensory evoked potentials (SSEPs) in scoliosis surgery.

METHODS

We prospectively categorize and analyze the records of 107 (83(77.5%) Female and 24(22.4%) male) Scoliosis surgery patients with Transcranial electric motor evoked potential and somatosensory evoked potential performed at spine surgery center, Ghurki Trust Teaching Hospital Lahore from March 2016- April 2018. Data is collected after approval from ethical committee.

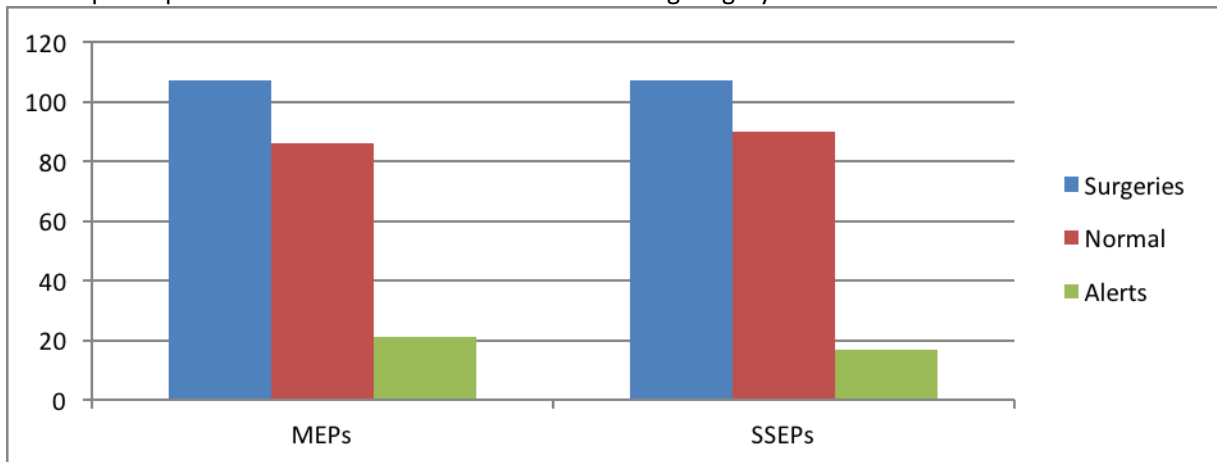
Mean age of patients was 14.7 (7-17) years. Patients who showed significant up to (45%) drop from baseline signals unilateral or bilateral during surgical intervention in scoliosis surgery under total intravenous anesthesia is included.

In order to assess Sensitivity and Specificity of Transcranial Electric Motor Evoked Potential (TcMEP) and Somatosensory Evoked Potentials (SSEPs) signals was design as false-positive, false-negative, true-positive and true negative. There are three levels of loss of signals was designed as 25%,50% and 70%, used to judge the consequence of any reduction in signals during surgical intervention by surgeons.

On patient scalp cock screw electrodes were put on patient scalp at C1/C2 and C3/C4 according to ten-twenty system of brain stimulation(9). At C3/C4 SSEPs were recorded with trains of 4-7 square wave of stimuli (200-500µsec duration) with intensities of ranging from 120-200 mA.

Adhesive surface electrodes were used in SSEPs for Tibial nerve in lower limb and Median nerve in upper limb peripheral nerve stimulation. Sub-dermal needle electrodes were used for TCeMEPs and EMG recordings from different groups of muscles. In hand, thenar & hypothenar muscles used bilaterally most of the time and in lower limbs Rectus femoris, tibialis anterior, medial gastrocnemius and abductor hallucis brevis were monitored for TCeMEPs. Spontaneous electromyography and electroencephalography were also monitored at the same time. Baseline SSEPs and TCeMEPs signals were obtained pre-operatively.

Table 1: Graphical presentation of MEPs and SSEPs alerts during surgery.



Before and after making position of patient on surgery table, TCeMEPs and SSEPs baselines will taken and surgeon were informed about any changes before and after making position.

During the surgery, continuous tibial and median nerve stimulation is performed for SSEPs recording. For the motor signals, firstly take permission from surgeon

for stimulation. Then information is given to surgeon regarding any change in baseline signals.

RESULTS

MEPs and SSEPs of 107 patients in intraoperative neurophysiological monitoring were performed jointly.

21 patients have prominent changes in baseline signals on transcranial motor evoked potentials.

Seventeen patients have complete return of baseline signals after surgical intervention by surgeon, whereas four patients have return of motor signals after 14 hours of surgery. Baseline changes is quickly

picked in Transcranial motor evoked potentials, while Somatosensory evoked potentials take approximately 17 minutes to identify changes. Transcranial electric motor evoked potentials monitoring was 100% specific and 100% sensitive, whereas Somatosensory evoked potential was 100% specific and 84% sensitive.

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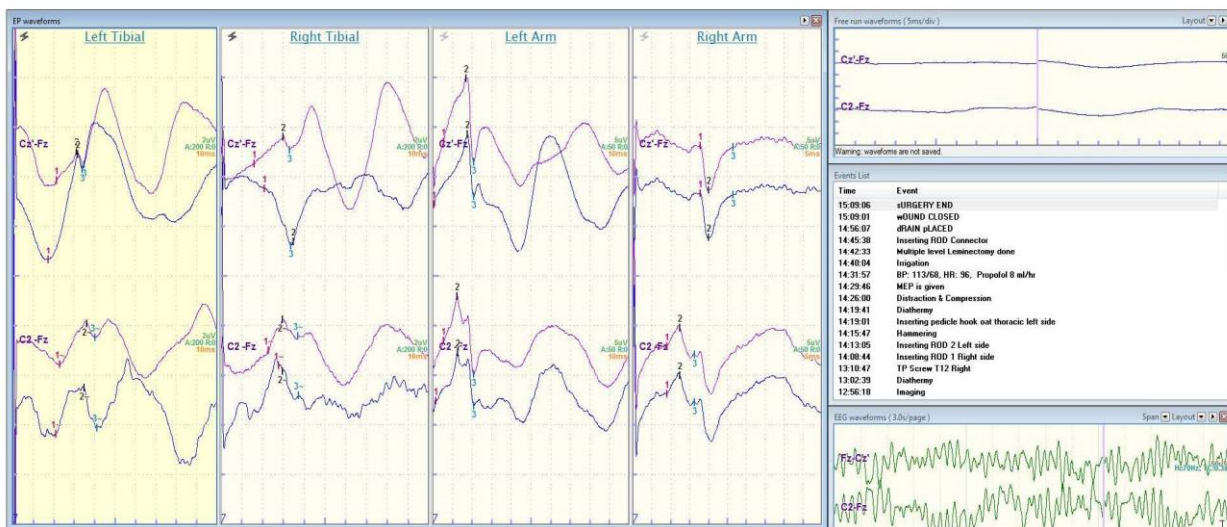


Fig 1: Presents SSEPs of Left Tibial, Right Tibial, Left Arm and Right Arm.

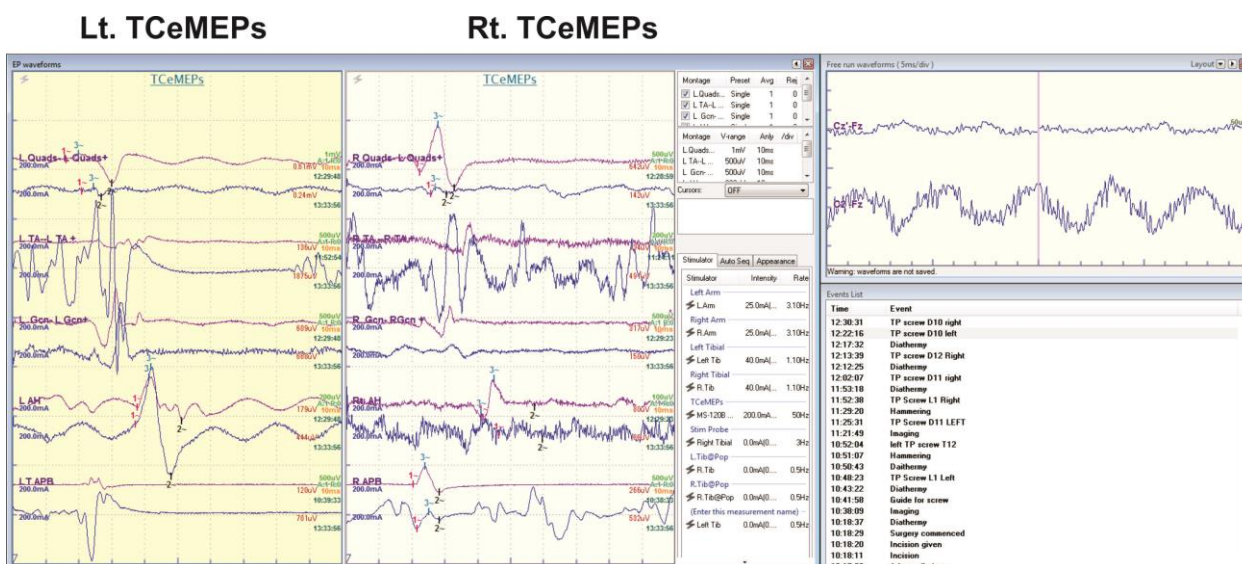


Fig 2: Shows Baselines of Motor Evoked Potentials.

DISCUSSION

Xu R, Witham TF 2018, stated in retrospective study that Somatosensory Evoked Potentials (SSEPs) and Transcranial Electric Motor Evoked Potentials (TCeMEPs) produced more accurate and quick results, when used in combination.¹⁰ In another study Mikula AL 2016, described that during deformity correction

scoliosis surgery use of intraoperative neurophysiological monitoring gives confidence to surgeons in surgery regarding the safety of peripheral nerves and spinal cord.¹¹ This advance multimodality system has many benefits and advantages in favor of patient outcome.¹² Chang-Hyun Lee et al stated that Baseline of MEPs and SSEPs should be taken before and

after making positions on surgery table.^{13, 14} It is most of times noted that during making of position on surgery table extra pressure may put during patients position on brachial plexus, which may lead to false positive results and make confusion to predict the insult on spinal cord.¹⁴

Schwartz DM et al¹⁵ report a retrospective study and proposed that Intra Operative Neurophysiological Monitoring is most useful and accurate way of recognition of spinal cord injury in real time during surgical intervention without wakeup test. As we already mention that variations on Transcranial Electric Motor Evoked Potentials (TCeMEPs) are more quickly picked during surgery, Bayard Wilson et al¹⁶ also concluded the similar findings during intraoperative neurophysiological monitoring in cervical spine surgery. Somatosensory Evoked Potentials (SSEPs) is also useful to check the integrity of dorsal root ganglion in real time¹⁷. Calancie B et al¹² performed a blind and randomized study and concluded that Intraoperative Neurophysiological Monitoring during surgery have more fast and rapid results from Transcranial Electric Motor Evoked Potentials (TCeMEPs), on the other hand Somatosensory Evoked Potentials (SSEPs) lag behind about 14 minutes during any damage in surgery .

We are using total intravenous anesthesia, it is also recommended for fine and excellent signals to minimize the noise and signals in Intra Operative Neurophysiological.¹⁸ Malcharek MJ et al ¹⁹ compare Desflurane gas with TIVA and concluded that desflurane reduces the motor signals markedly as compared to use of propofol and ketamine during surgeries During Distraction and Compressions of Rods there are more variations with the changes in mean arterial pressure, it should be noted and informed the surgeon and anesthetic about all changes.²⁰

As intraoperative neurophysiological monitoring is performed in operation theater, so there are few limitations to our study. Electrical interference by C-arm imaging used in the operating room causes much interference to signal obtained from patients. So, imaging must be use for the short duration of time and its extensive use should be avoided. There are many factors that may give false positive alerts for MEPs as anesthesia dose, patient body temperature, mean arterial pressure, patients positioning and electrical interference. SSEPs may disturb due to excessive use of propofol in long-duration surgery. There should be trained electrophysiologist, who monitor all the events during surgical interventions.²¹ Thirumala PD 2017

strongly suggested that the use of Transcranial Electric Motor Evoked Potentials (TceMEPs) and Somatosensory Evoked Potentials (SSEPs) monitoring in a combine during spine deformity correction and Scoliosis surgeries.²²

CONCLUSION

MEPs and SSEPs, in combination, give accurate and correct information of any surgical insult to the spinal cord and peripheral nervous system in real-time during Scoliosis surgery. This multimodality method is accurate to early detect of any injury in order to improve the patient functional outcome during scoliosis surgeries.

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Authorship and Contribution Declaration

Muhammad Kamran, Conception and design of the study

Abdullah Shah, Collected the data

Farrukh Bashir, Drafting the manuscript

Rizwan Akram, Revising the manuscript critically for important intellectual content

Shahzad Javed, interpreted the data

Amir Aziz, Final approval of the version for publication