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Report of Seizure Following Intraoperative Monitoring of Transcranial Motor Evoked Potentials

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ABSTRACT

Background: Transcranial motor evoked potentials are used to detect iatrogenic injury to the corticospinal tracts and vascular territory of the anterior spinal artery. Tongue and lip lacerations are the most common complication of this modality. Theoretical complications include cardiac arrhythmia and seizure although there are no published reports of either.

Case Report: We report a case of postoperative seizure following motor evoked potential testing in a patient without a seizure history. Although anecdotal reports exist, ours is the first known published report of seizure following transcranial electrical stimulation.

Conclusion: The intent of this novel report is to encourage the use of anesthetic regimens that raise seizure threshold, decrease stimulation threshold, and increase the specificity of motor evoked potentials. Providers should be prepared to treat intraoperative or perioperative seizure activity when the monitoring protocol includes transcranial motor evoked potentials.

INTRODUCTION

Transcranial motor evoked potentials (MEPs) are a widely accepted electrophysiologic modality used to monitor the integrity of the corticospinal tract specifically, with inferred protection of the entire vascular territory of the anterior spinal artery.[1] MEP monitoring is considered safe; the most prevalent complication is tongue and lip laceration.[2-4] The most serious safety concern is seizure generation from transcranial low-frequency pulse train stimulation, so seizure history is a contraindication for MEP testing although no reports of seizures resulting from MEP monitoring in anesthetized patients have been published to date. There are unpublished observations by Deletis and MacDonald of rare seizure occurrences.[4]

We report a case of unexplained postoperative seizure in a patient without a seizure disorder who underwent MEP monitoring for thoracic laminectomy and fusion. While MEP testing is the most plausible explanation for this occurrence, other contributing factors cannot be ruled out. Nevertheless, minimizing transcranial stimulation intensity is important to avoid any contribution of MEP monitoring to the generation of a seizure event, as well as to prevent other complications such as tongue or lip laceration. This report should encourage safe and reliable MEP monitoring.

CASE REPORT

A 53-year-old male with a history of type 2 diabetes and no history of prior seizure underwent a T7-8 laminectomy and T5-10 instrumented arthrodesis for methicillin-sensitive *Staphylococcus aureus* (MSSA) discitis. Induction was accomplished with propofol, lidocaine, and fentanyl, and intubation was facilitated with succinylcholine. Bilateral soft bite blocks were placed to prevent tongue and lip laceration. Anesthesia was maintained with desflurane (peak end tidal concentration 3.7%) and a propofol infusion of 60-100 mcg/kg/min.

Neurophysiological monitoring with somatosensory and motor evoked potentials was performed throughout the procedure. Motor evoked potentials were performed by transcranial pulse train stimulation

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of constant voltage. Seven pulses of 75 μs duration were applied via 2 stimulating electrodes placed at the C3 and C4 scalp locations according to the International 10-20 system. Myogenic responses from the hand and the intrinsic foot musculature were recorded bilaterally. MEP recordings were obtained 13 times during the procedure. Stimulation intensities producing a recordable myogenic response ranged from 900 to 1,000 V.

No electrophysiological changes were reported during the procedure, and MEPs were consistently obtained in all 4 extremities. Postoperatively, immediately upon waking and approximately 30 minutes after the final MEP stimulation, the patient was able to communicate and follow commands with good strength in the left upper and bilateral lower extremities. He was monoplegic in the right upper extremity and had rhythmic jaw jerking movements. The clinical presentation was most consistent with a simple partial seizure. He was treated with an intravenous 2 mg dose of Ativan administered over 3 minutes, resulting in abatement of seizure-like activity without reoccurrence. The patient's right upper extremity weakness resolved within 24 hours, and he has remained seizure free.

DISCUSSION

Ours is the first known report of a seizure following MEP monitoring in a patient without a prior history of seizures. Our parameters for MEP stimulation were within accepted stimulation values[5]; however, stimulation intensities of 900-1,000 V using constant voltage stimulation are at the upper limits of accepted values. The equivalent current delivered was 100-110 mA. These intensities were the minimum intensities that yielded a reliable myogenic response, but in addition to delivering more current to the brain, these intensities increase the risk of patient movement and tongue/lip laceration.

The occurrence of the seizure approximately 30 minutes poststimulation makes it difficult to definitively correlate with MEP testing. Some volatile inhalants, such as sevoflurane, have proconvulsive properties.[6-9] Conversely, desflurane and propofol, which were used in this case, are demonstrated anticonvulsive agents.[10-14] Therefore, we have no reason to suspect the anesthetic regimen as the direct cause of the event. Indirectly, however, the use of any volatile inhalant raises the threshold of MEP activation by a mechanism that inhibits temporal summation of descending inputs on the alpha motor neuron as well as by hyperpolarizing the lower motor neuron pool.[15] Increased stimulation parameters are necessary to overcome this effect. Thus, MEP stimulation was likely a contributing factor to the seizure. The patient's history of diabetes and infection may also have contributed to a predisposition for seizure generation.

The presence of any predisposing factors for seizure generation should be considered when performing MEP testing. Whether these factors lower the range of safe stimulation parameters is unknown, but clinicians should presume that they do, and high-intensity stimulation should be avoided if possible.

We believe the risk of seizure from MEP stimulation is extremely low, and this risk is outweighed by the potential benefit of MEP monitoring. While we cannot definitively link MEP monitoring with the occurrence of seizure in this case, the link is strongly suspected. Because the reports of seizure following MEP testing have been anecdotal, practitioners may not be as attentive to minimizing patient risk as they should be. We hope this report will raise awareness of the risk of seizure generation, regardless of the rarity. One method of lowering the risk of seizure generation is to use the propofol/narcotic anesthetic protocol described by Sloan and Heyer.[15] Such a protocol not only raises the seizure threshold but also decreases the threshold intensity required to record reliable MEPs.

CONCLUSION

Practitioners should always be prepared to treat intraoperative seizure when MEPs are included in the monitoring plan, especially if the patient has a seizure history or predisposing factors. This report should not discourage the use of MEPs for spinal cord monitoring but should rather encourage the use of a favorable anesthetic regimen for safe and reliable motor monitoring.

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