ELECTROENCEPHALOGRAPHY DURING TRANSCRANIAL ELECTRICAL STIMULATION FOR MOTOR EVOKED POTENTIALS

3.100

Erik J. Kobylarz[1], Mark Bilsky[2], Sonia K. Sandhu[1], Edward A. Avila[1] and Jonathan D. Victor[1]

[1]Department of Neurology and Neuroscience, Weill Medical College of Cornell University, New York, NY 10021

[2]Department of Neurosurgery, Memorial Sloan Kettering Cancer Center, New York, NY 10021

INTRODUCTION

Transcranial electrical motor evoked potential (MEP) intraoperative monitoring can help reduce morbidity from spine surgery. However, it poses some risks, including intraoperative seizures. Transcranial electrical and magnetic stimulation at sufficiently high intensities have both been shown to produce epileptiform afterdischarges, as well as seizures. *The purpose of this study is to determine the effects of transcranial electrical stimulation on the electroencephalogram (EEG), and the possible utility of the EEG during MEP monitoring for spine surgery.*

METHODS

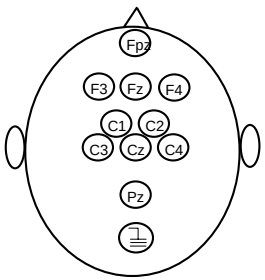
PATIENTS - 27 patients with spine tumors undergoing surgical resection with instrumentation

Inclusion Criteria
- Spine lesion and/or surgery which posed a risk to motor pathways (e.g., anterior-lateral location)

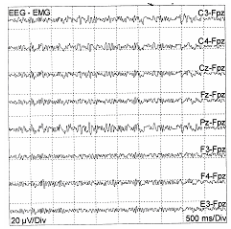
Exclusion Criteria
- History of seizures or anticonvulsant treatment
- Known intracranial lesions (e.g., tumor, stroke)

STIMULI - MEP stimulation settings varied between individual patients: 250-600V, 4-6 pulse trains at 1.5 to 2 ms intervals.

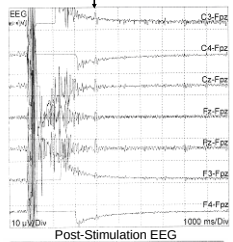
PROCEDURE –
-Patients underwent intraoperative MEP monitoring during spine tumor resection and instrumentation surgery.
- An electrode montage surrounding the MEP scalp stimulation site was used for EEG monitoring (Cz-Fpz, C3-Fpz, C4-Fpz, Fz-Fpz, F3-Fpz, F4-Fpz, Pz-Fpz; see diagram below).
- C1 and C2 stimulation electrodes were located slightly medial and anterior to C3 and C4, respectively.
- Baseline, post-stimulus and inter-stimulus EEGs were recorded with stimulation amplifiers temporarily disconnected to decrease electrical noise.
- If afterdischarges occurred, MEP monitoring was discontinued.



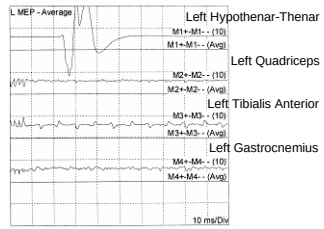
Patient 1



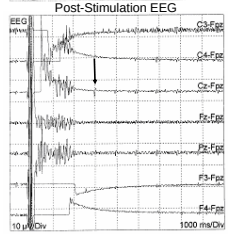
Pre-Stimulation EEG

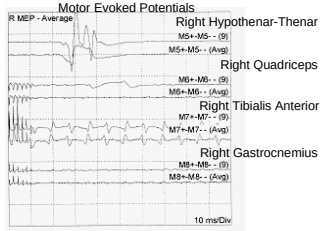


Post-Stimulation EEG



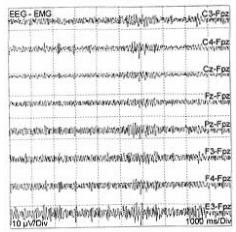
Motor Evoked Potentials



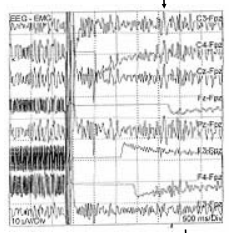


- Electrical stimulation consistently caused a polyspike burst in all EEG channels lasting several seconds.
- The pure midline EEG derivations returned to baseline more rapidly after transcranial stimulation than those involving C3, C4, F3 and F4.
- For this study an afterdischarge was defined as a spike-and-aftercoming slow wave, not looking like artifact, that is separated in time from the polyspike burst that immediately follows the electrical stimulation.

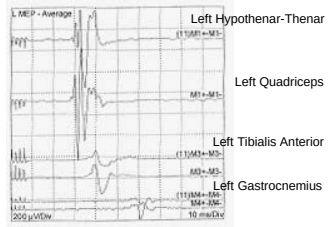
Patient 2



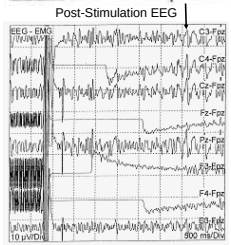
Pre-Stimulation EEG

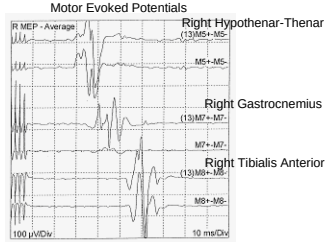


Post-Stimulation EEG



Motor Evoked Potentials





RESULTS

➢Baseline EEGs revealed no epileptiform activity or electrographic seizures in all patients.

➢ In 4 of 27 patients, there were single or brief bursts of afterdischarges lasting up to several seconds, following transcranial MEP stimulation.

➢ In all cases, there was spontaneous return of the EEG to normal baseline activity.

➢ No patients demonstrated clinical or electrographic seizures prior to or after transcranial MEP stimulation during the intraoperative monitoring period.

SUMMARY & CONCLUSIONS

➢ **Concurrent electroencephalography during motor evoked potential stimulation is practical and occasionally reveals afterdischarges.**

➢ **This suggests that concurrent EEG monitoring may improve the safety of MEP monitoring.**

REFERENCES

MacDonald DB. Safety of intraoperative transcranial electrical stimulation motor evoked potential monitoring. J Clin Neurophysiol 2002;19(5):416-429.

Okamura H, Jing H, Takigawa M. EEG modification induced by repetitive transcranial magnetic stimulation. J Clin Neurophysiol 2001;18(4):318-325.