Title: Effect of Dexmedetomidine on Neurophysiologic Monitoring during Spinal Surgery (EEG, Tibial Somatosensory and Lower Extremity Transcranial Electrical Motor Evoked Potentials, F-responses and H-reflexes).

Author(s): G. M. Cramolini, R. Leppanen, L. Smithson

Affiliation(s): East Tennessee Children's Hospital, Knoxville, TN

ABSTRACT BODY:

Introduction: Dexmedetomidine is an _2 agonist with sedative, analgesic and sympatholytic/vasodilatory properties, which also demonstrates neuroprotection in a model of focal cerebral ischemia. [1] Approved for use in adults for short term ICU sedation, it is being utilized off label in adults and children for a variety of anesthetic and sedative needs, including as a component of a total intravenous anesthetic (TIVA) for spinal surgery. [2, 3, 4, 5, 6] Although there have been several reports, both in an animal model and in patients, that dexmedetomidine infusions do not interfere with cortical somatosensory nor auditory evoked potentials, [6, 7, 8, 9] we were concerned that dexmedetomidine could interfere with neurophysiologic monitoring during posterior spinal fusion. Therefore, prior to utilizing dexmedetomidine as a component of our total TIVA regimen, we embarked on a controlled study to examine the effects of dexmedetomidine on brainstem and cortical tibial somatosensory evoked potentials (SEPs), lower extremity transcranial electrical motor evoked potentials (TCeMEPs), EEG, F-responses, and H-reflexes during spinal surgery, using each subject as their own control. (Since beginning this study, there has been a case report showing loss of TCeMEPs with dexmedetomidine during 2 pediatric spinal surgeries. [10])

Methods: Institutional Review Board approval and informed consent were obtained to enroll patients with idiopathic scoliosis scheduled for posterior spinal rodding, distraction and fusion. Nine patients, ages 14 to 19, have been studied to date. Study patients all received the same standard evoked potential benign anesthetic (pre-operative and supplemental midazolam, fentanyl and propofol by infusion, and N_2O/O_2 at 50% F_iO_2 with labetalol and/or esmolol for induced hypotension) and the same standard intra-operative monitoring (including intra-arterial pressure monitoring, and lower extremity TCeMEPs, brainstem and cortical tibial SEPs, EEG, F-responses and H-reflexes) as non-study patients routinely receive.

After final distraction and fixation of the spine without neurophysiologic changes (at which time neurophysiologic monitoring is normally discontinued but while TIVA is continued to allow for wound closure) a loading dose of dexmedetomidine of 1 mcg/kg over 10 minutes, followed by a continuous infusion of dexmedetomidine at 0.5 mcg/kg/hour were added, as per the FDA approved dosing recommendations of the manufacturer (Hospira, Inc.). Neurophysiologic monitoring continued throughout the

study period (10 minutes of a loading dose, followed by 15 to 25 minutes of continuous infusion, during surgical wound closure and dressing placement). Since continued neurophysiologic monitoring was for research purposes only and no longer required for patient safety, no changes were made to the dexmedetomidine infusion regardless of the evoked potential findings. Fentanyl and propofol infusions were weaned based on clinical parameters, in anticipation of extubation and transfer to the post anesthesia care unit. Unfortunately, dexmedetomidine serum levels were not available for this study.

Results: Compared to the control period of surgery without dexmedetomidine, the dexmedetomidine phase demonstrated no changes in brainstem or cortical SEPs or EEG. In contrast, dexmedetomidine did markedly affect the TCeMEPs, F-responses and H-reflexes in all patients. Lower extremity TCeMEP amplitudes were decreased (0-100, mean: -86±16.6% decrement), F-response amplitudes were decreased (0-100, mean: -58±12.5% decrement) and H-reflex amplitudes were decreased (0-100, mean: -71±13.9% decrement). These dexmedetomidine induced changes could not have been distinguished from those associated with spinal cord dysfunction secondary to ischemia and/or distraction injury.

Discussion: Lower extremity TCeMEPs, F-responses and H-reflexes are known to activate different populations of motor neurons and it appears that dexmedetomidine affects each of these motor neuron populations differently.
Furthermore, dexmedetomidine, when administered at the loading and infusion doses recommended for adult ICU sedation, interferes significantly with lower extremity TCeMEPs, F-responses and H-reflexes. Additional studies are needed to delineate if lower loading doses and/or lower infusion rates of dexmedetomidine may be safe for these cases and whether such lower doses would offer any of the potential benefits of using this $_2$ agonist as part of a TIVA for spinal surgery.

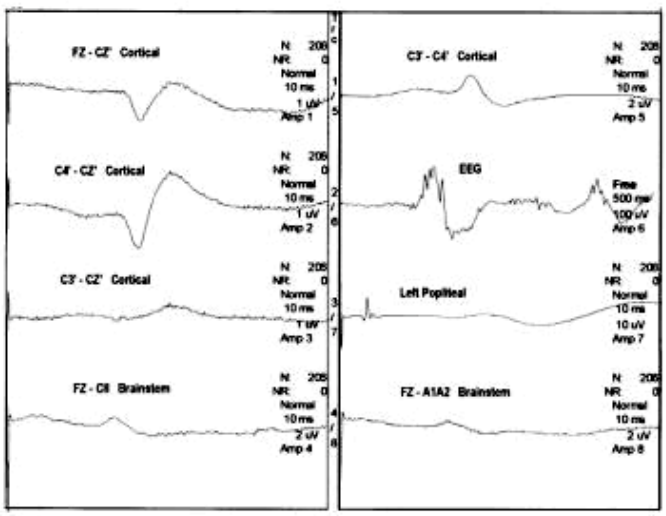
Refs:

1. Maier C. et al., Anesthesiology 79:306-312, 1993
2. Tobias J. et al, Paediatric Anaesthesia 12:171-175, 2002
3. Everett L. et al, Paediatric Anaesthesia 16:338-342, 2006
4. Mason K. et al, Anesthesia & Analgesia 103:57-62, 2006
5. Tobin J et al, Anesthesia & Analgesia 103:43-47, 2006
6. Anschel D. and Hoegerl C., Preliminary Report. 2006 Annual Meeting, American Academy of Neurology
7. Li B. et al, Anesthesia & Analgesia 96:1155-1160, 2003
8. Bloom M. et al, Journal of Neurosurgical Anesthesiology 13:320-322, 2001
9. Thornton C. et al, British Journal of Anaesthesia 83:381-386, 1999
10. Mahmoud M. et al, Anesthesiology 106:393-396, 2007

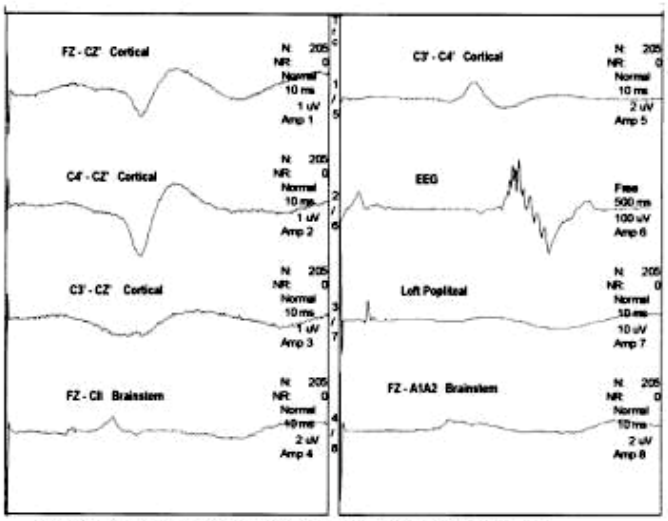
Acknowledgements: The authors wish to acknowledge the efforts of orthopedic surgeons Drs. Robert Madigan and Cameron Sears, neurodiagnostic technologists Betty Johnson, Julie Duncan, and Rick Maiden, the members of the Department of Anesthesia, the OR nursing staff, and East TN Children's Hospital, in support of this research.

Disclosures: The authors have no financial disclosures to report. No extra-mural funding was used for this research.

Example Of Tibial SEP's



14 year old female with idiopathic scoliosis. Intraoperative left tibial somatosensory evoked potentials. Before dexmedetomidine.

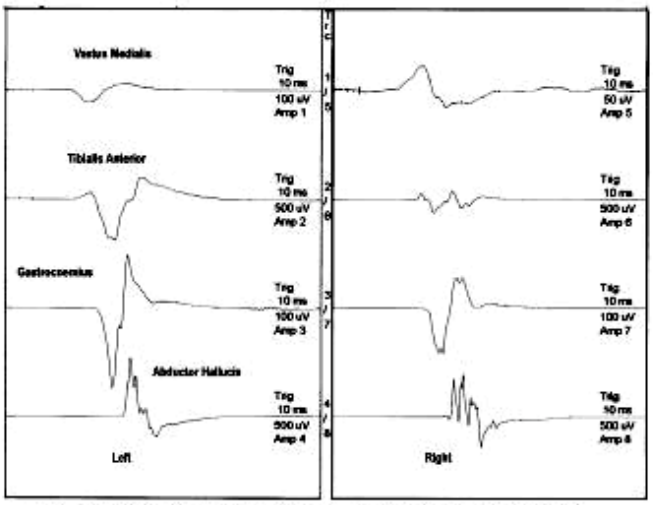


14 year old female with idiopathic scoliosis. Intraoperative left tibial somatosensory evoked potentials 15 minutes after dexmedetomidine.

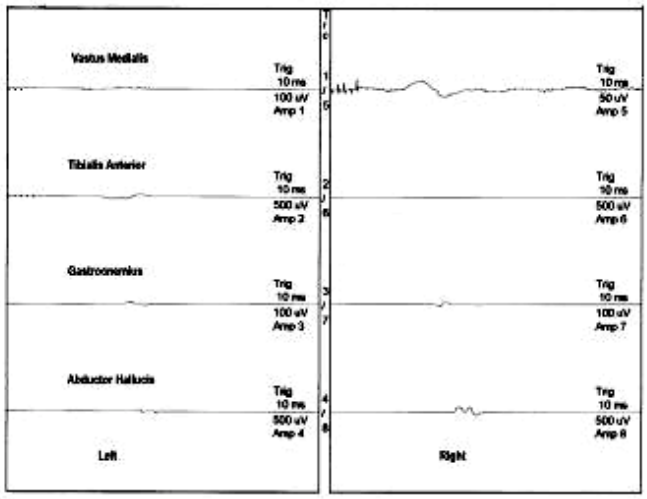
Before Dexmedetomidine

After Dexmedetomidine

Example Of Lower Extremity TCeMEP's



14 year old female with idiopathic scoliosis. Intraoperative lower extremity transcranial electrical motor evoked potentials before dexmedetomidine.



14 year old female with idiopathic scoliosis. Intraoperative lower extremity transcranial electrical motor evoked potentials 15 minutes after dexmedetomidine.

Before Dexmedetomidine

After Dexmedetomidine