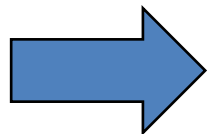


“What should I plan for  
maintenance anesthetic if  
neuromonitoring is involved for this  
spine case?”

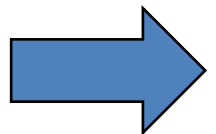
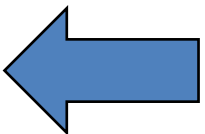
Laura Hemmer, MD

Antoun Koht, MD



# Case Presentation

- 24 year old man without significant past medical history presents for elective thoracic-lumbar spinal deformity surgical correction.
- Planned neuromonitoring modalities are tcMEPs, SSEPs, and EMG.

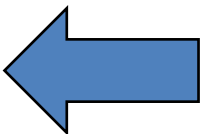
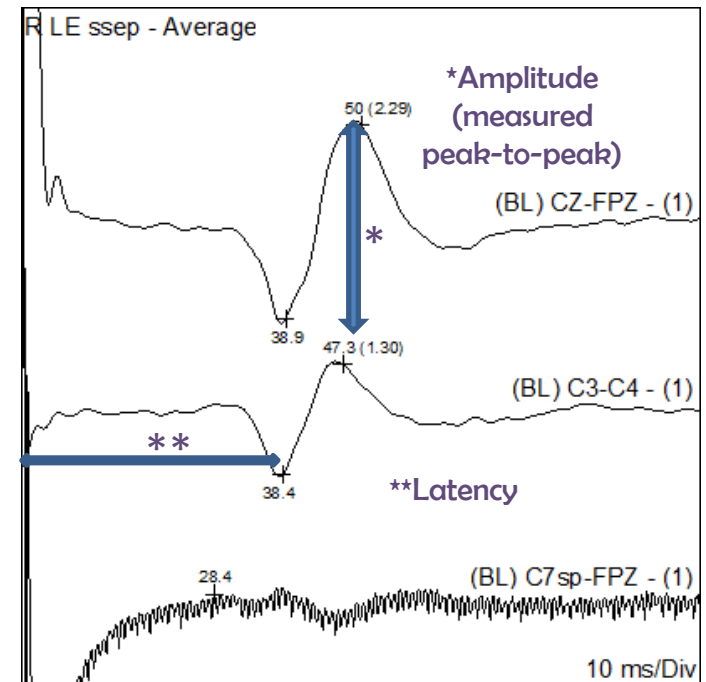


# Neuroanesthesia and IONM

True/False: It is expected that most anesthesia maintenance regimens will have a more pronounced effect on evoked potential amplitude than on evoked potential latency.

A) True

B) False



# Neuroanesthesia and IONM



[Try again](#)

No. The statement is true. Since anesthetics impact synaptic function much more than neuronal conduction, it is expected that there will be more of an amplitude decrease than a latency increase in evoked potential signals with most maintenance anesthesia regimens.

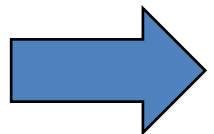
Sloan TB. "General Anesthesia for Monitoring" In: *Monitoring the Nervous System for Anesthesiologists and other Health Care Professionals*. Koht A, Sloan TB, Toleikis JR, eds. Springer; 2012, pp 319-35.

# Neuroanesthesia and IONM



True: It is expected that there will be more of an amplitude decrease than a latency increase in evoked potential signals with most maintenance anesthesia regimens. This is because anesthetics generally impact synaptic function more than neuronal conduction.

Sloan TB. "General Anesthesia for Monitoring" In: *Monitoring the Nervous System for Anesthesiologists and other Health Care Professionals*. Koht A, Sloan TB, Toleikis JR, eds. Springer; 2012, pp 319-35.



# Neuroanesthesia and IONM

Rank the evoked potential modalities in order of decreasing sensitivity to anesthetic agents\*:

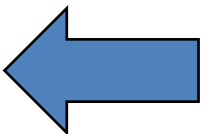
A) VEP, tcMEP, SSEP, BAEP

B) tcMEP, VEP, SSEP, BAEP

C) BAEP, SSEP, VEP, tcMEP

D) BAEP, SSEP, tcMEP, VEP

\*where VEP = visual evoked potential, tcMEP=transcranial motor evoked potential, SSEP=somatosensory evoked potential, and BAEP=brainstem auditory evoked potential



# Sorry – I disagree



[Try again](#)

# Neuroanesthesia and IONM

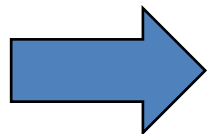
Correct answer is:



✓ a. VEP, tcMEP, SSEP, BAEP

✓ Impact of anesthetic agents on evoked potentials ↑ with number of synapses.

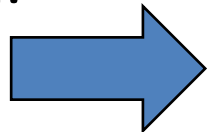
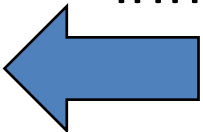
Koht A, Sloan TB, Hemmer LB. Neuromonitoring in Surgery and Anesthesia. In: UpToDate, Crowley M, ed. UpToDate, Waltham, MA, 2015





# Neuroanesthesia and IONM

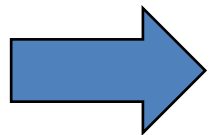
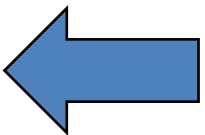
- For our spine case, as frequently occurs, several neuromonitoring modalities will be utilized.
- In addition to considering patient comorbidities and surgical needs, the choice of anesthetic maintenance technique will be guided by the intraoperative neuromonitoring technique that is the most sensitive to anesthetics.
- Thus, for this case, the use of MEP monitoring will be the neuromonitoring modality to have the most influence on our maintenance anesthetic selection.



# TcMEPs

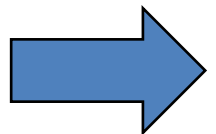
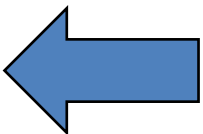
TcMEPs are sensitive to anesthetic agents at 3 sites

- motor cortex
  - anterior horn cell
  - neuromuscular junction
- Impacted by some agents used for anesthesia maintenance
- Impacted by neuromuscular blockade only



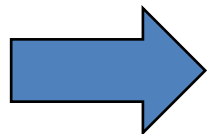
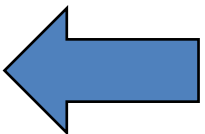
# Maintenance Regimen

Many protocols for MEP monitoring recommend a total intravenous anesthetic (TIVA). However, there are reasons why some volatile anesthetic would be preferred (such as for minimizing risk of recall), and MEPs can often be recorded with some limited volatile anesthetic ( $\leq 0.5$  MAC) supplemented with less suppressive anesthetic agents.



# Patient Factors and MEPs

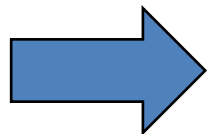
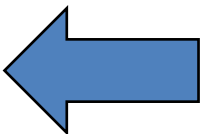
- Certain patient factors should be considered prior to planning to incorporate volatile anesthetic in the maintenance regimen:
  - neurologic status
  - age
  - comorbidities



# Patient Factors and MEPs

- Lower success rate for tcMEPs for < 7 yo
  - Motor pathway matures during 1<sup>st</sup> decade of life
- Lower success rate for tcMEPs for > 64 yo
  - Accelerated loss of nerve fibers and other medical problems could contribute to decreased monitoring success rates

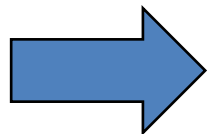
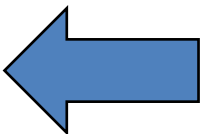
Chen X, et al. *J Clin Neurophys* 2007;24:281-5.





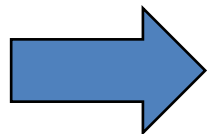
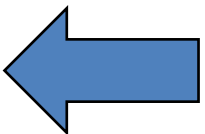
# Patient Factors and MEPs

- Independent factors predicting failure to obtain baseline lower extremity MEPs in spine surgery:
  - hypertension
  - diabetes mellitus
  - anesthetic technique
    - nitrous + propofol versus nitrous + volatile anesthetic



# Maintenance Regimen

- Thus, in our 24 year old patient without significant past medical history and who is neurologically intact, a maintenance anesthetic regimen could be:
  - $\leq 0.5$  MAC volatile anesthetic + sufentanil IV infusion + avoidance of neuromuscular blockade during neuromonitoring (some neuromuscular blockade may be desirable during surgical exposure).



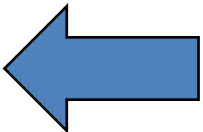
# Maintenance Regimen

- What intravenous anesthetic agents could be added to the maintenance anesthetic regimen to increase evoked potential amplitude?

[A\) dexmedetomidine](#)

[B\) lidocaine](#)

[C\) ketamine](#)





# Maintenance Regimen

[Try again](#)



Answer: A) Dexmedetomidine.

Dexmedetomidine does not enhance evoked potentials, although, with limited infusion dosing, it may be used as an anesthesia adjunct in the maintenance regimen.

1. Mahmoud M, et al. *Anesthesiology* 2010; 112:1364-73.
2. Bala E, et al. *Anesthesiology* 2008; 109:417-25.

# Maintenance Regimen



[Try again](#)

Answer: B) Lidocaine. Lidocaine does not enhance cortical SSEP or tcMEP evoked potential amplitudes, although it may be used as an anesthesia adjunct in the maintenance regimen.

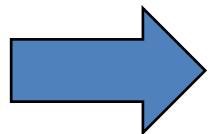
1. Sloan TB, et al. *J Clin Monit Comput* 2014;28(2):139-47.

# Maintenance Regimen



Answer: C) Ketamine. Yes, ketamine can be administered as an intravenous infusion during spine surgery and enhances evoked potential amplitudes.<sup>1</sup> Etomidate also enhances evoked potentials, but its effect on adrenal suppression limits its clinical use during spine surgery.<sup>2</sup>

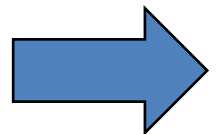
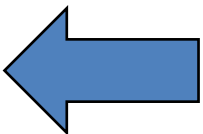
1. Schubert A, et al. *Anesthesiology* 1990;72(1):33-9.
2. Koht A, et al. *Anesth Analg* 1988;67(5):435-41.



# Maintenance Regimen

Malcharek *et al* prospectively evaluated effects of TIVA (propofol + remifentanil) and volatile (0.5-0.6 MAC desflurane + remifentanil ) on upper extremity tcMEP amplitude in neurologically intact patients undergoing CEA. They found that tcMEPs were recordable with both regimens.

Their conclusion makes an important point: “...if patients had initially small MEP amplitudes,...monitoring might be facilitated with...TIVA...**This finding may be important to ensure intraoperative sensitivity to MEP changes and a clear interpretation of surgical events.**”



# Maintenance Regimen

Thus, if baseline MEPs are not adequate, use a more facilitating anesthetic technique and consider other causes of poor baseline signals!

For our patient, if difficulty is encountered in obtaining acceptable baseline MEPs, switch to a TIVA (starting with a TIVA would also have been acceptable but likely not necessary in this patient). Also, consider adding an anesthetic adjunct with a positive effect on signals (i.e. ketamine infusion).

