Analysis of Transcranial Motor Evoked Potentials (Tc-MEP) to Predict Motor Deficits in Spinal Surgeries

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Introduction

During spinal surgeries, TcMEP are often more sensitive for predicting corticospinal injury, particularly in the anterior and lateral columns than somatosensory evoked potentials (SEP) [1]. Although a 50% amplitude decrease in SEP correlates with potentially reversible spinal cord injury during intraoperative neurophysiological monitoring (IONM), there are no corresponding standardized warning criteria for TcMEP. IONM physicians typically report a change in TcMEP waveforms at a gain of 50uV and the parameters of latency, amplitude, duration, turns, phases, area-under-the-curve (AUC) and the parameters of latency, amplitude, duration, turns, phases, area-under-the-curve (AUC) and duration before TcMEP loss.

From Stanford Hospital and Lucile Packard Children’s Hospital, 11 true-positive cases were retrospectively identified in 2011-2012 wherein TcMEP were lost intraoperatively and the patients woke up with new postoperative motor deficits. A board certified neurologist analyzed the TcMEP waveforms at a gain of 50 uV and the parameters of latency, amplitude, duration, turns, phases, area-under-the-curve (AUC) and duration before TcMEP loss. ISCI was calculated as (amplitude x phases x AUC x duration)/latency. Five traces prior to the loss of TcMEP were identified and the traces had to be collected more than 30 seconds apart.

Methods

Discussion

Among the 11 cases there were 18 muscle groups monitored.
- Amplitude
  - 4/18 increased
  - 10/18 decreased
  - 4/18 had no change
- Latency
  - 5/18 increased
  - 1/18 decreased
  - 12/18 had no change
- AUC
  - 5/18 increased
  - 8/18 decreased
  - 5/18 had no change
- ISCI
  - 5/18 increased
  - 9/18 decreased
  - 4/18 had no change

In 8/11 cases, SEP also changed: 1/8 changed before MEP; 4/8 changed simultaneously with MEP; 2/8 changed after MEP.

Results

Conclusions

- There was a trend towards a smaller and simpler waveform (decreased TcMEP amplitude, AUC and ISCI) before complete TcMEP loss.
- Latency tended not to change before TcMEP loss.
- TcMEP should be obtained more frequently during IONM to increase the sensitivity of detecting impending motor compromise.
- Further research on TcMEP characteristics is warranted to derive a reliable index of early neurophysiologic warning parameters that precede irreversible corticospinal tract injury.

Limitations

- This is a retrospective analysis.
- Within a given patient, there may be significant variability of TcMEP because the same (compound muscle action potential) CMAP is not recorded with each evoked potential; this may limit the use of TcMEP as early warning signs.

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References