Neurophysiology Quiz

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Notice: Authors are encouraged to submit quizzes for possible publication in the Journal. These may be in any field of Clinical Neurophysiology, and should approximately follow the format used here (maximum of 2 figures). Please address any submissions to the quiz editor: Dr. David B. MacDonald, Head, Section of Neurophysiology, Department of Neurosciences, King Faisal Specialist Hospital & Research Centre, MBC 76 PO Box 3354, Riyadh 11211, Kingdom of Saudi Arabia. E-mail: dmacdonald@kfshrc.edu.sa

Optimizing tibial P37 somatosensory evoked potentials for intraoperative monitoring

Instructional Objectives

Given a fundamental knowledge of somatosensory evoked potentials (SEPs), after studying this quiz the reader should be able to:

1. Describe a method to optimize tibial P37 amplitude.
2. Discuss the importance for effective intraoperative monitoring.

Clinical History

A 10-year-old neurologically intact girl underwent intraoperative neurophysiologic monitoring during posterior spinal fusion and instrumentation for idiopathic scoliosis. After induction and prior to positioning, the recording in Figure 1 was obtained under propofol and remifentanyl anesthesia.

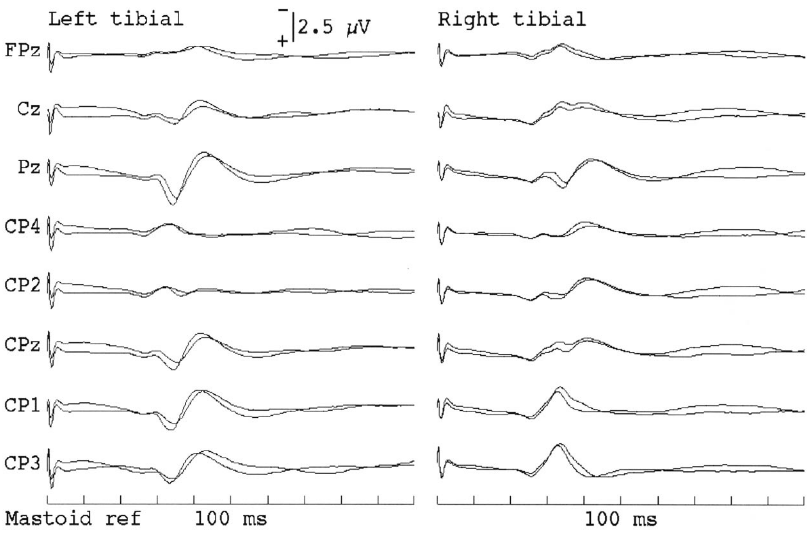

Figure 1 - Bilateral tibial SEPs from strategic scalp locations to a mastoid reference. CP sites are midway between C and P sites (e.g. CPz is midway between Cz and Pz).

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Questions

1. What do the SEPs demonstrate?

2. How can the results be used to enhance tibial SEP monitoring for this patient?

3. What is the importance for effective intraoperative Monitoring?

Answers

1. The recordings demonstrate a widespread far-field subcortical P31 of low amplitude followed by the higher amplitude and more localized near-field cortical P37 and N37 potentials (Figure 2a). The left and right tibial P37 is maximal at Pz, the left tibial N37 is maximal at CP4 and the right tibial N37 is maximal at CP3.
2. For each side, monitoring derivations should use the P37 maximum for input one and the N37 maximum for input 2 in order to maximize amplitude (Figure 2b).
3. Higher amplitude signals provide a better signal to noise ratio and thereby minimize averaging time to speed surgical feedback.

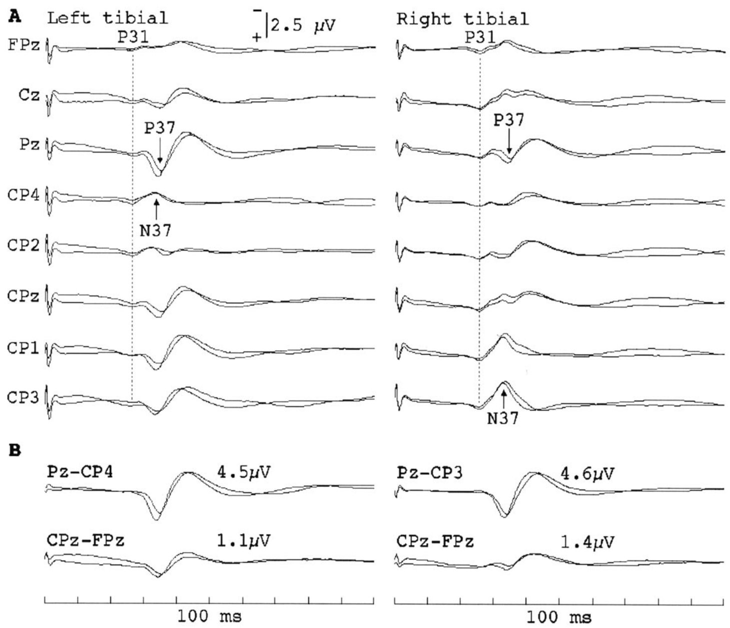

Figure 2 - In **a**), the P31 appears at all scalp sites but is of low amplitude and thus ineffective for monitoring. The larger P37/N37 cortical potentials have localized maximums (arrows). In **b**), the P37 and N37 maximums are used to construct optimal (highest amplitude) derivations, which are compared to the standard CPz-FPz derivation.

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Discussion

The tibial P37 is usually monitored with a standard derivation, most often Cz' or CPz-FPz. However, the scalp topography of tibial cortical SEPs varies substantially between patients and sides.[1] The P37 maximum occurs at CPz (52%), Pz (17%), Cz (17%), CP1/CP2 (10%) or CP3/CP4 (2%) and using the maximum site for input one, helps to optimize amplitude.[2] The N37, when present, is normally located at the contralateral central scalp (CP4 for the left tibial nerve and CP3 for the right). Because of its opposite polarity and approximately simultaneous timing, its use as input 2 will boost cortical response amplitude even further in approximately 80% of tibial nerves.[1,2] In addition, these derivations contain less random EEG noise than derivations using FPz for input 2, and this further enhances the signal to noise ratio.[2]

This method to optimize P37 monitoring derivations has been developed over several years at the University of British Columbia and the King Faisal Specialist Hospital and has become standard practice.[1-4] The technique provides substantial signal to noise ratio gains in the majority of patients, and in fact, it has been shown that CPz-FPz is actually suboptimal in 96% of patients, contrary to existing guidelines.[2,5]

A higher signal to noise ratio translates directly to more effective intraoperative monitoring, because less averaging time is required to achieve satisfactory reproducibility and therefore feedback to surgeons is more rapid and accurate.[2] The success of this technique is further enhanced by the avoidance of inhalational anesthetics including nitrous oxide because total intravenous anesthesia with propofol and opioids causes less cortical SEP suppression.[2]

References

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3. MacDonald DB, Janusz M. An approach to intraoperative neurophysiologic monitoring of thoracoabdominal aneurysm surgery. ***J Clin Neurophysiol*** 2002; 19: 43-54.
4. MacDonald DB, Al-Zayed Z, Khodeir I, Stigsby B. Monitoring scoliosis surgery with combined transcranial electric motor and cortical somatosensory evoked potentials from the lower and upper extremities. ***Spine*** 2003; 28: 194-203.
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