Neurophysiology Quiz

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Notice: This is the second of a series of neurophysiology quizzes. Other authors are encouraged to submit quizzes of their own 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, 11211 Riyadh, Kingdom of Saudi Arabia. E-mail: dmacdonald@kfshrc.edu.sa

An unusual somatosensory evoked potential abnormality

Instructional Objectives

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

1. Describe an unusual abnormality that will not be detected by standard methods.
2. Discuss the implications for evoked potential practice.

Clinical History

A 12-year-old boy was referred for baseline median and tibial somatosensory evoked potentials (SEPs) in preparation for intraoperative monitoring during scoliosis surgery (Figures 1 and 2). His scoliosis was congenital and progressive. He also had bilateral horizontal gaze palsy, but no other neurological abnormalities on clinical examination. In particular, vibration, proprioception, fine touch and pinprick sensation was normal.

Figure 1 - Median nerve cortical somatosensory evoked potentials recorded from the scalp. Peripheral and subcortical potentials were normal (not shown).
Questions

1. What is the SEP abnormality?

2. What is the diagnosis?

3. What are the implications for evoked potential practice?

Figure 2 - Tibial nerve cortical somatosensory evoked potentials recorded from the scalp. Peripheral and subcortical potentials were normal (not shown).
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Answer Page

Answers
1. The median N20 potentials are abnormally ipsilateral to the stimulated nerve. The tibial P37 potentials spread abnormally contralateral to the stimulated nerve and the N37 potentials are abnormally ipsilateral.
2. Dorsal column-medial lemniscus sensory pathway non-decussation.
3. Accurate interpretation requires bilateral scalp recording to unilateral stimulation in order to detect or rule-out non-decussation that will not be detected by standard methods.

Discussion

The median N20 potential is the primary cortical sensory response and normally arises from the contralateral post-central gyrus hand area. It is commonly recorded with a single standard Cc'-FPz (contralateral post-central to frontopolar midline) derivation, C4'-FPz for the left median nerve and C3'-FPz for the right. This approach assumes sensory decussation. FPz is not inactive but contains the frontal P22 potential, so that Cc'-FPz actually records a compound response adding together the upgoing N20 from input 1 (negative up) and the upgoing P22 from input 2 (positive up). With non-decussation, the N20 is absent at Cc but the P22 is still present at FPz, so that an upgoing deflection in Cc'-FPz still occurs and will be mistaken for a small N20 with unilateral recording (e.g. Figure 1). Therefore, simultaneous C4'-FPz and C3'-FPz recording with unilateral stimulation is necessary to demonstrate decussation or detect non-decussation. The derivation recording the higher amplitude upgoing potential indicates the hemisphere generating the cortical response.

The tibial P37 potential is the primary cortical sensory response and normally arises from the contralateral post-central gyrus foot area, located in the anterior mesial parietal lobe. The response is most often maximal at the overlying midline near Cz', but because of its mesial source, the field projects to the scalp ipsilateral to the stimulated nerve, which has been called 'paradoxical lateralization'. An approximately simultaneous contralateral N37 potential usually occurs and may represent the negative pole of a response dipole. The P37 is commonly recorded with a standard midline Cz'-FPz derivation, which also assumes sensory decussation. With non-decussation, the response at Cz'-FPz is apparently normal, but lateralization of P37 and N37 potentials is reversed. Therefore simultaneous recording from C4'-FPz, Cz'-FPz and C3'-FPz is required to demonstrate decussation or detect non-decussation.

Although rare, decussation anomalies do occur. Non-decussation may be the rule in patients with horizontal gaze palsy and scoliosis, and may possibly also occur in other scoliosis patients, congenital hemiplegia, mirror movements, other congenital cranial nerve dysinnervation disorders, or very rarely even otherwise normal individuals. Consequently, accurate SEP interpretation and monitoring should include decussation assessment with bilateral scalp recording to unilateral stimulation.

Teaching Points
2. Bilateral scalp recording to unilateral stimulation assesses decussation.
3. Decussation anomalies exist.
4. Accurate SEPs should include decussation assessment.

References