Electrical perceptual threshold testing in different spinal cord syndromes

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Introduction

Electrical perceptual threshold (EPT) testing is a promising method for quantitatively assessing sensation in people with spinal cord injury. EPT values depend on the dermatome tested (see normative template for healthy volunteers in Fig 1). Previous data from our group has shown that our results were consistent with international data[1,2] (Fig 1), showing reproducibility of EPT testing across continents.

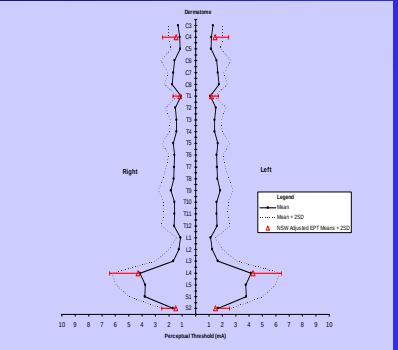

Figure 1. Adjusted mean of EPTs + 2 SD for 4 dermatomes obtained in NSW plotted against normative template for perceptual threshold to electrical stimulation (mean + 2 SD) by ASIA dermatomes (C3–S2). *Adapted by permission from Macmillan Publishers Ltd: Savic et al. Spinal Cord 2006; 44: 560-66, copyright 2006.*

Aim

To compare EPT results obtained from patients with different cord syndromes.

Methods

We applied EPT testing to 2 patients, 1 with an anterior cord syndrome and the other with predominantly central and posterior cord involvement. The person is asked when they first feel a tapping sensation as a square wave electrical current is increased at a constant rate. The current at which the person first feels the sensation is recorded as the EPT. The process is repeated 3 times and the lowest EPT value is plotted.

An ASIA and clinical examination was performed within 24 hours of EPT testing by a blinded, independent assessor.

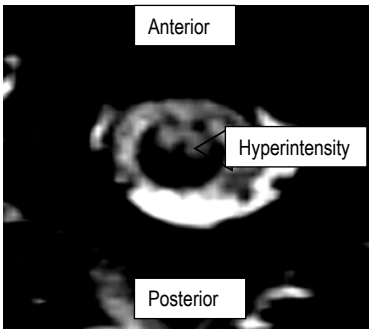

Figure 2: T2 weighted MRI of Patient 1 showing hyper intensity in the anterior aspect of the spinal cord.

Patient 1

- 48 y.o. male with anterior spinal artery infarct of cardio embolic cause
- T2 ASIA D paraplegia, anterior cord syndrome
- Clinical testing revealed:
  - preserved light touch sensation & proprioception
  - altered pinprick discrimination
- MRI shows ischaemic changes in the anterior portion of the spinal cord from T1-T4 (Fig 2).

Results

Patient 1's EPT values were plotted against the normative template, which includes means -2SD (Fig 3). Most EPT values fell within the normal range (mean +/- 2 SD) of the normative template and Patient 1 reported a tapping sensation similar to that perceived by healthy volunteers. This was consistent with preserved light touch sensation and proprioception found on clinical examination. Altered pinprick discrimination did not appear to alter the EPT values.

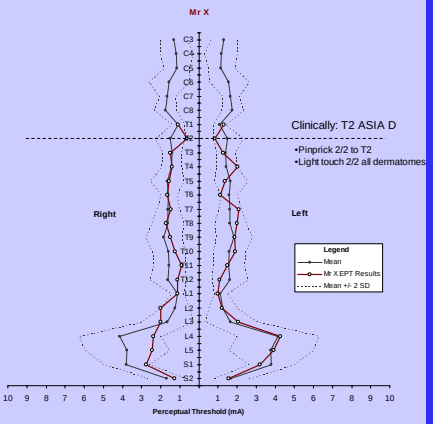

Figure 3: EPT results of Patient 1 plotted against normative template for perceptual threshold to electrical stimulation (mean +/- 2 SD) by ASIA dermatomes (C3–S2). *Adapted by permission (see Figure 1)*

Patient 2

- 58 y.o. male who had a fall
- C2 ASIA D tetraplegia, central cord syndrome
- Clinical course was complicated by syringomyelia within the posterior cord at the C3/4 level.
- Clinical testing revealed:
  - patchy sensory loss, worse for light touch than pinprick discrimination and worse on the right
  - severely impaired proprioception (worse on right)
  - good preservation of motor power in most myotomes

Results

Patient 2's EPT values were also plotted against the normative template (Fig 4). His EPT values fell outside the normal range more often on the right than on the left, correlating to clinical examination findings of altered light touch sensation that was worse on the right. Patient 2 found it difficult to feel the tapping sensation and often reported different sensations such as tightening and pricking.

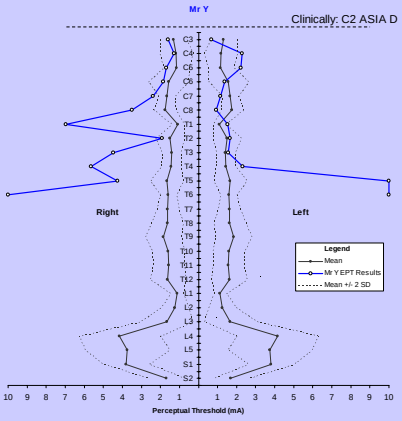

Figure 4: EPT results of Patient 2 plotted against normative template for perceptual threshold to electrical stimulation (mean +/- 2 SD) by ASIA dermatomes (C3–S2). *Adapted by permission (see Figure 1)*

Discussion

Our previous study on healthy volunteers found that at threshold, a tapping sensation was perceived, followed by sharp, pricking sensations when threshold was exceeded. Other studies have found that activation of the larger fibres is associated with a tapping or tingling sensation, with sharp pricking sensations perceived at higher stimulation of Aδ and possibly some C fibres[3,4]. The fastest, lowest threshold skin afferents project to the dorsal column nuclei[5,6]. In anterior cord syndrome, there is motor loss and incomplete sensory loss. In general, sensation subserved by the dorsal columns (light touch, vibration sense and proprioception) is preserved, but pinprick discrimination (spinothalamic tract) is altered.

Patient 1 has a typical anterior cord syndrome with preserved dorsal column function and it is interesting to note that despite altered pinprick discrimination, his EPT values lie within the normal range for healthy volunteers. This suggests that EPT testing activates large fibres which travel predominantly in the dorsal columns.

In Patient 2, there has been damage to the spinothalamic tract and dorsal columns. EPT values were grossly abnormal, often exceeding our safety limit of 10mA. Furthermore, the patient did not perceive a normal tapping sensation in many dermatomes. This suggests that alternative pathways to the dorsal column may have been activated at higher currents.

Conclusion

The square wave stimulation used in our EPT testing most likely activates the largest, lowest threshold afferents near the site of stimulation. These fibres are likely to project into the posterior column pathway to give rise to the tapping sensations reported by our subjects. This would be consistent with the normal EPTs found in Patient 1 with anterior cord syndrome, where posterior columns are preserved. EPT has the potential to add further information in the diagnosis of different spinal cord syndromes.

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