Journal Club: Improved diagnosis of spinal cord disorders with contact heat evoked potentials

Antonella Macerollo, MD
Johann Sellner, MD

Correspondence to
Dr. Macerollo
antonella.mac@hotmail.it

BACKGROUND AND SIGNIFICANCE Spinal cord disorders (SCD) comprise a group of traumatic injuries, vascular diseases, and infectious and inflammatory processes that cause spinal cord damage or dysfunction.1

Neurophysiologic tools, including evoked potentials, were shown to improve the sensitivity of clinical sensory testing in spinal cord injury. Dermatomal somatosensory evoked potentials (dSSEP) are recorded from the CNS following stimulation of sense organs elicited by tactile/electrical stimulation of a sensory/mixed nerve in the periphery. This technique is widely used in clinical routine as the gold standard for evaluation of the dorsal column pathways.2 In cases in which pain is in the foreground of the symptoms, laser evoked potentials (LEP) have proven suitable to study nociceptive pathways.3 Contact heat evoked potentials (CHEP) have been introduced recently to study nociceptive pathways. This technique allows studying the cerebral response to thermal stimuli mediated by Aδ and C fibers by using a contact thermode that rapidly increases skin temperature.4 A strong similarity between CHEP evoked potentials and LEP has been described.5 CHEP are advantageous with regard to obtaining reliable scalp potentials and absence of pain and cutaneous lesions compared to LEP. Thus, the function of ascending pathways of the spinal cord can be comprehensively investigated by combining dSSEP and LEP/CHEP.4 Recent guidelines including the recommendations from the European Federation of Neurological Sciences, however, recommend LEP but could not identify studies that demonstrate the diagnostic value of CHEP.6

HYPOTHESIS AND DESIGN The primary aim stated by Ulrich et al.7 was to assess the diagnostic value of CHEP in SCD. The authors investigated the sensitivity of CHEP compared with the current gold standard techniques (dSSEP, light touch [LT], and pinprick [PP]) to individuate specific ascending pathways involved in focal disorders of the spinal cord. This is a relevant question, as it has been speculated that CHEP offer a higher sensitivity but are currently not used routinely in clinical practice.8

The significance of this study is related to the large cohort of patients with SCD studied in a prospective study. Patients recruited were adults with different spinal cord lesions defined by MRI. They were studied in 3 different groups (complete, incomplete, diffuse and central-anterior) and further distinguished by the injury levels (cervical and thoracic cord), causes (traumatic and nontraumatic), and clinical impairment of SCD. The sensitivity of each test was assessed separately and was defined as the percentage of patients with at least one impaired dermatome at or below MRI lesion level.

METHODS All subjects underwent routine MRI of the spine (1.5T). Seventy-five patients (76% female) were enrolled (complete lesion n = 7, incomplete/diffuse n = 33, central/anterior n = 35). Patients were classified as incomplete-diffuse if they had an incomplete lesion of the spinal cord with a diffuse lesion pattern according to MRI. The larger patient groups were represented by traumatic SCD (n = 29) and chronic compressive myelopathies (n = 27), whereas the other groups were spinal cord ischemia (n = 7), myelitis (n = 5), and syringomyelia (n = 5). The mean age of the patients was 48.6 years (SD 18.5). CHEP and dSSEP were tested at the same dermatomes in each individual above and below the spinal lesion as defined by MRI. C3 was the most rostral dermatome tested. CHEP control values for peak latencies and amplitudes were established in a cohort of 31 healthy volunteers with an age range of 25–75 years. The normal values could be readily recorded in the cohort of healthy subjects in the predefined dermatomes. The normal peak latencies of N1 were the reference for the interpretation of dSSEP. The authors performed clinical sensory examination on the grounds of LT and PP testing. The examination was based on the protocol provided by the American Spinal Injury Association and performed according to

From the Sobell Department of Motor Neuroscience and Movement Disorders (A.M.). The National Hospital of Neurology and Neurosurgery, Institute of Neurology, University College London, UK; the Department of Neurosciences and Sense Organs (A.M.), Aldo Moro University of Bari, Italy; the Department of Neurology (J.S.), Christian-Doppler-Klinik, Paracelsus Medical University, Salzburg, Austria; and the Department of Neurology (J.S.), Klinikum rechts der Isar, Technische Universität München, Germany.

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INTERPRETATION

The weakness of this study, as stated by the authors, includes the choice of the cutoff level to consider CHEP as abnormal. This was defined as the mean 1 SD of the N2/P2 latency measured in the control group, which is rather loose for evoked potential analysis. Indeed, more than 70% of pathologic CHEP had no detectable N2/P2 peak. Concomitant intake of sedative or analgesic medications may have influenced the findings. It has been shown that the routinely recorded N2/P2 vertex component in CHEP correlates with perceived intensity of the heat stimulus and alertness. A possible influence of central neuropathic pain can be also argued, since it was not an exclusion criterion. Another limitation of the study was the recruitment bias. The major patient groups studied were traumatic spinal cord injuries and chronic compressive myelopathies. The current study does not reflect the spectrum of SCD in the general population of SCD. Further studies should not only focus on the potential dynamics in the course of SCD but also on individual characteristics in SCD such as different forms of spinal cord inflammation, cerebrovascular disorders, or developmental anomalies. This limitation compromises the opportunity to expand our knowledge on individual disease characteristics. Not only the group of controls needs to be expanded for the establishment of thresholds but also aging needs to be considered in this regard. Recent studies indicate that aging interferes with the nociceptive threshold. In addition, the initial negative latency correlates with sex, with shorter latencies noted in female patients.

The authors have shown that CHEP can provide a noninvasive additional clinical tool of potential utility in the evaluation of nociceptive pathways in SCD. The findings indicate that CHEP possess properties that are desired for an appropriate diagnostic test in SCD. Further research, including on use in patients with central neuropathic pain, and studies reporting applicability in clinical practice will disclose the value of CHEP over time.

AUTHOR CONTRIBUTIONS

Antonella Macerollo: design and conceptualization of the study, analysis and interpretation of the data, drafting and revising the manuscript.
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**REFERENCES**
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