Electrodiagnosis of lesions of median and ulnar nerve hand sensory branches. A case series

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INTRODUCTION

Two palmar proper digital nerves (PaPDNs) course along the lateral and medial side of each finger. PaPDNs are sensory terminal branches and derive from the three palmar divisions of the median nerve (PDMNs) and the superficial ulnar branch (SUB). They may be damaged by traumatic lesions of the palm of the hand and fingers, but their selective exploration with nerve conduction study (NCS) has long been difficult because of technical issues, which include innervation overlap, volume conduction artifacts, and the spread of the stimulating current to the intact PaPDNs. Moreover, carpal tunnel syndrome (CTS) may coexist with PaPDN damage and confuse the interpretation of conventional NCS findings. We have recently introduced a NCS technique for the selective antidromic stimulation of the PaPDNs at the hand webspace, and provided reference data, but validated it in two patients only. Here we applied our technique to a larger series of patients with clinical suspicion of PaPDN lesions with a twofold goal. The first aim was to document whether this technique could reliably document PaPDN damage, by comparing webspace NCS findings to those from surgical exploration. The second aim was to explore whether it may yield clear-cut results in patients with coexistent CTS.

SUBJECTS & METHODS

We included 19 patients (8 men, 46.8 ± 17.9 years, range: 24-77) with clinical suspicion of PaPDN, PDMN or SUB lesion. Apart from CTS, they did not have other comorbidities that might have influenced NCS results. All the subjects underwent selective antidromic PaPDN webspace stimulation and standard mixed nerve NCS at the wrist. For PaPDN stimulation, sensory nerve action potentials (SNAPs) were recorded with a Sierra Wave (Cadwell, Kennewick, WA, USA) electromyograph. PaPDN antidromic stimulation (stimulus duration 0.1 ms, intensity initially set at 0.5 mA and then increased by 0.5 mA steps until supramaximal stimulation) was done with a needle cathode placed in the webspace, and a surface anode on the dorsum of the hand (Figure 1). PaPDN SNAPs were recorded (sensitivity 20 μV/division; band pass filter 10–2000 Hz) from a pair of Ag-AgCl surface electrodes on the medial and lateral aspect of the fingers at the proximal and distal interphalangeal joints (Figure 1). Median and ulnar mixed nerve stimulation (stimulus duration 0.1 ms, stimulus intensity set at 1 mA, then increased by 1 mA until supramaximal stimulation) at the wrist was done with a bipolar stimulator, ring recording electrodes, and the same electromyograph, sensitivity and band pass filters as for selective PaPDN stimulation. The diagnosis and severity of CTS was made according to NCS criteria, including median-ulnar sensory latency difference, and confirmed with median nerve ultrasound. Data from normal controls were considered as the normative range for PaPDN stimulation.

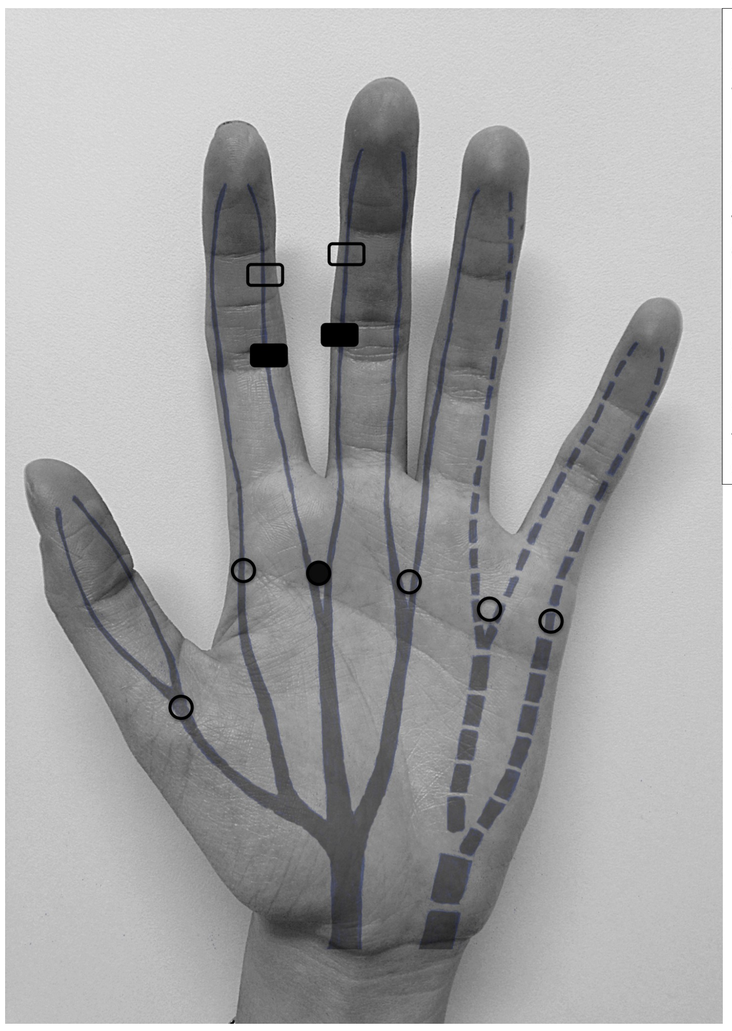

Figure 1. The open/closed circles show the position of the stimulating needle cathode, according to the hand palmar creases. The anatomy of the median and ulnar nerve hand sensory branches, which was verified by ultrasound in a normal subject, is shown in gray and superimposed on the hand. The stimulating cathode was placed on the palmar side of the hand in the webspace, and the reference anode was placed on the dorsal side of the hand in the space between two adjacent metacarpophalangeal joints in correspondence to the cathode. The closed circle shows the position of the cathode for stimulating the second PDMN. The rectangles show the position of the electrodes (closed rectangles: active electrodes, open rectangles: reference electrodes) to record SNAPs in the index finger medial PaPDN and the middle finger lateral PaPDN that are the branches of the second PDMN.

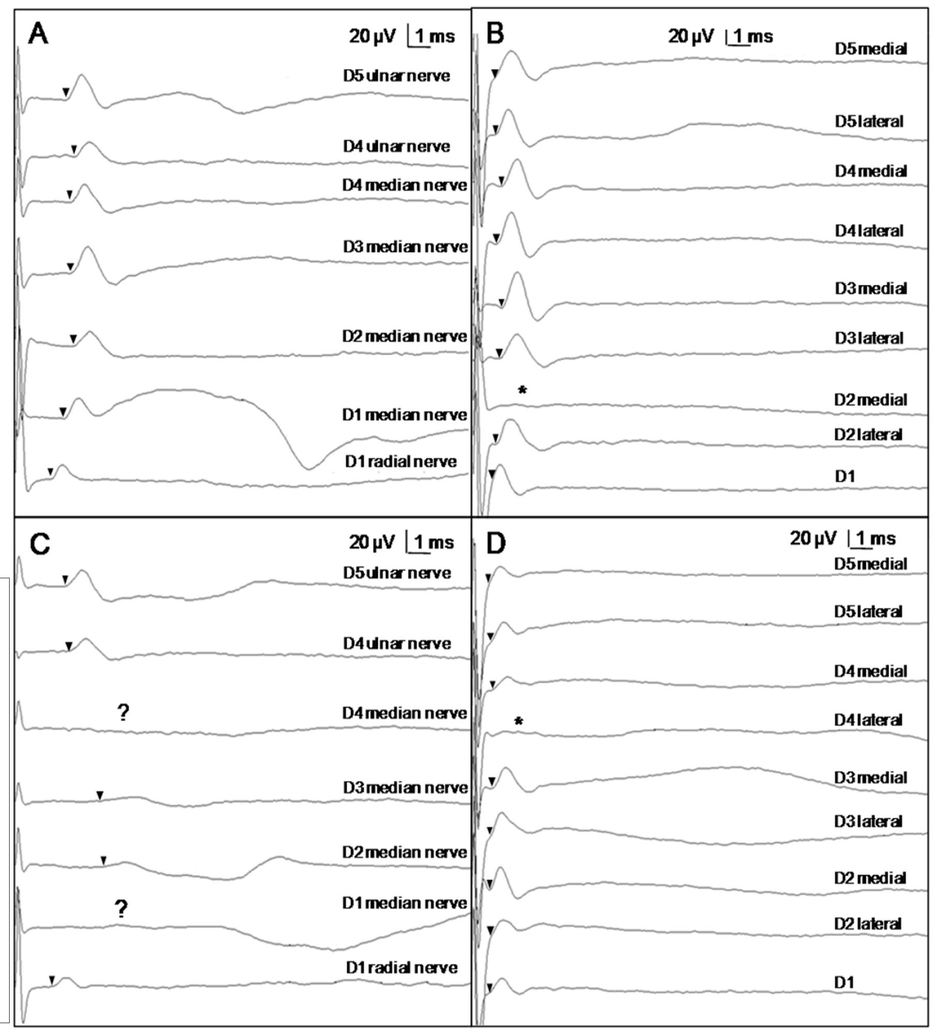

Figure 2. SNAPs to mixed nerve stimulation at the wrist and to webspace selective stimulation in two representative patients. The arrowheads (▼) indicate SNAPs onset. In patient 6, wrist stimulation yielded normal SNAPs in all fingers (panel A), but webspace stimulation documented damage to D2 medial PaPDN (panel B, marked by *). In patient 7, wrist stimulation showed the absence of SNAP in D4 and D1 (marked by ?) to median nerve stimulation at the wrist, and these findings were compatible with carpal tunnel syndrome, which was confirmed by ultrasound (panel C). In this patient, webspace stimulation documented that the SNAP was absent only in D4 lateral PaPDN (panel D, marked by *), indicating selective damage of this nerve in addition to median nerve entrapment at the wrist. D1 = thumb finger, D2 = index finger, D3 = median finger, D4 = ring finger, D5 = small finger.

RESULTS

The mechanism of nerve damage was cut in most patients (84%), and pressure (11%) or fracture (5%) in a minority. Conventional wrist mixed NCS showed absent SNAPs in the ring and fifth fingers with normal ulnar motor NCS, which were suggestive of SUB lesion, in patient 3, and absent SNAPs in ring finger with normal fifth finger SNAPs that indicated ring finger medial PaPDN lesion in patient 15. The findings from wrist NCS were inconclusive in the other patients, even when compared to those from the contralateral side. Selective webspace NCS yielded clear-cut results and documented DPMN lesion in 6 patients, SUB lesion in one, and PaPDN lesion in 12 patients. SNAP was absent in 17 patients (89%) and markedly reduced in two. When compared to standard mixed nerve NCS, webspace technique was informative in 17 patients (89%). CTS was found in 11 patients (58%). Coexisting CTS represented a source of bias in the interpretation of mixed NCS findings in 10 out of 11 patients (91%), but webspace stimulation clearly documented a sensory branch lesion in all of them. Examples of representative patients are reported in Figure 2. All the patients underwent surgical exploration, which confirmed nerve damage (nerve loss-of-continuity in 15 patients, neuroma-in-continuity in three, intraneural hematoma in one), and were treated with suture of the damaged nerve.

DISCUSSION

We investigated the clinical utility of antidromic PaPDN stimulation at the webspace in a group of patients with PDMN, SUB, and PaPDN lesions. We documented that webspace stimulation offers additional information when compared to standard mixed nerve NCS and that it may give clear-cut results in patients with median sensory branches lesion when CTS coexist. We documented that SNAPs could be easily and clearly obtained for normal radial and ulnar PaPDNs, even in elderly patients, despite age may reduce PaPDNs SNAP amplitude. The only finger where the two PaPDNs could not be separated was the thumb, because they bifurcate from the division of the lateral PDMN at the metacarpophalangeal joint and cannot be separately stimulated. Webspace NCS offered additional information in comparison to mixed nerve stimulation in the majority of patients, except two of them. Patient 3 had complete SUB damage, which was already clear at ulnar wrist NCS. Webspace stimulation was not helpful in one patient, who had ring finger medial PaPDN lesion, because for this finger the medial and lateral PaPDNs derive from the ulnar and median nerves respectively, and can be explored separately by mixed nerve wrist stimulation. Absent PaPDN SNAP was the commonest finding, and markedly reduced SNAP amplitude was found in two patients, but we did not document patients with reduced SNAP latency. This result probably depends on the presence of nerve loss-of-continuity in most of our patients. Future studies should explore the role of our technique in studying patients with coexisting polyneuropathies to understand if it can separate axonal vs. demyelinating damage. More than half of the patients had coexisting CTS. This finding is not surprising, because many hand lesions are caused by work accidents, and occur in people prone to CTS because of work-related repetitive traumas. In most of them, coexisting CTS confused the interpretation of wrist NCS. At variance, the results of webspace stimulation was clear-cut, as CTS had no or minimal influence on SNAP amplitudes, which were larger than to wrist stimulation because of the reduced temporal dispersion with shorter distance between the stimulating and recording electrodes. An example was patient 7 (Figure 2), where the absence of ring finger SNAP to median wrist stimulation could be ascribed to moderate CTS, as this SNAP is known to be involved earlier in CTS course, but webspace stimulation clearly documented the selective damage of ring finger lateral PaPDN.

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