Ultrasound study is useful to discriminate between axonotmesis and neurotmesis also in very small nerves: a case of sensory digital ulnar branch study

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Abstract
Discrimination between axonotmesis and neurotmesis is crucial in traumatic nerve injury. We present the case of a 43-year-old woman which presented hypoesthesia in the fourth and fifth right fingers, started after surgery for Dupuytren syndrome. At ultrasound study, the ulnar digital sensory branch was identified. Before the division into the two terminal branches, a neuroma was observed, while neurotmesis was excluded. This case shows the utility of ultrasonography in peripheral nervous system examination and the possibility of visualization of very small nerves and their terminal branches.

Keywords: ultrasonography, ulnar nerve, neuroma.

Introduction
Discrimination between axonotmesis and neurotmesis is crucial in traumatic nerve injury in order to make a comprehensive diagnosis, decide the appropriate therapy, and make a prognostic judgment. Neurophysiologic evaluation, the traditional tool to assess nerve function, cannot distinguish the two types of damage. Ultrasonography (US) allows the clinician to view most nerves, thus providing crucial information for nerve assessment. Thanks to the progressive improvement of probes, even nerves of very small size can be now visualized. The following case demonstrates the usefulness of ultrasound in studying very small nerves and the possibility to discriminate axonotmesis from neurotmesis.

Case presentation
A 43-year-old woman presented to our neurophysiology lab for hypoesthesia in the fourth and fifth right fingers. These symptoms started acutely after surgery for Dupuytren syndrome (retraction of the flexor tendons of the fifth finger of the right hand).

At neurophysiologic evaluation, sensory electroneurography (ENG) of ulnar nerve revealed marked reduction of sensory action potential (SAP) amplitude of the fourth digit-wrist segment and absence of SAP in the fifth digit-wrist segment. Motor ENG showed normal compound motor action potential amplitude recorded from right abductor digitii minimi with normal distal motor latency. Motor-sensory ENG of median nerves and left ulnar nerve was normal. The clinical picture strongly suggested iatrogenic damage of the sensory branch of right ulnar nerve and, on the basis of nerve conduction studies, axonotmesis or neurotmesis was suspected.
At US study, the right ulnar nerve was visualized in the distal forearm; its course was followed until the palm of the hand. The nerve showed cross action area (CSA) within normal values in all the examined segments. At the level of the right ulnar styloid, the palmar cutaneous sensory branch was visualized and, about 5 cm distal, in the palm, the ulnar digital sensory branch supplying the volar fifth and medial fourth fingers was also identified. The branch was well depictable and, before the division into the two terminal branches, proximal to the scar, a neuroma (mild hypoechoic enlargement, CSA 4 mm²) was observed. Distally the nerve was normal and the two digital branches were also identified. On the basis of US findings, neurotmesis damage was excluded.

The patient underwent surgery expecting to not graft the nerve. Surgeons confirmed the continuity of the nerve and found that the palmar digital artery to the fourth finger was occluded (fig 1).

**Discussions**

Nerve lesions may be caused by different factors, such as direct contusion or laceration, mechanic damage by bone fragments, stretching or traction, and iatrogenic damage. It is often difficult to establish the exact site, mechanism, severity, and type of nerve damage, in particular in closed traumas and or postsurgical cases. All these information are crucial in decision of the appropriate therapeutic approach and in making a prognosis. Neuroma is a non-neoplastic and disorganized proliferation of axons in a background of Schwann cells, perineurial cells, and connective tissue elements. It occurs at the site of partial or complete nerve transaction, when the gap between the severed ends is wide or filled with inflammatory cells or collagenous scar. In such cases, the attempt of nerve regeneration is unsuccessful, resulting in a mass known as traumatic neuroma. Neuromas may also represent a post-surgical complication. They are demarcated, slow growing and often painful masses at the site of injury and arise at the proximal stump.

US has a well established role in the assessment of the peripheral nervous system and its damages [1,2]. In particular, its most important contribution is to allow the differential diagnosis between axonotmesis and neurotmesis, while neurophysiologic studies are not useful in such cases. Moreover, it should be considered that US is a low cost and non-invasive procedure and it is better accepted by the patients in comparison to magnetic resonance imaging. It might be considered as an initial imaging modality, reserving magnetic resonance imaging for doubtful cases. Its diagnostic accuracy also increases with clinician experience, so it should be performed by expert neurologists. So, all patients with suspected peripheral nervous system disorders that are candidate for surgical treatment should be evaluated clinically, neurophysiologically and sonographically in order to obtain the most complete picture of patients’ conditions. Indeed, US may help neurologists and neurophysiologists in choosing the best therapeutic approach.

Recently, great attention has been placed on the role of US in the assessment of the peripheral nervous system; a growing amount of data in the literature progressively underline its importance in different settings, such as carpal tunnel syndrome [3-5], ulnar neuropathy at the elbow [6-7], polyneuropathies [8], and post herpetic neuralgia [9]. Moreover, US allows a dynamic examination of peripheral nervous system and the study of long nerve segments in a short time; it is a non-invasive and low cost procedure and it is better accepted by the patients in comparison to magnetic resonance imaging.

The described case demonstrates that US has a high resolution power, allowing the visualization of very small nerves and their terminal branches, thus extending US role in diagnostic procedures. To our knowledge, there are no other cases published about US examination of digital ulnar branch neuromas.

**Fig 1.** A. The surgical scar (arrow) and the site of neuroma (arrowhead); B. The right fourth distal branch of palmar cutaneous sensory nerve; C. The occluded palmar digital artery to the fourth finger.
References