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EDITORIAL

Peripheral nerve imaging: Not only cross-sectional area

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Abstract

Peripheral nerve imaging is recognized as a complement to clinical and neurophysiological assessment in the evaluation of peripheral nerves with the ability to impact patient management, even for small and difficult nerves. The European Society of Musculoskeletal Radiology, suggest to use ultrasound (US) for nerve evaluation due to the fact that, in sever anatomical area, magnetic resonance imaging is not able to give additional informations. US could be considered the first-choice approach for the assessment of peripheral nerves. The relative drawback of peripheral nerve US is the long learning curve and the deep anatomic competence to evaluate even small nerves. In the recent years, the role of US in peripheral nerve evaluation has been widened. In the past, nerve US was mainly used to assess nerve-cross sectional area, but now more advanced measurements and considerations are desirable and can boost the role of peripheral nerve US. Nerve echotexture evaluation was defined in 2010: The ratio between the hypoechoic and hyperechoic areas of peripheral nerves on US was called "nerve density". For evaluation of patients who have peripheral neuropathies, the role of peripheral nerve is US wider than simple cross-sectional area evaluation. Quantitative measurements describing the internal fascicular echotexture of peripheral nerves introduce the concept of considering US as a possible quantitative imaging biomarker technique. The potential of nerve US has started to be uncovered. It seems clear that only cross-sectional area measurement is no more sufficient for a comprehensive US evaluation of peripheral nerves.

Key words: Ultrasound; Imaging; Magnetic resonance imaging; Nerve density; Fascicular ratio

Core tip: Ultrasound (US) is a possible quantitative imaging biomarker technique for peripheral nerves evaluation. The potential of nerve US has therefore started to be uncovered and it seems clear that only cross-sectional area measurement is no more sufficient for a comprehensive US evaluation of peripheral nerves.

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INTRODUCTION

Peripheral nerve imaging is recognized as a complement to clinical and neurophysiological assessment in the evaluation of peripheral nerves with the ability to impact patient management, even for small and difficult nerves[1-7]. In daily radiological clinical practice, ultrasound (US) and magnetic resonance imaging (MRI) are the technics of choice. The European Society of Musculoskeletal Radiology, suggest to use US for nerve evaluation due to the fact that, in sever anatomical area, MRI is not able to give additional informations[8]. For deep nerve or central disease, conventional MRI, MRI neurography, diffusion tensor imaging, fiber tractography[9] and 3D MRI[10] are promising but are not always available and need long acquisition time. Therefore, US could be considered the first-choice approach for the assessment of peripheral nerves. US is a relative low-cost technique, widely available and with dynamic capabilities[1-13]. In addition, evaluation of the entire limb during a unique exam is possibly with great spare of time compared to MRI. The relative drawback of peripheral nerve US is the long learning curve and the deep anatomic competence to evaluate even small nerves[1-14]. To improve the knowledge of peripheral nerve US, the International Society of Peripheral Neurophysiological Imaging (http://www.ispni.org/), founded in 2014, supports the pivotal role of peripheral nerve US in the assessment of patients with suspect peripheral nerve pathological involvement. Not surprisingly, in the recent years, the role of US in peripheral nerve evaluation has been widened[15,16]. In the past, nerve US was mainly used to assess nerve-cross sectional area[17-22], but now more advanced measurements and considerations are desirable and can boost the role of peripheral nerve US.

Nerve echotexture evaluation was defined in 2010. Our research group, using US, developed a software that quantifies the ratio between the hypoechoic and hyperechoic areas of peripheral nerves on US[23]. We called this parameter: "nerve density"[23]. We evaluated sixty-five different patients and (n = 65) controls (age range, 35-81 years; mean 55 years) prospectively. Nerve density was capable of discriminating between normal and pathologic nerves of patients affected by carpal tunnel syndrome or neurofibromas. Moreover, nerve density measure was useful to discriminate between patients with mild and severe Carpal Tunnel Syndrome[23].

In addition, we defined and quantitatively evaluated the fascicular ratio (FR) on MRI in patients with peripheral neuropathies compared with healthy controls[24,25]. On MRI, FRs were significantly increased in patients compared with controls (FR, 76.7 ± 15.1 *vs* 56 ± 12.3; $P < 0.0001$ for the semiautomatic interface; and FR 66.3 ± 17.5 *vs* 47.8 ± 18.4; $P < 0.0001$ for the automatic interface). The increase in FR was caused mainly by an increase in the hypointense part of the nerve and this observation was valid for all causes of neuropathies[24,25].

CONCLUSION

For evaluation of patients who have peripheral neuropathies, the role of peripheral nerve is US wider than simple cross-sectional area evaluation[25]. Quantitative measurements describing the internal fascicular echotexture of peripheral nerves introduce the concept of considering US as a possible quantitative imaging biomarker technique[22]. Indeed, quantitative assessment of nerve echogenicity or the FR has been considered a step further in the evaluation of peripheral nerves by the means of US[23-27]. The potential of nerve US has started to be uncovered. It seems clear that only cross-sectional area measurement is no more sufficient for a comprehensive US evaluation of peripheral nerves.

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