Thieme

How small can small nerves be for diagnostic ultrasonography?

Wie klein können kleine Nerven sein für den diagnostischen Ultraschall?

Prof. Dr. Uwe Walter

Correspondence
Prof. Dr. Uwe Walter
Klinik und Poliklinik für Neurologie
Universitätsmedizin Rostock, Gehlsheimer Str. 20,
18147 Rostock, Germany
Tel.: ++49/3 81/4 94 96 96
Fax: ++49/3 81/4 94 47 94
uwe.walter@med.uni-rostock.de

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Ultrasonography is the method of choice for imaging the peripheral nervous system [1]. Clinically, imaging especially of small peripheral nerves is relevant for the following purposes: (i) their localization for avoiding harm during surgical or other invasive procedures [2–4], (ii) the targeting of therapeutics or surgical procedures at these nerves [5–9], and (iii) the measuring of their caliber for assessing compressive, inflammatory or degenerative neuropathies [12–18].

In the recent decade high-frequency (15–25 MHz) and ultra-high-frequency (30–70 MHz) ultrasound probes became available for medical diagnostic use, that allowed, along with advanced image post-processing, for the improved visualization of small nerves and nerve fascicles (▶ **Table 1**) [19]. This has opened the door to a more precise diagnostic assessment of small subcutaneous sensory nerves, especially the detection of its entrapment or traumatic lesion [20–23]. High-resolution ultrasonography also allows for the detection of gender-related differences of nerve calibers and may reveal fiber-type specific changes of small nerves with aging and in neurodegenerative disorders [24]. Local inflammation of small nerve branches has been visualized [25]. First data suggest that ultra-high resolution ultrasonography may enable a more detailed assessment of inflammatory neuropathies thanks to the better display of single nerve fascicles [19]. High-resolution ultrasound-guided anaesthetic blockade of small subcutaneous nerves is increasingly applied to relieve and prevent local pain [26, 27].

Nerve ultrasound is a good example for the swift transfer of technological advances into clinical applications by multiple clinical disciplines. Many more new diagnostic and therapeutic applications of nerve ultrasonography can be expected.

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Die Sonografie ist die Methode der Wahl für die Bildgebung des peripheren Nervensystems [1]. Klinisch ist die Darstellung insbesondere der kleinen peripheren Nerven für folgende Anwendungen relevant: (i) ihre Lokalisierung, um Schäden während chirurgischer oder anderer invasiver Eingriffe zu vermeiden [2–4], (ii) die Zielführung applizierbarer Therapeutika oder chirurgischer Eingriffe an diesen Nerven [5–9], und (iii) zur Bestimmung ihres Kalibers für die Beurteilung von kompressiven, entzündlichen oder degenerativen Neuropathien [12–18].

In den letzten 10 Jahren wurden hochfrequente (15–25 MHz) und ultrahochfrequente (30–70 MHz) Ultraschallsonden für die medizinische Diagnostik entwickelt, die zusammen mit der hochentwickelten Bildnachbearbeitung eine verbesserte Visualisierung kleiner Nerven und Nervenfaszikel ermöglichen (▶ **Tab. 1**) [19]. Dies hat die Tür zu einer genaueren diagnostischen Beurteilung kleiner subkutaner sensorischer Nerven geöffnet, insbesondere zur Detektion ihrer Kompression oder traumatischen Läsion [20–23]. Die hochauflösende Sonografie ermöglicht auch die Erkennung geschlechtsspezifischer Unterschiede bei den Nervenkalibern und kann Fasertyp-spezifische Veränderungen kleiner Nerven bei zunehmendem Alter und bei neurodegenerativen Erkrankungen aufzeigen [24]. Auch eine lokale Entzündung kleiner Nervenäste wurde dargestellt [25]. Erste Daten legen nahe, dass die ultrahochauflösende Sonografie aufgrund der besseren Visualisierung einzelner Nervenfaszikel eine detailliertere Untersuchung entzündlicher Neuropathien ermöglichen könnte [19]. Die hochauflösende ultraschallgesteuerte Anästhesieblockade von kleinen subkutanen Nerven wird zuneh-

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▶ **Table 1** Comparison of ultrasound frequency, image resolution, and exemplary nerves.

Frequency [MHz]	image resolution[1]		imaging depth[1] [mm]	typical nerve/structure
	Axial [mm]	lateral [mm]		
5	0.30	1.0	100	schiatic nerve
10	0.16	0.6	50	tibial nerve
15	0.12	0.4	20	median nerve
20	0.07	0.2	14	supraorbital nerve
30	0.05	0.18	9	proper digital nerve
40	0.04	0.14	6	superficial motor nerve fascicles
50	0.03	0.07	4	subcutaneous sensory nerve fascicles

[1] Given are rough values that can vary depending on tissue composition, quality of ultrasound transducer, and image post-processing technology.

mend angewendet, um lokale Schmerzen zu lindern bzw. zu verhindern [26, 27].

Nervenultraschall ist ein gutes Beispiel für den schnellen Transfer von technologischen Neuerungen in die klinische Praxis über eine Vielzahl klinischer Fachgebiete hinweg. Viele weitere neue diagnostische und therapeutische Anwendungen der Nervensonografie sind zu erwarten.

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