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Letter to the Editor

Median nerve dissection after brachial artery catheterization revealed by high-resolution ultrasound

Traumatic peripheral nerve injuries are relatively frequent complications of endovascular diagnostic and therapeutic procedures. High median nerve (MN) palsy has been reported after brachial artery cannulation, with an estimated incidence of MN injury in up to 1.4% of patients undergoing cardiac catheterization (Kennedy et al., 1997). Several mechanisms have been implicated in the periprocedural MN impairment after puncture of the adjacent brachial artery. Firstly, nerve compression may occur due to hematoma or (pseudo-) aneurysm formation; secondly, focal nerve ischemia may occur due to compression of the vasa nervorum (Patten, 1969); thirdly, direct nerve impairment may be caused by inappropriately inserted forceps, arterial ligatures or needle tips (Kennedy et al., 1997). In the latter occasion, MN dissection (corresponding initially to Sunderland class 1 due to nerve compression with ensuing class 3 or 4 due to endoneurial or perineurial damage (Sunderland, 1991)) may be noted as result of intraoperative tear of the epineurium and rupture of the vasa nervorum with consecutive bleeding within the perineurium (Fig. 1a).

High-resolution ultrasound (HR-US) is a widely-available imaging modality that enables the depiction of anatomical details of peripheral nerves and allows the accurate distinction between nerve structures from surrounding vessels and muscle tissue (Walker et al., 2018). As the assessment of the extent of nerve damage is often not possible during the first weeks after nerve trauma by means of classical electrophysiological studies (i.e., nerve conduction studies and electromyography), HR-US is an invaluable modality for early diagnosis and classification of peripheral nerve injury. Moreover, as improved outcomes from early surgical intervention have been shown for patients diagnosed with nerve torsion or neurotmesis, early evaluation of the continuity, morphology and extent of nerve damage by means of HR-US is crucial (Walker et al., 2018).

Here we present a 47-year-old man, who presented with dysesthesia of the palmar and dorsal nail beds of the lateral three-and-a-half digits and palsy of the left flexor digitorum superficialis (causing weakness of flexion of the 2nd digit at the proximal interphalangeal joint, MRC 4/5) directly after ipsilateral brachial artery catheterization for insertion of an iliac side branch endoprosthesis for endovascular aneurysm repair (EVAR) of a right common iliacal artery aneurysm. Pre- and post-operatively the patient was treated with aspirin (100 mg po qd). On clinical examination, a cutaneous hematoma in the left upper arm was noted at the site of brachial artery puncture (approx. 12 cm above the cubital fossa). Based on the post-operative sensorimotor deficits a suspected diagnosis of MN neurapraxia (Sunderland 1) or axonotmesis (Sunderland 2–4) was reached, but no electrophysiological or HR-US studies followed. Two months after the EVAR procedure, the patient presented with persistent and consistently-distributed dysesthesias, positive Tinel's sign at the site of brachial artery puncture, but fully recovered motor function. The motor and sensory MN conduction studies were normal (Table 1 in Fig. 1). Despite the normal findings of the motor MN conduction study (with recording site over the left abductor pollicis brevis) a subclinical involvement of MN fibers innervating the flexor digitorum superficialis could not be ruled out. Due to the absence of motor deficits at this point, suggesting sufficient functional recovery, and the reluctance of the patient to undergo needle electromyography, this was not performed. Nevertheless, due to the positive Tinel's sign and the persisting symptoms, HR-US (6–14 MHz linear probe, Mindray UMT-400 Ultrasound System, Shenzhen Mindray Bio-Medical Electronics Co., Ltd.) was performed and revealed a proximal MN dissection at the site of brachial artery puncture without evidence of concomitant hematoma or pseudoaneurysm formation.

MN dissection was visualized as a focal nerve distention with evident separation of the connective tissue layers and false lumen formation, depicted in an axial scan, as a hypoechogenic, intramural, crescent-shaped fluid formation between the epineurium and the underlying perineurium (Fig. 1b). In a sagittal scan, sub-epineurial fluid was shown with consequent nerve fascicle compression, accompanied by focal nerve edema. Power mode US revealed no active bleeding. Along the MN course, no fibrous scarring tissue or neuroma formation was noted. At follow-up, six months after the EVAR procedure, the patient presented with mild dysesthesias of the lateral three-and-a-half digits. Yet, due to the subsidence of the clinical deficits and the absence of findings of neuroma formation on HR-US, no neurosurgical treatment was recommended.

Currently, the percutaneous brachial approach is being increasingly used for endovascular procedures. This case illustrates the utility of HR-US for diagnosis of patients presenting with neuropathies after arterial catheterization. Although in this case, post-operative HR-US was not performed, we stress the importance of early sonographic evaluation of patients with post-procedural neuropathic symptoms, especially when anticoagulation or antiplatelet regimens are administered, in order to exclude active arterial or epineurial bleeding and (pseudo-) aneurysm formation. In the case of nerve dissection, after diagnosis has been reached, sonographically guided percutaneous fine-needle aspiration (FNA) for evacuation of the epineurial hematoma may be discussed as an acute decompressive option to reduce entrapment symptoms (Chuang et al., 2002). If significant MN compression is noted or if the sonographic findings suggest concomitant nerve torsion, immediate neurosurgical assessment should follow. Furthermore, we stress the importance of follow-up in patients diagnosed with MN dissection, firstly, to evaluate the hematoma absorption and

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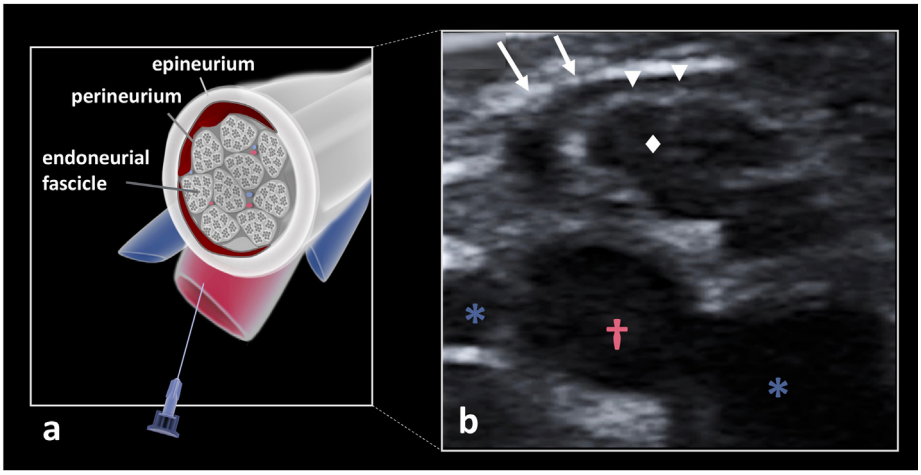

Fig. 1. High-resolution ultrasound (HR-US) reveals median nerve (MN) dissection in a patient after brachial artery catheterization for endovascular aneurysm repair. (a) Schematically shows MN impairment after needle insertion in the adjacent brachial artery, causing tear of the epineurium and rupture of the vasa nervorum with consecutive bleeding within the perineurium. (b) An axial HR-US image shows the MN (rhombus) dissection in our patient, depicted as focal nerve distention with hypoechogenic, false lumen formation due to separation of the epineurium (arrows) from the underlying perineurium (arrow tips). The adjacent brachial artery and brachial veins are depicted with a red cross and blue asterisks, respectively. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Table 1
Motor and sensory nerve conduction studies of the left median nerve.

	Recording site	Amplitude distal/proximal (mV)	NCV (m/s)	DML (ms)	F-wave (ms)
Motor NCS	APB	11.3/10.6	50	4.4	28.0
	Recording site	Amplitude (μV)		DSL (ms)	
Sensory NCS	2nd digit	7.7		2.9	

Abbreviations: NCS: nerve conduction study; APB: abductor pollicis brevis; NCV: nerve conduction velocity; DML: distal motor latency; DSL: distal sensory latency.

secondly, to exclude secondary formation of perineurial scarring tissue. In the latter occasion, neurosurgical exploration or neurolysis may be indicated for symptomatic patients. Finally, we underline that HR-US holds significant advantages in reducing the risk of perioperative peripheral nerve injury when utilized to guide arterial catheterization in the setting of percutaneous cardiovascular and neurovascular interventions. In addition, peripheral nerve injury may be also noted after placement of peripherally inserted central catheters or intravenous devices (Cartwright et al., 2005). Therefore, we recommend performance of arterial or deep vein catheterization under HR-US imaging, and particularly in patients undergoing endovascular procedures under anticoagulant or antiplatelet treatments.

Conflict of interest statement

None of the authors have any conflicts of interest or financial ties to disclose.

References

Cartwright MS, Donofrio PD, Ybema KD, Walker FO. Detection of a brachial artery pseudoaneurysm using ultrasonography and EMG. Neurology 2005;65:649.
Chuang YM, Luo CB, Chou YH, Cheng YC, Chang CY, Chiou HJ. Sonographic diagnosis and treatment of a median nerve epineural hematoma caused by brachial artery catheterization. J Ultrasound Med 2002;21:705–8.
Kennedy AM, Grocott M, Schwartz MS, Modarres H, Scott M, Schon F. Median nerve injury: an underrecognised complication of brachial artery cardiac catheterisation? J Neurol Neurosurg Psych 1997;63:542–6.
Patten BM. Neuropathy induced by hemorrhage. Arch Neurol 1969;21:381–6.
Sunderland S. Nerve injuries and their repair: a critical appraisal. Churchill Livingstone; 1991.
Walker FO, Cartwright MS, Alter KE, Visser LH, Hobson-Webb LD, Padua L, et al. Indications for neuromuscular ultrasound: expert opinion and review of the literature. Clin Neurophysiol 2018;129:2658–79.

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