Cite as: Antenucci P, Carlucci D, Pugliatti M, Lucchetta M: Considerations about the multidimensional evaluation of a stab wound tibial neuropathy: a case report. J Ultrason 2023; 23: e97–e100. doi: 10.15557/JoU.2023.0017.

Submitted: 19.10.2022
Accepted: 12.01.2023
Published: 28.04.2023

Considerations about the multidimensional evaluation of a stab wound tibial neuropathy: a case report

Pietro Antenucci[1], Domenico Carlucci[2], Maura Pugliatti[1], Marta Lucchetta[2]

[1] *Department of Neurosciences and Rehabilitation, University of Ferrara, Italy*
[2] *Division of Neurology, Santa Maria della Misericordia Hospital, Rovigo, Italy*

Corresponding author: Pietro Antenucci; e-mail: pietro.antenucci1@gmail.com

DOI: 10.15557/JoU.2023.0017

Keywords

peripheral nerve diagnosis; nerve ultrasound; sciatic nerve; tibial nerve; mononeuropathy

Abstract

We present a rare case of a traumatic lesion of the tibial fibers of the sciatic nerve with spared peroneal fibers. A 33-year-old victim of a three month earlier stabbing attack came to our attention with gait impairment and weakened left foot plantar flexion and left foot internal rotation and supination. Based upon clinical signs and neurophysiological investigations we suspected that a traumatic injury of the left tibial nerve had occurred. Ultrasound examination detected a lesion of part of the left sciatic nerve, in a different site than expected. The patient was immediately enlisted for a tailored surgical reconstruction.

Introduction

Mononeuropathy is a damage or a dysfunction of a single peripheral nerve, resulting in muscle weakness, numbness, tingling or pain in the innervated area. Nerve trauma is a common cause of acquired mononeuropathy and a major source of disability among younger people[1,2]. A multidimensional evaluation through ultrasound examination (US) and neurophysiological examination can provide a meaningful contribution in the diagnostic and therapeutic approach of traumatic mononeuropathies[3,4]. The role of a comprehensive assessment of the peripheral nerve pathology should be highlighted in clinical practice, especially when multiple sources of potential nerve injuries are present.

Case report

We report the case of a 33-year-old man who came to our attention after being a victim of a stabbing attack, which had occurred three months earlier, resulting in multiple knife wounds. No clinical reports or imaging investigation had been recorded at the time of the event. His past medical history was significant for alcohol and cocaine abuse five years before. He presented at least four lesions at the posterior face of the left thigh and the left leg, subsequently developing severe gait impairment with abolished left foot plantar flexion and chronic intermittent pain radiating from the injured thigh to the foot plantar region. Physical examination showed hyposthenia in the left leg: the Medical Research Council Scale for Muscle Strength was 2/5 in foot and toe plantar flexion, in foot internal rotation and supination. Triceps surae reflex was absent. No other neurological symptoms and signs were reported and no left anterior leg muscles were involved. The rest of the physical examination was unremarkable. No abnormalities were found in blood tests. A left lower tibial nerve injury was suspected, and a neurophysiological examination was performed.

Nerve conduction study showed absent motor response after left tibial nerve proximal and distal stimulation (Tab. 1), while left peroneal nerve conduction recorded in the fibular nerve territory, as well as sensitive response of the left sural nerve were normal (Tab. 2). Needle electromyography showed significant hallmarks of denervation without recruitment patterns of motor units of the lower muscles innervated by the left tibial nerve at rest and during voluntary contraction. The muscles of the left anterior leg showed normal activity. (Tab. 3). All the electrical activity recorded in the right lower limb was within normal limits. A severe neuropathy of the left tibial nerve was diagnosed.

US was performed for the assessment of the suspected traumatic tibial nerve lesion in the patient. The left tibial nerve was detected just below the popliteal fossa and then antidromically followed all along its course up to the lower division of the sciatic nerve trunk. Surprisingly, no signs of lesion were detected at this level. A hypoechoic swelling of the sciatic nerve, one cm in length, was instead detected more proximally, twenty cm below the left gluteal fold secondary to another cutaneous injury. The swelling was followed by a second three cm-long hypoechoic swelling similar to the one described above. Between them, apparently untouched nerve fascicles with a significant reduction of the trunk cross-sectional area were detected. Even more proximally, the nerve structure appeared normal (Fig. 1). These findings were found to be consistent with a partial lesion of the sciatic nerve fibers, without a complete structural inter-

Tab. 1. Motor nerve conduction study. At the level of the left medial malleolus and fibular head, compound motor action potentials (CMAPs) of the left tibial nerve are not elicited. CMAPs of the left common peroneal nerve and CMAPs of the right lower limb are within normal limits

Left tibial nerve	Nerve/ Positions	Latency ms	Peak amplitude 2–4 mV	Distance cm	Velocity m/s
Medial malleolus 1	Right common peroneal nerve				
50 ms 5 mV	Ankle (1)	5,15	15,7		
	Fibular head (2)	10,85	14,7	27	47,4
	(3)	13,05	14,0	10	45,5
	Left common peroneal nerve				
	Ankle (1)	5,35	7,4		
	Medial malleolus (2)	5,25	10,0		
	Fibular head (3)	11,95	8,9	30	44,8
Fibular head 2	(4)	14,30	8,7	10	42,6
50 ms 5 mV	Right tibial nerve				
	Medial malleolus (1)	5,50	21,1		
	Fibular head (2)	4,85	21,8		

Tab. 2. Sensory nerve conduction study. Sensory action potentials (SAPs) of the left sural nerve are non-significantly reduced compared to the right lower limb. SAPs of bilateral superficial peroneal nerves are within normal limits

Nerve/ Positions	Site	Latency	Peak amplitude 2–3 μV	Distance cm	Velocity m/s
Sural – Lateral malleolus					
Left sura	Lateral malleolus	2,55	14,0	11,5	45,1
Right sura	Lateral malleolus	2,45	22,6	11	44,9
Superficial peroneal – foot					
Left lateral leg	Foot	1,75	28,4	10	57,1
Right lateral leg	Foot	1,80	27,6	10	55,6

ruption of the trunk: between the two traumatic neuromas, nerve fibers appeared to be spared. Considering neurophysiological results together with US findings, we concluded for a traumatic injury to the tibial fibers of the left sciatic nerve located in the median third of the thigh, with peroneal fibers apparently spared. A neurotmetic nature of the lesion was suspected with a high degree of confidence. The nerve lesion was found to be significantly more proximal than expected. The patient was immediately enlisted for a reconstructive procedure of direct nerve repair, tailored to the site and the degree of the unexpected lesion and scheduled for elective surgery.

Discussion

The sciatic nerve arises from the lumbosacral plexus and descends posteriorly in the thigh generating two main terminal nerves, the common peroneal nerve and the tibial nerve, which are already well-defined inside the sciatic nerve trunk before the division(5). Traumatic injuries to the tibial division are rather rare lesions among acquired sciatic neuropathy and they are usually located below the distal thigh downstream of the tibial nerve origin(6).

Neurotmesis is a complete physiological and anatomical transection of both axons and connective tissue of a peripheral nerve(3). Without a surgical approach, regeneration of the nerve is unlikely(2) and early surgical interventions often result in the best outcome(3,7), for these reasons neurotmetic lesion requires a rapid identification of site and degree of the injury(8).

Neurophysiological studies provide functional information with significant efficiency, but anatomical and morphological detailing often requires neuroimaging assessment(9).

Magnetic Resonance Neurography and US have emerged as the most comprehensive imaging modalities in the assessment of peripheral nerve pathology and their applications are mostly based on clinical experience and their availability(10,11).

US of the peripheral nerve system requires a linear multifrequency transducer with frequencies up to 15 MHz(12). Higher-frequency transducers, up to 17 to 18 MHz, can be useful for scanning the nerve in the ankle area and more distally. Frequency may need to be lowered for patients of larger body habitus(13). On US, nerves appear more echogenic than muscles and less echogenic than tendons and in a longitudinal view, a nerve appears as a hypoechoic stripe (nerve fascicles) partitioned by hyperechoic lines (perineurium)(14). This imaging

Tab. 3. Needle Electromyography. Significant hallmarks of denervation without recruitment patterns of motor units of the lower muscles innervated by the left tibial nerve at rest and during voluntary contraction. Muscles of the left anterior leg show normal activity

	Spontaneous					Motor unit action potential			Recruitment
	Insertion activity	Fibrillations	Positive sharp wave	Fasciculations	High frequency	Amplitude	Durations	Polyphasic potentials	Pattern
Left tibialis anterior	Normal	None	None	None	None	Normal	Normal	Normal	-
Left vastus lateralis	Normal	None	None	None	None	Normal	Normal	Normal	Normal
Left gastrocnemius (MED)	+	++	+++	+	None	0	0	0	0
Left tibialis posterior	+	+	+++	+	None	0	0	0	0
+, ++, +++ – degree of finding severity; 0 – absen									

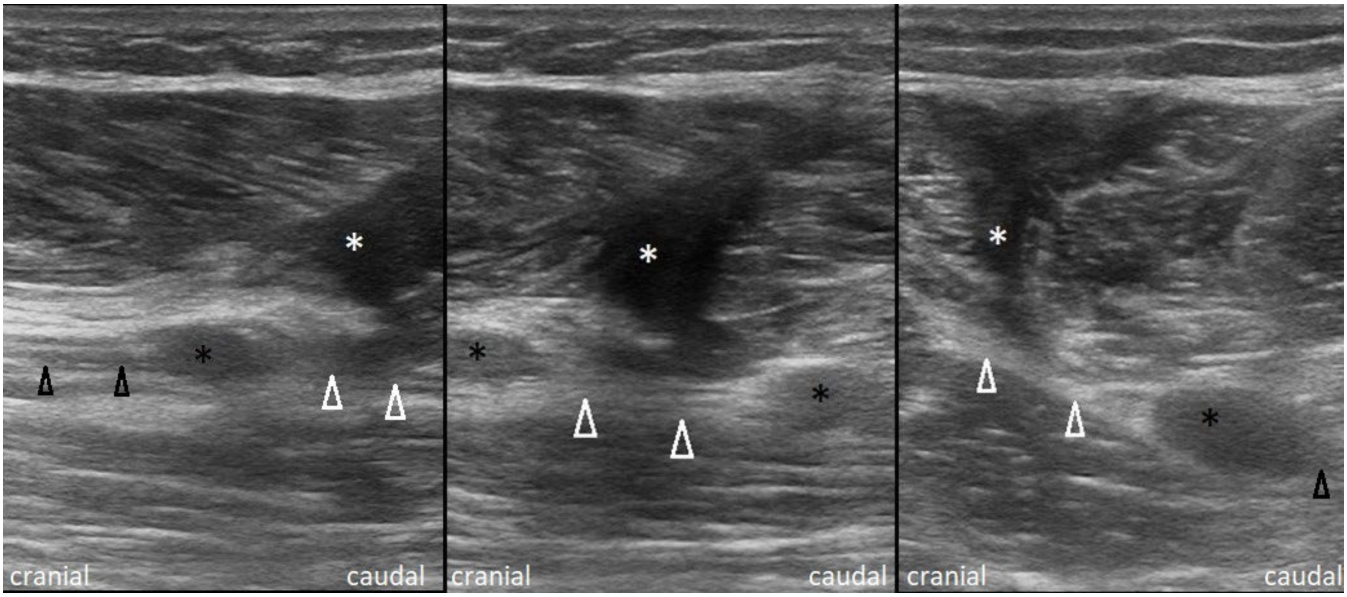

Fig. 1. *Long-axis ultrasound imaging of the left sciatic nerve through a posterior, sovra-popliteal approach of the left thigh with a longitudinally orientated linear multifrequency probe (12–15 mHz). Sciatic nerve (black arrowheads) in continuity with two hypoechoic neuromas (black asterisks). The cranial neuroma is located at a depth of around 4.2 cm from the cutaneous surface, with a long axis length of 0.9 cm and a short axis cross sectional area up to around 59 mm² in its largest part. The caudal neuroma is located at a depth of around 3.7 cm from the cutaneous surface, with a long axis length of 1.2 cm and a short axis cross sectional area up to around 65 mm² in its largest part. Between them, intact fascicles on the nerve course (white arrowheads). Superiorly, one stab wound lesion (white asterisk)*

technique can assess structural abnormalities of nerve trunk thanks to a very high spatial resolution and a high sensitivity especially for detecting focal neuropathic injuries[15]. US has also a pivotal role in estimating the degree of lesions together with physical examination, clinical expertise and neurophysiological findings[16], and in diagnosing many types of peripheral neuropathies in asymptomatic stages through elastography, an US application capable of evaluating the biological tissue stiffness[17]. In brief, US of the peripheral nervous system is an essential diagnostic contribution and helps guide treatment decisions without side effects and with a high level of tolerance[18].

Regarding the case, relying only on the clinical presentation of our patient and neurophysiological findings together with the presence of multiple scars in the left leg close to the nerve path, we suspected severe neuropathy of the left tibial nerve. Three months had passed from the event, so a neurotmetic damage had likely occurred. Imaging investigations appeared to be necessary to confirm the diagnosis and to plan the future therapeutic approach. Those considerations led us to perform US of the peripheral nerve as a first choice. US allowed us an easy and immediate access to the entire course of the nerve with identification of the unexpected site of the injury on the sciatic trunk and confirmation of the lesion degree.

In conclusion, a multidimensional diagnostic approach including US should be part of the clinical practice for the assessment of traumatic peripheral nerve pathology, especially when a neurotmetic damage is suspected and a surgical intervention is potentially required. Based on our experience, when a traumatic lesion with a tibial neuropathy-like presentation occurs consequently to multifocal cutaneous wounds of the lower limbs, the involvement of the sciatic nerve should be excluded. US could also be considered as an appropriate choice for this neuroimaging request.

Conflicts of interest

The authors do not report any financial or personal connections with other persons or organizations which might negatively affect the contents of this publication and/or claim authorship rights to this publication.

Author contributions

Writing of manuscript: PA. Analysis and interpretation of data: PA, DC. Final acceptation of manuscript: ML. Critical review of manuscript: MP, ML.

References

1. Fuller G: Diagnosing and managing mononeuropathies. Clin Med 2004; 4: 113–117. doi: https://doi.org/10.7861/clinmedicine.4-2-113
2. Simon NG, Spinner RJ, Kline DG, Kliot M: Advances in the neurological and neurosurgical management of peripheral nerve trauma. J Neurol Neurosurg Psychiatry 2016; 87: 198–208. doi: 10.1136/jnnp-2014-310175
3. Grinsell D, Keating CP: Peripheral nerve reconstruction after injury: a review of clinical and experimental therapies. Biomed Res Int 2014: 698256. doi: 10.1155/2014/698256
4. Korus L, Ross DC, Doherty CD, Miller TA: Nerve transfers and neurotization in peripheral nerve injury, from surgery to rehabilitation. J Neurol Neurosurg Psychiatry 2016; 87: 188–197. doi: 10.1136/jnnp-2015-310420
5. Yuen EC, So YT: Sciatic neuropathy. Neurol Clin 1999; 17: 617–631. doi: 10.1016/s0733-8619(05)70155-9
6. Gosk J, Rutowski R: Traumatic injuries of the tibial nerve: etiopathogenesis and surgical outcome. Ortop Traumatol Rehabil 2005; 7: 406–410.

7. Gordon T: Peripheral nerve regeneration and muscle reinnervation. Int J Mol Sci 2020; 21: 8652. doi: 10.3390/ijms21228652

8. Ciaramitaro P, Mondelli M, Logullo F, Grimaldi S, Batiston B, Sard A *et al.*: Traumatic peripheral nerve injuries: epidemiological findings, neuropathic pain and quality of life in 158 patients. J Peripher Nerv Syst 2010; 15: 120–127. doi: 10.1111/j.1529-8027.2010.00260.x

9. Domkundwar S, Autkar G, Khadilkar SV, Virarkar M: Ultrasound and EMG–NCV study (electromyography and nerve conduction velocity) correlation in diagnosis of nerve pathologies. J Ultrasound 2017; 20: 111–122. doi: 10.1007/s40477-016-0232-3

10. Morag Y, Yang LJS: Imaging nerve pathology of the knee: magnetic resonance imaging and ultrasound. Semin Musculoskelet Radiol 2017; 21: 122–136. doi: 10.1055/s-0037-1599206

11. Holzgrefe RE, Wagner ER, Singer AD, Daly CA: Imaging of the peripheral nerve: concepts and future direction of magnetic resonance neurography and ultrasound. J Hand Surg Am 2019; 44: 1066–1079. doi: 10.1016/j.jhsa.2019.06.021

12. Qrimli M, Ebadi H, Breiner A, Siddiqui H, Alabdali M, Abraham A *et al.*:. Reference values for ultrasonograpy of peripheral nerves. Muscle Nerve 2016; 53: 538–544. doi: 10.1002/mus.24888

13. Becciolini M, Pivec C, Riegler G: Ultrasound imaging of the deep peroneal nerve. J Ultrasound Med 2021; 40: 821–838. doi: https://doi.org/10.1002/jum.15455

14. Ranjan T, Chandak S, Malhotra A, Aggarwal A, Haria J, Singla D: Role of high-resolution ultrasonography in the evaluation of the tibial and median nerves in diabetic peripheral neuropathy. J Ultrason 2022; 22: 209–215. doi: 10.15557/JoU.2022.0035

15. Padua L, Di Pasquale A, Liotta G, Granata G, Pazzaglia C, Erra C *et al.*: Ultrasound as a useful tool in the diagnosis and management of traumatic nerve lesions. Clin Neurophysiol 2013; 124: 1237–1243. doi: 10.1016/j.clinph.2012.10.024

16. Padua L, Liotta G, Di Pasquale A, Granata G, Pazzaglia C, Caliandro P *et al.*: Contribution of ultrasound in the assessment of nerve diseases. Eur J Neurol 2012; 19: 47–54. doi: https://doi.org/10.1111/j.1468-1331.2011.03421.x

17. Zakrzewski J, Zakrzewska K, Pluta K, Nowak O, Miłoszewska-Paluch A: Ultrasound elastography in the evaluation of peripheral neuropathies: a systematic review of the literature. Pol J Radiol 2019; 84: e581–e591. doi: 10.5114/pjr.2019.91439

18. Coraci D, Faiola A, Mazzola L, Padua L: "United we stand, divided we fall": The multidimensional evaluation of neurotmesis. A specific case and literature review based on graph theory. Neurophysiol Clin 2021; 51: 480–482. doi: 10.1016/j.neucli.2021.03.003