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Neuromuscular Ultrasound in the Diagnosis of Focal Neuropathies Superimposed on Polyneuropathy: A Case Report

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Neuromuscular ultrasound is an emerging technique for the diagnosis of a variety of nerve and muscle conditions, and it has proven particularly helpful in the evaluation of focal neuropathies. (Wiesler et al., 2006) In these conditions, focal enlargement of nerve cross-sectional area can be detected and quantified with ultrasound. One of the more difficult diagnoses to establish with electrodiagnostic studies is that of a focal neuropathy superimposed on a polyneuropathy. In our lab, we have found ultrasound to be a very helpful complement to electrodiagnostic studies in this type of situation, and the following case illustrates its use in the diagnosis of several focal neuropathies in an individual with polyneuropathy.

A neurology consult was requested for a hospitalized 61 year-old man with frequent arm jerks. His history included 20 years of insulin-dependent diabetes, renal cell carcinoma with vertebral metastases (without nerve root involvement), and end-stage renal disease requiring hemodialysis (secondary to bilateral nephrectomies). The jerks were thought to be asterixis from uremia, but it was noted that he had atrophy and weakness in the intrinsic hand muscles, so nerve conduction studies and electromyography (EMG) were ordered.

Physical examination showed an average built man with prominent atrophy of the bilateral first dorsal interossei (FDI), abductor digiti minimi (ADM), and abductor pollicis brevis (APB) muscles. Strength in the FDI and ADM muscles was 3/5 with APB being 4/5 bilaterally. The rest of the strength testing was unremarkable, with full strength in ulnar and median innervated finger flexor muscles. Deep tendon reflexes were diminished symmetrically in the arms (1+ at biceps and triceps) and absent in the legs. Sensation to pinprick was diminished symmetrically below the mid-shin level and at all finger tips bilaterally, and we also noted severe diminution of pin prick sensation in the ulnar distribution of the hands, out of proportion to the median and radial distributions.

His nerve conduction studies demonstrated absent antidromic sensory responses in the bilateral median and ulnar nerves, with reduced amplitude of the right radial nerve (12uV, normal is > 20uV). The right ulnar motor showed no response and the left showed a prolonged distal latency (4.1 ms, normal is < 3.5ms), low amplitude (1.8mV, normal is > 6.0mV), and conduction velocity slowing around the elbow (49 m/s in forearm and 26 m/s across elbow, normal is > 49 m/s). Both median motor studies showed prolonged distal latencies (6.0 ms on right and 5.8 ms on left, normal is < 4.4 ms) and only mild velocity slowing in the forearm segment (44 m/s both sides, normal is > 49 m/s).

Based on these nerve conduction study results, it was suspected that he had polyneuropathy, bilateral ulnar mononeuropathies at the elbows, and bilateral median mononeuropathies at

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the wrists. EMG was considered, but the patient had already experienced a fair amount of discomfort with the nerve conduction studies. In addition, extensive EMG would be needed to confirm the multiple diagnoses (polyneuropathy and bilateral ulnar and median mononeuropathies), and it was possible that EMG could not further localize the multiple processes. Therefore, neuromuscular ultrasound was used to further investigate his condition.

High-resolution ultrasound of the bilateral ulnar and median nerves was obtained using an Esaote Biosound MyLab 25 (Esaote Group, Genoa, Italy) with an 18 MHz linear array transducer. Each nerve was examined, with a cross-sectional view, from the wrist to the upper arm, and focal areas of interest were also examined in the sagittal view. Focal enlargement of nerve cross-sectional area was seen in the ulnar nerves at the elbows and the median nerves at the wrists (Figure 1). At these areas of focal enlargement the nerves were noted to be hypoechoic with loss of the normal “honeycomb” architecture (Figure 1). Neither ulnar nerve subluxed with flexion of the elbow.

Based on the nerve conduction studies and neuromuscular ultrasound, he was diagnosed with a sensorimotor axonal polyneuropathy and superimposed bilateral ulnar mononeuropathies at the elbows and median mononeuropathies at the wrists. The polyneuropathy was likely from diabetes, although chronic uremia was possible as well. The focal mononeuropathies were suspected to be caused by entrapment.

One of the more difficult diagnostic scenarios in clinical medicine occurs when similar symptoms arise from two separate pathophysiologic processes. This challenge is not uncommon in electrodiagnostic medicine, and the possibility of focal neuropathy superimposed on polyneuropathy is often considered in electrodiagnostic cases. Diabetes is a frequent cause of polyneuropathy and it is estimated that more than 6% of all cases of median mononeuropathy at the wrist and ulnar mononeuropathy at the elbow are seen in diabetics. (Mondelli et al., 2009) A combination of detailed nerve conduction studies and EMG can often establish the diagnosis of focal mononeuropathy and polyneuropathy in the same individual, but extensive testing is needed and in some cases it is just not possible to demonstrate both with electrodiagnosis alone. For this reason, alternative diagnostic methods are needed.

Neuromuscular ultrasound is an emerging field with increasing diagnostic capabilities, and we use it routinely in the diagnosis of individuals with focal mononeuropathy superimposed upon a polyneuropathy, as demonstrated with this case. Many studies have demonstrated focal nerve enlargement with mononeuropathies, (Wiesler et al., 2006) and recent reports have focused on ultrasonographic findings in polyneuropathies. (Cartwright et al., 2009; Zaidman et al., 2009) Ultrasonography in demyelinating polyneuropathies shows diffuse or patchy nerve enlargement, whereas axonal polyneuropathies do not show the same degree of nerve enlargement. (Zaidman et al., 2009) In addition, previous studies have demonstrated that peripheral nerves are consistent in cross-sectional area throughout their course, and focal enlargement of the median nerve at the distal wrist crease greater than 1.5 times the nerve area in the forearm is an accurate cut-off for the diagnosis of carpal tunnel syndrome. (Hobson-Webb et al., 2008) Therefore, we consider a focal nerve cross-sectional area enlargement of greater than 1.5 times the area of adjacent portions of the nerve to be abnormal and consistent with a mononeuropathy, particularly when this is seen just proximal to a common area of entrapment.

Neuromuscular ultrasound is painless, radiation-free, inexpensive, readily accessible, and it provides high-resolution images of peripheral nerves. For these reasons it is an ideal

complement to nerve conduction studies and EMG, and as this case demonstrates, it can improve diagnostic capabilities in some of the more challenging electrodiagnostic scenarios.

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Abbreviations

ADM	abductor digiti minimi
APB	abductor pollic brevis
CTS	carpal tunnel syndrome
EMG	electromyography
FDI	first dorsal interosseous

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Nerve	Location	Area (mm ²)	
		Left	Right
Ulnar	4 cm distal to medial epicondyle	8	12
	At the medial epicondyle	21	32
	4 cm proximal to medial epicondyle	7	8
Median	Wrist	13	16
	Proximal Forearm	7	6

Figure 1.

Ultrasound of the right ulnar (A and B) and median (C and D) nerves (the nerves are marked with an “N” in each image). The top images show the ulnar nerve at 4cm distal to the elbow (image A, cross-sectional area is 12mm²) and at the level of the medial epicondyle (image B, area is 32mm²). The bottom images show the median nerve in the forearm (image C, area is 6mm²) and at the distal wrist crease (image D, area is 16mm²). In addition to focal enlargement at the site of entrapment, the nerves are also hypoechoic at these sites. The nerve cross-sectional areas are provided below the images for all sites measured.