



## August 1997 EMG Case-of-the-Month

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### **HISTORY**

A 57-year-old Vietnamese man presents with a 2 month history of progressive numbness of the left small finger and left hand weakness. Past medical history is significant for shrapnel injury to the left wrist 30 years ago.

The patient was also seen for EMG 1 1/2 years ago at which time a right C8 radiculopathy was diagnosed, based upon the clinical examination and evidence of denervation in the first dorsal interosseous, flexor pollicis longus, and cervical paraspinal muscles. The neck pain and right upper limb symptoms have since resolved.

- **Prior to continuing, please develop a differential diagnosis and list each diagnosis in order of likelihood.**
- **Is there any additional information from the clinical history that might be helpful in clarifying your differential list or changing its order of priority?**

### **COMMENTARY I**

Given the prior EMG indicating right (contralateral) C8 radiculopathy, one is concerned about cervical spondylosis and the possibility of a new left sided cervical radiculopathy at the same level. It would be interesting to know if the patient has neck pain.

The history of shrapnel injury to the left wrist raises the possibility of ulnar neuropathy at or near the wrist. It is also possible, but less likely, that this patient's symptoms could come from ulnar neuropathy at the elbow or perhaps a lower brachial plexus lesion. Added history clarifying the distribution of sensory symptoms may help further localize the lesion.

### **HISTORY, continued**

The patient denies any recent neck pain. It is difficult, through the interpreter, to obtain clear information about the distribution of sensory symptoms. The patient does indicate that both dorsal and palmar aspects of the small finger are involved, but is unclear whether or not the palm or forearm have impaired sensation.

- **If necessary, please revise your differential diagnosis based on the additional clinical history.**
- **On what details of the physical examination do you think you should focus at this point?**

### **COMMENTARY II**

Absence of neck pain makes C8 radiculopathy less likely, but does not completely exclude this possibility. Ulnar neuropathies at the wrist typically impair sensation to the palmar



aspect of the hand, unless there is isolated involvement of the deep motor branch, in which case cutaneous sensation is completely spared. Ulnar neuropathies in the forearm or about the elbow occur proximal to the dorsal ulnar cutaneous branch and hence usually impair sensation over the dorsal aspect of the hand as well. C8 radiculopathies or brachial plexopathies, since they occur proximal to the medial antebrachial cutaneous nerve, may cause sensory symptoms in the medial forearm in addition to the hand.

## PHYSICAL EXAMINATION

Muscle strength testing in the upper limbs is limited by give-way weakness. It is at least 4/5 throughout, but subtle weakness cannot be ruled out. No muscle atrophy is apparent. Sensation to pinprick is reduced along the dorsal and palmar aspects of the left small finger. Sensation in the palm is not impaired. Muscle stretch reflexes are 2+ and symmetric at the biceps, brachioradialis, and triceps. An old scar is noted over the volar aspect of the left wrist, approximately 2 cm proximal to the distal wrist crease.

- **At this point, review your differential diagnosis and revise as appropriate.**
- **Are there additional observations on physical examination that might be helpful in narrowing your differential list?**

## COMMENTARY III

The physical examination seems to have offered little additional information to narrow down the differential diagnosis list. Hence the differential diagnoses still include: C8 radiculopathy, ulnar neuropathy at the wrist or elbow, or possibly lower brachial plexopathy.

## PHYSICAL EXAMINATION, continued

No other neurologic deficits are found.

- **Design your approach to the electrophysiologic examination based on the existing data.**

## COMMENTARY IV

The electrodiagnostic examination should be tailored to explore each of the possible sites of pathology included in the differential diagnosis list. The ulnar nerve should be evaluated throughout its length by appropriate nerve conduction studies, with special attention to the most likely sites of involvement, i.e. the elbow and wrist. The possibility of C8 radiculopathy should be explored by needle examination of C8 innervated muscles supplied by ulnar, radial, and median nerves, as well as paraspinal muscles. This combination of the needle examination and nerve conduction studies will also evaluate for a brachial plexus lesion affecting the lower trunk or medial cord.



**ELECTROPHYSIOLOGIC DATA**

<b>ELECTROMYOGRAPHY</b>										
N = normal incr = increased decr = decreased 0 = absent 1+ = minimal 4+ = maximal crd = complex repetitive discharge fasc = fasciculation potential myk = myokymic discharge myt = myotonic discharge nmt = neuromyotonic discharge p wave = positive sharp waves fib = fibrillation potentials recr = recruitment amp = amplitude dur = duration poly = polyphasic potentials										
R/L	MUSCLE	INSERTION		SPONTAN		VOLUNTARY				
		activ	p wave	fib	other	recr	amp	dur	poly	effort
L	deltoid	N	0	0	0	N	N	N	N	full
L	biceps brachii	N	0	0	0	N	N	N	N	full
L	triceps brachii	N	0	0	0	N	N	N	N	full
L	abductor digiti minimi	N	0	0	0	N	N	N	N	full
L	abductor pollicis brevis	N	0	0	0	N	N	N	N	full
L	1 <sup>st</sup> dorsal interosseous	N	0	0	0	decr	N	N	N	full
L	extensor indicis proprius	N	0	0	0	N	N	N	N	full
L	cervical paraspinals	N	0	0	0	-	-	-	-	-

<b>SENSORY and MIXED NERVE CONDUCTION</b>										
nr = no response										
NERVE	RECORD	LATENCY (ms)			AMPLITUDE (µV)			CONDUCT VEL (m/s)		
		R	L	Norm	R	L	Norm	R	L	Norm
ulnar	ring finger	-	-	-	-	-	-	-	-	-
wrist	-	3.4	3.5	-	22	41	-	-	-	-
median	ring finger	-	-	-	-	-	-	-	-	-
wrist	-	3.4	3.1	-	46	64	-	-	-	-

<b>MOTOR NERVE CONDUCTION</b>											
nr = no response											
NERVE	RECORD	LATENCY (ms)			AMPLITUDE (mV)			CONDUCT VEL (m/s)			
		R	L	Norm	R	L	Norm	R	L	Norm	
ulnar	-	-	-	-	-	-	-	-	-	-	
wrist	abd dig min	2.9	3.0	-	14.2	17.1	-	-	-	-	
below elbow	-	5.6	5.6	-	14.1	16.6	-	59	58	-	
above elbow	-	7.6	6.9	-	13.3	15.8	-	62	65	-	
axilla	-	9.1	9.5	-	12.9	14.7	-	57	54	-	



ulnar	-	-	-	-	-	-	-	-	-	-
wrist	1 <sup>st</sup> dors int	3.2	3.1	-	7.1	20.3	-	-	-	-
below elbow	-	5.9	5.8	-	6.9	20.2	-	59	56	-
above elbow	-	8.1	7.2	-	6.8	12.8	-	56	61	-
axilla	-	9.6	9.9	-	6.7	12.7	-	57	52	-
ulnar (inching)	1 <sup>st</sup> dors int	-	-	-	-	-	-	-	-	-
4cm below med epi	-	-	6.0	-	-	21.1	-	-	-	-
2cm below med epi	-	-	6.3	-	-	21.2	-	-	-	-
medial epicondyle	-	-	6.6	-	-	13.2	-	-	-	-
2cm above med epi	-	-	7.4	-	-	13.1	-	-	-	-
4cm above med epi	-	-	7.8	-	-	13.0	-	-	-	-

Ulnar motor nerve conduction studies recording from abductor digiti minimi (ADM) are completely normal, as are ulnar sensory conduction studies. However, ulnar motor conduction studies recording from first dorsal interosseous (FDI) demonstrate a focal conduction block at the elbow, between the medial epicondyle and a point 2 cm distal. Approximately 35% of the axons are blocked over this 2 cm segment. Contralateral studies are normal.

Needle EMG demonstrates reduced recruitment in the first dorsal interosseous, but no evidence of denervation in any muscles tested.

- **On the basis of both the clinical and electrodiagnostic evaluations, formulate your final impression. List the most likely diagnosis followed by other possibilities that are not excluded by the data. Eliminate those diagnoses not supported by the data.**

1. There is electrodiagnostic evidence of left ulnar neuropathy at the elbow. The lesion is neurapraxic without evidence of axon loss and occurs just distal to the medial epicondyle. Fascicles supplying the first dorsal interosseous are selectively affected while those supplying the abductor digiti minimi are spared.
2. There is no electrodiagnostic evidence of C8 radiculopathy or brachial plexopathy affecting the left upper limb.

**COMMENTARY**

Electrodiagnostic studies in this patient were helpful in resolving a diagnostic question that could not have been answered otherwise. While recurrent C8 radiculopathy was initially high on the list of differential diagnoses, and ulnar neuropathy at the site of prior shrapnel injury was second, a third somewhat less likely diagnosis was actually revealed to be the cause of the patient's symptoms.

This case is of particular interest in several respects:

1. There is focal conduction block without evidence of axon loss.
2. The FDI muscle is selectively affected, while the ADM is spared.



3. Could peripheral nerve anomaly cause the electrical findings?

Conduction block is demonstrated in this case by the sudden drop in compound muscle action potential (CMAP) amplitude at the elbow, while recording from FDI. A drop in amplitude of approximately 35% is noted over a 2cm segment just distal to the medial epicondyle. This drop far exceeds any expected value that might result from temporal dispersion alone, and indicates a neurapraxic injury has occurred. There are several findings indicating no axon loss has taken place:

- a. Distal CMAP amplitudes are normal.
- b. Distal SNAP amplitudes are normal.
- c. There is no evidence of denervation on needle EMG.

Thus, given the presence of selective neurapraxia with full axon preservation, prognosis is good for a complete recovery.

Selective involvement of the FDI, sparing the ADM, has been reported (see references). Apparently, the fascicles supplying FDI are more likely to sustain injury than those supplying ADM, even at the elbow, despite being a considerable distance proximal to the branching of these fibers. In this patient, recording from ADM alone would have missed the lesion entirely. In our laboratory we always record from 2 channels (ADM and FDI) when evaluating for ulnar neuropathy and have encountered several cases similar to this one.

Whenever a selective drop in amplitude is noted in ulnar nerve studies, particularly recording from the FDI, one must ask whether or not a forearm anastomosis could be responsible. The Martin-Gruber anastomosis, typically a crossover from median to ulnar nerves in the forearm, produces a drop in amplitude of the ulnar CMAP as one stimulates proximally along the upper limb. The FDI is the most commonly affected muscle. This drop is noted as one moves across the site of where the anastomosis joins the ulnar nerve in the proximal forearm. Thus the drop is seen between wrist and below-elbow stimulation sites, and is potentially confused with ulnar neuropathy in the forearm. In contrast, "conduction block" at the elbow is more proximal than the anastomosis and cannot be confused with Martin-Gruber anomalies.

Whenever a drop in amplitude is noted between wrist and below elbow sites, a search for Martin-Gruber should be carried out. The test simply involves recording from ulnar innervated hand muscles (FDI and ADM) while stimulating the median nerve at the elbow. The best recording site for FDI includes placement of the active electrode over the midpoint of the muscle and the reference proximally over the CMC joint of the thumb. Presence of a sizeable, initially negative potential indicates presence of the anomaly.

## BIBLIOGRAPHY

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