



## EMG CASE No. 63, July 2003

### Presenting Symptom(s): Neck pain, arm pain, and right hand numbness

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**Appropriate Audience:** Residents and practicing physicians

**Learning Objectives:** After completing this educational activity, participant will be able to:  
1) formulate common differential diagnoses for presenting complaints of neck pain and hand numbness, 2) identify the findings in "EMG disease," and 3) in managing patients with "EMG disease," explain the limitations of EMG as a diagnostic tool and explain how the electrodiagnostic study should be modified.

**This case is no longer available for CME credit.**

### History

A 52-year-old right hand dominant man presents with a 4-month history of insidious onset, worsening neck pain, right upper limb pain, and numbness and tingling in the medial 3 digits of the right hand. He denies any recent trauma or inciting event, and denies ever having these symptoms in the past. He is unable to identify specific aggravating factors other than increased activity in general. Treatment to date has included physical therapy, hot packs, and NSAIDs with no improvement. His past history is significant for hypertension, high cholesterol, gout, and hypothyroidism. He has never had neck or back surgery or significant trauma. He is married and employed as an apartment manager. His symptoms have not interfered with his job, but have prevented him from participating in his usual hobbies. He smokes one pack per day and drinks alcohol in moderation.

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

### Commentary I

The differential diagnosis at this point is very broad. Therefore, prior to proceeding to the physical examination, the differential can be narrowed to the most commonly seen problems in your electrodiagnostic laboratory with this presentation. Some of the diagnoses that should be considered include cervical radiculopathy, plexopathy, radiculitis, proximal or distal entrapment neuropathies, and myofascial pain syndrome.

### History, continued

When asked to rank his problems in order with the most bothersome first, he says the neck pain is far worse than anything else. His pain in the arm is only present when the neck pain is very severe. He denies any weakness in the arms or hands. The numbness in the hand is annoying but not severe. He does awaken with hand numbness occasionally.



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

## Commentary II

Severe neck pain can be seen in radiculopathy, radiculitis, cervical disc disease, and myofascial syndrome. The physical examination will yield key information that should help support or refute these diagnoses. The history of awakening with hand numbness is suggestive of carpal tunnel syndrome.

### Physical Examination

There is no notable atrophy, deformity, or asymmetry of the upper extremities. He has limited range of motion in the neck in all planes secondary to pain. Spurling's maneuver produces axial neck pain. Cervical traction and axial compression do not alter his symptoms. There are tender points on palpation of the cervical paraspinal and upper trapezius muscles bilaterally, worse on the right. Shoulder and elbow examination is normal. Tinel's at the wrists and elbows are negative. Compression over the median nerve at the wrists does not exacerbate symptoms.

- 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 so far supports the diagnosis of myofascial neck pain. Spurling's maneuver is negative, but radiculopathy is still possible. Tests for entrapment neuropathies are negative. However, the sensitivity of these tests is relatively poor, so negative findings are less meaningful than positive findings.

### Physical Examination, continued

The neurological examination shows normal muscle tone. Sensation to light touch and pin prick is diminished in the entire right hand and normal in the arm. Reflexes at the biceps, triceps, and brachioradialis are 2+ and equal bilaterally. Hoffman's is negative. Strength is normal and symmetric. Balance and gait are normal. The remainder of the physical examination is normal.

- If necessary, revise your differential diagnosis based on the additional physical findings.
- Design your approach to the electrophysiologic examination based on the existing data.



**Commentary IV**

Radiculopathy is less likely given the normal strength and reflexes. Radiculitis is still a possibility. Myofascial pain is a good possibility at this point. Diminished sensation in the entire hand does not help the differential because it does not make sense anatomically given his complaints.

**Electrophysiologic Data**

<b>SENSORY NERVE CONDUCTION STUDIES</b>							
<b>NERVE</b>	<b>SIDE</b>	<b>STIM SITE</b>	<b>RECORD</b>	<b>cm</b>	<b>AMPL</b>	<b>LAT</b>	<b>CV</b>
Median	Right	Wrist	3 <sup>rd</sup> digit	14	20	4.52	31.0
Median	Right	mid-palm	3 <sup>rd</sup> digit	7	40	1.94	27.2
Ulnar	Right	Wrist	5 <sup>th</sup> digit	14	34	3.60	48.9

<b>MOTOR NERVE CONDUCTION STUDIES</b>							
<b>NERVE</b>	<b>SIDE</b>	<b>STIM SITE</b>	<b>RECORD</b>	<b>cm</b>	<b>AMPL</b>	<b>LAT</b>	<b>CV</b>
Median	Right	Wrist	APB	7	8.7	4.6	
Median	Right	Elbow	APB	24	7.4	9.6	47.9
Ulnar	Right	Wrist	ADM	7	9.3	2.9	
Ulnar	Right	Bel elbow	ADM	23	8.7	7.1	54.5
Ulnar	Right	Abov elbow	ADM	14	8.0	9.5	58.6



<b>NEEDLE ELECTROMYOGRAPHY</b>									
INSERtional activity: N, sust, unsust									
FIB: 0, 1+, 2+, 3+, 4+									
OTHer: 0 or fascic, myotonia, myokymia									
EFFort: N, decr									
RECruitment: N, inc or dec 1+, 2+, 3+, 4+									
AMPplitude: N, inc or dec 1+, 2+, 3+, 4+									
DURation: N, inc or dec 1+, 2+, 3+, 4+									
POLyphasia: N, inc or dec 1+, 2+, 3+, 4+									
R/L	MUSCLE	INSER	FIB	OTH	EFF	REC	AMP	DUR	POL
R	Biceps	N	0	0	N	N	N	N	N
R	Triceps	sust	0	CRD	N	N	inc 1+	N	N
R	Pronator teres	sust	1+	0	N	N	N	N	N
R	1st Dorsal interosseous	sust	0	0	N	N	N	N	N
R	Abductor pollicis brev	sust	0	0	N	N	N	N	N
R	Mid cervical paraspin	N	0	0					
R	Low cervical paraspin	sust	0	CRD					

- On the basis of both the clinical and electrophysiologic evaluations, formulate your diagnostic impression. List the most likely diagnosis first and follow in order with the other possibilities that are not excluded by the data. Eliminate those diagnoses not supported by the data.
- Are there additional electrophysiologic data that you feel would further delineate the diagnosis? (Remember, collecting data that are not needed for the diagnosis is costly and uncomfortable for the patient.)

**Electrophysiologic Data, continued**

- Make the final revisions of your diagnostic impression(s).

**Disgnostic Impression**

There is electrophysiologic evidence supporting the diagnosis of right sensorimotor median mononeuropathy at the wrist with evidence of denervation in the abductor pollicis brevis. There is electrophysiologic evidence supporting the diagnosis of right C8 radiculopathy, and



there is a probable remote right C7 root lesion. This is a little surprising given the findings on physical examination, but we know that clinical presentations can vary widely.

- What other diagnostic procedures (laboratory tests, etc.), if any, are needed?
- What treatment would you recommend?

**Commentary V**

The patient returns to the electrodiagnostic laboratory 13 weeks later, status post right carpal tunnel release with good outcome. He reports near complete resolution of his symptoms. However, he is now complaining of symptoms on the contralateral side. For the past 2 months, he has had mild neck and left arm pain associated with bothersome left hand numbness and tingling involving the 4th and 5th digits primarily and occasionally extending up the arm to the axilla. These symptoms started slowly and have been gradually worsening. He denies any weakness or recent trauma. Physical examination is essentially unchanged with the exception of diminished sensation now in the left hand in a patchy distribution. The right hand sensation is intact.

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

**Commentary VI**

There are some facts that do not add up at this point. How did his symptoms resolve completely after the carpal tunnel release if he had a cervical radiculopathy?

**Electrophysiologic Data**

SENSORY NERVE CONDUCTION STUDIES							
NERVE	SIDE	STIM SITE	RECORD	cm	AMPL	LAT	CV
Median	Left	Wrist	3 <sup>rd</sup> digit	14	37	3.9	31.0
Median	Left	mid-palm	3 <sup>rd</sup> digit	7	38	1.9	27.2
Ulnar	Left	Wrist	5 <sup>th</sup> digit	14	36	3.7	

MOTOR NERVE CONDUCTION STUDIES							
NERVE	SIDE	STIM SITE	RECORD	cm	AMPL	LAT	CV
Median	Right	Wrist	APB	7	9.4	3.9	
Median	Right	Elbow	APB	28	8.5	9.1	55
Ulnar	Right	Wrist	ADM	7	9.0	3.8	



Ulnar	Right	Bel elbow	ADM	21.5	8.5	7.6	58
Ulnar	Right	Abov elbow	ADM	13	7.7	9.8	59

<b>NEEDLE ELECTROMYOGRAPHY</b>									
INSERtional activity: N, sust, unsust									
FIB: 0, 1+, 2+, 3+, 4+									
OTHer: 0 or fascic, myotonia, myokymia									
EFFort: N, decr									
RECRuitment: N, inc or dec 1+, 2+, 3+, 4+									
AMPliitude: N, inc or dec 1+, 2+, 3+, 4+									
DURation: N, inc or dec 1+, 2+, 3+, 4+									
POLyphasia: N, inc or dec 1+, 2+, 3+, 4+									
R/L	MUSCLE	INSER	FIB	OTH	EFF	REC	AMP	DUR	POL
L	Biceps	sust	0	0	N	N	N	N	N
L	Triceps	sust	0	0	N	N	N	N	N
L	1 <sup>st</sup> Dorsal interosseous	sust	0	0	N	N	N	N	N
L	Abductor pollicis brev	sust	0	0	N	N	N	N	N
L	Anterior tibialis	sust	0	0	N	N	N	N	N
L	Medial gastrocnemius	sust	0	0	N	N	N	N	N
L	Rectus abdominis	sust	0	0	N	N	N	N	N

- On the basis of both the clinical and electrophysiologic evaluations, formulate your diagnostic impression. List the most likely diagnosis first and follow in order with the other possibilities that are not excluded by the data. Eliminate those diagnoses not supported by the data.
- **Diagnostic Impression**  
 There is diffuse abnormal insertional activity on the EMG needle portion of the examination consistent with "EMG disease," a completely benign process that does not cause symptoms and is not progressive. We cannot rule out left cervical radiculopathy or other possible causes of denervation. Although the median sensory



latency is prolonged for this laboratory and the report was written as demonstrating a mild left median mononeuropathy consistent with carpal tunnel syndrome, the relative latency does not meet the .5msec difference that is necessary to establish a diagnosis of CTS and this diagnosis should be viewed with caution.

**Commentary VII**

This may explain the history of improvement after carpal tunnel release. The previous diagnosis of right C8 radiculopathy was probably erroneously based on increased insertional activity that we now know is from "EMG disease." The current electrodiagnostic study is unable to assess for acute or subacute radiculopathy.

**History, Continued**

The patient is seen one year after his last EMG. In the interim since his last examination, he underwent a left carpal tunnel release with only mild improvement in his symptoms. He is now complaining of worsening neck pain and bilateral arm pain. His pain is again primarily in the neck. The arm pain is described as a general ache involving the entire arm. There is intermittent bilateral numbness and tingling but no significant weakness. Physical examination is normal with the exception of patchy diminished sensation bilaterally. The referral asks to evaluate both upper extremities to rule out radiculopathy. What do you do?

**Electrophysiologic Data**

SENSORY NERVE CONDUCTION STUDIES							
NERVE	SIDE	STIM SITE	RECORD	cm	AMPL	LAT	CV
Median	Right	Wrist	3 <sup>rd</sup> digit	14	22	4.1	35
Median	Right	mid-palm	3 <sup>rd</sup> digit	7	37	1.9	33
Ulnar	Right	Wrist	5 <sup>th</sup> digit	14	28	3.5	40
Median	Left	Wrist	3 <sup>rd</sup> digit	14	32	3.6	40
Median	Left	mid-palm	3 <sup>rd</sup> digit	7	46	2.0	45
Ulnar	Left	Wrist	5 <sup>th</sup> digit	14	28	3.6	39

MOTOR NERVE CONDUCTION STUDIES							
NERVE	SIDE	STIM SITE	RECORD	cm	AMPL	LAT	CV
Median	Right	Wrist	APB	7	4.8	4.3	



Median	Right	Elbow	APB	23	3.7	8.9	50
Ulnar	Right	Wrist	ADM	7	9.5	2.8	
Ulnar	Right	Bel elbow	ADM	24	8.6	6.9	58
Ulnar	Right	Abov elbow	ADM	14.5	8.2	9.2	63
Median	Left	Wrist	APB	7	7.1	3.9	
Median	Left	Elbow	APB	22	6.5	8.2	52
Ulnar	Left	Wrist	ADM	7	7.5	3.1	
Ulnar	Left	Bel elbow	ADM	24	6.6	7.1	59
Ulnar	Left	Abov elbow	ADM	14	6.3	9.8	52

**NEEDLE ELECTROMYOGRAPHY**

INSERtional activity:

N, sust, unsust

FIB: 0, 1+, 2+, 3+, 4+

OTHer: 0 or fascic, myotonia, myokymia

EFFort: N, decr

RECrutment: N, inc or dec 1+, 2+, 3+, 4+

AMPlitude: N, inc or dec 1+, 2+, 3+, 4+

DURation: N, inc or dec 1+, 2+, 3+, 4+

POLyphasia: N, inc or dec 1+, 2+, 3+, 4+

R/L	MUSCLE	INSER	FIB	OTH	EFF	REC	AMP	DUR	POL
R	Biceps	sust	0	0	N	N	N	N	N
R	Triceps	sust	0	0	N	N	inc 1+	N	N
R	Pronator teres	N	0	0	N	N	N	N	N
R	1 <sup>st</sup> Dorsal interosseous	sust	0	0	N	N	N	N	N
R	Deltoid	sust	0	0	N	N	N	N	N



- On the basis of both the clinical and electrophysiologic evaluations, formulate your diagnostic impression. List the most likely diagnosis first and follow in order with the other possibilities that are not excluded by the data. Eliminate those diagnoses not supported by the data.
- Are there additional electrophysiologic data that you feel would further delineate the diagnosis? (Remember, collecting data that are not needed for the diagnosis is costly and uncomfortable for the patient.)

## Diagnostic Impression

There is electrodiagnostic evidence of a mild right median mononeuropathy at the wrist. There is improvement in motor and sensory responses compared to the study done prior to surgical release. We are unable to assess whether there is denervation present. There is no electrodiagnostic evidence of left median mononeuropathy. There is electrodiagnostic evidence of a remote right C7 radiculopathy given the large amplitude motor units found in the right triceps. This is consistent with the previous right upper extremity study that also showed fibrillation potentials in a C7 innervated muscle, the pronator teres.

There is evidence, again, in support of the diagnosis of "EMG disease." This potentially limits the usefulness of EMG for diagnosing radicular lesions.

## Commentary VIII

"EMG disease" has also been called syndrome of diffuse insertional activity, syndrome of diffuse positive waves, and forme fruste of myotonia congenita. The first case described in the literature was of a medical student who volunteered to be the subject in a demonstration of EMG. He had no symptoms but showed positive sharp waves in all muscles examined. An exhaustive medical workup ensued including repeat EMG examinations, blood draws, and muscle biopsy, which were all unremarkable. The pathophysiology of this condition is unknown, but the current theory states this is the electrical manifestation of a mild defect in one of the transmembrane ion channels such as sodium, potassium, or chloride. This is similar to the other known channelopathies such as myotonia congenita or paramyotonia, but in a much less severe form. "EMG disease" is usually discovered incidentally during the EMG evaluation of a focal complaint. It is an asymptomatic condition with no known progression or associated pathology. Family studies have demonstrated an autosomal dominant mode of genetic transmission, and one author reported a possible female predominance. Lab tests, imaging tests, and muscle biopsy results are all normal. The EMG shows short duration (5-10 ms) positive sharp waves in decrescendo runs in all muscles. There is variable involvement among muscles at any one time, and even within the same muscles over separate examinations. There are no, or very rare, fibrillation potentials. MUAP and motor recruitment are normal. Nerve conduction studies and single fiber EMG are normal. The differential diagnosis of diffuse positive sharp waves on EMG study includes neurogenic, myogenic, and metabolic disorders. However, the history and physical examination is usually very different in these disorders compared to "EMG disease." It is important clinically to be aware of this diagnosis for several reasons. A limited needle examination may lead to an erroneous diagnosis, as was probably the case in the initial electrodiagnostic examination presented here. After recognition of this phenomenon, the evaluation of peripheral nerve injuries or entrapment should be done with nerve conduction



studies primarily. However, some may argue that radiculopathy can be detected even in someone with EMG disease. The positive sharp waves are usually not fulminant and do have a decrescendo run in EMG disease. They are usually uniform in amplitude but not frequency. If there are significant fibrillation potentials, another cause should be sought. For instance, in the case presented here, there were fibrillation potentials seen in the pronator teres, a C7 innervated muscle. There were also large amplitude motor units seen in the triceps (another C7 innervated muscle) on 2 different occasions, which would not be expected in EMG disease. A radiculopathy may also show decreased recruitment and large amplitude motor units and/or polyphasia in the affected muscles, which would not be present in EMG disease. Unfortunately, the inter-tester differences in interpretation limit the usefulness of recruitment and fibrillation potentials as diagnostic indices, particularly in cases with subtle changes. Therefore, it is recommended that EMG be used with caution when evaluating possible radiculopathy in a patient with known EMG disease. Lastly, it is important to recognize EMG disease to spare the patient extensive and possibly painful medical evaluations. In the case presented here, the patient underwent 3 EMG examinations, the last of which was of questionable utility.

## Bibliography

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