



EMG Case No. 49, February 2001

Presenting Symptom: Unilateral Hand Weakness

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Appropriate Audience: Residents and practicing physicians

Learning Objectives: After completing this educational activity, participants will be able (1) to formulate a comprehensive differential diagnosis for patients with complaints of unilateral hand weakness, and (2) Identify differences on electrodiagnostic studies in order to establish a diagnosis.

History

A 51-year-old man, who is a retired business executive, complains of left hand weakness that began approximately 5 to 6 weeks ago. He cannot grip objects because of worsening weakness of his ring and small fingers. Intermittent dull aching pain has developed near his wrist. He denies any direct trauma to his hand and has no other limb weakness or pain.

- *Prior to continuing, please develop a differential diagnosis and list each possible diagnosis in order of likelihood.*

Differential diagnosis for unilateral hand weakness.

- C8/T1 radiculopathy
- Lower trunk brachial plexopathy
- Ulnar mononeuropathy at the elbow
- Ulnar mononeuropathy in forearm
- Ulnar mononeuropathy at the wrist
- Hypothenar hammer syndrome (injury to ulnar artery in hand with secondary involvement of the ulnar nerve)
- Carpal tunnel syndrome
- Thoracic outlet syndrome (neurogenic)
- Monomelic amyotrophy or other motor neuron disease
- Cervical syringomyelia
- Combined carpal tunnel syndrome and ulnar mononeuropathy
- Median mononeuropathy above the level of the pronator teres
- Medial/lateral epicondylitis
- Wrist capsulitis
- *Is there any additional information regarding the clinical history that might be helpful in clarifying your differential list or changing its order of priority?*



The patient reports numbness in the left ring finger and the small finger (the palmar aspect). He notes loss of muscle bulk at the heel of the hand and palm but not at the thumb. No sensory loss is reported over the dorsum of the hand. He reports no hand pain. There is no report any neck pain or trauma. He denies shoulder or elbow weakness or pain.

Commentary I

The distribution of the sensory loss significantly impacts the differential diagnosis. Sensory loss of the medial hand, with sparing of the thumb region, reduces the likelihood that the complaints are due to carpal tunnel syndrome, median mononeuropathy of the forearm, or a focal spinal cord lesion. An ulnar mononeuropathy at Guyon's canal falls lower on the list of possible etiologies, since the classic lesion at Guyon's canal spares sensation.

Impaired sensation is not consistent with monomelic amyotrophy or other forms of motor neuron disease. Musculoskeletal problems (epicondylitis or wrist capsulitis) are also less likely with impaired sensation.

The remaining differential for unilateral hand weakness and numbness includes: C8/T1 radiculopathy, lower trunk brachial plexopathy (including thoracic outlet syndrome), and ulnar mononeuropathy at the elbow or wrist are consistent with the reported sensory and motor loss.

History, continued

His past medical history is negative.

He is right handed. He is an avid golfer and recently began competing as a senior golf professional. For the past several months, he has increased his practice time in preparation for the senior tour.

- *If necessary, revise your differential diagnosis based on the additional clinical history.*

The differential diagnosis remains essentially the same. However, the history of recently beginning professional golf competition increases the likelihood that the lesion is localized to the hand and wrist. The increased golf activity could possibly stress the ulnar nerve at the elbow as well or could cause or exacerbate symptoms of medial epicondylitis (golfer's elbow). Hypothenar hammer syndrome, a primary vascular syndrome with secondary ulnar nerve involvement, is a possibility if the golf club handle repeatedly traumatizes the ulnar artery in the hand upon impact.

- *On which details of the physical examination should you focus at this point?*

The physical examination should focus on presence or absence of atrophy, strength loss, sensory deficits, and muscle stretch reflexes. If motor or sensory deficits are noted, the clinician should determine if the findings are consistent with a dermatomal or myotomal pattern.

Commentary II

The absence of complaints regarding the strength and sensation of thumb and lateral digits eliminates a median mononeuropathy at the wrist (carpal tunnel syndrome). Similarly, a lesion of the lower trunk of the brachial plexus is less likely since the median innervation is unaffected. The lack of median involvement in the hand, coupled with the lack of neck pain or trauma, makes a C8/T1 radiculopathy less likely.



An ulnar lesion localized to the wrist and hand area remains the most likely diagnosis but we cannot exclude a lesion at the elbow.

Physical Examination

Physical examination shows marked atrophy of the left hand intrinsic muscles, including abductor digiti minimi (ADM). The thenar muscles are spared and have normal bulk. No other limb atrophy is noted. The strength of the ADM, the interossei, including the first dorsal interosseous, is graded as 1+. The strength of the remaining muscles of the upper limbs is normal. Sensation is normal except for light touch along the palmar aspects of the small finger and the medial ring finger, which is decreased. Muscle stretch reflexes are normal any symmetric at the triceps, biceps, and brachioradialis. No Hoffman reflex is present bilaterally. Allen's test for vascular arch insufficiency is normal.

- *At this point, review your differential diagnosis and revise as appropriate.*

The differential diagnosis is limited to ulnar mononeuropathy of the left upper limb, lower trunk brachial plexopathy, or a C8/T1 radiculopathy, with an ulnar lesion the most likely. There is no evidence to support a central lesion or a diffuse process. The normal Allen's test make hypothenar hammer syndrome less likely.

- *Are there additional observations on physical examination that might be helpful in narrowing your differential list?*

Range of motion of the neck is normal. No crepitation or areas of tenderness of the neck or spine are present. Spurling maneuver does not elicit any hand or upper extremity pain or paresthesias. Resisted wrist flexion/extension and forearm supination/pronation is normal. There is no tenderness with palpation of the elbow or wrist. The muscle stretch reflexes of the finger flexors are intact and symmetric. Muscle tone is normal except in the atrophic muscles of the involved hand.

Commentary III

The asymmetry of this lesion reduces the likelihood that the etiology is a diffuse process, such as a peripheral polyneuropathy.

The history and clinical presentation are not consistent with a central nervous system lesion. The absence of abnormal muscle tone and upper motor neuron signs, such as a Hoffman reflex, makes a central nervous system lesion very unlikely.

C8/T1 radiculopathy or brachial plexopathy is unlikely since muscle stretch reflexes are symmetric, and medial and radial innervated muscle strength and sensation are intact. A more likely diagnosis is ulnar mononeuropathy.

Physical Examination, continued

Phalen's maneuver was negative. No skin trauma, e.g., callus, or other lesions are noted on the hands. No pain is reported on palpation of the bony or soft tissue structures of the hand. Two-point discrimination and pinprick testing confirm the previously noted sensory loss and show that sensation of the proximo-medial palm is intact. No pain was reported with resisted ring and small finger flexion, abduction, or adduction. Tinel's at the cubital and carpal tunnels, as well as at Guyon's canal, was negative.

- *If necessary, revise your differential diagnosis based on the additional physical findings.*



A brachial plexopathy or C8/T1 radiculopathy are all but eliminated from the differential. An ulnar mononeuropathy remains the most likely diagnosis. The most likely lesion is an injury at Guyon's canal; however, sensory loss is not usually seen with the classic lesion. The involvement of the hypothenar muscles and the sensory loss suggest a lesion more proximal than Guyon's canal, since there is involvement of more than the deep motor branch of the ulnar nerve. The challenge is to verify the clinical diagnosis, to precisely locate the site of the lesion, and to characterize the severity of the lesion.

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

Commentary IV

Nerve conduction studies can help localize the lesion and verify the involvement of the ulnar nerve distal to the wrist. In addition to recording the sensory motor responses to the fifth digit, the diagnostician should obtain the response of the ulnar dorsal cutaneous nerve, which will assist in localizing the lesion as distal or proximal to the wrist.

An F response will yield little additional information in this situation. If the lesion is indeed an ulnar lesion in the forearm or hand, a localized lesion will not appreciably affect the F response.

During the needle examination, the muscles that are weak should be evaluated. The absence of an ulnar motor or sensory response on nerve conduction tests should also direct the diagnostician to sample the ulnar innervated muscles of the hand. Other muscles innervated by the same nerve, such as the flexor digitorum profundus (ulnar portion) and flexor carpi ulnaris, will also be studied. Also, muscles supplied by the same root but different peripheral nerve, such as the abductor pollicis brevis, should be sampled. A proximal lesion, i.e., a cervical radiculopathy complicating the situation, should be accompanied by abnormalities of needle examination in the corresponding cervical paraspinal muscles.

Electrophysiologic Data

SENSORY NERVE CONDUCTION									
nr = no response									
NERVE	LATENCY			AMPLITUDE			CONDOC VEL		
	R	L	M	R	L	M	R	L	M
Ulnar sensory nerve from the wrist to the fifth digit	-	nr	-	-	-	-	-	-	-
Dorsal ulnar cutaneous nerve	-	2.6	-	-	12	-	-	-	-
Median sensory (wrist to index finger)	-	2.8	-	-	30.6	-	-	50.0	-



Radial sensory (forearm to wrist)	-	1.9	-	-	28.0	-	-	52.6	-
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MOTOR NERVE CONDUCTION									
nr = no response									
NERVE	LATENCY			AMPLITUDE			CONDUCT VEL		
	R	L	Normal	R	L	Normal	R	L	Normal
Ulnar motor (wrist to hypothenar)	-	nr	-	-	-	-	-	-	-
Ulnar motor (wrist to first dorsal interosseous)	-	nr	-	-	-	-	-	-	-
Median motor (wrist to thenar)	-	3.4	-	-	10.6	-	-	-	-
Median motor (elbow to thenar)	-	7.7	-	-	10.4	-	-	56.0	-

ELECTROMYOGRAPHY										
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 potential										
R/L	MUSCLE	INSERTIO		SPONTAN		VOLUNTARY				
		activ	p	fib	othe	recr	amp	dur	poly	effor
L	first dorsal interosseous	incr	sust	4+	0	decr 4+	incr 4+	incr 4+	0	N
L	abd dig quinti (hand)	incr	sust	4+	0	decr 4+	incr 4+	incr 4+	0	N



L	flex dig profund (ulnar portion)	N	O	O	O	N	N	N	N	N
L	flex carpi ulnaris	N	O	O	O	N	N	N	N	N
L	abd pollicis	N	O	O	O	N	N	N	N	N
L	pronator teres	N	O	O	O	N	N	N	N	N
L	extensor indicis	N	O	O	O	N	N	N	N	N
L	cervical paraspinal (C7/8/T1)	N	O	O	O	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.)*
- *Make the final revisions of your diagnostic impression(s).*

Diagnostic Impression

There is electrodiagnostic evidence of a severe, left ulnar mononeuropathy at Guyon's canal, with axon loss, affecting the superficial sensory branch, the hypothenar branch, and the deep motor branch. Although ulnar nerve conduction across the elbow cannot be assessed, the presence of the ulnar dorsal cutaneous response localizes the lesion to the wrist as opposed to the elbow. Conduction block cannot be assessed when the motor response is absent. The lesion is at or just proximal to the major bifurcation of the ulnar nerve as it enters the hand.

- *What other diagnostic procedures (laboratory tests, etc.), if any, are needed?*

A MRI of Guyon's canal should be ordered. Fractures of the hook of the hamate are typically not visible on plain radiographs. Since space-occupying lesions, e.g., ganglion cyst, are associated with 35 to 40% of these cases, a MRI is imperative (Shea, 1969; Olney, 1983). Fractures of the hook of the hamate are rare but occur in settings of repeated local trauma.

- *What treatment would you recommend?*

Referral to a hand surgeon would be appropriate since over a third of these lesions are surgically remediable (Olney, 1983).

Commentary V

In 1861, Felix Guyon first described the oblique canal the ulnar nerve traverses as it enters the hand. The canal is formed by the pisiform bone and the hook of the hamate medially. The triquetrum and the hamate create the bony floor of the canal. The roof is more loosely bound and is only rigid where the ligamentous band between the pisiform and the hook of the hamate create the pisohamate hiatus. Because of the anatomy of the canal and its

contents, lesions in the wrist and hand can produce very specific clinical presentations, including motor only, sensory only, or sensorimotor lesions.

Within the canal, the ulnar nerve bifurcates into the deep and superficial branches. The superficial branch provides sensation to the distal medial hand and the palmar aspect of the fourth (medial palmar aspect) and fifth digit.

After sending the hypothenar motor branch to the abductor quinti muscle, the remaining deep motor branch exits the pisohamate hiatus and crosses the palm, innervating the dorsal interossei and the third and fourth lumbricals.

Four ulnar nerve lesions are described at the level of Guyon's canal. First, a lesion of the deep motor branch will spare sensation and innervation to the hypothenar muscles, while the interossei and lumbrical muscles will be involved. This is the classic lesion described by Guyon.

A lesion that is just proximal to or at the hypothenar branch will also spare sensation but will involve not only the interossei and the lumbricals but the hypothenar muscles as well. In these lesions, the hypothenar involvement is usually mild and can be easily overlooked.

Involvement of the superficial ulnar branch will impair sensation only and not cause motor impairment.

The fourth lesion is described in this case, at or just proximal to the ulnar bifurcation causing motor impairment of all the ulnar innervated muscles of the hand. Sensory impairment of the superficial ulnar sensory nerve distribution will be seen while the dorsal cutaneous ulnar nerve distribution is spared.

Lesions to the deep branch as well as those just proximal to or at the hypothenar branch are the most common. Because of the absence of sensory loss, these are the lesions that may be confused with early anterior horn cell disease.

Approximately 6 weeks before the patient reported for medical evaluation, he changed the grips on his golf clubs. MRI of the hand demonstrated a 1 cm ganglion cyst and suggested that a fracture of the hook of the hamate was present.

The patient underwent hand surgery. A one-centimeter ganglion cyst was identified and excised. No evidence of a hamate fracture was found. The nerve appeared structurally intact. No arterial or other structural abnormality was visualized.

In addition to space occupying lesions, such as a ganglion, ulnar nerve lesions at Guyon's canal can occur from acute trauma, repetitive blunt trauma, vasculitis, and ulnar artery anomalies. Additionally, fractures of the hamate can cause ulnar lesions. In contrast to the findings in carpal tunnel syndrome, ulnar neuropathy at the wrist is 4 times more common among men compared to women.

A hamate fracture occurs in only 2% of carpal bone fractures; a fracture of the hook of the hamate is rarer. Torisu (1972) first described a fracture of the hook of the hamate caused by golf.

Though these fractures are unusual, the increasing popularity of golf and racquet sports has increased the incidence and recognition of hamate lesions. Approximately one third of the fractures of the hook of the hamate are caused by golf. Typically, the fracture occurs in the non-dominant hand. It appears to result from the repeated trauma of the grip of the club against the hook of the hamate in the medial palm. The associated ulnar mononeuropathy



may appear acutely or insidiously. The diagnosis is often delayed, averaging 10 months to presentation.

If a fracture of the hook of the hamate is present, painful flexion of the ring and small fingers is pathognomonic. Painful flexion is caused by tendinitis of the finger flexors, which if it persists can cause tendon rupture.

The mechanism of injury occurs typically with a fat shot (i.e. hitting too much of the ground instead of the ball). To prevent the injury, the golfer should be fitted with a proper length club. Attention should be made to choose a club that extends beyond the hypothenar border of the hand. A shorter club allows the butt of the club to rest directly over the hook of the hamate, increasing the risk of injury.

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