Ulnar Neuropathy at the Wrist

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Published online: 9 June 2009

Statement of Need

We have identified the following educational gaps to demonstrate need for this journal CME activity:

- Ulnar neuropathy at the wrist is often difficult to diagnose and is often missed
- Lack of familiarity with the ulnar nerve's anatomical course is critical in order for diagnoses and treatment for ulnar neuropathies
- Electrodiagnostic testing is necessary to correctly evaluate ulnar neuropathy conditions
- Compressive ulnar neuropathies are often misdiagnosed both in etiology and location of compression.

Target Audience

This activity is targeted at primary care physicians, rehabilitation specialists, orthopaedic surgeons, rheumatologists, general medicine, physiatrists, pain physicians, residents and fellows.

Objectives

HSS activities are intended to improve the quality of patient care and safety. At the conclusion of the activity, the participant should be able to:

- Differentiate ulnar nerve entrapment from other nerve problems of the wrist
- Describe the nerve's anatomical course and distribution
- Choose electro-diagnosis (MRI) as the preferred tool in evaluation of nerve conditions at the wrist
- Prescribe the appropriate plan of care for these nerve conditions.

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HSSJ (2009) 5: 180–183
DOI 10.1007/s11420-009-9110-2

ELECTRODIAGNOSTIC CORNER/CME ARTICLE

Ulnar Neuropathy at the Wrist

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Received: 19 September 2008/Accepted: 22 January 2009/Published online: 9 June 2009

Abstract A case of ulnar nerve compression at the wrist within Guyon's canal is reported. The clinical presentation initially appeared consistent with an ulnar nerve entrapment at the elbow. The true diagnosis of an ulnar sensorimotor nerve lesion occurring within the canal of Guyon was made electrophysiologically. Magnetic resonance imaging demonstrated compression of the nerve within the canal by a ganglionic cyst, which was confirmed by surgical intervention. Ulnar nerve entrapment at the wrist is uncommon and difficult to diagnose; therefore, it is important to understand the nerve's anatomical course and distribution to allow for accurate diagnosis by clinical and electrodiagnostic evaluations. Electrodiagnosis is an important tool in identifying ulnar nerve lesions at the wrist while excluding other disorders in the differential and recognizing coexisting pathology.

Keywords ulnar neuropathy · Guyon's canal · ulnar nerve compression · entrapment neuropathy · ganglion · wrist

Case presentation

A 29-year-old right-handed female presented with 2 weeks of numbness and tingling in her right hand. She also noted clumsiness in that hand. She did not report a history of trauma or injury to her head, neck, or right upper extremity. The symptoms were aggravated by applying ice and by typing. The patient denied overt weakness of her right upper extremity, neck pain, or shoulder pain. A review of systems was otherwise normal. Her past medical history was significant for a right shoulder labral tear for which she underwent arthroscopic labral reinsertion in February of 2007. She did report a history of similar right hand symptoms several years earlier, which she attributed to her shoulder injury after electrodiagnostic studies were unrevealing.

On physical exam, her cervical spine demonstrated full painless range of motion with no exacerbation of her right upper extremity symptoms. Examination of her shoulder revealed full abduction in external rotation with negative Wright's and Adson's tests. There was no evidence of muscle atrophy or skin changes in the extremity. Tinel's sign was positive over the ulnar nerve at the elbow with radiation to the finger tips. Tinel's sign was also positive over the ulnar nerve at the wrist with dysesthetic sensations into the hypothenar eminence. The medial half of the palmar aspect of the hand, including the hypothenar eminence, along with the palmar side of the fourth and fifth digits showed decreased sensation to light touch using the Semmes–Weinstein monofilament test. Both Tinel's sign over the median nerve and Phalen's test were negative. Froment's and Wartenberg's signs were negative, though mild weakness of the abductor digiti minimi (ADM) was noted.

An elbow extension night splint was prescribed and a nerve conduction study was performed 4 weeks after the onset of symptoms to help clarify the diagnosis. Nerve conduction studies of both median nerves and the left ulnar nerve were normal. The right segmental motor branch of the ulnar nerve showed a reduced amplitude (2.1 mV; Table 1). The right ulnar sensory amplitude was decreased proximal to the wrist (20.7 mV) when compared to distally at the palm (76.5 mV) and was also decreased when compared to the left side (89.6 mV; Table 2). The dorsal ulnar cutaneous sensory amplitudes were normal and symmetric bilaterally. There was no focal slowing or drop in amplitude in the right motor nerve across the elbow to either the ADM or the first dorsal interosseus (FDI; Table 1). Electromyographic needle evaluation of the right FDI revealed a decreased recruitment pattern. The right ADM showed abnormal spontaneous activity and a discrete recruitment pattern which was decreased (Table 3). Therefore, there was electrodiagnostic evidence of compression of the right ulnar nerve at the wrist

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Table 1 Nerve conduction studies: motor summary

Nerve	Site	Onset (ms)	Norm onset (ms)	O-P Amp (mV)	Norm O-P Amp	Site 1	Site 2	Delta-0 (ms)	Dist (cm)	Vel (m/s)	Norm Vel (m/s)
Right median motor (Abd Poll Brev) 29.5°C	Wrist	2.8	<3.6	14.5	>4	Pron Ter	Wrist	3.9	24	61.5	>50
	Pron Ter	6.7		14.6							
Right ulnar Seg motor (Abd Dig Minimi) 28.1°C	Wrist	3.4	<3.6	2.1	>3	Abv FCU	Wrist	3	20.5	68.3	>50
	Abv FCU	6.4		1.6		Abv Uln Grv	Abv FCU	1.9	9.5	50	>50
	Abv UIn Grv	8.3		1.8							
Right ulnar Seg FDI motor (FDI) 29.3°C	Wrist	3.8	<3.6	5.5	>3	Abv FCU	Wrist	3.4	21.5	63.2	>50
	Abv FCU	7.2		5.8		Abv UIn Grv	Abv FCU	1.9	10.5	55.3	>50
	Abv UIn Grv	9.1		5.7							

O-P onset to peak, *Pron Ter* pronator teres, *FCU* flexor carpi ulnaris, *Uln Grv* ulnar groove, *Amp* amplitude, *Dist* distance, *Vel* velocity

within Guyon's canal. This was consistent with a lesion in the proximal canal affecting both the sensory and motor components of the ulnar nerve before it bifurcates. According to the most recent classification system of five types of ulnar nerve lesions at the wrist, this lesion could be classified as a type 1 based on these results [1]. A magnetic resonance image (MRI) of the hand was performed to further evaluate the nerve, which demonstrated a multiloculated cystic structure consistent with a ganglion in Guyon's canal just proximal to the hook of the hamate. The cyst measured 1.2 cm×4 mm and was compressing the ulnar nerve against the pisiform bone (Figs. 1 and 2).

Surgical intervention was recommended. The patient underwent open exploration of Guyon's canal with excision of the ganglion which emanated from the pisotriquetral joint. A tissue sample was sent to pathology and was confirmed to be a ganglionic cyst. On follow-up 10 days after the operation, the patient had a mild subjective decrease in sensation and slight dysesthesia in the ulnar nerve distribution of the hand with intact strength.

Discussion

Ulnar nerve entrapment at the wrist is uncommon and difficult to diagnose; therefore, it is important to understand the nerve's anatomical course and distribution to allow for accurate diagnosis by clinical and electrodiagnostic evaluations. Electrodiagnosis is proving to be an important tool in identifying ulnar nerve lesions at the wrist while excluding other disorders in the differential such as brachial lower trunk plexopathy and C8–T1 radiculopathy [2]. Because associated complaints of paresthesias and trace weakness are frequently nonspecific and coexisting pathologies are common, the diagnosis of these lesions is difficult [3, 4]. Though there are many potential sites of injury to the ulnar nerve between the brachial plexus and the hand, the nerve's course renders it most vulnerable at the elbow and less commonly at the wrist [4].

The ulnar nerve originates from the C8 and T1 nerve roots and then branches off the medial cord of the brachial plexus. It passes through the axilla, arm, elbow, and

Table 2 Nerve conduction studies: sensory summary

Nerve	Site	Onset (ms)	Norm onset (ms)	O-P Amp (mV)	Norm O-P Amp	Site 1	Site 2	Delta-0 (ms)	Dist (cm)	Vel (m/s)	Norm Vel (m/s)
Left dorsal cutaneous (4th web space) 31.8°C	Wrist	1.3		31.2		Wrist	4th web space	1.3	7.5	57.7	
Right dorsal cutaneous (4th web space) 30.4°C	Wrist	1.3		41.2		Wrist	4th web space	1.3	7.0	53.8	
Right median (palmar) sensory (2nd Digit) 27.7°C	Mid Palm	1.2		42.0		Mid Palm	2nd Digit	1.2	7.5	62.5	>45
	Wrist	2.7	<3.2	52.3		Wrist	Mid Palm	1.5	8.5	56.7	
Left ulnar sensory (5th Digit) 31.8°C	Wrist	2.5	<3.2	89.6	>10	Wrist	5th Digit	2.5	0.0		
Right ulnar (palmar) sensory (5th Digit) 28.2°C	Palm	1.6		76.5		Palm	5th Digit	1.6	7.5	46.9	
	Wrist	2.8	<3.2	20.7	>10	Wrist	Palm	1.2	6.5	54.2	>45
	Abv FCU					Abv FCU	Wrist	2.7	0.0		

O-P onset to peak, *Pron Ter* pronator teres, *FCU* flexor carpi ulnaris, *Uln Grv* ulnar groove, *Amp* amplitude, *Dist* distance, *Vel* velocity

Table 3 Needle electromyography

Side	Muscle	Nerve	Root	Ins Act	Fibs	Psw	Fascic	Amp	Dur	Configuration	Rec Pat	Rec Int
Right	Abd Poll Brev	Median	C8–Ti	Nml	0	0	0	Nml	Nml	Di/triphasic	Full	Nml
Right	ist Dor Int	Ulnar	C8–Ti	Nml	0	0	0	Nml	Nml	Di/triphasic	Dec	Nml
Right	Flex Car Rad	Median	C6–C7	Nml	0	0	0	Nml	Nml	Di/triphasic	Full	Nml
Right	Abd Dig Mm	Ulnar	C8–Ti	Nml	1+	2+	0	Nml	Nml	Di/triphasic	Discrete	Dec
Right	Flex Dig Prof	Ulnar	C8, Ti	Nml	0	0	0	Nml	Nml	Di/triphasic	Full	Nml
Right	Flex Car Uln	Ulnar	C8–Ti	Nml	0	0	0	Nml	Nml	Di/triphasic	Full	Nml
Right	Ext Indicis	Radial (Post Int)	C7–C8	Nml	0	0	0	Nml	Nml	Di/triphasic	Full	Nml

Flex Car Uln flexor carpi ulnaris, *Flex Dig Prof* flexor digitorum profundus, *Flex Car Rad* flexor carpi radialis, *Abd Dig Mm* abductor digiti minimi, *Abd Pol Brev* abductor pollicis brevis, *Ext Indicis* extensor indicis, *1st Dor Int* first dorsal interosseus, *Psw* positive sharp waves, *Fibs* fibrillations, *Fascic* fasciculation, *Dur* duration, *Nml* normal, *Rec Pat* recruitment pattern, *Dec* decreased, *Ins Act* insertional activity, *Rec Int* recruitment interval

forearm. Proximal to the wrist, the dorsal cutaneous nerve branches off to the dorsal hand followed by the palmar cutaneous branch to the proximal palm. These two sensory branches to the hand do not go through the canal. The ulnar nerve then courses through Guyon's canal to the palmar surface of the hand. The triangular canal is bordered medially and proximally by the pisiform bone and laterally and distally by the hook of the hamate. It is bounded anteriorly by the flexor carpi ulnaris tendinous insertion along with the anterior carpal ligament and posteriorly by the transverse carpal ligament overlying the pisotriquetral joint. In the canal or as it exits under the palmaris brevis muscle, the nerve bifurcates into the superficial sensory branch and the deep motor branch. The superficial branch supplies sensation to only the ulnar surface of the hypothenar eminence, the ulnar half of the fourth digit and the fifth digit. The deep motor branch gives off a branch to the hypothenar muscles, including the ADM, then turns about the hook of the hamate and deviates laterally across the palm to innervate the dorsal interossei, the third and fourth lumbricals, the adductor pollicis (AP), the flexor pollicis brevis, and terminates in the FDI [4–6].

The ulnar nerve may be compressed anywhere along its course in Guyon's canal causing sensory deficits, motor deficits, or a combination of both. Ulnar nerve lesions at the wrist can be traditionally classified into three types, or more recently classified into five types, based on the location of the lesion [1, 2, 4, 6]. The location and, consequently, the classification can be best determined by electrodiagnosis. Type 1 is a lesion located just proximal to or just inside Guyon's canal and results in a mixed motor and sensory neuropathy in the distribution of both the deep motor and superficial sensory branches as described above. Type 2 involves only the superficial branch and is an entirely sensory neuropathy. Type 3 is a proximal lesion of the deep motor branch before it sends innervation to the hypothenar muscles and results in a pure motor neuropathy in this distribution. A type 4 lesion is also a pure motor lesion but occurs after the branch to the hypothenar muscles, therefore sparing them. Type 5 is a pure but limited motor neuropathy

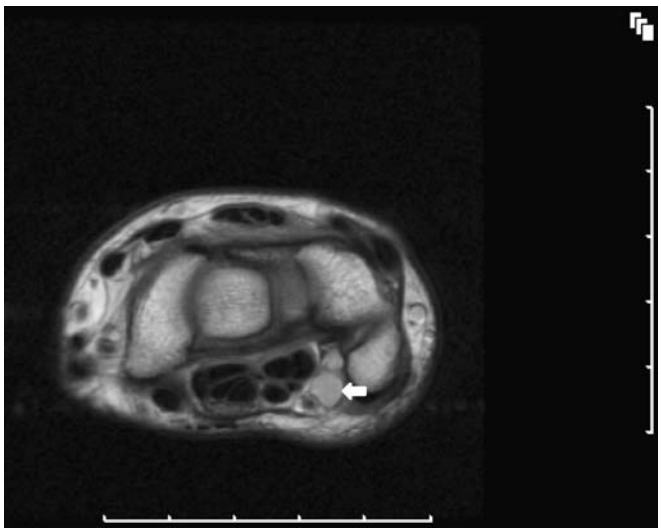

Fig. 1. Axial proton density-weighted magnetic resonance image demonstrating a ganglion cyst (*white arrow*) compressing the ulnar nerve within Guyon's canal

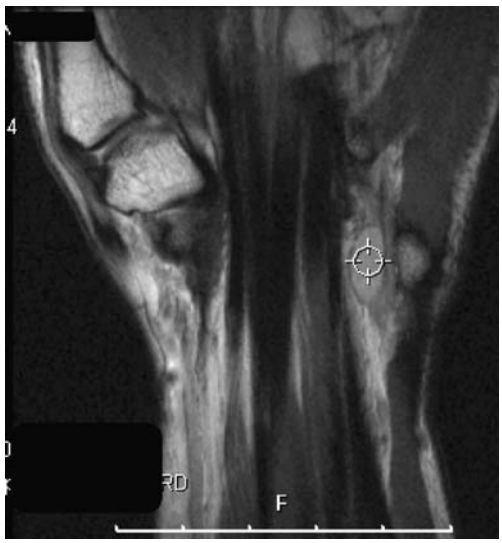

Fig. 2. Coronal proton density-weighted magnetic resonance image demonstrating the ganglion compressing the ulnar nerve within Guyon's canal

with the lesion occurring just proximal to the distal deep motor branches to the FDI and AP [1, 2, 6].

Ulnar nerve entrapment at the wrist is the second most common ulnar neuropathy after compression at the elbow. Nevertheless, it is still rare occurring with a frequency which is one twentieth of that occurring at the elbow [2, 7]. The numerous causes of ulnar nerve lesions at the wrist are well described, but the reported incidences are variable. This is likely due to the limited existing studies, which essentially consists of reports of a small number of cases or reviews of individual case reports. The most common reported causes are ganglion cyst compression and chronic trauma (occupational neuritis, repetitive trauma neuropathies) [3–6, 8–11]. Compression caused by ganglia can be further subdivided. Ganglia that originate proximally at the pisotriquetral or radioulnar joints are sometimes palpable and cause sensory and motor deficits (type 1) [5]. Ganglia that originate from the distal row of carpus are usually impalpable and cause purely motor deficits that often spare the hypothenar muscles (type III) [5]. The findings based on the individual case reports may not represent the true distribution of causes. One retrospective study of 31 subjects by Murata et al. found the most common cause to be idiopathic (45%) [12]. Other important causes to consider include ulnar artery disease, acute trauma or fracture, aberrant muscles, tumors, osteoarthritis, rheumatoid arthritis, joint dislocations, and activities with prolonged wrist extension [4, 5, 12]. Handlebar palsy is a recently described cause in bicycle and motorcycle riders usually occurring as an isolated deep motor branch lesion [12, 13].

Despite the specific cause, ulnar neuropathy is traditionally a clinical diagnosis based on history and physical exam which includes sensory and strength testing, as well as special maneuvers. This is founded on an understanding of the nerves course and sensorimotor innervation as reviewed above. However, the evaluation can be complicated by commonly nonspecific or atypical presentations, coexisting pathologies (carpal tunnel syndrome), and the infrequent occurrence of this condition [3]. Electromyography and nerve conduction are essential tools to confirm the diagnosis, detect the location of the lesion, allow classification, and determine the extent of nerve damage in order to further guide diagnostic and therapeutic decisions. This is of particular importance in cases of acute compressive injury that require immediate surgical intervention [3, 11].

The case described here involves ulnar nerve entrapment at the wrist caused by a ganglion cyst arising from the proximal pisotriquetral joint and leading to subtle sensory and motor symptoms found to be consistent with a type 1 lesion by electrodiagnosis. This case illustrates how the presentation of an ulnar neuropathy at the wrist is often nonspecific and can be complicated by coexisting pathologies. Considering the high incidence of ulnar nerve entrapment at the elbow and a positive Tinel's sign at the elbow, a lesion occurring in this location was initially deemed more likely. The diagnosis of a lesion occurring within Guyon's canal was revealed electrophysiologically. This demonstrates how an understanding of the anatomy, along with proper electrodiagnosis, can be used to accurately identify the location of a lesion. The compressive ganglion could then be detected by MRI, allowing for successful treatment by surgical decompression.

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Ulnar Neuropathy at the Wrist: Questions

Please read each question and circle the correct answer.

1. Handlebar palsy in cyclists usually involves:
   a. median sensory nerve
   b. ulnar sensory nerve
   c. median motor branch
   d. ulnar motor branch

2. The most common site of compression of the ulnar nerve is:
   a. at the wrist
   b. in the mid forearm
   c. at the elbow
   d. in the mid arm

3. A type 2 lesion of the ulnar nerve at the wrist involves:
   a. the superficial sensory branch
   b. the deep motor and sensory branch
   c. the deep motor branch including innervation of the hypothenar muscles
   d. the deep motor branch sparing the hypothenar muscles

4. The deep motor branch of the ulnar nerve at the wrist innervates:
   a. abductor pollicus brevis
   b. abductor digiti minimi
   c. ulnar skin surface of the hypothenar eminence
   d. none of the above

5. A 68 y.o. female undergoes ulnar nerve transposition for severe ulnar nerve compression at the elbow with symptoms of claw deformity, atrophy and loss of sensation in the ring and small fingers. Two months after surgery, her pain is improved, her small finger Semmes Weinstein monofilament testing shows improvement, but her claw posture has worsened considerably. You advise no further ulnar nerve intervention because:
   a. revision ulnar nerve surgery is uniformly unsuccessful after the age of 50
   b. worsening claw deformity suggests median neuropathy
   c. claw posture worsens as the profundus muscles strengthen
   d. claw posture worsens as the intrinsic muscles further degenerate
   e. this response suggests brachial plexus involvement or Pancoast tumor

6. A 25 y.o. roofer presents to the emergency department 2 hours after a nail gun accident. He has a puncture wound in his mid palm and a nail exiting from his dorsal hand. His attempt at pinch is shown in figure 1. His radiographs are shown in figure 2. He has normal sensation throughout the hand and a moderate degree of pain. There is minimal swelling of the hand and passive extension of the interphalangeal joints is not painful. You advise tetanus prophylaxis, operative exploration, irriga-

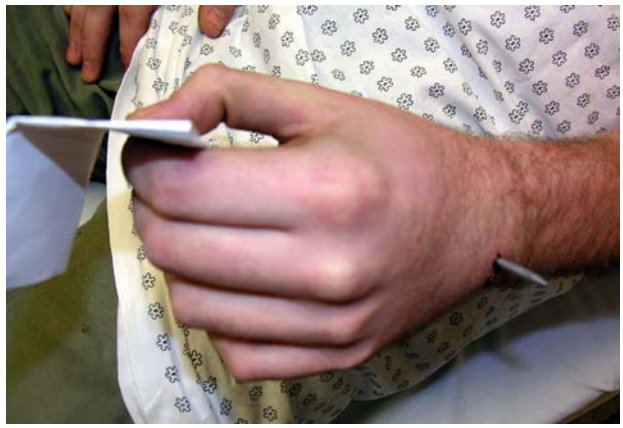

Figure 1

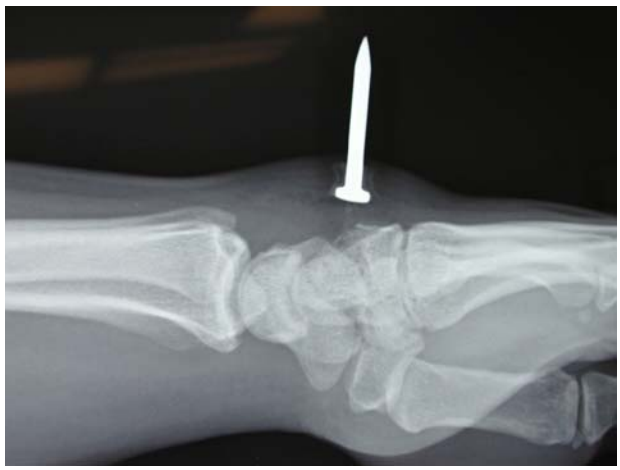

Figure 2

tion and debridement, K-wire fixation of a hamate body fracture and:

a. repair of the extensor pollicis longus tendon
b. repair of the median nerve
c. decompression of the deep and intrinsic compartments of the hand
d. transfer of the extensor carpi radialis brevis to the the adductor pollicis brevis
e. repair of the deep branch of the ulnar nerve

7. The dorsal ulnar cutaneous nerve:

a. provides sensation to the dorsum of the medial forearm
b. provides sensation to the dorsum of the 4th & 5th digits
c. branches off the ulnar nerve proximal to the wrist
d. branches off the ulnar nerve distal to the palmar branch

8. The most common cause of ulnar nerve compression at the wrist is:

a. a ganglion cyst
b. an aberrant muscle
c. a lipoma
d. sarcoidosis
e. rheumatoid arthritis

9. A clinical sign of entrapment of the ulnar nerve in Guyon's canal is:

a. loss of sensation over the thenar eminence.
b. weakness of the long digital flexors to digits 4 & 5.
c. loss of sensation over dorsum of the medial hand.
d. atrophy of the 1st dorsal interosseous.

10. Electrodiagnostic studies should reveal which of the following with entrapment of the ulnar nerve in Guyon's canal:

a. denervation demonstrated by positive sharp waves and fibrillation potentials in the 1st dorsal interosseous.
b. a drop in sensory amplitude when stimulating proximal to the wrist.
c. denervation demonstrated by positive sharp waves and fibrillation potentials in the abductor digiti minimi.
d. a relative decreased sensory amplitude to the 4th digit when compared to the contralateral side.
e. all of the above

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