Ulnar Neuropathy Differential Diagnosis and Prognosis

Disclosures: None
Goals of Lecture

• Describe anatomy: sites of entrapment
  – Ulnar nerve
• Discuss differential diagnosis of ulnar nerve pathology
• Identify pitfalls of EMG/NCV
• Discuss clinical scenarios
• Review electrodiagnostic features of evaluation
The Commandments

• Identify the goal of the study
• History and physical
• Know thy anatomy
• Understand the pros and cons of the test
• Do not over interpret the data
• Consider musculoskeletal etiologies
Ulnar nerve

• Passes in retroepicondylar groove* (tardy ulnar palsy) posterior to medial epicondyle and medial to olecranon
Ulnar nerve

- Travels between two heads of flexor carpi ulnaris*: humeroulnar arcade
- Arcade is .3 to 2 cm distal to retroepicondylar groove
Ulnar nerve

- Exits from the deep surface of FCU at deep flexor pronator aponeurosis*
  - 2.8 to 6.9 cm distal to retroepicondylar groove
- Passes into forearm between FCU and flexor digitorum profundus
Ulnar nerve forearm innervation

- Flexor carpi ulnaris receives branches distal to medial epicondyle
- Ulnar innervated Flexor digitorum profundus receives innervation a few centimeters distally
- Both receive branches from ulnar nerve under cover of FCU
Palmar cutaneous branch of ulnar nerve

- In midforearm palmar cutaneous branch supplies branch to skin on hypothenar eminence
Dorsal Ulnar Curtaneous Nerve

- Dorsal ulnar cutaneous next arises 5-10 cm proximal to wrist and passes posteriorly between ulna and FCU tendon
Superficial branch of ulnar nerve

- Variable
- Supplies palmar digital branches
- Supplies palmaris brevis 1-4 cm distal to origin of deep and superficial divisions
Deep branch of ulnar nerve

• Supplies abductor digiti minimi distal to split in 50%
  – 25% get innervation proximal to split
  – 25% between two divisions

• After ADM and hypothenar muscle, innervates interossei, ulnar lumbricals, ends in adductor pollicis and deep portion of FPB
Type I: Shea and McClain I

• Proximal Guyon’s canal
  – Superficial and entire deep branches
  – Prolonged sensory nerve distal latency
  – Prolonged distal latency to ADQ and FDI
  – Potential abnormalities on emg in ulnar interossei and hypothenar musculature
Type II: Shea and McClain II

- Distal portion of guyon’s canal
  - Entire deep branch
  - Normal sensory nerve distal latency
  - Prolonged distal latency to ADQ and FDI
  - Potential abnormalities on EMG in intrinsic and hypothenar musculature
Type III (Shea and McClain II)

• Within the palm
  – Palmar deep branch
  – Normal sensory distal latency
  – Prolonged distal latency to FDI, normal latency to ADQ
  – Potential abnormalities on EMG in FDI, not ADQ
Type IV (Shea and McClain III)

• In the palmaris brevis muscle
  – Superficial branch
  – Prolonged sensory distal latency
  – Normal distal latency to FDI and ADQ
  – Normal EMG
Case one

• Patient is a 27 year old waitress who presents with 3 month onset of paresthesias in the right ulnar 2 fingers
• No weakness
• No true deficit on sensory exam
# Case one: raw data

## Ulnar motor results

<table>
<thead>
<tr>
<th>Nerve</th>
<th>DL</th>
<th>Amp</th>
<th>CV</th>
</tr>
</thead>
<tbody>
<tr>
<td>R Ulnar wrist</td>
<td>2.8 ms</td>
<td>8.6 mV</td>
<td></td>
</tr>
<tr>
<td>BE</td>
<td>6.4 ms</td>
<td>8.3 mV</td>
<td>50 m/s</td>
</tr>
<tr>
<td>AE</td>
<td>8.8 ms</td>
<td>8.1 mV</td>
<td><strong>44 m/s</strong></td>
</tr>
<tr>
<td>Left Ulnar wrist</td>
<td>3.1 ms</td>
<td>8.7 mV</td>
<td></td>
</tr>
<tr>
<td>BE</td>
<td>5.8 ms</td>
<td>8.6 mV</td>
<td>63 m/s</td>
</tr>
<tr>
<td>AE</td>
<td>7.7 ms</td>
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<td>54 m/s</td>
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</table>

## Ulnar sensory results

<table>
<thead>
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<tbody>
<tr>
<td>Left Ulnar wrist</td>
<td>3.5 ms</td>
<td>40 mV</td>
<td>14 cm</td>
</tr>
<tr>
<td>Right ulnar wrist</td>
<td>3.4 ms</td>
<td>35 mV</td>
<td>14 cm</td>
</tr>
</tbody>
</table>


Ulnar sensory and mixed motor-sensory studies across elbow

- Significant pitfalls
- Decreased sensory amplitudes are nonlocalizing
- Across elbow studies not reliable
  - Small potentials
    - Shock artifact
    - Difficulty extracting signal from noise
    - Phase cancellation
  - Not a practice recommendation
    - Practice Parameters AAMEM
Case One

• Emg normal
  – First dorsal interosseus
  – Abductor pollicis brevis
  – Triceps
  – Pronator teres
  – biceps
Case One

• Diagnostic options
  – Normal study
  – Slow conduction velocity
  – Temporal dispersion
  – Axonal lesion
  – Conduction block
Prognosis

• Good prognosis
• Asymptomatic; may wish to address joint protection
Case 2

- 54 year old left handed pitcher with paresthesias in left ulnar one and one half fingers over last month
- Tinel’s sign positive over ulnar groove.
- No symptoms or sensory signs at the time of the study
Raw Data: Case 2

- EMG normal
  - First dorsal interosseus
  - Abductor pollicis longus brevis
  - Extensor digitorum communis
  - Triceps
  - Biceps
  - Cervical paraspinals
Diagnostic Options

- Complete conduction block
- Slow conduction velocity
- Temporal dispersion
- Axonal lesion

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<tr>
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<td>7.0</td>
<td>14.0</td>
<td>38 m/s</td>
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The answer is:

- Temporal Dispersion
- Slow conduction velocity
- Temporal dispersion explains symptoms
- Myelinopathy
- Prognosis?

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Prognosis

- Should be good with myelinopathy
- May need to change pitching style or shut down for a bit while symptoms abate
Case 3

- 17 year old quarterback hit in left elbow by oncoming defensive end 6 weeks prior to evaluation.
- Immediate feeling of numbness in ulnar 2 fingers
- Sensation decreased in ulnar 1 ½ fingers
- 4/5 strength in first dorsal interosseus
Case 3: Raw Data

- **EMG findings**
  - FDI, positive waves, polyphasics, repetitive firing
  - APB NL
  - Pronator teres NL
  - FCU NL
  - Biceps NL
  - Triceps NL
Diagnostic options

- Complete conduction block
- Partial conduction block
- Slow conduction velocity
- Temporal dispersion
- Axonal lesion

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<td>4.4 mv</td>
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The answer

- Partial axonal lesion
- Partial conduction block
- Partial myelinopathy
- Temporal dispersion
- Prognosis?

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Prognosis

• Should be good
• Partial axonopathy
• Recent injury
• Good residual nerve function
Case 4

• 45 yr old physician who is 6’4” tall and having paresthesias in the left ulnar 1 ½ fingers after taking 4 hrs to use emr to write up a new evaluation; this has progressed over 5 years

• 4/5 strength in the left first dorsal interosseus and abductor digiti minimi

• Sensation altered in the left ulnar 1 ½ fingers
Case 4: Raw Data

- EMG findings
  - FDI small fibs, large amp potentials, polys, rep fire
  - APB NL
  - FCU NL
Diagnostic options

- Slow conduction velocity
- Temporal dispersion
- Axonal lesion
- Conduction block

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<td>4.0 ms</td>
<td>4.5 ms</td>
<td>3 mv</td>
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<tr>
<td>BE</td>
<td>12.2 ms</td>
<td>4.1 ms</td>
<td>3 mv</td>
<td>49 m/s</td>
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<tr>
<td>AE</td>
<td>15.1 ms</td>
<td>7.0 ms</td>
<td>3 mv</td>
<td>34 m/s</td>
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Answer

- 70% axonal death
- Slow conduction velocity
- Chronic changes
- Prognosis?

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<tr>
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<td>9.7 ms</td>
<td>5.5 ms</td>
<td>9 mv</td>
<td>60 m/s</td>
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<tr>
<td>AE</td>
<td>11.5 ms</td>
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Prognosis

- Poor
- Long duration of injury with significant axonal drop out
- Long distance
Case 5: Clinical scenario

• 28 year old female with paresthesias in left ulnar one and one half fingers for 6 weeks following long bike ride
• No pain in cervical spine or significant medical history
• Physical exam
  – Diminished sensation left ulnar 1 ½ fingers
  – 4/5 strength in left FDI and ADM
# Motor conduction studies

<table>
<thead>
<tr>
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<th>DL</th>
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<th>C.V.</th>
</tr>
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<tbody>
<tr>
<td>Wrist</td>
<td>4.9 ms</td>
<td>1.0 mV</td>
<td></td>
</tr>
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<td>BE</td>
<td>8.7 ms</td>
<td>1.0 mV</td>
<td>53 m/s</td>
</tr>
<tr>
<td>AE</td>
<td>10.7 ms</td>
<td>1.0 mV</td>
<td>50 m/s</td>
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<tr>
<td>Wrist</td>
<td>4.1 ms</td>
<td>4.3 mV</td>
<td></td>
</tr>
<tr>
<td>BE</td>
<td>7.8 ms</td>
<td>4.3 mV</td>
<td>57 m/s</td>
</tr>
<tr>
<td>AE</td>
<td>9.3 ms</td>
<td>4.3 mV</td>
<td>67 m/s</td>
</tr>
</tbody>
</table>
## Sensory nerve conduction studies

<table>
<thead>
<tr>
<th></th>
<th>Left</th>
<th></th>
<th>Right</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DL</td>
<td>Amp</td>
<td>DL</td>
<td>Amp</td>
</tr>
<tr>
<td>Ulnar</td>
<td>3.5 ms</td>
<td>11 mV</td>
<td>3.4 ms</td>
<td><strong>31 mV</strong></td>
</tr>
<tr>
<td>Median</td>
<td>3.2 ms</td>
<td>49 mV</td>
<td>3.3 ms</td>
<td>49 mV</td>
</tr>
<tr>
<td>DUC</td>
<td>2.5 ms</td>
<td>20 mV</td>
<td>2.2 ms</td>
<td>23 mV</td>
</tr>
</tbody>
</table>
EMG findings

- Left first dorsal interosseus
  - Positive waves, fibs +1, repetitive firing
- Left abductor digiti minimi
  - Positive waves, fibs +1, repetitive firing
- Left triceps normal
- Left flexor carpi ulnaris is normal
- Left biceps normal
Diagnostic options

Type of injury
- Conduction block
- Slow conduction velocity
- Temporal dispersion
- Axonal lesion

Location of lesion
- Type I: Shea and McClain I
- Type II: Shea and McClain II
- Type III: Shea and McClain II
- Type IV: Shea and McClain III
Diagnosis

- Partial axonopathy
- Partial conduction block?
- Prognosis?

- Type I: Shea and McClain I
Prognosis

• Good
• Recent injury
• Distal location
• Not sure how much is myelinopathy or axonopathy
Patient returns 2 weeks later

• Minimal paresthesias
• Strength is 5/5 left first dorsal interosseus
• Now what do you think?
  – Primarily Axonopathy
  – Primarily Myelinopathy
Any other studies that may have been helpful?

<table>
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<tr>
<th>Sensory</th>
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<tbody>
<tr>
<td>L ulnar</td>
<td>3.5 ms</td>
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<thead>
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<th>Motor</th>
<th>DL</th>
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<tbody>
<tr>
<td>Ulnar</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L wrist</td>
<td>4.9 ms</td>
<td>1.0 mV</td>
<td></td>
</tr>
<tr>
<td>BE</td>
<td>8.7 ms</td>
<td>1.0 mV</td>
<td>53 m/s</td>
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Case 6

- 64 year old male
- 1 year hx of R upper extremity weakness
- 2 months ago, pain in R trap, increased weakness in right hand and numbness in ulnar forearm and hand
Any other studies that may have been helpful?

<table>
<thead>
<tr>
<th>Sensory</th>
<th>DL</th>
<th>Amp</th>
</tr>
</thead>
<tbody>
<tr>
<td>L ulnar: wrist to little finger at 14 cm</td>
<td>3.5 ms</td>
<td><strong>11 µV</strong></td>
</tr>
<tr>
<td>L ulnar: palm to little finger at 7 cm</td>
<td>2.0 ms</td>
<td>40 µV</td>
</tr>
<tr>
<td>R ulnar: wrist to little finger at 14 cm</td>
<td>3.4 ms</td>
<td>31 µV</td>
</tr>
<tr>
<td>R ulnar: palm to little finger at 7 cm</td>
<td>2.0 ms</td>
<td>40 µV</td>
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**wrist**

14 cm

**S palm**

7 cm
Case 6: Physical examination

• Cervical rom full
• Right wrist extensor: 4/5
• Right triceps: 4/5 (absent triceps reflex)
• Right extensor digitorum indicis: 2/5
• Right FDI and ABB: 2/5
• Sensation intact
## Motor conduction studies

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Sensory conduction studies

• Normal
EMG

- FDI: positive waves, fibs, dec recruitment
- ABP: positive waves, fibs and large amplitude with dec recruitment
- EDI: positive waves, fibs, polys, and large amplitude with dec recruitment
- Triceps: large amplitude, dec recruitment
- Cervical paraspinals: CRD
- Pronator, biceps, ECRL: nl
Diagnosis ?
Conclusions

• Prognosis: ?
• What is the moral of the story?
  – Not all that radiates into the ulnar forearm is ulnar nerve
  – Sensory complaints for ulnar nerve are generally true to the ulnar 2 fingers
  – Evaluate APB and EDI as well as the APB
Conclusion

• History and physical is the cornerstone of diagnosis

• Anatomic studies and electrophysiologic studies assist in verifying or refuting your clinical impression