Ulnar nerve vulnerability at elbow

Using the Sensory Nerve Action Potential

Amplitude

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Stedman – 25th Ed.

extremitas (eks-trem’I-tas)

[L. fr. extremus, last, outermost] [NA]. Extremity; one of the ends of an elongated or pointed structure. Incorrectly used to mean Limb. See membrum.
LI MBS - *not* extremities

- **Upper limb**
  - Arm - shoulder to elbow
  - Forearm - elbow to wrist
  - Hand - this is end of limb
Possible entrapments

- **Wrist**
  - Proximal palm
  - Deep branch (tunnel)

- **Elbow**
  - Ulnar groove
  - Cubital tunnel
CV ulnar nerve across elbow

- Must do study with elbow flexed (70 degrees)
- Proximal conduction is *ALWAYS* faster
- Note the amplitude (reduced- if compromised at elbow)
- Include SNAP of digit 5
Must do study with elbow flexed!
Use monopolar needle for stimulation

- Advantages –
  - Better localization
  - Less intense current (.05ms)
    - It’s the duration that is painful
  - EMG’er hands are free
Monopolar needle stimulation

- Resistance can change -
  - Surface - inter-electrode of 300-400 K ohms
  - To needle - inter-electrode of 10-20 K ohms bypass cornium (high resistance)
    - Can reduce stim duration to .05 ms
  - NB. pulse duration is most painful
Monopolar needle stimulation of ulnar nerve above and below elbow.

**Note CMAP amplitude**

- And latency
- Conduction across elbow
- And *duration* of negative spike
- NOTE SNAP ALSO
  - Ring electrodes digit 5
Tardy ulnar nerve palsy

- Occurs late (15-20 years) after distal humeral fracture
- Gradual onset of weakness and numbness

Supracondylar fracture
At age 14
below elbow

above elbow

‘Benediction hand’
Swimmer with hand weakness

- 20 y/o backstroke swimmer
  - Put on special exercise to increase time
  - 3 months later c/o pain and weakness of hand and forearm
  - Team physician suggested tendinitis, later stress fx
  - Sent ot PM&R for consultation
Ulnar nerve compromise at wrist

- Dorsal cutaneous branch of ulnar nerve will locate the lesion above the wrist
- SNAP of digit 5 will identify lesion at wrist (and CMAP of abd dig V)
- **CMAP of 1st dorsal interosseus m will locate lesion at or distal to Guyon canal.**

38 y/o cyclist weakness right hand

- 100 mile trip
- Weakness right hand
- No sensory sx or deficit
- DX?????
  - What edx should be done?
Sensory SNAP

- Note the duration and amplitudes
  - Calculate the estimated loss of amplitude 2d to phase cancellation
Sensory CV

Can stimulate in only one place
Distance/Latency = CV

SENSORY NERVE CV

Can measure after the fact since recording is directly from SNAP
(must subtract ‘latency of activation’-.1 ms)
Sensory CV

- Divide latency into distance
- To be precise, subtract 0.1ms from latency before division (latency of activation)
- Similar calculation for mixed nerve CV

Ulnar CV - Sensory

- Record –
  - *Digit 5 separate recording electrodes 4 cm*
  - Dorsal hand
  - *NB. If stimulating proximally also, factor in ‘phase cancellation’ when recording SNAP*
SNAP - antidromic

- 4 cm separation of recording

NB. Assume 50 M/s; this separation will minimize phase cancellation
Cool hand will change ratio of latencies distal and proximal

- Normal – distal 7 cm is slightly more than ½ (smaller diameter and cooler)
- If hand is very cool (sympathetic ++), distal latency > proximal latency
- Cold = increased amplitude, duration and latency
Filter settings - sensory

- Filters - open
- If use high frequency cut-off values change
Phase cancellation

- Recording from nerve directly will record from many axons
- Each axon conducts at a slightly different rate
- Slowest and fastest will cancel each other thus reducing the amplitude
Read SNAP - baseline to peak

Amplitude - baseline to peak
Latency to onset - fastest axons CV can be normal even if some axons conduct slowly
- If some axons are slow, PEAK latency will be longer (duration and rise time increased)
Sensory CV - measure

- Measure latency to peak rather than onset
  - If some axons in peripheral nerve are conducting normally and some slowly, onset will only measure the ‘normal’ axons
  - Peak will include the slow axons (as will rise time and duration of negative spike of SNAP)
Estimating SNAP amplitude w/ prox stim

- Using wrist and mid palm stimulation and recording from digit 3 (median N)
  - 7 uV per cm (amplitude)*
  - .2 ms per cm (latency)

Dig 3 SNAP 7 & 14 cm

- Mean latency 1.6 ms; 3.1 ms (+/- .3ms)
- Mean amplitude 50 uV; 40 uV
- Cold increases amplitude and latency

NB. Patients with Raynaud phenomenon or over-active sympathetics will have marked increases in ampl & latencies
Estimate loss of amplitude 2d to phase cancellation

- I used the data obtained in a study of median nerve SNAP latency and amplitudes from wrist and midpalm stimulation.
  - Measure baseline to peak
SNAP amplitude - phase cancellation

- SNAP at wrist - 40 uV
- SNAP at elbow - 10 uV
  - 30 uV/20 cm = 1.5 uV - per cm
  - WNL
sensory amplitudes with proximal stimulations

- Divide distance into the difference in SNAP at midpalm and wrist
  - Estimation of phase cancellation loss of amplitude on proximal stimulation
  
  - *In possible compromises also note the duration of the SNAP negative spike*

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Phase cancellation and SNAP amplitudes

- Over 3 cm distance  18 uV
- Over 2 cm distance  7-8 uV
- Over 1 cm distance  2-3 uV

- *This would average to 2+ uV/cm*

- NB. .2 ms/cm is peak latency change

*In normal state*
Bank teller

- Leaning on elbow
- Ulnar nerve traumatized between medial epicondyle and hard surface
Calibr: 1 ms, 50 uV / division
Distance 25 cm
60 - 40 = 20 uV / 25 = .8 uV/cm
Clearly less than phase cancellation
Ergo. Block at elbow NOTE increase duration

Volleyball player

- 17 y/o c/o pain in wrist for 2 months
- All imaging studies normal
- Px - slight weakness in ulnar intrinsics
- Referred for EDX
- NB. SNAP above elbow
48 y/o man w/ numb digit 5

- Weight lifter
  - Elbow & wrist curls
  - Left hand dominant
  - Needle EMG - fibrillation potentials and positive waves in ulnar intrinsic muscles
43 y/o truck driver

- C/O numbness left hand (digits 4,5)
- PX - ulnar nerve subluxes with elbow flexion
- MCV 53 M/sec forearm (5K); 30 M/sec across elbow (2.3 K)
- SNAP wrist 30 uV above elbow NR
8 y/o son

- PX - ulnar nerve subluxes with elbow flexion bilaterally
- SNAP wrist 20 uV; AE 10 uV
- NO SX
Other techniques

- Short segment stimulation
  - Problems ‘location of nerve’
  - Conduction block if <20% CMAP or <10uV over .5 ms segment*
- Stimulation median/ulnar nerves at wrist – record CNAP
  - Problems – both nerves lie close together above elbow


CNAP – short segment across elbow

- Can record proximal or distal to compromise fo ulnar nerve

NOTE
- Amplitude, latency, duration of compound nerve action potential
SNAP amplitude & latency short segment

- Record SNAP digit V

- Adjust for distance: 1-2 uV/cm
  - Note increase of latency - .2 ms/cm
  - Note loss of amplitude - 1-2 uV/cm
  - Note duration of negative spike of SNAP

Take home message I

- Use the SNAP for nerve entrapments
  - Amplitude absent or markedly reduced if block at elbow (est. phase cancellation)
  - Negative spike duration
  - And......latency

- NB. Motor CV can be misleading and less sensitive!
Take home message

- Try monopolar needle stimulation
  - Anode must be just opposite cathode
- Ensure recording electrodes are separated by 4 cm
- Open the filters!
- Needle stimulation will bypass the cornium and reduce resistance from 400+K to 10K (and can reduce to .05ms duration stimulation - less painful)