Upper Extremity Neuropathies in the Athlete

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Ultimate Question?
Objectives

- Review Anatomy of Upper Extremity
- Identify Common Neuropathies seen in an overhead athlete
- Review Diagnostic Evaluation and necessary Testing
- Update on treatment and return to play for Upper Extremity Neuropathies
Introduction

• Throwing/Overhead Athlete subset of sports medicine population
  – Coordination of complex biomechanical, kinematic, proprioceptive events
  – Huge stress placed on parts of body
Kinetic Chain

- Energy from legs, pelvis, trunk and upper extremity
- Coordinated!
- From body to ball
- Result is ball flight
- Subtle changes in velocity, direction, rotation
Phases of Throwing

- Knee Up
- Foot Contact
- Max ER
- Release
- Max IR

PHASES

- Wind-up
- Stride
- Arm Cocking
- Arm Acceleration
- Arm Deceleration
- Follow-through
Phases of Throwing

- 1. Wind up
- 2. Early cocking
- 3. Late cocking
- 4. Acceleration
- 5. Deceleration
- 6. Follow-through

Cummins et al. Phys Rehabil Clin N. America vol 26.1
Musculoskeletal System

- Bones of the Shoulder
  - Humerus
    - Humeral head
    - Greater tuberosity
    - Lesser tuberosity
  - Clavicle
  - Scapula
    - Glenoid
    - Coracoid process
    - Acromion
    - Scapular body
      - Supraspinatus fossa
      - Infraspinatus fossa
Musculoskeletal System

- **Elbow Bones**
  - Humerus
    - Trochlea
    - Capitellum
  - Ulna
    - Oleceranon process
    - Coronoid process
  - Radial head
- **Inherently stable joint**
Musculoskeletal System

- **Muscles**
  - Deltoid
  - Pectoralis minor and major
  - Teres Major
  - Latissimus Dorsi
  - Etc.
Musculoskeletal System

- Rotator Cuff Muscles
  - Supraspinatus
  - Infraspinatus
  - Teres Minor
  - Subscapularis
Muscles of the Elbow

- Brachialis and Biceps
- Triceps
- FCU and FDS important as secondary stabilizers during throwing!
Brachial Plexus

Brachial Plexus (schematic)

- Long thoracic
- Dorsal scapular
- Suprascapular
- Suprascapular nerve
- Nerve to subclavius
- Lateral pectoral
- Musculocutaneous
- C5
- Superior
- Posterior
- Lateral
- Medial pectoral
- Median
- Ulnar
- C6
- Middle
- Posterior
- Medial
- C7
- Inferior
- Anterior
- Posterior
- Radial
- Axillary
- Thoracodorsal
- Subscapular (Upper/Lower)
- C8
- T1

Cords
- Lateral Cord
- Medial Cord

Divisions
- Dorsal scapular nerve
- Suprascapular nerve
- Nerve to subclavius
- Lateral pectoral nerve
- Musculocutaneous nerve
- Axillary nerve
- Thoracodorsal nerve
- Subscapular nerve
- Radial nerve
- Median nerve
- Ulnar nerve
- Medial cutaneous nerve of the forearm
- Lower subscapular nerve
- Thoracodorsal nerve
- Upper subscapular nerve
- Radial nerve
- Median nerve
- Ulnar nerve
- Medial cutaneous nerve of the arm
Physiologic Pressure on a Nerve

• Likely due to ischemia:
  - 20-30mmHg >>>> decreased epineural blood flow
  - 30mmHg >>>> axonal transport disrupted
  - 30-40mmHg >>>> paresthesias
  - >60mmHg >>>> complete sensory/motor block
Nerve Innervation Elbow

I. Median Nerve (C6-T1; med/lateral cords)-

- All ventral muscles of forearm except FCU
- Wrist flexors/thenar eminence/volar 1st 3 digits and lateral half of 4th
- Cross elbow medially to antecubital fossa and pass through 2 heads of pronator teres
- Distally branches to Ant Interosseus Nerve.
Median Nerve

- Median nerve
- Pronator teres
- Flexor carpi radialis
- Palmaris longus
- Flexor digitorum superficialis
- Flexor digitorum profundus I & II
- Flexor pollicis longus
- Pronator quadratus
- Abductor pollicis brevis
- Flexor pollicis brevis
- Opponens pollicis
- First lumbral
- Second lumbral

Humerus
Radius
Ulna
Humeral head of pronator teres muscle
Ulnar head of pronator teres muscle
Median Neuropathy

• Anterior Interosseus Syndrome
  – Midshaft Fxr; well developed forearm musculature
  – Purely Motor: NO SENSORY LOSS!
  – Late sign: OK sign (weakness of FPL/FDP)
  – Weak pronation w/ arm flexed
Median Neuropathy

- **Pronator Syndrome**
  - Repetitive pronation/supination (racket sports)
  - @ Ball release and follow through in throwers
  - Pain on volar side of forearm
  - N/T median n. distribution
  - +/- weakness of thenar muscles (uncommon)

- **Treatment:**
  - Conservative w/ rehab
  - NSAIDs
  - Surgical exploration
Radial Nerve Innervation

II. Radial Nerve (C5-C8/post cord)--
EXTENSION

• Extension elbow/wrist/MTP and supination
• Sensory of dorsal forearm/hand, thumb
• Descends laterally and divides
  1) superficial sensory branch
  2) deep purely motor branch (Posterior Interosseus Nerve) as enters Arcade of Froshe (fibrous arch of supinator m.)
Radial Nerve Course

From axillary nerve
- Superior lateral brachial cutaneous nerve

From radial nerve
- Inferior lateral brachial cutaneous nerve
- Posterior brachial cutaneous nerve
- Posterior antebrachial cutaneous nerve
- Superficial branch of radial nerve and dorsal digital branches

Cutaneous innervation from radial and axillary nerves
Radial Neuropathy

• Radial Tunnel Syndrome
  – Seen in dominant arm in racket sports
  – No weakness
  – May be confused w/ Lateral Epicondylitis
    • Dull aching pain
    • Pain w/ resisted supination/extension of middle finger
    • Tender at muscle mass ~ 4 cm below elbow
    • +Tinels

• Treatment
  – Rest/Splinting
  – NSAIDs
  – Injections?
  – Surgery last resort-decompression
Radial Neuropathy

• **Posterior Interosseous Syndrome (Motor)**
  – Dominant arm
  – Compression injury
  – Overuse or Fxr proximal radius
  – Painless weakness of extensors (ck ECU)
  – Radial deviation
  – **NO SENSORY LOSS!**
  – MRI changes

• **Treatment**
  – Conservative
  – Surgery if mass/fxr/dislocation
  – Decompression
Radial Nerve Injury

- Fracture of Humerus in throwing
  - Middle distal 1/3 shaft
  - Torsional force > tensile strength in bone
  - Radial Nerve may be trapped in fragments
Ulnar Nerve

- C8/T1 from medial cord
- Innervates elbow joint
- Intrinsic hand muscles
- FCU/FDP
- Sensory 4th/5th digits ulnar border

https://epsomtissuetech.wordpress.com
Ulnar Nerve Compression Sites
Ulnar Neuropathy

• Cubital Tunnel - 2\textsuperscript{nd} most common UE compressive neuropathy
  – Physiologic cause w/ flexion
  – Overhead throwers/wgt lifting/racket sports/musicians
  – Often involve ligament injury/laxity*
Symptoms and PE

- Pain @ medial epicondyle w/ sensory complaints of ulnar distribution into hand
- Weakness thumb/finger abduction, pinch & grip>>> dropping objects
- Motor and Sensory Exam
  - Grip/pinch strength
  - Vibratory
  - 2 Point Discrimination
Physical Examination

- Tinel’s
- Elbow Flexion Test
- Elbow Scratch Collapse Test

- Froment Sign
- Wartenburg Sign
- Claw hand
Ulnar Neuropathy

• Cubital Tunnel
  – X-rays
  – MRI
  – EMG/NCV

• Treatment
  – Conservative
    • Rest w/ night splinting
    • Education
    • NSAIDs
    • Rehab including ITP
  – Surgery *(may involve UCL)*?
    • Throwers: anterior subcutaneous transposition or submuscular transposition
    • RTP preoperative strength and mobility
Cubital Tunnel Syndrome

**COMPRESSSION**
- Pressures elevated in patients undergoing UND and increased in flexion (Iba et al JHS 2006)
- Elbow flexion INCREASES intraneural pressure at cubital tunnel

**TRACTION**
- Unrestricted ROM produce strains up to 29%
- Post UND strain dropped from 30.5% to 5.5% in patients (Ochi et al JHS[EU] 2013)
Lateral Antebrachial Cutaneous Nerve

Branch of Musculocutaneous nerve

Anterior Lateral Elbow Pain/paresthesias in throwers

Bassett’s Lesion:
- Pronation and Extension with ball release

- RICE, NSAIDS, INJECTIONS
- May require surgical release @ biceps aponeurosis if fail conservative care
Suprascapular nerve

- Upper trunk C5-6 of Brachial Plexus
- Mixed motor/sensory
- Innervates subacromical bursae, AC & GH joint, SS and IS muscle
Suprascapular Nerve

- From brachial plexus to shoulder
- Under superior transverse scapular ligament in suprascapular notch
- Around spinoglenoid notch to infraspinatus
Suprascapular Neuropathy

• Dependent on site of injury involve SS/IS
  – +/- posterior shoulder pain with weakness

• Trauma, Surgery, Ganglion Cyst, Overhead activities with increase stress: traction/compression
  – Baseball 4% pitchers (Cummins et al. CJSM 2004)
  – Volleyball players (Ferretti et al. ALSM ‘87)
Suprascapular Neuropathy

- **Dx:** Clinical/ Imaging MRI/MR arthrogram NCV/EMG

- **Treatment:**
  - 1\textsuperscript{st} Conservative unless mass lesion
    - Modify activity
    - Rehab-flexibility/Postural ex/Improving IR contractures/ Cuff strengthening
  - Surgery
    - Resection Superior Transverse Scap Ligament
    - @ spinoglenoid ligament-decompression
    - Excise ganglion cyst; repair labrum
Axillary Nerve
• Posterior cord C5-6 nerve root
• Motor function Deltoid and Teres Minor
• Sensory lateral shoulder/joint capsule
• Exits posterior with PHCA through quadrangular space
  – Teres Minor
  – Long head triceps
  – Teres Major
  – Humeral shaft
Axillary Neuropathy

- <1% of all nerve injuries
- Trauma
- Quadrangular Space Syndrome
Axillary Neuropathy

- Extensive DDx
- Dull ache/burning/fatigue with throwing
  - Atrophy Deltoid
- X-rays/MRI/EMG/NCV
- Treatment
  - Conservative
  - Sx: Iatrogenic, trauma, lesion, no nerve recovery
Thoracic Outlet Syndrome: Types

- Compression of neurovascular bundle at the thoracic outlet:
  - Brachial plexus (nTOS)
    - 95%: most difficult to diagnose and treat
  - Subclavian artery (aTOS)
    - <1%
  - Subclavian vein (vTOS)
    - 2-3%
Anatomy of Thoracic Outlet

- Bony Boundaries
- Scalene triangle
- Costoclavicular space
- Pectoralis minor space
Thoracic Outlet Syndrome

- Compression results from combination of anatomic variants, physical activities and other events.
- Scalene muscles: wide vs narrow triangle, congenital bands
- Cervical ribs
- Anomalous first ribs
Characteristics

• Age: 20-50
  – <5% teenagers
  – 10% over 50
  – >65 rarely

• Sex: female 70%
  – Cervical ribs more common in female
TOS Symptoms

**nTOS**
- Pain, parasthesias, numbness, weakness
- Throughout affected hand/arm
  - Not necessarily localized to peripheral nerve distribution
- Extension to shoulder, neck, upper back not infrequently

**vTOS**
- Symptoms
- Pain
- Tightness
- Discomfort during exercise
- Edema
- Cyanosis
- Increased venous pattern
- Tenderness over axillary vein

**aTOS**
- Symptoms
- Finger or hand ischemia
- Cutaneous ulcerations
- Forearm pain with use
- Pulsatile supraclavicular mass/bruit
nTOS Symptoms

“Upper plexus” disorders - radial and musculocutaneous nerve distributions

“Lower plexus” disorders - median and ulnar nerve distributions

- Occipital headaches

- Perceived muscle weakness
  • Actual weakness and atrophy are rare

- Vasomotor symptoms
  • Vasospasm, edema, hypersensitivity (CRPS)
Physical Exam: TOS

- Check pulses
- Listen for bruits
- Note edema/cyanosis/collateral veins
- Tenderness over scalene or pec minor
- Decreased sensation to light touch
- Provocative maneuvers
Physical Exam: TOS

- Adson Test

- Healthy volunteers have up to 50% positive test

- Unreliable for diagnosis of TOS!!
Physical Exam TOS: EAST

- Elevated arm stress test
- Most accurate clinical test (per Roos)
- “surrender” position for 3 minutes while opening/closing hands
Physical Exam TOS: EAST

- nTOS: heaviness, progressive weakness, numbness, tingling in fingers, progressing up arm
- vTOS: cyanotic arm with distended forearm veins
- aTOS: ischemic, cramping pain
Thoracic Outlet Syndrome: Treatment

- PHYSICAL THERAPY
- Posture correction
- OMM
- If no improvement, surgical decompression versus living with symptoms.
Thoracic Outlet Decompression

- Transaxillary versus Supraclavicular approach
- Resection of anomalous 1\textsuperscript{st} ribs or cervical ribs
- Resection of anterior and middle scalene
- Possible pec minor tenotomy or brachial plexus neurolysis
- Possible vascular reconstruction
Conclusion

• A thorough and complete history is key
• Understanding the anatomy will help with the diagnosis
• Review Imaging and EMG/NCV
• Review the treatments with each athlete
• Know the Anatomy!!

• EAT A CHEESESTEAK
References