NERVE ENTRAPMENTS
FREQUENTLY SEEN & COMMONLY MISSED

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DISCLOSURE

I have no financial relationship with any diagnostic equipment utilized in this talk.

Faculty for American Medical Society for Sports Medicine advanced diagnostic ultrasound courses.

Faculty for MSKUS cadaver diagnostic and injection courses.
LEARNING OBJECTIVE

- Awareness of common nerve pain syndromes.
- Describe common nerve entrapment syndrome physical exam findings.
- Awareness of cutaneous nerve entrapment symptoms that masquerade as other diagnosis.
BASIC NERVE ANATOMY

- Anatomy
  - Endoneurium
    - Surrounds axons of peripheral nerves
  - Fascicles
    - Groups of axons
  - Perineurium
    - Surrounds individual fascicles
  - Epineurium
    - Intraneural
    - Outer circumferential
TYPES OF NERVE INJURY

- **Neuropraxia**
  - Injury - Mild
  - Recovery

- **Axonotmesis**
  - Injury - Severe
  - Regeneration (1 mm/day)
  - Recovery

- **Neurotmesis**
  - Injury
  - Degeneration
  - Neuroma Formation
HOW INJURED?

Etiologies

- Isolated contusion
- Repetitive compression
- Stretch injury
- Surgical injury
- Vibration
- Viral
- Compressive bracing/casting
ENTRAPMENT NEUROPATHY

Compression of nerve

- Fibrous bands
- Scar tissue, ORIF
- Masses
- Narrow anatomical space
- Bony callus, Fractures
- External compression
- Inflammation
THE WORK UP?

- AWARENESS
- HISTORY
- PHYSICAL EXAM
- SENSORY EXAM
- EMG/NCT
- MRI
- ULTRASOUND
WHAT THE HISTORY TELLS YOU!

- History is vague and non-localizing in early disease making a diagnosis challenging.

- Muscle weakness or atrophy is present in late stage disease.

- Most injuries will have subtle features of a more “classical” nerve entrapment syndrome.

- Our training provides little experience recognizing, diagnosing or treating many of the sensory cutaneous branch entrapments.

- Best diagnostic tool for entrapment neuropathy is good anatomical knowledge cutaneous nerve distribution.
PHYSICAL EXAM FINDINGS

- PE findings of decreased sensation of sensory nerve distribution.
- Pain distribution.
- Muscle fatigue with prolonged contraction.
- Weakness of motor nerves distal to injury site.
- Tinel’s over entrapment.
- Pain with compression maneuvers.
- Special test for some nerves.
SENSORY EXAM

- Although sensory exam findings can be classical, they are more often vague.
- Essential to know nerve innervation patterns.
- The provider must have a sophisticated sensory exam.
- Cutaneous sensory nerve knowledge is the key.
- Referral pain can radiate distal and proximal from site of injury.
Electrodiagnostic studies include two components: Nerve conduction and needle electromyography.

Nerve conduction studies evaluate how fast a nerve conducts electricity and how much electricity reaches the final destination.

In general, a decrease in nerve conduction velocity suggests a demyelinating injury to the nerve at the site of slowing.

A decrease in the amount of electricity that reaches the final destination suggests either a conduction block from a demyelinating injury or axonal injury.

Needle electromyography assist in differentiating between demyelinating and axonal injuries, grading injury severity, and determining injury chronicity.
EXCEPTIONS TO EMG/NCT

- Must have demyelination of the nerve or significant axonal damage.
- At least 3-6 weeks after injury. EMG -
- First Degree or neurapraxia injury not well identified. EMG -
- Second Degree injury or axonotmesis not well identified. EMG -
- Third Degree = injury to the axon & endoneurium. EMG + helpful.
- Fourth Degree = injury to axon, endoneurium, perineurium. EMG +
- Fifth Degree = injury to axon, endoneurium, perineurium & epineurium. EMG +
- CTS SENSITIVITY = 85%
MRI

- In late stage disease MRI is very accurate as muscle atrophy or edema is present. 93%
- MRI sequences images every 2-4 mm so they can miss an entrapment area.
- Good sensitivity but poor specificity if negative study. (20-30% sensitivity and specificity) for smaller nerves.
- Many peripheral nerves are “small” and can be missed unless grossly enlarged.
- Good at ruling in but poor at ruling out.
MRI FINDINGS

- Hyper-intense signal of the nerve suggest edema nerve damage.
- 60% of asymptomatic individuals have hyper-intense signal of the ulna nerve.
- Superior view for deep structures.
- Patient size?
MSK ULTRASOUND EVALUATION OF NERVES
MSKUS can show the constricting tissue which is creating a loss of normal nerve architecture.

- Proximal swelling with distal tapering.

- Sensitivity and specificity typically > 92%.

- Increase of greater than 2mm circumferential area.
FUNCTIONAL EXAMINATION

- Functional static and dynamic exam.
- Power and color flow doppler to identify inflammation, infection and vascular structures.
- Evaluation of surrounding structures for atrophy, fatty infiltration, scarring, instability.
REAL TIME EVALUATION
NEUROHYDROLYSIS

- Real time visualization.
- Diagnostic and therapeutic nerve block.
- Stretch out the constriction.
- Minimal side effects.
- Can be used for some chronic pain diagnosis.

Superficial Cutaneous Radial Nerve
EXCEPTIONS TO MSKUS

- Can’t see underneath bone.
- Patient size can be limiting.
- Requires a skilled & experienced sonographer in MSKUS.
- Good equipment.
- Very few boarded MSKUS in Montana.
- Most radiologists have limited MSK & nerve training.
A WORD ABOUT TREATMENT

- The hardest part is making the diagnosis!

- PT is more effect if they have the correct diagnosis.

- Avoid deep tissue work around the entrapment site.

- Avoid aggressive stretching of the nerve.

- Avoid dry needling, scraper, deep myofascial release, manual trigger point release, & compressive bracing.

- Dose pack, NSAIDS oral and topical, iontophoresis & correction of structural and ergonomic issues.

- Neurohydrolysis and or surgical release if failed conservative therapy.
BEWARE!

- Patients tend to dig into nerve entrapments.
- Hurts good?
- Makes it feel better for a short period of time.
- They become the problem.
- Like a knuckle cracker, they just can’t help themselves.
- Stop the digging is your first therapy goal.
IS IT SHOULDER PAIN OR IS IT NECK PAIN?

- Nerve entrapments to the neck & shoulder are common.
- Challenging to diagnosis.
- Scapula motion is the key!
- Suprascapular nerve
- Dorsal scapular nerve
- Axillary nerve
- Spinal accessory nerve
- Supraclavicular nerve
SUPRASCAPULAR NERVE

- Paralabral cyst thought to be most common?
- 28% of full thickness RTC tear also include nerve entrapment.
- Osteoarthritis association.
- Iatrogenically injured with RTC repair.
- Consider in the setting of pain with minimal MRI findings.
SUPRASCAPULAR NERVE ENTRAPMENT

- The most commonly injured branch of the brachial plexus in sports.
- Hallmark finding is painless weakness to resisted external rotation.
- Most common symptom is a vague lateral shoulder pain.
- Posterolateral dull, burning, deep or diffuse ache that is worse with overhead.
OVERHEAD WORK OR SPORT

- Common in the overhead athlete.
- Seen in 35-45% of professional volleyball athletes on the serving arm.
- Loss of throwing or hitting power or velocity.
- Not well documented in the overhead worker but may present similar to thoracic outlet with weakness during overhead work.
SUPRASCAPULAR NOTCH

- Nerve courses through the suprascapular notch.
- Notch is bridged by a thick transverse scapular ligament.
- Entrapment occurs as the nerve is relatively fixed at the notch.
- Maximal stretching of the nerve with cross body adduction or protracted forward flexion.
- Causes weakness of both abduction and external rotation.
SWALLOWING PAIN?

- With head rotated away and thumb pushing down in the suprascapular notch increasing pain with swallowing is suggestive of SSN entrapment.

- Omohyoid is just superficial to (above) the suprascapular nv.
SPINOGLENOID NOTCH

- Rapid motion of the infraspinatus muscle with throwing pulls the suprascapular nerve against the base of the scapular spine.

- Entrapment occurs secondary to repetitive stretching of the nerve at the sharp bend after the spinoglenoid notch.

- Can present as painless wasting of the infraspinatus.

- No abduction weakness.
THINK SUPRASCAPULAR NERVE

- Adhesive capsulitis
- Full thickness rotator cuff tear
- Pain control for a non-operative patient.
- Nerve block for pain management in glenohumeral OA.
SUPERFICIAL CERVICAL PLEXUS?

- Supraclavicular nerve (SCN)
- Spinal Accessory nerve (SAN)
- Lesser Occipital nerve (LON)
- Transverse Cervical nerve (TCN)
- Greater Auricular nerve (GAN)
SUPRACLAVICULAR NERVE

- Superficial cervical plexus stretch injury
- Presents with hyperesthesia and severe pain.
- Entrapment occurs after clavicle fracture, surgical fixation ORIF, arthroscopy portal incisions, & compression from shoulder sling immobilization.
- Pain out of proportion injury to MRI finding.
- EMG & MRI typically not helpful.
- Ultrasound guided nerve block for diagnosis.
HYPERESTHESIA AFTER SHOULDER INJURY

- Tented clavicle fractures cause impingement of the SCN.
- Symptoms may extend beyond anatomical zone and include the proximal deltoid and posterolateral scapula.
- Branch locations are highly variable.
- Surgically there is no clinically relevant safe zone.
- Horizontal incisions result in greatest risk.
SUPRACLAVICULAR NERVE BLOCKS FOR CLAVICLE FRACTURE

- For acute fracture pain control with long acting anesthetics.
SPINAL ACCESSORY NERVE INJURY

- Stretch or traction injury from whiplash/seatbelt.
- Compression from strap/backpacks, sling immobilization.
- Lymph node surgery to the neck.
- Neck manipulations, trigger point and dry needling.
SAN EXAM FINDINGS

- SAN has sensory and motor function (SCM).
- Scapular dysfunction and shoulder pain.
- Loss of prolonged abduction strength.
- Ipsilateral shoulder droop.
- Internal rotation of the shoulder
- Atrophy of the trapezius.
- Scapular winging with abduction.
- Think about diagnosis with failed shoulder rehab and minimal MRI findings.
SAN WORK UP

- Best identified by a good physical exam.
- EMG correlates poorly with shoulder dysfunction or pain.
- EMG helpful if shoulder weakness or atrophy.
- MRI is sensitive if atrophy.
- MSKUS for nerve block for confirmation of pain generation.
SAN ENTRAPMENT CAUSES OTHER SYMPTOMS?

- Adhesive capsulitis
- Shoulder impingement
- Muscle spasms
- Torticollis
- Shoulder pain refractory to PT and minimal MRI findings.
LONG THORACIC NERVE

- Innervation of the serratus anterior muscle.
- Winging with forward flexion of the inferior border of the scapula.
- Stretch injury with heavy lifting, wheelbarrow, hypertrophy of the pectoralis & serratus anterior.
- Travels down through the middle scalene before posterior to clavical and anterior to first-second rib.
- Parsonage Turner Syndrome
**LTN INJURY**

- Injured with prolonged traction of arm and head turned away.

- Nerve is relatively fixed within the middle scalene and the superior aspect of the serratus anterior muscle.

- Muscle pain is posterior as the rhomboid and levator scapula spasm due to compensatory overactivity.

- Painful popping, clicking, crepitation, catching of the scapular during movement.

- Insidious onset of shoulder weakness and loss of throwing power.

- At rest the scapula is elevated and the inferior pole appears closer to midline.
DORSAL SCAPULA NERVE
DSN INJURY

- Pure motor nerve derived from the C5 nerve root.
- Pierces the middle scalene muscle and travels between the posterior scalene and serratus posterior.
- Innervates the levator scapulae & rhomboid major and minor.
- Injured by compression (straps), hypertrophy of middle scalene, shoulder dislocation, & whiplash stretch injury.
- Can share a common trunk with Long thoracic.
DSN EXAM

- Pain along the medial border of the scapula.
- The shoulder pain that just won’t go away. Bursitis of the levator scapula?
- Subtle winging pattern that is best seen when lowering arms from forward flexion.
- The whole medial border slightly lifts.
- Place finger further underneath the medial border secondary to atrophy of the Rhomboids.
AXILLARY NERVE ENTRAPMENT

- History of shoulder dislocation or hyperlaxity.
- Overhead workers complains of weakness and fatigue.
- May occur with severe motor findings without sensory findings.
- Subtle numbness to lateral shoulder (deltoid patch).
- Hertel sign (extension lag).
AXILLARY NERVE INJURY

- Injury associated with hyperlaxity of the shoulder.
- Trauma to lateral shoulder from a fall.
- Weakness and fatigue with overhead activity and lifting.
- Worse with overhead activity.
- Weakness to extension.
QUADRILATERAL SPACE SYNDROME

- Compression of axillary nv & circumflex artery.
- Pain is usually vague & nonspecific.
- Deltoid & teres minor weakness.
- Dead arm with posterior lateral pain.
- Non dermatomal pattern.
- Point tenderness at QS.
- Pain with abduction and external rotation.
EVALUATION OF QS SYNDROME

- MRI is useful if tumor.
- MRI arteriogram is needed.
- EMG is typically negative unless study with arm overhead.
- Ultrasound with colorflow doppler to evaluate compression of flow with arm overhead.
THE FORGOTTEN NERVE
MUSCULOCUTANEOUS

- C5-C6 (lateral cord)
- Innervation of the bicep, brachialis, coracobrachialis
- Superficial sensory after elbow = lateral antebrachial cutaneous nerve
MCN SYMPTOMS

- Vague upper arm pain.
- Forearm pain or numbness during flexion.
- Weakness to bicep & brachialis is a late finding.
- Check for atrophy or asymmetry of muscle contraction.
- Radicular pain down the lateral flexor surface of the forearm.
- Repetitive lifting with supination/pronation
MCN = LATERAL ANTEBRACHIAL CUTANEOUS NERVE
LABCN

- Lateral elbow pain 3-5 cm proximal elbow crease.
- Associated with repetitive activity.
- Forearm paresthesia.
- Think of patient with forearm radiculopathy with minimal C-Spine MRI.
- Painful Brachioradialis.
- Numbness increases with lateral bicep tendon pressure at elbow crease during pronation/supination.
- EMG not helpful unless atrophy.
- Nerve block for diagnosis.
OTHER NERVE ENTRAPMENTS

- Lateral Femoral Cutaneous as a cause of hip pain.
- Lesser Occipital nerve as a cause of headaches and vertigo.
- Medial branch of the Superior Cluneal nerve as a cause of back pain.
- Saphenous nerve causing knee pain.
OCCIPITAL HEADACHES?

- Not all occipital = GON
- Lesser occipital nerve typically runs through the SCM and is found lateral to the trapezius insertion.
- Radiates to the eye across the temple
- Can cause vertigo.
- Can causes nausea.
- Nerve block to confirm.
BACKPAIN?

- Medial branch of the Superior Cluneal nerve.
- Entrapped in a fibrossous tunnel.
- 10-15% of all back pain.
- 7-8 cm from spinous process (L1) along iliac crest.
- Failed back program, minimal MRI findings, radicular pattern similar S1.
- Hand to back of hip to relieve pain.
LATERAL FEMORAL CUTANEOUS NERVE

- Sensory nerve to lateral thigh.
- Think about with hip OA exam when x-ray or MRI is mild to moderate (out of proportions to pain level).
- Exam finding include stiffness with range of motion & guarding.
- Painful ASIS
- May be a burning groin pain.
- The hyper-stretcher!
**KNEE PAIN?**

**SAPHENOUS NERVE ENTRAPMENT OF THE INFRAPATELLAR BRACH**

- Can mimic: including lumbar radiculopathy, patellofemoral d/o, suprapatellar plica, medial meniscus tear, tibial stress fx, pes anserine tendonopathy/bursitis, synovitis and CRPS.

- Can be injured during surgery (1-20%) risk.

- Seen with OA and TKA.

- Entrapped by a fibrous band spanning between the vastus medialis and adductor magnus (Hunters canal).

- 10cm proximal to medial femoral condyle.
COMMON FIBULAR NERVE
AKA
COMMON PERONEUS NERVE

- Painful lateral lower leg.
- S/P TKA
- May snap with flexion/extension of the knee.
- Pain posterior fibula just medial to hamstring insertion.
- Weakness is a late finding.
- EMG typically negative.
HEEL PAIN
INFERIOR CALCANEAL NERVE

- Mimic plantar fasciitis.
- Burning pain to lateral heel.
- Weakness to small toe abduction.
- Hard orthotics can irritate.
RADIAL TUNNEL SYNDROME

- Lateral elbow pain that just won’t go away.
- Tennis elbow plus finger extension weakness.
- Pain with palpation of the dorsal mid forearm between radius/ulan.
- Becomes the PIN after diving into the supinator.
Not all radiculopathy is cervical.

Not all shoulder pain is a rotator cuff tear.

MRI with minimal findings and pain out of proportion to clinical findings is a nerve entrapment syndrome until proven otherwise.
THANK YOU!

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WHY NEUROPATHY?

- Prolonged pressure causes ischemia due to compression of vasa nervorum.
- Impairment of axonal transport.
- Proliferation of intra-neural connective tissue.
A WORD ON SENSITIVITY & SPECIFICITY

- EMG/NCT is considered the gold standard. Studies of sensitivity & specificity depends on which nerve was studied.

- A clear understanding that the nerve must be physiologically affected for EMG/NCT testing to be clinically relevant.

- The correlation of pain and physiological changes is not clearly understood.

- EMG has only moderate sensitivity and specificity for many nerve entrapment to the upper and lower extremity.

- It is critical to remember that a normal study does not rule out the presence of cervical or lumbar radiculopathy.

- EMG correlation to symptoms is reported anywhere from 55% to 86% sensitivity.