Carpal Tunnel Syndrome

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Carpal tunnel is a...

...pinched nerve

Learning Objectives

• Recognize the signs and symptoms of carpal tunnel syndrome (CTS)
• Perform appropriate tests to confirm the diagnosis of CTS
• Institute therapy according to CTS severity

Off-Label/Investigational Discussion

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Carpal Tunnel Syndrome

Most common upper extremity nerve compression syndrome
3% of US adults affected
$45,000 - $88,000 in lost wages/patient in 6 year period around diagnosis

Median Nerve Anatomy

- Palmar cutaneous branch
  - 5-6 cm proximal to distal wrist crease
- Recurrent branch
  - Usually distal to carpal tunnel
- Point of highest compression is 1 cm distal to distal wrist crease

Physiology

- The median nerve supplies sensation to the thumb, index, middle, and half of the ring finger
- Motor for thumb palmar abduction
- Sympathetics for sweating

Pathophysiology

- Closed space
- Compression of median nerve from tendonitis or other space occupying material
- Thinning of myelin
- Increased number of Nodes of Ranvier
- Slowed or even absent electrical conduction
- Second “hit” to nerve, or “double crush”

Symptoms

- Pain on volar arm up to the elbow
- If the pain is elsewhere, something else going on!
- Wake up at night to shake hand to make it feel better
- Clumsiness
- Numbness in thumb, index, MF
- All small branch goes from median to ulnar, and so the fifth finger can feel numb
- Dry cracked skin from poor sweating
- Hand weakness
- Middle finger often the first to have sensory changes

Signs

- Dry cracked skin
- Thenar atrophy
- Bulge distal forearm shows tendonitis (subtle)
- Pinpricks from numerous tests for diabetes

Risk Factors

- Female gender
- Obesity
- Diabetes mellitus
- Thyroid disease, RA, renal failure
- Occurs in 45% of pregnant women, usually resolves postpartum (high chance later development of CTS)
- Only occupational correlation is handheld vibratory tools

Female Gender
• Reported as up to 3:1 female:male ratio
• Women likely to present earlier in disease process
• Men more likely to have more severe EMG results (unclear if this is a selection bias due to ignoring symptoms)
• Surgical outcomes equal between genders

Obesity and CTS
• Obesity has been linked to increased risk for CTS on EMG
  – Studies disagree if BMI has an overall effect on conduction velocity
  – BMI does affect the amplitude of sensory and motor nerve amplitude
  – No recovery shown with losing weight
• Relationship of age, diabetes, and BMI is complex

Diabetes and Peripheral Nerve Compression
• Diabetics are more susceptible to nerve compression in rat model
• Diabetic nerves have increased endoneurial edema and larger cross-sectional area and have reduced rate of axoplasmic flow

Diabetes and CTS
• CTS occurs in 11-21% of diabetics
• Conservative treatment less effective in diabetics with CTS
• Glycosylation of transverse carpal ligament results in increased stiffness. Glycosylation of basement membrane
• CTS correlates with retinopathy, tenosynovitis, and general peripheral neuropathy
• Ischemic hits shown on long sural nerve biopsies

Diabetes and CTS
• Diabetic rats had more neuropathy to a standardized nerve compressive challenge than did non-diabetic rats

ESRD and Carpal Tunnel Syndrome
• CTS occurs in 9-32% of patients on dialysis
  – May have higher incidence if duration of dialysis >5 years
  – May occur due to amyloid deposit in nerve
  – Often recurrent with incomplete resolution from surgery
  – Must rule out ischemia before surgery
### Patient Presentation

- **Nocturnal pain**
  - Alleviated by shaking ("flick sign")
- Sens 51%, Spec 68%
- With "flick sign" sensitivity/specificity debatable but reported as up to 93%/96%
- Numbness and tingling in digits, especially thumb/index/long
  - May also occur in ring/small
- Sens 64%, Spec 73%
- Paresthesias during wrist flexion-extension activities
- Driving
- Talking on phone

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### Physical Examination

- **Look for nerve irritation**
- Decreased sensation to light touch
- Thumb weakness
- Pain with compression
- Pain with flexion
- Tinel’s sign PROXIMAL TO THE WRIST

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### Cervical Arthritis and Radiculopathy in CTS

- 11% of patients with CTS have cervical arthritis
- If both neck and hand pain, 26% have “double crush” on EMG
- Patients with CTS have more limited cervical range of motion than healthy controls

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### Double Crush

- Idea that a nerve compressed at one site is more susceptible to compression elsewhere
- Idea introduced in 1973
  - Controversial and poorly understood even now
  - Due to axoplasmic flow problem?
- Generally, easiest site to decompress (most peripheral) is treated first

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### Double Crush

- Generalize this concept to two “hits” to the nerve
  - Compression and DM
  - Compression and uremia
  - Compression and cervical arthritis
  - Compression and wrist and elbow
Special Tests

- Tinel
  - Sens 50%/Spec 77%

- Phalen
  - Sens 68%/Spec 73%

- Durkan
  - Sens 64%/Spec 83%


Pathophysiology

- Increased carpal tunnel pressure
- Wrist flexion causes pressure to go up 30% acutely
- Acute change—decreased blood flow
- Chronic change—thinning of myelin

- CTS treatment is splinting, to keep the wrist at a neutral position and decrease carpal tunnel pressures


Testing

- Nerve conduction studies
- Ultrasound

Electrodiagnostic Studies

- Not truly a “gold standard”
- Sensitivity 56-85%, Specificity 94-99%
- Diagnosis is clinical
- Useful for ruling out other pathology
  - IE “Double crush” or cervical radiculopathy
- Surgery relieves symptoms even in patients with negative EMG/NCV


Management

- Diagnosis: Nerve conduction velocity (NCV) or ultrasound. Not always required
- Categorize as mild, moderate, or severe
- Mild: recent symptoms, never been splinted, no thumb weakness or atrophy
- Moderate: longer symptoms, thumb weakness, no diabetes or second crush
- Severe: Long symptoms, atrophy

JAAOS, Treatment of Carpal Tunnel Symptoms, 17: 397-405, 2009

Management, contd

- Mild symptoms
  - Wrist splint
  - Cortisone injection
  - Follow up in one month
Carpal pressures are 3-5 mm Hg in normal people at neutral position. Can go to 60 mmHg at 40 degrees extension.

Nonoperative Treatment

- Evidence supports trial of conservative treatment in mild-moderate cases
- 1/3 of mild cases may resolve spontaneously
- Short duration of symptoms is positive prognostic factor
- Positive special tests are negative prognostic sign

Conservative treatment

- A failure to respond to conservative treatment by one month makes it more likely that additional conservative treatment may not be successful.
- Severity of initial symptoms corresponded with more surgery
- More than half of patients treated conservatively more than the first month went on to have surgery

Nonoperative Treatment

- Splinting
  - Keeps carpal tunnel in position of least compression
  - Improves symptoms within 2 weeks, lasts 3-6 months
  - No difference between all-day and night only

Nonoperative Treatment

- Corticosteroid injection
  - Results in improvement within 1 month
  - 50% of mild/moderate patients still have relief at 12 months
  - Most severe patients have relief for 1 month only

Corticosteroid Injection

- Can hit the nerve
- Can cause fat atrophy
- If has a good response to cortisone, will probably have a good response to surgery
- For diagnostic uncertainty
- For pregnancy induced CTS
- 0.5 mL triamcinolone 10 mg/mL is what I use


Other conservative modalities

- Ultrasound shown to be effective, but only Grade C recommendation
- Oral steroids effective, but less so than cortisone shot. Grade C recommendation
- No recommendation before or against activity modification, exercise, acupuncture, electric stim, magnets, meds, NSAIDS, vit B6

Management

- Moderate
  - Diagnose with NCV, ultrasound
  - Cortisone injection?
  - Referral to hand surgery, especially if other problems of diabetes, uremia, or uncertainty of diagnosis
  
  - They are candidates for surgery if they do not turn around in 1-2 months of splinting

Management, contd

- Severe: Referral to hand surgery for release when symptomatic

Management: Surgery

- Failure of conservative treatment
- Severe symptoms unlikely to respond to nonoperative treatment
  - Thenar atrophy
  - APB weakness
  - Loss of hand function
  - Severe disease on EDS
- Surgery effective in 70-100% of patients for complete relief of symptoms

Surgery

- Carpal tunnel release
  - “Open”
  - “Mini-open”
  - “Endoscopic”

Open Carpal Tunnel Release

- Divide the transverse carpal ligament
- Either in office (“wide awake surgery” using local anesthesia only) or in operating room
“Wide-Awake” (Office) Hand Surgery

- Less time in hospital (2.6 vs 4 hours)
- Less preop testing
- Less preop anxiety
- Less narcotics postop (5% vs 67%)
- Same pain control

“Wide-Awake” (Office) Hand Surgery

- 0.4% minor infection rate in 1504 Canadian procedures done in office, field sterility
- No gowns, one drape
- No deep postop infections
- No antibiotics used

My Wide-Awake Hand Practice

- Carpal tunnels
- Easy cubital tunnels
- Peroneal nerves at knee
- Extensor tendons
- Some hand masses

Endoscopic CTS

- For bigger hands
- Best done in the OR
- Earlier return to work by 2-3 weeks
- Less need for postop therapy

Endoscopic vs Open

- 2014 Cochrane data base review
- Some data, lots of bias
- Endo—less pain, 8 days earlier return to work, better grip strength
- Endo—less small wound complications
- Open—less transient nerve injuries
- Endo more expensive

Risks

- 0.2 - 0.4% cut nerve
- Infection < 1%
- CRPS around 1%
- Recurrence
Peripheral Nerve Release in Setting of Diabetic Neuropathy

- 31 nerves decompressed in diabetics with neuropathy with + tinel sign, compared to contralateral side not decompressed
- 79% improved sensation with decompression
- If not decompressed, 32% worsened within 24 months versus 0% of decompressed patients.
- Tinel sign may convey capacity for improvement


Conclusion

- Anatomy
- Physiology/pathophysiology
- Associated conditions
- Management
- Surgery