Ultrasound of Peripheral Nerves

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Disclosures

• None relevant to this presentation

Educational Objectives

• Following the presentation, participant should be able to:
  – Discuss normal and pathologic anatomy of peripheral nerves
  – Describe the clinical scenarios where US provides helpful information

Different Scenarios in Nerve US Imaging

• Clinical assessment and US both positive
  – US confirms clinical diagnosis
  – US can show the anatomy (nerve injury, mass, entrapment, etc.) to help guide further treatment
• Clinical assessment positive, US negative
  – US may alter management decision, for example, show that a nerve release or exploration is unlikely to help

• Clinical assessment equivocal, US positive
  – US helps clarify pathology

• Clinical assessment equivocal, US negative
  – US may increase confidence in ruling out pathology
• US sees an incidental finding
  – Contralateral subclinical disease
  – Finding unrelated to the referral

Musculoskeletal Ultrasound Technique

• High frequency linear transducers
  • At least 12 MHz
    – Higher frequency, better resolution but less penetration
Musculoskeletal Ultrasound Technique

- Contralateral side for comparison
  - Helps differentiate normal from abnormal
  - Beware of bilateral pathology, especially where one side is asymptomatic

Peripheral Nerves

Peripheral Nerves: Short Axis

Peripheral Nerves: Long Axis

Clinical Scenario: Signs and Symptoms of Median Neuropathy

Normal Carpal Tunnel
**Bifid Median Nerve**

**Bifid Median Nerve with Median Artery**

**Carpal Tunnel Syndrome US Criteria**

- Cross-sectional area of median nerve at distal wrist crease
  - Up to 0.09 sq cm is normal
  - Greater than 0.12 sq cm is abnormal
  - 0.09 to 0.12 sq cm: “gray zone”
- Other signs
  - Thickening of flexor retinaculum
  - Flattening of median nerve within tunnel

**Klauser Carpal Tunnel Criteria**

*Radiology* 2008; 250: 171-177

- 100 wrists in 68 patients
- Clinical and EMG “gold standard”
- Measure median nerve at proximal third of pronator quadratus (CSAP)
- Measure median nerve at carpal tunnel (CSAC)
- CSAC minus CSAP > 0.02 sq cm
  - 99% sensitive
  - 100% specific

**Normal Median Nerve Measurement**

**Carpal Tunnel Syndrome**
Severe Carpal Tunnel Syndrome

Secondary Carpal Tunnel Syndrome

Median Neuropathy, History of CMT

Severed Median Nerve: Shot in Iraq
Motor branch that arises just after the median nerve emerges from the pronator teres muscle
It lies deeply on the anterior interosseous membrane and supplies the flexor digitorum profundus (II-III), the flexor pollicis longus, and the pronator quadratus

- Difficult to visualize directly
- Muscle atrophy in classic pattern
  - Pronator quadratus
  - Flexor digitorum profundus
  - Flexor pollicis longus
Anterior Interosseous Nerve Entrapment

61-Year-Old Woman Who Cannot Actively Flex Her First and Second DIP Joints After Wrist Surgery

“Localize site of FDP and FPL Rupture”

Flexor Tendons Intact
Clinical Scenario:
Signs and Symptoms of Ulnar Neuropathy

Ulnar Nerve – elbow

Condylar Groove
- At the distal humerus, the ulnar nerve passes in an osteofibrous ring formed by the medial epicondyle and the medial collateral ligament and bridged by the cubital tunnel retinaculum (Osborne ligament)
Distal to the condylar groove, the ulnar nerve enters in a tunnel formed between the ulnar and humeral heads of the flexor carpi ulnaris muscle, which are connected by the arcuate ligament.
Ulnar Nerve: Which Side is Symptomatic?

Ulnar Nerve Subluxation

- Seen on elbow flexion
- Occurs in 15% of normals
- Differentiate from snapping triceps syndrome

Ulnar Nerve Subluxation

Snapping Triceps Syndrome

Guyon Tunnel - anatomy

- The walls of the Guyon tunnel consist of the pisiform medially and the hook of the hamate laterally
- Floor: flexor retinaculum
- Roof: palmar carpal ligament
- The Guyon tunnel houses the ulnar nerve and the ulnar artery
Clinical Scenario: Competitive biker, severe APB atrophy, mild CTS at EMG
Clinical Scenario: Signs and Symptoms of Radial Neuropathy

Radial Nerve Mass

Intraoperative Guidance: Neurofibroma

Medical intern with wrist drop the day after a flu shot

Transverse Radial Nerve
Two Weeks Later: PIN

- Presents with motor weakness in extensors of wrists or fingers
- May have pain and tenderness mimicking lateral epicondylitis
- US has been shown useful in DDx

PIN Entrapment Arcade of Frohse

Clinical Scenario:
Lateral thigh pain and numbness

Meralgia Paresthetica

Clinical Scenario:
Lateral thigh pain and numbness. History of total hip replacement.

Lateral Femoral Cutaneous Nerve
Clinical Scenario: Signs and Symptoms of Sciatic Neuropathy

Sciatic Nerve Transection
Clinical Scenario: Signs and Symptoms of Peroneal Neuropathy

Normal Peroneal Nerve

Peroneal Nerve Entrapment

Peroneal Ganglion: MRI

Peroneal Ganglion
Peroneal Neuropathy After MVA

Clinical Scenario:
Signs and Symptoms of Tibial Neuropathy
Tibial Nerve

Tibial Nerve Schwannoma

Loss of Plantar flexion After Calf Laceration

Tarsal Tunnel Syndrome From Anomalous Artery

Tarsal Tunnel Ganglion
Tarsal Tunnel: “Inject Nerve Sheath Tumor”

Stump Neuroma of Sural Nerve

Morton’s Neuroma

**Technique**
- Linear transducer
- 10-12 MHz
- Place transducer at plantar aspect
- Compress with finger dorsally, try to trap neuroma between finger and probe
- Also can try Mulder test

Stump Neuroma of Sural Nerve

Morton’s Neuroma
Disadvantage of US

• Shows form not function

Advantages of US vs. MRI

• Well tolerated
• Low cost
• Superior resolution
• Not limited to one body segment
• Contralateral comparison
• Real time dynamic studies

Conclusion

• When combined with the clinical examination, ultrasound is an excellent tool to depict the anatomic cause of peripheral neuropathies