HIGH FREQUENCY
ULTRASOUND EVALUATION OF
PERIPHERAL NERVES
ULTRAEMG 5-11-17

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LEARNING OBJECTIVES

• Review Important Principles of Peripheral Nerve Sonography Scanning Techniques
• Review the Anatomy of Sonographic Appearance for Identification of Peripheral Nerves
• Review the Methods of Assessing Normal and Abnormal Peripheral Nerve Appearance
• Discuss Principles and Examples of Assessing Clinical Cases Nerves with Ultrasound.

DISCLOSURES

• Member of Muscle and Nerve Editorial Board
• Textbook Royalties from Demos Medical Publishing
PROGRESSION OF TECHNOLOGY EDX: 1990

1990

2017

ULTRASOUND

1990

2017
**EDX vs US**

- EDX and US are complimentary technologies.
- EDX = Physiologic Assessment
- Ultrasound = Anatomic Assessment

**Strength of EDX**

- Single reliable testing modality for peripheral nerve function and is highly sensitive for some nerves.
- Can assess nerve conduction slowing, conduction block and axonal loss.
- Can assess neurapraxia vs axonotmesis.
- Can assess relative chronicity.
- Can assess more generalized peripheral neuropathy.
**Weakness of EDX**

- User dependent
- Techniques and values are often not standardized
- Requires understanding of temporal changes
- Does not provide anatomic correlation of often the source of the neuropathy.
- Can not distinguish complete axonotmesis from neurotmesis

**Strengths of US**

- Provides anatomic correlation in peripheral neuropathy
- Can assess vascular flow
- Dynamic Assessment
Advantages of MSK Ultrasound

- Relatively inexpensive
- Better soft tissue differentiation than MRI
  - Better spatial resolution (150 microns vs 450)
- Can provide focused evaluation
- Dynamic assessment
- Allows easy side-to-side comparisons
- No issues with "claustrophobia"
- No interference with implants or pacemakers

Weakness of US

- User dependent
- Not standardized, newer technology
- Little physiologic assessment
- Does generally less than EDX to assess relative severity
- Does not reliably identify a more generalized process
Ultrasound weakness cont

- More difficult to evaluate large fields
- Doesn’t penetrate bone
- Increasing difficulty with tissue thickness
PRINCIPLES OF IMAGING PERIPHERAL NERVES WITH ULTRASOUND

- Correctly identify the nerve tissue
- Use good technique
- Know the surrounding anatomy
- Use consistent measurement techniques
- Assess in both short and long axis
- Follow the course of the nerve
NORMAL NERVE

NERVE ECHOTECTURE
IMAGING STRATEGIES

USE COUPLING GEL LIBERALLY
PAY ATTENTION TO TRANSDUCER PRESSURE

USE ANATOMIC LANDMARKS TO HELP WITH LOCATION
LANDMARKS CONTINUED

FOLLOW THE NERVE TO OTHER LOCATIONS WHEN NEEDED
TOGGLE THE TRANSDUCER

ALTER THE SPEED OF SCANNING
NORMAL FASCICULAR ARCHITECTURE CAN VARY

NERVE HISTOLOGY

- Sural Nerve
- Cable model
- Plexiform model
- Appearance
  - monofascicular
  - oligofascicular
  - polyfascicular
BACK AND FORTH SCANNING

USE SURROUNDING VEINS
USE SURROUNDING ARTERIES
USE TISSUE MOVEMENT

USE DOPPLER WHEN NEEDED
REMEMBER:

- Understanding of basic scanning and imaging techniques is needed for successful use of this modality in assessment of peripheral nerves and focal neuropathies.
- Detailed assessment of nerve size, internal architecture and the static and dynamic influence of the surrounding tissue can provide considerable information in the evaluation of focal neuropathies.

ULTRASOUND FOR FOCAL NEUROPATHIES

- Helpful in the context of compression, trauma, post-surgical alteration and tumors.
- Can provide some information about severity.
- Can provide more precise localization than EDX.
- Can be helpful with peripheral nerve blocks.
MEASUREMENT OF CROSS SECTIONAL AREA

CROSS SECTIONAL AREA
FOR CSA MEASUREMENT

- Transducer must be placed perpendicular to the nerve for accuracy.
- Measure the inner border of the echogenic epineurium.
- Optimize Focal Zone.
- Optimize Gray Scale Mapping

CSA CALCULATION
DIRECT VS ELLIPSE

DIRECT VS ELLIPSE
CONFIRM THAT THE TISSUE BEING MEASURED IS ENTIRELY NERVE
ALLOW INSPECT IN SHORT AND LONG AXIS
LONGITUDINAL IS MORE CHALLENGING

LONGITUDINAL MEASURE
INSPECT FASCICULAR ARCHITECTURE
PERIPHERAL NERVE VASCULAR SUPPLY

ASSESS FOR ENLARGEMENT
INSPECT IN SHORT AND LONG AXIS
CHANGE IN FASCICULAR SIZE

SIDE-TO-SIDE
ARCHITECTURAL DISRUPTION

FOLLOW THE COURSE OF THE NERVE
ABNORMAL MOVEMENT

Left ulnar nerve at medial epicondyle
Transverse
xx
ENCROACHING LUMBRICAL

ENCROACHING FDS
ENCROACHING FDS

TISSUE COMPRESSION
ANATOMIC VARIATION

• Assess normal variation or traumatic or post-surgical variation
PERSISTENT MEDIAN ARTERY

- Frequently seen in between bifid median n.
- Is a branch from the ulnar artery.
- Is not seen with all bifids
- Can be seen on the ulnar side of typical median nerve
- Seen in up to 20% in cadaveric study

Propeck et al. AJR, 2000
BIFID MEDIAN NERVE

PERSISTENT MEDIAN ARTERY WITHOUT BIFID
OTHER EXAMPLES

- Anconeus Epitrochlearis
- Ligament of Struthers
- Accessory ADM
- Reverse Palmeris Longus

ANCONEUS EPITROCHLEARIS
NERVE TRAUMA

- US has good reliability for finding transected nerves (Cartwright 2007) and focal neuromas.
- Neuroma is seen as a well-defined hypoechoic mass along the course of the nerve.
NERVE INJURY
NERVE SCAR

POST-SURGICAL
Assess for:
-anatomic alteration
-scarring
-other compression or injury
*get detailed history of complaint
INSPECT FOR CHANGES IN MUSCLE ECHOTECTURE

ACCURATE MEASUREMENTS
LCN

S/P THR “FOOT DROP”
CASE: ISOLATED SURAL MONONEUROPATHY
CASE

- 16 yo f with “foot drop” and numbness. Sat with crossed legs frequently.
- EDX: fibular neuropathy at fibular head
NORMAL OR ABNORMAL?

Right superficial fibular nerve at leg Transverse sx

Left fibular nerve just above fibular head Transverse sx

Right fibular nerve just above fibular nerve Transverse sx
CASE:

- 22 yo college football player with acute injury. “Foot drop.”
NORMAL OR ABNORMAL?
DISRUPTED ARCHITECTURE FROM STRETCH?
SURGICAL INTERVENTION?

CASE
- 21 year old football player with acute injury. "Foot-drop"
Left fibular nerve at popliteal crease
Longitudinal sx

PROGNOSIS? SURGICAL INTERVENTION?
CONTINUE SCANNING: COMPLETE NEUROTMESSIS

CASE: RECURRENT FOOT DROP
CASE: LEFT FOOT DROP. R/O “PERONEAL” NEUROPATHY

Normal or abnormal?
NORMAL OR ABNORMAL?
WHAT ELSE CAN WE CHECK?

NORMAL OR ABNORMAL?
THANK YOU!