Ultrasound to Enhance NCS and EMG

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Overview

• Background
  • Rationale for use of ultrasound

• Clinical applications
  • Localization for NCS
  • Localization for EMG
  • \textit{Diagnostic nerve ultrasound}
  • \textit{Diagnostic muscle ultrasound}
Why use US in the EMG lab?

- Electrodiagnosis provides pathophysiologic information
- Ultrasound provides anatomical and structural information
- Using the two tests together is often complementary
  - Improving safety and accuracy
  - Increasing diagnostic yield
NCS: Reasons to consider US

- Near nerve needle placement
  - Verify conduction block
  - Repetitive stimulation (femoral)
  - Record from small sensory nerves
- Direct visualization of needle
  - Enhance safety
  - Enhance accuracy (obesity)
- Observe the target muscle
Near Nerve Needle Placement
Ultrasound is Particularly Helpful for Challenging Cases

- Obesity
- Altered anatomy
- Anticoagulation
- High risk structures in proximity
- Unusual or less commonly studied nerves
Difficult Sensory NCS

- Lateral femoral cutaneous
- Saphenous
- Transposed ulnar nerve
- Femoral
  - Obesity, anticoagulation
Lateral Femoral Cutaneous Nerve
Results

• 50 patients, 21 – 82 years old
• Mean BMI 27.7 (high 36.8)
• No response using Shin’s technique
  • 4 subjects
• No response using US guided technique: 3/50 normals
  • 1 patient with BMI > 35
  • Needle recording in 3 cases
Eliminate false negatives
M mode

- Visualization of the diaphragm muscle with ultrasound improves diagnostic accuracy of phrenic nerve conduction studies.
  
Intraneural Ganglion – Fibular
Muscle Imaging

• As a localization tool for EMG
  • Do we really need it??

• As a diagnostic tool
Accuracy of Needle EMG

- Cadaver studies
  - High rate of inaccuracy in certain muscles even with experience $^1$
    - $< 50\%$ accuracy (18 muscles)
  - Subscapularis accuracy $^2$
    - 3 methods: 0\% to 78\% accuracy
  - Lumbar multifidi: 87\% accuracy $^3$
  - Thoracic muscles: 69\% accuracy $^4$

$^1$Haig et al. 2003  $^2$Choido et al. 2005  $^3$Chinsethagij et al. 2003  $^4$Choido et al. 2006
27 gauge EMG needle
Muscle US: As a localization tool

• If selective activation not possible
  • Severely weak
  • Spasticity
    • Chemodenervation
• Adjacent muscles activated with same motion, different innervation
• Fine wire placement
Muscle US: As a Localization Tool

- Less experienced EMGer
  - Enhance accuracy
  - Improve anatomical knowledge

- Experienced EMGer
  - Small, deep or unfamiliar muscles
  - Anticoagulation: high risk muscles
  - High risk muscles
  - Altered anatomy, graft
  - Obesity
Muscles where I might use US

- Chest wall muscles
- Diaphragm
- Popliteus
- Gracilis transplant
- FDP I/II vs. FDP III/IV
- Iliopsoas, Posterior tibialis, FHL, FPL
Unusual Muscles - Popliteus
Supinator, with radial nerve
Anticoagulation

- US: good tool for high risk muscles
- Use Doppler to identify vessels
- Can place needle under direct US guidance
  - Iliopsoas, Posterior tibialis, FPL, Paraspinals, Diaphragm
- Post procedure monitoring
Anticoagulation

• We studied bleeding risk post EMG
  • Risk of stopping A/C outweighs risk of EMG

• Helped change our practice
  • Proceed with EMG if INR < 3.0
  • INR > 3.0, determined by the individual staff
  • We now have literature to support that practice
US Guidance for High Risk Muscles

- Diaphragm
- Chest wall muscles
High Risk Muscles
Serratus Anterior

Normal side

Atrophic side
Diaphragm
Needle Localization: Diaphragm

• Now use ultrasound for all cases
  • Identify safest interspace
  • Identify depth of diaphragm
  • Identify best side to examine

• Particularly helpful in obese patients, altered anatomy, COPD, Coumadin, severe atrophy
  • Can use real time US guided needle placement when needed
Summary: US as a Localization Tool

• Easy to learn
  • Dynamic aspect plus knowledge of anatomy

• Patient may serve as control
  • In cases of unilateral pathology

• Many potential applications
Summary: US application in EDX

- Needle placement for accurate nerve conduction studies
- Needle placement for EMG of difficult or higher risk muscles
- Anatomic and pathophysiologic information about nerve and muscle
- Real time information on muscle activation
- Diaphragm function
Summary

• EDX measures function, ultrasound evaluates structure
  • The two are complementary in the EMG lab
• Highly portable
• Relatively low cost
• Constantly improving technology
Questions