ULTRASOUND GUIDANCE FOR PERIPHERAL NERVE PROCEDURES

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DISCLOSURES

• Member of Muscle and Nerve Editorial Board
• Textbook Royalties from Demos Medical Publishing
HYDRODISSECTION OF PERIPHERAL NERVES

- Currently little literature support (case reports and anecdotal).
- Ultrasound guided.
- Introduces large volumes for fluid around peripheral nerves to alleviate entrapment.
- Often D5W, NS, steroid, local anesthetic.
- Live visualization, better than surgical field.
- No post-surgical scar.
- Can be performed safely
- Many positive case reports.
- More studies needed.

CASE REPORT:

- 42 year old woman sent for ultrasound evaluation for persistent pain and “RSD” after an ankle contusion 6 months prior.
- Refractory to treatment.
- Clinically sensitive over the superficial fibular distribution
- EDX: Demonstrates absent a very low superficial fibular SNAP amplitude.
ELECTED HYDRODISSECTION

Left intermediate branch of superficial fibular nerve injection
LEARNING OBJECTIVES

- Review Important Principles of Peripheral Nerve Identification
- Review the Anatomy of Sonographic Appearance for Common Peripheral Nerve Procedure Locations
- Review the Methods for Performing Peripheral Nerve Procedures
PRINCIPLES OF IMAGING PERIPHERAL NERVES WITH ULTRASOUND IN PRE-SCANNING

- 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
US GUIDED INJECTION BASICS

• Pre-plan, pre-scan
• Consider depth of the injection
• Use an oblique standoff when needed
• Understand in-plane vs out-of-plane injections
• Use toggling and heel-to-toe rocking to optimize needle conspicuity
• Be aware of needle reverberation artifact
• Avoid too many moving parts

PRESCAN

Actual depth of image is 3.3 cm
1 cm ➝
2 cm ➝
SHALLOW ANGLE

OBLIQUE STANDOFF
IN-PLANE

OUT-OF-PLANE
DANGER OF OUT-OF-PLANE

HEEL-TO-TOE ROCK
EFFECT OF HEEL-TO-TOE ROCK

TOGGLE
NEEDLE ARTIFACT

CORRECTLY IDENTIFY NERVE TISSUE
NORMAL NERVE

NERVE ECHOTECTURE
PAY ATTENTION TO TRANSDUCER PRESSURE

USE ANATOMIC LANDMARKS TO HELP WITH LOCATION
BACK AND FORTH SCANNING

USE SURROUNDING VEINS
IDENTIFY SURROUNDING ARTERIES

USE TISSUE MOVEMENT
USE DOPPLER WHEN NEEDED

CONFIRM THAT THE TARGET IS ENTIRELY NERVE
PRESCAN IN INSPECT IN SHORT AND LONG AXIS
MOST INJECTIONS SHOULD BE SHORT AXIS VIEW OF ANATOMY BUT IN-PLANE TO THE NEEDLE

PRE-SCAN FOR ANATOMIC VARIATION
BIFID MEDIAN NERVE

- Helpful for delivering the injectate (steroid, anesthetic, saline) close to the nerve.
- Allows visualization of the procedure in real time.
- Helpful to avoid vascular structures.
- Can be useful with therapeutic injections, peripheral nerve blocks and hydrodissection.

ULTRASOUND GUIDED NERVE INJECTIONS
REMEMBER:

• Accurate identification of the nerve tissue is needed for effective injections.
• Pre-scan the surrounding region for potential areas to avoid and to facilitate the proper approach with the needle.
• Have a straight line between the patient and injection site, and ultrasound screen.
• Do a checklist for all necessary equipment in advance and have it within reach during the procedure.

NERVE SAFETY

• Transducer must be placed perpendicular to the nerve for accuracy.
• Identify the outer epineurium.
• Optimize Focal Zone.
• Optimize Gray Scale Mapping
• Set depth so target takes up majority of the screen.
• Use highest frequency with effective penetration to visualize the nerve.
• Caution with intraneural injections
  • Must avoid injuring the fascicles.
PERIPHERAL NERVE INJECTIONS: GENERAL

- Need to know course and function of the nerve.
- Do adequate pre-scan.
- High frequency linear transducer is used for most nerve injections.
- Most injections will use a short-axis view of the nerve and in-plane view of the needle.
- With hydrodissections, might also use long-axis view of needle.
- Creating a halo around the nerve with injectate will increase conspicuity.
- The patient should be positioned between the ultrasound screen to allow easy visualization of both the needle at the target site and the ultrasound image.
Oblique standoff can help provide direction with superficial injections. The injectate used for each procedure is based on the desired intervention. Local anesthetics alone in a volume of 1-4 mL are typically used for most nerve blocks. Injectable corticosteroids are often used in conjunction with the anesthetic if the goal is longer lasting relief, particularly in the context of entrapment neuropathies. The flow of the injectate should always be initiated slowly and watched carefully to insure proper location because of the potential vulnerability of the target. Larger volumes of injectate are used for hydrodissection. This can consist of 10 to 15 ml of a combination of normal saline and local anesthetic. Some also use dextrose solution.
STERILE TECHNIQUE

SUPRASCAPULAR NERVE AT SUPRASCAPULAR NOTCH
SUPRASCAPULAR NERVE: INDICATIONS

- For intractable shoulder pain.
- Acutely in post-operative pain.
- Diagnostic trial with anesthetic agent.
- Longer activating agents: steroids, toxic agents such as phenol, radiofrequency ablations
- Drainage of compressive cyst

SUPRASCAPULAR NERVE: ANATOMY AND IDENTIFICATION
SUPRASCAPULAR NERVE: ANATOMY

• Derived from C5 and C6 roots.
• Provides motor function to the supraspinatus and infraspinatus
• External rotation of the shoulder
• Sensory innervation to acromioclavicular and glenohumeral joint

SUPRASCAPULAR NERVE: SCANNING

• Visualized at the suprascapular notch and spinoglenoid foremen.
• Transducer is placed in the same plane as the spine of the scapula.
• Use internal and external rotation (and Doppler) to distinguish the artery and vein.
SUPRASCAPULAR NERVE: PROCEDURE

- Needle: 22 gauge 2.5-3.5 inch
- Patient position: Seated with hand on opposite shoulder or prone with arm hanging off the end of the table.
- Transducer position: parallel to the spine of the scapula over the suprascapular notch.
- Needle approach: medial to lateral or lateral to medial are both effective.
- Target: near the suprascapular nerve at the suprascapular notch. The needle should be directed deep to the superior transverse scapular ligament.
- Avoid: intravascular injection of the suprascapular artery and vein.
- Tip: there is often temporary resistance when passing through the superior transverse scapular ligament.
EXTRINSIC GANGLIA

DEEP RADIAL NERVE AT SUPINATOR
DEEP RADIAL NERVE: INDICATIONS

• Established source of neuropathy or more controversial source of forearm pain (recalcitrant “tennis elbow”).
• Procedure can range from “test dose” of anesthetic to steroid to hydrodissection.

DEEP RADIAL NERVE: ANATOMY

• The radial nerve bifurcates into the deep branch of the radial nerve and the superficial radial sensory nerve near the level of the radiocapitellar joint.
• The deep branch of the radial nerve enters the radial tunnel through the Arcade of Frohse.
• The nerve becomes the posterior interosseus nerve once it exits the supinator and lies on the posterior interosseus membrane.
• It gives off innervation to the extensor digitorum, extensor digiti minimi, extensor carpi ulnaris, abductor pollicis longus, extensor pollicis longus, extensor pollicis brevis and extensor indicis.
• Significant injury to this nerve can result in weakness of digit extension and radial deviation of the wrist with extension.
DEEP RADIAL NERVE: SCANNING

- It can be identified as it bifurcates from the superficial sensory branch near the elbow joint.
- It is followed in short axis toward its entrance of the supinator.
- The recurrent radial artery and its accompanying veins (Leash of Henry) can be identified prior to the entrance of the nerve through the Arade of Frohse.
- The nerve should then be followed through the exit of the supinator.
- It should be assessed in both short and long axis for both focal and diffuse enlargement.
- Compare to other side.

DEEP RADIAL MOTOR NERVE: PROCEDURE

- Needle: 25-27 gauge 2.0-3.5 inch
- Patient position: Supine or seated with the forearm resting on the table, the elbow slightly flexed and thumb pointed upward.
- Transducer position: short axis for injection. Use of both short and long axis for hydrodissection.
- Needle approach medial to lateral for single injection. Use of medial to lateral and also distal to proximal for hydrodissection.
- Target: the deep branch of the radial nerve near an identified focal flattening and proximal swelling. Often between the superficial and deep heads of the supinator.
- Avoid: intraneural injection and injury to the recurrent radial artery.
ULNAR NERVE AT THE ELBOW
ULNAR NERVE AT THE ELBOW

- Needle: 25 gauge, 1.5 inch needle
- Patient position: Supine with the shoulder mildly abducted and forearm in supination.
- Transducer position: Short axis to ulnar nerve and in-plane to needle.
- Needle approach: Medial to lateral or lateral to medial
- Target: Area surrounding ulnar nerve
- Avoid: Intraneural injection and posterior recurrent ulnar artery.
MEDIAN NERVE AT PRONATOR TERES

MEDIAN NERVE AT PRONATOR TERES:
INDICATIONS

• Controversial
• Rarely neurologic deficit
• “Pronator Tunnel Syndrome” – vague ache in forearm worsened by repetitive motion.
• Procedure can range from test anesthetic block to steroid injection to hydrodissection.
MEDIAN NERVE AT PRONATOR TERES: ANATOMY

• is supplied by the cervical roots of C6-T1.
• traverses across the elbow medial to the nearby brachial artery.
• passes beneath the lacertus fibrosis and travels beneath the radial head of the pronator teres and then between the radial and ulnar heads of the pronator teres.
• the brachial artery and traverse posterior to the median nerve at the level of the pronator tunnel.
• The innervations for the flexor carpi radialis, palmaris longus and flexor digitorum superficialis emerge near the level of the pronator teres.
• The anterior interosseus typically emerges from the main trunk of the median nerve just after exiting the pronator teres.
• The main trunk innervate the abductor pollicis brevis, opponens pollicis, superficial head of the flexor pollicis brevis as well as the 1st and 2nd lumbricals.
• provides cutaneous sensation to the palm and palmar aspect of the thumb, index, long and radial side of the ring fingers.

SCANNING:
MEDIAN NERVE AT PRONATOR TERE: PROCEDURE

- Needle: 25-27 gauge 1.5-2.5 inch
- Patient position: seated or supine with the forearm resting on the table in supinated position and the elbow in relatively extended.
- Transducer position: short axis for injection. Use of both short and long axis for hydrodissection.
- Needle approach: medial to lateral for single injection. Use of medial to lateral and also distal to proximal for hydrodissection.
- Target: the median near an identified focal flattening and proximal swelling. Often between the radial and ulnar heads of the pronator teres.
- Avoid: intraneural injection, brachial or ulnar artery, anterior interosseus nerve and artery.

MEDIAN NERVE AT THE CARPAL TUNNEL
MEDIAN NERVE AT CARPAL TUNNEL: INDICATIONS

- Established source of neuropathy.
- This is the most well-defined of all entrapment neuropathies.
- Procedure can range from steroid injection to hydrodissection.

CARPAL TUNNEL INLET
CARPAL TUNNEL OUTLET
MEDIAN NERVE AT CARPAL TUNNEL: PROCEDURE

- Needle: 22-25 gauge, 1-1.5 inch needle
- Patient position: Seated or supine with the wrist in supinated position and slight dorsiflexion.
- Transducer position: Short axis to median nerve and in-plane to needle.
- Needle approach: Ulnar to radial.
- Target: Deep and superficial to the median nerve.
- Avoid: Ulnar nerve and artery.
MEDIAN AT CARPAL TUNNEL

LATERAL CUTANEOUS NERVE OF THE THIGH
LATERAL CUTANEOUS NERVE OF THIGH: PROCEDURE

- Needle: 25 gauge, 1-2 inch needle
- Patient position: Supine
- Transducer position: Short axis to nerve and in-plane to needle. Short axis and long axis for hydrodissection
- Needle approach: Block: Lateral to medial. Hydrodissection: Lateral to medial, complete distal to proximal.
- Target: Area around nerve nerve inguinal ligament.
- Avoid: Starting the needle approach too deeply.
FIBULAR NERVE AT FIBULAR HEAD

- Needle: 25 gauge, 1.5 inch needle
- Patient position: Supine or lying on contralateral side
- Transducer position: Short axis to nerve and in-plane to needle.
- Needle approach: Block: Posterior to anterior
- Target: Area around nerve nerve.
- Avoid: An intraneural injection. Avoid too proximally or too distally to avoid branch points.

COMMON FIBULAR NERVE: PROCEDURE
FIBULAR NERVE AT FIBULAR NECK
TIBIAL NERVE AT TARSAL TUNNEL

- Needle: 22-25 gauge, 1.5-2 inch needle
- Patient position: Prone or lateral decubitus
- Transducer position: Short axis to nerve and in-plane to needle.
- Needle approach: Block: Posterior to anterior
- Target: Area around nerve nerve.
TIBIAL NERVE – IDENTIFY CALCANEAL BRANCH

TIBIAL NERVE INJECTION
ANATOMY

- Found between the VMO and sartorius and gracilis
SAPHEOUS AT KNEE: PROCEDURE

- Needle: 22-25 gauge, 2.5-3 inch needle
- Patient position: Supine
- Transducer position: Short axis to nerve and in-plane to needle.
- Needle approach: Block: Posterior to anterior
- Target: Area around nerve nerve.
- Avoid: Perivascular injection

HYDRODISSECTION - SAPHEOUS
MORTON NEUROMA

MORTON NEUROMA: PROCEDURE
- Needle: 25-27 gauge, 1.5 inch needle
- Patient position: Supine or prone
- Transducer position: Long axis to nerve and in-plane to needle.
- Needle approach: Distal to proximal
- Target: Area around and into neuroma
CYST DRAINAGE
CONCLUSIONS

• Understanding of basic scanning and imaging techniques is needed for successful use of this modality in performing effective injection techniques.

• Injections around peripheral nerves requires reasonable caution because of the vulnerability of the targets.

• Preparation with knowledge of the course of the nerve and surrounding anatomy, adequate pre-scanning and planning preparation can lead to success.

THANK YOU!