Ultrasound Guided Pain Procedures For The Physiatrist

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Disclosure

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None

Off Label Usage
None.
Why US for Imaging?

The ASRA Evidence-Based Medicine Assessment of Ultrasound-Guided Regional Anesthesia and Pain Medicine

Executive Summary

(Reg Anesth Pain Med 201:35: S1-9)

- US superior to or equal – none found US to be dangerous or inferior
  - Most serious of complications (permanent nerve injury and LAST) too rare
- Statistical advantage – not necessarily clinical advantage
- No evidence US eliminates complications – limited data suggests complication rates similar
  - Poor technique, failure to image needle or novice behavior may increase risk!
  - No literature on US in specific patient populations (Pediatrics, DM, chemotherapy neuropathy)
- US significant advance but does not lessen responsibility for using time proven strategies
Ten Basic Skills

1) Visualize key landmark structures such as vascular, muscular, bony structures
2) Identify target structures on short-axis imaging as well as long axis if appropriate
3) Survey the target area in general checking for anatomic variations prior to needle intervention
4) Plan for a safe needling approach
5) Maintain an aseptic technique
6) Follow needle advancement under real-time visualization
7) Consider a secondary confirmation technique, such as nerve stimulation for regional anesthesia or fluoroscopy for pain interventions
8) Inject a small local anesthetic volume as a test solution to rule out unintentional/intravascular injection
9) Make necessary needle adjustments to ensure proper spread of local anesthetic and other injected agents
10) Maintain traditional safety guidelines.

Chan, V et al 2010
Learning Objectives

- For Each Selected Block
  - Anatomy
  - Common Indication
  - Possible Complications
  - Procedure
  - Brief review of the Literature
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Basics of Nerve Imaging

- **Sonoanatomy – Nerve Tissue**
  - Proximal – Hypoechoic (supraclavicular..)
  - Distal – Honeycombed and Hyperechoic
- **Orientation** –
  - Transverse
  - Longitudinal
- **Probe Selection**
- **Image Optimization** –
  - Anisotropy
Selected US Guided Blocks

- Greater Occipital Nerve
- Suprascapular Nerve
- Intercostal Nerve
- Ilioinguinal/Iliohypogastric/TAP block
- Lateral Femoral Cutaneous
Greater Occipital Nerve

- The GON is the posterior ramus of C2
- Emerges below the posterior arch of atlas
- Wraps around Obliquus Capitis Inferior Muscle (OCIM)
  - Nerve runs lateral to medial at level of C1
- The nerve pierces
  - Semispinalis Capitis
  - Splenius Capitis
  - Trapezius/Fascia
- Areas of entrapment
  - Emerges between the C1-2
  - OCI and SSC
  - Pierces the SSC
  - Exit from tendinous aponeurosis of Trapezius

Cho et al. 2010
Greater Occipital Nerve

- **Indication:**
  - Occipital Neuralgia
  - Differentiate headaches of cervical origin
  - Site of Neuromodulation
    - Chronic Daily Headache, Migraine and even Cluster Headaches

- **Potential Complications:**
  - Hemorrhage
  - Seizure
  - Stroke
Greater Occipital Nerve

- **Position:**
  - Prone (with flexion) or Lateral

- **Probe:**
  - Linear high frequency

- **Scan:**
  - Begin midline over the occiput – scan caudally
  - First bifid spinous process is C2
  - Lateral with lateral end of probe aimed at the transverse process of C1 (mastoid)

- **Approach:**
  - In plane
  - Lateral to medial
Fig 1 GON

White open rectangle in a) indicates transducer position/orientation, white open arrows point at mastoid process and external occipital protuberance, respectively.

b) OCIM: left obliquus capitis inferior muscle, spanning between TP of atlas, ATL, and SP (left tubercle, short white arrow) of axis, AX; GON (yellow arrow) appears “on top” of OCIM (on its posterior surface); long white arrows indicate dorsal surface of AX (SP and lamina).

As seen here, the second dorsal root ganglion is often visible too (open yellow arrow). The OCIM is directly covered by semispinalis capitis muscle, GON is positioned between them.
Greater Occipital Nerve

- Cho et al. 2010
  - CSA GON (2mm), OCI

- Greher et al. 2010
  - Compared two US techniques injected with .1 ml dye
    - 16/20 vs. 20/20

- Shim et al 2011
  - Blind vs. US guided at level of EOP significant difference in VAS at 4 weeks
Suprascapular Nerve Block

- Upper trunk (C5-6) –
- Suprascapular notch under ligament
  - Medial branch to SS and articular branch
  - Supraspinous fossa
  - Around lateral border of the spine (spinoglenoid notch) to infraspinatus fossa
- Sensory – post/sup capsule, AC joint, subacromial bursa and coracoclavicular and acromial ligaments

Narouze et al 2010; Chan and Peng 2011
FIGURE 3. Suprascapular nerve and its branches. Superior articular branch (Br. SA) supplies the coracohumeral ligament, subacromial bursa, and posterior aspect of the acromioclavicular joint capsule; inferior articular branch (Br. IA) supplies the posterior joint capsule; Br. SS indicates branch to the supraspinatus muscle; Br. IS, branch to the infraspinatus muscle. Reproduced with permission from USRA (www.usra.ca).
Suprascapular Nerve Block

- **Indication:**
  - Various types of shoulder pain
    - Rheumatologic disorders, cancer, trauma, postoperative pain
  - Pulsed RF

- **Reported Complications:**
  - Arterial puncture
  - Direct nerve injury
  - Bruising
  - Parasthesias

CHAN AND PENG 2011
Suprascapular Nerve Block

- Position:
  - Sitting or Prone

- Probe:
  - Linear high frequency

- Scan:
  - Probe perpendicular to line connecting coracoid process and acromion

- Approach:
  - In plane
  - Medial to Lateral
FIGURE 2. Superior view of the left shoulder. The course of the suprascapular nerve (shaded) enters the suprascapular fossa through the suprascapular notch (SSNo) and then enters the infraspinatus fossa through the spinoglenoid notch (SGNo). Reproduced with permission from Ultrasound for Regional Anesthesia (www.usra.ca).
Suprascapular Nerve Block

Traditional

- Posterior, superior, lateral, anterior
- Blind, nerve stimulator, electromyography, fluoro and CT
- Risk of Pneuomothorax, intravascular or nerve injury
- Amount of injectate –
  - 10 ml – can spread to plexus
  - Blind injectate in SS or above

Dangoisse MJ et al., Acta Anaesth Belg, 1994
US Suprascapular Nerve Block

- Harmon 2007 –
  - Trapezius, Supraspinatus and transverse ligament
  - <5 cm deep, Doppler will reveal artery
  - Medial to lateral approach, 5 ml total

- Peng et al. 2010 –
  - Supraspinous fossa

- Taskaynatan et al 2011
  - US accuracy measured with NS
    - 5/27 successful, 19/27 semi, 3/27 unsuccessful
Intercostal Nerve Block

- Ventral rami of thoracic nerves
  - Mixed
  - Branches
    - Lateral cutaneous branch (mid-axillary line)
    - Anterior cutaneous branch
  - Exceptions:
    - 1st – no anterior and usually no lateral (join C8)
    - Fibers from 2nd and 3rd - intercostobrachial nerve
      - Axilla, medial aspect of upper arm
    - 12th – call subcostal nerve
Intercostal Nerve Block

- Three layers of intercostal muscles
  - External, internal and innermost
  - Neurovascular bundle between internal and innermost muscles in costal groove
  - Hardy 1998 – up to 73% of cadavers NV bundle lay between the ribs rather than costal groove
Intercostal Nerve Block

- **Indication:**
  - Pain - acute or chronic pain
    - Thorax and upper abdomen

- **Complication:**
  - Pneumothorax reported in up to 8.7% (0.9 – 8.7%)
  
  Abrahams et al. 2010
  - Grade C – one small case series
US Intercostal Nerve Block

- Curatolo et al. 2007
- High frequency probe
  - Prone, angle of rib (approx 7 cm) from spinous process
  - Short axis of rib, in-plane approach preferred
  - Enter upper margin one level below
  - Hydrodissection
- Post procedure scan for pneumothorax
  - Highly sensitive and specific (100%/96.5%)
    (Wu et al 1995)
Ilioinguinal/Iliohypogastric Nerve Block

- Confusing/opposite landmark techniques
- Low success rates

Indication:
- Post hernia or appendectomy pain
- Groin/penis/labia/medial thigh pain

Complication:
- Femoral nerve palsy, bowel perforation or pelvic hematoma.
Ilioinguinal/Iliohypogastric Nerve Block

- **Ilioinguinal Nerve**
  - Anterior rami of L1
    - lateral psoas and pierce TA above the iliac crest
    - superomedial area of thigh and skin over root of penis and scrotum

- **Iliohypogastric Nerve**
  - Anterior rami of L1
    - Pierces internal oblique above above the ASIS
    - Travels between EO and IO
    - Lower abdomins rectus

- Deep circumflex iliac artery
US IL/IH nerve block

- High Frequency probe
  - Perpendicular to line connecting of ASIS and pubic tubercle
  - Lateral end of probe just above or posterior to ASIS
  - Between TA and IO
  - 5ml injectate
Anterior superior iliac spine

Inguinal ligament

medial

lateral
US IL/IH nerve block

- Eichenberger 2006 – Cadaver study
  - 95% accuracy
- Abrahams et al. 2010-
  - Grade A
    - 2 RCTs/1 dose-finding study
      - Less analgesic post op
      - 50% with US scanning blind
      - Higher serum volume of LA?
    - Higher probability of block success with a lower volume compared to blind techniques
Lateral Femoral Cutaneous Block

- Purely Sensory
- Dorsal branch of 2\(^{nd}\) and 3\(^{rd}\) lumbar nerves
  - Lateral border of psoas
  - Across the iliacus between 2 layers of iliac fascia
    - Beneath the inguinal ligament
    - Medial to ASIS over the sartorius
      - Varying distance from ASIS
        - 4.6 to 7.3 cm
Lateral Femoral Cutaneous Block

- **Indication:**
  - Meralgia Parasthetica
  - LFCN compression/entrapment
    - Obesity and Pregnancy

- **Complication:**
  - Coincidental block of other nerves
  - Direct nerve trauma or damage to local vascular structures
Lateral Femoral Cutaneous Block

- **Position:**
  - Supine

- **Probe:**
  - High frequency linear (If possible)

- **Scanning:**
  - Lateral probe on ASIS at inguinal ligament
  - Distal
  - Sartorius inverted triangle – nerve superficial
  - Variable location and appearance

- **Approach:**
  - In line
  - Lateral to medial
1 = external oblique muscle
2 = internal oblique muscle
3 = transverse abdominis muscle
4 = iliacus muscle

ASIS = anterior superior iliac spine
LFCN = lateral femoral cutaneous nerve
Fig 2 LFCN

White bar in a) indicates transducer position for initial detection of LFCN at POV.; note that this is far distal to ASIS.
b) cross section at initial scanning level and
c) corresponding US image

The LFCN (yellow arrow) is deep to fascia lata, FL (white arrows) between sartorius, SM, and tensor of FL, TFL; RF rectus femoris.
Note in b) that the SM is within a duplication of FL, while the fascia iliaca, (white open arrow) covers the iliopsoas and femoral nerve, FN
Lateral Femoral Cutaneous Block

- High variability as it passes into thigh
- Ng et al. 2008 –
  - very poor correlation in cadaver and volunteers using blind technique
- Shannon et al. 1995 –
  - Blind technique 40 % success
  - Femoral nerve spread 35%
  - With stimulator 85% success
- Bodner et al. 2009
  - 15/16 successful blocks with .3 ml of LA
US LFCN Block

  - Distal localization
    - Triangular shape laterally over sartorius
  - Proximal localization more difficult
    - 70% success rate
    - Inguinal level, lateral probe on ASIS
    - Hyperechoic dot between fascia lata and iliaca 2-3 cm from ASIS

- Tagliafico et al. 2011 –
  - Complete resolution in 20 patients at 2 mos.

- Kim et al 2011
  - Case report –success in 94 kg patient

- Mulvaney 2011
  - Case report -US guided percutaneous nucleoplasty
WEB SITES

- http://www.usra.ca/
- http://www.nysora.com/techniques/ultrasound2
- http://www.dhmc.org/webpage.cfm?site_id=2&org_id=594&gsec_id=0&sec_id=0&item_id=33614
Selected US Guided Blocks

Live Models

- Intercostal, Cervical Paraspinal and Facet joints
  - Dr. Adam Jacob
- Sacroiliac Region
  - Dr. Mederic Hall
- Suprascapular nerve/Shoulder
  - Dr. Steve Wisniewski
- Greater Occipital Nerve, Cervical Paraspinals
  - Dr. Mike Derr
- Ilioinguinal/Iliohypogastric/TAP/LFCN
  - Dr. Terry Macnamara
- Blue Phantom/Turkey Breast Needle localization
  - Dr. Jake Sellon
Selected US Guided Blocks
Cadavers

- Intercostal, Cervical Paraspinal and Facet joints
  - Dr. Matthew Pingree
- Greater Occipital Nerve/Suprascapular Nerve
  - Dr. Mark Hurdle
- Sacroiliac Region/Caudal Epidural
  - Dr. Jon Finnoff
- Ilioinguinal/Iliohypogastric/TAP/LFCN
  - Dr. Susan Moeschler