Review of Brachial Plexus Anatomy & Blockade
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Regional and APS Rotations
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Regional and APS Rotations

(Slides by Randall Malchow MD)
Brachial Plexus
ISB, SCB, ICB, and Axillary

- General Anatomy - ‘applied anatomy’
- Anatomy and Techniques
  - Interscalene
  - Supraclavicular
  - Infraclavicular
  - Axillary
C5-T1 Nerve Roots
Ant and Mdl Scalenes
Subclavian Artery
Mid-clavicle
Coracoid Process
“Sheath”
Brachial Plexus in situ
Ant and Mdl Scalenes
Phrenic Nerve
Vertebral Artery
Subclavian Vein
Mid-Clavicle and 1st Rib

NB: relation of B.P. to 1st part of Ax Art
- "Hour Glass"
- 4 Approaches to BrPl
Rule of 3’s

- **Roots:**
  - Phrenic (C3,4,5)
  - Lg Thoracic (C5,6,7)
  - N.s to Strap m.s

- **Upper Trunk:**
  - Dorsal Scap
  - Suprascap (C5,6)
  - Lat Pectoral (C5,6,7)

- **Post Cord:**
  - Upper Subscap
  - Lower Subscap
  - Thoracodorsal

- **Med Cord:**
  - Med Pectoral
  - Med Brachial
  - Med Antebrachial
nerve leaves at coracoid process

Supraclavicular Branches

Rhom/LevScap

Infraclavicular Branches

Supra/infraspinatus/75% shoulder joint

Pect Maj

Infraclavicular Branches

Pect Min

Lat Dorsi

Subscap/TerMaj

(Outside Sheath)
Brachial Plexus

- Distal Anatomy
Sensory: Dermatomes (Nerve)

- C4
- C5
- C6
- C7
- C8
- T1
- T2
- T3
Sensory: Peripheral Nerve Distribution

- Supraclavicular n.
- Axillary n.
- Intercostobrachial n.
- Median antebrachial cutaneous n.
- Musculocutaneous n.
- Radial nerve cutaneous innervation
- Median n.
- Ulnar n.

Note: Medial Brachial Nerve Not Shown
Motor Response to MUSCULOCUTANEOUS Nerve Stimulation

Flexion
Supination

Biceps/Brachialis
Coracobrachialis
4. Elbow Extension
5. Supination (Brachioradialis; Supinator)
Motor Response to MEDIAN Nerve Stimulation

1. Wrist Flexion
2. Fingers’ Flexion
3. Thumb Opposition
4. Pronation-Pron Teres/Quad
Motor Response to ULNAR Nerve Stimulation

1. Ulnar Deviation of the Wrist
2. Metacarpo-Phalangeal Flexion
3. Thumb Adduction
Interscalene Techniques:

History:
- Kappis, 1912, Posterior
- Mulley, 1919, Ant, immobile

Classic N. Stim:
- Avoid These Muscle Stim Patterns:
  - Serratus Ant (Lg Th)
  - Rhomboid/Lev Scap (Dors Scap)
  - Trapezius (XI)
  - Diaphragm (Phren)

USG

Posterior ISB:
- “Cervical PVB”
- Excellent for ISB Caths
Interscalene Approach:
Surrounding Structures

Phrenic Nerve (C3, C4, C5)

- Ventral rami
- C3, C4, C5
- Anterior scalene m.
- R. common carotid a.
- Brachial plexus
- Right phrenic nerve
- R. subclavian a.
- R. vagus (X) n.
- Internal thoracic a.
- Brachiocephalic trunk
- L. subclavian a.
- L. common car.
- L. vagus (X)
- Internal thoracic
- Thoracodorsal
- L. pericardiophrenic a.
Surface Anatomy and Technique:
Pos’n (head, arm)
At C6 level, IS groove, 2-3cm post to SCM
(NB: EJ, and posterior location)
If too deep, anterior:
Interscalene Approach- other

**Indications:**
- Shoulder Surgery- esp open
- Proximal humeral or scapular fx’s, other

**Initial Block Eval:**
- “Money sign”
- “Deltoid sign”
- “Triangle Sign”

**Limitations:**
- Minimal Blockade of Lower Trunk (C8,T1) (w/ >40ml may get lower trunk)
- Poor approach for surgery distal to shoulder
- If awake, know the operation
- Cath difficult (placement/dislodge)
Posterior Cervical Paravertebral Block

- Alternate approach for ISB

- Advantages:
  - Avoids anterior vascular structures: Vert artery, carotid, ext jugular, etc
  - Less phrenic nerve block?; improved diaphragm function.
  - Less catheter leaking, dislodging, etc
  - Catheter not in surgical prep area.
Point of needle entry

C6

Levator scapulae

Trapezius (lateral border)

Sitting position; C6 Level
Direct needle anterior, medial, and caudal towards suprasternal notch, until C6 transverse process reached. Walk needle off laterally using LOR or needle stimulation to Brachial Plexus.
Interscalene Approach Distribution:

Will miss med antebrachial
Interscalene Approach Complications

- SAB/Epidural
- Intravascular - vert art leading to sz’s
- Other Nerve Blockade:
  - Phrenic: 100%
  - Recurrent Laryngeal: hoarseness 10-20%
  - Stellate Ganglion: horner’s syndrome 25-50%
- Bezold Jarisch/vagal: esp right isb 10-20%
- Seizures 0.7%
- Cough/bronchospasm
- Pneumothorax - rare
Supraclavicular Approach

- **History:**
  - Kulenkampff, 1911
  - Adv inf, med, post; paresthesia tech

- **Indications:**
  - Excellent for elbow and forearm surgery
  - Good for hand and wrist

- **Special considerations:**
  - Pneumothorax: 0.1-5%
    - Franco: 1001 SCB's: no pneumothorax
  - Phrenic Nerve Blk: 40%
1-2cm from SCM or width of clavicular head away.

SCM
Supraclavicular Techniques - Desired Stimulation

- Avoid:
  - Shoulder stimulation
  - Upper trunk stim: (musculocutaneous)

- Aim for stimulation:
  - Franco: 97% success w/ distal twitch
  - Subclav Art “pushes” local towards upper trk

- If cough, too deep (against pleura)
Supraclavicular Spread

variable

Supplement ICBN
Infraclavicular Approach

**Overview:**
- **Intent:** Blockade distal to pleura, prox to branches (ie block at level of cords)
- **History:**
  - Bazy 1917; Labat 1927 (aiming med.)
  - Raj, 1973 (aiming lateral)

**Indications:**
- Excellent for forearm/wrist/hand surgery
- Popular location for brachial plexus catheter
Infraclavicular Approach:

Advantages:
- >success w/ MC, Med Brachial & Antebrachial nerves compared to traditional AXB;
- Intercostobrachial often blocked
- Min phrenic block/ pneumothorax risk
- Arm in any position

Disadvantages:
- ? Benefit over USG Axillary block with > risk
- Difficult to see needle at steep angles
- < Patient Satisfaction? (deeper block)
- Sml < success compared to AXB? (94% vs 99%)
Infraclavicular Approach Anatomy:

- **Landmarks:**
  - Jugular Notch
  - AC Joint
  - Deltopectoral Groove
  - Pectoral Major m.
  - Deltoid m.
  - Cephalic Vein
ICB: Specific Anatomy

Biceps-short head
Coracobrachialis
Pect. minor
Subscapularis
Teres major

Lateral Cord (C5,6,7): MC. & median
Medial Cord (C8,T1): Ulnar, median, med brach and antebrach
Posterior Cord (C5-T1): Radial & Axillary

Axillary n. (65% lat to CP)

Head of humerus
Axillary sheath:
- Brachial plexus
- Axillary vessels

Teres major

Lateral Cord (C5,6,7): MC. & median

Medial Cord (C8,T1): Ulnar, median, med brach and antebrach

Posterior Cord (C5-T1): Radial & Axillary

Radial n.
Ulnar n.
Median n.
Axillary a.
Musculocutaneous n. (90% lat to CP)
Infraclavicular Approach: techniques

- Nerve Stimulation
  - Lateral Direction/Raj:
    - Mid-clavicle aiming laterally
  - Vertical /Coracoid process:
    - Wilson 1998: aim directly posterior
  - Single vs Multi-nerve stim

- USG
Raj Technique
- Arm at 90 deg
- 21 gu x 4in
- Mid-clavicle entry, 45 deg to skin
- Aim laterally towards ax art
- Depth: ave 4.5cm
- CPNB
Raj Technique:

- Safety of infraclav approach
- Axillary boundaries:
  - Anterior
  - Posterior
  - Medial
Coracoid Process Technique:

- 2cm med & inf to coracoid
- 21 gu x 4in
- Aim post:
- If lat to CP, could miss MC/ Ax n.s.
- Depth: ave 4cm (2-7cm)
Infraclavicular Approach: Desired stimulation

- Goal: distal twitch in wrist or hand
  - Lateral Cord: avoid
  - Medial Cord: median/ulnar ok
  - Posterior Cord: radial ideal

- Upshot:
  - flex or ext wrist/digits
  - Extension best
  - Consider multi-stim
Axillary Approach

History:
- Hirschel, 1911
  - 4in needle to 1st rib
- Pitkin, 1927:
  - 8in needle to trans proc!
- 1950: > popularity
- 1989: Ting, USG
Axillary Block - continued

- **Indications:**
  - Hand and wrist surgery
  - Elbow/forearm with multistim/USG tech

- **Goal:**
  - Simple brachial plexus anesthesia at most distal point to avoid complications

- **Advantages:**
  - > 98% success
  - > Very high Pt satis
  - Exc USG imaging
  - Short MC block vs Long duration AXB

- **Disadvantages:**
  - > needle movement?
  - Arm at 90 deg
Axillary Anatomy

- Pyramid shape
- (-)MC, Ax, Med brach and antebrach
- Neurovasc bundle lying atop the lat dorsi/ teres m.
- Between coracobrach. and triceps
Axillary Approach:
Cross sectional anatomy

- Note relationships of:
  - Biceps
  - Coracobrachialis
  - Long Head of triceps
  - Musculocutaneous nerve route thru coracobrachialis (variable)
  - Lateral: M&M
  - Medial: U&R

- Deltoid
- Long head of triceps
- Medial head of triceps
Techniques of Axillary Approach

1. Transarterial
   - Either all posterior (Urmey)
   - or 50% post, 50% ant
2. Single Nerve Stim
3. Paresthesia
4. Multiple Nerve Stimulation (2-3)
   - Quick onset
   - < LA toxicity risk
   - < Hematoma risk
   - > Success >95%
5. Ultrasound – ideal technique
   - NB. > 98 % success w/ these 2 techs

NB: No difference in 1st 3 tech, all 80% (Goldberg)
Mult Nerve Stim AXB
(3 injections)

- 5mm above and below artery
- M/M on top
- U/R below

![Diagram showing injection sites and volumes]
Axillary Approach Supplementation

- If operating above elbow
- Not needed for tourniquet
- Medial Brachial Nerve, T1
- Intercostobrachial T2 (not part of brach plex)
- Subcutaneous infiltration above and below sheath
Axillary Distribution

- Good coverage of:
  - Ulnar
  - Median
  - Radial
  - Musculocutaneous
  - Medial antebrachial

- Supplement prn:
  - ICBN
  - Med Brachial

Will capture MCN with separate injection