

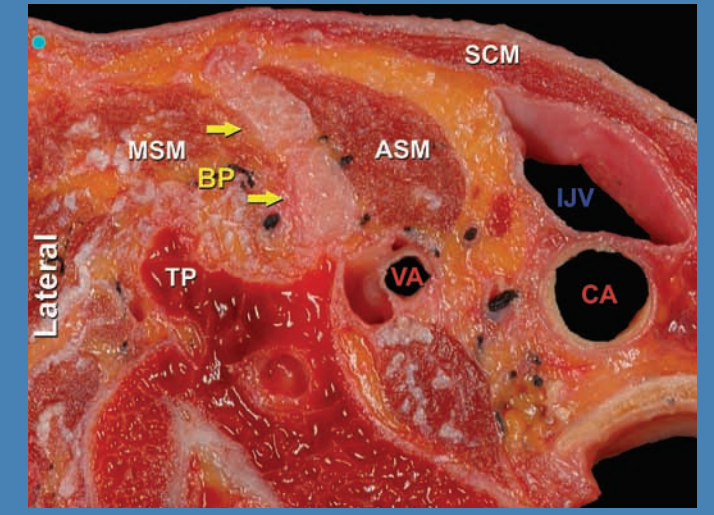
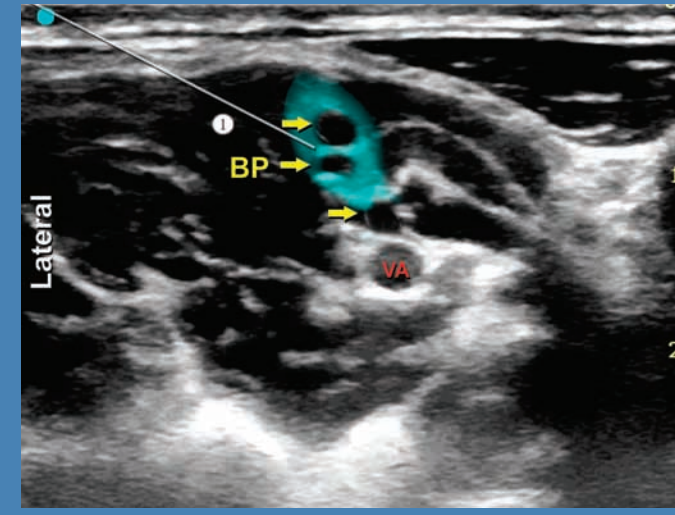
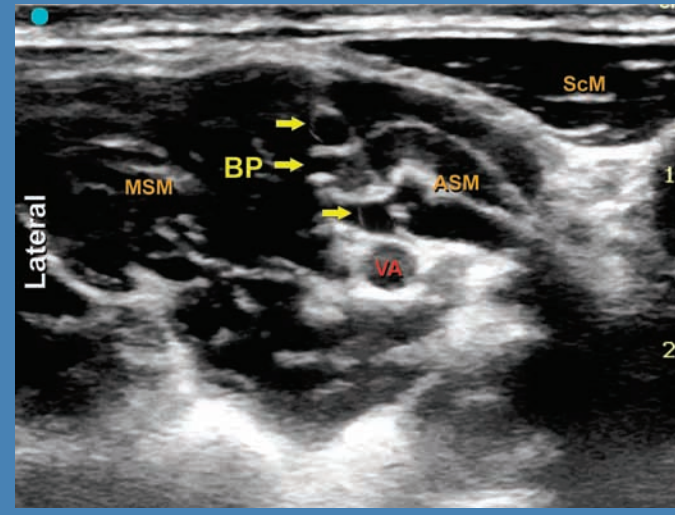
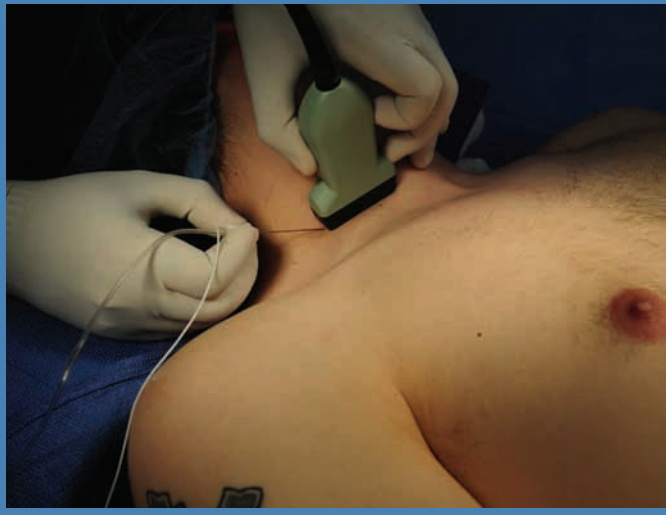
Transducer Placement

Ultrasound imaging

Cross-sectional Anatomy

Interscalene Block

Indications:
Surgery on shoulder, distal clavicle, proximal humerus



ABBREVIATIONS
ASM Anterior Scalene Muscle
BP Brachial Plexus
CA Carotid Artery
IJV Internal Jugular Vein
MSM Middle Scalene Muscle
SCM Sternocleidomastoid muscle
TP Transverse Process
VA Vertebral Artery

Patient Position: Supine, beach chair, or semi-lateral
Transducer: 10-16 MHz, linear array
Transducer Placement: Over external jugular vein, approx 3cm above clavicle
Needle: 22G 5cm short bevel
Nerve stimulation response: Shoulder, arm, forearm

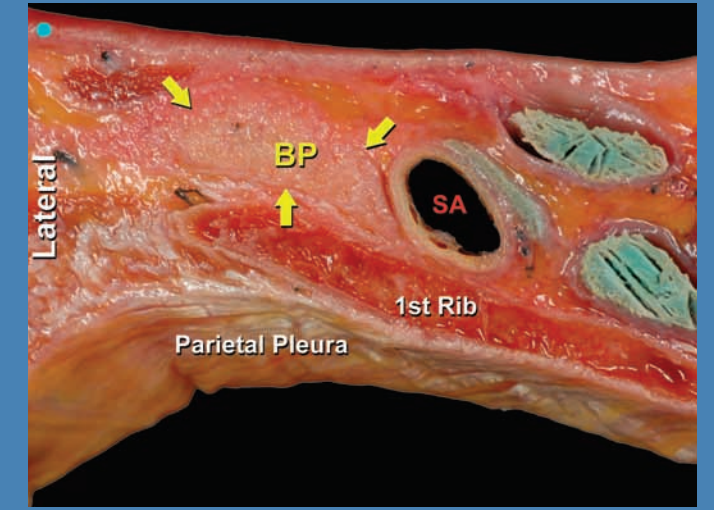
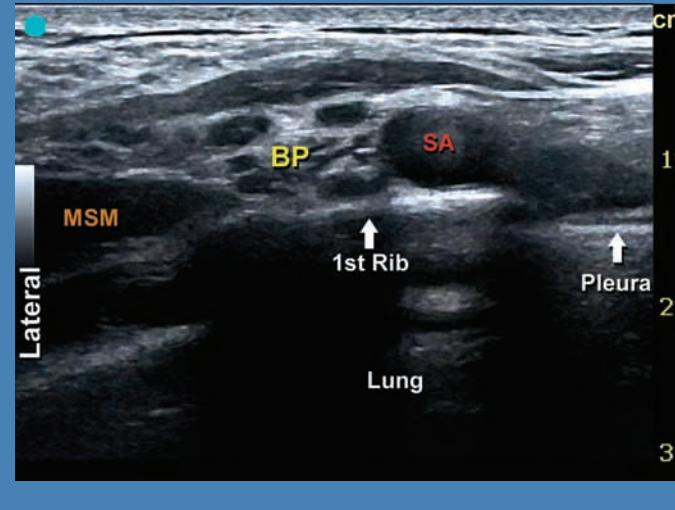
Initial depth setting: 3cm
Local Anesthetic (LA): 15-20mL
Ideal view: 2-3 trunks visualized
Key anatomy: Anterior and middle scalene muscles, 2 or 3 round hypochoic structures (trunks) between the two muscles

Technique
Needle insertion: In plane (most common), lateral to medial
Ideal LA deposit: Within the interscalene groove
Number of injections: As few as possible, based on spread; typically 1-2
Ideal spread of LA: Between ASM and MSM around trunks

Tips:
• Avoid vertebral injection
• Re-consider in patients with shortness of breath
• Start scanning from supraclavicular level when imaging proves challenging

Supraclavicular Block

Indications:
Surgery on humerus, elbow, hand



ABBREVIATIONS
BP Brachial Plexus
DSA Dorsal Scapular artery
MSM Middle Scalene Muscle
SA Subclavian Artery
TCA Transverse Cervical Artery

Patient Position: Supine, or semi-lateral
Transducer: 10-16 MHz, linear array
Transducer Placement: In supraclavicular fossa, lateral to clavicular head of SCM, pointed caudally
Needle: 22G 5cm short bevel needle
Nerve stimulation response: Forearm, hand

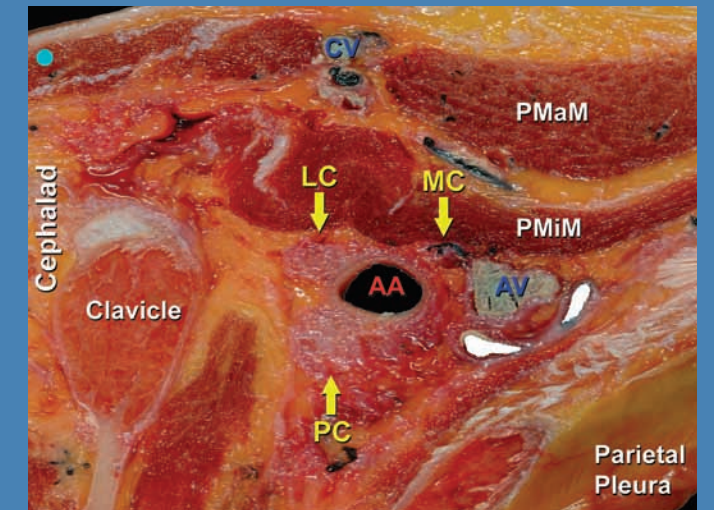
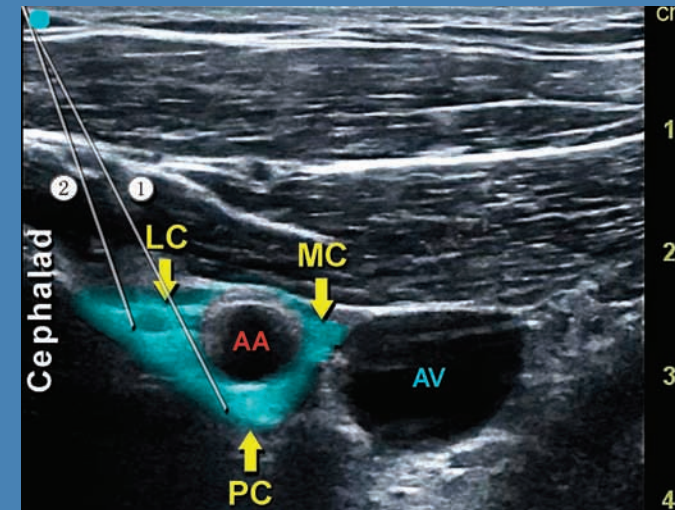
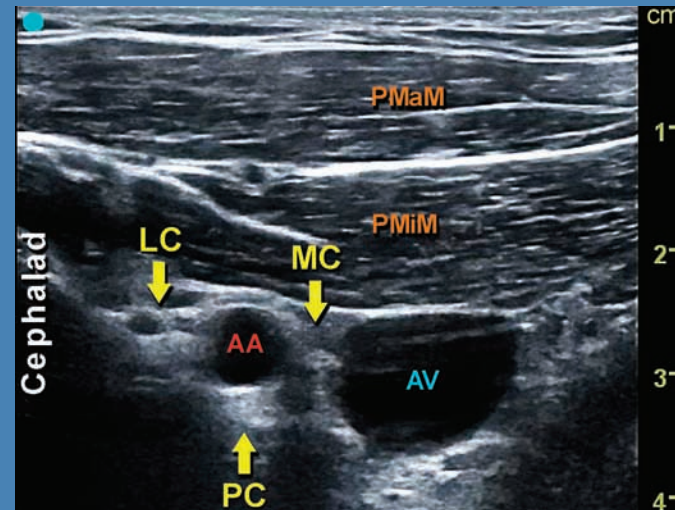
Initial depth setting: 3cm
Local Anesthetic (LA): 20-25 ml
Ideal view: Brachial plexus and subclavian artery above first rib and pleura, respectively.
Key anatomy: Subclavian artery; a honeycombed hyper and hypochoic structure (divisions) lateral and superficial to the artery

Technique:
Needle insertion: In plane, lateral to medial
Ideal LA deposit: Within brachial plexus sheath lateral and superficial to subclavian artery
Number of injections: 2-3
Ideal spread of LA: Within the tissue sheath encompassing brachial plexus

Tips:
• Avoid pneumothorax, TCA, DSA, subclavian artery puncture
• Use power Doppler to detect and avoid TCA, DSA
• Needle angle should be shallow to avoid pneumothorax
• Injection of LA should result in swelling of the sheath and separation of the nerves within sheath by the LA

Infraclavicular Block

Indications:
Surgery on humerus, elbow, hand



ABBREVIATIONS
AA Axillary Artery
AV Axillary Vein
CV Cephalic Vein
LC Lateral Cord
MC Medial Cord
PC Posterior Cord
PMaM Pectoralis Major Muscle
PMiM Pectoralis Minor Muscle

Patient Position: Supine with arm abducted and flexed at elbow
Transducer: 10-16 MHz, linear array
Transducer Placement: Perpendicular to and below clavicle, medial to coracoid process
Needle: 20-21G 8-10cm short bevel needle
Nerve stimulation response: Hand twitch

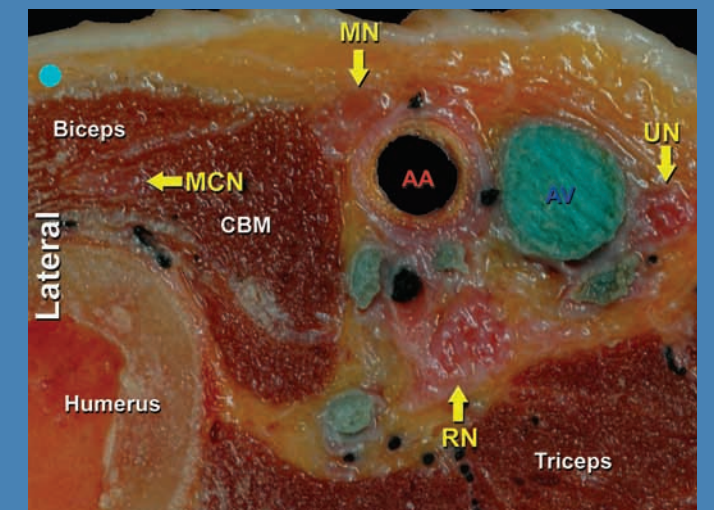
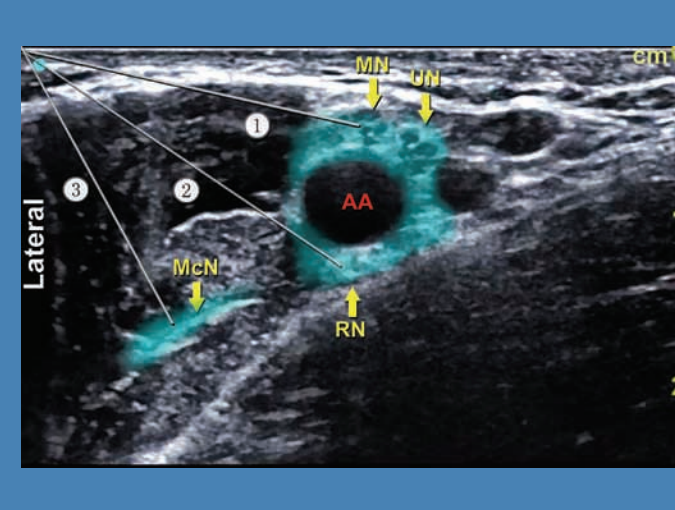
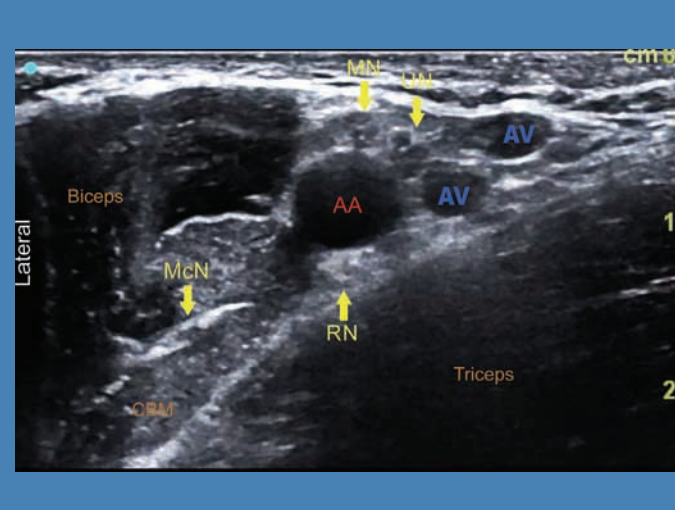
Initial depth setting: 5cm
Local Anesthetic (LA): 20-30mL
Ideal view: Axillary artery and vein below the fascia of pectoralis minor muscle
Key anatomy: Axillary (subclavian) artery, and fascia of pectoralis minor muscles

Technique:
Needle insertion: In plane, cranial to caudal
Ideal LA deposit: Posterior and lateral to the artery
Number of injections: 2, deep and lateral to artery
Ideal spread of LA: Around AA, under the PMiM fascia

Tips:
• Avoid Axillary (Subclavian) artery or vein puncture and pneumothorax
• Release transducer pressure before injection to detect axillary vein and decrease the risk of intravenous injection
• Abduction of the arm and flexion in elbow helpful to visualize pectoral fascia

Axillary Block

Indications:
Surgery on elbow, forearm, hand



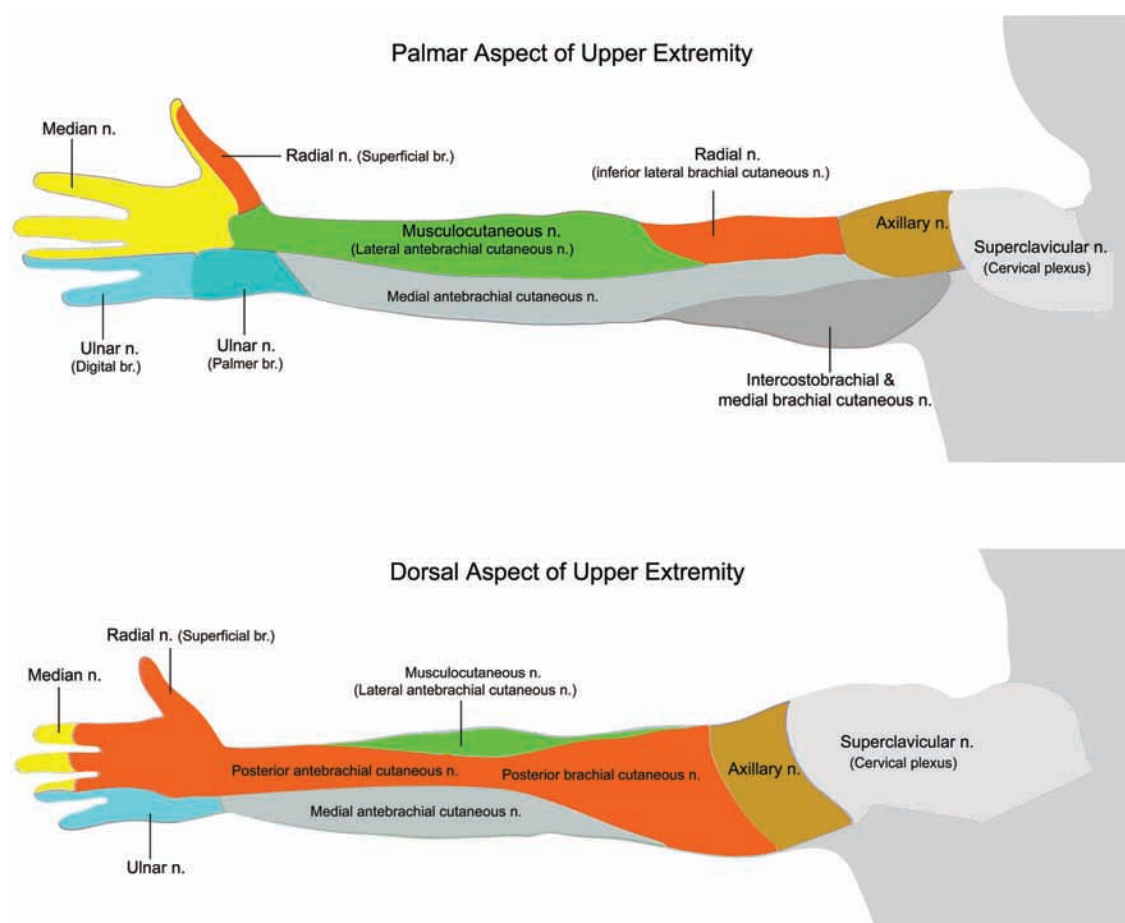
ABBREVIATIONS
AA Axillary Artery
AV Axillary Vein
CBM Coracobrachialis Muscle
MCN Musculocutaneous Nerve
MN Median Nerve
RN Radial Nerve
UN Ulnar Nerve

Patient Position: Supine with arm abducted and flexed at elbow
Transducer: 10-16 MHz, linear array
Transducer Placement: Perpendicular to humerus in the axillary fossa
Needle: 22G 5cm short bevel needle
Nerve stimulation response: Hand twitch

Initial depth setting: 3cm
Local Anesthetic (LA): 20-30mL
Ideal view: Axillary artery and its sheath; separate view usually required for McN
Key anatomy: Median, ulnar, radial nerves scattered around AA, McN outside the sheath.

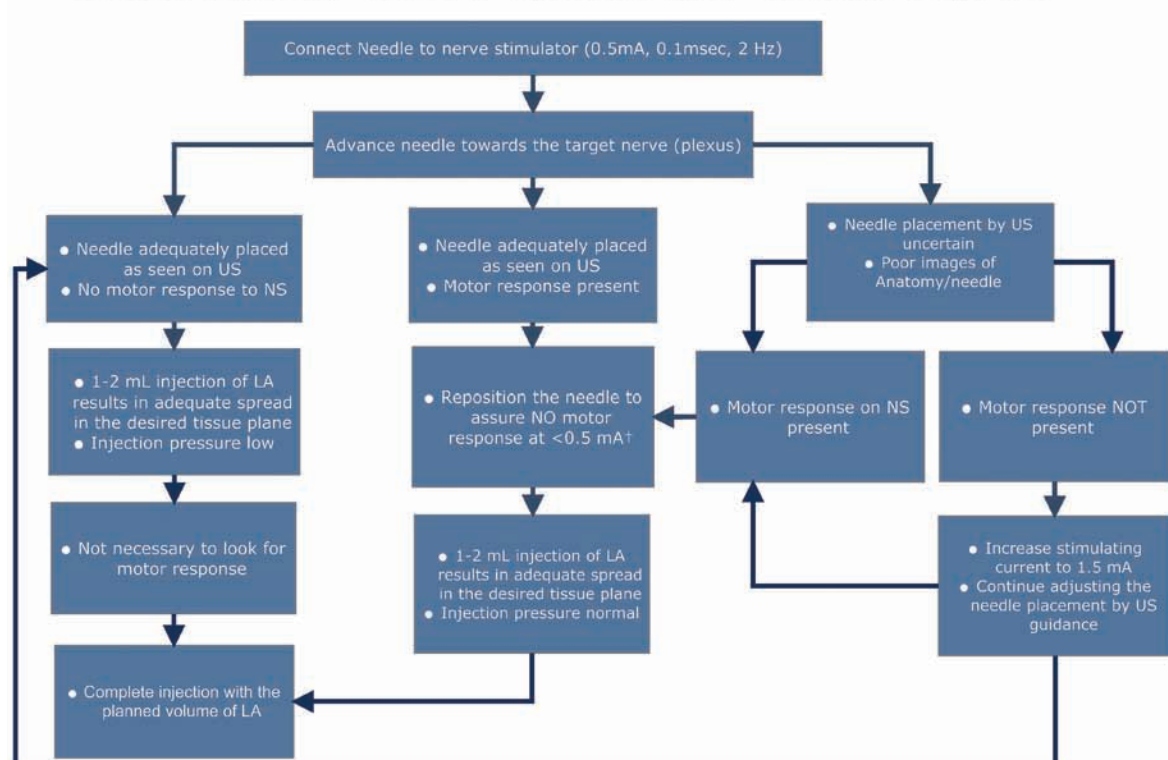
Technique:
Needle insertion: In plane or out of plane
Ideal LA deposit: 10 mL posterior and 10mL anterior to the artery, 5mL for McN
Point of injection: deep to artery at 6:00, then redirect to 1:00
Number of injections: 2-3 + McN
Ideal spread of LA: Around AA, within the sheath; separate injection required around McN

Tips:
• Musculocutaneous nerve must be blocked separately with 5mL of LA
• Release transducer pressure before injection to detect axillary veins and decrease the risk of intravenous injection
• Not necessary to visualize/block individual nerves, except for McN



Suggested Standard Monitoring For Nerve Blocks

Combined Monitoring: Ultrasound + Nerve Stimulation + Resistance to Injection



Legend: US=ultrasound, NS=nerve stimulator, Low Injection Pressure <15 psi*
* Experimental studies in large models/human cadavers suggest that opening pressure for intrafascial injection requires >15 psi
† Experimental studies suggest that EMR at < 0.2 mA (0.1 ms) indicates intraneural needle placement; For additional safety margin, 0.5 mA is recommended in the guidelines by the collaborative group. EMR=Evoked Motor Response

TREATMENT OF LOCAL ANESTHETIC TOXICITY

- 1) Airway, hyperventilation, 100% O₂
- 2) Abolish convulsions (Diazepam, Midazolam, Propofol)
- 3) Intralipids (1.5 mL/kg over 1 minute (~100mL), then continuous infusion 0.25 mL/kg/min (~500 mL over 30 minutes)
- 4) CPR/ACLS; consider cardiopulmonary bypass

DOCUMENTATION AND MONITORING CHECK-LIST

- Patient consent obtained
- Laterality checked
- Resuscitative equipment present
- Patient monitoring applied (EKG, BP, Pulse Oxymetry)
- Skin disinfection
- Premedication: Medication(s), dose(s)
- Local anesthetic: type, volume(mL), concentration %
- Injection monitoring:
 - Motor response at <0.5 mA: NO YES
 - Motor response _____ (specify type and mA)
 - High resistance to injection: NO YES
 - Injection pressure (if monitored): _____ (psi)
 - Pain/Paresthesia on injection: NO YES Not applicable
 - Aspiration before injection

