Ultrasound-Guided Upper Extremity Blocks

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1. **<u>Interscalene brachial plexus block</u>**

Indications:

1. Shoulder Surgeries like shoulder arthroscopic surgery, rotator cuff repair, shoulder arthroplasty.
2. Clavicle surgery – Resection / ORIF of clavicle
3. Surgeries above the elbow – ORIF Humerus, Bicep tendon repair

Anatomy

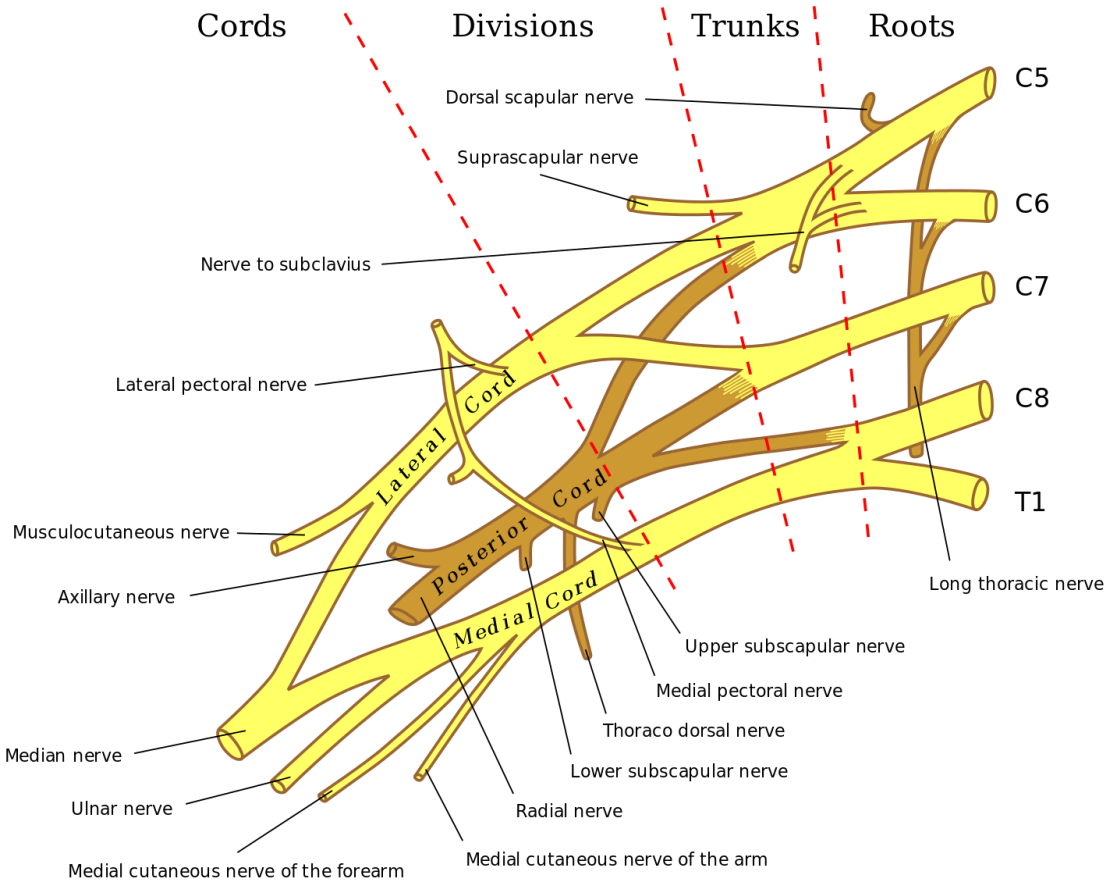


Figure:1

The brachial plexus is formed by nerve roots from C5-T1. Nerve roots join or continue to form the trunks -

The superior (C5-6), middle (C7), and inferior (C8-T1) trunks. Each trunks divide to form anterior and posterior divisions. All the posterior trunks join to form the posterior cord; The anterior divisions of superior and middle trunk join to form the lateral cord and the anterior division of inferior trunk continue as the medial cord. Cords continue to form the main nerves supplying the upper limb- Median, Ulnar, Radial and Musculocutaneous nerves.

Interscalene brachial plexus block is performed traditionally at the level of the C5,C6 nerve roots. These roots can be located between the anterior and middle scalene muscles in the – interscalene groove.

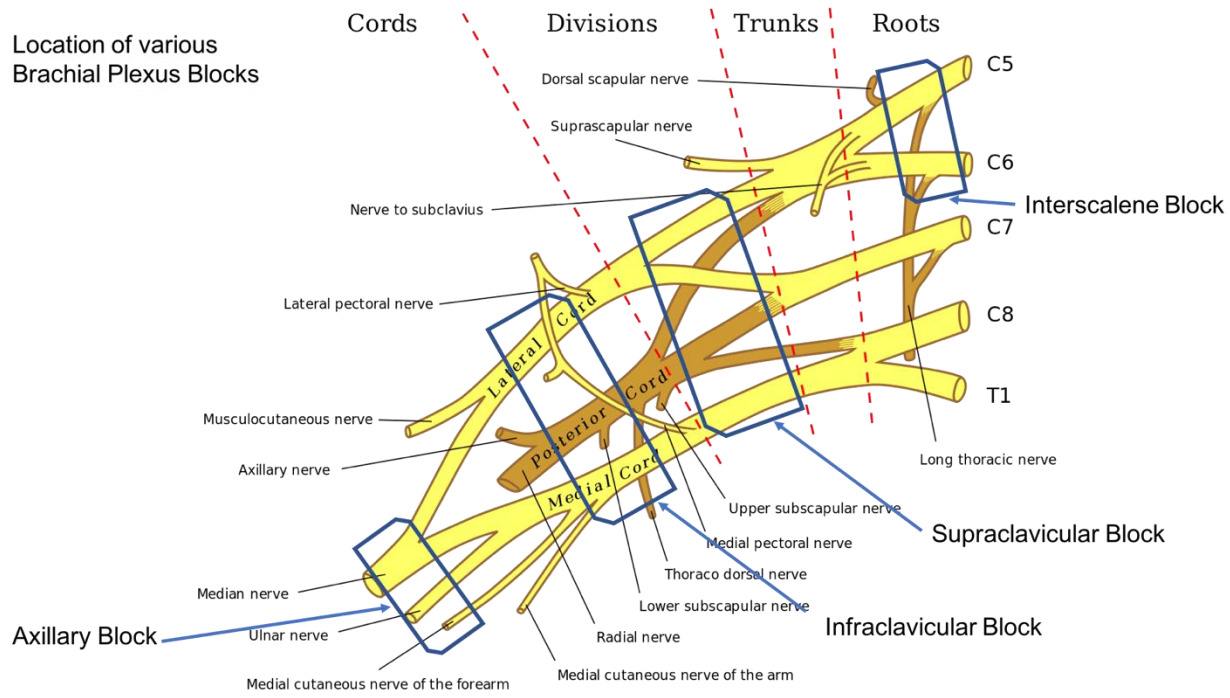


Figure:2

Sonoanatomy

C5,C6 nerve roots can be located in between the anterior and middle scalene muscles, beneath the posterior margin of the sternocleidomastoid muscle. Carotid artery and internal jugular vein are seen medial to anterior scalene muscle. (Figure 3)


SCM –posterior border
Clavicle
Shoulder
In-plane approach for interscalene BPB
Figure:3

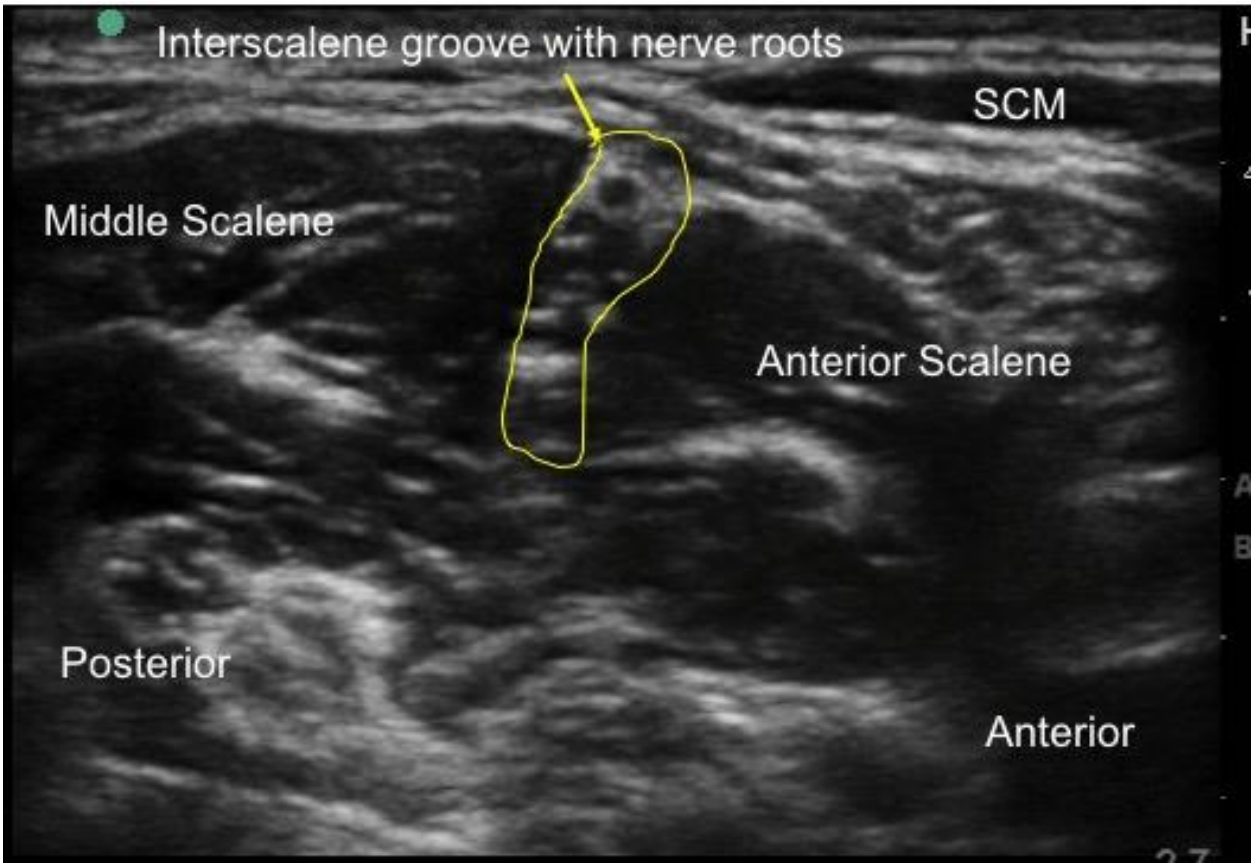


Figure :4

Block technique

Transducer: Linear, high-frequency probe

Needle : 50mm, short bevel needle

Scanning technique

- Patient is lying supine with head turned slightly to contralateral side. (Figure 3)
- Approach 1: The roots can be located by scanning from the supraclavicular fossa and tracking the nerves cephalad from posterior aspect of the subclavian artery.
  Approach 2: They can also be located by scanning laterally at the level of the cricoid.

The roots are located between the anterior and middle scalene muscles and inferior to the posterior margin of the sternocleidomastoid muscle. (Figure 4) At this level, the nerves are hypoechoic and often appear as a "traffic light". The carotid artery and the jugular vein are visualized medially.

Needling technique

After antiseptic skin preparation, a skin wheel with local anesthetic is placed. An in plane approach is used to reach the nerve roots from posterior /lateral to anterior /medial direction with a 50 mm short bevel block needle. (Figure 5)

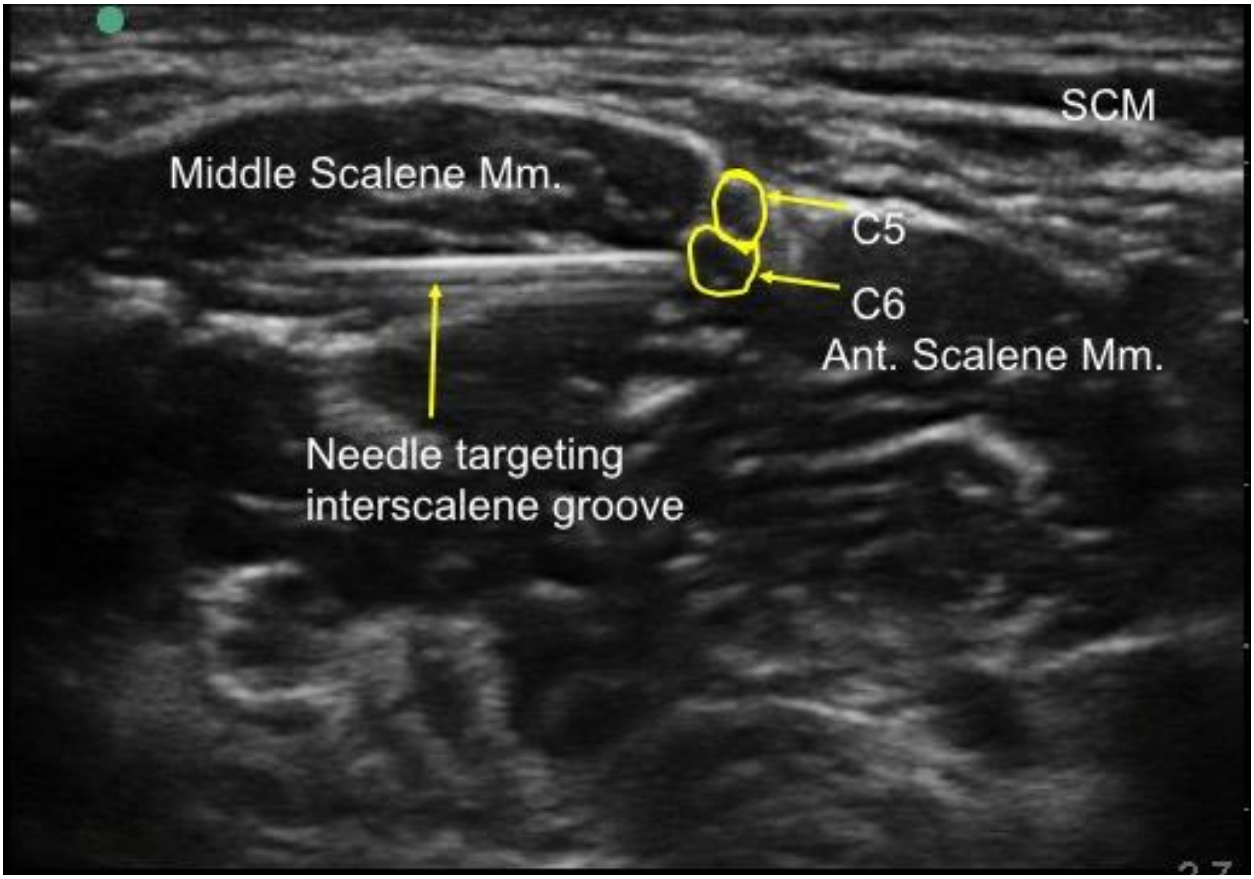


Figure: 5

Volume of Local Anesthetic

Analgesic block : 10-15 ml of 0.5 % Ropivacaine or 0.25% Bupivacaine with 1:400000 epinephrine

Anesthetic block: 15-20 ml of 50:50 mixture of 2% Lidocaine and 0.5 % Bupivacaine with 1:200000 epinephrine

Complications

- Inadvertent epidural or intrathecal injection.

- Intravascular injection with subsequent seizure and loss of consciousness (vessels near brachial plexus: vertebral artery, transverse cervical artery and its branches (superficial branch: superficial cervical artery, deep branch: dorsal scapular artery).
- Phrenic nerve injury is rare, however, phrenic nerve block is not uncommon. Therefore, do not perform bilateral blocks.
- Recurrent laryngeal, vagus, and cervical sympathetic blockade (Horner's syndrome).
- Pneumothorax (rare).
- Ecchymosis and hematoma formation at the block site.
- Injury to long thoracic nerve and/or dorsal scapular nerve may cause winged scapula.

Clinical pearls

- Identify brachial plexus at supraclavicular level first and scan cephalad to identify the targeted nerve roots.
- Maintain visualization of needle tip, injectate and intermittent aspiration during injection to avoid nerve injury and intravascular injection.
- If internal jugular vein or carotid artery is seen, move the probe more laterally.
- Be aware of vertebral artery which is located anteroinferior to C7 nerve root.
- Use color doppler to identify the vessels and avoid them.
- Beware of anatomical variations and be prepared to alter your technique.

2. Supraclavicular Block

Indications

Upper extremity surgery at or below elbow.

Anatomy

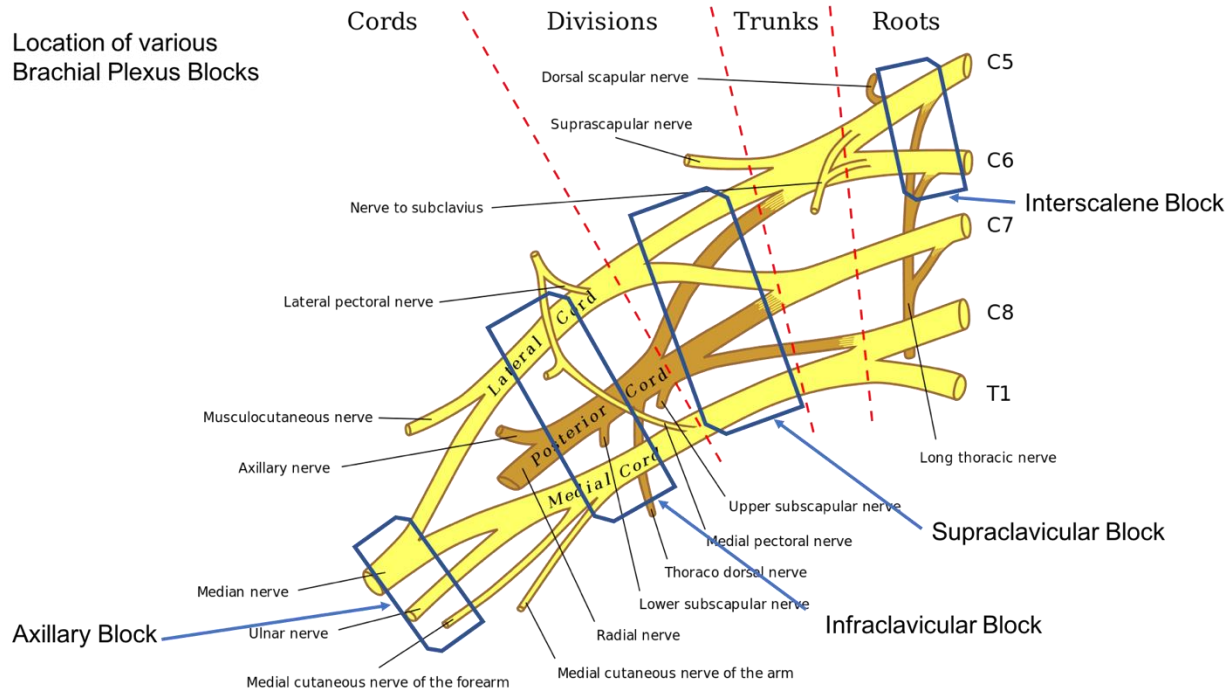


Figure: 1

The brachial plexus descends from the interscalene groove and is present above the first rib and posterior to the subclavian artery in the supraclavicular fossa.
At this level, brachial plexus are seen as divisions and is located postero-lateral to subclavian artery. (Figure 1)

Sonoanatomy

The divisions of the brachial plexus are seen as a cluster of nerves closely packed and located postero-lateral to the artery and above the first rib. (Figure 2)
The transducer is positioned in the coronal oblique plane almost parallel to the clavicle in the supraclavicular fossa. Slight tilting the transducer shows the subclavian artery and the nerves

identified as hypoechoic circles appearing as a “bunch of grapes” postero-lateral to the artery. (Figure 3) Pleura is located as a hyperechoic line underneath and on either side of the first rib.

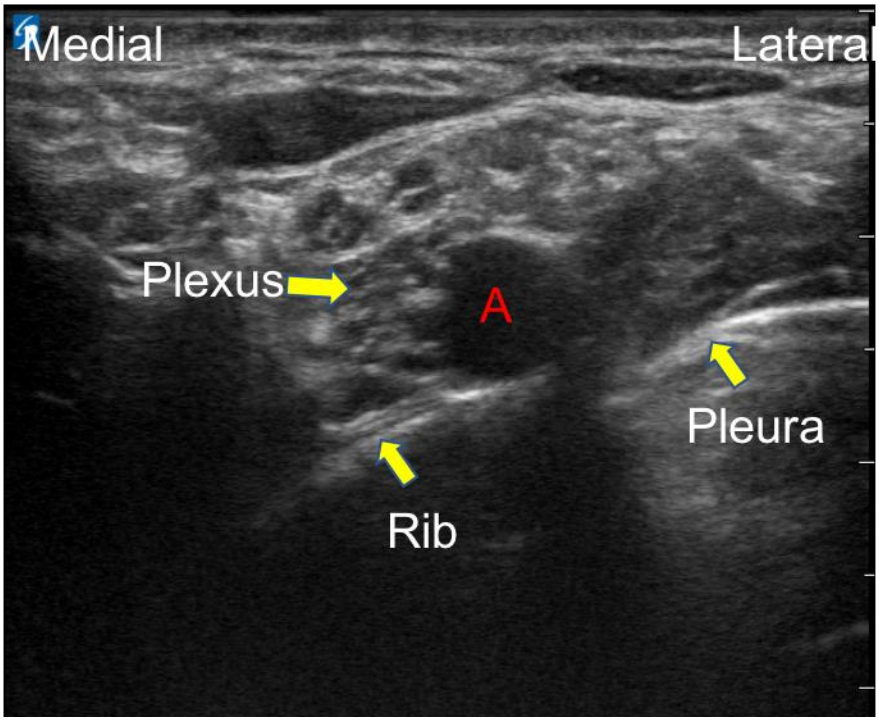


Figure: 2

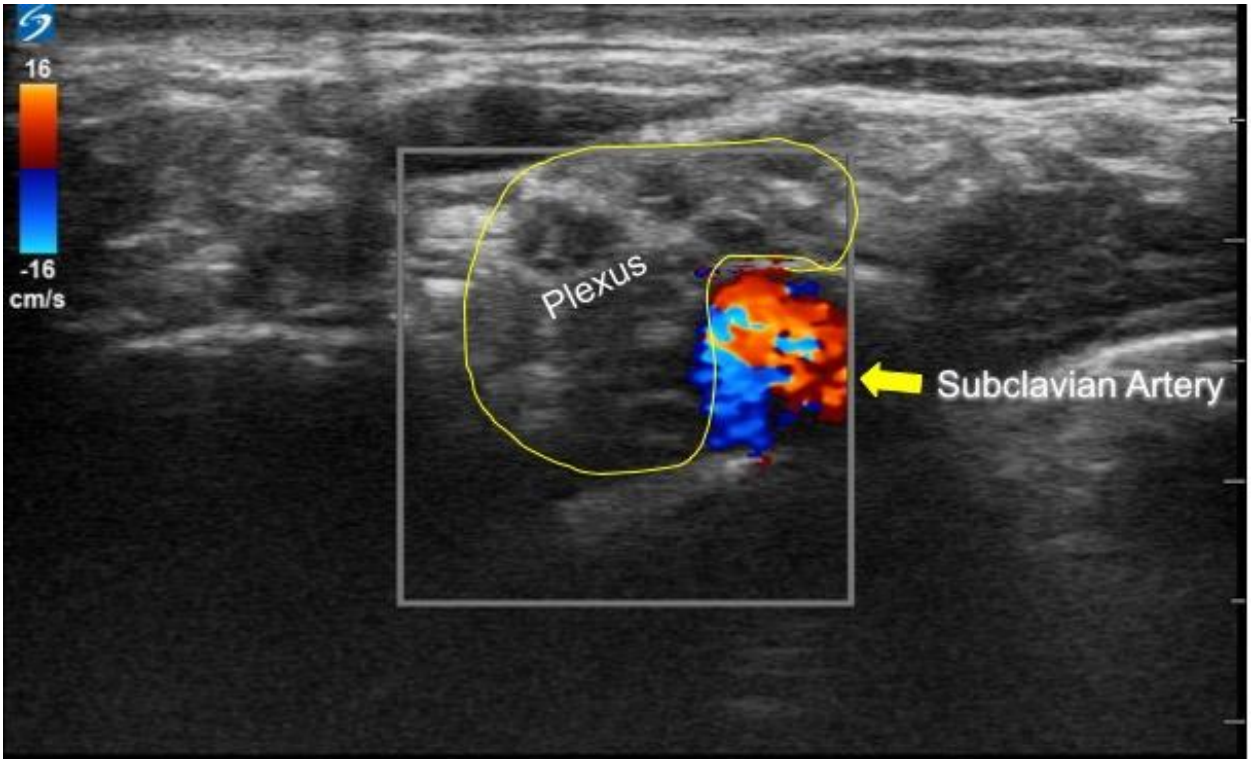


Figure: 3

Block technique

Transducer : Linear, high-frequency probe

Needle : 50mm, short bevel needle

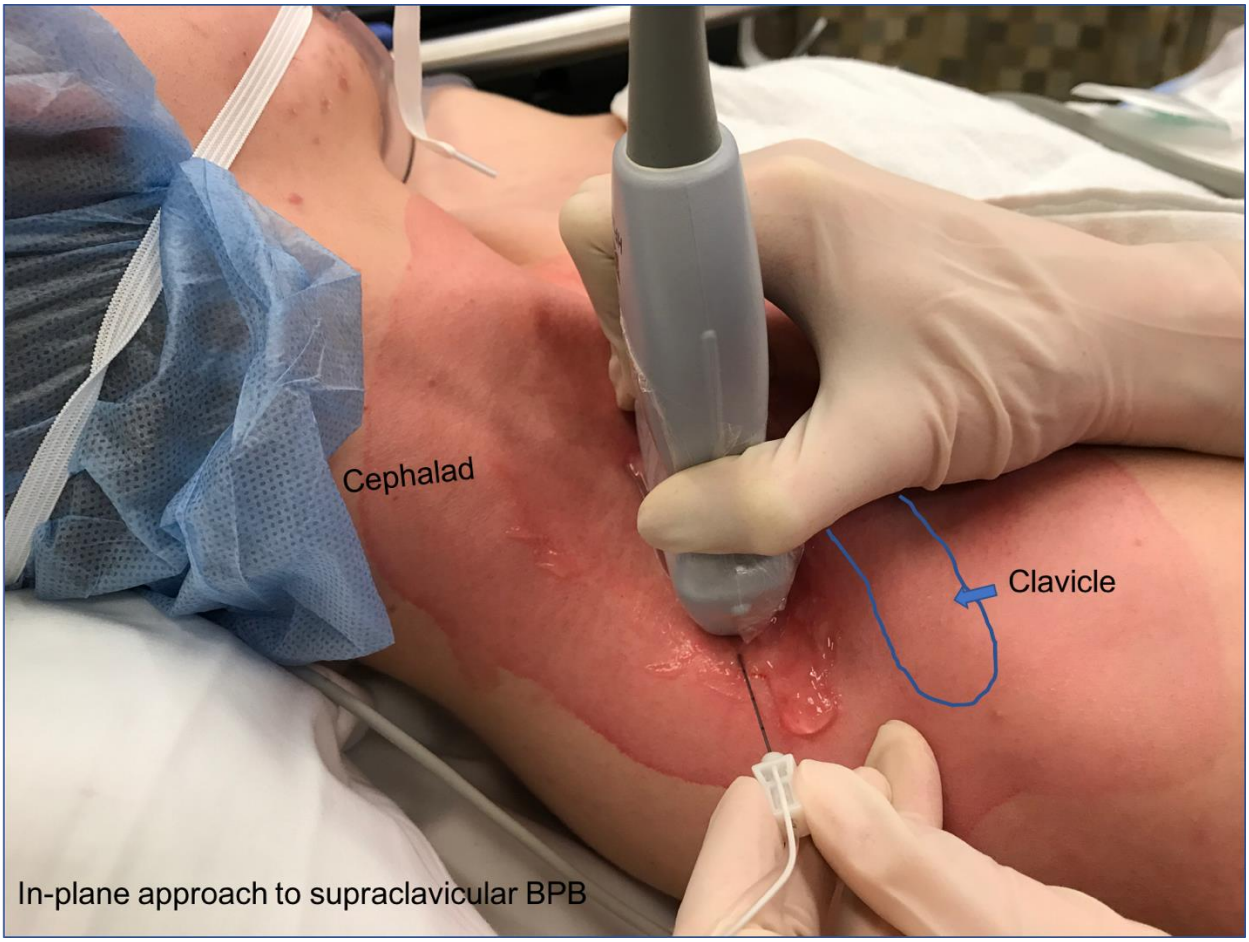


Figure: 4

Scanning technique

The patient is positioned in supine or semi-upright position and head slightly turned to contralateral side.(Figure 4) The skin is disinfected and the transducer is positioned just above the clavicle.

Needling technique

A skin wheel with local anesthetic is placed just lateral to the transducer. The block needle is inserted lateral to medial with needle in-plane approach. Needle repositioning and injections

may be necessary to anesthetize entire nerves. Local anesthetic is deposited to cover the entire bunch of the nerves (divisions).(Figure 5)

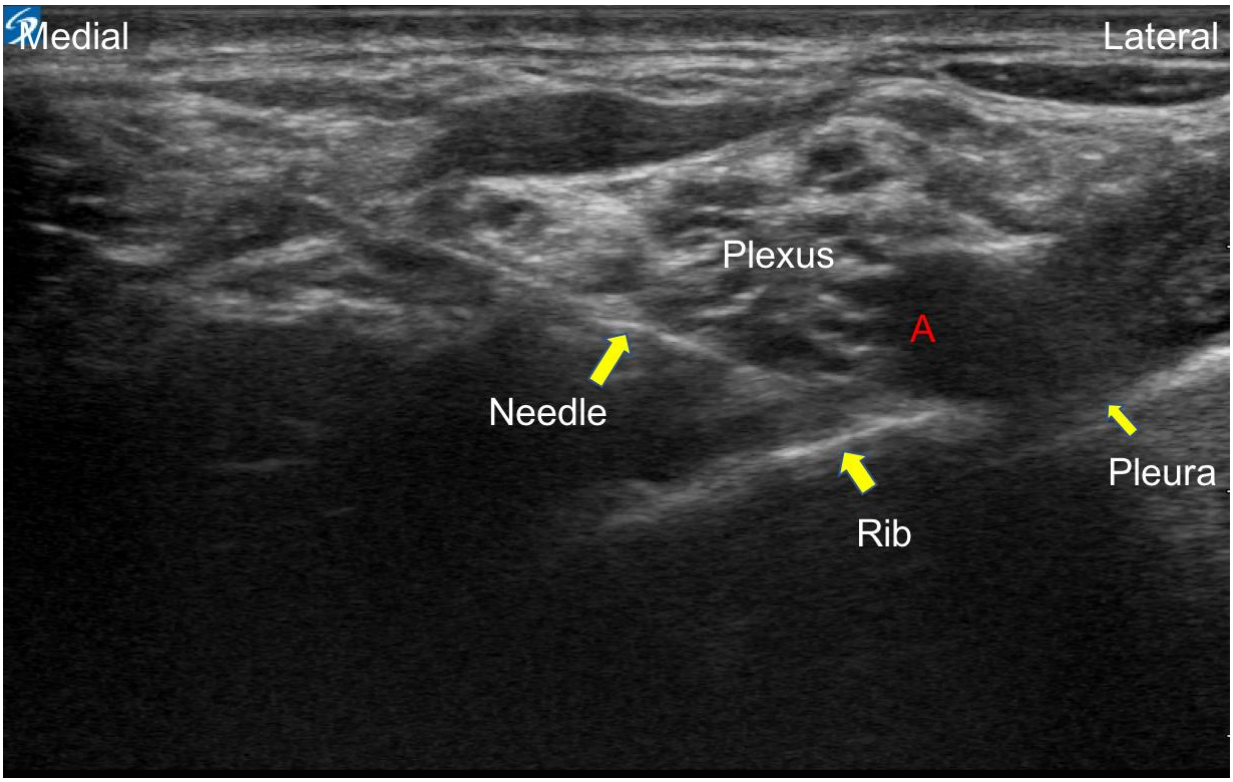


Figure: 5

Volume of Local Anesthetic

Anesthetic block: 50:50 mixture of 2% Lidocaine and 0.5% Bupivacaine with epinephrine 1: 200,000; Volume 30-40 ml

Analgesic blocks: 30 ml of 0.25% Bupivacaine with 1:400,000 or
30 ml of 0.5% Ropivacaine

Complications

Pneumothorax
Intravascular injection
Intraneural injection
Hematoma
Phrenic nerve blockade

Clinical pearls

Maintain visualization of needle tip and constant aspiration to avoid nerve injury and intravascular entry.

The sensory of the medial skin of the upper arm is supplied by the intercostobrachial nerve (arises from T2) and requires a separate subcutaneous injection just distal to the axilla.

3. Axillary Block

Indications

Distal upper arm and hand surgery

Anatomy

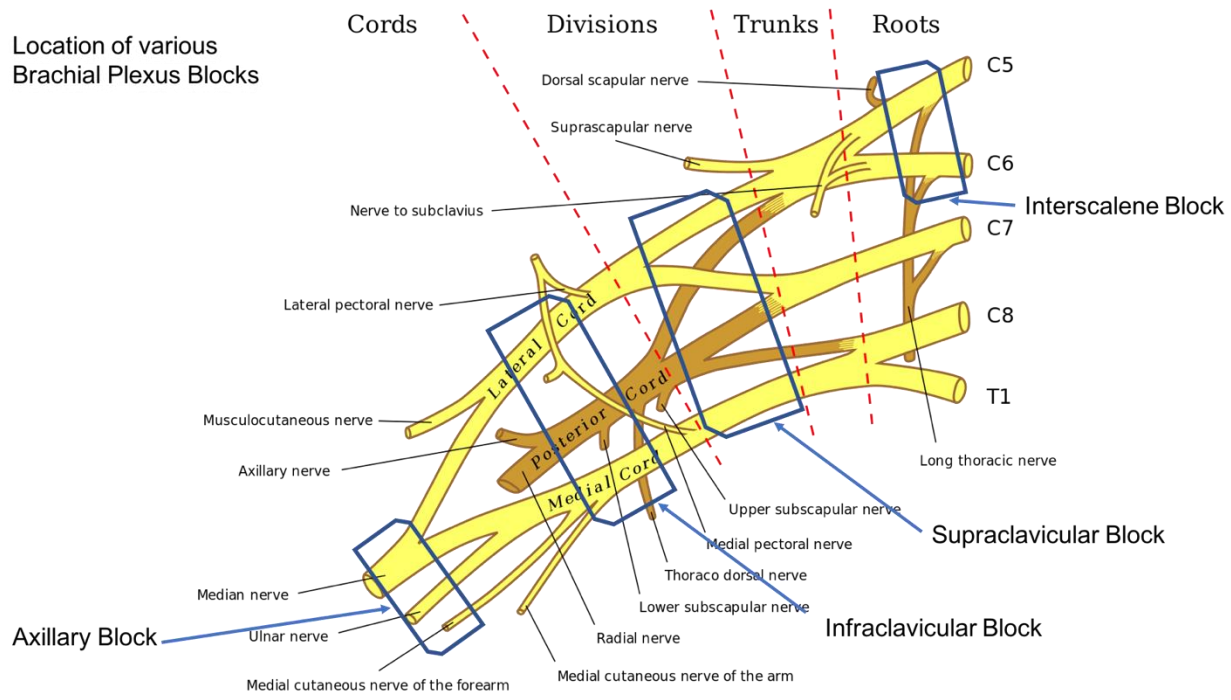


Figure: 1
At the level of axilla, brachial plexus is seen as terminal branches; median, ulnar and radial nerves. Musculocutaneous nerve has already left the sheath and lies within the coracobrachialis muscle. (Figure 1)

Sonoanatomy

The transducer is placed just distal to axillary fold to obtain an axial view of the brachial plexus. Identify axillary artery and one or more axillary vein. The three main nerves (median, ulnar, radial) are located around the axillary artery. (Figure 2)

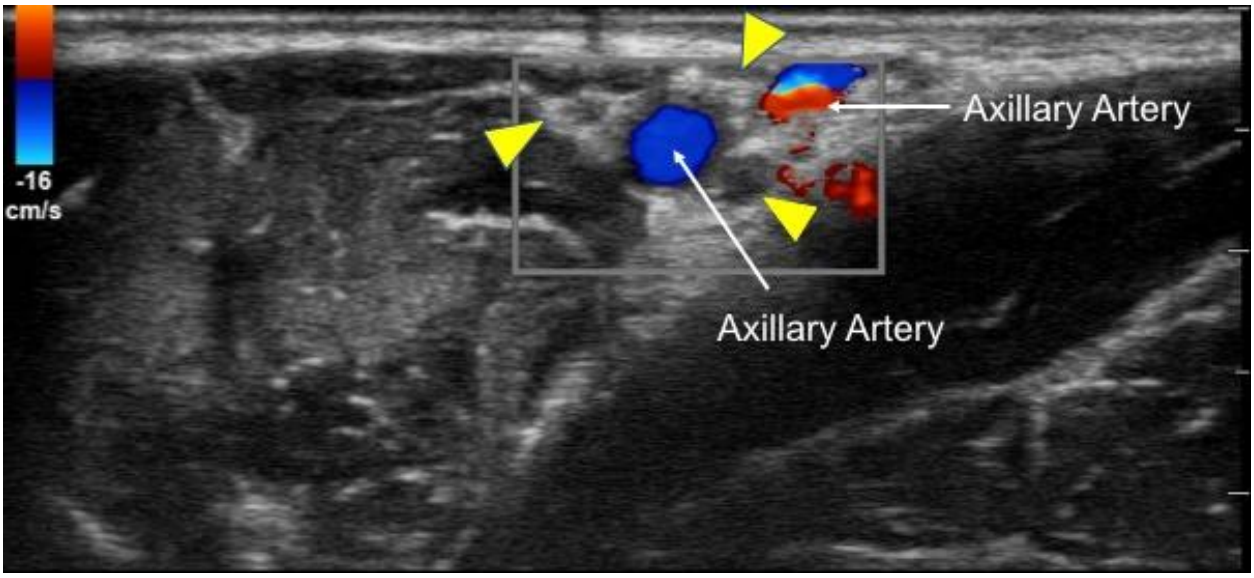


Figure:2

Median nerve is typically located superficial and lateral to the artery. Ulnar nerve is located superficial and medial to the artery. The radial nerve is located posterior to the artery. The musculocutaneous nerve is typically found between biceps and coracobrachialis muscles, although in Figure 3 musculocutaneous is captured close to median nerve before it travels beteen the biceps and coracobrachialis.

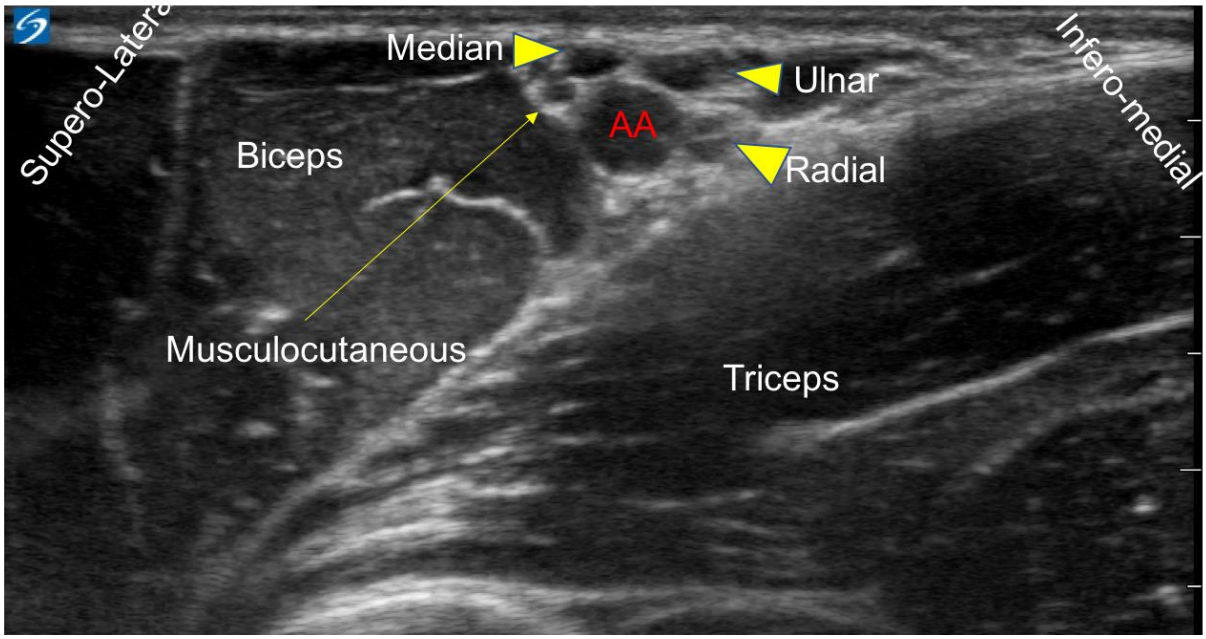


Figure: 3

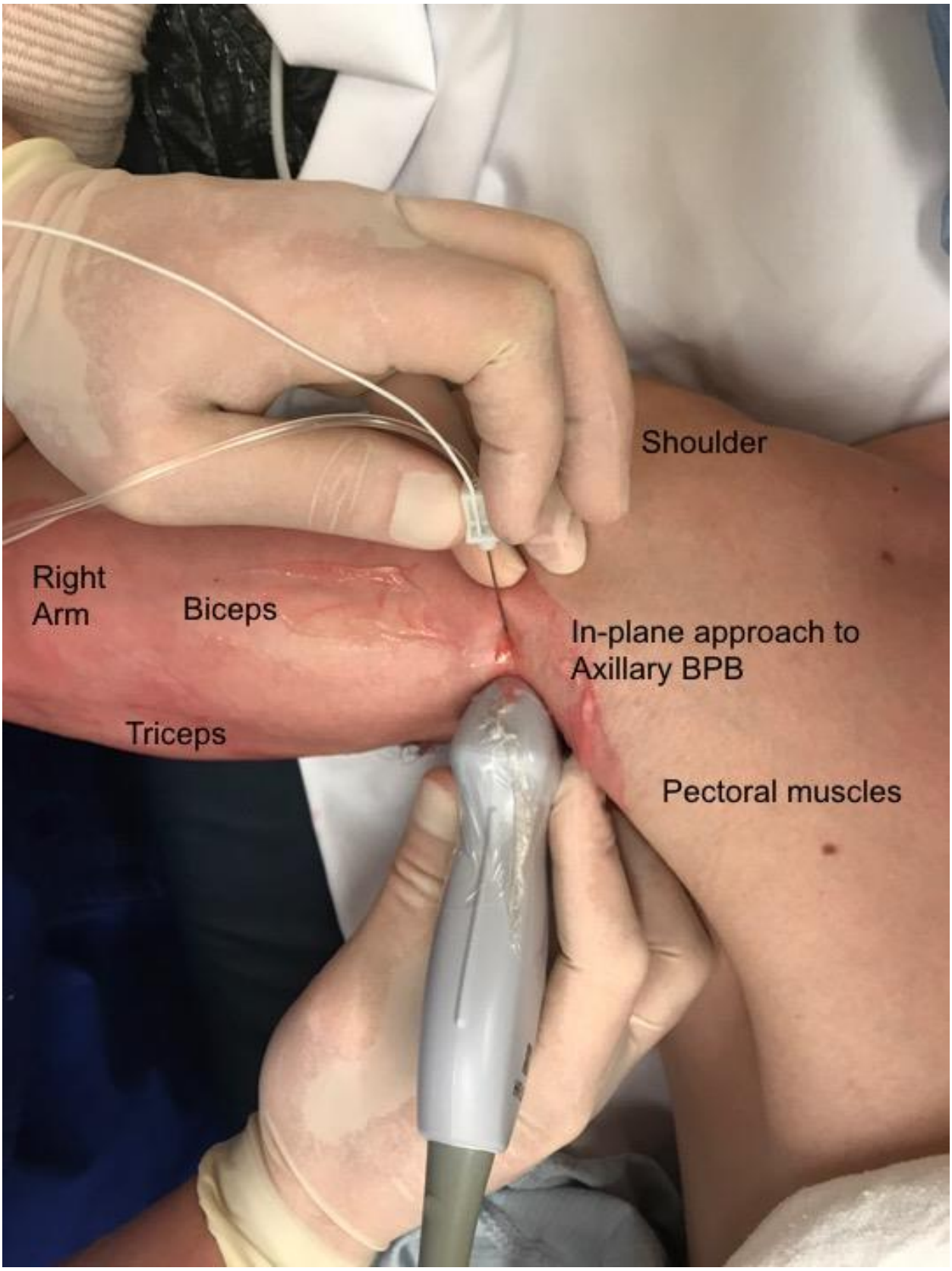
Block technique

Transducer: Linear, high-frequency probe

Needle : 50mm, short bevel needle

Scanning technique

Abduct the arm to 90 degrees, a pillow is placed under the arm for patient's comfort. (Figure 4) After skin is disinfected, the transducer is placed at or immediately distal to axillary fold, in short axis orientation. Identify median, ulnar and radial nerves around axillary artery.


Shoulder
Right
Arm
Biceps
In-plane approach to
Axillary BPB
Triceps
Pectoral muscles
Figure : 4

Needling technique

The skin wheel with local anesthetic is placed to the transducer. The needle is inserted in-plane, from the cranial aspect directed towards the posterior aspect of the axillary artery. (Figure 5) Each nerve is anesthetized with 3-8 ml of local anesthetic. (Figure 6) The musculocutaneous nerve may need to be blocked with a separate redirection or insertion point of the needle.

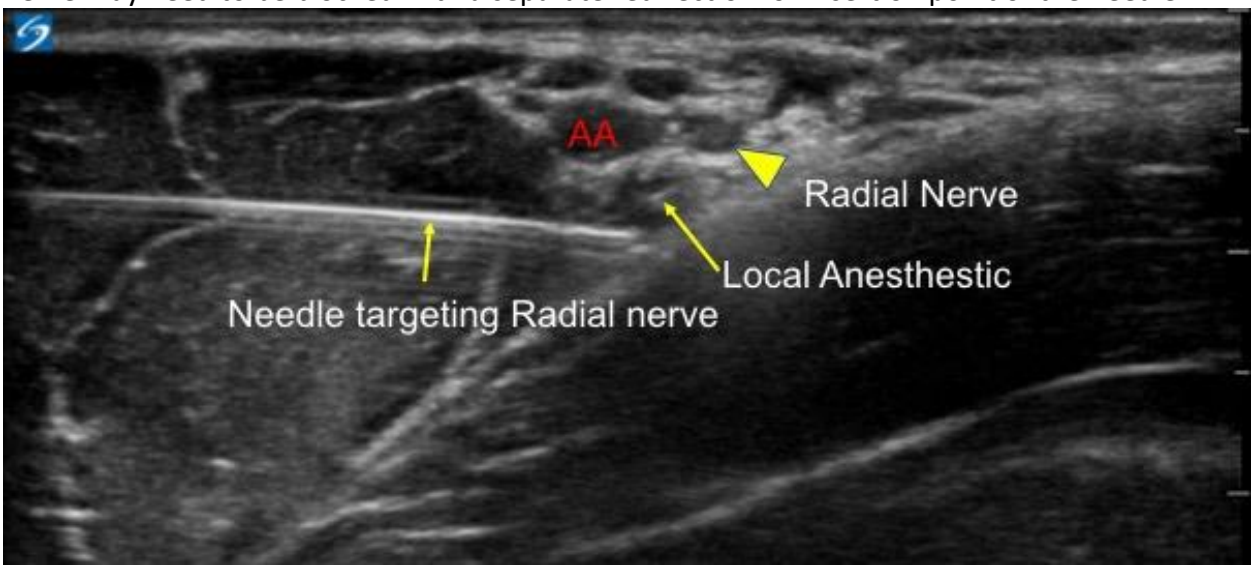


Figure: 5

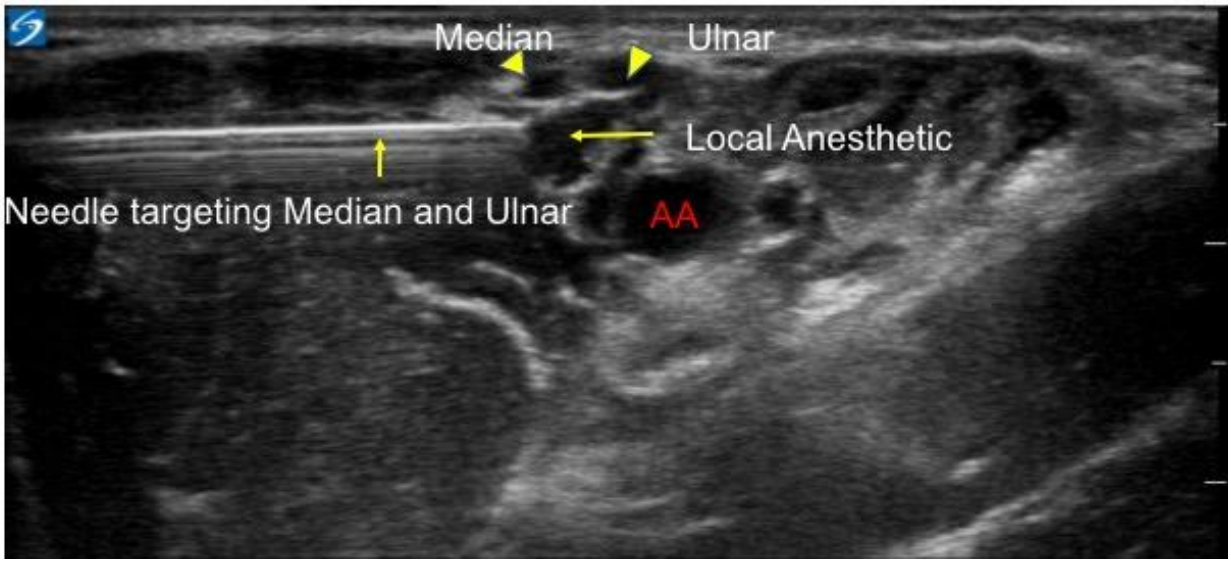


Figure: 6

Volume of Local Anesthetic

Anesthetic block: 30-40 ml 50:50 mixture of 2% Lidocaine and 0.5% Bupivacaine with 1:200,000 epinephrine

Analgesic block: 30 ml 0f 0.25% Bupivacaine with 1:200,000 epinephrine.

Complications

Intravascular injection
Intraneural injection
Hematoma

Clinical pearls

Location of nerves is highly variable at this level.
Radial is the frequently missed nerve- trace the axillary artery distally to locate the radial nerve going deep to humerus bone and then trace back the radial nerve cranially again to identify its locate next to axillary artery.
Constant visualization of the needle and frequent aspiration is needed to avoid intravascular injection.