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Head and neck and upper extrimety Peripheral Nerve Blocks

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Cervical Plexus Blocks

- The cervical plexus is derived from the C1, C2, C3, and C4 spinal nerves and supplies branches to the prevertebral muscles, strap muscles of the neck, and phrenic nerve.
- The deep cervical plexus supplies the musculature of the neck.
- The superficial cervical plexus provides cutaneous sensation of the skin between the trigeminal innervation of the face and the T2 dermatome of the trunk.

Clinical Applications

- Blocks of the cervical plexus are easy to perform and provide anesthesia for surgical procedures in the distribution of C2 to C4, including lymph node dissections, plastic surgery repairs, and carotid endarterectomy.
- The ability to continuously monitor the awake patient's neurologic status is an advantage of this anesthetic technique for the latter procedure and has resulted in an upsurge in the popularity of this technique.
- Bilateral blocks can be used for tracheostomy and thyroidectomy. A variety of approaches to cervical plexus block have been described, including some guided by ultrasound imaging.

Superficial Cervical Plexus

- The superficial cervical plexus is blocked at the midpoint of the posterior border of the sternocleidomastoid muscle.
- A skin wheal is made at this point, and a 22-gauge, 4-cm needle is advanced, injecting 5 mL of solution along the posterior border and medial surface of the sternocleidomastoid muscle .
- It is possible to block the accessory nerve with this injection, resulting in temporary ipsilateral trapezius muscle paralysis.
- Deep cervical plexus blocks also are possible but have been associated with a higher incidence of respiratory complications.

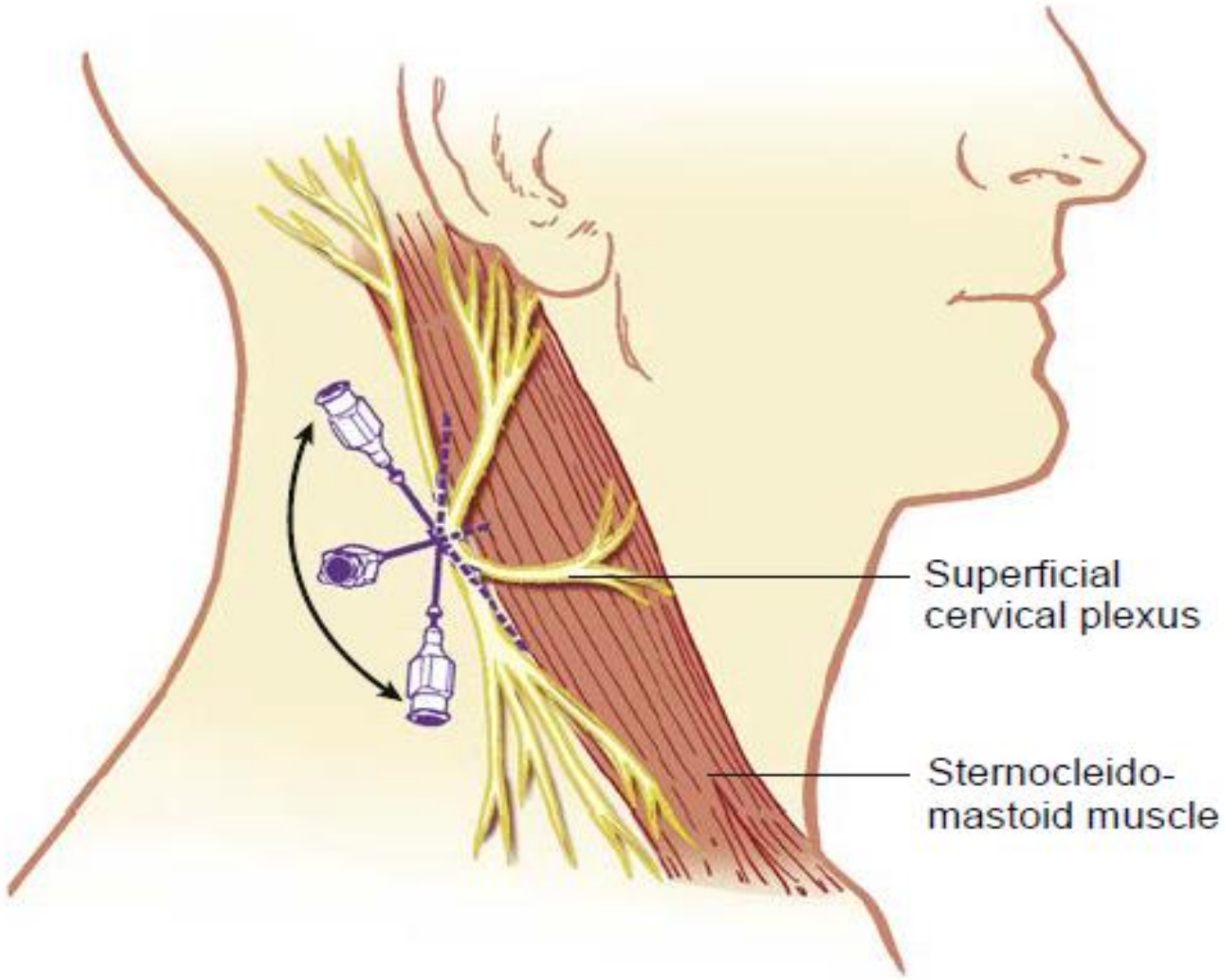
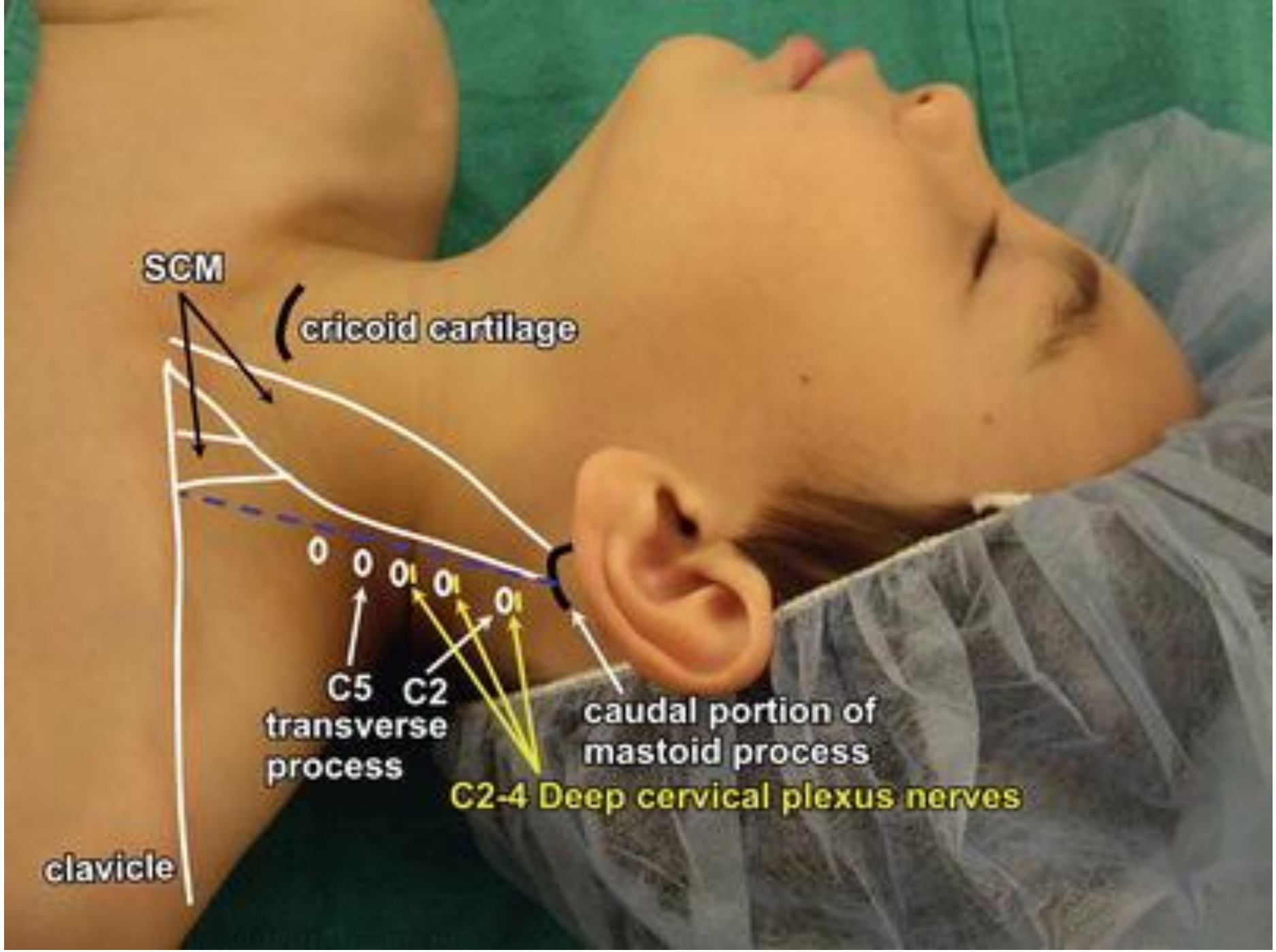


Fig. 46.15 Anatomic landmarks and method of needle placement for a superficial cervical plexus block.


SCM
cricoid cartilage
C5
transverse
process
C2
caudal portion of
mastoid process
C2-4 Deep cervical plexus nerves
clavicle

Brachial Plexus Blocks

- **BRACHIAL PLEXUS ANATOMY**
- The brachial plexus is derived from the anterior primary rami of the fifth, sixth, seventh, and eighth cervical nerves and the first thoracic nerve, with variable contributions from the fourth cervical and second thoracic nerves.
- After leaving their intervertebral foramina, these nerves course anterolaterally and inferiorly to lie between the anterior and middle scalene muscles.

BRACHIAL PLEXUS ANATOMY

- The anterior scalene muscle passes caudally and laterally to insert into the scalene tubercle of the first rib; the middle scalene muscle inserts on the first rib posterior to the subclavian artery, which passes between these two scalene muscles along the subclavian groove.
- The prevertebral fascia invests the anterior and middle scalene muscles, fusing laterally to enclose the brachial plexus in a fascial sheath.
- Between the scalene muscles, these nerve roots unite to form three trunks, which emerge from the interscalene space to lie cephaloposterior to the subclavian artery as it courses along the upper surface of the first rib.

BRACHIAL PLEXUS ANATOMY

- The superior (C5 and C6), middle (C7), and inferior (C8 and T1) trunks are arranged accordingly and are not in a strict horizontal formation, as often depicted. At the lateral edge of the first rib, each trunk forms anterior and posterior divisions that pass posterior to the midportion of the clavicle to enter the axilla.
- Within the axilla, these divisions form the lateral, posterior, and medial cords, named for their relationship with the second part of the axillary artery.
- The superior divisions from the superior and middle trunks form the lateral cord, the inferior divisions from all three trunks form the posterior cord, and the anterior division of the inferior trunk continues as the medial cord.

BRACHIAL PLEXUS ANATOMY

- At the lateral border of the pectoralis minor, the three cords divide into the peripheral nerves of the upper extremity. The lateral cord gives rise to the lateral head of the median nerve and the musculocutaneous nerve; the medial cord gives rise to the medial head of the median nerve, as well as the ulnar, the medial antebrachial, and the medial brachial cutaneous nerves; and the posterior cord divides into the axillary and radial nerves .
- Aside from the branches from the cords that form the peripheral nerves as described, several branches arise from the roots of the brachial plexus providing motor innervation to the rhomboid muscles (C5), the subclavian muscles (C5 and C6), and the serratus anterior muscle (C5, C6, and C7).
- The suprascapular nerve arises from C5 and C6, supplies the muscles of the dorsal aspect of the scapula, and makes a significant contribution to the sensory supply of the shoulder joint.

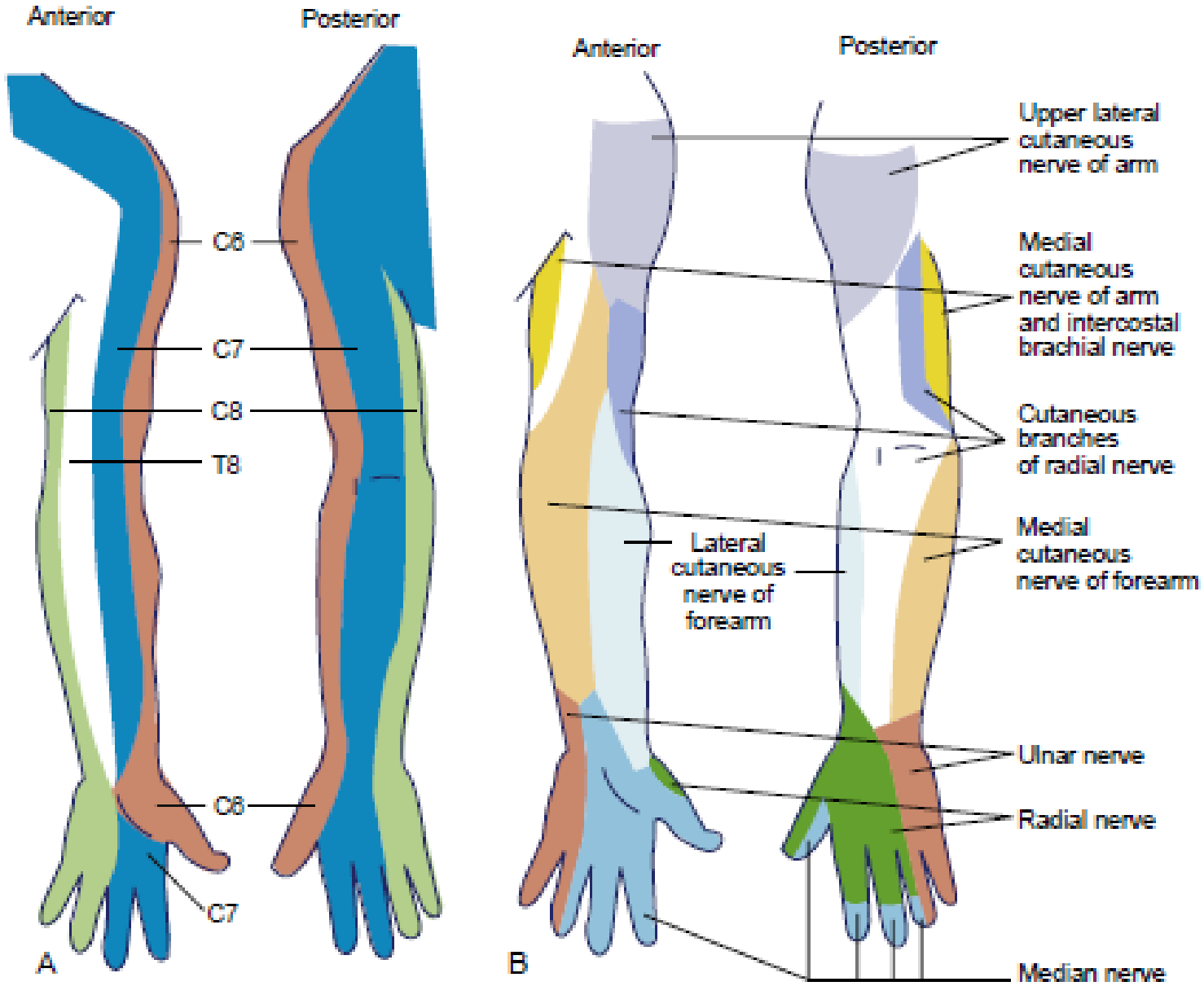
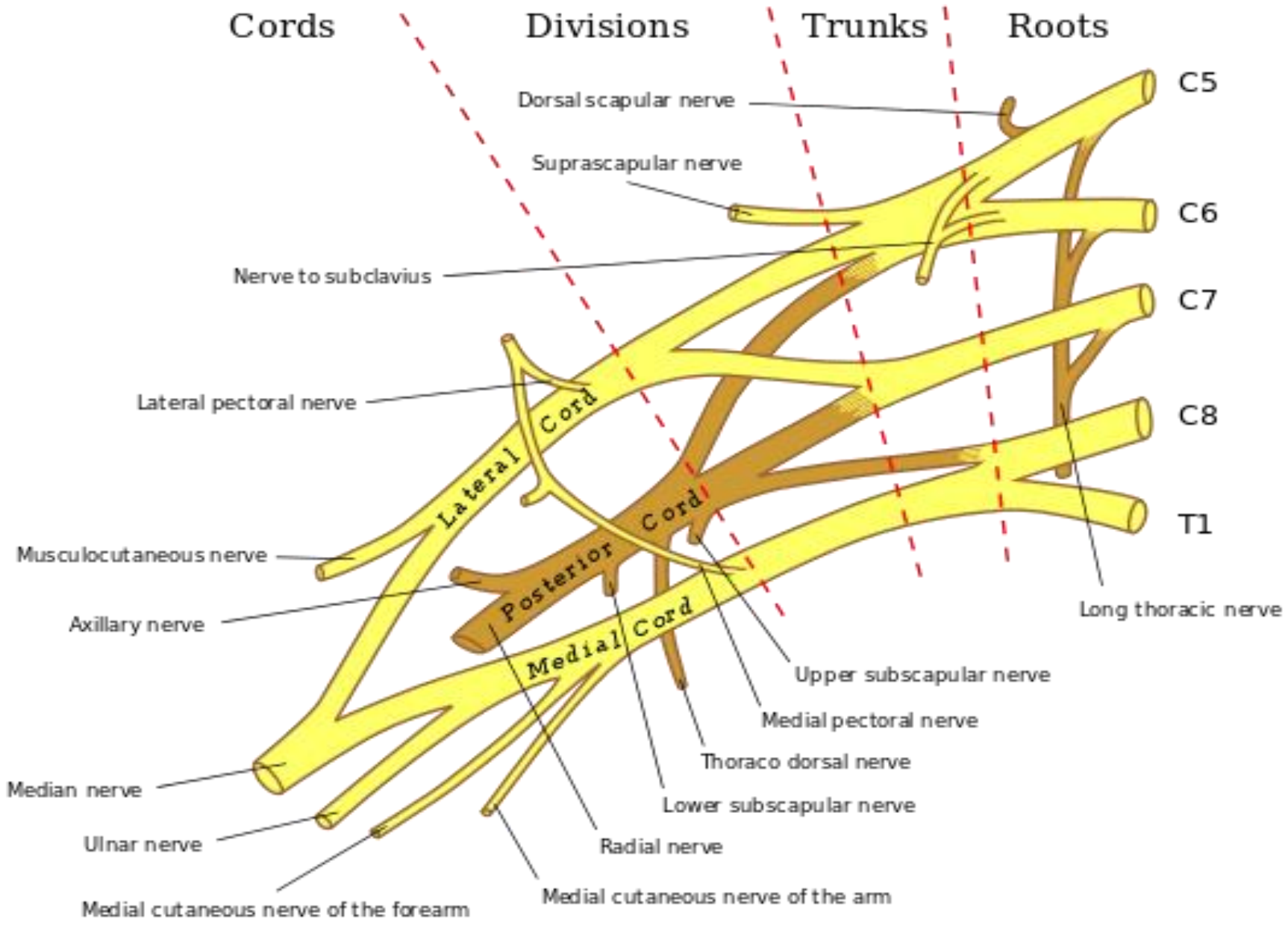


Fig. 46.17 (A) Cutaneous distribution of the cervical roots. (B) Cutaneous distribution of the peripheral nerves.

BRACHIAL PLEXUS ANATOMY

- Branches arising from the cervical roots were traditionally blocked with the interscalene approach to the brachial plexus. However, interscalene block has a well-documented risk of concomitant phrenic nerve block.
- This can result in symptomatic hemi-diaphragmatic paralysis and respiratory compromise, especially among those patients with obesity or moderate to severe obstructive pulmonary disease.
- By design, brachial plexus blocks above the clavicle (e.g., interscalene and supraclavicular blocks) primarily target local anesthetic placement near the ventral rami, trunks, and divisions. Blocks below the clavicle (e.g., infraclavicular and axillary blocks) primarily target the cords and terminal nerves.


Cords
Divisions
Trunks
Roots
C5
C6
C7
C8
T1
Dorsal scapular nerve
Suprascapular nerve
Nerve to subclavius
Lateral pectoral nerve
Musculocutaneous nerve
Axillary nerve
Median nerve
Ulnar nerve
Medial cutaneous nerve of the forearm
Lateral Cord
Posterior Cord
Medial Cord
Long thoracic nerve
Upper subscapular nerve
Medial pectoral nerve
Thoraco dorsal nerve
Lower subscapular nerve
Radial nerve
Medial cutaneous nerve of the arm

Interscalene Blocks

- The interscalene block is often chosen for regional anesthesia technique of the shoulder in those patients without significant pulmonary disease.
- Blockade occurs at the level of the superior and middle trunks of the brachial plexus.
- Although this approach can be used for forearm and hand surgery, blockade of the inferior trunk (C8 and T1) can be incomplete and may require supplementation of the ulnar nerve for adequate surgical anesthesia in that distribution.

Interscalene Blocks

- Several adjacent anatomic structures can serve as important landmarks for performance of interscalene block. The patient should be in the supine position, with the head turned away from the side to be blocked and the patient's arm in any comfortable position.
- The posterior border of the sternocleidomastoid muscle is readily palpated by having the patient briefly lift the head. The interscalene groove can be palpated by rolling the fingers posterolaterally away from this border over the belly of the anterior scalene muscle into the groove .
- A line is extended laterally from the cricoid cartilage to intersect the interscalene groove, indicating the level of the transverse process of C6. Although the external jugular vein often overlies this point of intersection, it is not a consistent landmark.

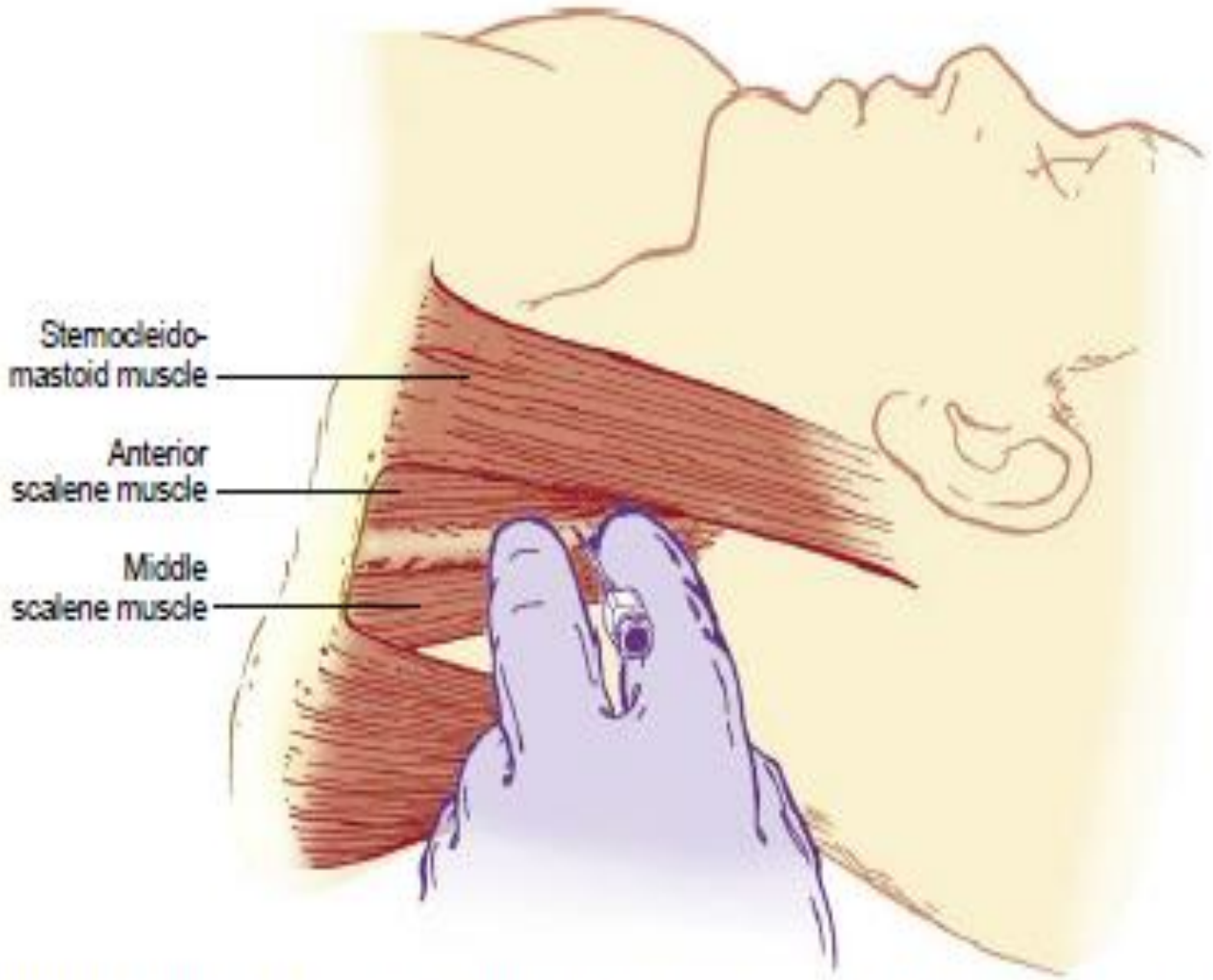
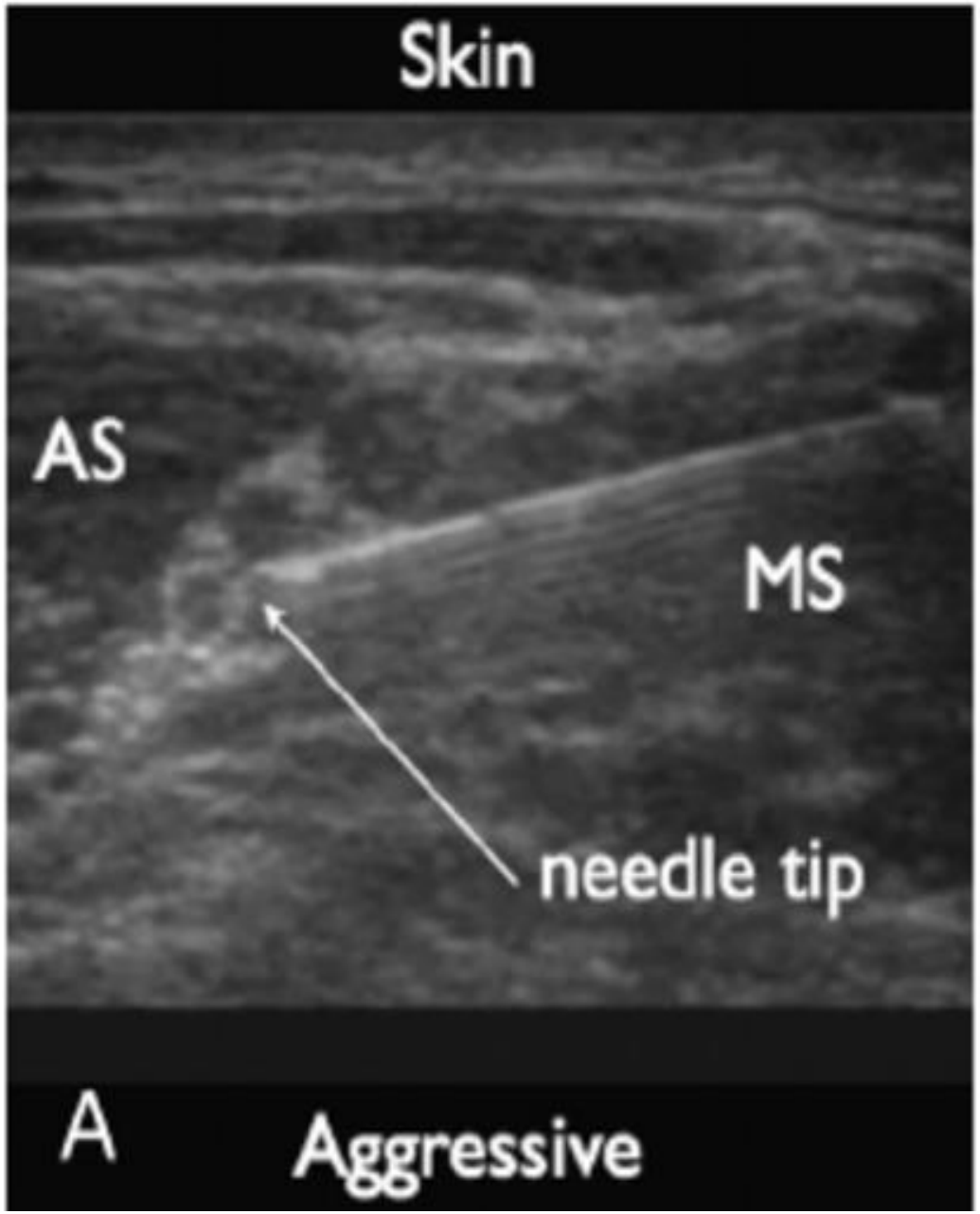
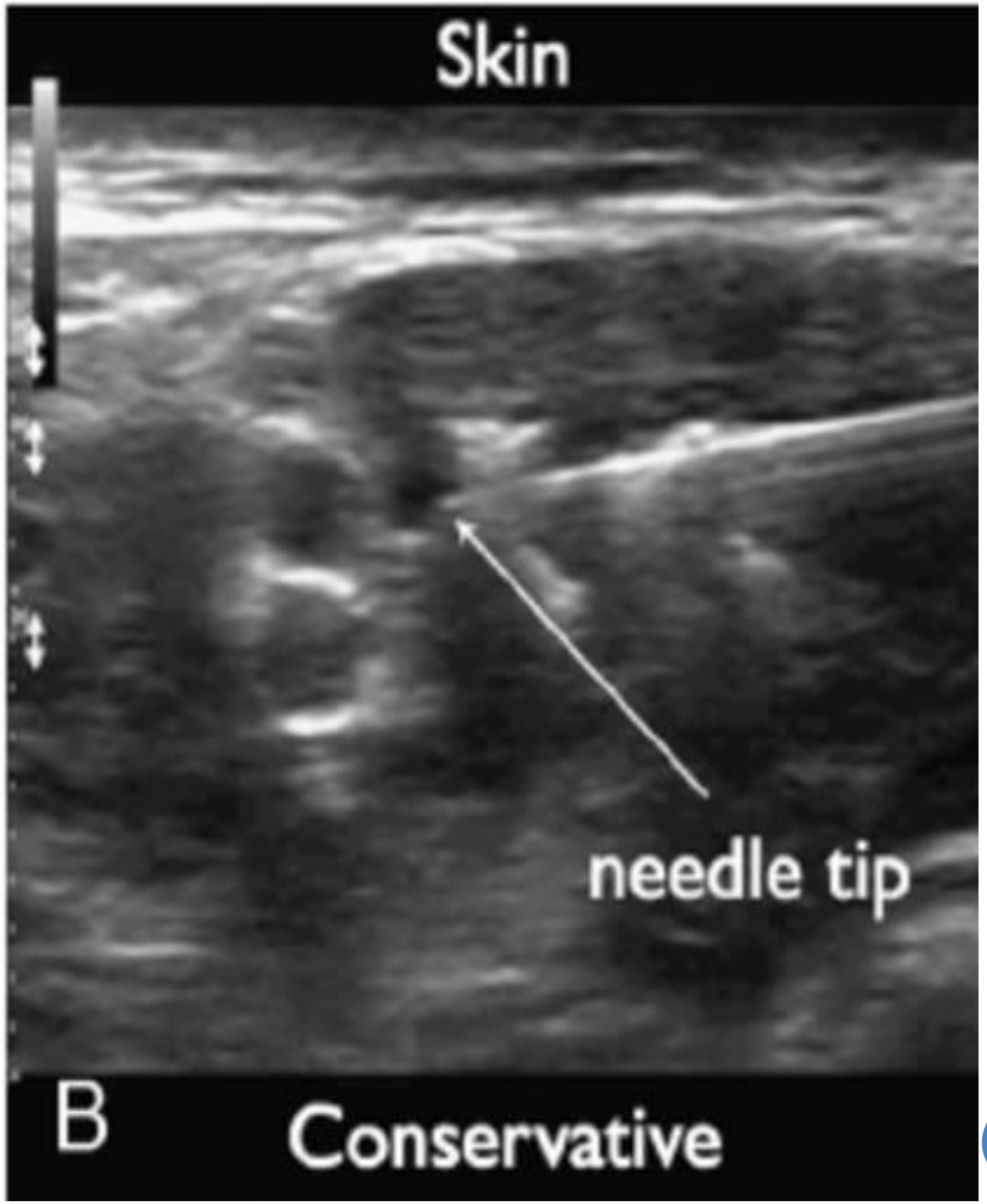


Fig. 46.18 Interscalene block guided by palpation. The fingers palpate the interscalene groove, and the needle is inserted with a caudad and slightly posterior angle.

Ultrasound-Guided Technique

- Traditional approaches to the interscalene block include paresthesia or peripheral nerve stimulation technique. However, this block is well suited to the use of ultrasound guidance.
- It is often easiest to obtain a supraclavicular view of the subclavian artery and brachial plexus and then trace the plexus up the neck with the ultrasound probe until the plexus trunks are visualized as hypoechoic structures between the anterior and medial scalene muscles (the “stoplight” sign).
- The needle can then be advanced with either an in-plane or out-of-plane approach. After negative aspiration, a small test dose is administered, and local anesthetic spread around the brachial plexus confirms appropriate placement of the needle. Volumes as little as 5 mL may be successful and associated with a decreased frequency of diaphragmatic paresis.


Skin
AS
MS
needle tip
A
Aggressive


Skin
needle tip
B
Conservative

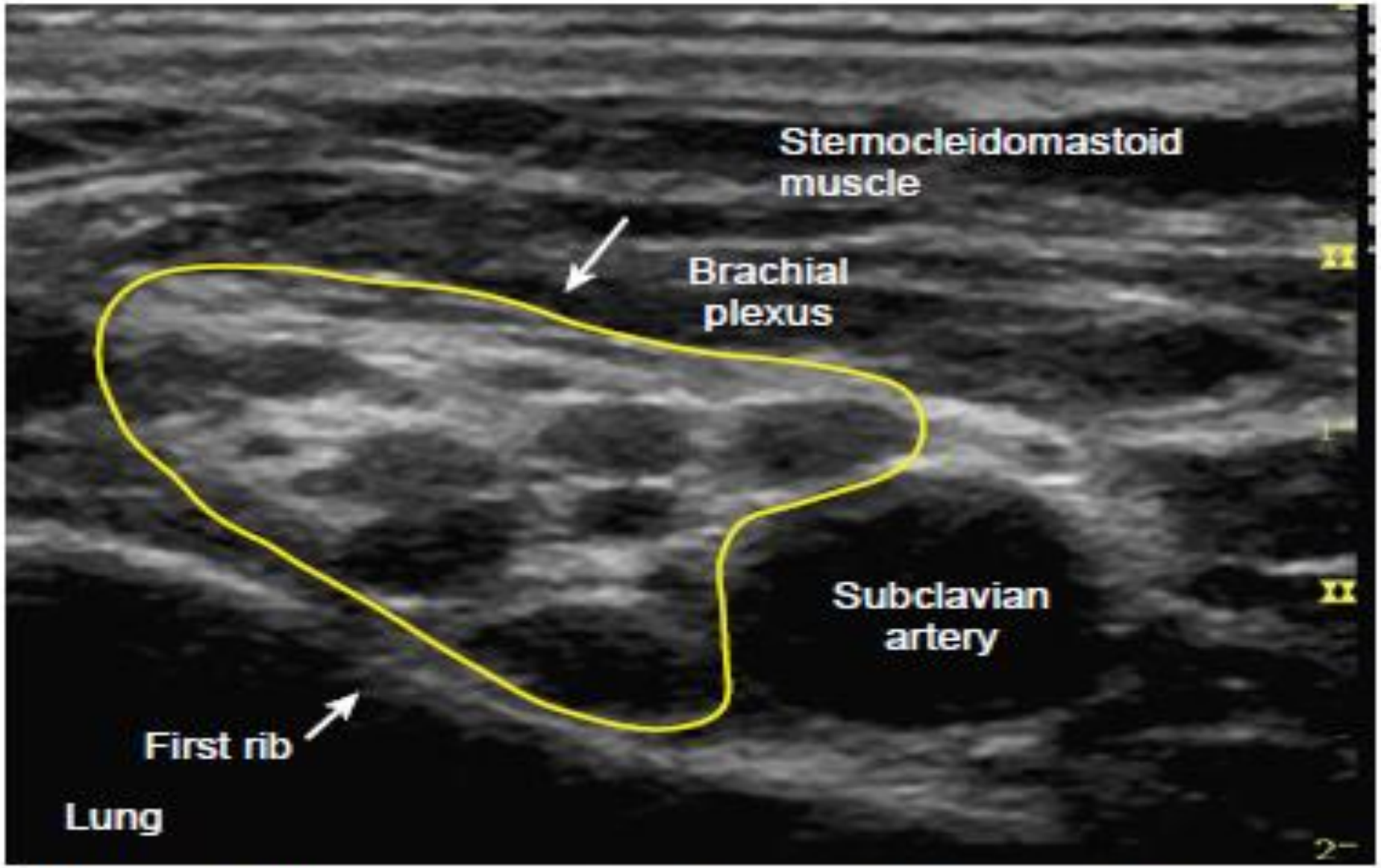


Fig. 46.19 Ultrasound image of the brachial plexus at the level of the first rib.

Side Effects and Complications

- At the traditional (C6) level of interscalene block, ipsilateral phrenic nerve block and resultant diaphragmatic paresis are inevitable.
- This effect probably results from the proximity of the phrenic nerve at this leve and may cause subjective symptoms of dyspnea. Respiratory compromise can occur in patients with severe preexisting respiratory disease or contralateral phrenic nerve dysfunction.
- Involvement of the vagus, recurrent laryngeal, and cervical sympathetic nerves is rarely significant.
- The risk of pneumothorax is small when the needle is correctly placed at the C5 or C6 level because of the distance from the dome of the pleura.

Side Effects and Complications

- Severe hypotension and bradycardia (i.e., Bezold-Jarisch reflex) can occur in awake, sitting patients undergoing shoulder surgery under an interscalene block. The cause is presumed to be stimulation of intracardiac mechanoreceptors by decreased venous return, producing an abrupt withdrawal of sympathetic tone and enhanced parasympathetic output.
- This effect results in bradycardia, hypotension, and syncope. The frequency is decreased when prophylactic β-adrenergic blockers are administered.
- Epidural and intrathecal injections can occur with this block. The proximity of significant neurovascular structures may increase the risk of serious neurologic complications when interscalene block is performed in heavily sedated or anesthetized patients. Accordingly, interscalene blocks are usually placed under light sedation in adult patients.

Supraclavicular Blocks.

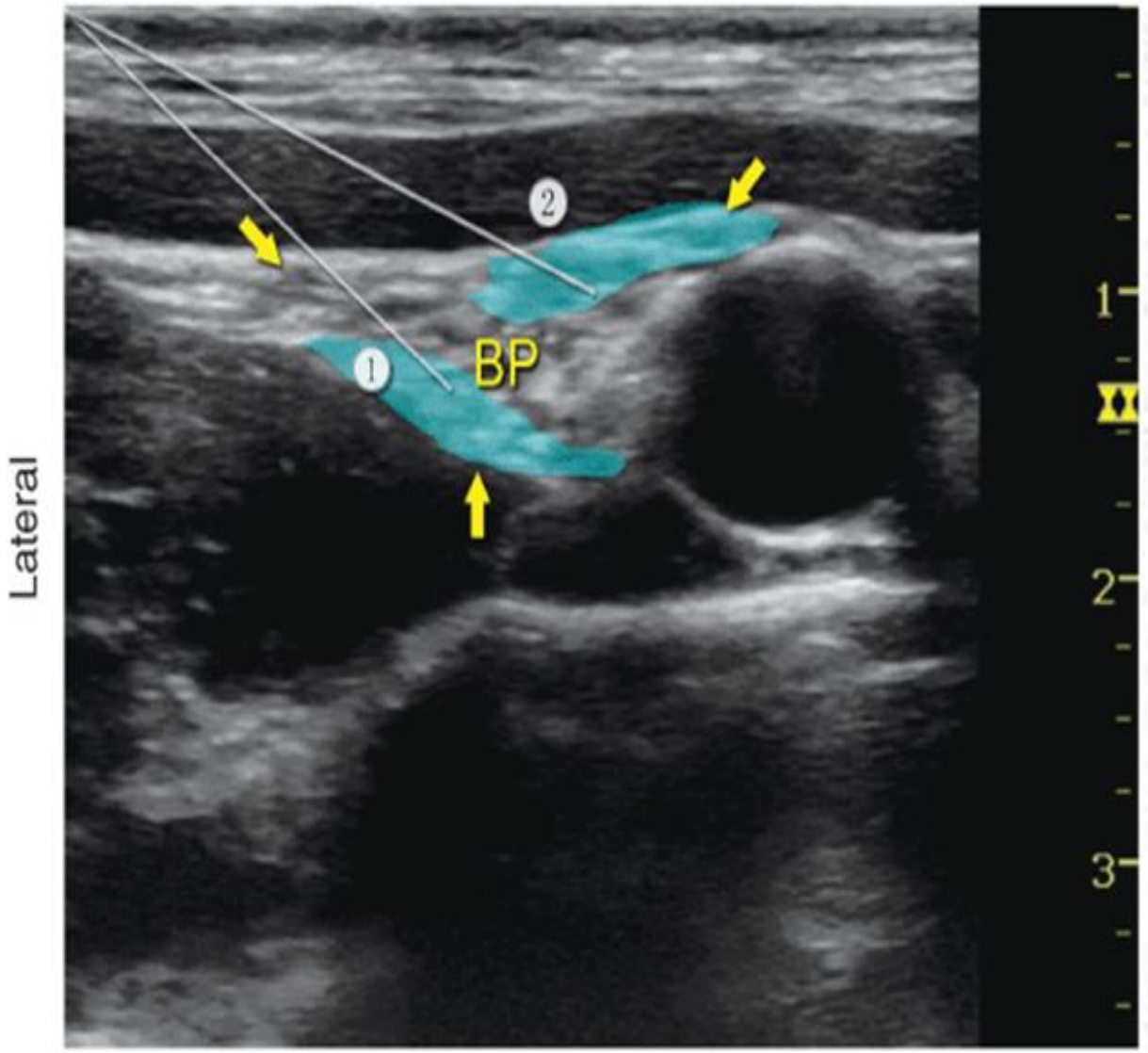
- Indications for supraclavicular blocks include operations on the elbow, forearm, and hand.
- Blockade occurs at the distal trunk–proximal division level of the brachial plexus.
- At this point, the brachial plexus is relatively compact, and a small volume of local anesthetic produces rapid onset of reliable blockade.

Ultrasound-Guided Technique

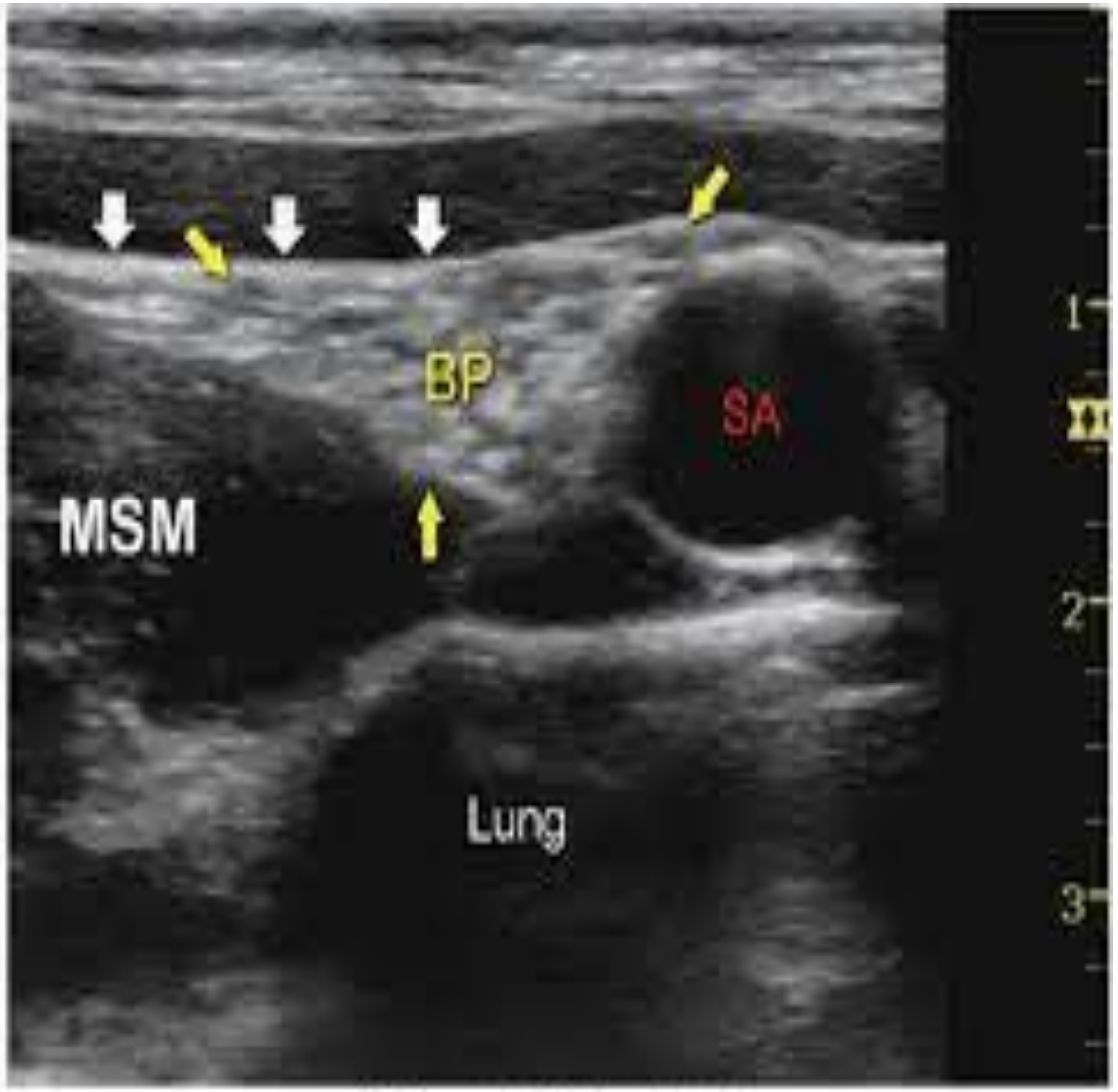
- The patient is placed in supine position, with the head turned away from the side to be blocked. The arm to be anesthetized is adducted against the side of the body.
- Similar to interscalene block, traditional approaches to the supraclavicular block include paresthesia or peripheral nerve stimulation.
- this block is now more commonly performed with sonographic guidance. This allows the practitioner to visualize the brachial plexus, subclavian artery, pleura, and first rib.
- The inherent safety of this technique requires continuous visualization of the needle tip and adjacent anatomic structures during needle advancement.

Ultrasound-Guided Technique

- A high-frequency (15-6 MHz) linear transducer is positioned just proximal to the supraclavicular fossa to obtain a supraclavicular view .
- The brachial plexus trunks and divisions are clustered vertically over the first rib on the lateral side of the subclavian artery. The first rib acts as a medial barrier to the needle reaching the pleural dome and is short, wide, and flat.
- The needle can then be advanced under direct ultrasound guidance using an in-plane approach from lateral to medial. The transducer rests near the clavicle so manipulation can be challenging. Thus advanced skills with needle control are required.
- After negative aspiration, a small test dose is administered, and local anesthetic spread around the brachial plexus confirms appropriate placement of the needle tip. Volumes as low as 15 to 30 mL may be successful.



Supraclavicular block



Supraclavicular block

Side Effects and Complications

- The prevalence of pneumothorax after supraclavicular block is 0.5% to 6% and diminishes with increased experience. Importantly, although the use of ultrasound may decrease the incidence of pneumothorax, the risk has not been eliminated. When this occurs, the onset of symptoms is usually delayed, and it can take up to 24 hours to develop.
- Thus routine chest radiography after the block is not justified. The supraclavicular approach is best avoided when the patient is uncooperative or cannot tolerate any degree of respiratory compromise. Other complications include phrenic nerve block (as high as 40%-60%), Horner's syndrome, and neuropathy.
- The presence of phrenic or cervical sympathetic nerve block usually requires only reassurance. Although nerve damage can occur, it is uncommon and usually self-limited.

Suprascapular Nerve Blocks.

- Suprascapular nerve (SSN) block above the clavicle (anterior approach) is a viable alternative to interscalene block for analgesia of the shoulder region.
- The advantage of this more peripheral approach is that the chance of concomitant phrenic nerve block is significantly reduced.
- In addition, if the block is semi-selective then other nerves that contribute articular branches to the shoulder joint (e.g., axillary nerve, lateral pectoral nerve) also can be blocked.

Suprascapular Nerve Blocks.

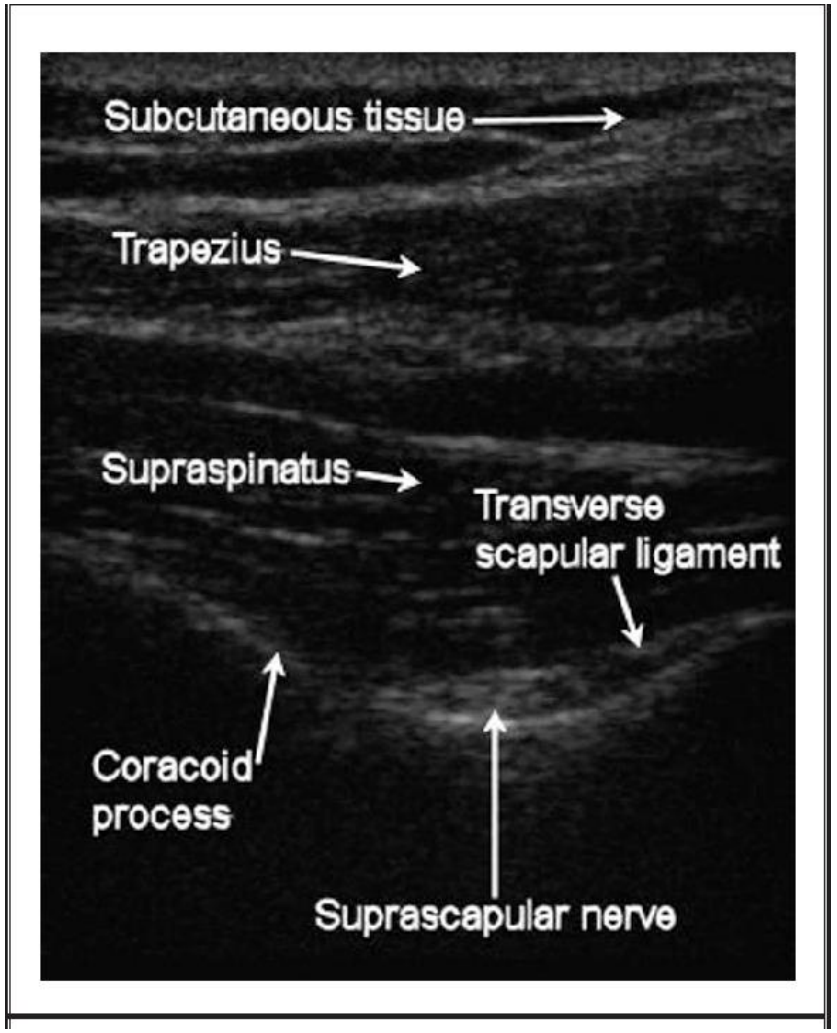
- The anterior approach to SSN block is more shallow (5-10 mm depth) than the more traditional block of the SSN block at the suprascapular notch (20-40 mm depth).
- Furthermore, the suprascapular notch has variable morphology and in some subjects this landmark is absent.
- The SSN is the primary sensory innervation of the shoulder joint and is not blocked with approaches to the brachial plexus below the clavicle.
- Selective low-volume approaches to SSN block above the clavicle also may be useful for pain medicine and rehabilitation.

INDICATIONS

- The SSN, a mixed-motor and sensory nerve originating from the superior trunk (C5 and C6 nerve roots and often C4 as well) makes a significant contribution to the sensory supply of the shoulder joint.
- The SSN root may be accessed from within the posterior cervical triangle of the neck where it passes underneath the omohyoid muscle toward the suprascapular notch.
- The SSN, unlike the suprascapular vessels that remain superficial, then passes deep to the superior transverse scapular ligament exiting through the scapular foramen into the supraspinous fossa finally providing nerve branches to muscles of the shoulder girdle.

Ultrasound-Guided Technique

- The anterior SSN block is performed in the supine position with head turned to the contralateral side when accessing the nerve within the posterior cervical triangle (similar positioning as the interscalene nerve block).
- Alternatively, the patient would be in a seated position to access the scapula for a more distal and posterior SSN block. In the seated position, ask the patient to place his/her hand over to the contralateral shoulder (full shoulder adduction) to move the target (nerve) and scapula lateral from the thorax.
- Ultrasound guidance is the preferred technique, although a landmark-based method with nerve stimulation for neuro-localization is an option.


Subcutaneous tissue
Trapezius
Supraspinatus
Transverse scapular ligament
Coracoid process
Suprascapular nerve


NYSORA APP


Trapezius
Supraspinatus
Suprascapular Nerve & Artery
Scapula spine
NYSORA

Proximal Suprascapular Nerve Block (Anterior Suprascapular Nerve Block).

- The anterior SSN block technique has emerged as the preferred lung-sparing block alternative to interscalene nerve block. A high-frequency linear transducer (15-6 MHz) probe is positioned just proximal to the supraclavicular fossa.
- Under dynamic scanning, the SSN can be visualized as a round hypoechoic structure deep to the inferior belly of the omohyoid muscle and lateral to the superior trunk in the posterior cervical triangle of the neck .
- Consider tracing the SSN from its origin (nerve root C5) to facilitate identification. The nerve is then traced more posterior-lateral to a distance away from the superior trunk.

Proximal Suprascapular Nerve Block (Anterior Suprascapular Nerve Block).

- A 22-gauge, 5-cm needle is most often selected with shallow 2- to 3-cm depths to the target. Through an out-of-plane or in-plane approach approximately 5 to 15 mL of local anesthetic is deposited deep into omohyoid muscle, but shallow to the prevertebral fascia (higher volumes could result in phrenic nerve blockade).
- Color Doppler use is advised as the superficial cervical artery and the suprascapular artery, also hypoechoic structures, are strong mimickers of the SSN within the posterior cervical triangle.

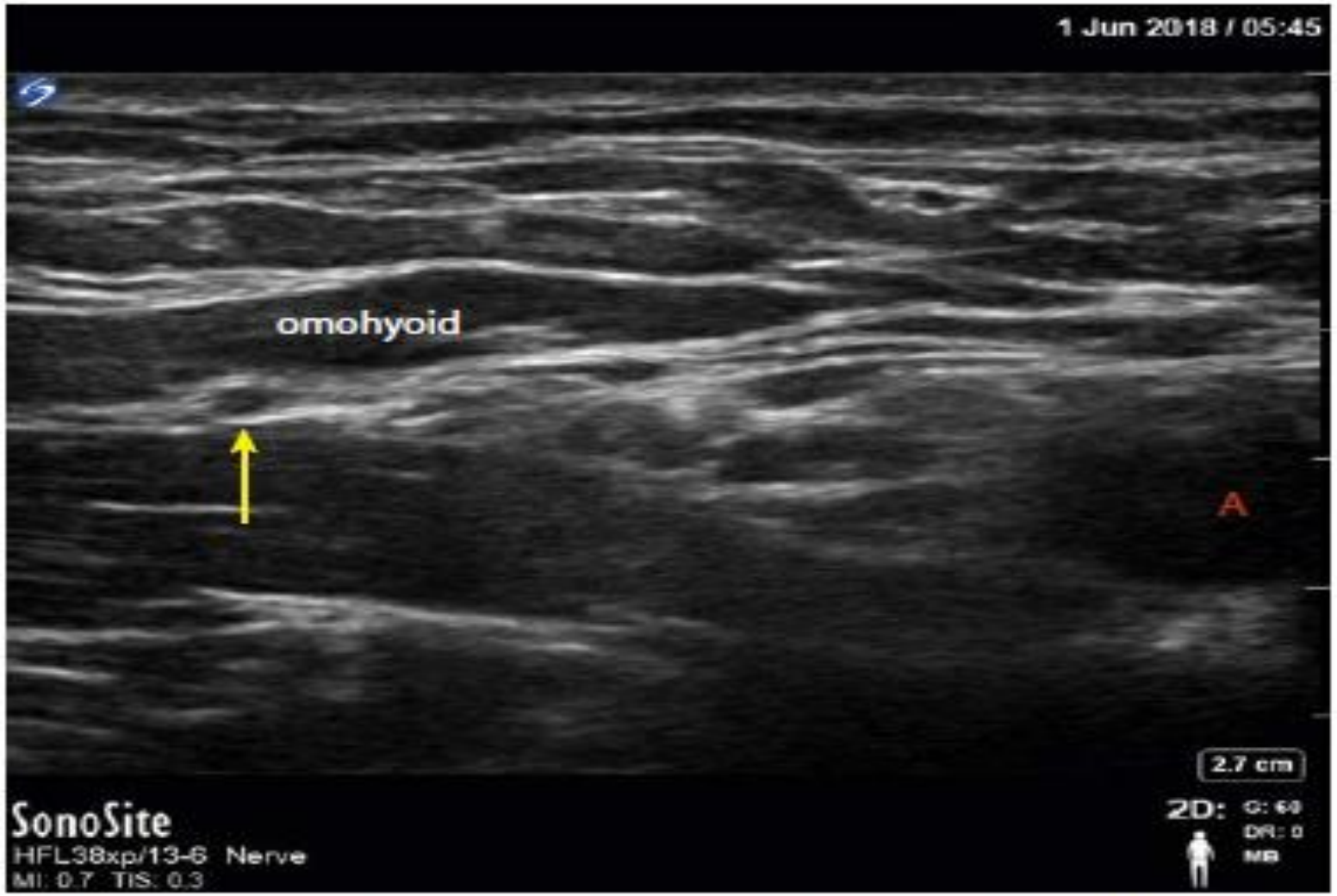


Fig. 46.20 Proximal suprascapular nerve block (anterior suprascapular nerve block). The suprascapular nerve is featured as a round hypoechoic structure deep to the inferior belly of the omohyoid muscle lateral to the superior truck of the brachial plexus within the posterior cervical triangle.

Side Effects and Complications

- Serious side effects and complications are primarily due to insertion complications and side effects from local anesthesia use.
- Avoid directly targeting the SSN in the suprascapular notch because accidental anterior needle advancement can puncture the pleura.

Side Effects and Complications

- Also, avoid intramuscular placement whether it be avoiding deposit of local anesthesia within the omohyoid (anterior) or within the supraspinatus muscle (posterior), which may result in myotoxicity/myonecrosis.
- a more proximal injection on the posterior upper arm carries a risk of entering the glenohumeral joint space with the block needle and higher local anesthesia volumes have been associated with spread to the posterior cord resulting in radial nerve blockade.

INFRACLAVICULAR BLOCKS

- The advantages of the infraclavicular block are that it usually results in complete brachial plexus anesthesia, it is a stable place for a catheter, and no manipulation of the arm is necessary.
- The disadvantages are that the infraclavicular block is a deeper block; therefore needle or probe manipulations are necessary, along with steep angles of needle insertion that result in needle tip visibility issues.
- Although the arm can remain at the side of the patient, the block is easier when the arm is abducted to straighten the neurovascular bundle.

INFRACLAVICULAR BLOCKS

- The three arterial wall-hugging cords are named with respect to the second part of the axillary artery; therefore the expected positions are medial, lateral, and posterior.
- The artery is visualized in short-axis view deep to the pectoralis major and minor muscles .Most practitioners use an in-plane approach from the head of the table or side of the table.
- The ideal place for local anesthetic distribution to achieve complete infraclavicular block of the brachial plexus is posterior to the axillary artery for single-shot or catheter placement.

INFRACLAVICULAR BLOCKS

- Substantial evidence suggests that local anesthetic distribution posterior to the axillary artery produces complete brachial plexus block in the infraclavicular region .
- The cords of the brachial plexus do not need to be directly visualized for successful block. Duplication of the axillary vein is one of the few anatomic variations in the infraclavicular region.
- The clinical problem is that the accessory vein lies adjacent to the lateral cord of the brachial plexus and near the usual desired position of the needle tip.

Box 46.2 Sonographic Signs Indicating Infraclavicular Block Success

- Reduction in axillary artery diameter during injection
- "U-shaped" distribution underneath the axillary artery
- Separation of cords from axillary artery
- *White wall* appearance to the axillary artery (free walls)
- *Dark layer* underneath the axillary artery (long-axis view)

Several studies of clinical block characteristics have validated the high predictive value of local anesthetic distribution underneath the axillary artery for three-cord anesthesia ("U-shaped" distribution).

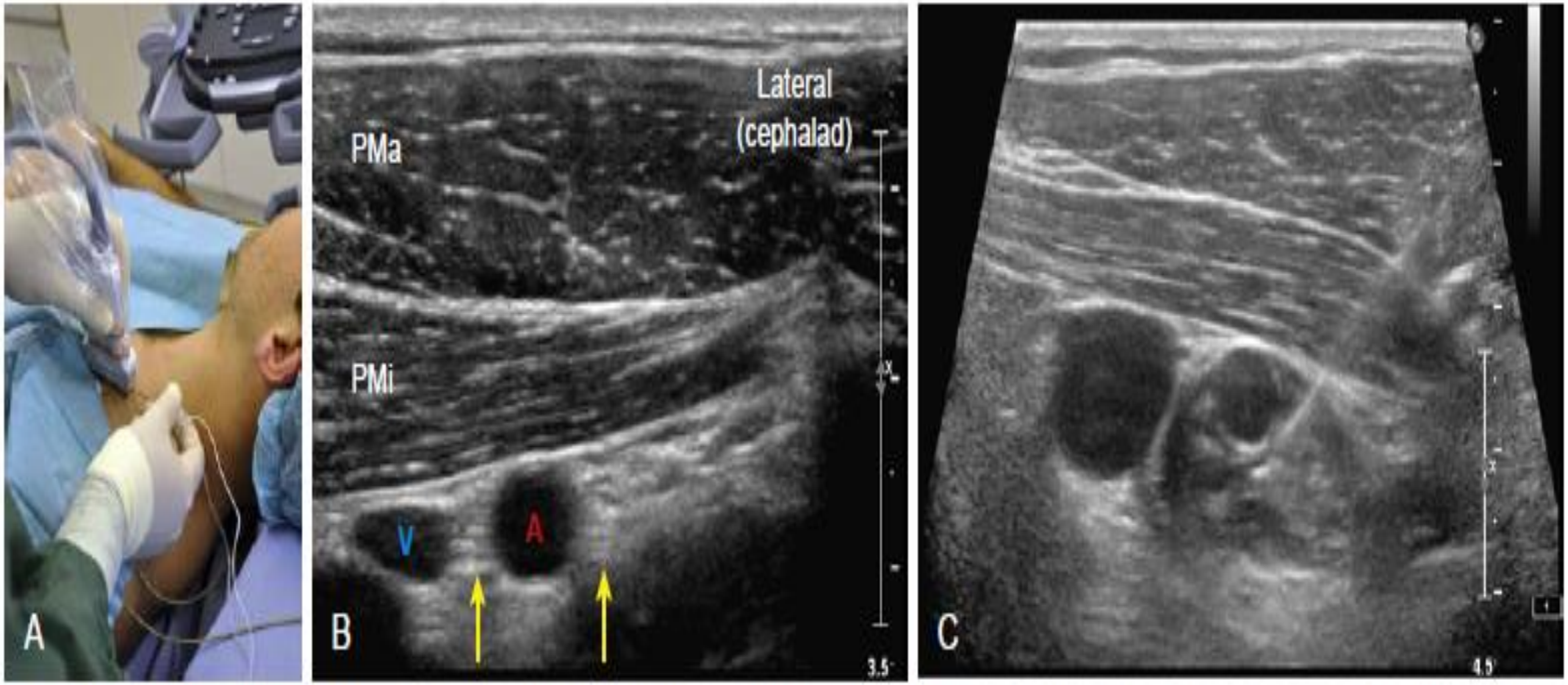


Fig. 46.21 Infraclavicular block with ultrasound imaging. (A) External photograph of the setup for infraclavicular block shows the arm has been abducted in this case. (B) Sonogram of the cords of the brachial plexus *(yellow arrows)* are adjacent to the axillary artery *(A)* and vein *(V)*. The neurovascular bundle lies deep to the pectoralis major *(PMa)* and pectoralis minor *(PMi)* muscles in this anatomic region. (C) Needle tip is in position for infraclavicular block and the resulting local anesthetic distribution.

AXILLARY BLOCKS

- The axillary block is a versatile block for upper extremity anesthesia. Although relatively safe and effective with classical approaches, the cardinal weakness has been the failure to block the musculocutaneous nerve.
- With the advent of ultrasound imaging, this limitation can be overcome by directly visualizing the musculocutaneous nerve.
- The axillary block provides surgical anesthesia of the elbow and more distal upper extremity.

AXILLARY BLOCKS

- The shallow depth of the neurovascular bundle (a 20-mm field is typical) make this block relatively easy with ultrasound guidance .
- Usually, three arterial wall-hugging branches (median, ulnar, and radial) and one branch with a characteristic medial-to-lateral course in the axilla (musculocutaneous) are visualized.
- In addition, the musculocutaneous nerve has a characteristic change in shape as it moves from adjacent to the artery (round) to within the coracobrachialis muscle (flat) and then exiting the muscle (triangular).

Table 46.3 Comparison of the Infraclavicular and Axillary Approaches to Brachial Plexus Block

	Infraclavicular Block	Axillary Block
Depth	Deep (two overlying muscles)	Shallow
Onset	Slower	Faster
Tourniquet tolerance	Good	Fair
Catheter success	High	Low

AXILLARY BLOCKS

- Both in-plane (with needle approaching from the lateral side of the arm) and out-of-plane (with needle approaching from distal to proximal) techniques can be used .
- The block is performed in the proximal axilla, with the transducer gently pressed against the chest wall to visualize the conjoint tendon of the latissimus dorsi and teres major.
- A high-frequency linear probe with a small footprint (25–50 mm) with sterile cover can be used for axillary block.

AXILLARY BLOCKS

- The ideal location for local anesthetic injection is between the nerves and the artery so that separation between the two structures occurs to ensure distribution within the neurovascular bundle. These injections result in excellent clinical sensory and motor blocks.
- The musculocutaneous nerve is usually blocked within the coracobrachialis, where its flat shape gives a large amount of surface area for rapid block.
- Duplication of the axillary artery and musculocutaneous-median nerve fusion (low-lying lateral cord) are common anatomic variations in the axilla.

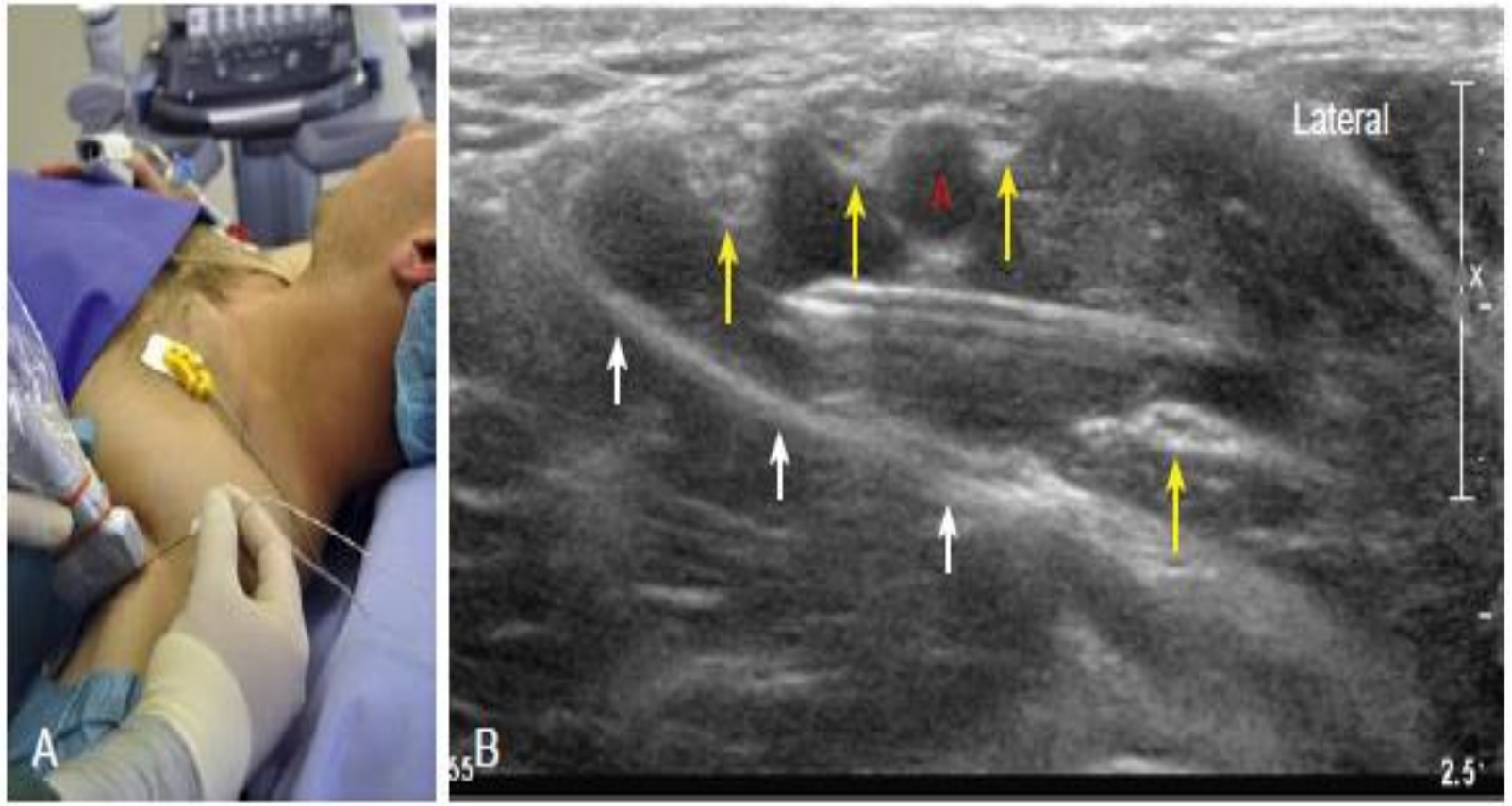


Fig. 46.22 Axillary block with ultrasound guidance. (A) External photograph demonstrates the in-plane approach. (B) Sonogram of the neurovascular bundle in the short-axis view shows the needle tip in-plane after injection of the local anesthetic. The probe compression is just sufficient to coapt the walls of the satellite veins. The block is performed at the level of the conjoint tendon of the latissimus dorsi and teres major *(white arrows)*, which lies under the neurovascular structures. The third part of the axillary artery (A) and nerves of the brachial plexus—radial, ulnar, median, and musculocutaneous—in order from medial to lateral *(yellow arrows)* are shown.

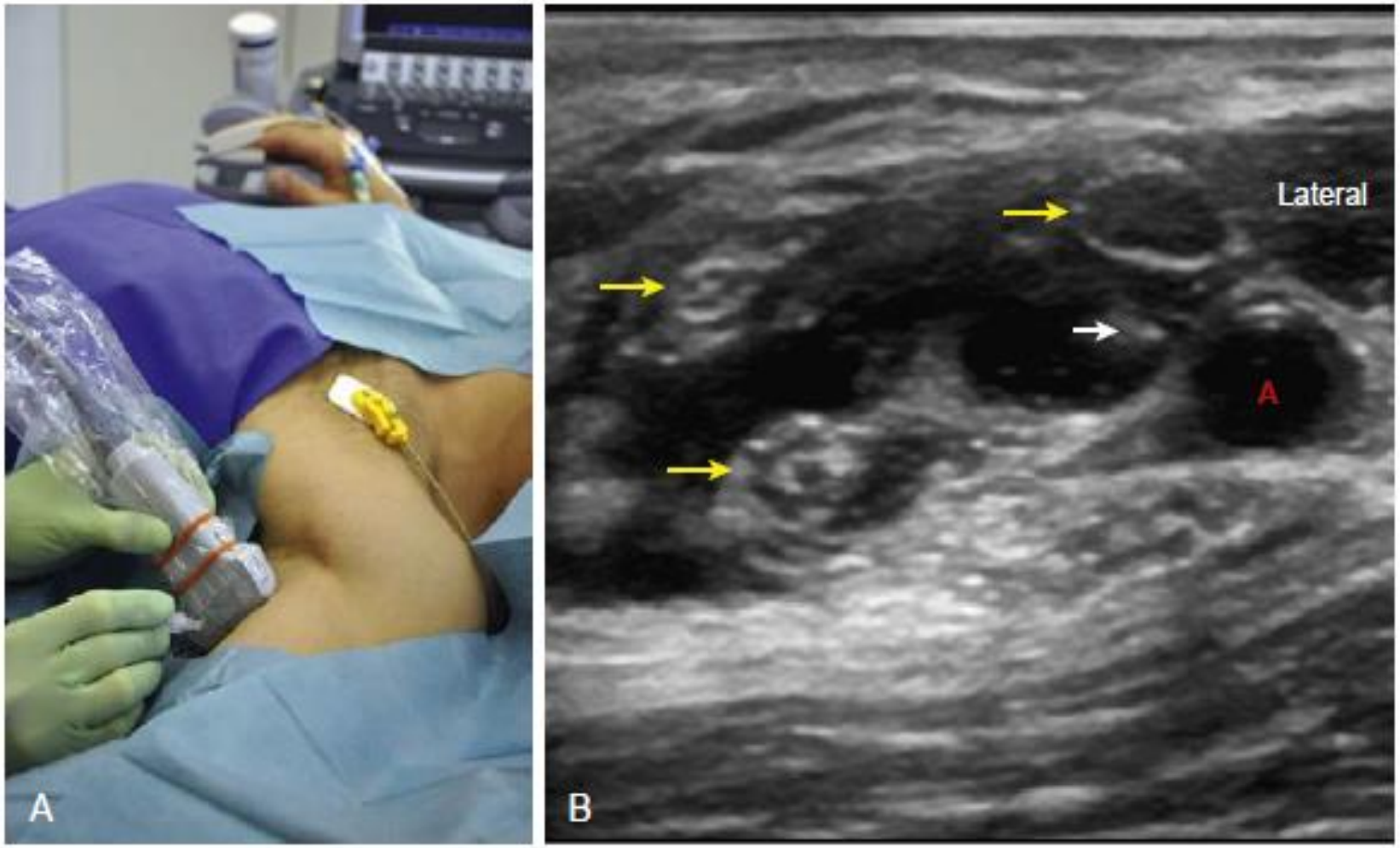


Fig. 46.23 Axillary block with ultrasound guidance. (A) External photograph demonstrates the out-of-plane approach. (B) Sonogram of the neurovascular bundle in the short-axis view shows the needle tip *(white arrow)* crossing the plane of imaging. The probe compression is just sufficient to coapt the walls of the satellite veins. The third part of the axillary artery (A) and nerves of the brachial plexus *(yellow arrows)* are shown.