Chapter 2

Interscalene Blocks

- Single-Injection Interscalene Block
- Continuous Interscalene Block




SINGLE-INJECTION INTERSCALENE BLOCK

Introduction

Single-injection interscalene block is done almost entirely for pain associated with shoulder surgery. This block usually is not indicated for surgery of the upper extremity distal to the shoulder joint. The approach used in this description is the longitudinal approach or lateral approach (1-3). This approach is used to avoid possible entry into the vertebral neuroforamina.

It is important to realize that continuous pain, paresthesia, and dysesthesia distal to the elbow are almost never symptoms of bona fide shoulder disease (4) (see Chapter 19). These symptoms almost always indicate an existing brachial plexopathy, and care should be taken in patients presenting with shoulder pain who also have pain distal to the elbow. Special care should be taken in patients presenting with primary frozen shoulder or "adhesive capsulitis". This condition is a fibromatosis like Dupuytren's disease, which in itself should not be painful if it is not in the acute phase. The pain of primary frozen shoulder is possibly caused by traction on the brachial plexus due to rotation of the scapula (see Chapter 19).

The clinician should be cautious of the patient scheduled for subacromial decompression without a clear diagnosis. The exact diagnosis of the shoulder lesion is often unclear in patients with existing brachial plexopathy. Interscalene block can potentially aggravate this condition (see Chapter 19).

Specific Anatomic Considerations

The osteotomes included in this block are illustrated in Figure 2-1. When studying this illustration, it should be clear that the inferior part of the glenoid, as well as the distal part of the ulna and the bones of the fourth and fifth fingers, are usually not included by interscalene block unless large volumes of local anesthetic agent are used. Also compare this figure with Figure 1-3, and note that the cephalad part of the clavicle is innervated by the C8-T1 osteotomes.

The C5, C6, and C7 dermatomes are usually included in interscalene block, but the C8 and T1 dermatomes usually are not included (Fig. 2-2).

The neurotomes involved in interscalene block include the neurotomes of the axillary, radial, musculocutaneous, and the median nerves (Fig. 2-3). The ulnar nerve and brachial and antebrachial cutaneous nerves are usually not included. Similarly, the intercostal brachial nerves are excluded.

Technique

The patient is placed in the supine position with the head slightly turned away from the operative side, and the patient's hand on the operative side is placed on the abdomen (Fig. 2-4).

The posterior border of the sternocleidomastoid muscle, the external jugular vein (*dotted line*), and the clavicle are marked (Fig. 2-5).

Before the skin is penetrated with the needle, all the nerves in the posterior triangle of the neck can be mapped transcutaneously (1,5). This can be done with a special probe (Fig. 2-6A) or with the tip of the needle (Fig. 2-6B). The nerve stimulator is typically set at 5 to 10 mA for this nerve mapping (5). The operator stands at the head, facing the patient's feet.

The clavicle forms the caudal border or base of the posterior triangle of the neck, and the circled area in Figure 2-7 indicates the position of the superficial cervical plexus.

After disinfecting the skin with an antiseptic agent, the superficial cervical plexus is blocked just behind the midpoint of the sternocleidomastoid muscle (Fig. 2-7).

The anesthesiologist stands at the head of the table facing the patient's feet. The interscalene groove is palpated with the index and middle fingers in the area of Winnie's point (Fig. 2-8).

These two fingers are now split, leaving the middle finger in the interscalene groove (Fig. 2-9). This causes congestion of the external jugular vein, which makes it easy to identify, and the index finger applies traction to tighten the skin for easy needle penetration.

The needle enters behind the sternocleidomastoid muscle approximately midway between the clavicle and the mastoid process, and is aimed at the brachial plexus, which is deep to the middle finger of the operator's left hand (Fig. 2-10). The needle enters longitudinally and is typically aimed approximately at the nipple on the ipsilateral side or at the midpoint of the clavicle.

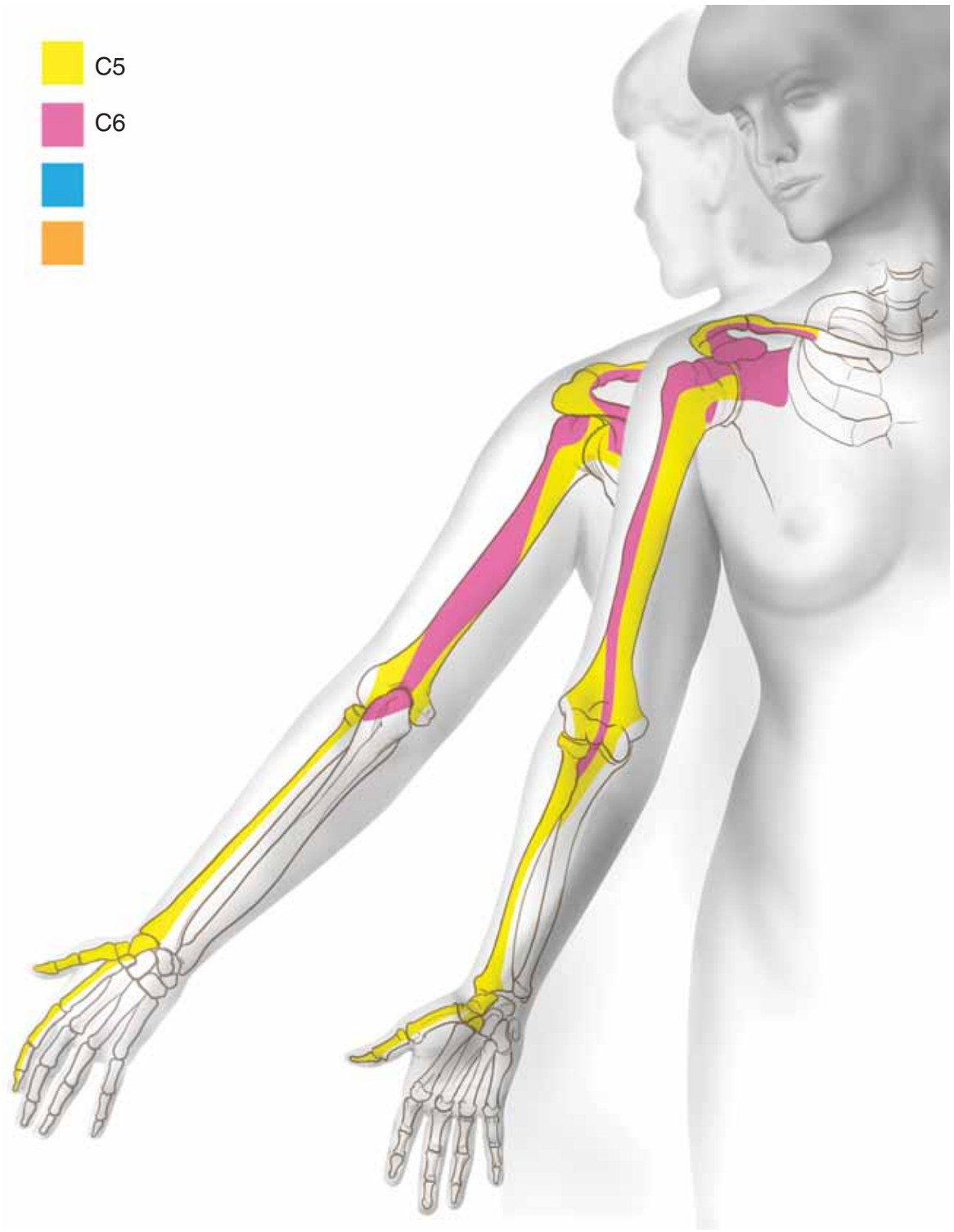

FIGURE 2-1 Osteotomes blocked by the interscalene block.

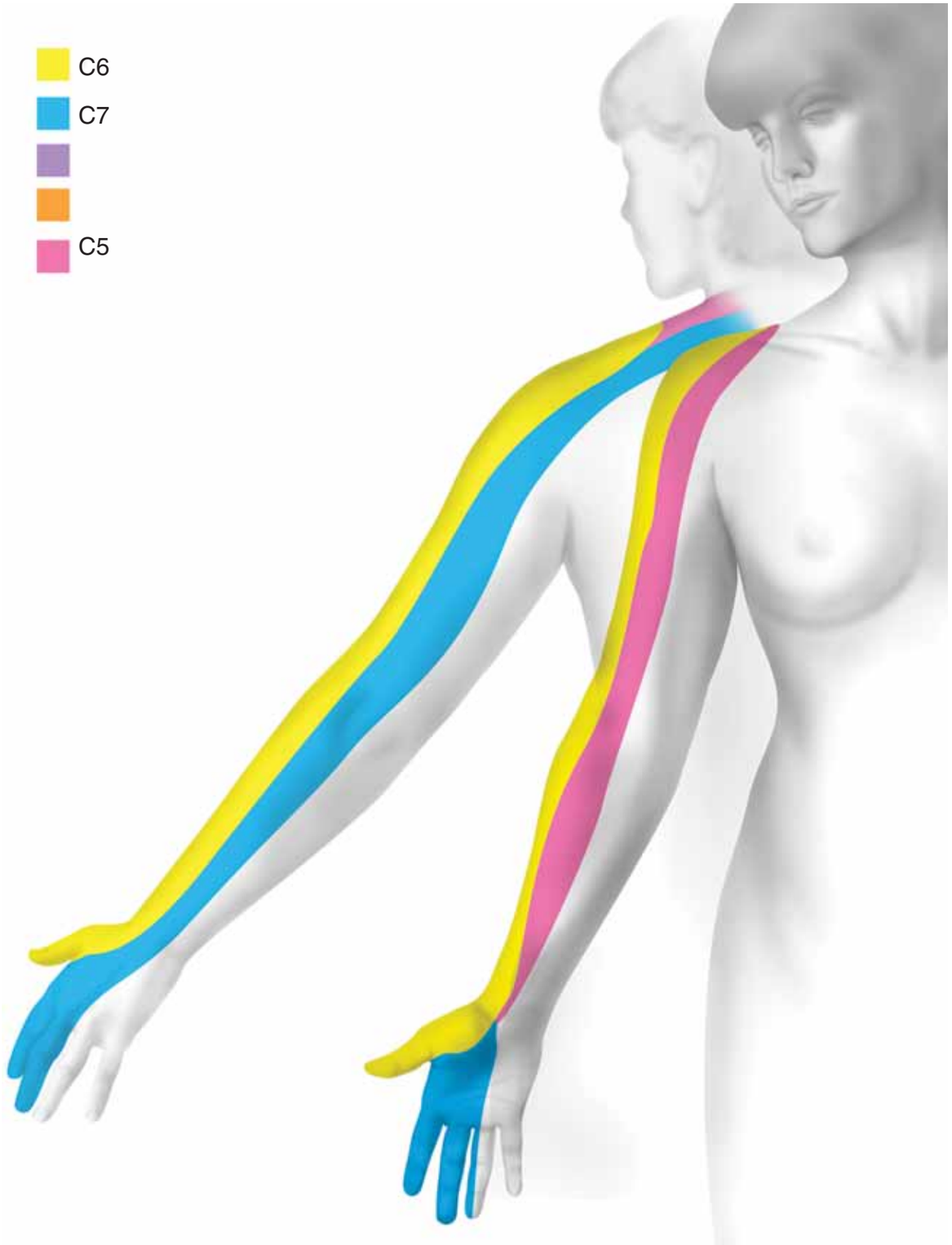

FIGURE 2-2 Dermatomes blocked by the interscalene block.

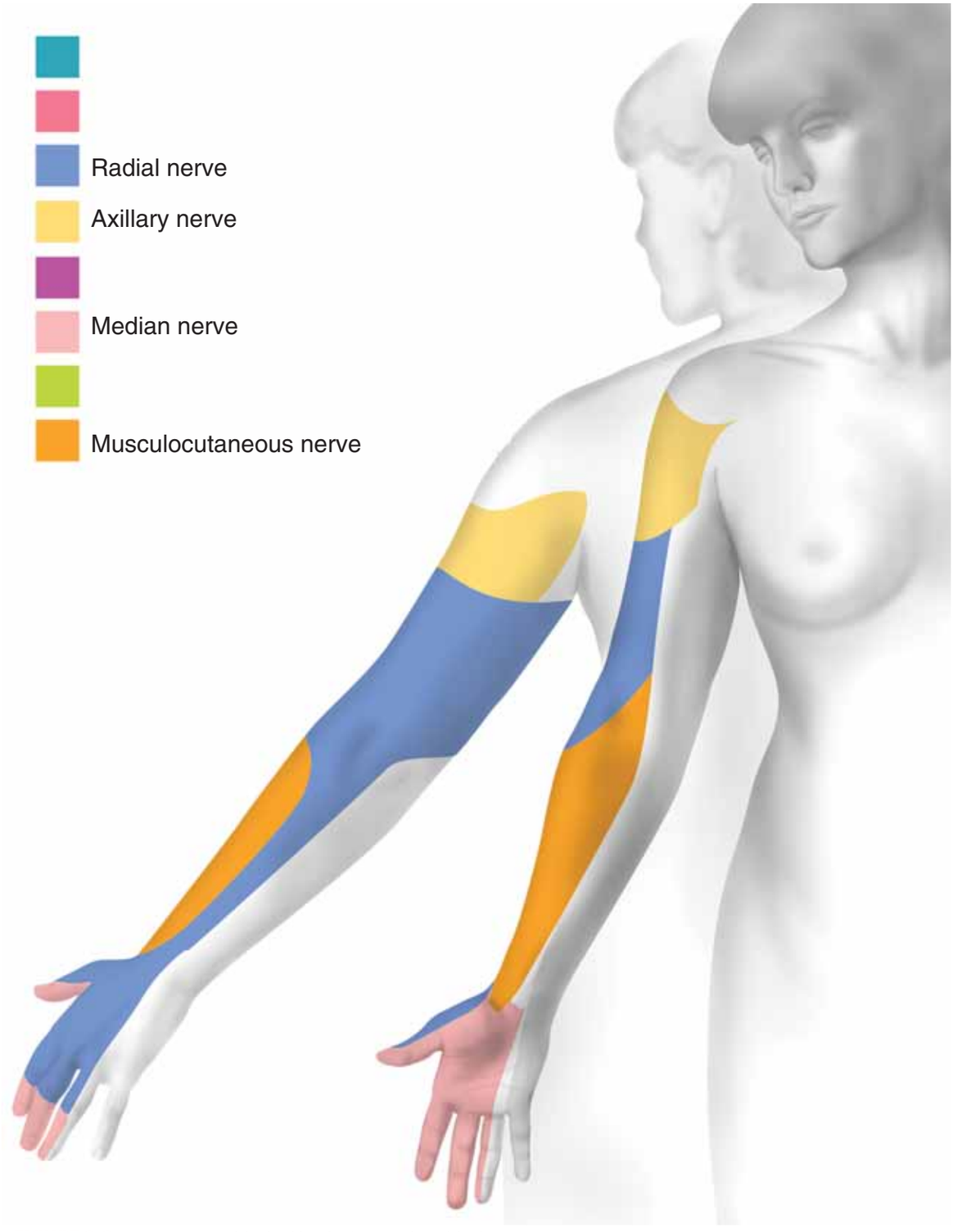

FIGURE 2-3 Neurotomes blocked by the interscalene block.

FIGURE 2-4 The patient is positioned in the supine position with the head turned slightly away from the operative side.

FIGURE 2-5 The *solid lines* indicate the position of the sternocleidomastoid muscle, and the *dotted line* the position of the external jugular vein.

If the needle is aimed too anterior, the phrenic nerve will be stimulated and an unmistakable diaphragmatic motor response will be noticed.

The nerve stimulator is typically set at 1 to 2 mA, 2 Hz, and a 100- to 300-μsec pulse width at this stage.

Contact with the brachial plexus will cause either a triceps or biceps motor response as the proximal (triceps) or distal (biceps) aspect of the superior trunk of the brachial plexus is encountered. If the phrenic nerve is encountered, there will be an unmistakable motor response of the abdomen as the diaphragm contracts, and the needle must be withdrawn slightly and redirected approximately 0.5 to 1 cm more posteriorly. If, on the other hand, the rhomboid muscles contract, the dorsal scapular nerve has been stimulated and the needle must, after slight withdrawal, be moved approximately 0.5 to 1 cm more anteriorly.

When the brachial plexus is stimulated and a brisk biceps or triceps motor response is demonstrated, the nerve stimulator is turned down to approximately 0.3 to 0.5 mA, and the brisk motor response should still be seen in the biceps or triceps muscle. If this brisk motor response is still present at 0.2 mA, it may indicate intraneural

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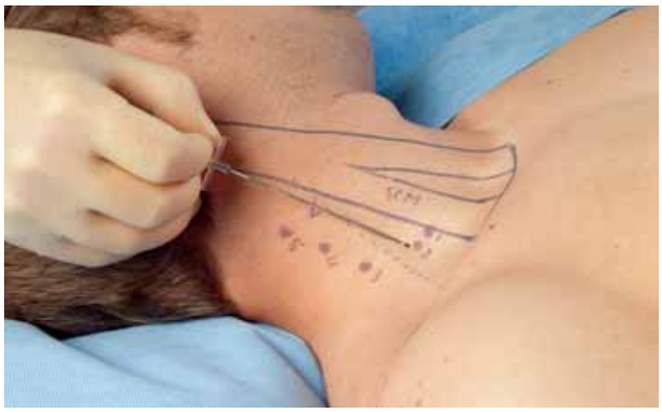


B

FIGURE 2-6 **A,** A dedicated probe is used to stimulate the nerves in the posterior triangle of the neck transcutaneously. SCM, sternocleidomastoid muscle; V, jugular vein; 1, position of the phrenic nerve; 2, brachial plexus; 3, position of the dorsal scapular nerve; 4, position of the nerve to the levator scapulae; 5, position of the accessory nerve. **B,** The needle can also be used for transcutaneous stimulation or mapping of the nerves in the posterior triangle of the neck.

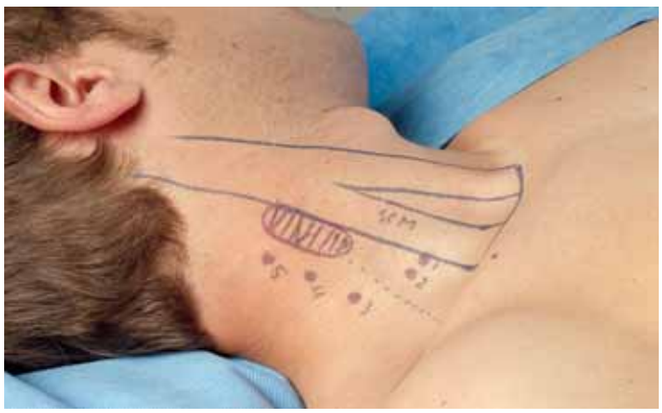


FIGURE 2-7 The *oval* indicates the position of the superficial cervical plexus as it exits behind the midpoint of the clavicular head of the sternocleidomastoid muscle.

needle placement and the needle should be withdrawn 1 or 2 mm. Brisk muscle twitches should ideally be seen at a nerve stimulator output setting of 0.3 to 0.5 mA. A motor response of the hand flexors or extensors or deltoid or pectoral muscles may also be accepted.

A positive Raj test is obtained when the motor response immediately ceases after injection of the local anesthetic agent or normal saline. This block is also ideally suited to the use of ultrasound (Figure 2-11).

Local Anesthetic Agent Choice

Amounts ranging from 15 to 60 mL of all known regional anesthetic agents have been used for

FIGURE 2-8 The groove between the anterior and middle scalene muscle is palpated.

FIGURE 2-9 The index and middle fingers are split such that the index finger puts traction on the skin and the middle finger obstructs the external jugular vein.

FIGURE 2-10 A 22-gauge stimulating needle, attached to a nerve stimulator, enters the skin, avoiding the jugular vein, and is aimed at the brachial plexus deep to the operator's middle finger.

single-injection interscalene block. The choice of this author is 20 to 40 mL of ropivacaine 0.5% to 0.75% or 20 to 40 mL bupivacaine 0.5%. The addition of buprenorphine may increase the block's duration of action up to threefold (6), but if a long-lasting block is required, it is advisable to place a catheter for continuous infusion (1).

(See single-injection interscalene block movie on DVD.)

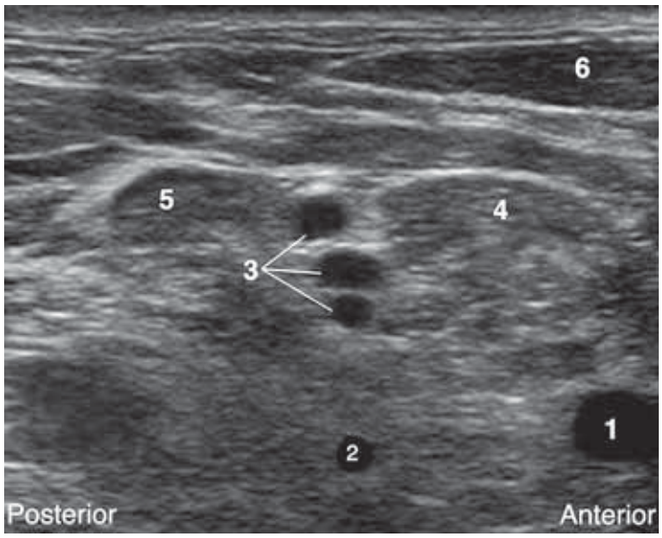


FIGURE 2-11 Transverse sonogram of the interscalene area: 1. Subclavian artery; 2. Vertebral artery; 3. Trunks of the brachial plexus; 4. Anterior scalene muscle; 5. Middle scalene muscle; 6. Sternocleidomastoid muscle.

CONTINUOUS INTERSCALENE BLOCK

Introduction

The continuous interscalene block is indicated for intraoperative and postoperative pain management in major shoulder surgery (1-3) such as shoulder arthroplasty and rotator cuff repair. This block should be used with caution in patients with frozen shoulder and is not indicated for conditions that are not painful for an extended period, such as arthroscopic subacromial decompression (4) (see Chapter 19). The same concerns regarding existing brachial plexopathy that were discussed for single-injection interscalene block apply for continuous interscalene block, and great care should be taken to protect other threatened nerves in the insensate arm. Nerves commonly injured by pressure (e.g., on the bed in the supine position) or poorly fitted arm slings are the ulnar nerve at the elbow or the radial nerve as it curls around the elbow. The use of an arm sling is important to prevent traction injury to the brachial plexus.

Specific Anatomic Considerations

The osteotomes (see Fig. 2-1), dermatomes (see Fig. 2-2), and neurotomes (see Fig. 2-3) shown for the single-injection interscalene block are similar to those for the continuous interscalene block. It should, however, be noted that although a wider spread of local anesthetic will be present during high-volume initial bolus injections, the area of block coverage will be smaller and more nerve-specific during the infusion of a smaller volume of a more dilute regional anesthetic agent.

Technique

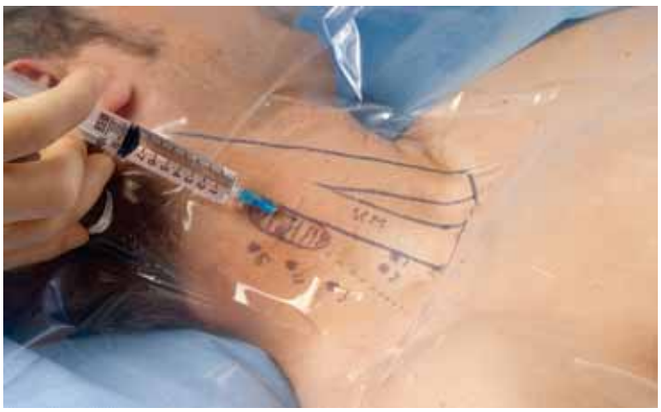
The positioning of the patient (see Fig. 2-4), surface anatomy, and skin markings (see Fig. 2-5) are similar to those for a single-injection interscalene nerve block.

The area is covered with a fenestrated, clear, sterile plastic drape after skin preparation (Fig. 2-12).

For continuous interscalene nerve block, perform a superficial cervical plexus block (Fig. 2-13A) and anesthetize the path intended for subcutaneous tunneling (Fig. 2-13B). In this case, the path is toward the suprasternal notch. Make sure not to injure the external jugular vein with the needle.

The nerve stimulator, set at a current output of 5 to 10 mA, a frequency of 2 Hz, and a pulse width of 200 to 300 μsec, is clipped to the proximal end of an insulated 17-gauge Tuohy needle. The position of the brachial plexus and all the other nerves in the posterior triangle of the neck can now be confirmed by transcutaneous stimulation using the flat side of the tip of the Tuohy needle, or a specially manufactured probe as illustrated in Figure 2-6A. Once nerve positions are confirmed, the nerve stimulator is turned down to 1 to 2 mA.

FIGURE 2-12 After preparation of the skin, a fenestrated, transparent drape is applied to the neck.



A

B

FIGURE 2-13 **A,** The superficial cervical plexus is blocked. **B,** The intended path for tunneling of the catheter is also anesthetized, taking care not to injure the external jugular vein.

The interscalene groove is palpated with the middle and index fingers and the fingers are split to put traction on the skin, leaving the middle finger in the interscalene groove (Fig. 2-14).

Needle entry is from behind the sternocleidomastoid muscle, halfway from the clavicle to the mastoid (Fig. 2-15). Ultrasound imaging can also be used (see Fig. 2-11). The needle entry is longitudinal, aiming toward the brachial plexus just deep to where the left-hand middle finger is placed. This is generally in the direction of the midpoint of the ipsilateral clavicle.

The phrenic nerve may be encountered, which causes unmistakable abdominal twitches

FIGURE 2-14 The index and middle fingers of the nonoperative hand palpate the groove between the anterior and middle scalene muscles, and the fingers are split such that the index finger applies traction to the skin and the middle finger remains in the groove between the two scalene muscles.

FIGURE 2-15 Needle entry is caudal to the external jugular vein and aimed at the brachial plexus deep to the operator's middle finger. The nerve stimulator is attached to the Tuohy needle.

because of a diaphragm motor response. The needle is then withdrawn slightly and moved approximately 0.5 to 1 cm posteriorly until the biceps or triceps muscle is twitching, which indicates stimulation of the superior or middle trunk of the brachial plexus. The nerve stimulator can then be turned down and a clear, brisk motor response should still be present at 0.3 to 0.5 mA. This indicates correct needle placement. It is essential that no saline or local anesthetic agent be injected through the needle at this stage because this will make later nerve stimulation through the catheter impossible or very difficult. If the anesthesiologist does subscribe to the notion that fluid "opens up the space," 5% dextrose in water can be used (7). This fluid, unlike normal saline, does not conduct electricity and therefore will not obliterate the electrical nerve stimulation response by dispersing the current density, as saline does.

If the needle tip is placed too far posterior, the dorsal scapular nerve will be encountered. This is indicated by contractions of the rhomboid muscles, which can easily be mistaken for deltoid muscle contractions.

Once the brachial plexus is identified with the needle, the stylet of the needle is removed (Fig. 2-16), the nerve stimulator is attached to the proximal end of the stimulating catheter, and the distal end of the catheter is placed inside the needle shaft (Fig. 2-17).

The special mark on the catheter, in this case a broad black mark, situated at the needle hub indicates that the catheter's tip is now situated at the tip of the needle (Fig. 2-18).

The catheter is advanced beyond the needle tip (Fig. 2-19).

If the motor response stops or decreases, carefully withdraw the catheter to inside the needle shaft again (Fig. 2-20).

FIGURE 2-16 After an optimal motor response is obtained, the stylet is removed from the needle.

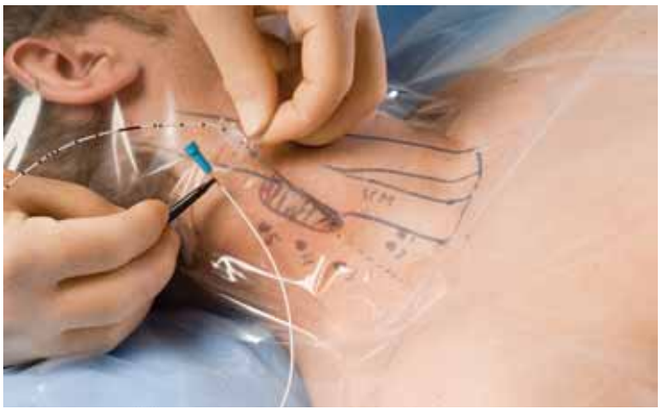


FIGURE 2-17 The needle is left on the plexus and a stimulating catheter, now attached to the nerve stimulator, is advanced through the needle.

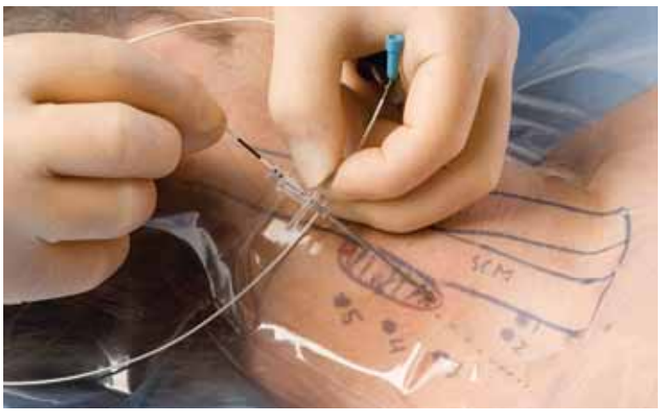


FIGURE 2-18 The special marking on the catheter indicates whether the tip of the catheter protrudes beyond the needle tip. Note that the nerve stimulator and proximal end of the catheter are held in the palm of the operator's left hand.

Rotate the needle a quarter of a turn clockwise or counterclockwise and advance the catheter again. If the motor response again disappears, withdraw the catheter again (Fig. 2-21), turn the needle in the opposite direction, and try again. Repeat this maneuver by rotating the needle, withdrawing the needle slightly, or advancing the needle slightly, until the motor response remains constant and brisk during advancement of the catheter.

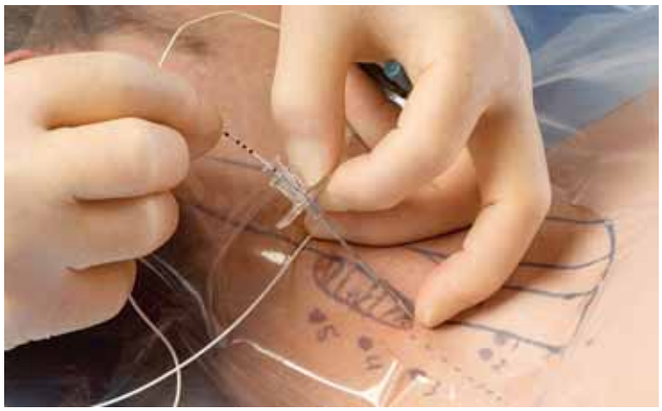


FIGURE 2-19 If the catheter is advanced so that the special mark on the catheter can no longer be seen, it means that the tip of the catheter has been advanced beyond the tip of the needle.

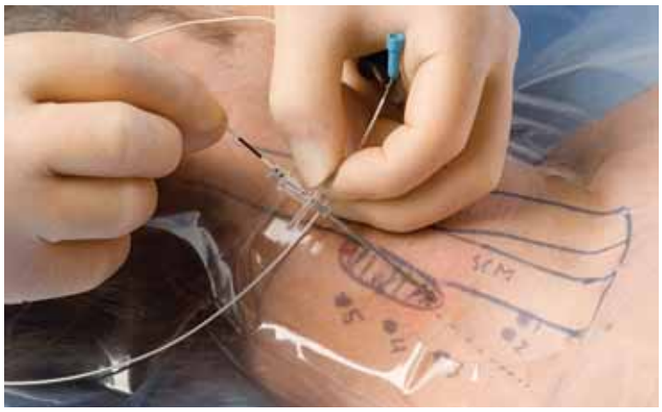


FIGURE 2-20 Should the motor response disappear, the catheter is carefully withdrawn until the special mark on the catheter is visible again. This means that the tip of the catheter is now inside the needle shaft and the needle can be safely manipulated.

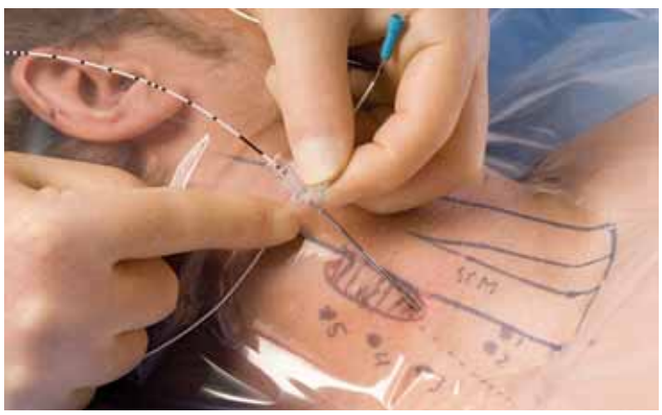
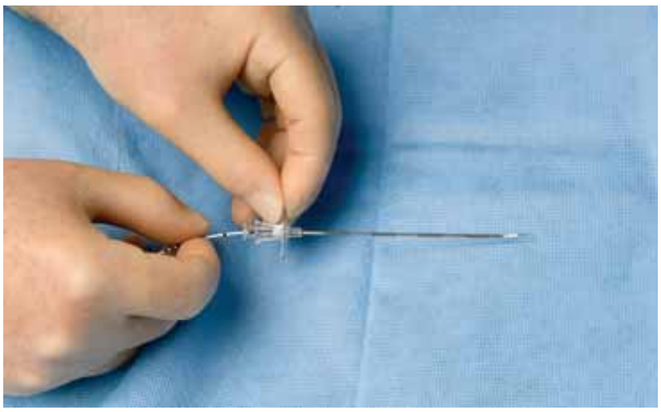


FIGURE 2-21 With the special mark on the catheter visible, the needle is now manipulated—in this case, turned a quarter turn clockwise—and the catheter is advanced again.

Make sure that the catheter is always withdrawn to inside the needle shaft before the needle is manipulated. Figure 2-22A shows the special marking on the catheter visible, which indicates that the tip of the catheter does not protrude beyond the needle tip. Figure 2-22B illustrates the catheter protruding beyond the needle tip, and the special marking on the catheter is no longer visible. This is an important concept because maneuvering the catheter while it protrudes

A



B

FIGURE 2-22 **A,** When the special mark on the catheter is visible outside the hub of the needle, the tip of the catheter has not yet reached the needle tip. **B,** If the special mark on the catheter disappears within the hub of the needle, it indicates that the catheter is now protruding beyond the tip of the needle.

FIGURE 2-23 If an unchanged motor response is evoked by the catheter, it means that the catheter is now on the brachial plexus, and the needle is removed without disturbing the catheter.

beyond the needle tip can lead to shearing of the catheter. All makes of stimulating catheters have a marking indicating when the catheter tip leaves the needle tip.

The needle is removed without disturbing the catheter, similar to epidural catheterization (Fig. 2-23).

The catheter can now be tested again by attaching the nerve stimulator to its proximal end (Fig. 2-24). It should then be tunneled subcutaneously to prevent catheter dislodgement.

As illustrated in Chapter 12, the inner stylet of the needle is placed subcutaneously from a point approximately 1 to 2 mm from the catheter

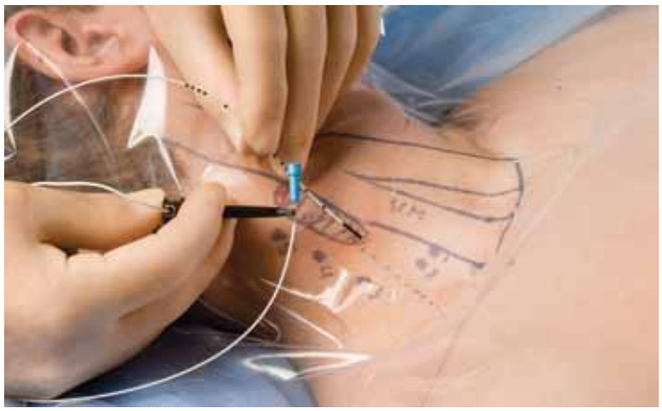


FIGURE 2-24 After removal of the needle, the position of the catheter can be tested again by attaching its proximal end to the nerve stimulator.

exit site toward the suprasternal notch, taking care not to puncture the external jugular vein by going deep to it. If a skin bridge is not required, the stylet of the needle enters through the same catheter exit site, taking care not to damage the catheter.

The needle is then "railroaded" back over the stylet while still taking special care not to disturb or damage the catheter.

The catheter is advanced retrograde through the needle and the needle is removed, leaving a loop of catheter at the original catheter exit site. The catheter is situated deep to the external jugular vein and exits in the area of the suprasternal notch.

Place the piece of silicone tubing that protected the catheter tip while it was packaged in the loop to protect the skin bridge (see Chapter 12).The skin bridge makes removal of the catheter easier.

If a skin bridge is not used, the catheter is "buried" under the skin.

Place the Luer lock connecting device on the proximal end of the catheter and attach the nerve stimulator and the syringe with the local anesthetic agent to the connecting device (Fig. 2-25). The nerve stimulator is set to an output of zero and then slowly turned up until a motor response can just be seen.

The motor response ceases immediately after the injection is started. This constitutes a positive Raj test, which further ensures that the secondary block through the catheter as well as the primary block will be successful.

Place the connecting device and catheter in the fixation device (see Chapter 18) or similar device, and place this on the contralateral shoulder of the patient in a convenient location.

Cover the catheter with a transparent adhesive dressing to enable daily inspection of the catheter exit site.

Local Anesthetic Agent and Infusion Choice

Most authors use 20 to 40 mL ropivacaine 0.5% to 0.75%, bupivacaine 0.5%, or levobupivacaine 0.5% for intraoperative analgesia, and an infusion of 0.2% of the same drug is usually used for the management of postoperative pain. There are various infusion strategies, but it should be successful to start with 0.2% ropivacaine or 0.25% bupivacaine at 5 mL/hour. Additional patient-controlled regional anesthesia consisting of 2- to 10-mL boluses at a lockout time of 30 to 60 minutes can be used.

There is a spectrum of infusion strategies, and which is used depends on the desired effect. For example, the infusion strategy for a rotator cuff repair, in which motor function is undesirable initially, would use a high volume and high concentration of local anesthetic drug initially, followed by a high infusion rate of a relatively high concentration of drug and zero or a small volume of patient-controlled boluses.

Adhesive capsulitis or frozen shoulder, on the other hand, would require a small volume and low concentration of the initial bolus drug

A

B

FIGURE 2-25 **A** and **B,** The Luer lock connecting device is attached to the proximal end of the catheter.

because motor function and patient participation in physical therapy are desirable, followed by a low infusion volume of a low-concentration drug, but a higher volume and concentration of patient-controlled boluses for physical therapy sessions. Ropivacaine is probably the drug of choice because of its motor-sparing properties. It may also be desirable to provide a higher infusion volume at nighttime so that patient-controlled boluses are unnecessary, thus ensuring that the patient has a good night's rest; a lower infusion rate and higher patient-controlled boluses can be reinstituted during the daytime.

Catheter Removal

Removal of the catheter is a sterile procedure (see Chapter 12).

Clean the skin bridge area with a suitable disinfectant. Hold the proximal part of the catheter with the left hand, fold the silicone tubing skin bridge around the catheter with the right hand, and remove the distal end of the catheter. Inspect the tip of the catheter for completeness, keep this part sterile, and with the left hand remove the entire catheter.

(See continuous interscalene block movie on DVD.)

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