Chapter 6

Infraclavicular Block

- Single-Injection Infraclavicular Block
- Continuous Infraclavicular Block




SINGLE-INJECTION INFRACLAVICULAR BLOCK

Introduction

This block is commonly used for single-injection regional anesthesia for hand, wrist, arm, and elbow surgery (1). This block is performed at the level of the cords of the brachial plexus; it is easy to perform, has a short onset time, and covers all the nerves distal to the shoulder joint.

All the neurotomes distal to the shoulder joints are typically incorporated in this block; unless the suprascapular nerve is specifically blocked separately, this block is not suitable for shoulder surgery.

Technique

A point approximately 2.5 cm (1 inch) medial and 2.5 cm (1 inch) caudal from the midpoint of the coracoid process marks the point of needle entry if the pericoracoid technique is used (2) (Fig. 6-1). The *dotted line* in Figure 6-1 indicates the midline of the clavicle, and a point 1 cm caudal on this line marks the point of needle entry in the vertical infraclavicular plexus (VIP) block technique, which is popular in Europe (3). The "superior" approach is described here (1,4,5).

The patient is placed in the supine or semi-sitting position to decrease venous congestion in the infraclavicular area. The hand is placed on the patient's abdomen or held in the anesthesiologist's hand (Fig. 6-1 and 6-2).

After skin preparation, the skin and subcutaneous tissue is anesthetized in the coracodeltoid trough with a local anesthetic agent, as indicated in Figure 6-3. Only a superficial skin wheal is required for this block.

A 50- to 100-mm, shallow-bevel insulated needle is used (Fig. 6-4). It is connected to a nerve

FIGURE 6-1 Patient positioning for infraclavicular block. C, coracoid process; VIB, needle entry point for the vertical infraclavicular block. The *circle* on the *solid line* indicates the needle entry for the superior approach to the brachial plexus cords.

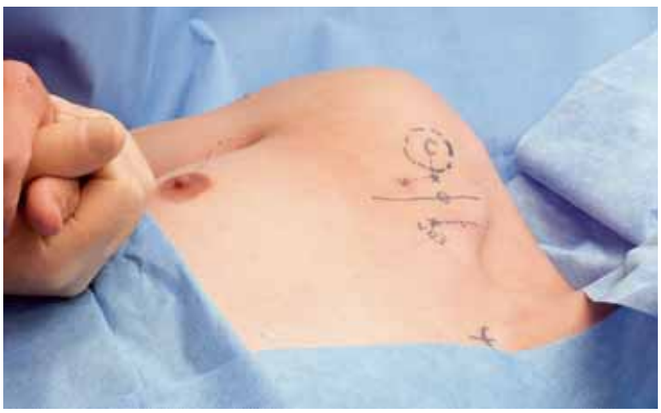

FIGURE 6-2 The patient's hand can be held in the anesthesiologist's nonoperative hand or can be placed on the abdomen.

FIGURE 6-3 A small skin wheal is raised in the deltopectoral trough.

FIGURE 6-4 A 50-mm stimulating needle enters at 45 degrees to the coronal plane while remaining in the parasagittal plane.

stimulator, set to an output of 1 to 1.5 mA, 100- to 300-µsec pulse duration, and a frequency of 2 Hz. Needle entry is close to the clavicle in the coracoclavicular trough, aimed posteriorly at an angle of 15 degrees to the coronal plane. The needle is advanced until arm muscle motor responses are observed.

It is important that the needle should remain within the parasagittal plane, without medial or lateral deviation. Medial misdirection of the needle can result in lung and pleura penetration. Lateral misdirection of the needle may place it on the base of the coracoid bone, which, although harmless, may cause incomplete nerve block.

After the correct cord is located with a brisk motor response at a current output of 0.3 to 0.5 mA, the local anesthetic agent can be injected.

As the needle is advanced, the musculocutaneous nerve, which is usually separated from the lateral cord of the brachial plexus, may be encountered. This causes unmistakable biceps contractions without hand flexion or pronation, and it should be ignored at this stage of the block. Similarly, the axillary nerve may be encountered, which causes a deltoid muscle motor response. This response should also be ignored at this stage of the block.

Ultrasonography may be very helpful in performing the single-injection infraclavicular block (6). Hold the probe in the coracopectoral trough and identify the axillary artery (Fig. 6-5). Inject local anesthetic agent approximately at the same point described previously for the superior approach to anesthetize the skin. Because muscles are not penetrated with this approach, only a small skin wheal is required.

Place a 50–90 mm, shallow-beveled stimulating needle through the skin and, under ultrasonographic guidance, behind the artery—between the artery and the cords—and inject local anesthetic to "push" the nerves away from the artery (Fig. 6-6). The "doughnut" sign can be seen as the local

FIGURE 6-5 The relative position of the ultrasonography probe and the stimulating needle for performing the infraclavicular block.

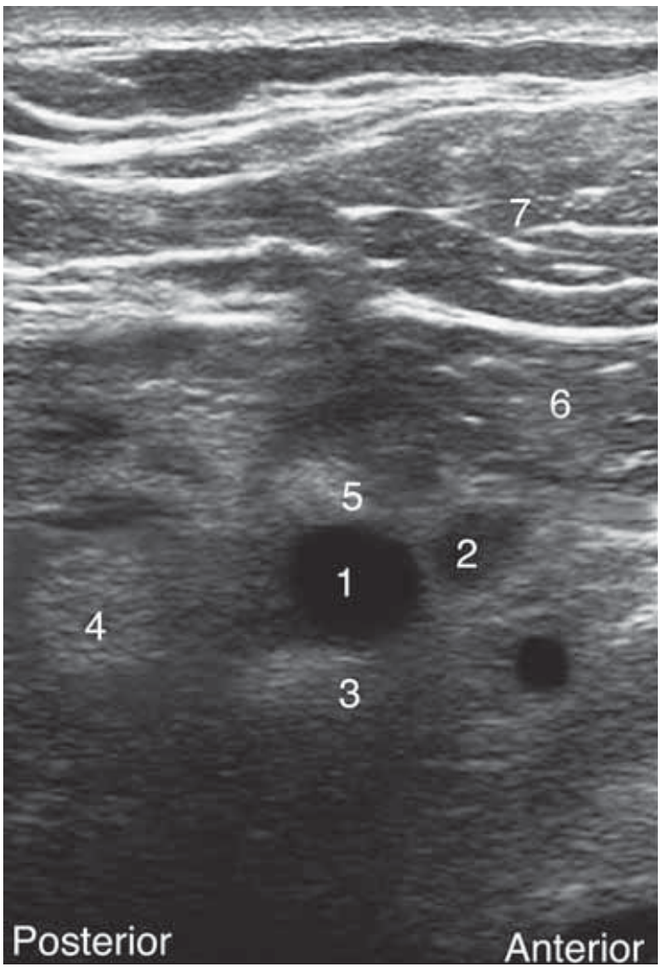

FIGURE 6-6 Ultrasonograph of the infraclavicular area: 1. Axillary artery; 2. Axillary vein; 3. Medial cord of the brachial plexus; 4. Posterior cord of the brachial plexus; 5. Lateral cord of the brachial plexus; 6. Minor pectoral muscle; 7. Major pectoral muscle.

anesthetic agent spreads around the brachial plexus cords.

Flexion of the fingers and ulnar deviation at the wrist indicate medial cord stimulation—the fifth digit (little finger) moves medially (7) (Fig. 6-7).

Pronation and hand flexion would indicate lateral cord stimulation, in which the fifth digit moves laterally (7) (Fig. 6-8).

Extension of the fingers (i.e., the fifth digit moves posteriorly) would indicate posterior

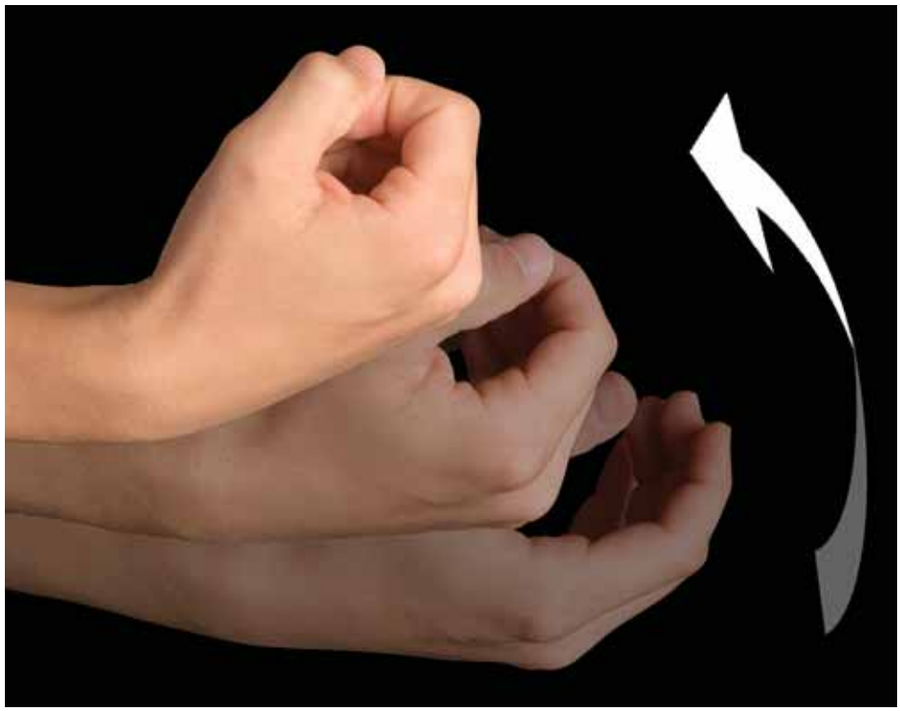

FIGURE 6-7 During medial cord stimulation, the fifth digit (little finger) moves medially.

FIGURE 6-8 During lateral cord stimulation, the fifth digit (little finger) moves laterally.

FIGURE 6-9 During posterior cord stimulation, the fifth digit (little finger) moves posteriorly.

cord stimulation (7) (Fig. 6-9). The fifth digit thus moves toward the cord that is being stimulated.

The current of the nerve stimulator is turned down until a brisk motor response of the muscles innervated by the most appropriate cord for the planned surgery can still be observed at 0.3 to 0.5 mA. Brisk motor twitches at an output of less than 0.2 mA may indicate intraneural placement, but this statement has not been verified by research.

While keeping the needle steady and observing the motor response, the operator injects the local anesthetic agent. The motor response stops immediately on injection. This constitutes a positive Raj test and is an indication that the block will be successful. Any solution that conducts electricity, such as normal saline, disperses the current density and causes a cessation of the motor response if the needle tip is in the same fascial plane as the nerve.

The other cords of the brachial plexus can now be sought and blocked, if appropriate. The best results are obtained if the posterior and medial cords are blocked.

Local Anesthetic Agent Choice

Most local anesthetic agents and combinations have been used for this block. Typically, 15 to 40 mL of ropivacaine 0.5% to 0.75% is used, of which 10 to 25 mL is injected onto the most appropriate cord and the remainder into at least one of the other cords. Adding buprenorphine 0.3 mg (8) to the mixture may lengthen the duration of action of the block, but if a long-acting block is required, it is best to place a continuous nerve block. The addition of dexamethasone 40 mg has been suggested to lengthen the duration of action of local anesthetic agents, but this needs to be verified by research.

(See pericoracoid approach for infraclavicular block movie on DVD.)

CONTINUOUS INFRACLAVICULAR BLOCK

Introduction

Like the single-injection infraclavicular block, the continuous infraclavicular block is used for surgery of the arm distal to the shoulder (9). This block has been inconsistent in clinical practice. Wrist and elbow surgery requires blockage of all three cords of the brachial plexus, as does postoperative pain management of these joints. However, with the continuous infraclavicular block, all three of the cords are blocked with the initial, relatively large-volume primary block, but

FIGURE 6-10 After skin preparation, a sterile, fenestrated drape is placed over the infraclavicular area.

FIGURE 6-11 The skin and subcutaneous tissue are anesthetized.

only the cord on which the catheter has been placed seems to be affected by the smaller-volume continuous infusion. This sometimes leaves the other two cords unblocked, and relatively large-volume boluses are needed to recapture blockage of these cords.

Technique

The patient is positioned in the supine or semi-sitting position with the hand placed on the abdomen. After skin preparation, the area is covered with a sterile, fenestrated, transparent plastic drape (Fig. 6-10).

The surface landmarks are similar to those for the single injection pericoracoid infraclavicular block: 2.5 cm medial and 2.5 cm caudal from the coracoid process. Another approach is 1 cm caudal on a line from the midline of the clavicle. Many authors have different approaches to the infraclavicular block. Of note are the more medial-to-lateral approach used by Borgeat and colleagues (10), the more superior approach used by Klaastad and associates (4,5), and the pericoracoid approach used by Whiffler (11). The pericoracoid approach, in which the needle (and catheter) is aimed medially and cephalad, is described here. The needle and catheter are placed on the brachial plexus at the trunks in the vicinity of the first rib (1).

The skin, subcutaneous tissue, and the intended path of tunneling are thoroughly anesthetized with lidocaine and 1:200,000 epinephrine (Fig. 6-11). The epinephrine is added to reduce skin and subcutaneous bleeding.

An insulated 17- or 18-gauge Tuohy needle, attached to a nerve stimulator set to a current output of 1 to 2 mA, a frequency of 2 Hz, and a pulse width of 100 to 300 μsec, is aimed medially and cephalad towards the interscalene groove (Fig. 6-12). Penetration of the fascia surrounding the major pectoral muscle can usually be felt clearly.

FIGURE 6-12 Needle entry is 2 cm medial and 2 cm caudal to the midpoint of the coracoid process and aimed medially and cephalad.

FIGURE 6-13 After the needle is placed on the appropriate cord, the nerve stimulator is attached to the proximal end of the catheter and the catheter advanced through the needle.

A more anteroposterior approach is often also used (9).

When the appropriate cord of the brachial plexus is encountered, the nerve stimulator output is turned down to 0.3 to 0.5 mA. This confirms accurate needle placement, but it does not guarantee accurate catheter placement. It is important not to inject any conducting fluid such as local anesthetic agent or normal saline through the needle at this point because this will render stimulating catheter placement impossible. If the anesthesiologist subscribes to the notion of "opening of the space," 5% dextrose and water can be used because saline will disperse the current and render further nerve stimulation with the catheter useless.

The bevel of the needle is pointed in the direction the catheter is intended to go. The needle is placed on the most appropriate cord of the brachial plexus for the planned surgery.

The nerve stimulator is set to 0.5 to 1 mA, or at a level that is comfortable for the patient, and attached to the proximal end of the stimulating catheter. Note the special mark on the catheter, which indicates that the catheter tip is situated at the tip of the needle. The catheter is advanced beyond the needle tip, and if the motor response disappears, it simply means that the catheter tip is moving away from the cord.

Withdraw the catheter tip carefully to inside the needle shaft, make a small adjustment to the needle such as turning it clockwise or counterclockwise or advancing or withdrawing it slightly, and advance the catheter again (Fig. 6-14). Repeat this maneuver until the motor response remains constant during catheter advancement. Advance the catheter 3 to 5 cm beyond the needle tip, but not more than 5 cm.

Remove the needle without disturbing the catheter (Fig. 6-15).

A special tunneling device can now be used to tunnel the catheter subcutaneously, or the

FIGURE 6-14 If the motor response is lost, the catheter is withdrawn and the needle manipulated. The catheter is advanced again.

FIGURE 6-15 After the catheter is properly placed on the desired port, the needle is removed without disturbing the catheter.

Tuohy needle and its stylet can be used. Tunneling is essential to prevent catheter dislodgement (see Chapter 12). The skin bridge may be important for short- to medium-term catheter use because it can facilitate easy catheter removal. However, a skin bridge may be responsible for a higher incidence of leakage around the catheter. The risk of leakage may be offset against tunneling without a skin bridge, which in turn may make catheter removal more difficult.

The Luer lock connecting device is attached to the proximal end of the catheter. The nerve stimulator, set to an output of 0 mA, is attached to the connecting device and the nerve stimulator output is slowly turned up until a muscle twitch can just be seen. Local anesthetic agent or any conducting fluid, such as normal saline, can be injected and the muscle twitches will stop immediately once the injection is started. This constitutes a positive Raj test and gives further assurance that the secondary block will be successful. The catheter adaptation device and catheter are attached to the fixation device, which is attached to a convenient place on the opposite side of the patient's upper body.

Local Anesthetic and Infusion Choice

Most local anesthetic agents have been used for this block. Typically, 15 to 40 mL of ropivacaine 0.5% to 0.75% is used as the initial bolus, followed by a 5- to 10-mL/hour continuous infusion of ropivacaine 0.2%. It is essential to allow relatively large patient-controlled boluses of 10 to 15 mL every 60 minutes to recapture unblocked cords in the postoperative period, should this become necessary.

Catheter Removal

The catheter is removed after the patient no longer requires continuous block and full

sensation has returned to the limb (see Chapter 12). Any radiating pain during catheter removal may indicate that the catheter is coiled around a nerve or cord, and this situation should be managed with utmost care. Remove the catheter by stabilizing the proximal part and first removing the distal end from the skin bridge. Once this is done, keep the catheter sterile and then remove the remaining catheter.

(See pericoracoid approach for continuous infraclavicular block movie on DVD.)

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