chapter III

Continuous Cervical Paravertebral Block (Brachial Plexus Root Block)

Introduction

In 1912, Kappis was attempting to develop techniques for blocking the spinal nerves at all levels where they emerge from the vertebral column. He described the lateral approach where he injected the nerves just lateral to the intervertebral foramina. He extended the use of "paravertebral conduction anesthesia" to include the cervical and brachial plexuses, but because of the presence of the vertebral artery and vein in front of the intervertebral foramina, Kappis chose to block these nerves by the posterior rather than lateral approach. Kappis claimed that this technique was easy to perform and he reported a 100% success rate, but this block was extremely painful to the patient and this block never became popular until Pippa revisited it in 1990.[1] It has only recently been realized that the pain of placing this block from the posterior approach can be avoided if the needle and catheter are placed between the levator scapula and trapezius muscles, avoiding the extensor muscles of the neck, when continuous cervical paravertebral block has been described.[2] These muscles, and in fact all the extensor muscles of the neck, are notoriously painful and sensitive in most people.

Most continuous catheter techniques that followed the attempts of Ansbro in 1946 were hampered by inaccurate catheter placement or catheter dislodgment. In order to provide reliable analgesia for ambulatory surgery and prevent readmission due to failed catheter placement, it was necessary to develop a method to assure real-time (while placing the catheter) catheter position. This can now be done immediately and not hours later when the initial block had worn off by stimulating the nerves *via* both the needle through which the catheter is placed and the catheter itself.[3] This accurate catheter placement is combined with a method to secure the catheter so that it does not dislodge.[3]

Please see nerve damage WARNING on page 6.

Patient position

The patient can be in the sitting or lateral decubitis position with the head slightly flexed forward.

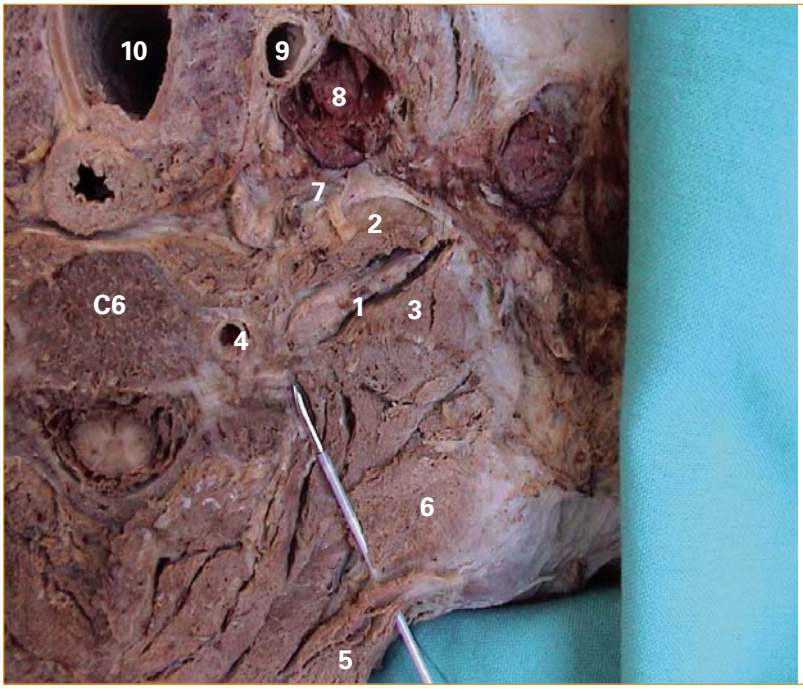
Indications

The continuous cervical paravertebral block is ideal for relief of post-operative pain following shoulder, elbow and wrist surgery. Unless separately addressed, this approach sometimes does not involve the nerves of the superficial cervical plexus and the skin around the shoulder area may therefore not be anesthetized. Loss of resistance to air as well as nerve stimulation may be used for the placement in this block. If proven successful by formal research, the loss-of-resistance-to-air technique should make this block ideally suited for post-operative use or when severely painful conditions such as fractures of the shoulder are present where nerve stimulation is not advisable or impractical.

Equipment

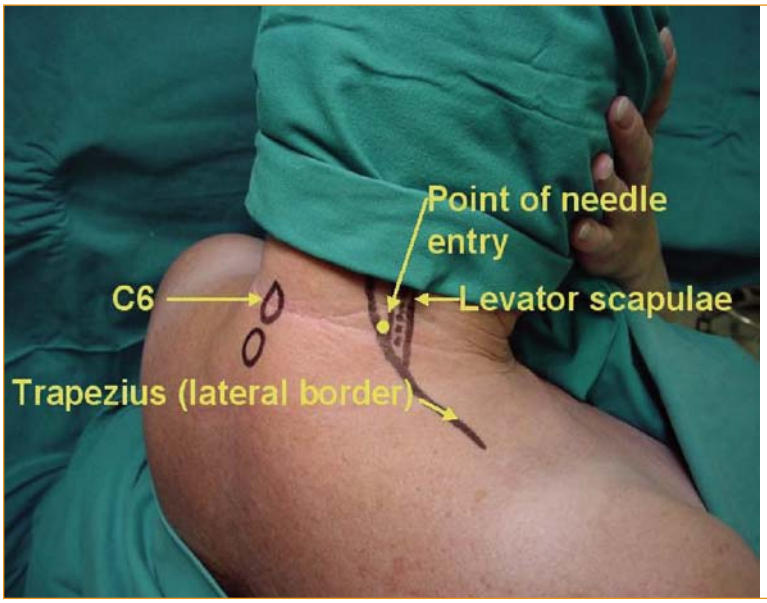
A sheathed insulated 17 or 18-gauge Tuohy needle (Arrow International, Reading, PA, USA) and a catheter with an inner steel spring capable of conducting electrical impulses to its distal end—a "stimulating catheter" are used for the methods described here (Arrow StimuCath®, Arrow International, Reading, PA, USA) (See Chapter 1).

Anatomy



The brachial plexus (1) is situated between the anterior (2) and middle (3) scalene muscles, while the vertebral artery (4) is guarded by the bony structures of the vertebrae. This approach to the brachial plexus is antero-lateral to the trapezius muscle (5) and postero-medial to the levator scapulae muscle (6). The phrenic nerve (7) is situated on the belly of the anterior scalene muscle (2). The internal jugular vein (8), carotid artery (9) and trachea (10) are marked for anatomical orientation.

Figure 3.1—Anatomy



The point of needle entry is in the apex of the "V" formed by the trapezius muscle posterior and the levator scapulae muscle anterior.

Figure 3.2—Surface anatomy

Anatomic landmarks

See Figure 3.2. The site of needle entry is located immediately lateral to the cervical paravertebral musculature, immediately medial to the levator scapula muscle and immediately superolateral to the trapezius muscle at the level of the C7 spinous process. Penetration of the extensor muscles of the neck should be avoided, since they are usually tender.

Technique

Needle entry should be at the level of C6 and just antero-lateral to the trapezius muscle and postero-medial to the levator scapulae muscle in the apex of the "V" formed by these two muscles.

Figure 3.3

Patient position

The patient can be in the sitting or lateral decubitis position with the head slightly flexed forward.

Needle Placement

- After liberal skin and subcutaneous tissue injection of local anesthetic agent, the needle enters the skin at the apex of the "V" formed by the trapezius and levator scapulae muscles at the level of the dorsal spine of the 6th cervical vertebra (C6) (Figure 3.3).
- The insulated Tuohy needle is attached to the peripheral nerve stimulator with the current set at 1–3 mA and 200–300 μs and directed anteriorly, caudally and medially towards the suprasternal notch until contact with the transverse process of C6 is made.
- At this point, the needle stylet should be removed and a syringe (loss-of-resistance device) containing 2–3 ml of air should be attached to the needle (Figure 3.4).
- The needle is then walked laterally off of the transverse process and slowly advanced antero-inferiorly.
- When the needle enters the cervical paravertebral space, there will be a sudden loss of resistance to air followed immediate by muscle twitches due to stimulation of the brachial plexus. The needle should be stabilized in this position. In some instances, especially in young people, muscle twitches do not occur but the patient will report light "electrical shocks" down the arm. This is because, at this level, the nerve roots have already split into anterior motor fibers and posterior sensory fibers and, since the nerve stimulation is from posterior, this will cause sensory stimulation only.

The nerve stimulator is clipped to the needle and a loss-of-resistance-to-air device is placed on the needle. The needle is directed mesiad, anteriorly and caudad, aiming for the suprasternal notch.

Figure 3.4

Catheter placement

> The nerve stimulator clip is now removed from the needle and attached to the proximal end of the stimulating catheter (Figure 3.5).

After loss of resistance to air and appropriate muscle twitching, the nerve stimulator is clipped to the proximal end of the catheter and the catheter is advanced through the needle. See text.

Figure 3.5

> Introduce the stimulating catheter into the needle.
> The muscle twitches should begin again and should be unchanged. The catheter is then gradually advanced beyond the tip of the needle for a distance of approximately 3–5 cm. The muscle twitches should continue over the entire distance of the catheter advancement.
> If stimulation ceases during catheter advancement, the catheter should be withdrawn to inside the shaft of the needle, the needle position changed in rotation, angulation or depth until the catheter can be easily advanced with unchanged muscle twitches throughout the procedure.
> The catheter is now correctly placed near the plexus but will most likely dislodge over time unless secured.

A non-stimulating standard soft epidural catheter may be advanced through the needle after loss of resistance to air and nerve stimulation *via* the needle and catheter omitted if muscle twitches are undesirable or painful. A lower success rate may have to be accepted if this is done, but this notion has not yet been evaluated by formal research.

Tunneling to secure catheter

> Penetrate the skin with the inner steel stylet of the needle 1–3 mm from the catheter entry site and advance the stylet subcutaneously in a medial direction to exit the skin near the C6 dorsal spine (Figure 3.6).

Insert the inner stylet of the needle 3–5 cm from the catheter exit site and advance subcutaneously to exit the skin approximately 6–8 cm medially. See text.

Figure 3.6

> "Rail-road" the needle over the stylet (Figure 3.6).
> Remove the stylet and feed the catheter retrogradely through the needle and proceed as outlined in Chapter 1.

Drugs

Initial bolus injection

The author uses 15–40 ml ropivacaine (0.5%–0.75%) or bupivacaine (0.5%) as a bolus injection for intra- and post-operative analgesia if the block is combined with general anesthesia. If it is used as sole anesthetic, 40 ml is usually required. Care must then be taken to block the superficial cervical plexus separately if required.

Continuous Infusion

Breakthrough pain was rare and patient satisfaction high in a recent study in which patients were discharged from hospital with disposable elastometric infusion pumps delivering 3–10 ml/h of 0.2% ropivacaine or 0.25% bupivacaine.[4] Patient-controlled injection of 5–10 ml and a lockout time of 30–60 minutes will provide satisfactory results.

Sedation for placing block

Very little or no sedation is typically required for this block. Based on a study of sedation for retrobulbar block,[5] the author uses midazolam 10–50 µg/kg combined with remifentanil 0.3–0.5 µg/kg given as an intravenous bolus 1 minute before the placement of the block. The remifentanil injection can be repeated when necessary. Sedation should be used cautiously if the patient is in the upright position for this block. Alfentanil 5–10 µg/kg is also very successful in this application, but most pain with this bock is due to anxiety and midazolam is usually all that is required.

Blocks are usually performed in non-anesthetized patients, but under certain circumstances they are performed in anesthetized patients. These circumstances include when the patient is a child, when very painful conditions, for example, fractures, are present or when the patient is very anxious. The skin and subcutaneous tissue should always be properly anesthetized for blocks as well as for the intended tunneling path of the catheter.

Tips

- The catheter should always be withdrawn entirely into the needle before the needle is repositioned. Catheter withdrawal should be done carefully to prevent damage to the catheter.
- The presence of significant paresthesia during catheter advancement should be carefully evaluated before advancing the catheter.
- Conditions such as existing brachial plexitis or pre- or sub-clinical complex regional pain syndromes should be specifically documented before any brachial plexus block is administered. Patients with *bona fide* shoulder joint pathology present with shoulder pain, but very infrequently with pain distal to the elbow. Pain distal to the elbow is usually an indication of a neurological condition.
- Be suspicious of sub-perineural needle or catheter placement if brisk muscle twitches are present with nerve stimulator settings less than 0.2 mA (except in children).
- Since an indwelling catheter is left in situ for some time, formal sterile procedures are necessary. The entry site of the catheter should be inspected daily for early signs of infection.
- Sensation should be allowed to return to the limb before the catheter is removed. Catheters should never be cut while being removed. If the surgical pain is still intolerable, a bolus of the local anesthetic agent should be injected and the infusion initiated again. If surgical pain is tolerable or manageable with simple analgesics, the catheter may be removed by gently pulling on it in the direction of the tunneling or by removing the part distal to the skin bridge first. Radiating pain experienced during removal may indicate that the catheter has curled around a nerve root. Surgical removal of catheters has never been reported to be necessary but should probably be considered if radiating pain persists during attempted removal. The skin bridge makes removal easier.
- Because the entire arm is likely to be insensitive for the duration of the continuous block, the ulnar nerve at the level of the elbow and the radial nerve at the mid-humeral level should always be protected. Special attention should also be given to the positioning of the patient on the operating table, and ambulatory patients with continuous brachial plexus blocks in place should always use a properly fitted arm sling to prevent traction injury to the brachial plexus. In addition to pressure

on these nerves, intra-operative traction on the brachial plexus, or post-operative traction due to a poorly fitted sling may be responsible for secondary nerve injury. This can often be confused with primary nerve injury with the needle or catheter. The latter is extremely rare, however.

> This block is almost always associated with a Horner's syndrome. Reassurance of patients is all that is required if this syndrome occurs.

Suggested reading

1 Pippa P, Cominelli E, Marinelli C, Aito S. Brachial plexus block using the posterior approach. *European Journal of Anaesthesiology* 1990; 7: 411–420.

2 Boezaart AP, de Beer JF. Continuous low cervical paravertebral block for shoulder surgery (Abstract). *American Society of Regional Anesthesia Meeting*, Vancouver, BC, Canada, May 10–13, 2001. Poster exhibit number 68

3 Boezaart AP, de Beer JF, du Toit C, van Rooyen K. A new technique of continuous interscalene nerve block. *Canadian Journal of Anesthesia* 1999; 46(3): 275–281.

4 Boezaart AP, de Beer JF. The ambulatory management of acute pain following major shoulder surgery by continuous plexus blocks (Abstract). *American Society of Regional Anesthesia Meeting*, Vancouver, BC, Canada, May 10 –13, 2001. Poster exhibit number 129.

5 Boezaart AP, Berry AR, Nell ML, van Dyk AL. A comparison of propofol and remifentanil for sedation and limitation of movement during peri-retrobulbar block. *Journal of Clinical Anesthesia* 2001; 13: 422–426.