

Posterior interscalene block: An ultrasound-guided case series and overview of history, anatomy and techniques

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BACKGROUND: The posterior interscalene block has been described as an alternative to the lateral interscalene block. However, this technique has not gained popularity because of the close proximity of the approach to vascular and central neural structures.

OBJECTIVE: To describe the posterior interscalene block technique using ultrasound imaging, and to review the history of its evolution.

METHODS: The use of ultrasound imaging to facilitate the insertion of interscalene catheters using the posterior approach in 11 patients undergoing total shoulder arthroplasty is described.

RESULTS: All 11 patients had satisfactory analgesia in the first 24 h of the postoperative period. None of the patients complained of neck pain, as had been found in earlier techniques using the posterior approach.

CONCLUSIONS: This modification of the posterior approach is a safe and effective method for the insertion of interscalene brachial plexus catheters. These catheters are also comfortable for patients and, in the present study, none of the catheters inadvertently fell out.

Key Words: *Brachial plexus ultrasonography; Local anesthetics; Nerve block; Parenteral infusions; Prospective studies*

The traditional anterior interscalene block (ISB) described by Winnie (1) has recently been modified several times to facilitate the insertion and fixation of a continuous interscalene catheter, and to minimize the risk of catheter dislodgment. Some of these modifications, while they have different names, share a similar anatomical entry point – posterior to the brachial plexus at the cervical level (2,3). These modifications have not gained wide acceptance because they require needle insertion that passes close to vascular and central neural structures. In the present case series, we describe our experience with the placement of continuous interscalene catheters in 11 patients undergoing total shoulder arthroplasty, using ultrasound imaging to guide a modified posterior ISB. We also provide an overview of the history, technical aspects and anatomy pertinent to the area.

METHODS

With approval from the Sunnybrook Health Sciences Centre Research Ethics Board (Toronto, Ontario), and having obtained written informed consent, 11 patients were prospectively recruited. Inclusion criteria were total shoulder arthroplasty using a deltopectoral approach and an American Society of

Le bloc interscalénique par abord postérieur : Une série de cas orientée par échographie et un aperçu de l'historique, de l'anatomie et des techniques

HISTORIQUE : Le bloc interscalénique par abord postérieur est décrit comme une solution de rechange au bloc interscalénique par abord latéral. Cependant, cette technique ne s'est pas popularisée en raison de l'étroite proximité de l'abord avec les structures vasculaires et du système nerveux central.

OBJECTIF : Décrire la technique du bloc interscalénique par abord postérieur au moyen de l'imagerie échographique et analyser l'historique de son évolution.

MÉTHODOLOGIE : Est décrit le recours à l'imagerie échographique pour faciliter l'insertion de cathéters dans la portion interscalénique par abord postérieur chez 11 patients subissant une arthroplastie de l'épaule.

RÉSULTATS : Les 11 patients ont profité d'une analgésie satisfaisante dans les 24 premières heures de la période postopératoire. Aucun n'a décrit de douleurs cervicales, comme on le constatait par le passé lorsqu'on utilisait des techniques par abord postérieur.

CONCLUSIONS : Cette modification de la méthode par abord postérieur est sécuritaire et efficace pour insérer les cathéters dans la portion interscalénique du plexus brachial. Ces cathéters ne causent pas d'inconfort aux patients et, dans la présente étude, aucun n'est tombé par inadvertance.

Anesthesiologists physical status of 1 to 3. Exclusion criteria were the inability to provide consent, significant psychiatric comorbidity, previous cervical spine surgery or injury, a pre-existing neurological deficit, or brachial plexus injury in the upper extremity to be blocked. Patient characteristics are presented in Table 1.

In the block room, intravenous access was established and patients were sedated with intravenous midazolam (1 mg to 2 mg) and fentanyl (50 µg to 100 µg) as needed. Routine monitors were attached (an electrocardiogram, a noninvasive blood pressure monitor and an oxygen saturation monitor), and the skin was prepared with standard antiseptic and draping. Patients were positioned in the lateral decubitus position with the surgical side uppermost (Figure 1), although this block can be sited with the patient in the sitting position. Bony landmarks were identified before ultrasound imaging. A linear array probe (3 MHz to 12 MHz; HD11 XE, Koninklijke Philips Electronics NV, The Netherlands) covered with a sterile sheath was applied to the skin at the level of C6. All blocks were sited by either a staff anesthesiologist or a fellow in regional anesthesia with direct supervision from a staff anesthesiologist.

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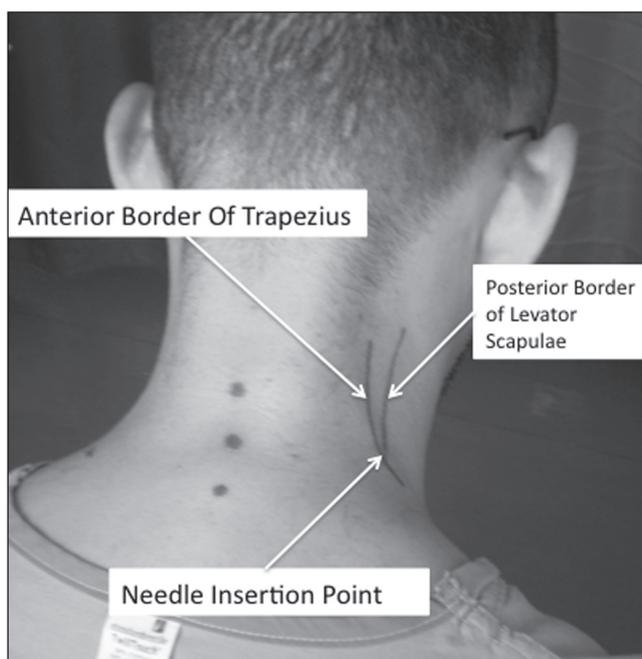
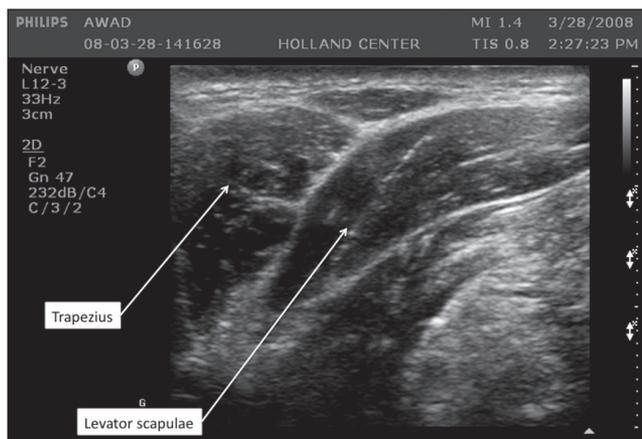
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TABLE 1
Patient characteristics

Age, years, mean \pm SD	64.8 \pm 12.5
Sex, male/female, n	3/8
Morphine equivalents received in the first 24 h after surgery, mg	10.6

**Figure 1)** Patient in position for preparation for the catheter insertion

At the junction of the trapezius and levator scapulae muscles (Figures 2 and 3), 5 mL of local anesthetic was injected (2% plain lidocaine) and an insulated nerve-stimulating needle (17-gauge Tuohy needle, Arrow International, USA) was advanced toward the interscalene groove under direct ultrasound guidance. The needle was guided using an in-plane ultrasound technique until the posterior aspect of the brachial plexus at the C5/C6 level was reached. The bevel of the needle was turned laterally toward the shoulder. The location of the needle tip was further confirmed using a nerve stimulator producing a 0.5 mA current to evoke a contraction of the muscles innervated by the C5 and C6 roots (biceps, deltoid or triceps twitch). A stimulating catheter was advanced 4 cm to 5 cm beyond the needle tip, making sure that the elicited twitch was sustained at a current of 0.5 mA (Figure 4). Advancement of the catheter, if performed under ultrasound guidance, does not require nerve stimulation; however, it was undertaken for the purposes of the present case series. The needle was then removed and the catheter secured with liquid skin adhesive (Dermabond, Ethicon, USA) and a clear, sterile adhesive dressing. A bolus of 20 mL 0.5% plain ropivacaine was then injected in increments of 5 mL through the catheter after negative aspiration. This was performed under ultrasound guidance to ensure proper spread and to avoid intravascular injection. The entire procedure was timed from the first application of the ultrasound probe (time 0) to the end of local anesthetic

**Figure 2)** The needle insertion point for the Boezaart technique**Figure 3)** Ultrasound image showing the junction of the levator scapulae and trapezius muscles

injection through the stimulating catheter (time 1). The transverse process with which the point of entry was most closely correlated was noted. The distance from the needle to the C6 or C7 transverse process was recorded. The length of the needle and the catheter inserted were also measured. The muscles stimulated by the nerve stimulator and the minimum current in mA were also recorded. The discomfort experienced by patients during the procedure was also measured using a verbal rating scale (VRS) of 0 to 10.

An observer evaluated sensory and motor blocks 30 min after the end of injection of local anesthetic solution through the catheter. Asking the patient to flex and extend the forearm at the elbow joint and to abduct the arm at the shoulder joint assessed motor function for the biceps, triceps and deltoid muscles, respectively. Motor function was graded on a scale of 1 to 5, where 1 = no contraction or movement, 2 = weak muscle contraction unable to resist gravity, 3 = weak muscle contraction but able to resist gravity, 4 = resistance against

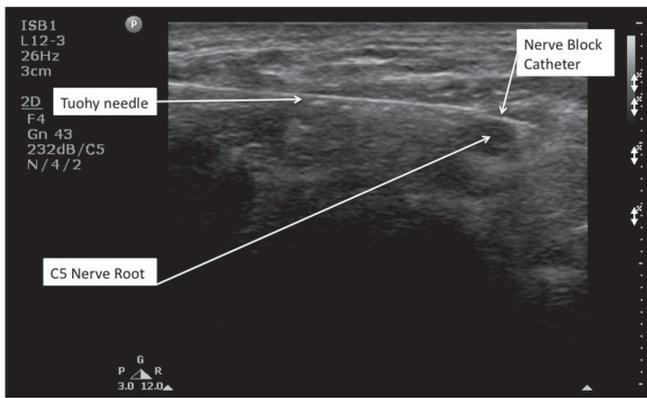


Figure 4) Ultrasound image showing the catheter emerging from the Tuohy needle immediately above the C5 nerve root

gravity with weak resistance against the examiner and 5 = normal power. Sensory assessment of the C4, C5 and C6 dermatomes was performed using a blunt 22-gauge needle and was classified on a scale from 1 to 3, where 1 = normal sensation, 2 = sensation of dull pressure and 3 = absence of sensation (anesthesia). The dermatome map was adapted from Hermanns et al (4).

All patients received standardized general anesthesia. The total intraoperative narcotic requirement in the operating room was documented. In the postanesthesia care unit (PACU) and on postoperative day 1, patients were assessed for pain scores, the presence of complications and total narcotic requirements.

Postoperative analgesia consisted of a continuous infusion of 0.1% plain ropivacaine at a rate of 5 mL/h, as well as oral celecoxib 200 mg twice a day, gabapentin 200 mg three times a day and oxycodone 5 mg to 15 mg as required. The catheter was maintained for 24 h. Patients were also contacted by telephone seven days after the surgery, and were assessed for complications and level of satisfaction with their anesthetic care.

RESULTS

Eleven patients had interscalene catheters inserted. All were successfully placed; however, one failed clinically. The failure manifested as a sensory and motor block present at the 30 min assessment; however, the patient experienced pain after surgery that was unresponsive to analgesic top-up through the catheter. This was managed successfully with 6 mg of oral hydro-morph contin per day for two days in combination with oral adjuncts (celecoxib, acetaminophen and gabapentin). Placement of the catheters, from first visualization with the ultrasound probe to injection of local anesthetic through the catheter, lasted for a mean of 12 min, with a range from 5 min to 22 min. Needle entry point, depth and distance from the transverse process of C6 or C7 are shown in Table 2.

In the PACU, three of the patients initially had pain mainly in the deltopectoral groove and the axilla. These patients were given a 10 mL bolus of 2% lidocaine through the catheter with the patient in a sitting position and morphine boluses (largest total amount given 10 mg) to relieve the pain. This pain may have been associated with the surgical incision through the deltopectoral groove, performed as part of the total shoulder arthroplasty. The sensory dermatomes at this level are T2 and T3, while the catheter tip is at the level of C5 or C6, so the groove

TABLE 2
Needle entry point, depth and distance from the transverse process of C6 or C7

	Mean (range), mm
Needle entry distance from midline	42 (20–60)
Needle distance from transverse process	8.4 (5–13.5)
Depth of insertion of Tuohy needle	62 (30–80)
Depth of insertion of catheter beyond needle tip	44 (15–70)

may lie outside the blocked dermatomes. Overall, there was a mean VRS of 0.6 of 10 in the PACU, with eight of the 11 patients choosing 0 of 10 on the VRS.

Five of the 11 patients displayed signs of recurrent laryngeal nerve palsy in the PACU, and another two had a subjective sense of altered breathing.

On postoperative day 1, the mean VRS was 1.4 of 10. One patient was distressed by numbness in her hand and did not receive any top-up of ropivacaine on the day after surgery. One week after the surgery, the authors were able to contact seven of the 11 patients. Of these seven, five described their satisfaction with the catheter as either good or excellent.

In the present group of patients, none of the catheters fell out or were removed inadvertently.

DISCUSSION

This adaptation of a previously described technique was developed to make use of ultrasound imaging to improve the safety of the posterior approach. We also set out to show that this approach was acceptable to patients and provided good, reliable analgesia.

In all cases, the C6 transverse process was visualized, with the closest needle path being 6 mm from the tip of the process. There is a concern in the literature that the posterior approach may not be safe because it is possible to lose the midline and proceed in a medial direction (5). A few published case reports (6,7) demonstrated intrathecal and epidural injection with the posterior approach – all of which have led to concerns over the safety of the approach. With ultrasound guidance, it was possible to visualize the transverse process and maintain an approach lateral to the bony prominence.

Another reason why the posterior approach has not been widely adopted is that passing a needle through the posterior neck muscles can be painful. The levator scapulae lies laterally, and the splenius colli lies medially, posterior to the middle scalene muscle at the C6 level. Posterior and posteromedially to the splenius colli lie the splenius capitis and semispinalis capitis, respectively. These muscles are pierced using the Pippa technique (2). The insertion point for this block lies where the superior border of the trapezius intersects with a horizontal line drawn from the midpoint between C6 and C7. The needle is then advanced through the splenius cervicis and levator scapulae to reach the posterior and middle scalene muscles. As it leaves the middle scalene muscle, the needle passes through the scalene fascia, in which loss of resistance is elicited.

Pippa et al (2) proposed that this new posterior approach to the brachial plexus would be safer than the Winnie 'lateral' approach (1). This was because most of the structures that could be inadvertently hit by the advancing needle (the carotid artery or phrenic nerve) lie anterior to the plexus. The Pippa approach passes through the levator scapulae and splenius colli. The

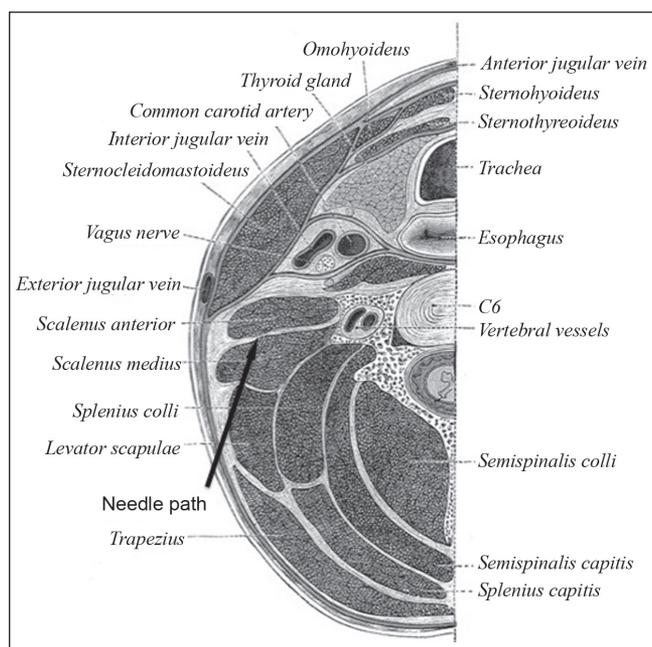


Figure 5) Cross-section of the neck at C6 with the needle pathway superimposed. Adapted from reference 13

Boezaart technique (3) uses a more lateral approach than the Pippa approach, with needle entry at the junction of the levator scapulae and trapezius; however, it may also pass through the levator scapulae (Figure 5). This insertion point corresponds to the C6 vertebral level. The modification was designed to minimize the amount of muscle traversed by the needle on its course to the plexus, with the aim of minimizing the pain experienced with needle insertion. We found that passing through the middle scalene muscle and, on occasion, the levator scapulae is unavoidable. It may even be beneficial, by tethering the catheter once in situ. This can cause some discomfort, which can be minimized by intravenous fentanyl.

In 2005, Sandefo et al (8) published a case series of 120 patients who had brachial plexus catheters inserted using the Boezaart technique. These were shown to provide good analgesia with a peak mean visual analogue scale pain score in the first 48 h of 17 mm. They also showed that this technique could be performed with a low incidence of side effects. Of the 120 patients, only four had Horner's syndrome and one experienced difficulty breathing. Three patients described neck pain, which disappeared once the catheter was removed. This incidence of neck pain corresponds with Boezaart et al's experience in 2003 (3). None of our patients reported neck pain when they were contacted seven days postoperatively. In 2006, Rettig et al (9) published a trial comparing the Pippa approach with the Winnie approach. They found no significant difference in the success rate of the block or in the complications associated with either block. They used an 80 mm insulated block needle for this technique. The use of a sharp needle in place of a large-gauge loss-of-resistance needle for a paravertebral block was criticized (10). This was due to the proximity of the approach to the dural cuffs and the risk of intrathecal injection. This is interesting, given that Pippa was using a 21-gauge needle in his description of the block (2).

Recently, van Geffen et al (11) demonstrated the use of ultrasound to aid the insertion of a single-shot interscalene brachial plexus block using a 22-gauge stimulating needle. He also showed that this technique could be taught to operators new to the use of ultrasound. They used an approach similar to the classical Pippa approach, using a needle insertion point 30 mm to 35 mm from the midline between the spinous processes of C6 and C7. They had nine cases of Horner's syndrome and five cases of dyspnea.

We found that, with ultrasound guidance obviating the need to aim for the transverse process, a more superficial approach was possible, avoiding the bulk of the muscles in the back of the neck. This may lead to a decrease in the amount of pain associated with the procedure.

Despite the lack of any injection through the needle to open a path for the catheter, all of the catheters were threaded easily, with only one exception. The one catheter that did not pass smoothly was threaded after minor manipulation of the needle. In a similar case series (12), 1 mL to 3 mL of 5% dextrose was used to facilitate catheter threading.

The blocks were all clinically effective, as described above, apart from one. On sensory testing, the C4 and C5 dermatomes were blocked in all patients. C6 was also blocked in eight of 10 patients. Initially, the interscalene catheters were placed above the C5 nerve root. In the results of the present study, some of the patients had pain in the deltopectoral groove, at the site of the surgical incision. This skin falls in the dermatome supplied by T2 and is unlikely to be covered by an ISB. Analgesia may be improved by subcutaneous infiltration of local anesthetic by the surgeons along the site of their incision. If this is ineffective, it may be necessary to give systemic analgesia to cover this source of pain.

The presence or absence of motor block at 30 min in the biceps, triceps or deltoid muscle did not predict block success. The median motor function in each of these muscles was deltoid = 0, biceps = 0 and triceps = 3.

SUMMARY

We describe a new adaptation of the use of ultrasound to guide the insertion of interscalene catheters. This, we believe, made an established technique safer and allowed the safe insertion of the catheters with less risk of catheter dislodgment than the traditional Winnie approach.

REFERENCES

1. Winnie AP. Interscalene brachial plexus block. *Anesth Analg* 1970;49:455-66.
2. Pippa P, Cominelli E, Marinelli C, Aito S. Brachial plexus block using the posterior approach. *Eur J Anaesthesiol* 1990;7:411-20.
3. Boezaart AP, Koorn R, Borene S, Edwards JN. Continuous brachial plexus block using the posterior approach. *Reg Anesth Pain Med* 2003;28:70-1.
4. Hermanns H, Braun S, Werdehausen R, Werner A, Lipfert P, Stevens MF. Skin temperature after interscalene brachial plexus blockade. *Reg Anesth Pain Med* 2007;32:481-7.
5. Harrop-Griffiths W, Denny NM. The cat in the kitchen: Problems with the Pippa technique. *Anaesthesia* 2006;61:1028-30.
6. Grefkens JM, Burger K. Total spinal anaesthesia after an attempted brachial plexus block using the posterior approach. *Anaesthesia* 2006;61:1105-8.
7. Gomez RS, Mendes TC. Epidural anaesthesia as a complication of attempted brachial plexus blockade using the posterior approach. *Anaesthesia* 2006;61:591-2.

8. Sandefo I, Bernard JM, Elstraete V, et al. Patient-controlled interscalene analgesia after shoulder surgery: Catheter insertion by the posterior approach. *Anesth Analg* 2005;100:1496-8.
 9. Rettig HC, Gielen MJ, Jack NT, Boersma E, Klein J. A comparison of the lateral and posterior approach for brachial plexus block. *Reg Anesth Pain Med* 2006;31:119-26.
 10. Boezaart AP, Franco CD. Thin sharp needles around the dura. *Reg Anesth Pain Med* 2006;31:388-9.
 11. van Geffen GJ, Rettig HC, Koornwinder T, Renes S, Gielen MJ. Ultrasound-guided training in the performance of brachial plexus block by the posterior approach: An observational study. *Anaesthesia* 2007;62:1024-8.
 12. Antonakakis JGS, Brian D, Shiffrin J. Ultrasound-guided posterior approach for the placement of a continuous interscalene catheter. *Reg Anesth Pain Med* 2009;34:64-8.
 13. Gray H. *Anatomy of the Human Body*. Philadelphia: Lee & Febiger, 1918; Bartley.com, 2000.
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