

TECHNICAL NOTES

SUPRACLAVICULAR APPROACH TO BRACHIAL PLEXUS BLOCK USING FLUOROSCOPIC ANATOMIC LANDMARKS AND NERVE STIMULATION

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Irritation of neural structures, specifically the brachial plexus outside of the cervical spine is capable of producing pain in the upper extremity. These pain patterns may be similar to pain originating from the cervical spine, presenting a diagnostic challenge.

Brachial plexus block is performed at multiple levels, including interscalene, supraclavicular, infraclavicular, and axillary. Interscalene block is frequently utilized by

interventional pain management physicians for diagnostic and therapeutic purposes to isolate and manage the brachial plexus as a pain generator. The traditional methods employed in performing interscalene or supraclavicular brachial plexus blocks are associated with multiple disadvantages.

A new technique is described to meet five essential requirements encompassing safety, specificity, consistency, reproducibility and a high success rate.

Relevant anatomy and proposed technique of brachial plexus block is described. The procedure is performed under fluoroscopy with contrast injection.

It is concluded that the proposed technique of brachial plexus block is useful for brachial plexus blockade providing precision and specificity with minimal complications.

Keywords: Brachial plexus block, supraclavicular block, interscalene block, neck pain, upper extremity pain, fluoroscopy

Patients with persistent pain of neck, shoulder and upper arm comprise a significant number of patients seen in an interventional pain clinic setting. These symptoms are most often associated with cervical spine pathology, however, irritation of neural structures, specifically the brachial plexus, outside of the cervical spine are capable of producing similar pain patterns presenting a diagnostic challenge (1, 2). Patients present with similar history and physical findings, and diagnostic testing, including magnetic resonance imaging and electromyograms etc., often reveals only non-specific cervical abnormalities. The differential diagnosis frequently becomes one of cervicogenic pain versus thoracic outlet syndrome or varying contributions from both.

All of the deep structures of the upper extremity and the skin distal to the middle of the upper arm are rendered insensitive by blocking the brachial plexus. The nerves of the plexus may be blocked anywhere in their course: from their emergence from intervertebral foramina and entrance into the sheath between the anterior and middle scalene muscles un-

til they terminate in the specific nerves in the hand (3). Techniques for blocking of the plexus involve infiltration at one of five anatomic areas – that is, paravertebral (interscalene), supraclavicular, infraclavicular, in the axilla, and by blocking the specific terminal nerves.

The brachial plexus supplies all of the motor and almost all of the sensory function of the upper extremity (3). The plexus is formed from the anterior primary rami of the fifth to eighth cervical and first thoracic nerves, and frequently receives small contributing branches from the fourth cervical and second thoracic nerve. After these nerves leave their respective intervertebral foramina, they proceed anterolaterally and caudally to occupy the interval between the anterior and middle scalene muscles, where they unite to form three trunks. These trunks emerge from the interscalene space at the lower border of these muscles and continue anterolaterally and inferiorly to converge toward the upper surface of the first rib, where they are closely grouped cephaloposterior to the subclavian artery (3). In its course, the brachial plexus is closely related to specific osseous and fascial structures, some of which serve as important landmarks during injection of the anesthetic.

Interventional pain management physicians are frequently asked to per-

form diagnostic/therapeutic interscalene blocks in an attempt to isolate the brachial plexus as a pain generator. The traditional methods utilized for this procedure have been those described in most regional anesthesia texts (3, 4). We felt that the proximity to the exiting nerve roots/fascial planes, and local anesthetic volumes utilized in this technique precluded the acquisition of any useful diagnostic information in differentiating a cervical, versus brachial plexus etiology of pain. Indeed, the literature is rife with case reports of interscalene block complications consistent with epidural, subdural, or subarachnoid spread and other complications (5-16).

The technique herein described was developed to meet five essential requirements: 1) be safe 2) provide greater specificity for the upper brachial plexus when compared to previously described techniques 3) have consistent fluoroscopic landmarks 4) be reproducible, and 5) have a high success rate.

TECHNICAL CONSIDERATIONS

Relevant Anatomy

The brachial plexus is formed from the anterior primary rami of the fifth, sixth, seventh and eighth cervical and the first thoracic nerves and frequently receives small contributing branches from

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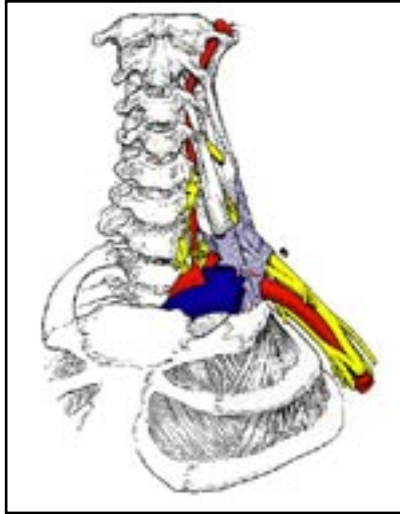


Fig 1. Adapted and modified from Cousins and Bridenbaugh, Neural Blockade in Clinical Anesthesia, Third Edition, 1998(3).

the fourth cervical and second thoracic nerve.

The cervical nerves of the brachial plexus, after leaving their respective intervertebral foramina, pass laterally in a deep groove or gutter in the superior surface of the transverse process of the cervical vertebra (3). Transverse processes are separated into anterior and posterior tubercles by this group. They give origin to the scalenus anterior and scalenus medius muscles, respectively (3) (Fig. 1). The direction of the gutters in the lower cervical vertebrae is primarily lateral but also slightly anterior and almost 45° caudad. The transverse processes in this region not only tend to overlap but they are also quite short and offer little protection to the intervertebral foramina from a horizontally directed needle.

Technique

The procedure is performed in an operating room or a procedure room equipped with radiolucent table and high-resolution mobile C-arm fluoroscopy. Anesthesia is obtained utilizing subcutaneous infiltration of local anesthetic (1% buffered lidocaine), with or without light sedation.

The patient is positioned supine with the head neutral or turned slightly to the contralateral side. A posterior-anterior projection is obtained, centered on the sternal notch. The C-arm is rotated 15° to the ipsilateral side, placing the angle of the

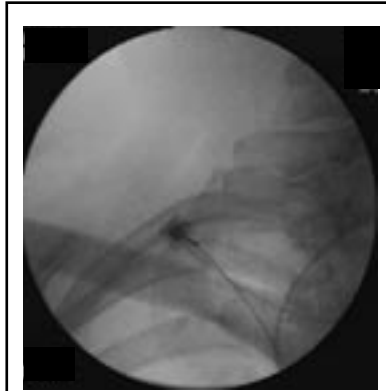


Fig 2. Fluoroscopic image without contrast.

beam closer to alignment with the path of the brachial plexus, and, more importantly, makes unintentional pleural puncture impossible as long as the needle is not allowed to violate the plane of the medial border of the first rib. A cephalad tilt of approximately 15° is then applied to the C-arm, projecting the proximal/upper 1/3 to 1/2 of the first rib superior to the clavicle. The target point is the midpoint of the 1st rib, 1.0 cm. above the clavicle (Fig. 2). After anesthetizing the skin, a 22ga. 2 inch insulated nerve block needle (Braun Stimuplex[®]) is advanced coaxial to the beam until motor stimulation of the brachial plexus is consistently obtained between 0.4 and 0.7 volts. 1-3 mL of contrast (Isovue-M[®] 200) is then slowly injected and should be met with little resistance and produce minimal to no discomfort to the patient. This frequently yields unmistakable contrast spread within the fascial sheath and outline of the trunks of the plexus (Fig. 3).

Once appropriate needle placement, stimulation parameters, and contrast spread are obtained; a total volume of 5-8 mL, preservative free, 0.5% (diagnostic) or 4 mL .75% bupivacaine, buprenorphine 1.0 mg, betamethasone 6.0 mg, and clonidine 0.2 mg) is injected while monitoring washout patterns to ensure the absence of significant intravascular injection (failure to see dilution of contrast within the sheath/soft tissues) and that contrast washout remains well outside the neural foramen (Fig. 4).

Post Procedure

Patients frequently have subjective symptoms of brachial plexus block and pain relief (if brachial plexus is the pain



Fig 3. Needle placement and injection of contrast.

generator) within minutes following the procedure. Objective findings occur 5-10 minutes post injection. Profound motor block may occur, however vasodilatation and diffuse weakness is more commonly seen due to the low volumes utilized.

Complications

With interscalene block, unintentional epidural or spinal anesthesia is always possible and has been reported (5-16). In addition, with interscalene block, the vertebral artery is close to the point of even a correctly placed needle. Further, the phrenic nerve is blocked almost uniformly, either because of direct C4 root involvement or anterior spread to reach the anterior surface of the anterior scalene muscle (11, 12). However, this is seldom significant in unilateral blocks. Additionally, vagus, recurrent laryngeal, and cervical sympathetic nerves are blocked occasionally with no clinical significance. All these complications are avoided by this technique and we have not observed any such complications.



Fig 4. Contrast washout injection

DISCUSSION

Brachial plexus nerve block was first performed by Halsted in 1884 (3). Hirschel (17) and Kulenkampff (18), working independently, injected the brachial plexus percutaneously without the exposure of the nerves. Numerous modifications of these original techniques, varying mostly according to site, have been described (3). Among the multitude of techniques, the interscalene block was developed and later described as an alternative to the supraclavicular approach to the brachial sheath (19-21).

Multiple modifications of brachial plexus block include interscalene, supraclavicular, infraclavicular, axillary, and continuous techniques. It has been most commonly used in providing surgical anesthesia. However, with the introduction of intravenous and inhalational anesthetics, the enthusiasm for brachial plexus block waned. In current years, the technique has had a resurgence, not only as a regional anesthetic technique in surgical anesthesia, but also in interventional pain management for diagnostic as well as therapeutic purposes. Multiple advantages and disadvantages have been described for each technique. Advantages of supraclavicular block include blocking of the brachial plexus where it is most compactly arranged (at the level of three trunks), with requirement for a low volume of solution and rapid onset of action. However, disadvantages of supraclavicular block include requirement for elicitation of paraesthesia to attain a reliable rapid onset block (3). Further, the risk of pneumothorax is higher with this approach. In contrast, interscalene block provides a proximal block with inclusion of cervical plexus. Further, the risk of pneumothorax is minimal. The disadvantages of interscalene block include unintentional epidural or spinal anesthesia, and puncture of vertebral artery. In addition, the recommended volumes of local anesthetic injections range from 15 to 25 mL with interscalene block (3). Thus, this fails to provide any significant diagnostic information.

The technique described here is safer than interscalene block, and is target specific, requiring low volume local anesthetic (5 to 8 mL vs 10 to 15 mL), thus providing reliable diagnostic information. In addition, it has been shown in our evaluation that contrast washout following lo-

cal anesthetic injection remains well outside the neural foramen (Fig. 3). None of the complications described, either with supraclavicular approach or interscalene approach have been experienced. Further, no other complications were experienced in our initial series.

One of the disadvantages of this technique is that we recommend the procedure to be performed only under fluoroscopic visualization. Nerve stimulation may be optional.

CONCLUSION

Patients with persistent neck, shoulder, upper thoracic, and upper extremity pain, frequently pose a diagnostic challenge. Greater acceptance, recognition, and interventions for a brachial plexus etiology have lead to a demand for better diagnostic tools including neural blockade. Techniques for brachial plexus blockade useful for surgical anesthesia lack the precision and specificity required for interventional diagnostics and therapeutics.

We have demonstrated a safe, documentable, and consistent technique to produce a specific block of the brachial plexus. Additional research evaluating clinical outcomes from information obtained from this procedure is needed to evaluate clinical relevance and utility.

ACKNOWLEDGMENTS

The authors wish to thank Dr. Zong Fu of the University of Colorado Medical School Department of Anatomy for the cadaver brachial plexus dissection, John Wolfson XRT and Ginny Hall XRT for their support in obtaining the fluoroscopic images, and David Bailey for his assistance in obtaining and editing the photographic imaging.

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