BRIEF REPORT

Supraclavicular Brachial Plexus Block for Arteriovenous Hemodialysis Access Procedures

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ABSTRACT

Ultrasound-guided supraclavicular brachial plexus block using 1% and 2% lidocaine in 21 procedures is reported. Average procedure time was 5.1 minutes (± 1.2 min; range, 2–8 min). Average time of onset and duration were 4.8 minutes (± 3.7 min; range, 0–10 min) and 77.9 minutes (± 26.7 min; range, 44–133 min), respectively, for sensory block and 8.4 minutes (± 5.7 min; range, 3–23 min) and 99 minutes (± 40.5 min; range, 45–171 min), respectively, for motor block. The pain scale assessment averaged 0.4 (± 1.1; range, 0–4). There were no complications.

ABBREVIATION

BPB = brachial plexus block

Regional anesthesia has an important role in the surgical creation of arteriovenous fistulae. The technique is ideally suited for procedures performed in the upper extremity, providing immobility of the arm, complete anesthesia, and significant vasodilation (1). The use of regional anesthesia during outpatient treatment of dysfunctional hemodialysis fistulae in the hospital setting has been reported as a simple, reliable, and safe alternative to intravenous sedation and analgesia, which can result in respiratory depression (2). Complex maturation procedures and percutaneous arteriovenous fistula creation can benefit from safe, high-quality analgesia, immobility, and vasodilation provided by brachial plexus block (BPB) (3,4). Many complex arteriovenous hemodialysis access procedures are now being done in the outpatient office setting without resources such as anesthesiology, surgery, and critical care (5). This retrospective study reports on our experience using supraclavicular BPB for complex dialysis access intervention in the outpatient office setting.

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A **Video** is available online at *www.jvir.org*.

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MATERIALS AND METHODS

A retrospective chart review of all BPBs performed between December 2014 and September 2015 identified 21 supraclavicular BPBs performed on 19 patients. Western Institutional Review Board provided regulatory review and approval for this study. All supraclavicular BPB procedures were performed by an interventional radiologist in a freestanding office–based vascular center. The supraclavicular BPB was used in the creation of 14 percutaneous arteriovenous fistulae and in seven maturation procedures. Per protocol, the patients undergoing fistula creation were on daily antiplatelet therapy (aspirin 325 mg and clopidogrel 75 mg).

Supraclavicular BPB was performed with ultrasound (US) guidance (SonoSite, Inc, Bothell, Washington) and aseptic technique in the preparation and holding area. The head of the bed was elevated 30°–45°. The patient's head and neck was positioned with a rolled sheet between the shoulder blades and the face turned away from the operative side. A 13-6 MHz linear transducer was positioned in the supraclavicular fossa. The brachial plexus above the clavicle and adjacent to the subclavian artery and first rib was identified (**Fig 1**). Using US guidance, an echogenic, facet-tip, 30° bevel, 21 gauge × 3⅛ inch needle with fixed extension tubing (EchoBlock; Hakko Co Ltd, Nagano-ken, Japan; distributed by Havel's Inc, Cincinnati, Ohio) was advanced to the brachial plexus (**Video** [available online at *www.jvir.org*]). Injection of 10 mL of lidocaine 2% into the brachial plexus was followed by injection of up to 10 mL of 1%

lidocaine. Injection of anesthetic adjacent to the deep, middle, and superficial nerve trunks of the brachial plexus was directed by US guidance (Fig 2a–c). Care was taken to aspirate the needle before each injection to ensure that the needle tip was not intravascular. Patients were also instructed to report any tinnitus, circumoral numbness, or lightheadedness that would suggest possible intravascular injection so that injection could be stopped. On completion of the nerve block, the needle was removed (Fig 3), and the patient was moved to the angiography suite to undergo the planned procedure. At the start of the procedure, 1% lidocaine was injected to raise a weal and allow safe dermatotomy at the access site for dialysis access intervention in all patients.

The nursing staff performed all recorded assessments of the block by touching the hand, forearm, and upper arm while the patient looked away and by asking patient to touch his or her nose until the block took effect. The same evaluations were performed as the block wore off. Additional intravenous sedation was administered in the procedure room to patients who were anxious or uncomfortable on the table as needed. The patient's level of sedation, vital signs, and verbal and nonverbal indications of pain were evaluated every 5 minutes in the procedure room and every 10 minutes after the procedure (6).

On completion of the procedure, the patient was asked by the nurse to rate his or her pain level during the procedure using the Wong-Baker 10-point visual analog scale combined with pain level descriptions from the Mankoski Pain Scale (Table) (7). The patients were observed for 30 minutes after the procedure. One patient with persistent motor block was placed in a sling and was asked during a follow-up phone call the time of motor function return.

All data collected were from chart review and included the block location and amount and type of local anesthetic. Quantitative assessments were performed using Microsoft Excel for Mac 2011 version 14.5.7 (Microsoft Corporation, Redmond, Washington) and included minimum, maximum, and average values and SD. Complications included local anesthetic systemic toxicity, pneumothorax, Horner syndrome, inadvertent phrenic nerve block, and intraneural nerve injection.

Relevant definitions are as follows:

1. Technical success: The loss of sensory and motor function in the intended region.
2. Sensory block: The patient verbalizes impaired sensation when the hand and arm are rubbed.
3. Motor block: The inability to lift or abduct the arm with control.
4. Sensory return: The patient verbalizes return of touching sensation when the hand and arm are rubbed.
5. Motor return: The ability to touch the nose with the index finger.

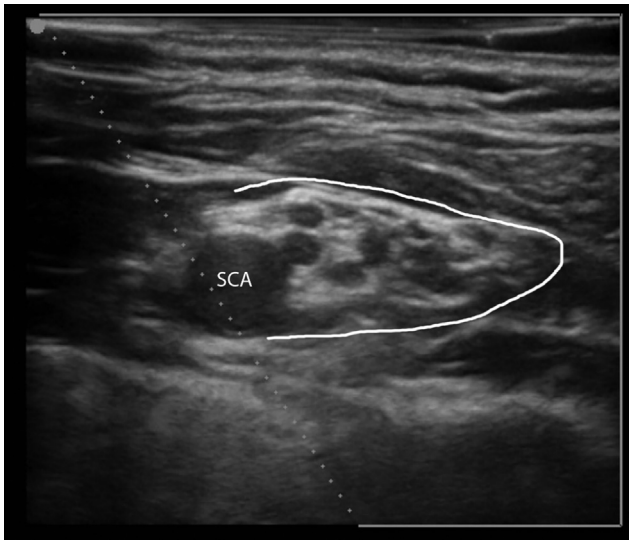

Figure 1. The left brachial plexus demonstrated in oblique view with the transducer above the clavicle and 30° caudal and to the right. The brachial plexus is superior and lateral to the subclavian artery (*SCA*) and is encircled by a white line.

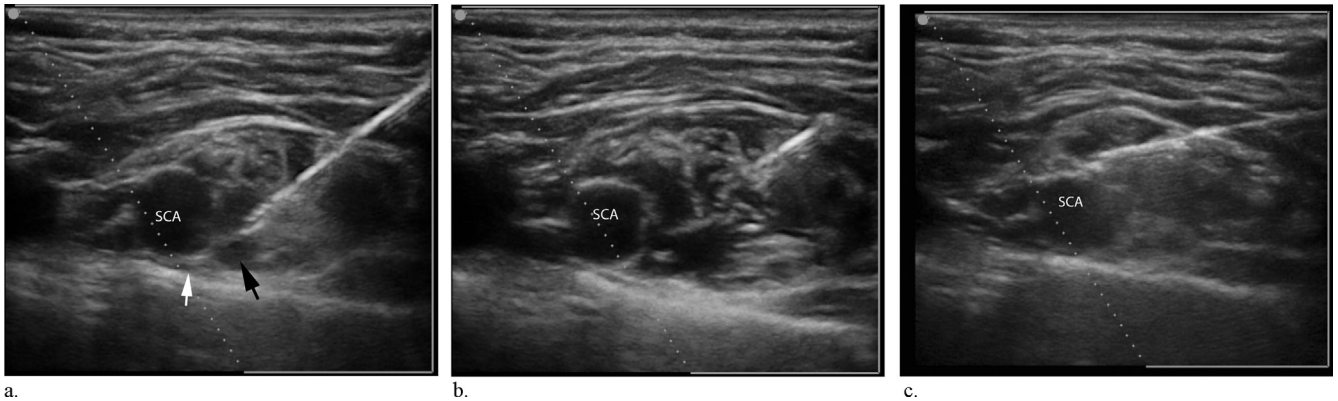

Figure 2. Multiple-injection technique. **(a–c)** Injection around the three major trunks of the brachial plexus—low, middle, and high. **(a)** Low injection. The white arrow points to the space between the pleura and the subclavian artery (*SCA*). This is often referred to as the "corner pocket." The inferior trunk of the brachial plexus contains the ulnar nerve (black arrow), and injecting local anesthetic in this location improves the anesthesia of the ulnar nerve. The **(b)** middle and **(c)** upper injections anesthetize the C5, C6, and C7 nerve roots supplying the radial distribution.

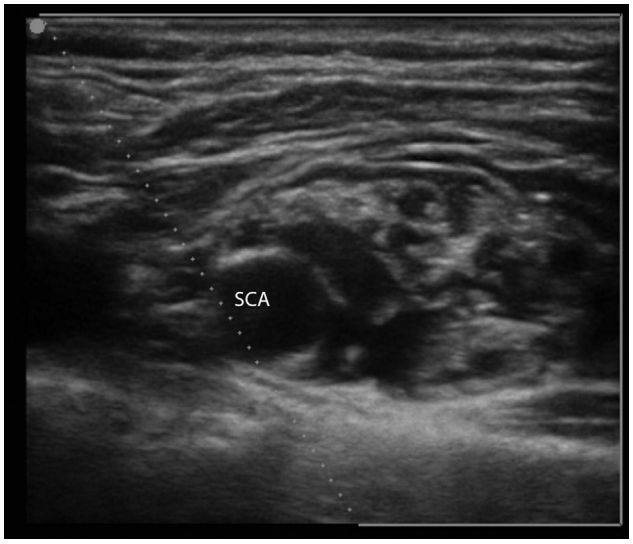

Figure 3. After needle removal, local anesthetic has infiltrated around the nerve trunks of the brachial plexus. *SCA* = subclavian artery.

Table. Pain Scale Descriptions from Mankoski Pain Scale

Scale	Description
0	Pain free.
1	Very minor annoyance—occasional minor twinges.
2	Minor annoyance—occasional strong twinges.
3	Annoying enough to be distracting.
4	Can be ignored if you are really involved in your work, but still distracting.
5	Can't be ignored for more than 30 minutes.
6	Can't be ignored for any length of time, but you can go to work and participate in social activities.
7	Makes it difficult to concentrate, interferes with sleep. You can still function with effort.
8	Physical activity severely limited. You can read and converse with effort. Nausea and dizziness set in as factors of pain.
9	Unable to speak. Crying out or moaning uncontrollably—near delirium.
10	Unconscious. Pain makes you pass out.

RESULTS

Technically successful nerve blocks without complications were recorded in all 21 cases. Average procedure time was 5.1 minutes (± 1.2 min; range, 2–8 min). The mean lidocaine dose was 24.6 mg (±3.6 mg; range, 20–30 mg) in a mean volume of 17.0 mL (± 2.4 mL; range, 10–20 mL). The average time to sensory block was 4.8 minutes (± 3.7 min; range, 0–10 min). The average time to motor block was 8.4 minutes (± 5.7 min; range, 3–23 min). The duration of sensory nerve block averaged 77.9 minutes (± 26.7 min; range, 44–133 min). The duration of motor block averaged 99 minutes (± 40.5 min; range, 45–171 min). The pain scale assessment averaged 0.35 (± 1.1; range, 0–4); 19 patients reported a pain assessment of 0, and two patients reported a pain assessment >0 (one assessment of 3 and one assessment of 4). Intravenous sedation was administered in five patients (24%): midazolam 1–2 mg in five patients and fentanyl 50 μg in one patient, resulting in mild sedation in one patient and moderate sedation in four patients.

DISCUSSION

US-guided supraclavicular BPBs with lidocaine for arteriovenous hemodialysis access procedures were performed by an interventional radiologist in the outpatient office setting with high technical success, excellent pain control, and low complications. A prior study performed by radiologists in the outpatient hospital setting with assistance from anesthesiologists had similar results (2). Similar to the present study, US guidance was used, with a similar average procedure time of 3.8 minutes, block onset of 5.4 minutes, and block duration of 65.2 minutes. Lidocaine was used in the present study as a local anesthetic with a potentially better safety profile than bupivacaine used in a prior study (8). Preparing for performance of supraclavicular BPB in the outpatient office setting required staff training; updating malpractice coverage; creating policies and procedures for performing nerve blocks; and preparation for potential complications, such as seizure, pneumothorax, and local anesthetic systemic toxicity (9).

US-guided techniques improve the procedure time and effectiveness of BPBs, with fewer inadvertent vascular punctures compared with techniques relying on anatomic landmarks, paresthesia, or nerve stimulation (10). Multiple-injection perineural techniques similar to the technique used in this study have been shown to have a higher rate of success compared with a single-injection technique (11). The use of US guidance has been shown to lower the known complications of supraclavicular nerve block, including intravascular injection, hematoma, seizure, arrhythmia, pneumothorax, Horner syndrome, inadvertent phrenic nerve block, intraneural nerve injection, and local anesthetic systemic toxicity (12).

Lidocaine in low dose and volume was chosen to provide safe nerve block of short duration (13). Bupivacaine has been used for BPB and is a long-acting, lipophilic anesthetic associated with cardiac toxicity and local anesthetic toxicity (2,8). Lidocaine has been reported to be shorter acting and much less arrhythmogenic than bupivacaine, making it a potentially safer choice for short-term nerve block desired in dialysis access procedures (14).

Operating physicians need to be aware of the risks and complications of BPBs and to be prepared to treat potential complications (12). Most of these complications and their treatments are familiar to interventional radiologists. One possible exception is local anesthetic systemic toxicity, a rare but serious complication occur-

ring in 1.5 per 10,000 nerve blocks as a result of intravascular injection of local anesthetic causing seizures and arrhythmias (15). Treatment consists of airway management, benzodiazepines for seizure control, and lipid emulsion therapy for arrhythmia and cardiac toxicity (9).

This study has several limitations; it was a single-site, single-operator, and retrospective report on the use of regional anesthesia for patients undergoing dialysis access procedures. All patients had local anesthetic injection at the procedure access site providing additional analgesia. This technique was not compared with other methods of anesthesia or sedation for patients undergoing dialysis access procedures. Selection bias was likely, as most patients (14 of 21) had percutaneous arteriovenous fistula creation. The remaining patients were known to be having a painful procedure or had problems with adequate analgesia during prior procedures. During the time of the study, an additional 38 patients had similar procedures.

In conclusion, supraclavicular BPBs can be performed with US guidance in the outpatient setting with good technical and clinical results. The supraclavicular BPB provides excellent pain control for dialysis access procedures with low morbidity. Physicians who are not anesthesiologists should be aware of the potential complications of supraclavicular nerve blocks and their treatment.

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