Ultrasound-Guided Supraclavicular Brachial Plexus Block for Analgesia during Endovascular Treatment of Dysfunctional Hemodialysis Fistulas

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ABSTRACT

Purpose: To evaluate prospectively the efficacy and safety of ultrasound (US)-guided supraclavicular brachial plexus block (BPB) for analgesia during endovascular treatment of dysfunctional hemodialysis fistulas.

Materials and Methods: US-guided supraclavicular BPB was performed before endovascular treatment of dysfunctional hemodialysis fistulas in 40 consecutive patients. After BPB, standard interventional procedures were performed for treatment of dysfunctional hemodialysis fistulas. A visual analog scale (0–10) was used to assess pain related to performance of BPB immediately after the endovascular procedure. Patient satisfaction and operator satisfaction during the procedure were also assessed after the procedure.

Results: Satisfactory regional anesthesia and analgesia were achieved in all patients without a need for supplemental intravenous analgesia. The mean onset time for complete block was 5.4 minutes ± 2.6. Pain scores were 0 (no pain) in 26 patients and 1–3 (mild, annoying pain) in 14 patients. The patient's satisfaction with pain control was recorded as satisfied (very well) in all cases. The operator's satisfaction with this anesthetic technique was also recorded as satisfied (very well) in all cases. Complications related to the block procedure did not occur in any patient.

Conclusions: US-guided supraclavicular BPB can be used safely to provide analgesia during endovascular treatment of dysfunctional hemodialysis fistulas in adult patients.

ABBREVIATION

BPB = brachial plexus block

Hemodialysis patients are usually poor surgical and anesthetic candidates. Various sedation and anesthesia techniques are used to provide anesthesia during surgical creation or revision of fistulas or prosthetic access grafts. The use of brachial plexus block (BPB) for these procedures results in analgesia and sympathetic block that achieves desired surgical conditions. BPB reduces morbidity, mortality, postoperative complications, length of hospital stay, and costs after surgery compared with general anesthesia. Simplicity and reliability of BPB anesthesia has made it particularly desirable for outpatient upper limb surgery (1–8).

Most hemodialysis fistula problems can be treated by percutaneous endovascular methods in an outpatient setting. Although less invasive than surgery, percutaneous endovascular procedures are still stressful and painful and usually require sedation and analgesia during the procedure. The most commonly used drugs for this purpose are midazolam and fentanyl, which should be used carefully in hemodialysis patients because of increased risk of respiratory depression (9–12).

Many studies demonstrate the safety and efficacy of BPB in hemodialysis patients who require surgical creation or revision of an arteriovenous fistula. However, there is no information on efficacy of BPB during percutaneous endovascular treatment of dysfunctional hemodialysis fistulas. Ultrasound (US)-guided BPB can

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offer analgesia without the adverse respiratory side effect of intravenous sedation and analgesia in hemodialysis patients. We designed a prospective study to investigate the safety and efficacy of US-guided supraclavicular BPB for analgesia during endovascular treatment of dysfunctional hemodialysis fistulas in adult patients.

MATERIALS AND METHODS

Patients

The study was approved by the institutional review board. This prospective single-arm study included 40 consecutive adult patients (21 women; age range, 19–81 y; mean age, 56.7 y ± 15.6) referred to our interventional radiology department for evaluation and treatment of a dysfunctional hemodialysis fistula. An interventional radiologist and an anesthesiologist assessed patients for inclusion in the study, risk of complications of the block and contraindications, and alternative anesthesia methods when required. Potential risks and benefits of the procedures for BPB and endovascular treatment of the dysfunctional hemodialysis fistula were explained in detail, and written informed consent was obtained from each patient. Patient exclusion criteria are listed in the **Table**. The definition of criteria and complications were based on reporting standards of the Society of Interventional Radiology (SIR) (13). Two patients were excluded from the study because they had a history of neurologic deficit in the ipsilateral upper limb.

Patient Preparation and Block Procedure

All patients were monitored with blood pressure measurement and pulse oximetry throughout the procedure. Diagnostic fistulography was obtained in each patient to determine any vascular problems. The entire route of the hemodialysis fistula was evaluated, including the afferent artery, anastomosis, and efferent vein to the level of the superior vena cava.

All patients were informed about the signs of local anesthetic toxicity, such as circumoral numbness and lightheadedness. Premedication was not administered during the BPB procedure because cooperation from an alert patient was required. In all patients, supraclavicular BPB were performed under US guidance by the same interventional radiologist (M.G.) to provide uniformity to the procedure. This operator also participated to the fistula treatment together with four other interventional radiologists or interventional radiology fellows. All blocks were performed under aseptic conditions. The patients were positioned supine on the operating table with the head turned to the opposite side. A linear 9- to 13-MHz transducer (Antares; Siemens AG, Erlangen, Germany) was placed transversally on the supraclavicular fossa to locate the brachial plexus. The brachial plexus, as a cluster of hypoechoic nodules, was found posterolateral to the subclavian artery (**Fig 1**). After skin anesthesia with local prilocaine, a 21-gauge needle with a cutting tip was advanced longitudinally to the transducer (in-plane) under real-time US guidance (**Fig 2**). Once the needle tip cut through the capsule and entered the brachial plexus, a mixture of 5 mL of bupivacaine 0.5%, and 5 mL normal saline was injected into the sheath (**Fig 3**, **Video 1**: The video shows US-guided puncture of the brachial plexus sheath and infiltration of the brachial plexus with anesthetic agent. [available online at *www.jvir.org*]). The needle tip was repositioned if spread of the local anesthetic was not appropriate. If the patients complained of paresthesia, the needle was withdrawn and repositioned until the patients did not complain.

All patients were checked for respiratory discomfort, Horner syndrome, and voice changes throughout the procedure. Side effects and complications, including blood vessel puncture, intravascular injection, overdose, dyspnea, and Horner syndrome, were noted after the procedure. If the patient was not symptomatic for pneumothorax, a chest radiograph was not obtained routinely (**Fig 4**).

Table. Patient Exclusion Criteria

Inability to understand nature of study
History of neurologic deficit in ipsilateral upper limb
Respiratory diseases such as chronic obstructive lung disease or asthma
Abnormal coagulation parameters (INR > 1.3 and platelet count < 50,000/mL)
Allergy to local anesthetics or contrast media
Pregnancy

INR = international normalized ratio.

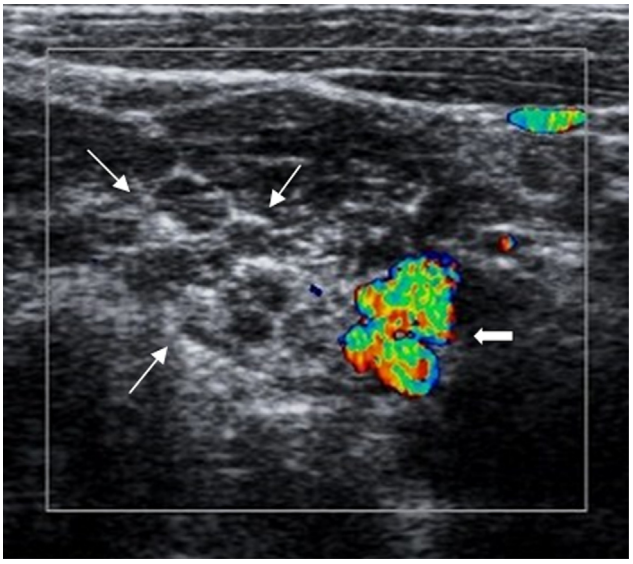

Figure 1. US image of right supraclavicular region with color Doppler. Thin arrows indicate brachial plexus, and thick arrow indicates subclavian artery.