Ultrasound-Guided Rescue Blocks: A Description Of A Technique For The Median And Ulnar Nerves

B Sites, B Spence

Citation

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Abstract

Strategies for supplementing incomplete brachial plexus blocks are important skills for the regional anaesthesiologist. We report two patients who presented for hand surgery and had incomplete brachial plexus blockades. High resolution ultrasound was utilized to localize the median and ulnar nerves in the forearm. Patient 1 had sparing in the median nerve distribution following an infraclavicular plexus block. The median nerve was localized 6 cm proximal to the wrist and anesthetized using 5 ml of 1.5% lidocaine. Patient 2 sustained ulnar nerve sparing following an axillary plexus block. The ulnar nerve was visualized 4 cm proximal to the wrist and anesthetized with 5 ml of 1.5% lidocaine. Both patients developed a surgical anesthetic with the supplemental block and surgery was completed uneventfully.

INTRODUCTION

Brachial plexus blocks have a success rate for surgical anesthesia ranging between 70 and 100% ([1,2,3]). In fact, there is a need for distal arm supplementation in up to 22% of patients having brachial plexus blocks ([4]). There is a paucity of literature examining different techniques of targeting the terminal branches of the brachial plexus in the forearm. This is potentially due to theoretical concerns of an increased risk of nerve damage secondary to the tighter anatomical compartments of peripheral nerves in the forearm ([5]).

Ultrasound is becoming an increasingly popular technique to facilitate the performance of peripheral nerve blocks ([6]). This is partially due to improvements in ultrasound fidelity which allows the visualization of actual neural structures. Ultrasound guidance is an attractive option for the median nerve in the forearm because it does not have predictable relationships to easily identifiable vascular structures.

In this case report, we describe a technique of using real-time high resolution ultrasound guidance to facilitate the local anesthetic blockade of the median and ulnar nerves in the forearm.

CASE REPORTS

Patient 1 was a 56 year old female with hypertension who presented for a left ulnar and median nerve decompression. She underwent a non-ultrasound guided infraclavicular nerve block using 30 ml of 1.5% lidocaine and 5 µg/ml of epinephrine. 30 minutes following completion of the nerve block, the patient had complete sensation to ice on the volar aspect of her thumb, first, and second fingers. Given the isolated median nerve sparing, a decision was made to perform an ultrasound-guided median nerve block. The right arm was prepped and the ultrasound probe (L12-5, 38 mm, 5-12 MHz, Envisor, Philips Medical Systems, Inc, Bothell, Wa., scanning at 12 MHz.) was placed on the distal forearm, approximately 6 centimeters proximal to the radial-lunate articulation (Figure 1a) such that the median nerve was visualized on axial section. The median nerve was visualized as a single circular hyperechoic structure with internal hypoechoic circles (Figure 1c). The final resting point of the probe was determined by which location generated the best image of the median nerve. A 22 gauge b-bevel stimulating needle (Stimuplex. B.Braun, Bethleham, PA) was inserted from the radial side of the probe and in the longitudinal axis of the ultrasound beam. The stimulating current was set at 0.45 mA. The needle was observed until it just contacted the nearest aspect of the nerve. At this point, the patient demonstrated a subtle flexion of the 2nd and 3rd fingers. Following negative aspiration, 5 ml of 1.5% lidocaine with 5 µg/ml of epinephrine was injected. The lidocaine was visualized circumferentially spreading around the median nerve. The patient developed loss of sensation to ice in the median nerve distribution within 10 minutes. The surgery was successfully conducted under sedation, totaling 2 mg of midazolam and 100 µg of fentanyl.

Patient 2 was a 29 year old male with depression who presented for a right fifth finger flexor tendon repair under an axillary plexus block. 30 minutes following the completion of a trans-arterial axillary plexus block, he was noted to have sensation to ice on the volar surface of his four and fifth fingers. A decision was made to perform a supplemental block of the ulnar nerve in the forearm. The probe (L12-5, 38 mm, 5-12 MHz, Envisor, Philips Medical Systems, Inc, Bothell, Wa., scanning at 12 MHz) was placed on the lateral aspect of the forearm approximately 4 cm proximal to the radial-lunate articulation (Figure 1b) such that the ulnar nerve was visualized on axial section. The ulnar nerve appeared as a triangular hyperechoic structure with internal hypoechoic circles lying to the ulnar side of the ulnar artery (Figure 1d) . A 22 gauge b-bevel stimulating needle (Stimuplex. B.Braun, Bethleham, PA) was inserted from the radial side of the probe and in the longitudinal axis of the ultrasound beam. The needle was visualized until it just contacted the outer most aspect of the ulnar nerve. At this point, thumb adduction was noted at a current of 0.5 mA. Following negative aspiration, 5 ml of 1.5% lidocaine with 5 µg/ml of epinephrine was injected. Following the first 2 ml, the needle was repositioned in a second location adjacent to the nerve in order to generate a complete circumferential spread of lidocaine around the ulnar nerve. The patient developed a loss of sensation to ice within 15 minutes of the block. The surgery was successfully completed under sedation utilizing a propofol infusion with a maximum rate of 30 µg/kg/minute.

Figure 1

Figure 1a: Simulated technique of a real-time ultrasound-guided median nerve block for the right hand dominant individual. The operator holds the probe with their non-dominant hand. The probe is on the volar surface of the distal forearm. The probe is then moved proximally until the clearest image of the median nerve is visualized. The needle is inserted with the operator's dominant hand such that it is in plane with the longitudinal axis of the ultrasound beam.

Figure 2

Figure 1b: Simulated technique of a real-time ultrasound-guided ulnar nerve block for the right hand dominant individual. The operator holds the probe with their non-dominant hand. The probe is on the volar surface of the distal forearm. The ulnar artery is identified by ultrasound and the probe is moved proximally until the nerve is easily visualized lying to the ulnar side of the artery. The needle is inserted with the operator's dominant hand such that it is in plane with the longitudinal axis of the ultrasound beam.

Figure 3

Figure 1c: Ultrasound image of the left median nerve of Patient 1 using a 12 mHz 38 mm linear probe. The nerve appears as a single circular hyperechoic structure with internal hypoechoic circles. We describe this image as the Â“Popcorn effect.Â” N = Median nerve. T = Tendons.

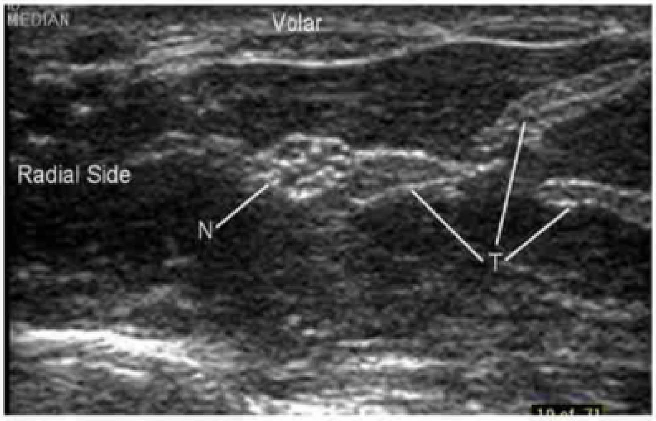
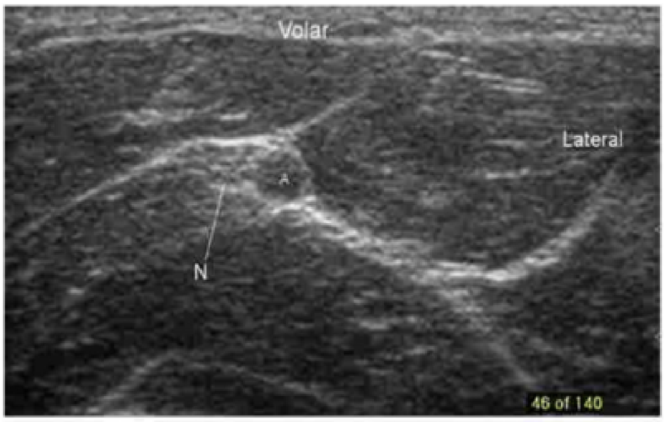


Figure 4

Figure 1d: A 12 MHz image of the right ulnar nerve in the distal forearm of Patient 2. A = ulnar artery. N = Nerve



DISCUSSION

In this case report, we describe the use of a high resolution ultrasound system to facilitate the localization and blockade of the median and ulnar nerves in the distal upper extremity. Historically, practitioners have relied on palpable anatomical landmarks to identify needle insertion sites (5). Anyone who uses these techniques realizes that the degree to which these landmarks are appreciated depends on multiple variables such as body habitus, prior surgical distortion of anatomy, ability to position the patient, and vascular disease. Therefore, alternative techniques for nerve localization may be clinically useful.

Ultrasound offers the ability to visualize the target nerve of interest, direct the needle under live guidance, and witness local anesthetic spread (6). This technique has been demonstrated to facilitate the performance of nerve blocks in both in the upper and lower extremities (7,8). Although an ultrasound description of the median and ulnar nerves in the forearm has been described in the neurology literature (9), this case report represents the first description of an ultrasound-guided forearm block of the median nerve. To our knowledge, there as been one description of an ultrasound-guided ulnar nerve block at the wrist (10).

For the blocks of the forearm, we have found that a high resolution ultrasound system is required to visualize the individual nerves. The ideal probe would have resolution capabilities between 10-15 MHz. The more resolution a system has (higher MHz), the less the depth of penetration. Therefore, patients with thick arms from muscle or adipose tissue will be better served with a 10 MHz resolution. In patients who have thin arms, a 12 MHz or higher resolution probe provides the best image of the median and ulnar nerves in the forearm.

Although the needle may be brought into the ultrasound beam on axial section, a 22 gauge needle on axial section appears as a small dot which can be easily missed. In addition, when the needle is imaged on axial section, the operator may be visualizing a cross-section of the needle shaft, rather than its tip. When the needle is advanced in the longitudinal plane of the ultrasound beam, the operator can see the entire needle and make adjustments as needed.

In conclusion, we describe a technique for anaesthetizing two of distal branches of the brachial plexus in the forearm. Whether or not such a technique offers any advantages over conventional means of nerve localization will depend on the results of future controlled trials.

CORRESPONDENCE TO

Brian D. Sites, M.D. Assistant Professor of Anesthesiology Dartmouth-Hitchcock Medical Center One Medical Center Drive Lebanon, New Hampshire, 03756, U.S.A. email: brian.sites@hitchcock.org

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Author Information

Brian D. Sites, M.D.
Assistant Professor of Anesthesiology and Orthopedics, Department of Anesthesiology, Dartmouth Medical School, Dartmouth- Hitchcock Medical Center

Brian C. Spence, M.D.
Assistant Professor of Anesthesiology, Department of Anesthesiology, Dartmouth Medical School, Dartmouth- Hitchcock Medical Center