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IDEAS AND INNOVATIONS

Hand/Peripheral Nerve

Surgeon-administered Ultrasound-guided Peripheral Nerve Blocks in Outpatient Procedures of the Upper Extremity

Jessica Winter, MD
Graham McLeod, MD
Tanis Quaife, MD
Christian Petropolis, MD, FRCSC

Summary: Outpatient hand surgery is often performed in the operating room, which can result in prolonged waiting times for patients when operating room resources are limited. Few studies have explored the application of ultrasound-guided nerve blocks in the setting of outpatient hand surgery. Fifty patients were enrolled in this prospective study. Ultrasound-guided peripheral nerve blocks were performed at the level of the elbow and proximal forearm for outpatient hand surgeries. A timer was used to record the time to administer the block and time to affect. A post-procedure survey was administered, which included a numerical analogue scale (0–10) and Likert rating scale questions to characterize the patients' pain experience for receiving the block and pain during the procedure: pain experienced by patients receiving the ultrasound-guided nerve block(s) (0–10), mean: 1.84; pain experienced by patients during a procedure (0–10), mean: 0.56; surgeon satisfaction during the procedure (0–10), mean 9.78. Average time to perform the ultrasound-guided nerve block(s) was 4 minutes 58 seconds; average time from completion of the block to effect reported by patients, 5 minutes 42 seconds; the average time for performing the procedure, 21 minutes 30 seconds. Our study shows that the use of ultrasound to block peripheral nerves of the forearm is effective; <10% of patients required additional local anesthetic. The technique is safe; no complications were reported. The technique is efficient in an outpatient hand surgery setting. *(Plast Reconstr Surg Glob Open 2020;8:e3227; doi: 10.1097/GOX.0000000000003227; Published online 24 November 2020.)*

INTRODUCTION

In a limited resource setting where healthcare expenses are heavily scrutinized, it is important to implement strategies that both reduce operating expenses and improve patient comfort and care. Outpatient hand surgery requiring the use of an operating theater with either the use of general anesthetic or regional blocks with sedation can result in prolonged wait times for patients due to limited operating room availability. This can lead to suboptimal timing of surgical fixation, longer healing time, and a delay in return to work.

From the Section of Plastic Surgery, Department of Surgery, Rady College of Medicine, University of Manitoba, Winnipeg, Manitoba, Canada.

Received for publication May 18, 2020; accepted September 8, 2020.

Electronic poster presented at 2020 American Association for Hand Surgery – Fort Lauderdale, Florida, January 8–11, 2020.

DOI: 10.1097/GOX.0000000000003227

Wide awake local anesthesia no tourniquet hand surgery has grown in popularity and scope over the past 10 years globally amongst hand surgeons.[1] The main benefits of this surgery include reduced costs, increased patient convenience, faster access to definitive surgical management, increased simplicity and safety, with the elimination of sedation and general anesthetic.[1,2] Ultrasound-guided nerve block of the forearm has been reported in the literature to be feasible options for hand procedures in both adult and pediatric emergency departments.[3–5] Recent research suggests that Blind wrist blocks have a substantially long time to achieve anesthesia.[6] Additionally, research suggests that ultrasound-guided nerve blocks can significantly reduce a moderate to severe pain following hand and wrist surgery.[7]

PURPOSE

The purpose of this study was to show that the use of ultrasound in peripheral nerve blockade of the forearm by the operating surgeon is an effective, safe, and efficient

Disclosure: *The authors have no financial interest to declare in relation to the content of this article.*

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technique to perform outpatient hand surgery in a minor operating theater.

METHODS

This study was approved by our institutional research ethics board. We conducted a prospective study, which included 50 adult patients that consented and met our inclusion criteria over a 6-month period. Inclusion criteria included all adult patients requiring an outpatient hand surgery at our center. Exclusion criteria included patients with peripheral neuropathy, patients with chronic opioid use or with a history of chronic pain disorder, and minors (<18).

The time to administer the block was defined as the time from the first needle poke to removal of needle of the final nerve to be blocked. The time to onset was recorded from time of final needle removal to the onset of subjective loss of sensation (Fig. 1).

Following the procedure patients were asked to score the pain of receiving the block, and the pain experienced during the procedure on a numerical analogue scale from 1 to 10. In addition, the type of procedure performed, length of procedure, amount of local anesthetic used, additional anesthetic required, surgeon's satisfaction level, and the level of training of the person performing the block were recorded. Participating patients received a follow-up within 2-4 weeks depending on the procedure performed and were evaluated for any postoperative complications related to the nerve block and procedure.

Fig. 1. Materials required to perform ultrasound-guided block: iPad, Bluetooth probe, sterile ultrasound gel, and tegaderm.

Nerve Identification

All injections were done in-plane with the ultrasound probe. Caution was taken not to inject within the nerve, as this may result in prolonged paresthesias post-block or neuropraxia. All blocks were performed by positioning the patient (with the arm extended in supination) onto a table at the patient's shoulder height.

The median nerve can be identified by placing the probe on the proximal volar forearm. Through identification of the radial and ulnar artery, a fascial plain connecting these structures can be appreciated by panning proximally. In between this fascial plain is the median nerve, which appears as a bright honeycomb round structure (Fig. 2).

The ulnar nerve can be identified by placing the probe on the ulnar side of the volar forearm just proximal to the wrist crease and identifying the ulnar artery (pulsatile structure) with the ulnar nerve located directly adjacent ulnar to the artery. Scanning proximally on the forearm, the neurovascular bundle can be followed to mid- proximal forearm where the ulnar artery and nerve separate. This proximal location reduces the risk of intravascular injection (Fig. 3).

The radial nerve can be identified by placing the ultrasound probe radially on the antecubital fossa. Orientating the probe at a 45-degree angle to the arm can help identify what is commonly referred to as the *chili pepper sign* or *J sign'*. This is a fascial compartment resembling the letter J

Fig. 2. Median nerve landmark.

Fig. 3. Ulnar nerve landmark.

or a chili pepper. The Radial nerve is found radially to the radial artery[8] (Fig. 4). (**See Video [online],** which displays the median, ulnar, and radial nerve scanning.)

RESULTS

One or more forearm (median, radial, and ulnar) nerves were blocked using local anesthetic along with epinephrine (mixed ratio 8:1:1 of 1% Lidocaine, 0.25% Marcaine and 5% bicarbonate) depending on the clinical scenario (Table 1). An average of 20.44 ml of local anesthetic was used per patient. A variety of procedures were performed, including fracture reductions, percutaneous pinning of the metacarpal and proximal phalanx, repair of flexor and extensor tendons, proximal digital revision amputation, and incision and drainage of deep space infections of the hand. Ultrasound-guided nerve blocks were performed by residents, ranging from their first to fourth year (average, 2.1). There were no complications in patients who participated in the study.

DISCUSSION

Ultrasound-guided nerve blocks are an efficient, cost-effective, and safe way to obtain pain control when performing outpatient hand surgery.[9] In contrast, a recent article by Lovely et al. investigates the effectiveness of non-ultrasound–guided wrist blocks and ideal volume of local anesthetic to achieve adequate anesthesia, where participants were divided into 2 groups—those who would receive 6 ml of local and those who would receive 11 ml for a blind median nerve block. Results showed that in the 6 ml and 11 ml group, only 50% and 92%, respectively achieved adequate anesthesia.[6] The results in the 11 ml group were similar to our results of 10% of patients requiring additional local anesthetic; however, the perceived maximal numbness occurred at roughly 40 minutes

Fig. 4. Radial nerve landmark.

after injection, but actual numbness to painful needle stick took around 100 minutes.[6] The time to effective anesthesia is substantially longer without the use of ultrasound, than our recorded time values (average time to effect: 5 minutes and 42 seconds). We believe the use of ultrasound guidance in peripheral nerve blocks improves precision of local anesthetic placement, leading to a quicker and more efficient onset of anesthesia.

We have demonstrated that even junior residents can perform ultrasound-guided nerve blocks in a timely and effective manner. Anecdotally, we have found this method works better than traditional peripheral field or more distal blind nerve blocks for procedures with longer operative times, manipulation of the metacarpal or carpal bones, and drainage of deep space infections of the hand. Anecdotally, we also found that there was a reduced need to pause the procedure for additional anesthetic and better pain control intraoperatively and postoperatively.

Our center now does the majority of hand trauma cases outside the main operating theater because we began utilizing ultrasound-guided peripheral nerve blocks. This has led to a reduction in wait times for trauma cases requiring the main operating theater.

CONCLUSIONS

The use of ultrasound to provide upper extremity nerve blocks for outpatient hand surgery has been well

Table 1. Results from Post Procedure Survey

Pain Experienced by Patients Receiving the Ultrasound-guided Nerve Block(s) (scale of 0–10)	Pain Experienced by Patients during the Procedure (scale of 0–10)	Surgeon Satisfaction during the Procedure (scale of 0–10)	Average Time to Perform the ultrasound-guided Nerve Block(s)	Average Time from Completion of Block to Effect Reported by Patients	Average Time of Procedure Performed
Mean 1.84 (upper limit 7/10, lower limit 0/10)	Mean 0.56 (upper limit 4/10, lower limit 0/10)	Mean 9.78 (upper limit 10/10, lower limit 7/10)	4 min 58 s (upper limit 8 minutes, lower limit 1 min 2 s	5 min 42 s (upper limit 15 min 23 s, lower limit 51 s)	21 min 30 s (Upper limit 62 min, lower limit 2 min)

established in the literature as an effective and safe method of anesthesia in the operating theater.[9] We have shown that this technique can be safely and efficiently taken from the operation room to the minor procedure room and performed by the operating surgeon.

Jessica Winter, MD
Faculty of Health Sciences
University of Manitoba
Winnipeg, Manitoba
Canada
E-mail: winterj3@myumanitoba.ca

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