Randomized Comparison of the Single-Injection Volar Subcutaneous Block and the Two-Injection Dorsal Block for Digital Anesthesia

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Background: Two commonly used methods of digital nerve block with local anesthetic are the two-injection dorsal technique and the single-injection volar subcutaneous technique. The authors compared these two digital block techniques with respect to local anesthetic injection pain and recipient preference of anesthetic technique.

Methods: Twenty-seven volunteers had the long finger of each hand injected with 2% lidocaine with 1:100,000 epinephrine. The two-injection dorsal method was used on one long finger and the other long finger received the volar single-injection technique. Volunteers completed a pain scale for each block and were then asked which technique they would prefer. The area of anesthetic skin was assessed in each finger by pinprick testing, and photographs were taken.

Results: Although there was a lower pain score for the volar single-injection block, the difference in pain scores between the two techniques was not statistically significant. However, 22 of the 27 subjects indicated that they would select the volar over the dorsal block if a future block was required, and this preference for the volar block was statistically significant.

Conclusions: Although the difference in pain scores between the two techniques was not statistically significant, volunteers who received both blocks would prefer the volar single-injection subcutaneous block if given a choice. Therefore, the single-injection volar subcutaneous block is recommended as the technique of choice for anesthesia of the digit, except in patients for whom anesthesia over the dorsum of the proximal phalanx is required. These patients may prefer a supplementary dorsal nerve block or a traditional two-injection block. (*Plast. Reconstr. Surg.* 118: 1195, 2006.)

Fundamental to the practice of outpatient hand surgery is the ability to provide adequate local or regional anesthesia. The digital nerve block, therefore, is a frequently performed procedure, and it is important for any physician managing hand injuries to be able to administer an effective, reliable, and safe block.

Knowledge of the bilateral sensory nerve supply to the fingers has led to the development of many different techniques of digital nerve blockade with local anesthetic. Two of the more commonly used techniques today are the classic two-injection dorsal approach block, as originally described by Braun and Harris,[1] and the more recently described subcutaneous volar block.[2] The dorsal approach, or traditional digital block, typically involves an injection of local anesthetic on each side of the digit. Although we have not been able to find validating evidence to prove it, the dorsal finger skin has long been said[1] to be less painful to puncture with a needle than the volar glabrous skin, and this method has gained favor as a result. This belief may have contributed to the fact that this has been the technique frequently taught to medical students and residents.

The volar approach is an alternative to the traditional two-injection dorsal block and typically involves only a single injection. There are

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two basic variations of the volar block. Chui[3] described the intrathecal block in 1990, which uses a single volar injection into the flexor tendon sheath, which acts as a conduit, to deliver local anesthetic to the digit. It has been shown to be an effective and reliable technique.[3–7] Harbison[2] described the second volar block variation with the midline subcutaneous injection in 1991. He reported this technique to carry all the advantages of the transthecal block, but was less painful and easier to administer. Brutus et al.[8] also found the subcutaneous single-injection block to be safe, efficient, and easy to perform. Subsequently, Low et al.[5] compared the subcutaneous block with the transthecal block in a randomized, controlled study and confirmed that the subcutaneous block was as effective but was easier to administer and caused less discomfort than the transthecal block. Hill et al.[4] and Cummings et al.[7] separately compared the single-injection transthecal block technique with the traditional two-injection dorsal block. Hill et al.[4] found that the mean pain score for the transthecal block was slightly higher ($p = 0.02$) than for the traditional block in their series of 162 blocks on 31 volunteer subjects. Cummings et al.,[7] in their study of 50 blocks on 25 volunteer subjects, found the transthecal and traditional blocks to be equal in terms of pain perception ($p = 0.579$).

To our knowledge, the single-injection volar subcutaneous block of Harbison[2] has not been compared with a traditional two-injection dorsal block approach in a controlled, prospective fashion. The purpose of this study is to prospectively compare these two techniques in terms of pain of injection and recipient preference.

METHODS

Approval of this study was granted by the Research Ethics and Review Board of the Saint John Regional Hospital, Saint John, New Brunswick, Canada. Twenty-seven volunteers were enrolled between July and September of 2003. Informed consent was obtained from each individual. The subject was excluded if any medical contraindications to the procedure existed. Exclusion criteria for lidocaine with epinephrine digital nerve blocks included a history of allergy to the agents, preexisting vascular insufficiency in the fingers such as might occur with Raynaud's disease or phenomenon, severe peripheral vascular disease, or a history of previous digital replantation or other vasospastic conditions.

A sequence of injections was planned for all subjects before the study was performed so that the following two factors were counterbalanced (evenly distributed) across the subjects: (1) which hand received the first injection and (2) which type of block was delivered first. This randomized which finger was injected first (right or left) and which technique was used first (volar or dorsal). All injections were performed by the same physician (J.G.W.) with a standard technique (Fig. 1). All injections were performed using a reusable dental syringe with a disposable 30-gauge needle, and prefilled 1.8-ml cartridges of 2% lidocaine with 1:100,000 epinephrine.

The dorsal technique (Fig. 1, *above*) involved injection of 0.9 ml of anesthetic into the web spaces on either side of the long finger from a

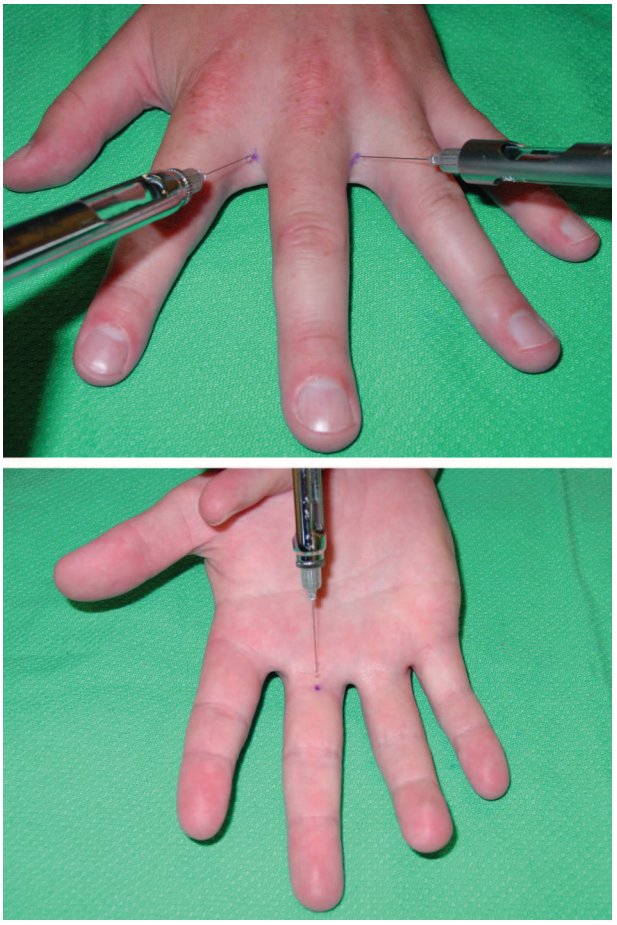

Fig. 1. (*Above*) Two-injection dorsal approach digital block technique. The needle is inserted through the dorsal web space, and anesthetic is deposited on both sides of the digit with two separate injections. (*Below*) Single-injection volar subcutaneous block technique. The needle is inserted into the subcutaneous space at the level of the proximal digital flexion crease in the midline midway between the neurovascular bundles.

dorsal approach. The needle was inserted 3 to 4 mm, directed toward the base of the digit. The volar technique (Fig. 1, *below*) used 1.8 ml injected subcutaneously just deep to the skin in the midline at the level of the proximal flexion crease of the long finger. Care was taken to ensure that the volar injection was neither intradermal (too superficial) nor intrathecal (too deep).

The volunteers were instructed to look away during the procedure. After each block, the subjects wrote the discomfort experienced on a standard visual analog scale of 0 (no pain) to 10 (most pain imaginable). After both blocks were completed, subjects were asked: "If you required a digital block in the future, which method would you prefer?"

Thirty minutes after the injections, the distribution of anesthesia was determined by pinprick testing. Areas in which pinpricks were interpreted with pain were considered to be the areas of absent or incomplete anesthesia. Fingers that were not anesthetized distal to the proximal phalanx crease were considered to be incompletely anesthetized. The areas of anesthesia were mapped and photographed. The duration of anesthesia was determined from the time of injection to the time that normal sensation returned to the finger. The time of return of normal sensation was defined as the moment when the entire anesthetized finger felt exactly the same as the nonanesthetized fingers.

We subjected two variables to statistical analysis: pain scale scores and the preference of one of the two treatments using randomized block (subject) design. Therefore, we generated paired data. On the basis of the data, we tested the following hypotheses. (a) Null Hypothesis: There was no difference in the median pain scores with respect to volar and dorsal injection techniques. We chose the nonparametric sign test to test the null hypothesis of no difference in the median pain scores. We also performed the Wilcoxon signed-rank test for paired data. (b) Null Hypothesis: Both methods are equally preferred by the volunteers. Because the preference of two methods is measured on binary scale, a simple binomial test was sufficient to test this second null hypothesis. We then calculated the power of the binomial test according to the method of Zar.[9]

RESULTS

Of the 27 volunteers, there were 16 women and 11 men with a mean age of 31 years (range 23–51 years). The subjects included nurses, staff physicians, administrators, medical students, and technicians. No subjects were excluded because of medical comorbidity.

Thirty minutes after the injections, the distribution of anesthesia was determined by pinprick testing. Typical areas of anesthesia of the volar and dorsal blocks are shown in Figure 2 (*above*, volar view; *center*, dorsal view). The subject in Figure 2, *below*, is one of two who did not achieve complete digital block with the dorsal two-injection technique. It can be clearly seen from the mapped areas of anesthesia that the ulnar half of the long finger was not anesthetized. All other fingers receiving the two-injection dorsal block technique achieved complete anesthesia. All fingers receiving the volar injection achieved complete anesthesia of the finger with the exception of the dorsal aspect of the proximal phalanx. Of the 27 volar blocks performed, only three resulted in anesthesia over the entire dorsal proximal phalanx. Five blocks left the dorsal aspect of the proximal phalanx with completely intact sensation, and 19 blocks resulted in a level of anesthesia ending between the metaphalangeal and proximal interphalangeal joint levels. The mean time from injection until complete loss of digital anesthesia was 6 hours and 57 minutes for the volar injections, and 5 hours and 4 minutes for the dorsal injections.

Statistical Analysis

With regard to null hypothesis (a), there was no difference in the median pain scores with respect to volar and dorsal injection techniques. The mean pain scale number (0 to 10) for the volar technique was 4.06 (range, 1 to 9) (SD, 2.145). The mean pain scale number (0 to 10) for the dorsal technique was 4.52 (range, 2 to 8) (SD, 1.858). On the basis of 27 pairs, there were 10 +, 16 −, and 1 zero, with a p value of 0.3269 for the sign test. Also, the 95 percent confidence interval for the median difference included zero. Therefore, there was no significant difference in median pain scores for the two methods in our sample size. For the Wilcoxon signed-rank test, the test statistic value was 113.5 with a p value of 0.118. This test also concludes that there was no significant difference in median pain scores for the two methods.

With regard to null hypothesis (b), both methods were equally preferred by the volunteers. When asked which of the two blocking techniques they would select in the future if they were given a choice, 22 of the 27 subjects said they would select the volar injection technique. If the null

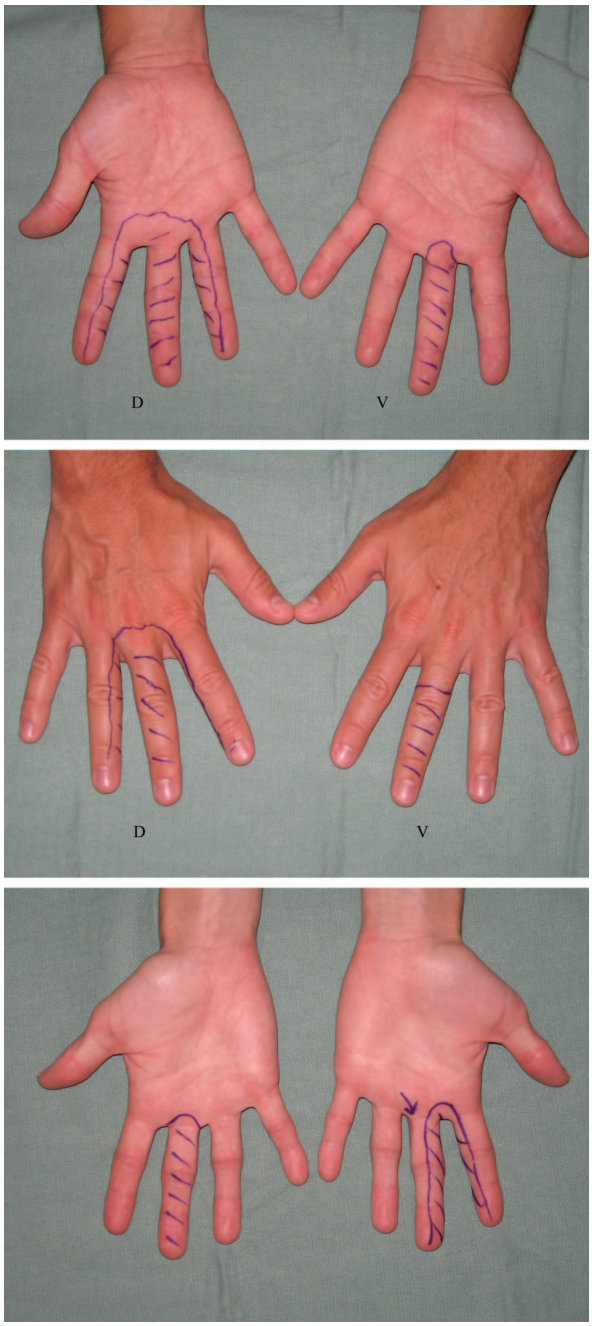

Fig. 2. (*Above*) Volar view of the distribution of anesthesia typically achieved with the dorsal block (*D*) and the volar subcutaneous block (*V*). *Lines* indicate the areas of anesthesia. (*Center*) Dorsal view of the distribution of anesthesia typically achieved with the dorsal block and incomplete dorsal proximal phalanx anesthesia achieved with the volar subcutaneous block. (*Below*) Only half of the digit became anesthetized with the two-injection dorsal block in two subjects, one of whom is shown here.

hypothesis is true, then there was a 0.14 percent ($p = 0.0014$) chance that 81.48 percent or more of the 27 randomly chosen subjects preferred the volar injection over the dorsal injections. A significantly higher number of subjects preferred the single-injection volar subcutaneous digital block to the traditional two-injection dorsal digital block. We also calculated the power of the binomial test, which turned out to be 88.88 percent.

The mean duration time of anesthesia for all fingers in all subjects was 361 minutes, or 6 hours. There was no statistically significant difference in the pain responses between sexes.

DISCUSSION

We compared the volar subcutaneous single-injection finger block with the traditional two-injection dorsal injection local anesthesia technique. Our results demonstrated that there was more pain experienced with the use of the two-injection dorsal technique, but the difference in pain scores was not statistically significant. When we asked the volunteers which technique they would prefer if they required a digital block in the future, 22 of 27 volunteers would choose the single-injection technique. Our results showed that a significantly higher number of subjects preferred the single-injection volar subcutaneous digital block to the traditional two-injection dorsal digital block.

Why is it that we found no statistically significant difference in the pain scores and yet most volunteers would prefer a volar block given a choice in the future? One possibility is that the standard 0 (no pain) to 10 (most pain imaginable) pain scale itself is not as sensitive as it should be, or that the results may simply reflect a sample size that was too small to show a difference that might be there. It was for this reason that we also asked the question about which technique the volunteers would request if they became patients in the future. Other possible reasons for the discrepancy are anecdotal comments from subjects that included the feeling that one needle stick was generally preferable to two. Other subjects commented that the "collateral numbness" of adjacent digits was an annoying negative aspect of the dorsal block and did not occur with the volar approach.

One possible limitation of this study is the fact that the volunteers received a pain stimulus with one technique and then in the same sitting had a second (or third injection, if the two-injection technique was used first) pain stimulus. It is possible that the first digital block may have affected the volunteer's response to the second injection, and we may have avoided this variable by having the two blocks performed at two different sittings.

However, injecting the volunteers on two different days may have introduced a greater number of other variables, such as the presence of pain relievers for a headache on one day and not the other, the ability of the volunteers to remember exactly how painful the previous block was in making their comparison, or the difference of their psychologic state on the different days affecting their response to pain. We therefore decided to inject both blocks at the same sitting and try to compensate for two consecutive blocks interfering with each other by randomizing which block was administered first.

In the 10-year clinical experience of the senior author with this technique, the single-injection volar block has provided predictable, consistent, dense anesthesia of all of the fingers with the exception of the dorsal proximal phalanx region. The technique has been easy to teach and learn. We call it the SIMPLE block (*s*ubcutaneous *i*njection in the *m*idline of the *p*halanx with *l*idocaine and *e*pinephrine). There is little resistance to injection in the subcutaneous plane; therefore, if the needle is too deep (intrathecal in the flexor sheath or tendon) or too superficial (dermis), increased resistance is present and the needle position can be changed. Because it is a midline injection, there is little chance of direct trauma to the neurovascular structures compared with the dorsal web space approaches.

Anesthesia at the level of the dorsal proximal interphalangeal joint distally was achieved with the volar approach in all of our subjects. However, a drawback of the volar block is that anesthesia of the entire dorsal aspect of the proximal phalanx proximal to the proximal interphalangeal joint was not achieved in 24 of 27 blocks. This is consistent with the literature, and as suggested by previous authors, a secondary dorsal sensory nerve block may be necessary if procedures are planned over the dorsum of the proximal phalanx.[2,4,7] Therefore, in a situation such as a lacerated extensor tendon over the proximal phalanx, the two-injection dorsal technique may be preferable to a single volar injection technique because the latter technique would have to be supplemented with a second dorsal injection.

Disadvantages of the two-injection dorsal technique were that the volunteers did not prefer this technique, and that completeness of anesthesia was not consistently achieved. The only incomplete or failed blocks distal to the proximal interphalangeal joint in this series were in the dorsal block group. Two of 27 subjects had only hemifinger anesthesia at 30 minutes after injection. Evidently in these cases the local anesthetic was not deposited close enough to the digital nerve unilaterally because of technical injection error (Fig. 2, *below*). It has also been our clinical experience that technical injection errors are more common with the two-injection dorsal technique than with the single volar injection technique. Another potential drawback of the two-injection dorsal approach is the increased chance of inflicting direct injury to the nerve or artery, because the needle is inserted much closer to the neurovascular bundles with the dorsal approach than with the volar technique, in which the needle is inserted midway between the neurovascular bundles.

Another possible shortcoming of this study is that only the long finger was studied in both hands of each subject. It is possible that the outcome of the study might be different for border digits because of anatomical variation of digital innervation. However, our years of clinical experience have shown us that the volar block is equally effective in the index and small fingers as it is in the middle and ring fingers. A further possible limitation of this study is that the same investigator evaluated the areas of skin anesthetized by both blocks. Using this form of measurement as opposed to having a blinded evaluator is a potential source of bias. The results with respect to the areas within the digits that became anesthetized with the two techniques therefore have to be interpreted in this light.

There were no complications in this series. Specifically, there were no adverse effects related to the use of epinephrine in our injection of 1.8 ml of 1:100,000 in the proximal phalanges of 54 fingers in 27 volunteers. Although some still fear the use of local anesthetics containing low-dose epinephrine in the fingers, this study adds to the growing body of literature supporting the use of epinephrine in routine digital blocks.[10–15] The main advantages of using epinephrine in digital blocks are twofold: increased duration of the block and elimination of the tourniquet (because bleeding is decreased).

This study showed that most of the volunteers who received both single-injection volar blocks and two-injection dorsal blocks would prefer the single-injection volar block in the future if given a choice. Except in those patients in whom anesthesia over the dorsum of the proximal phalanx is required, the single-injection volar block is recommended as the technique of choice. In patients in whom complete anesthesia of the digit is required, either a supplementary dorsal nerve block

or a traditional two-injection block may be preferred.

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