



Wide-awake foot and ankle surgery: A retrospective analysis



A. Luke MacNeill^{a,*}, D. Joshua Mayich^b

^a University of New Brunswick, Saint John, NB, Canada

^b Horizon Health Network, Saint John, NB, Canada

ARTICLE INFO

Article history:

Received 11 August 2015

Received in revised form 26 September 2016

Accepted 27 September 2016

Keywords:

Wide-awake
Local anesthesia
Epinephrine
Pain
Anxiety

ABSTRACT

Background: The “wide-awake” approach to foot and ankle surgery is characterized by a surgeon-administered mixture of local anesthetic and epinephrine. No tourniquet, sedation, or general anesthesia are required for surgery. This paper describes a retrospective survey of the initial patients to undergo wide-awake foot and ankle surgery at our center.

Methods: Thirty former wide-awake patients were surveyed about their perioperative anxiety, pain, and satisfaction.

Results: Twenty-seven of 30 patients (90%) completed the survey. Patients received a variety of forefoot, hindfoot, and lower leg procedures. In general, they reported a decrease in anxiety over the course of the perioperative period ($p = 0.005$). Pain fell from the preoperative to the intraoperative period, then rose to preoperative levels during recovery ($p < 0.001$). Most patients said that the surgery was better than expected (83%); would choose wide-awake surgery for a subsequent procedure (87%); and would recommend wide-awake surgery to someone who required surgery (88%).

Conclusions: Results indicate that the wide-awake approach to foot and ankle surgery causes little discomfort to patients who receive many common procedures. The removal of hindfoot hardware under local anesthesia is contraindicated.

© 2016 European Foot and Ankle Society. Published by Elsevier Ltd. All rights reserved.

1. Introduction

The operative treatment of foot and ankle patients typically involves the induction of general or regional anesthesia. These anesthetic techniques can be expensive and may entail some medical risk for the patient. The “wide-awake” approach to surgery, which has been popular in the field of hand surgery [1–7], is a viable alternative for many foot and ankle procedures. Wide-awake surgery is characterized by a surgeon-administered dose of local anesthetic injected into the operative site. Epinephrine is added to the local anesthetic to provide vasoconstriction and hemostasis. No tourniquet, sedation, or general anesthesia are needed, and the patient remains fully conscious (or “wide-awake”) during the operation.

The advantages of the wide-awake approach have been discussed at length elsewhere [8–12]. Briefly, wide-awake surgery has fewer risks and side effects than surgery with sedation or

general anesthesia. Preoperative testing is often unnecessary, and there is no need for anesthetic staff or equipment. The surgeon can communicate with a sober and coherent patient throughout the perioperative period, thereby providing the patient with greater insight into both the procedure and the recovery process. Patients are also able to leave the medical facility shortly after their surgeries, typically within 15 min of exiting the operating room.

Concerns about patient comfort and well-being are understandable given the nature of wide-awake surgery. Several studies have assessed the patient experience associated with wide-awake hand surgery, and results have been favorable. These patients report low levels of preoperative anxiety, and anxiety levels decrease steadily as the perioperative period progresses [13,14]. Pain during the surgery itself is negligible or nonexistent [14,15]. Most patients would choose the same method of surgery if another operation were necessary [13–15], and they would also recommend wide-awake surgery to a friend [14].

The purpose of the present study was to determine whether these positive results generalize to a foot and ankle setting. To this end, the current authors retrospectively assessed the anxiety, pain, and satisfaction that patients felt with regard to their wide-awake foot and ankle surgeries. Based on past research with

* Corresponding author at: Department of Psychology, University of New Brunswick Saint John, 100 Tucker Park Road, PO Box 5050, Saint John, NB E2L 4L5, Canada.

E-mail address: luke.macneill@unb.ca (A. L. MacNeill).

Table 1
Typical dosages for commonly performed procedures (assuming a 70–80 kg patient).

Procedure type	Sample case	Saline bag size	Local anesthetic dosage	Sodium bicarbonate (8.4%) dosage
Small	Hammer toe correction, hallux valgus procedure (e.g., Scarf osteotomy), first MTP fusion	50 cc	Lidocaine 1% + 1:100 000 epi—10 mL Bupivacaine 0.25% (no additive)—5 mL	1.5 mL
Medium	Hoffmann procedure (RA), talonavicular fusion, midfoot fusion	100 cc	Lidocaine 1% + 1:100 000 epi—15 mL Bupivacaine 0.25% (no additive)—5 mL	2 mL
Large	Ankle fracture ORIF, bridle procedure	2 × 100 cc	Lidocaine 1% + 1:100 000 epi—20 mL Bupivacaine 0.25% (no additive)—10 mL	3 mL

wide-awake hand surgery, it was expected that patients would report (a) a steady decrease in anxiety from the preoperative to the postoperative period; (b) a reduction in pain from the preoperative to the intraoperative period (i.e., due to the local anesthetic) and a subsequent increase in pain during the postoperative recovery period; and (c) high satisfaction with their surgical experience.

2. Methods

2.1. Description of the wide-awake anesthetic technique

All patients included in the retrospective study received surgery using the wide-awake anesthetic technique. On the day of surgery, wide-awake anesthesia was delivered by the surgeon. First, the size of the operative field was determined and classified as small, medium, or large. Based on this determination, local anesthetic was mixed with epinephrine according to modified wide-awake guidelines from Lalonde [8]. See Table 1. All local anesthetic dosages were well below the safe maximum of 7 mg/kg, and a total dose of 300 mg was never exceeded in any circumstance. Sodium bicarbonate was mixed at 10% per anesthetic volume to neutralize the pH of the anesthetic solution, and 50 cc or 100 cc bags of normal saline were used as a dilutional agent. Note that wide-awake surgery requires strict adherence to safe dosages of local anesthetic, and the surgeon should be aware of the clinical signs of local anesthetic toxicity. To date, the senior author has encountered no incidences of toxicity in his wide-awake patients.

Patients were injected in the designated waiting area prior to entering the operating room. Mixed local anesthetic was drawn from the saline bag using a filling needle with 20 cc syringes. The filling needle was then replaced with a 30-gauge needle. At this point, the entire operative field was anesthetized down to bone. The needle for the initial injection was positioned at 90° to the skin, and distraction techniques (e.g., gentle pinching) were performed at the time of needle insertion [8]. This initial injection proceeded slowly. Once a relatively large area was anesthetized, as indicated by the whitish appearance of the adrenalized skin, additional injection sites were used to anesthetize the rest of the operative field. To minimize the number of needle pokes that patients felt, the needle was only introduced to previously anesthetized tissue. See Fig. 1. A longer 25-gauge needle was required to anesthetize specific areas, such as: (1) the intermetatarsal regions and areas past the intermetatarsal ligament (for first MTP fusion, etc.); (2) the plantar and dorsal aspects of the midfoot or higher (for talonavicular joint fusion, etc.); and (3) the medial and lateral aspects of the calcaneus and ankle (for ankle arthroscopy, etc.). Patients were taken to the operating room directly after the injections, where they were prepped and draped. Surgery commenced immediately thereafter. If a surgery was not finished within 90 min of the preoperative anesthetic injection, patients

were given an additional injection before closure to ensure adequate postoperative pain control.¹

2.2. Retrospective study

Ethics approval for the retrospective study was obtained from the local research ethics board. The first 40 patients to receive wide-awake foot and ankle surgery from the senior author were considered for the study. Five patients were excluded due to partial neuropathy of the feet, and an additional patient was omitted because of concerns over dementia. This left a potential pool of 34 patients. Thirty patients were successfully contacted by telephone, and all provided consent to participate in the study.

Consenting patients were mailed a series of questionnaires that were adapted (with permission) from previous surveys used to assess wide-awake hand surgery [13,14]. These questionnaires focused on the anxiety and pain that patients felt during the perioperative period, as well as their overall satisfaction with the operative experience (see Appendices A–C in Supplementary materials). Anxiety was measured with an 11-point numerical rating scale that covered the preoperative, intraoperative, and immediate postoperative periods. Ratings ranged from 0 (not anxious) to 10 (very anxious). Pain was measured with an 11-point numerical rating scale that covered the preoperative, intraoperative, and postoperative recovery periods. Ratings ranged from 0 (no pain) to 10 (worst possible pain). Pain during the initial anesthesia injection was recorded using the same scale. Patient satisfaction was evaluated using three categorical questions that covered (1) preferred anesthetic state for future surgeries, (2) how the surgery compared to preoperative expectations, and (3) whether the patient would recommend wide-awake surgery to someone who required surgery. Additional perioperative information was collected for descriptive purposes. Patients were informed that their surgeon would not see their specific answers, only tabulated data from all participants.

Once questionnaires were received back from patients, data were entered into SPSS for statistical analysis. Preoperative, intraoperative, and postoperative ratings of anxiety were compared using a repeated measures ANOVA and post hoc Bonferroni tests. Pain ratings were analyzed in the same manner. Sphericity was achieved for both the anxiety ($p=0.963$) and pain ($p=0.307$) analyses, and so no test corrections were necessary. Injection pain and intraoperative pain were compared using a dependent *t*-test. Patient satisfaction data were analyzed using chi-square goodness of fit tests. The significance level was set at $p < 0.05$ for each analysis.

¹ In patients with documented peripheral vascular disease or patients over the age of 70 with significant comorbidities (e.g., poorly controlled type 2 diabetes), there is a risk of necrosis due to the use of epinephrine in the local anesthetic mixture. It is the current practice of the senior author to perform phentolamine rescue following completion of these surgeries. An injection of 1 mg of phentolamine diluted in 5–10 mL of sterile injectable saline will reverse the effects of the epinephrine when required.



Fig. 1. Photograph of a foot that has been injected with the wide-awake anesthetic mixture. The circular line indicates the boundary of the adrenalized area. The inner lines are filler. Note that the adrenalized skin is blanched and can be seen easily. Great care is taken to stay within this adrenalized area when introducing the needle and progressively injecting the anesthetic mixture throughout the intended area. Patients rarely report pain from any needle introduction beyond the first injection site.

Table 2
Patient anxiety and pain ratings (0–10 scale).

	Anxiety <i>M</i> (<i>SD</i>)	Pain <i>M</i> (<i>SD</i>)
Preoperative	3.08 (2.45)	5.00 (3.11)
Intraoperative	2.50 (2.40)	0.75 (0.85)
Postoperative	1.83 (1.93)	5.21 (2.90) ^a
Anesthesia injection	NA	2.29 (2.03)

^a Refers to maximum pain during the postoperative recovery period.

3. Results

Twenty-seven patients (18 males and 9 females; *M* age = 56.56 years, *SD* = 12.88; age range 27–77) returned their completed surveys for a 90% response rate. Questionnaires were filled out an average of 6.5 months following surgery (*M* = 193.11 days, *SD* = 100.52), an interval that is comparable to previous studies of wide-awake hand surgery [14,15]. On average, patients spent 3.40 h (*SD* = 1.22) at the hospital on the day of the surgery. Sixty-three percent of patients received forefoot surgery, 18.5% received hindfoot surgery, and 18.5% received lower leg surgery. See Appendix D in Supplementary materials for a complete list of the performed procedures. Patients undergoing hindfoot hardware removal (*N* = 3) were excluded from the analysis as statistical outliers, although their data is presented in Section 4.²

Ratings of patient anxiety showed a gradual decline over the perioperative period, $F(2, 46) = 6.06$, $p = 0.005$, $\eta_p^2 = 0.21$. Means and standard deviations are presented in Table 2. Follow-up tests indicated that only the difference between preoperative and postoperative anxiety was significant ($p = 0.005$). Power for this analysis was adequate (0.86).

Ratings of pain also showed a significant change over the period of interest, $F(2, 46) = 30.11$, $p < 0.001$, $\eta_p^2 = 0.57$. Follow-up tests indicated that pain ratings dropped from the preoperative to the intraoperative period ($p < 0.001$). Pain subsequently rose to preoperative levels during recovery ($p < 0.001$). Power for this analysis was maximal (1.00). Notably, patients' intraoperative pain

was significantly less than the mild pain reported during their anesthesia injections, $t(23) = 3.49$, $p = 0.002$, $d = 0.99$.

When asked about their future anesthetic preferences, 87% of patients indicated that they would prefer to be wide-awake for a similar procedure, whereas 13% would choose to be sedated, $\chi^2(1, N = 23) = 12.57$, $p < 0.001$, $w = 0.74$. No patients would prefer to be asleep, and one patient was excluded from the analysis for selecting two answers ('wide-awake' and 'sedated'). Regarding their expectations, 83% of patients said that the surgery was better than expected, compared to 17% who said that it was similar to what they expected, $\chi^2(1, N = 24) = 10.67$, $p = 0.001$, $w = 0.67$. No patients said that the surgery was worse than expected. Regarding their endorsement of wide-awake surgery, 88% of patients would "definitely" or "probably" recommend wide-awake surgery, versus 12% who were unsure whether they would recommend wide-awake surgery, $\chi^2(1, N = 24) = 13.50$, $p < 0.001$, $w = 0.75$. No patients indicated that they would not recommend wide-awake surgery.

4. Discussion

The purpose of this study was to perform a retrospective assessment of the anxiety, pain, and satisfaction associated with wide-awake foot and ankle surgery. Results were similar to past research involving wide-awake hand surgery [13–15]. Patient anxiety was low and showed a steady decline over the duration of the perioperative period. Intraoperative pain was typically negligible and significantly less than the day-to-day pain that characterized patients' injuries or conditions. Overall satisfaction was high, and several patients have since requested wide-awake surgery for subsequent procedures.

The three patients undergoing hindfoot hardware removal reported greater intraoperative anxiety (*M* = 5.67, *SD* = 2.52) and pain (*M* = 7.33, *SD* = 2.08) than other patients and were removed from the analysis as statistical outliers (see Appendix D in Supplementary materials for more details on these patients). It is currently unclear why their injections failed to provide appropriate anesthesia. It is possible that diffusion of the anesthetic mixture was prevented by scar tissue from patients' traumas and prior surgeries. For this reason, we recommend that interested surgeons continue to perform hindfoot hardware removal using conventional anesthetic techniques.

² Note that significant results would have persisted in all analyses with these cases included. However, pain and anxiety ratings would have been highly skewed.

Although the findings from this study are encouraging, they are limited by their reliance on retrospective patient reports. Patients filled out the questionnaire package an average of 6.5 months following their surgeries, a time delay that may have affected their recall of anxiety and pain. Some studies have shown that patients can recall former pain levels with a reasonable degree of accuracy, even after a number of weeks [16–18]. Regardless, one could avoid potential memory biases by collecting patient ratings during the perioperative period itself. The current authors are presently conducting a study that addresses this point. The study in question is also assessing the experience of patients undergoing surgery with general anesthesia. This data will be compared to similar data from wide-awake patients to determine if there are differences in the preoperative or postoperative experiences of these patients.

5. Conclusion

Our results indicate that wide-awake foot and ankle surgery causes little discomfort to patients receiving many common procedures. Moreover, patients tend to report high levels of satisfaction with their operative experience. Considering the various advantages of wide-awake surgery, the value of this approach is not likely to be overestimated.

Conflicts of interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

Acknowledgement

The senior author would like to acknowledge the leadership and guidance of Dr. Don Lalonde. This research would not be possible without his support and assistance.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at <http://dx.doi.org/10.1016/j.fas.2016.09.004>.

References

- [1] Farhangkhoe H, Lalonde J, Lalonde DH. Wide-awake trapeziectomy: video detailing local anesthetic injection and surgery. *Hand* 2011;6(4):466–7, doi:<http://dx.doi.org/10.1007/s11552-011-9367-z>.
- [2] Gregory S, Lalonde DH, Fung Leung LT. Minimally invasive finger fracture management: wide-awake closed reduction, K-wire fixation, and early protected movement. *Hand Clin* 2014;30(1):7–15, doi:<http://dx.doi.org/10.1016/j.hcl.2013.08.014>.
- [3] Higgins A, Lalonde DH, Bell M, McKee D, Lalonde JF. Avoiding flexor tendon repair rupture with intraoperative total active movement examination. *Plast Reconstr Surg* 2010;126(3):941–5, doi:<http://dx.doi.org/10.1097/PRS.0b013e3181e60489>.
- [4] Lalonde DH. Wide-awake flexor tendon repair. *Plast Reconstr Surg* 2009;123(2):623–5, doi:<http://dx.doi.org/10.1097/PRS.0b013e318195664c>.
- [5] Lalonde DH. Hole-in-One local anesthesia for wide-awake carpal tunnel surgery. *Plast Reconstr Surg* 2010;126(5):1642–4, doi:<http://dx.doi.org/10.1097/PRS.0b013e3181f1c0ef>.
- [6] Lalonde DH. Reconstruction of the hand with wide-awake surgery. *Clin Plast Surg* 2011;38(4):761–9, doi:<http://dx.doi.org/10.1016/j.cps.2011.07.005>.
- [7] Lalonde DH, Martin AL. Wide-awake flexor tendon repair and early tendon mobilization in zones 1 and 2. *Hand Clin* 2013;29(2):207–13, doi:<http://dx.doi.org/10.1016/j.hcl.2013.02.009>.
- [8] Lalonde DH. Minimally invasive anesthesia in wide-awake hand surgery. *Hand Clin* 2014;30(1):1–6, doi:<http://dx.doi.org/10.1016/j.hcl.2013.08.015>.
- [9] Bismil MSK, Bismil QMK, Harding D, Harris P, Lamymman E, Sansby L. Transition to total one-stop wide-awake hand surgery service-audit: a retrospective review. *JRSM Short Rep* 2012;3(4):23, doi:<http://dx.doi.org/10.1258/shorts.2012.012019>.
- [10] Lalonde D, Martin A. Epinephrine in local anesthesia in finger and hand surgery: the case for wide-awake anesthesia. *J Am Acad Orthop Surg* 2013;21(8):443–7, doi:<http://dx.doi.org/10.5435/JAAOS10.5435/JAAOS-21-08-443>.
- [11] Leblanc MR, Lalonde J, Lalonde DH. A detailed cost and efficiency analysis of performing carpal tunnel surgery in the main operating room versus the ambulatory setting in Canada. *Hand* 2007;2(4):173–8, doi:<http://dx.doi.org/10.1007/s11552-007-9043-5>.
- [12] Nelson R, Higgins A, Doumit J, Conrad J, Bell M, Lalonde DH. The wide-awake approach to Dupuytren's disease: fasciectomy under local anesthetic with epinephrine. *Hand* 2010;5(2):117–24, doi:<http://dx.doi.org/10.1007/s11552-009-9239-y>.
- [13] Davison PG, Cobb T, Lalonde DH. The patient's perspective on carpal tunnel surgery related to the type of anesthesia: a prospective cohort study. *Hand* 2013;8(1):47–53, doi:<http://dx.doi.org/10.1007/s11552-012-9474-5>.
- [14] Teo I, Lam W, Muthayya P, Steele K, Alexander S, Miller G. Patients' perspective of wide-awake hand surgery—100 consecutive cases. *J Hand Surg Eur Vol* 2013;38(9):992–9, doi:<http://dx.doi.org/10.1177/1753193412475241>.
- [15] Koegst WHH, Wolffe O, Thoele K, Sauerbier M. The wide-awake approach in hand surgery—a comfortable anaesthesia method without a tourniquet. *Handchir Mikrochir Plast Chir* 2011;43(3):175–80, doi:<http://dx.doi.org/10.1055/s-0031-1280762>.
- [16] Terry R, Niven C, Brodie E, Jones R, Prowse M. An exploration of the relationship between anxiety, expectations and memory for postoperative pain. *Acute Pain* 2007;9(3):135–43, doi:<http://dx.doi.org/10.1016/j.acpain.2007.04.041>.
- [17] Terry RH, Niven CA, Brodie EE, Jones RB, Prowse MA. Memory for pain? A comparison of nonexperiential estimates and patients' reports of the quality and intensity of postoperative pain. *J Pain* 2008;9(4):342–9, doi:<http://dx.doi.org/10.1016/j.jpain.2007.11.008>.
- [18] Terry R, Gijsbers K. Memory for the quantitative and qualitative aspects of labour pain: a preliminary study. *J Reprod Infant Psychol* 2000;18(2):143–52, doi:<http://dx.doi.org/10.1080/02646830050008387>.