A Cost Analysis of Carpal Tunnel Release Surgery Performed Wide Awake versus under Sedation

Todd H. Alter, B.S.
William J. Warrender, M.D.
Frederic E. Liss, M.D.
Asif M. Ilyas, M.D.

Background: Hand surgery under local anesthesia only has been used more frequently in recent years. The purpose of this study was to compare perioperative time and cost for carpal tunnel release performed under local anesthesia ("wide-awake local anesthesia no tourniquet," or WALANT) only to carpal tunnel release performed under intravenous sedation.

Methods: A retrospective comparison of intraoperative (operating room) surgical time and postoperative (postanesthesia care unit) time for consecutive carpal tunnel release procedures performed under both intravenous sedation and wide-awake local anesthesia was undertaken. All operations were performed by the same surgeon using the same mini-open surgical technique. A cost analysis was performed by means of standardized anesthesia billing based on base units, time, and conversion rates.

Results: There were no significant differences between the two groups in terms of total operative time, 28 minutes in the intravenous sedation group versus 26 minutes in the wide-awake local anesthesia group. Postanesthesia care unit times were significantly longer in the intravenous sedation group (84 minutes) compared to the wide-awake local anesthesia group (7 minutes). Depending on conversion rates used, a total of $139 to $432 was saved in each case performed with wide-awake local anesthesia by not using anesthesia services. In addition, a range of $1320 to $1613 was saved for the full episode of care, including anesthesia costs, operating room time, and postanesthesia care unit time for each patient undergoing wide-awake local anesthesia carpal tunnel release.

Conclusion: Carpal tunnel release surgery performed with the wide-awake local anesthesia technique offers significant reduction in cost for use of anesthesia and postanesthesia care unit resources. (*Plast. Reconstr. Surg.* 142: 1532, 2018.)

Hand surgery performed under local anesthesia only without a tourniquet, also called "wide-awake local anesthesia no tourniquet surgery" (or WALANT), is a technique that is experiencing growing interest and use.[1–9] In wide-awake local anesthesia surgery, surgical pain is controlled through an injection of a local anesthetic. The patient does not receive an intravenous or general anesthetic agent, thus eliminating the need for an anesthesia provider. There is minimal bleeding because the local anesthetic is supplemented with epinephrine, which limits bleeding within the operative field and negates the need for and discomfort of a tourniquet. Although there exists a widely accepted belief that use of epinephrine in distal extremities can cause finger necrosis, recent studies have demonstrated both the safety and efficacy of epinephrine use in the hand.[1–12]

Advocates for wide-awake local anesthesia claim that this anesthetic method is safer because it eliminates standard anesthetic risks and is more convenient for the patient because it foregoes the need for preoperative diagnostic testing,

From the Rothman Institute at the Thomas Jefferson University.
Received for publication April 5, 2018; accepted June 5, 2018.
Presented at the American Association for Hand Surgery Annual Meeting, in Phoenix, Arizona, January 10 through 13, 2018.

DOI: 10.1097/PRS.0000000000004983

Disclosure: *None of the authors received any financial benefit or had any financial conflicts in the production of this article.*

eliminates fasting, eliminates the need for a driver, avoids the discomfort of having an intravenous line placed, foregoes anesthesia induction time in the operating room, and minimizes postanesthesia care unit recovery time. Another possible benefit of wide-awake local anesthesia surgery is financial.[1,3,4] There are several potential cost savings from using the wide-awake local anesthesia technique rather than intravenous sedation with local anesthetic (intravenous sedation). Areas worthy of economic comparison include the elimination of preoperative testing (blood work, electrocardiography, and physician consultation for clearance for anesthesia), reducing and/or possibly eliminating the cost of an anesthesia provider and the cost savings introduced by reducing the time patients need to spend in the operating room and postanesthesia care unit.

The purpose of this study was to perform an economic analysis of hand surgery using a carpal tunnel release surgery model, by comparing the facility costs of carpal tunnel release surgery performed under wide-awake local anesthesia versus those performed under intravenous sedation. The hypothesis was made that wide-awake local anesthesia surgery would result in decreased hospital cost compared with intravenous sedation surgery.

PATIENTS AND METHODS

After receiving institutional review board approval for retrospective review and analysis of patient records, a comparison of all carpal tunnel release operations performed between 2012 and 2015 were reviewed. All operations were performed by one fellowship-trained hand surgeon at our outpatient surgical center. All procedures followed were in accordance with the ethical standards of the responsible institutional committee on human experimentation. The surgeon transitioned from performing all carpal tunnel release operations under intravenous sedation to the wide-awake local anesthesia no tourniquet technique at the end of 2013. Therefore, consecutive carpal tunnel release operations performed between 2012 and 2013 with intravenous sedation were available for comparison with carpal tunnel release cases in 2014 to 2015 performed consecutively with the wide-awake local anesthesia no tourniquet technique. Inclusion criteria were all mini-open carpal tunnel release operations performed alone without concomitant procedures. Data points collected included total operating room time, surgical time, and postanesthesia care unit time, which were retrieved from the anesthesia record and nursing documentation. Anesthetic complications and reoperations were also recorded. These data points were compared and statistically analyzed using two-tailed *t* tests.

Surgical Preparation

Both intravenous sedation and wide-awake local anesthesia patients physically walked themselves into the operating room. Patients were positioned supine with their operative arm extended onto a hand table. A nonsterile tourniquet on the upper arm was applied to those undergoing intravenous sedation, whereas no tourniquet was applied in the wide-awake local anesthesia group. Both groups underwent similar preparation and draping. There was no change in the surgical scrub, preparation, and draping during the study period.

Induction of Anesthesia

After preparing and draping the surgical site and after induction of anesthesia for the intravenous sedation cases, but before initiating surgery, 10 cc of 1% lidocaine plain (without epinephrine) was injected into the surgical site. After injection but before incision, the intravenous sedation group underwent Esmarch exsanguination of the limb followed by insufflation of the tourniquet to 250 mmHg.

For patients undergoing wide-awake local anesthesia, 9 cc of 1% lidocaine with 1:100,000 epinephrine and 1 cc of sodium bicarbonate were mixed. A total of 10 cc of this mixture was injected into the surgical site on entry into the operating room but before preparing and draping the patient.[13] Although it has been recommended to preinject the surgical site 20 to 30 minutes before injection in the preoperative unit, it has been the practice of the senior author (A.M.I.) to inject in the operating room before preparing and draping the patient, with a negligible difference in bleeding and still no need for a tourniquet. An additional 10 cc of 1% lidocaine with 1:100,000 epinephrine was available on the field for additional injection, as needed. Phentolamine, a reversal agent for the vasoconstrictive effects of epinephrine, was available at all times in the surgical center but never needed to be used in any case.

Surgical Technique

The identical mini-open carpal tunnel release surgical technique was used for both the intravenous sedation and wide-awake local anesthesia

cases. A 2-cm longitudinal incision was placed at the base of the volar hand in line with the third web space. The superficial palmar fascia was cut in line with the skin incision. The transverse carpal ligament was identified and released longitudinally until complete decompression of the median nerve was confirmed. The skin incisions were closed with three 4-0 nylon horizontal mattress sutures followed by application of soft sterile dressing.

Cost Analysis

Anesthesia costs are calculated based on a base unit value assigned to the procedure based on its complexity added to the number of 15-minute time units the provider spends multiplied by the provider's charge per unit (i.e., conversion factor). The anesthesia clock starts when anesthesia personnel begin to prepare the patient for anesthesia care, and ends when the patient is safely placed in postanesthesia supervision and anesthesia personnel are no longer in personal attendance. We used the 2017 Centers for Medicare & Medicaid Services conversion rate of $23.14 for our institution's metropolitan area.[14] The anesthesia CPT code 01810 was used to determine that 3 base units are applied to basic nerve decompression surgery of the hand. For each case performed under wide-awake local anesthesia, a total of $138.84 was saved by not using anesthesia services. Please see below for calculation.

$$\left[Base\ unit\ +\ Time\ (units)\right]\ x\ Conversion\ factor = Anesthesia\ charge$$

$$\left[3\ units + 3\ units\right]\ x\ \$23.14\ /\ unit = \$138.84\ /\ case$$

Routine care provided to a patient in the postanesthesia care unit and before discharge is not separately billable to the Medicare program. To evaluate the potential cost savings to the hospital when wide-awake local anesthesia surgery was used for carpal tunnel release, we used $12.16 per minute that a patient is in the postanesthesia care unit based on a 2015 study that evaluated a detailed list of direct and indirect costs needed rather than amount billed. We felt this would provide the best estimate of potential cost savings to the hospital.[15]

Finally, to estimate standard costs for items associated with routine preoperative testing associated with anesthesia, we used figures publicly available from healthcarebluebook.com. This database used averages of actual amounts paid by insurance companies, including the Centers for Medicare & Medicaid Services, for common medical tests and services. The standard preoperative testing consists of a history and physical examination, chest radiographs, electrocardiogram, and standard blood work in the form of a complete blood count and basic metabolic panel.

RESULTS

A total of 190 patients met the inclusion criteria: 136 underwent surgery with sedation with intravenous sedation and 54 underwent surgery with wide-awake local anesthesia. The average ages were 59 ± 14 and 62 ± 12 for the intravenous sedation and wide-awake local anesthesia groups, respectively. There were 86 women in the intravenous sedation group (63 percent) and 24 women in the wide-awake local anesthesia group (44 percent). There were no anesthetic complications or reoperations in either group.

As defined by the in-room and out-of-room time, patients in the intravenous sedation group had an average total operating room time of 28 ± 5.5 minutes, whereas the wide-awake local anesthesia group averaged 26 ± 6.7 minutes ($p = 0.052$). Surgical time, as defined by the documented procedure start and end time, averaged 9.7 ± 2.2 minutes in the intravenous sedation group, whereas the wide-awake local anesthesia group averaged 10 ± 2.3 minutes ($p = 0.41$). Postoperatively, patients in the intravenous sedation group spent an average of 84 ± 29 minutes in the recovery room before discharge, compared with 7 ± 2 minutes in the wide-awake local anesthesia group ($p < 0.05$) (Table 1).

As anesthesia reimbursement and individual patient insurance contracts differ, we used standard Centers for Medicare & Medicaid Services reimbursement rates for anesthesia to determine cost differences. We estimated that each case performed under intravenous sedation had excess charges secondary to anesthesia reimbursement of approximately $138.84 (see Patients and Methods for calculation). At a rate of $12.16 per minute,[21] with an average 84 minutes in the postanesthesia care unit, intravenous sedation cases cost an additional $1021.44 to the hospital. Furthermore, we estimate that patients scheduled for intravenous sedation had standard preoperative medical clearance and testing consisting of a history and physical examination (established-patient 25-minute visit, $117), chest radiographs ($47), electrocardiogram ($22), and standard blood work in the form of a complete blood count ($21) and basic metabolic panel ($28).[16] The cost for these preoperative expenditures is $235 per patient. In

Table 1. Comparison of Time Variables for Intravenous Sedation versus Wide-Awake Local Anesthesia

	MAC	WALANT	*p*
OR time, min	28 ± 5.5	26 ± 6.7	0.052
Surgical time, min	9.7 ± 2.2	10 ± 2.3	0.41
Recovery room time, min	84 ± 29	7 ± 2	<0.05

MAC, monitored anesthesia care (intravenous sedation); WALANT, wide-awake local anesthesia no tourniquet; OR, operating room.

addition, a pneumatic tourniquet cuff and 10 cc of 1% lidocaine without epinephrine were used in each case, costing $10[17] and $4, respectively.[18]

Patients undergoing carpal tunnel release under wide-awake local anesthesia spent an average of 7 minutes in the postanesthesia care unit and thus assumed a cost of $85.12 ($12.16 per minute). In each wide-awake local anesthesia case, 20 cc of 1% lidocaine with 1:100,000 epinephrine was used, costing an additional $4.[18] The wide-awake local anesthesia patients assumed a $0 cost for all of the remaining preoperative and postoperative expenditures. Combining the anesthesia cost, preoperative clearance cost, tourniquet and lidocaine costs, and postanesthesia care unit costs, each case performed under wide-awake local anesthesia saved the health care system an average of $1320.16 (Table 2).

DISCUSSION

Carpal tunnel syndrome is a common hand condition that is often treated with carpal tunnel release when surgery is indicated.[19] Perioperative anesthesia with intravenous sedation (monitored anesthesia care), or general anesthesia, has traditionally been used for routine hand surgical procedures such as carpal tunnel release. Recently, advances in wide-awake local anesthesia technique have given surgeons and patients an additional method of administering anesthesia for routine hand surgical procedures such as carpal tunnel release, thereby forgoing the need for anesthesia staff involvement and postanesthesia care unit recovery time.[14,15,18]

Table 2. Cost Comparison for Intravenous Sedation versus Wide-Awake Local Anesthesia

	MAC	WALANT	Cost Difference
Preoperative costs	$235.00	—	$235.00
Anesthesia reimbursement	$138.84	—	$138.84
Tourniquet	$10.00	—	$10.00
Local anesthetics	$4.00	$4.00	—
Recovery room costs	$1021.44	$85.12	$936.32
Total	$1409.28	$89.12	$1320.16

MAC, monitored anesthesia care (intravenous sedation); WALANT, wide-awake local anesthesia no tourniquet.

In our analysis of wide-awake local anesthesia hand surgery performed in the treatment of carpal tunnel release surgery, we found no significant difference in the length of the procedure or in the total time spent in the operating room compared to the use of intravenous sedation. We speculate that the time spent by the anesthesiologist to sedate the patient in the intravenous sedation group was matched by the time spent injecting local anesthetics by the surgeon in the wide-awake local anesthesia group.

Preoperative nursing time was not measured. In general, patients in the intravenous sedation group would be expected to spend more time preoperatively for intravenous line placement and anesthesia evaluation, discussion, and consenting. Alternatively, patients in the wide-awake local anesthesia group did not require intravenous line placement or anesthesia staff involvement. Conceivably, surgeons may request that patients present early to the preoperative unit for injection of the surgical site, as it is recommended to give the epinephrine 20 to 30 minutes to maximize the vasoconstrictive effect.[19] However, it is the practice of the senior author (A.M.I.) to inject immediately preoperatively in the operating room, before preparing the limb, without any increased issue of bleeding or need for a tourniquet. As such, for study purposes, we ignored the preoperative time, as that may be variable among surgeons. Regardless, had we studied this, in our study, we would have found more time and cost only in the intravenous sedation group.

Postanesthesia care unit times were significantly shorter in the wide-awake local anesthesia group (7 ± 2 minutes) compared with the intravenous sedation group (84 ± 29 minutes). Because patients in the wide-awake local anesthesia group do not receive systemic anesthetic agents, they do not require time to recover from their effects. An additional advantage for patients in the wide-awake local anesthesia group is that they are allowed to drive themselves home after the procedure, and they therefore do not have to arrange for a ride.

The cost savings for each patient was $1320.16. This is an intentional, gross underestimation of the potential cost savings possible for wide-awake local anesthesia carpal tunnel release. Our anesthesia cost analysis was based on Medicare reimbursement schedules, with no representation of the reimbursements of private insurers. We used the 2017 Centers for Medicare & Medicaid

Services conversion rate of $23.14 for our institution's metropolitan area. Based on the 2015 American Society of Anesthesiologists commercial conversion factor survey results, the national average conversion factor was $71.92.[20] If we used this national average conversion rate, our cost savings would increase to $431.52 for anesthesia services and $1612.84 total per patient. In addition, because postanesthesia care unit cost is not billed separately to insurance, it is difficult to estimate the true cost. For this reason, we used the detailed cost analysis performed previously by Raft et al.[21] Because it is not based on billing charges, we feel this is the best estimate of actual cost (direct and indirect) saved by the hospital.

Codding et al. performed an economic analysis in which 78 consecutive cases of single–trigger finger release surgery with intravenous sedation ($n = 31$) were compared to those with wide-awake local anesthesia ($n = 47$).[21] Patients in the intravenous sedation group experienced an average operating room time and surgical time of 27.2 and 10.2 minutes, respectively. Similarly, patients in the wide-awake local anesthesia group experienced an average operating room time and surgical time of 25.2 and 10.4 minutes, respectively. Average recovery room time was 72.3 and 30.2 minutes in the intravenous sedation and wide-awake local anesthesia groups, respectively. This study reported an average savings of $105 secondary to anesthesia reimbursement in intravenous sedation cases. However, although the average operating room, surgical, and recovery room times were similar to our study, there was little detail on objective cost data (e.g., preoperative clearance, postanesthesia care unit, blood work) outside of anesthesia reimbursement, rendering the estimate of cost savings far less than the actual cost savings.

Anesthesia is also associated with increased rates of nausea and vomiting. Twenty-six percent of patients require additional treatment in the postanesthesia care unit, and 40 percent of patients require additional treatment for postoperative nausea and vomiting following discharge.[3,4] The cost of rescue treatment for postoperative nausea and vomiting has been estimated at a minimum of $283.[24] Although we did not record postoperative nausea and vomiting, this is an issue that can result in the need for ambulance transfer to a hospital costing $300 to $900 and result in an admission costing $1200 to more than $2400 per day. In addition, an economic impact would also be seen in patients with obstructive sleep apnea. Studies show that 22 to 39 percent of all surgical patients are at high risk for obstructive sleep apnea. Eighty percent of these patients are undiagnosed.[25] During recovery, residual anesthetics increase the number and duration of sleep apnea episodes but inhibit arousals that would normally occur during such episodes. For this reason, the guidelines from the American Society of Anesthesiologists for perioperative care of obstructive sleep apnea patients suggest that patients should stay in recovery for an extended period after the last episode (e.g., desaturation, reintubation, hypoxia). Eliminating these possible anesthetic complications completely further reduces the budget for postanesthesia care unit time and cost. Finally, we evaluated the basic costs for a preoperative visit and testing associated with clearance for anesthesia. Additional costs would be incurred for patients required to see a cardiologist or other specialist or if any further testing (echocardiogram, stress test, advanced laboratory work) was needed before surgery.

Although there have been reports that use of epinephrine in distal extremities can cause finger necrosis,[26] these events appear to be extremely rare, and recent studies have demonstrated both the safety and efficacy of epinephrine use in the hand.[8,11,13–18,22,24,26,27] In the senior author's personal experience of performing over 2000 cases under wide-awake local anesthesia , there have been no cases of digital ischemia or need for reversal. Nonetheless, it is good practice to keep phentolamine, a reversal agent for the vasoconstrictive effects of epinephrine, available at the surgical center where wide-awake local anesthesia surgery is being performed.[27] There is an associated cost in ensuring that there is phentolamine ($35 for 50 mg)[28] available that has not expired. However, as the use of phentolamine is extremely rare, it would have a negligible cost when spread out among all wide-awake local anesthesia cases occurring over the course of its shelf life. In addition, patients should be advised that they may feel jittery or shaky following injection but that this typically dissipates in 15 to 20 minutes.[14] This potential side effect requires no additional treatment and thus does not affect costs.

This study was designed to investigate perioperative times and perform an economic analysis and comparison of carpal tunnel release performed under intravenous sedation versus wide-awake local anesthesia. Therefore, no outcome measures, patient satisfaction scores, or follow-up data were collected. Several studies have, however, investigated such data in patients undergoing wide-awake local anesthesia no tourniquet carpal tunnel release surgery. Davison et al. found that 93 percent

of patients who underwent wide-awake local anesthesia surgery would choose it again in subsequent operations. In addition, it was found that patients' intraoperative anxiety for wide-awake local anesthesia surgery was not significantly different than their preoperative anxiety. However, patients who underwent wide-awake local anesthesia surgery had significantly less preoperative anxiety than patients who underwent sedation.[8] Teo et al. similarly found that 86 percent of patients who underwent wide-awake local anesthesia surgery would choose it again in subsequent operations. In addition, 91 percent reported that the operation was less painful or comparable to a procedure performed by a dentist.[29]

Our study has some limitations. First, it is a retrospective study that is based solely on the experiences of a single surgeon at a single institution. Multicenter, prospective, randomized trials could build on our data and provide further insight into use of the wide-awake local anesthesia no tourniquet method. As noted previously, this study was not designed to investigate outcomes or patient satisfaction and thus lacks any clinical data. In addition, the costs assumed by hospitals, patients, and insurance companies vary significantly and often are difficult to dissect on an item-by-item basis. This study aims to address costs to the hospital, but payer reimbursements often were used in their place when sufficient data were unavailable, which may affect the accuracy of our cost estimates.

CONCLUSIONS

Patients who underwent carpal tunnel release surgery under wide-awake local anesthesia (WALANT) demonstrated similar time in the operating room and similar surgical time from incision to closure compared to sedation with intravenous sedation. Patients in the wide-awake local anesthesia no tourniquet group also spent significantly less time in the postanesthesia care unit postoperatively, saving approximately $1320.16 per patient, which certainly underestimates the total savings. Avoiding use of anesthesia services for high-volume procedures such as carpal tunnel release surgery may result in significant systemic annual savings to payers and hospitals. These savings may be desirable with the growth of bundling and episode-based payments to patients, facilities, and surgeons.

Todd H. Alter, B.S.
1134 1/2 Lombard Street
Philadelphia, Pa. 19147
todd.alter@jefferson.edu

REFERENCES

1. 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 (N Y)* 2013;8:47–53.
2. Lalonde D, Eaton C, Amadio P, Jupiter J. Wide-awake hand and wrist surgery: A new horizon in outpatient surgery. *Instr Course Lect.* 2015;64:249–259.
3. 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;21:443–447.
4. Lalonde D, Martin A. Tumescent local anesthesia for hand surgery: Improved results, cost effectiveness, and wide-awake patient satisfaction. *Arch Plast Surg.* 2014;41:312–316.
5. Lalonde D. Minimally invasive anesthesia in wide awake hand surgery. *Hand Clin.* 2014;30:1–6.
6. Lalonde DH. Wide-awake extensor indicis proprius to extensor pollicis longus tendon transfer. *J Hand Surg Am.* 2014;39:2297–2299.
7. Lalonde DH, Wong A. Dosage of local anesthesia in wide awake hand surgery. *J Hand Surg Am.* 2013;38:2025–2028.
8. Ruxasagulwong S, Kraisarin J, Sananpanich K. Wide awake technique versus local anesthesia with tourniquet application for minor orthopedic hand surgery: A prospective clinical trial. *J Med Assoc Thai.* 2015;98:106–110.
9. Tang JB. Wide-awake primary flexor tendon repair, tenolysis, and tendon transfer. *Clin Orthop Surg.* 2015;7:275–281.
10. Ketonis C, Ilyas AM, Liss F. Pain management strategies in hand surgery. *Orthop Clin North Am.* 2015;46:399–408, xi.
11. Vinycomb TI, Sahhar LJ. Comparison of local anesthetics for digital nerve blocks: A systematic review. *J Hand Surg Am.* 2014;39:744–751.e5.
12. Al Youha S, Lalonde DH. Update/review: Changing of use of local anesthesia in the hand. *Plast Reconstr Surg Glob Open* 2014;2:e150.
13. Mckee DE, Lalonde DH, Thoma A, Dickson L. Achieving the optimal epinephrine effect in wide awake hand surgery using local anesthesia without a tourniquet. *Hand (N Y)* 2015;10:613–615.
14. Centers for Medicare & Medicaid Services. Anesthesiologists center. Available at: https://www.cms.gov/Center/Provider-Type/Anesthesiologists-Center.html. Accessed June 19, 2017.
15. Raft J, Millet F, Meistelman C. Example of cost calculations for an operating room and a post-anaesthesia care unit. *Anaesth Crit Care Pain Med.* 2015;34:211–215.
16. Healthcare Bluebook (website). Available at: http://www.healthcarebluebook.com/. Accessed June 19, 2017.
17. Alibaba (website). Available at: https://www.alibaba.com/. Accessed May 1, 2018.
18. ACE Surgical Supply Co., Inc. (website). Available at: http://www.acesurgical.com/. Accessed May 1, 2018.
19. Kim PT, Lee HJ, Kim TG, Jeon IH. Current approaches for carpal tunnel syndrome. *Clin Orthop Surg.* 2014;6:253–257.
20. Stead SW, Merrick SK. ASA survey results for commercial fees paid for anesthesia services: 2015. *ASA Monitor* 2015;79:48–54.
21. Codding JL, Bhat SB, Ilyas AM. An economic analysis of MAC versus WALANT: A trigger finger release surgery case study. *Hand (N Y)* 2017;12:348–351.
22. Apfel CC, Korttila K, Abdalla M, et al.; IMPACT Investigators. A factorial trial of six interventions for the prevention of postoperative nausea and vomiting. *N Engl J Med.* 2004;350:2441–2451.
23. Carroll NV, Miederhoff P, Cox FM, Hirsch JD. Postoperative nausea and vomiting after discharge from outpatient surgery centers. *Anesth Analg.* 1995;80:903–909.

24. Hill RP, Lubarsky DA, Phillips-Bute B, et al. Cost-effectiveness of prophylactic antiemetic therapy with ondansetron, droperidol, or placebo. *Anesthesiology* 2000;92:958–967.
25. Young T, Peppard PE, Gottlieb DJ. Epidemiology of obstructive sleep apnea: A population health perspective. *Am J Respir Crit Care Med.* 2002;165:1217–1239.
26. Zhang JX, Gray J, Lalonde DH, Carr N. Digital necrosis after lidocaine and epinephrine injection in the flexor tendon sheath without phentolamine rescue. *J Hand Surg Am.* 2017;42:e119–e123.
27. Nodwell T, Lalonde D. How long does it take phentolamine to reverse adrenaline-induced vasoconstriction in the finger and hand? A prospective, randomized, blinded study: The Dalhousie project experimental phase. *Can J Plast Surg.* 2003;11:187–190.
28. Cayman Chemical (website). Available at: https://www.caymanchem.com. Accessed May 1, 2018.
29. 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;38:992–999.