

Wide Awake Hand Surgery

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Background: "Wide awake hand surgery", where surgery is performed in local anaesthesia with adrenaline, without sedation or a tourniquet, has become widespread in some countries. It has a number of potential advantages and we wished to evaluate it among our patients.

Methods: All 122 patients treated by this method during one year were evaluated by the surgeons and the patients on a numerical scale from 0 (best/least) to 10 (worst/most). Theatre time was compared to that recorded for a year when regional or general anaesthesia had been used.

Results: The patients' mean score for the general care they had received was 0.1 (SD 0.6), for pain during lidocaine injection 2.4 (SD 2.2), for pain during surgery 0.9 (SD 1.5), and for other discomfort during surgery 0.5 (SD 1.4). Eight reported that they would want general anaesthesia if they were to be operated again. The surgeons' mean evaluation of bleeding during surgery was 1.6 (SD 1.8), oedema during surgery 0.4 (SD 1.1), general disadvantages with the method 1.0 (SD 1.6) and general advantages 6.5 (SD 4.3). The estimation of advantages was 9.9 (SD 0.5) for tendon suture. 28 patients needed intra-operative additional anaesthesia. The proportion was lower among trained hand surgeons and fell significantly during the study period. Non-surgical theatre time was 46 (SD 15) minutes during the study period and 55 (SD 22) minutes during the regional/general period ($p < 0.001$). This gain was cancelled out by a longer surgery time during the wide awake period.

Conclusions: Wide awake surgery is fully acceptable to most patients. It has a number of advantages over general or regional anaesthesia, but we feel it is unlikely to improve the efficiency of the operating theatre.

Keywords: Tourniquet, Local anaesthesia, Hand surgery, Wide awake

INTRODUCTION

Hand surgery accounts for approximately 1/5 of all operations in our general orthopaedic department. Traditionally, these patients have been operated on in regional or general anaesthesia. A substantial amount of the time when the patient is in the operating theatre is taken up with anaesthetizing the patient and waking him up after

surgery. It seems possible that the use of local anaesthesia given before the patient is brought to the operating theatre could reduce this time and thus make the use of the operating theatres more efficient.

Another benefit of operating in local anaesthesia is that the patient is able to tighten and relax muscles on demand. This can give the surgeon useful information, such as the ability of the tendons to glide in the tendon sheath, the tension and hold of a tendon suture, and the rotation of a metacarpal or phalanx.^{1,2)} As adrenaline has been added to the local anaesthetic, bleeding is minimal, making a tourniquet unnecessary. It has been shown that this is safe and useful,³⁻⁷⁾ and it is an advantage when surgery is expected to take longer than 15–20 minutes. Pain due to the tourniquet increases substantially after

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15 minutes.⁸⁾

Costs would normally also be reduced because there is no anaesthetist, no need for preoperative testing before general anaesthesia, and as the patient has not been sedated he can return home soon after leaving the operating theatre.^{9,10)}

95% of all hand surgery is now performed in local anaesthesia in some centres in Canada and has been named “wide awake surgery”.¹¹⁾ During a one year period we allocated one operating theatre to wide awake hand surgery. Most hand surgeries performed by trained hand surgeons in this period were done wide awake. We prospectively recorded details on all patients operated in this manner in order to assess any advantages. We wished to determine if patients are happy with this form of anaesthesia, if it makes the surgery more difficult, and if it makes the operating theatre more efficient.

METHODS

Anaesthesia

Patients were anaesthetized by the operating surgeon in the day-patient assembly room. They received no sedation. Wide awake surgery entails injecting substantial amounts of lidocaine 1% with adrenaline 0.005 mg/ml, buffered with 1 ml sodium bicarbonate 0.5 mmol/ml to each 9 ml of lidocaine. Buffering substantially reduces the stinging sensation of the lidocaine.¹²⁾ The solution may be diluted with an equal amount of saline if more than 50 ml needs to be injected or an equal amount of bupivacaine 2.5 mg/ml with adrenaline 0.005 mg/ml when the procedure is expected to last for a very long time. The solution is injected slowly as infiltration and sometimes also as a nerve block. It is important to inject all tissues that are to be incised in order to allow the vaso-constrictive effect of adrenaline to reduce bleeding. Surgery commences 25-60 minutes later, in order to give the adrenaline time to take effect.¹³⁻¹⁵⁾ The local oedema caused by the injected liquid has by this time dissipated. A tourniquet is not used. There is usually some bleeding when the skin is incised, but this rapidly lessens.

Thus, in cases with a flexor tendon injury of the finger, a bolus of 10-15 ml is injected in the palm of the hand and 2 ml volarly in the proximal and middle phalanx and 1ml in the distal phalanx of the finger to be operated. Anaesthetic should also be infiltrated subcutaneously proximal to the wrist if it is probable that tendons have retracted into the carpal tunnel. The surgeon can ask the patient to flex his finger during surgery to make sure that the tension on a tendon suture is adequate

and that the tendon does not catch on a pulley. If one is unsure which tendon ends are to be joined, this becomes clear when the patient tries to flex one finger at a time.

On excision of the trapezium for arthrosis of the first carpometacarpal joint, we infiltrated approximately 20 ml volarly and dorsally around the bone and injected 2 ml into the joint.

Study

122 patients were treated with this method from March 2012 to March 2013. Children, demented patients, and those who did not speak Norwegian were not considered suited for wide awake surgery. Surgeons noted their evaluation of intra-operative bleeding and oedema, and overall inconvenience and overall advantages with the method. All patients, except one, were contacted by telephone the next day by a nurse. In answer to a structured questionnaire they reported overall quality of care, pain on administration of the anaesthetic, pain during the operation, and whether there had been other discomfort during the procedure. A numerical scale from 0 (best or least) to 10 (worst imaginable or most) was used to record all responses. Patients were also asked whether they would choose the same form of anaesthesia, in case of a subsequent procedure or would prefer general anaesthesia.

In order to evaluate the patient flow in the operating theatre, the recordings from the study period were compared to those that had been noted for the year 2010. These patients had received regional block or a general anaesthetic. We selected only procedures where the operating technique is fairly standardized and only operations performed by trained hand surgeons during normal working hours during the study and control periods.

Phentolamine antidote to adrenaline vasoconstriction was available, but was never required. Statistical evaluation was performed with the Student's t-test for independent samples, bivariate correlation analysis, and the Chi square test, as appropriate. Patients during the wide awake study period gave their written consent to participation. The protocol was reviewed by the Regional medical ethics committee who considered that their approval was not required.

RESULTS

Patients gave a mean evaluation (0 = best; 10 = worst) of 0.1 (SD 0.6) for the general care they had received. The mean score for pain during injection of lidocaine was 2.4 (SD 2.2), pain during surgery 0.9 (SD 1.5),

and for other discomfort during surgery 0.5 (SD 1.4). A total of 113 stated that they would like to have wide awake anaesthesia if they were to be operated at a later time. Eight replied that they would prefer general anaesthesia.

Surgeons evaluated (0 = least; 10 = most) drawbacks because of intra-operative bleeding and oedema at 1.6 (SD 1.8) and 0.4 (SD 1.1), respectively. They evaluated drawbacks in general from operating this patient wide awake at 1.0 (SD 1.6), and advantages in general at 6.5 (SD 4.3). The surgeons' highest estimation of general advantage was recorded for tendon suture, with a mean score of 9.9 (SD 0.5).

The mean amount of anaesthesia injected at various types of surgery is recorded in Table 1. Additional intra-operative anaesthesia was required in 16 of the 103 surgeries performed by trained hand surgeons and 12 out of 19 surgeries performed by surgeons in training ($p < 0.001$). The need for supplementary anaesthesia fell significantly during the study period ($p < 0.05$; Fig. 1).

The surgeons spent an average of 6 (SD 3) minutes administering the anaesthetic before the patient was brought to the operating theatre. Patients reported that full sensibility had returned after 8.5 (SD 4.2) hours. There was no statistically significant association be-

tween this time and the amount of anaesthetic that had been given.

The time the patient had spent in the operating theatre before and after the actual surgery was calculated for the wide awake study period and compared to that noted for the control period. It was a mean of 46 (SD 15) minutes

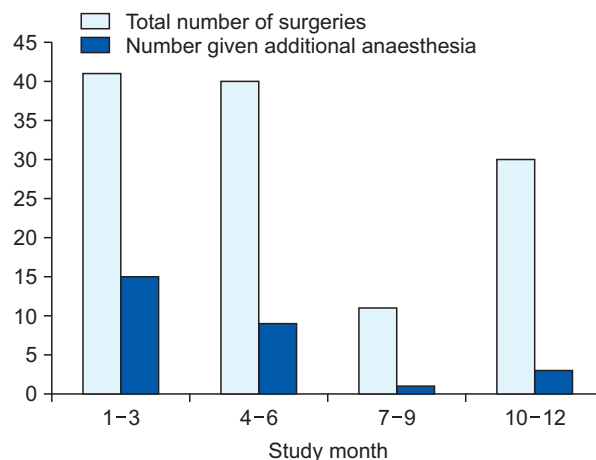


Fig. 1. The number of wide awake surgeries during each 3-month period of the study and the number of patients requiring additional intra-operative anaesthetic.

Table 1. Mean (range) ml anaesthetic used at wide awake surgeries and the number requiring additional anaesthetic

Procedure	n	Mean ml initial anaesthetic	Number requiring additional anaesthetic	Mean ml additional anaesthetic
Cubital tunnel release	6	27 (20-40)	3	12 (5-20)
Simple trapeziectomy	20	25 (16-35)	10	8 (1-17)
Thumb ulnar colat. lig. rupture	8	14 (8-24)	0	0
Pinning metac/phalanx fracture	24	18 (7-22)	7	8 (3-14)
Interphalangeal arthrodesis	6	18 (14-24)	0	0
Extensor tendon suture (hand)	8	16 (10-22)	0	0
Flexor tendon suture (hand)	10	20 (13-24)	1	3
Tenolysis	4	16 (8-22)	0	0
Soft tissue tumor	7	13 (4-22)	0	0
Other	29	18 (7-44)	7	11 (5-20)

Table 2. Mean (range) minutes of operating time and total theatre time for selected types of surgeries during the wide awake study period and during a control period of one year when general or regional anaesthesia was used

Procedure	Wide awake (minutes)			Control period (minutes)		
	n	Surgery	Theatre	n	Surgery	Theatre
Cubital tunnel release	4	44 (23-75)	85 (45-120)	12	30 (20-43)	76 (48-122)
Simple trapeziectomy	15	53 (30-89)	88 (63-107)	8	39 (32-48)	87 (64-120)
Thumb ulnar colat. lig. rupture	7	35 (25-58)	77 (55-104)	13	39 (18-75)	105 (75-140)
Interphalangeal arthrodesis	5	49 (26-93)	106 (67-120)	7	43 (18-77)	105 (90-120)

during the wide awake study period and 55 (SD 22) minutes during the control period ($p < 0.001$). However, when the mean duration of surgery and the total time in the operating theatre were calculated for four types of surgery where it was felt that a comparison could be made, it was found that in many instances the reduction in time spent before and after surgery in the wide awake group was cancelled out by a shorter operating time during the period where the patients had received general or regional anaesthesia (Table 2).

The time between leaving the operating theatre and discharge was 67 (SD 32) minutes for the 59 wide awake patients where data on this had been recorded.

DISCUSSION

Patients were happy with the wide awake surgery. Only 7% stated that they would have preferred general anaesthesia. This is similar to the findings of others.^{9,16,17} Many of our patients had probably never had a general anaesthetic and did not know what it entails, other than that they would have been unconscious.

The most uncomfortable part of the procedure was the actual injection of the anaesthetic. It has been shown that this can be done almost painlessly. Key points are reported to be to use buffered lidocaine that has been heated to body temperature, to use a 27 gauge needle, to pass the needle through the skin at 90 degrees, to wait a few seconds after injecting a small volume subcutaneously, and to always have a ridge of raised or blanched skin 0.5-1 cm in front of the needle tip.¹⁸⁻²² In this way the pain can be reduced to the initial pinprick as the needle passes through the skin.^{20,21} We did often not adhere to all these guidelines and could probably have reduced pain and discomfort if we had done so.

Many of our patients needed additional anaesthetic during the procedure. The number was significantly lower among those treated by a trained hand surgeon and also fell significantly as we gained more experience. Koegst and co-workers reported having to give additional intra-operative anaesthetic in 10% of cases.¹⁷ Others have pointed out the gains to be achieved by formally teaching the correct procedure to students and residents.^{20,21} There are many variations on the recommended details on administering the local anaesthetic.^{11,16,18-20,23,24} Many recommend higher volumes than we employed in the beginning of our study period.

We found that, in general, the advantages of the wide awake approach in hand surgery far outweigh the drawbacks. This was particularly true for tendon surgery

where it was possible for the patient to assist during surgery by tightening and relaxing muscles when asked. Bezuhly et al. performed extensor indicis proprius to extensor pollicis longus transfers as wide awake surgery and found it very useful to evaluate the tension of the transfer intra-operatively.¹⁾ Higgins et al. re-did the suture in seven out of 102 flexor tendon sutures because intraoperative active movement of the finger demonstrated bunching or gapping at the suture site.²⁾ We often let the patient watch his finger move actively before applying the bandages after tendon surgery. In this way he sees what is mechanically possible and we hope that it will be an encouragement during the postoperative training period.

The local oedema from the injected fluid had completely disappeared by the time of surgery. Bleeding in the operative field was only a very minor problem in the great majority of cases.²⁵⁾

Like others, we found that non-surgical time in the operating theatre is reduced statistically significantly in wide awake surgery, indicating greater efficiency.¹³⁾ This could also be achieved in institutions where it is possible to give a regional block or general anaesthetic before the patient is brought to the theatre. We have not found reports comparing the surgery time when using wide awake and conventional anaesthesia. Such a comparison is difficult without a randomized study. We have attempted an historical comparison. On the whole, surgery times were longer during the wide awake period. We excluded operations not performed by trained hand surgeons, and also those undertaken outside of normal working hours when the logistics of the operating theatres are different from the usual routine during the day. Even so, the conclusion must be very uncertain as the numbers are small and even the few types of surgery that we have selected for the comparison do often not proceed in an absolutely standard fashion. In spite of this, it seems possible that the gains in non-surgical time are lost in slightly longer surgery times. In addition, the surgeon must spend a few minutes giving the anaesthetic.

Clear advantages with wide awake surgery, however, are that one can operate also when an anaesthetist is not available. There is no need for preoperative testing for general anaesthesia. Close observation in a recovery ward is unnecessary as no sedation has been given and the patient can be discharged early. The need for analgesics postoperatively may also be reduced as no pain is felt for some hours after surgery.²⁶⁾

We conclude that wide awake surgery is fully acceptable to most patients. It has a number of advantages over

general or regional anaesthesia, but we feel it is unlikely to improve the efficiency of the operating theatre.

DECLARATION OF INTEREST

The authors have no conflicts of interest.

REFERENCES

1. Bezuhly M, Sparkes GL, Higgins A, Neumeister MW, Lalonde DH. Immediate thumb extension following extensor indicis proprius-to-extensor pollicis longus tendon transfer using the wide-awake approach. *Plast Reconstr Surg.* 2007;119:1507-12.
2. Higgins A, Lalonde HD, Bell M, McKee D, Lalonde JF. Avoiding flexor tendon repair rupture with intraoperative total active movement examination. *Plast. Reconstr. Surg.* 2010;126:941-5.
3. Denkler K. A Comprehensive review of epinephrine in the finger: To do or not to do? *Plast Reconstr Surg.* 2001;108:114-24.
4. Finsen V. Necrosis in fingers and toes following local anaesthesia with adrenaline – an urban legend? (In Norwegian). *Tidskr Nor Laegeforen.* 2013;133:1827-30.
5. Lalonde D, Bell M, Sparkes G, Denkler K, Chang P. A Multicenter prospective study of 3,110 consecutive cases of elective epinephrine use in the fingers and hand: The Dalhousie project clinical phase. *J Hand Surg Am.* 2005;30:1061-7.
6. Mann T, Hammert WC. Epinephrine and hand surgery. *J Hand Surg Am.* 2012;37:1254-6.
7. Sylaidis P, Logan A. Digital blocks with adrenaline. An old dogma refuted. *J Hand Surg Br.* 1998;23:17-9.
8. Odinson A, Finsen V. The position of the tourniquet on the upper limb. *J Bone Joint Surg Br.* 2002;84:202-4.
9. Bismil MSK, Bismil QMK, Harding D, Harris P, Lamyman E, Sansby L. Transition to total one-step wide-awake hand surgery service-audit: a retrospective review. *J R Soc Med Sh Rep.* 2012; 3:23 DOI: 10.1258/shorts.2012.012010
10. Nelson R, Higgins A, Conrad J, Bell M, Lalonde D. The wide-awake approach to Dupuytren's disease. Fasciectomy under local anesthetic with epinephrine. *Hand.* 2010;5:117-24.
11. Lalonde D. Wide-awake flexor tendon repair. *Plast Reconstr Surg.* 2009;123:623-5
12. Capeda MS, Tzortzopoulou A, Thacrey M, Hudcova J, Arora Gandih P, Schumann R. Adjusting the pH of lidocaine for reducing pain on injection. *Cochrane Database Syst Rev.* 2010 Dec 8;(12):CD006581.
13. Caggiano NM, Avery DM, Matullo KS. The effect of anesthesia type on nonsurgical operating room time. *J Hand Surg Am.* 2015;40:1202-9.
14. McKee DE, Lalonde DH, Thoma A, Dickson L. Achieving the optimal epinephrine effect in wide awake hand surgery using local anesthesia without tourniquet. *Hand.* 2015;10:613-5.
15. Bashir MM, Qayyum R, Saleem MH, Siddique K, Kahn FA. Effect of time interval between tumescent local anesthesia infiltration and start of surgery on operative field visibility in hand surgery without tourniquet. *J Hand Surg Am.* 2015;40:1606-9.
16. Teo I, Lam W, Muthayya P, Steele K, Alexander S. Patients' perspective of wide-awake hand surgery – 100 consecutive cases. *J Hand Surg Eur.* 2013;38:992-9.
17. Koegst WHH, Wölflle O, Thoele K, Sauerbier M. Der "Wide Awake Approach" in der Handchirurgie – ein komfortables Anästhesieverfahren ohne Blutleere. *Handchir Mikrochir Plast Chir.* 2011;43:175-80.
18. Farhangkhoe H, Lalonde J, Lalonde D. Wide-awake trapeziectomy: video detailing local anesthetic injection and surgery. *Hand.* 2011;6:466-7.
19. Lalonde D. Wide-awake extensor indicis proprius to extensor pollicis longus tendon transfer. *J Hand Surg Am.* 2014;39:2297-9.
20. Farhangkhoe H, Lalonde J, Lalonde D. Teaching medical students and residents how to inject local anesthetic almost painlessly. *Can J Plast Surg.* 2012;20:169-72.
21. Strazar AR, Leynes PG, Lalonde DH. Minimizing the pain of local anesthesia injection. *Plast Reconstr Surg.* 2013;132:675-84.
22. Strazar R, Lalonde D. Minimizing injection pain in local anesthesia. *CMAJ.* 2012;184: 2016 DOI:10.1503/cmaj.111780
23. Lalonde D, Martin A. Tumescent local anesthesia for hand surgery: improved results, cost effectiveness, and wide-awake patient satisfaction. *Arch Plast Surg.* 2014;41:312-6.
24. Lalonde D, Wong A. Dosage of local anesthesia in wide awake hand surgery. *J Hand Surg Am.* 2013;38:2025-8.
25. Prasetyono TOH, Biben JA. One-per mil tumescent technique for upper extremity surgeries: broadening the indication. *J Hand Surg Am.* 2014;39:3-12.
26. Todd K, Berk WA, Huang R. Effect of body locale and addition of epinephrine on the duration of action of a local anesthetic agent. *Ann Emerg Med.* 1992;21:723-6.