RESEARCH ARTICLE

Comparison of Anesthesia Results between Wide Awake Local Anesthesia no Tourniquet (WALANT) and Forearm Tourniquet Bier Block in Hand Surgeries: A Randomized Clinical Trial

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Abstract

Background: There is still some debate regarding the most proper anesthetic technique in minor hand surgeries. We hypothesized that both the WALANT and forearm tourniquet Bier block methods provide effective anesthesia in minor hand surgeries without significant difference.

Methods: A total of 85 patients consented to participate in this study and were randomized into WALANT and single tourniquet forearm Bier block groups. In WALANT group, patients received adrenaline-contained lidocaine without tourniquet while lidocaine was administered accordingly after applying a forearm tourniquet in Bier group. Due to difference in intervention methods, the study was non-blinded. Need for additional analgesia during surgery, visual analogue scale (VAS) for pain intensity during operation and an hour later, amount of bleeding and active hand movements were evaluated and recorded.

Results: The need for analgesia and severity of pain (VAS) during surgery and one hour later were significantly less in WALANT group, whereas the amount of bleeding was less in Bier block group. The ability to move hand and fingers during the operation was the same in both groups.

Conclusion: Both WALANT and single cuff forearm tourniquet Bier block are effective methods in minor hand surgeries, however, forearm Bier block provides less analgesia and pain control with a drier field than WALANT method.

Level of evidence: I

Keywords: Bier block, Forearm IVRA, Hand surgery, WALANT

Introduction

Hand surgery is one of the most common operations that can be performed on an outpatient basis while there is no consensus on the optimal method of anesthesia for it. An online 2015 survey from members of the American Society of Surgeons of the Hand noted that intravenous sedation with local anesthesia was the most common practice (43%), followed by Bier block (18%) whereas 8% of surgeons performed the surgery with WALANT method (1). Intravenous regional anesthesia (IVRA) or double cuff arm tourniquet Bier block provides

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effective and short-term anesthesia and bloodless field in distal limb surgeries with a success rate of 94% to 98%. (2-3). In 1978, Rousseau et al. introduced an alternative to the traditional Bier block using a single cuff tourniquet in the forearm, that significantly reduced the dose of lidocaine used and hence, possible intoxication (4). In this technique, the minimum time required for the tourniquet to be inflated is reduced compared to the standard double cuff tourniquet in the arm that reduces tourniquet pain and ischemia (5). Forearm tourniquet helps to maintain functions of longer flexor and extensor muscles which is necessary for some surgeries (6-9). Wide awake local anesthesia no tourniquet (WALANT) in hand surgeries includes subcutaneous injection of a large volume of diluted lidocaine and epinephrine. Epinephrine infiltration causes vasoconstriction, thus, reducing bleeding. Many studies have shown the safety and effectiveness of epinephrine in hand surgery (10-15). The null hypothesis was that the forearm IVRA is as effective in providing a surgical block and reducing the need for additional analgesic as the WALANT technique. The secondary outcome measures included: (i) pain intensity (VAS) during operation and an hour later; (ii) amount of bleeding; (iii) ability to perform active movements of fingers and hand; (iv) onset time of sensory block; and (v) possible complications during and after surgery.

Materials and Methods

This randomized clinical trial was registered at the Iranian Registry of Clinical Trials (IRCT20180325039148N2). The study was carried out on 86 patients who needed minor hand surgeries (duration of operation less than 20 minutes) such as trigger finger, carpal tunnel syndrome and wrist ganglion from July 2018 to February 2019. The inclusion criteria were age 20-65 years and class I and II (American Society Anesthesiologists, ASA). Patients with history of allergy to local anesthetic drugs, seizure, psychological problems, peripheral vascular disorders and Raynaud's disease, coagulopathy, open wound in surgery field, cardiac arrhythmia, opium addiction and duration of surgery longer than 30 minutes were excluded from the study. The patients were divided into two groups (43 patients in each) using a block randomization with size of four. A written informed consent was obtained from each patient. An IV line was established on the non-operated hand for infusion of a crystalloid solution. Due to the different anesthesia techniques and the nature of the assessment during operation, blinding was not possible and both the patients and investigators were aware of the procedures conducted. All patients were monitored via pulse oximetry, electrocardiography and noninvasive blood pressure measurement. In the WALANT group, 25 ml of lidocaine 2% was mixed with 5ml of epinephrine 1/10000, 7.5 ml Na bicarbonate 8.4%, and 12.5 ml sterile normal saline. The required dose was selected based on the type of surgery and previous studies (15). In the Bier block group, an intravenous cannula was inserted into a distal vein of the operating forearm and then one cuff tourniquet was placed on the forearm below the elbow. After exsanguination with an esmarch bandage, the cuff was inflated to 100 mmHg above the patient's systolic blood pressure. Radial artery pulse was checked before and after tourniquet inflation. 7.5 ml of lidocaine 2% diluted with 12.5 ml of sterile normal saline (20 ml lidocaine 0.75 %) was slowly injected via the catheter. In Both groups, the block was tested with a 23 G needle at one-minute intervals in the thenar (median nerve), hypothenar (ulnar nerve), and first dorsal web (radial nerve) areas. Surgery began after ensuring enough anesthesia. All patients were operated by one hand surgeon. The pain intensity was measured during and one hour after surgery using visual analogue scale (VAS) from 0 to 10**:** zero indicates no pain and 10 shows the worst pain. If the VAS during surgery was equal to or greater than four, 50-100 µg of fentanyl was injected and recorded. If the patient did not tolerate surgery despite receiving three µg/Kg of fentanyl, deep anesthesia with propofol was performed and VAS was no longer recorded. All patients were transferred to the post anesthesia care unit (PACU) and VAS was measured one hour after surgery. If the VAS was above of four, 25 mg meperidine was injected. The amount of bleeding was estimated by the surgeon as: 1. bloodless, 2. little blood, 3. bloody field but performable, 4. bloody field (13). Active movements of wrist and fingers were checked if needed. During the surgery, patients were evaluated for possible complications such as: tinnitus, vertigo, nausea, local anesthetic toxicity signs (seizure, hypotension and arrhythmias) and were treated if necessary.

Data analysis

Data were analyzed by SPSS 16 (Chicago, USA). The descriptive results were presented as number, percentage, mean, median and standard deviation (SD). Chi square test, fisher's exact test, independent T test, and Mann–Whitney test were used for comparing of the results. A P value less than 0.05 was considered as statistically significant. Based on previous studies (5-6), forearm Bier block reduces the drug requirement by at least 50% compared to the conventional method and considering the first statistical error 5% and power of study 80%, the number of cases was estimated as 35 in each group by Open Epi software. For increasing the statistical power and also probability of missing cases, the sample size was considered as 43 in each group. Data collection was performed by observation and checklist.

Results

We followed the CONSORT (Consolidated Standards of Reporting Trials) guidance for reporting our results [Figure 1]. In this study 86 patients were analyzed, 43 in each group. In WALANT group, one case was excluded from the study because of having vascular mass and need for general anesthesia. No significant difference was found in demographic data including age and sex and duration of surgery between the two groups [Table 1]. During operation, there was significant difference in need for analgesia between two groups (*P=0.002),* nine patients (21%) in forearm IVRA received fentanyl (*P=0.002*) [Table 2]. As shown in Table 2, in the early postoperative phase and an hour later, VAS was

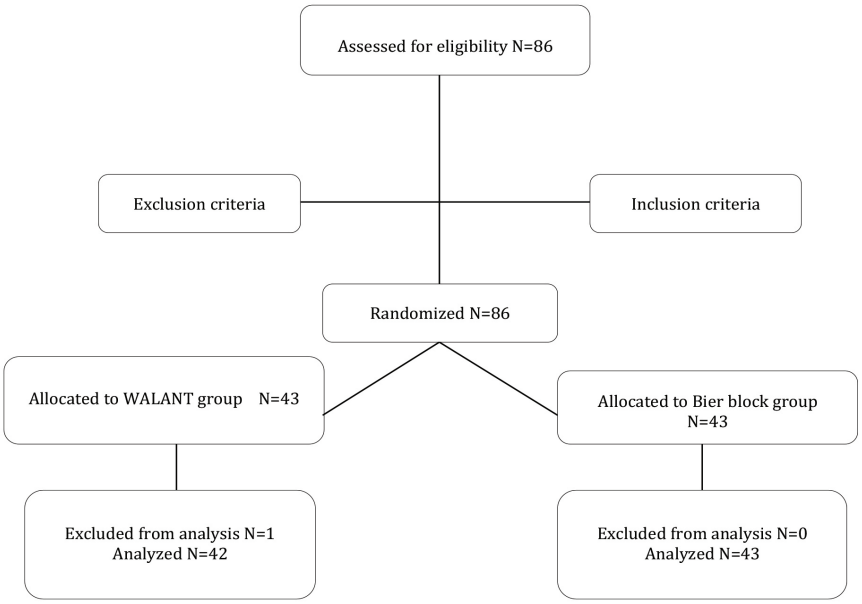

Figure 1. CONSORT flow diagram.

Table 1. Demographic data between the two groups

Variables		WALANT Anesthesia	Bier Block Anesthesia	*P value*
Sex	Male Number (%)	18(42.8)	20(46.5)	0.943
	Female Number (%)	24(57.2)	23(53.5)	
Age Mean(SD)		46.9(14.2)	49.9(14.3)	0.337
Surgery Duration Mean (SD)		10.7 (3.8)	10.7 (4.8)	0.737

Table 2. Comparision of VAS, need to opioid ,bleeding, and active hand movements between two groups during surgery ,PACU and one hour later

Variables		WALANT Anesthesia Number (%)	Bier Block Anesthesia Number (%)	*P value**
VAS *in* the early postoperative phase in PACU	= or <4	42 (100)	31(72)	<0.001
	>4	0(0)	12(28)	
VAS one hour after surgery	= or <4	37 (88)	18(42)	<0.001
	>4	5(12)	25(58)	
Need to fentanyl during surgery	No	42(100)	34(79.1)	0.002
	Yes	0(0)	9(20.9)	
Bleeding during surgery	Bloodless or Little blood	0 (0)	36(83.7)	<0.001
	Bloody field but performable	42(100)	7(16.3)	
Hand movement during surgery	Active	42(100)	40(93)	0.241
	Inactive	0(0)	3(7)	

*Fisher exact test p value

Table 3. The onset time of sensory block

Variable	WALANT Anesthesia		Bier Block Anesthesia		*P value*
	Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)	
The onset time of sensory block	14.5 (7.8)	13 (5)	13.4 (4.3)	11 (6)	0.459

significantly less in WALANT group compared to Bier block group (*P<0.001*), in Bier block group 12 patients (28%) at early PACU received 25 mg meperidine and one hour after surgery, 25 patients (58%) had VAS>4. In the Bier block group, the amount of bleeding was less than WALANT group (*P=0.001*) [Table 2]. All patients in both groups could actively move their wrist and fingers (*P=0.241*) [Table 2]. Based on Table 3, the onset time of sensory block was comparable in both groups (*P=0.459*). Local anesthetic toxicity, symptoms or signs, and local complications attributable to tourniquet application or epinephrine injection were none seen in any of the patients in the two groups.

Discussion

We hypothesized that there was no difference between forearm IVRA and WALANT technique in providing an adequate surgical block and reducing the need for additional analgesic during surgery. The need for additional analgesics during operation was significantly less in WALANT group. Although the need for more fentanyl in Bier block group during surgery seems to challenge our null hypothesis, it should be noted that the dose of analgesic received was only enough for sedation, so it did not cause any problems in the patient's cooperation with the surgeon while an appropriate surgical block was provided. The VAS in the early postoperative phase and 60 min later was significantly less in WALANT group compared to Bier block group (*P=0.001* and *P=0.001*, respectively). The amount of bleeding was less in forearm Bier block group (*P=0.001*) and there was no difference between two groups in the case of maintaining active hand movements (*P=0.241*).

Patients usually tolerate tourniquet for 20 minutes (16). Forearm tourniquet is more tolerable than arm tourniquet. Forearm tourniquet was not used frequently in the past because of the theory of systemic leakage of lidocaine via interosseous vessels secondary to distal anterior and posterior interosseous arteries obliteration in forearm (2). Recent studies have shown that forearm tourniquet does not increase the risk of local anesthetic agent leakage. Moreover, forearm tourniquet could be safe due low dose lidocaine usage (8, 17-20).

In Chiao study, forearm tourniquet was shown to led to more comfort, shorter recovery time, less pain, and less need for sedation compared to arm tourniquet (5). Also, according to Frank study, in forearm single tourniquet Bier block in comparison to arm double tourniquet Bier block, the operation field was drier, patients were more comfortable, and plasma level of lidocaine was lower, although of patient comfort was not durable after operation (21).

WALANT method causes more convenience by omitting the tourniquet (22). This method has less complications, cost, and time in comparison to general anesthesia and ability of preserving active hand movements (12, 16, 23). There were no reports for finger ischemia in several studies (24-25). The only self-limited complication was slight tremor and vasovagal reflux which was preventable by injecting in supine position (4).

Appropriate pain relief leads to shortened hospital stay, reduced hospital cost, and increased patient satisfaction. In our study, in the early postoperative phase, all patient in WALANT group had VAS less than 4 and an hour later, five patients experienced a VAS more than four [Table 2]. 93% of patients in Davison study; 86% in Teo study; and 83% in Koegst's study who underwent various hand surgeries with WALANT method said that they would choose this anesthesia again if necessary (26-28). According to Hegart study, WALANT method was safe and cheap and had low morbidity (29). In another study by him on nine patients with wrist arthroscopic or open surgery, it was concluded that in addition to the lower cost, active hand movements were maintained (30). This Important feature was also seen in our study in both groups.

In Glynn study on 58 patients who underwent carpal tunnel release with local anesthesia and forearm tourniquet, 44 patients (76%) reported no or little tourniquet pain (31). Our study had similar results, although we had to give fentanyl to nine patients (21%) in Bier block group, because of pain (VAS>4) or discomfort.

In our study the amount of bleeding was more in WALANT group. McKee DE study showed that waiting 26-30 min after injection of local anesthesia with epinephrine in WALANT technique results in less intraoperative bleeding in the hand, a relatively long waiting time to start a short-term surgery (16). In our research the onset time of anesthesia in Bier block and WALANT groups were 13.4+_4.3 and 14.5+_7.8 minutes respectively, without significant difference (*P=0.459*).

The special aspects of our study were the comparison of important features such as active hand movements, pain, and discomfort during and one hour after surgery between two methods of anesthesia. We found only a relatively similar research in which WALANT method was compared to local anesthesia with forearm tourniquet and they reported less discomfort and pain in WALANT method (22).

There may be some limitations to our study; first, we did not follow the patients after one hour in regard to their pain scores and satisfaction; second, the amount of bleeding during surgery was estimated in subjective method. Also, it was not possible to blind patients and

researchers.

Forearm single tourniquet block seems to have comparable advantages to the WALANT method, including minor bleeding (even drier surgery), maintaining active hand movements during surgery, and early onset of anesthesia, however, the pain and discomfort during operation until at least one hour later was less in WALANT method.

Conflict of Interests: Ramin Farzam, Mohammad Deilami, Saeed Jalili, Koorosh Kamali declare that they have no conflict of interest.

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References

1. Munns JJ, Awan HM. Trends in carpal tunnel surgery: an online survey of members of the American Society for Surgery of the Hand. J HAND SURG-AM. 2015;40(4):767-71.
2. Chan CS, Pun WK, Chan YM, Chow SP. Intravenous regional analgesia with a forearm tourniquet. Can J Anaesth.1987; 34(1): 21–5.
3. Choyce A, Peng P. A systematic review of adjuncts for intravenous regional anesthesia for surgical procedures. Can J Anaesth. 2002;49(1) :32–45.
4. Dekoninck V, Hoydonckx Y, Velde MV, Ory JP, Duboid J, Jamaer L, et al. The analgesic efficacy of intravenous regional anesthesia with a forearm versus conventional upper arm tourniquet: a systematic review. BMC Anesthesiology. 2018;18(1):86.
5. Chiao FB, Chen J, Lesser JB, Resta-Flarer F, Bennett H. Single-cuff forearm tourniquet in intravenous regional anaesthesia results in less pain and fewer sedation requirements than upper arm tourniquet. Br J Anaesth.2013; 111 (2): 271–5.
6. Arslanian B, Mehrzad R, Kramer T, Kim DC. Forearm Bier block: a new regional anesthetic technique for upper extremity surgery. Ann Plast Surg. 2014; 73(2):156-7.
7. Coleman MM, Peng PW, Regan JM, Chan VW, Hendler AL. Quantitative comparison of leakage under the tourniquet in forearm versus conventional intravenous regional anesthesia. Anesth Analg .1999; 89(6): 1482–6.
8. Plourde G, Barry PP, Tardif L, Lepage Y, Hardy JF. Decreasing the toxic potential of intravenous regional anesthesia. Can J Anaesth. 1989; 36(5): 498–502.
9. Karalezli N, Karalezli K, Iltar S, Cimen O, Aydogan N. Results of intravenous regional anesthesia with distal forearm application. Acta Orthop Belg. 2004; 70(5): 401–5.
10. Lalonde D. Minimally invasive anesthesia in wide awake hand surgery. Hand Clin. 2014; 30 (1): 1–6.
11. 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 (1):249-59.
12. Al Youha S, Lalonde DH. Update/review: changing of use of local anesthesia in the hand. Plast Reconstr Surg Glob Open. 2014; 2(5): e150.
13. Ruxasagulwong S, Kraisarin J, Sananpanick 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(1):106-10.
14. Vinycomb TI, Sahhar LJ. Comparison of local anesthetics for digital nerve blocks: a systematic review. J Hand Surg Am. 2014; 39(4):744-751.
15. Lalonde DH, Wong A. Dosage of Local Anesthesia in Wide Awake Hand Surgery. J Hand Surg Am. 2013; 38(10):2025-8.
16. Mckee DE, Lalonde DH, Thoma A, Dickson L. Achieving the optimal epinephrine effect in wide awake hand surgery using local anesthesia without a tourniquet. J Hand. 2015; 10(4):613-5.
17. Coleman MM, Peng PW, Regan JM, Chan VW, Hendler AL. Quantitative comparison of leakage under the tourniquet in forearm versus conventional intravenous regional anesthesia. Anesth. Analg. 1999; 89(6): 1482–6.
18. Lawes EG, Johnson T, Pritchard P, Robbins P. Venous pressures during simulated Bier's block. J ANESTH. 1984; 39(2):147–9.
19. Reuben SS, Steinberg RB, Maciolek H, Manikantan P. An evaluation of the analgesic efficacy of intravenous regional anesthesia with lidocaine and ketorolac using a forearm versus upper arm tourniquet. Anesth Analg. 2002; 95(2):457–60.
20. Rawal N, Hallen J, Amilon A, Hellstrand P. Improvement in i.v. regional anaesthesia by re-exsanguination before surgery. Br J Anaesth. 1993; 70(3):280–5.
21. Frank R, Cowan BJ, Lang S, Harrop AR, Magi E. Modification of the forearm tourniquet techniques of intravenous regional anaesthesia for operations on the distal forearm and hand. Scand J Plast Reconstr Surg Hand Surg. 2009; 43(2):102-8.

22. Gunasagaran J, Sean ES, Shivdas S, Amir S, Ahmad TS. Perceived comfort during minor hand surgeries with wide awake local anaesthesia no tourniquet (WALANT) versus local anaesthesia (LA)/tourniquet. J ORTHOP SURG-HONG K.2017; 25(3): 1–4.
23. Codding JL, Bhat SB, Ilyas AM. An economic analysis of MAC versus WALANT: a trigger finger release surgery case study. J Hand .2017; 12(4):348–351.
24. Lalonde DH, Bell M, Benoit P, 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. 2005; 30(5): 1061–7.
25. Chowdhry S, Seidenstricker L, Cooney DS, Hazani R, Wilhelmi BJ. Do not use epinephrine in digital blocks: myth or truth? Part II. A retrospective review of 1111 cases. Plast Reconst Surg. 2010; 126(6):2031-4.
26. 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(1):47-53.
27. 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.
28. Koegst WH1, Wölfle 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
29. Hagert E. Clinical diagnosis and wide-awake surgical treatment of proximal median nerve entrapment at the elbow: a prospective study. Hand (N Y). 2013; 8(1):41-6.
30. Hagert E, Lalonde DH. Wide-awake wrist arthroscopy and open TFCC repair. J. Wrist Surg. 2012; 1(1):55-60.
31. Glynn A1, Strunk S, Reidy D, Hynes DE. Carpal tunnel release using local anaesthetic and a forearm tourniquet. Ir Med J. 2005; 98(5):144-5.