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BIER'S BLOCK VERSUS WIDE-AWAKE LOCAL ANESTHESIA NO TOURNIQUET (WALANT) IN CARPAL TUNNEL DECOMPRESSION SURGERY

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ABSTRACT

Background: The present randomized study was designed to compare the clinical effects of Bier's Block and Wide-Awake Local Anesthesia No Tourniquet (WALANT) technique in patients submitted to open carpal tunnel decompression surgery.

Methods: The study included 120 patients. Sixty patients were allocated to receive WALANT (GI) while the other sixty patients received Bier's block (GII).

Results: GI patients had significantly lower intraoperative visual analog scale (VAS) for pain and lower VAS at one hour postoperatively. In addition, GI patients required significantly lower frequency of intraoperative analgesia. It was also noted that GI had significantly longer time to onset of sensory block. In contrast, GI had significantly lower frequency of bloodless or little blood operative field. No significant procedure related complications were reported in both groups.

Conclusions: WALANT anesthesia outperformed Bier's block in terms of pain control, and capability of intraoperative active hand movement while Bier's block had the advantages of less bloody operative field and shorter time to sensory block.

KEYWORDS

Carpal tunnel, carpal tunnel syndrome, decompression surgery, Bier's block, WALANT

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INTRODUCTION

Carpal tunnel decompression (CTD) is one of the most commonly performed hand surgeries. The operation aims to relieve increased pressure on the median nerve of the wrist which occurs in carpal tunnel syndrome and is related to increased cross-sectional area of the nerve[1].

CTD can be conducted as an outpatient procedure. Technically, it requires a bloodless field to clearly explore the anatomical structures and avoid iatrogenic injuries[2]. Anesthetic options for CTD include intravenous sedation with local anesthesia, Bier's block and Wide-Awake Local Anesthesia No Tourniquet (WALANT)[3].

Bier's block is a type of regional anesthesia that includes intravenous injection of a local anesthetic and use of a tourniquet that isolates the anesthetic agent in the anatomical region for short-term surgery. It provides good and short-term anesthesia with clear bloodless field with low failure rate. However, prolonged duration of tourniquet may lead to patient discomfort and nerve and muscle injury. Also, toxic metabolic release in systemic circulation may occur after cuff release[4].

WALANT is a local anesthetic technique that relies on local injection of a mixture of lidocaine, epinephrine as a hemostatic agent, in addition to sodium bicarbonate that buffers the acidity of the solution and thus minimizes pain during injection[5]. Recently, WALANT approach has gained increased popularity because of its several advantages over other anesthetic techniques. It avoids discomfort and complications of tourniquet, permits patients to be actively included in the surgical procedure, and provides acceptable bloodless field though injection of epinephrine[6,7]. Disadvantages of WALANT include patient's anxiety and injection pain[8]. The present randomized study was designed to compare the clinical effects of Bier's Block and WALANT technique in patients submitted to CTD.

PATIENTS AND METHODS

Setting and ethics

The present randomized study protocol was approved by the ethical committee of Al-Azhar University Faculty of Medicine for Girls with approval number 1763 on February, 15, 2023. All participants provided written informed consent in line with the Helsinki Declaration on clinical research involving human subjects.

Recruitment and randomization

Patients were included in this study if they were 21-50 years old with American Society of Anesthesiologists (ASA) status I or II and submitted to elective CTD surgery. Patients were excluded if they had history of allergy to local anesthetic drugs, seizures, peripheral vascular disorders, coagulopathy, or cardiac arrhythmia. The study screened 143 patients for eligibility. Finally, 23 patients were excluded and 120 patients were advanced to receive the study interventions. They were equally and randomly allocated to one of the study interventions using computer generated random numbers and sealed envelope technique *(Fig. 1)*. The whole randomization process was supervised by an independent researcher who wasn't aware of the study interventions.

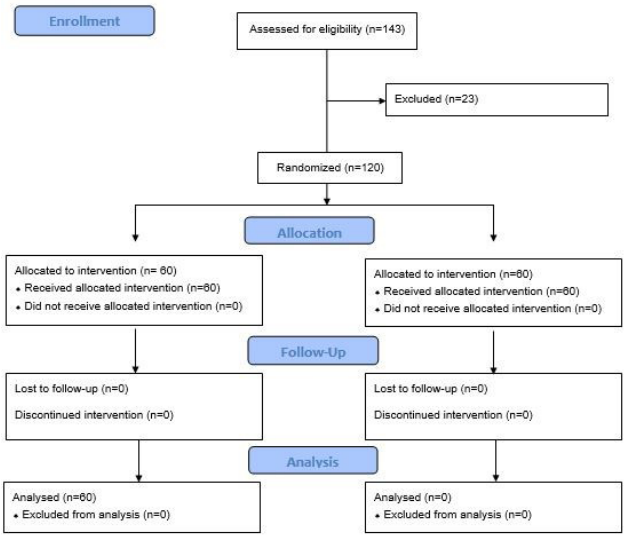


Figure 1. *CONSORT flow diagram.*

Study interventions

Sixty patients were allocated to receive WALANT (GI) while the other sixty patients received Bier's block (GII). An intravenous line was inserted into the non-operated hand for infusion of ringer solution. In the operating room, Electrocardiogram (ECG), non-invasive blood pressure (NIBP), and pulse oximeter (Drager Vista 120) monitors were applied to all patients and their baseline vital signs were measured.

In the WALANT group, 25 ml of lidocaine 2% was mixed with 5ml of epinephrine 1:200000, 10 ml Na bicarbonate 8.4%, and 10 ml sterile normal saline. The surgery site was injected with a sufficient volume to create an extravascular block. In the Bier block group, an intravenous cannula was inserted into a distal vein in the operated hand, pneumatic tourniquet was applied to the operating arm with a soft wrap under the cuff to improve comfort, and the tourniquet pressure was elevated to 100 mmHg above the patient's systolic blood pressure (max tourniquet pressure of 250 mmHg). Before inflating the cuff, limb exsanguination was performed by elevation of the affected arm for at least 1 minute. With the arm still elevated, the tourniquet cuff was inflated, a timer was started, the cuff was squeezed to observe pressure oscillations, and absence of radial pulse was confirmed. Then, 20 ml of lidocaine 2% diluted with 20 ml of sterile normal saline was slowly injected via the distal canula on the surgery site.

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 on by the same surgeon.

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Surgical technique

All patients were operated in supine position, with elevation of extended wrist by a rolled wrapping. After local anesthetic infiltration at the surgical site, 1.5 cm longitudinal incision was done, extending from the distal transverse crease, parallel and medial to the median crease, followed by incision in the superficial fascia to expose the transverse carpal ligament (flexor retinaculum) with the median nerve superficial to the flexor tendons in the carpal tunnel. The entire width of the ligament was transected in the direction perpendicular to its fibers and parallel to the median nerve, followed by skin closure after good compression.

Outcome assessment

The primary outcome measures of the present study included pain intensity during surgery and one hour later and intraoperative need for additional analgesia. Secondary outcomes included onset of sensory block, amount of bleeding, ability to perform active movements of fingers and hand and patient satisfaction during and after surgery.

Pain intensity was measured during and one hour after surgery using visual analog scale (VAS) (from 0 to 10): as zero indicates no pain and 10 indicates the worst imaginable pain. Patients with intraoperative VAS greater than three, received 50-100 µg fentanyl via intravenous route. All patients were transferred to the post anesthesia care unit (PACU) and VAS was measured one hour after surgery, and those with VAS >3 were treated with 25 mg meperidine via intramuscular route. The amount of bleeding was estimated by the surgeon as:

1) Bloodless;
2) Little blood;
3) Bloody field but performable;
4) Bloody field[9].

Active movement of wrist and fingers was checked when needed.

Patient satisfaction was assessed as:

1) Very dissatisfied (1 point);
2) Dissatisfied (2 point);
3) Neither (3 point);
4) Satisfied (4 point);
5) Very satisfied (5 points).

During the surgery, patients were evaluated for possible complications such as: tinnitus, vertigo, nausea, local anesthetic toxicity signs (peri oral numbness, seizure, hypotension, and arrhythmias) and were treated when necessary.

Statistical analysis

Data obtained from the present study were presented as number and percent or mean and standard deviation. Comparison between categorical variables was achieved using Fisher's exact test or chi-square test while numerical

	GI N = 60	GII N = 60	p value
Age (years, mean ± SD)	42.8 ± 7.7	44.8 ± 8.1	0.44
Male/female (n)	36/24	30/30	0.75
Duration of surgery (min, mean ± SD)	12.1 ± 2.2	12.3 ± 2.2	0.94

Table 1. *Baseline data in the studied groups.*

	GI N = 60	GII N = 60	p value
Pain scores (VAS) (n, %)			
- Intraoperative	3.2 ± 1.1	3.8 ± 1.6	0.016
- 1 hour postoperative	3.4 ± 1.4	4.8 ± 1.7	<0.001
Intraoperative analgesia (n, %)	-	18 (30.0)	<0.001
Onset of sensory block (min, mean ± SD)	15.4 ± 2.8	12.3 ± 2.2	<0.001
Intraoperative bleeding (n, %)			
- Bloodless or little blood	-	54 (90.0)	<0.001
- Bloody field but performable	60 (100.0)	6 (10.0)	
Intraoperative active movement (n, %)	60 (100.0)	54 (90.0)	0.027

Table 2. *Outcome parameters in the studied groups.*

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variables were compared using student t test. All statistical computations were processed using SPSS 27 with p value less than 0.05 considered statistically significant.

RESULTS

The present study was conducted on 120 patients. Sixty patients were allocated to receive WALANT (GI) while the other sixty patients received Bier's block (GII). Comparison between the two groups regarding baseline data revealed that they were matched regarding age (42.8 ± 7.7 years vs 44.8 ± 8.1, p = 0.44), sex distribution (male/female: 36/24 vs 30/30, p = 0.75) and duration of surgery (12.1 ± 2.2 minutes vs 12.3 ± 2.2, p = 0.94) *(Table 1)*.

Comparison between the studied groups regarding the clinical outcomes showed that GI patients had significantly lower intraoperative VAS (3.2 ± 1.1 vs 3.8 ± 1.6, p = 0.016) and lower VAS at one hour postoperatively (3.4 ± 1.4 vs 4.8 ± 1.7, p <0.001). In addition, GI patients required significantly lower frequency of intraoperative analgesia (0.0% vs 30.0%, p <0.001). It was also noted that patients in GI had significantly longer time to onset of sensory block (15.4 ± 2.8 minutes vs 12.3 ± 2.2, p <0.001). In contrast, patients in GI had significantly lower frequency of bloodless or little blood operative field (0.0% vs 90.0%, p <0.001). All patients in GI had intraoperative active hand movement in comparison to 90.0% of patients in GII (p = 0.027) *(Table 2)*. No significant procedure-related complications were reported in both groups.

No significant differences were noted between the studied groups regarding the overall patients' satisfaction with the operative procedures *(Table 3)*.

DISCUSSION

The present randomized study found that WALANT anesthesia outperformed Bier's block in terms of pain control, and capability of intraoperative active hand movement while Bier's block had the advantages of less bloody operative field and shorter time to sensory block. Both interventions were comparable regarding patients' satisfaction with the whole surgical procedure.

In harmony with these findings, Ki Lee et al.[10] randomized controlled trial on 185 patients who underwent hand surgery (including carpal tunnel, trigger finger release and De Quervain disease) reported that the duration of effective anesthesia was doubled in WALANT group compared to regional anesthesia group, and analgesic consumption in the first two days was significantly lower in WALANT group. Also, Gunasagaran et al.[11] reported that there was less pain and discomfort with WALANT method. Likewise, Abitbol et al.[12] in their comparative prospective study on patients who underwent distal radius fracture plating, showed that patients in WALANT group had prolonged duration of postoperative analgesia compared to patients in regional anesthesia group. In contrary to the results of the current study, Martin et al.[13] in their study reported that the difference in pain reduction between the two techniques was not significative.

In terms of intraoperative bleeding, the present study showed that the amount of bleeding was lower in Bier block group than in WALANT group. Although, the amount of blood loss in WALANT group had not interfered with the surgical procedure, as hemostatic control was maintained. These results were supported by the results of Farzam et al.[3] study on 86 patients who underwent minor hand surgeries, which showed that the amount of bleeding was more in WALANT group than in Bier block group. However, McKee et al.[14] reported that waiting 26-30 min after injection of local anesthesia with epinephrine in WALANT technique results in less intraoperative bleeding, which is considered a relatively long waiting time to start short procedures.

Interestingly, Ruxasagulwong et al.[15] in his prospective trial regarding minor orthopedic hand soft tissue surgery (including carpal tunnel syndrome, de Quervain's disease, and trigger finger), reported that although there was a more surgical field bleeding in WALANT group, however the amount of blood loss in tourniquet group was significantly higher because of vasodilatation with a moderate amount of bleeding after the release of tourniquet pressure prior to skin suture meaning that the amount of blood loss under the WALANT technique was relatively less than the uncalculated blood loss after tourniquet release.

The time delay between local anesthetic injection and onset time of anesthesia in the present study was longer in WALANT group than in Bier's block group. In contrast, Farzam et al.[3] in their randomized controlled study,

	GI N = 60	GII N = 60	p value
Very dissatisfied	9 (15.0)	6 (10.0)	0.42
Dissatisfied	15 (25.0)	9 (15.0)	
Neither	12 (20.0)	12 (20.0)	
Satisfied	15 (25.0)	18 (30.0)	
Very satisfied	9 (15.0)	15 (25.0)	

Table 3. *Patient satisfaction in the studied groups n (%).*

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reported that there was no significant difference between the WALANT group and Bier block group in the onset time of anesthesia.

Active movement of the operated limb is sometimes needed for intraoperative examination and assessment. The present study showed that there was better hand movement with WALANT. Likewise, Abitbol et al.[12] in their comparative prospective study on distal radius fracture plating, reported that patients in WALANT group, had better range of motion. Also, Hagert[16] study which was done on patients submitted to wrist surgery showed that, patients in WALANT group had better range of motion.

CONCLUSIONS

WALANT anesthesia outperformed Bier's block in terms of pain control, and capability of intraoperative active hand movement while Bier's block had the advantages of less bloody operative field and shorter time to sensory block. WALANT avoids the torniquet-related risks in Bier's block.

Limitations

Conclusions of the present study may be limited by the relatively small sample size and being a single-center study.

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