Plating Distal Radius Fractures Using Wide-Awake Local Anesthesia No Tourniquet (WALANT) Versus General Anesthesia: A Cohort Study

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Purpose: This study compared outcomes of plating distal radius (DR) fractures using wide-awake local anesthesia no tourniquet (WALANT) versus general anesthesia (GA).

Methods: From March 2018 to March 2019, 20 patients with DR fracture underwent plating using WALANT whereas 20 patients who underwent plating under GA were used as controls. Outcomes evaluated were pain control, waiting time for the operation, hemodynamic changes, blood loss, the occurrence of adverse effects of medications used in WALANT and GA, and the duration of postoperative stay.

Results: The WALANT group experienced a significantly shorter waiting time for surgery (6 vs 20 days; \( P < .001 \)) and a shorter postoperative stay (1 vs 2 days; \( P = .009 \)) compared with the GA group. They also reported mild to no pain during surgery. The groups were similar with regard to blood pressure, blood loss, and operative time. None in the WALANT group required conversion to GA during surgery and no adverse effects were reported.

Conclusions: The WALANT approach is a viable alternative to GA for plating of DR fractures.

Type of study/level of evidence: Therapeutic III.

Declaration of interests: No benefits in any form have been received or will be received by the authors related directly or indirectly to the subject of this article.

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physiotherapy exercises for patients. Operative findings and postoperative instructions can be discussed with the awake patient toward the end of the procedure.

Distal radius (DR) fracture is a commonly encountered upper-limb injury at most hospitals worldwide. Open reduction internal fixation of DR fractures has traditionally been performed under GA or regional anesthesia with a tourniquet to minimize bleeding and for better visualization of the surgical field. The prolonged waiting time for surgery has led to more challenging fracture reduction and fixation, and thus to longer surgery, exposure to anesthetic risks, and the higher incidence of surgical site infection.

This study aimed to evaluate whether the WALANT approach would be an alternative anesthesia to GA for the fixation of fractures proximal to the wrist such as plating of DR fractures. We hypothesized that the WALANT approach would be comparable to using GA in achieving anesthesia for the fixation of DR fractures and would reduce the waiting time for surgery and postoperative stays. The outcome measurements focused on patients’ waiting time to surgery, hemodynamics, estimated blood loss, duration of surgery, postoperative stay, and tolerability to pain, and the occurrence of adverse effects of lignocaine and epinephrine compared with those for patients who underwent similar surgery under GA.

Materials and Methods

From March 2018 to March 2019, we prospectively recruited 20 patients with DR fracture for fixation using the WALANT approach and another 20 who underwent plating of the DR under GA during that period, and whose records were reviewed retrospectively. All patients in the WALANT group were counseled by the surgeon regarding the nature of WALANT. Participants were included in the study only when they fully understood the approach employed and gave consent for the procedure. Ethical approval was obtained from our local institution.

On the day of surgery, all patients in the WALANT and GA groups received no oral or intravenous analgesics 6 to 8 hours before surgery. Table 1 describes the solution used and the method of WALANT administration for the fixation of the DR. The local anesthesia solution was injected into the skin and subcutaneous layer using a 27-gauge needle along the modified Henry skin incision and 1 cm beyond the site where the incision was planned and where the plate would be inserted (Fig. 1). To reduce the sensation of pain at the first prick of the needle, the skin was pinched slightly and then injected (Fig. 2). A total of 10 mL of the prepared solution was used to create this tumescent anesthesia. Another layer of local anesthesia was given periosteally and subperiosteally to obtain the desired effect of painless surgery during reduction and plating of the DR fracture. We injected the solution using a 23-gauge needle at the radial border of the radius, where it was easily palpable (marked as 3 dots in Fig. 1). A total of 30 mL local anesthesia was used, starting proximally with 10 mL in each injection site (Fig. 3). The soft tissue was tested for pain and the fracture site was manipulated to assess for the patient’s pain control before the first incision was made. Surgery was commenced only if the patient had a pain score of 0. No tourniquet was used during the surgery. The anesthetist was informed regarding the surgery to be on standby in case a patient required conversion to GA during the surgery.

Measurement outcomes were made before, during, and after surgery for both groups (Table 2).

We measured the WALANT and GA patients’ preoperative and intraoperative blood pressure and heart rate using an automated sphygmomanometer. Hemodynamic parameters recorded and included for evaluation were those at 30 minutes (if surgery was within 60 minutes) and 60 minutes (if surgery was longer than 60 minutes) to provide standardization because the duration of surgery varies among patients. The operating team for the WALANT group monitored these vital signs and conducted the start and end time for surgery, whereas monitoring for the GA group was performed by the anesthetist team. The pain score for the WALANT

| Composition of Local Anesthesia Solution Used in WALANT Approach |
|---------------------------------------------------------------|
| 50 mL 0.9% normal saline                                      |
| 50 mL lidocaine HCl 2%                                         |
| 1 mL adrenaline acid tartrate 0.18% 1 mg/mL                   |
| 10 mL sodium bicarbonate 8.4%                                  |

Figure 1. Local anesthesia infiltrated along the modified Henry skin incision.

Figure 2. Distraction method to reduce pain at the first prick of the needle.
group were based on a numerical pain rating scale (NPRS). Estimated blood loss for WALANT group was based on the number of gauze pads (10 × 10 cm) that were soaked, whereas for the GA group, it was based on the volume collected in the suction canister, because the anesthesia team wanted to monitor fluid output from patients during surgery, and this method was deemed to be more accurate. Surgery in both groups was performed by a single surgeon, but not the same surgeon for every case. The postoperative assessment for common side effects from drugs used in the WALANT group was made by the operating team, whereas the assessment for the GA group was carried out by the anesthetist team. This was conducted at 2 and 6 hours after surgery. For the WALANT group, Hamilton Anxiety Rating Scale questionnaires were used to assess the anxiety level during surgery (Appendix A).11

Patients from both groups were assessed on day 2 for wound-related complications. Subsequently, all patients underwent 4-weekly follow-ups at our outpatient clinic with repeated radiographs of the fracture to assess for bone healing and union (callus formation on radiograph, and reduced or no tenderness at the fracture sites) as well as any fixation failure (fracture displacement or implant cutout).

According to an unpublished case series of 10 patients with DR fracture for fixation using the WALANT versus the GA approach that we had conducted before this study, the calculated sample size for the current study was based on the mean duration of waiting time for surgery, because there was notable difference between the 2 groups in that case series. Our calculations for a sample size based on the case series' effect size of 0.8 and a power value of 0.8 resulted in at least 20 patients for the WALANT group and 20 patients for the GA group, to avoid a type II error in this comparative study.

Results

Demographics

There were 19 men and one woman in the WALANT group, mean age 41 years (range, 18–73 years). Of the 20 patients, 9 had existing medical conditions, as described in Table 3. The GA group was composed of 10 men and 10 women, mean age 44 years (range, 19–74 years). Seven patients from this group had underlying medical illnesses, whereas one was pregnant at 17 weeks’ gestation. A variety of patterns for DR fractures were observed and classified according to the AO/Orthopaedic Trauma Association (Table 3).

Waiting time to surgery

Patients in the WALANT group had a waiting time of 2 to 20 days (mean waiting time, 6 days) for surgery. Seventy percent underwent surgery within a week (Fig. 4). Three patients in the WALANT group experienced a delay of more than 7 days for surgery; one had had financial constraints in purchasing the volar plates whereas another 2 patients were initially planned for surgery under GA but developed upper respiratory tract infections and subsequently agreed to surgery under WALANT. There was a significantly shorter waiting time for surgery using WALANT (P < .001) compared with GA. The earliest waiting time for patients who opted for fracture fixation under GA was 8 days, and the longest was 51 days (mean waiting time, 20 days). Most patients underwent surgery in the second and third weeks because of the presence of upper respiratory tract infections (n = 4), which increased the risk for respiratory compromise with GA and other existing medical illnesses that required optimization before surgery under GA (n = 6) or delayed patients’ decision to operate (n = 4) (Fig. 5). Only 2 of 20 patients in the WALANT group (10%) and 4 of 20 in the GA group (20%) had upper respiratory tract infections during the time of surgery, when those in the GA group had to wait at least 2 weeks for the infection to resolve before they could undergo surgery under GA, because they were not eager for surgery under WALANT.

Pain control

After the administration of the local anesthesia solution, 14 patients reported no pain whereas 6 reported mild pain (NPRS ≤3) during fracture manipulation. All patients in the WALANT group were able to tolerate pain until the end of the procedure. Half experienced mild pain (NPRS 1–4), which occurred during fracture manipulation, drilling of the bones, and screw insertion, whereas another half reported no pain at all during surgery (Fig. 6). Of those who reported mild pain, only 4 required additional a local anesthesia injection (10–15 mL) during the surgery. No additional sedative analgesics were required, and none required conversion to GA or regional anesthesia during surgery.

Hemodynamics

The systolic blood pressure (SBP) of 12 patients and diastolic blood pressure (DBP) of 6 patients in the WALANT group increased

Outcomes Measured Before, During, and After Surgery

| Table 2 |
| --- |
| Before surgery |
| Waiting time from injury to surgery |
| Baseline BP and HR |
| Baseline pain score |
| During surgery |
| BP and HR |
| At 15th min after local anesthesia is given for WALANT group and 30th min during operation for WALANT and GA groups |
| Pain score |
| At 15th min after local anesthesia is given and during surgery at skin incision, deep dissection, manipulation of fracture site, and insertion of plate and screws for WALANT group only |
| Requirement for additional local anesthesia/sedative medications or conversion of mode of anesthesia |
| Adverse effects from: |
| Lidocaine and epinephrine in WALANT group |
| Drugs from anesthesia in GA group |
| Estimated blood loss |
| Duration of surgery |
| After surgery |
| BP and HR (2-h surgery) |
| Adverse effects from: |
| Lidocaine and epinephrine in WALANT group |
| Drugs from anesthesia in GA group |
| Duration of postoperative stay |
| Requirement for additional local anesthesia/sedative medications or conversion of mode of anesthesia |
| Adverse effects from: |
| Lidocaine and epinephrine in WALANT group |
| Drugs from anesthesia in GA group |
| Duration of postoperative stay |
| Requirement for additional local anesthesia/sedative medications or conversion of mode of anesthesia |

HR, heart rate.
during surgery (Fig. 7). These increased values correlated with a rise in the NPRS. Patients in the GA group demonstrated a variability in hemodynamics: 7 patients had an increase in SBP and DBP from baseline whereas 13 had a decrease in SBP and DBP from baseline during the surgery (Fig. 8). However, the groups were similar regarding changes in systolic ($P = .15$) and diastolic ($P = .23$) blood pressure during surgery from baseline. Heart rate changes were also similar between groups ($P = .1$).

Table 3  
Demographics of Subjects in WALANT and GA Groups and Patterns of DR Fracture Sustained

| Groups | Age, y | Sex | Comorbid, n | AO/Orthopaedic Trauma Association Classification of DR Fracture |
|--------|--------|-----|-------------|---------------------------------------------------------------|
| WALANT |        |     |             |                                                               |
| 1      | 67     | F   | 1 (DM)      | C2                                                            |
| 2      | 38     | M   | None        | C1                                                            |
| 3      | 20     | M   | None        | B3                                                            |
| 4      | 37     | M   | None        | B1                                                            |
| 5      | 73     | M   | None        | A3                                                            |
| 6      | 18     | M   | 1 (URTI)    | A2                                                            |
| 7      | 27     | M   | None        | B3                                                            |
| 8      | 18     | M   | 1 (URTI)    | B3                                                            |
| 9      | 22     | M   | None        | B2                                                            |
| 10     | 36     | M   | None        | B2                                                            |
| 11     | 53     | M   | 1 (HTN)     | B3                                                            |
| 12     | 47     | M   | 4 (DM, HTN, CKD, Hep C) | C3 |
| 13     | 53     | M   | None        | A3                                                            |
| 14     | 52     | M   | 1 (HTN)     | C2                                                            |
| 15     | 59     | M   | 3 (DM, HTN, CCF) | C1 |
| 16     | 31     | M   | None        | C3                                                            |
| 17     | 35     | M   | None        | B3                                                            |
| 18     | 49     | M   | 4 (DM, HTN, CKD, Epilepsy) | C1 |
| 19     | 40     | M   | None        | C2                                                            |
| 20     | 59     | M   | 2 (DM, HTN) | C2                                                            |
| GA     |        |     |             |                                                               |
| 1      | 38     | F   | None        | B2                                                            |
| 2      | 67     | M   | 1 (URTI)    | C1                                                            |
| 3      | 55     | F   | 1 (DM)      | A3                                                            |
| 4      | 61     | F   | 2 (DM, HTN) | C2                                                            |
| 5      | 26     | M   | 1 (URTI)    | B3                                                            |
| 6      | 56     | F   | None        | C3                                                            |
| 7      | 69     | F   | 2 (DM, HTN) | A3                                                            |
| 8      | 74     | F   | 2 (HTN, CVA) | C2 |
| 9      | 24     | M   | None        | A3                                                            |
| 10     | 27     | M   | None        | C1                                                            |
| 11     | 66     | F   | 2 (HTN, CKD) | B3 |
| 12     | 53     | F   | 1 (URTI)    | B1                                                            |
| 13     | 19     | M   | None        | B3                                                            |
| 14     | 44     | M   | None        | B2                                                            |
| 15     | 48     | M   | None        | B2                                                            |
| 16     | 34     | F   | 1 (pregnant at 17 wk) | C3 |
| 17     | 44     | F   | 1 (URTI)    | B1                                                            |
| 18     | 24     | M   | None        | A3                                                            |
| 19     | 34     | M   | None        | A2                                                            |
| 20     | 23     | M   | None        | C2                                                            |

CCF, congestive cardiac failure; CKD, chronic kidney disease; CVA, cerebrovascular accident; DM, diabetes mellitus; HTN, hypertension; URTI, upper respiratory tract infection.

Figure 4. Waiting time for WALANT group from trauma to day of surgery, in weeks.
Adverse effects

No adverse effects of lidocaine or epinephrine were reported by patients in the WALANT group during or after surgery. Three patients who underwent GA experienced nausea and vomiting for a day, whereas the others had an uneventful post-operative period.

Duration of surgery

Average time taken for open reduction internal fixation of DR fractures from the first incision to wound closure using WALANT versus GA was 86 and 102 minutes, respectively. We found no statistical significance in terms of the duration of surgery between groups ($P = .079$).

Blood loss

Mean estimated blood loss in the WALANT group versus the GA group was 49 and 63 mL, respectively. We found no statistical significance between groups ($P = .67$) (Fig. 9). Larger volumes of blood loss were not always the result of prolonged surgery time; they also occurred when surgery was of short duration.
Postoperative stay

Two patients in the WALANT group were able to go home on the same day as the surgery. The remaining patients in the WALANT group were discharged a day after the surgery, because we wanted to observe them further for potential adverse effects from WALANT and to monitor pain control requirements after surgery. Those who received GA stayed for 1 or 2 days (35% and 45%, respectively) for observation, as is our anesthesia protocol. As such, postoperative stay was statistically significant between groups ($P = .009$).

Clinical outcomes

All patients from both groups were reassessed after surgery on day 2 for wound conditions at the surgical site in the ward for those who underwent GA or at our outpatient clinic for those who underwent WALANT and were discharged on the same day. No patients developed a surgical site infection. Subsequent 4-week follow-ups at our outpatient clinic demonstrated similar time to fracture union and no evidence of fixation failure, except for one
patient from the WALANT group who experienced a reduction in radial inclination and an increase in dorsal tilt owing to a comminuted fracture pattern, and who thus required revision surgery with K-wire augmentation. Figure 10 shows plain radiographs of the wrist of patients who underwent DR fracture fixation using WALANT. When asked about their experience undergoing surgery wide-awake, the WALANT group expressed that they generally felt calm and satisfied with the analgesia effect of WALANT. The Hamilton Anxiety Rating Scale ranges from 0 (no anxiety) to 3 (mild anxiety); 10 patients reported no anxiety, 6 scored 1, 2 scored 2 and 2 scored 3 on this scale.

Discussion

Fracture of the DR involves all age groups; the pediatric and elderly populations are at greatest risk. Fixation of this fracture in a timely manner is important to enable patients to regain full wrist function for the continuation of activities of daily living. However, the decision regarding fracture fixation in older patients is often made with caution because increasing age is associated with decreased fitness, declining organ function, and the higher likelihood of chronic medical illnesses. Acute physiological derangements precipitated by anesthesia and surgery may cause patients with comorbidities to decompensate. As such, many of these patients experienced a delay in surgery and are eventually treated conservatively with cast immobilization.

Our study demonstrated several findings with regard to the fixation of DR fractures using the WALANT approach that could potentially benefit surgeons, patients, and the health system. The long waiting time for DR fracture fixations commonly results from a variety of reasons, such as the high patient load in our facility, the limited operation schedule during the week, and multiple comorbidities in the patient requiring optimization before surgery under GA. Patients with multiple medical comorbidities, who underwent fracture fixation using the WALANT approach, were able to bypass some of these factors, except the inability to purchase implants in time owing to financial constraints. Patients were not required to wait for more than a week or until they were deemed medically fit to undergo fixation of DR, because they were not exposed to GA drugs during the WALANT approach. They also did not have to wait for the next available operating list under GA. Most were scheduled for surgery in the day care unit as soon as implants were purchased.

Concerns have been raised regarding inadequate pain relief with the WALANT approach, which uses only a single lidocaine anesthetic. We acknowledge that adequate pain relief is essential for patient comfort and cooperation during surgery. Literature has shown that combining lidocaine and epinephrine can prolong the duration of action of lidocaine as an anesthetic up to 120 to 360 minutes (if used alone, 30–60 minutes). Pain from fracture manipulation and inserting screws into the bone are main areas to be addressed in proving that the WALANT technique is comfortable for patients. We focused on recording patients’ sensation of pain before surgery, immediately after injection of WALANT, and during the actual surgery. Huang et al had published a similar study, but they only measured the visual analog score 1 day after surgery and did not address pain during the actual WALANT surgery.

In our study, pain intensified during fracture fixation for some patients in the WALANT group, but it was generally tolerable. No patients in the focus group required adjunctive analgesia or conversion to GA during surgery. This contrasts with one study in which 1 of 24 patients was considered to have a failed WALANT and was converted to GA. Increases in pain during fracture fixation in the current WALANT group were the result of factors such as inadequate local anesthesia at the periosteum, stiffness in other joints owing to prolonged cast immobilization, and patient anxiety. Local anesthesia was initially injected into the periosteum of the
radius using a closed method based on an estimation of the fracture site, which resulted in some areas not receiving adequate amounts of lidocaine. This was effectively dealt with during surgery, when the fracture site was exposed, manipulated, and tested for pain. The exposed periosteum in and around the fracture site was easily injected with additional lidocaine to attain a pain-free area throughout surgery. Further improvements in the technique for injection to achieve a completely pain-free region before surgery could involve injecting the WALANT solution into the dorsal aspect and the middle column of the radius. These areas are often manipulated during fracture fixation where the drill bit or screw end normally over-penetrates through the middle column of the radius. In larger patients, the anesthesia solution injected during the initial steps may not infiltrate sufficiently as a result of the relatively shorter needle used. As additional areas for the injection of WALANT solution are required, preparing the WALANT solution to a dilution of 0.5% lignocaine and 1:200,000 epinephrine (add 25 mL lidocaine 2% and 1 mL epinephrine into 75 mL 0.9% normal saline) allows more volume to be used on a patient while achieving the same anesthesia effect without exceeding the safe limit of 7 mg/kg for lidocaine with epinephrine. Pain from joint stiffness can be reduced by injecting local anesthesia to that area.

A common belief among medical and dental practitioners and even among patients is that the use of epinephrine can cause a sudden rise in blood pressure and heart rate. No patients in the WALANT group experienced a significant rise in blood pressure and heart rate after the injection of local anesthesia solution. The relatively stable hemodynamic parameters as well as the absence of adverse effects of lidocaine and epinephrine for the amount required to achieve anesthesia for DR fracture fixation renders the WALANT approach a safe alternative for anesthesia.

Vasoconstriction by epinephrine reduces bleeding from surrounding tissues and enables good visualization of the surgical field. As such, the fixation of DR fractures can be performed comfortably without an upper-arm tourniquet. This reduces discomfort to the upper limbs that is often reported by patients after surgery. Statistically, there was no significant difference in blood loss between the WALANT and GA groups, but we were comparing soaked gauze counts and suction loss, which may be inaccurate. Moreover, no patients in the WALANT group developed finger necrosis after injection of epinephrine; however we do not expect this complication, because the sites of injection are far from digital end arteries. In cases in which the radial artery lies near the site of injection, there is a collateral supply from the ulna artery if severe vasoconstriction occurs.

The postoperative hospital stay was relatively shorter for the WALANT group because patients were not exposed to sedative analgesia or anesthesia and hence did not require prolonged monitoring. Given the shorter stay and lack of observed complications in the WALANT group, we believe that plating DR fractures using WALANT can be an approach for day surgery. This can potentially reduce health care costs for patients and result in substantial savings for government health care expenditures. However, our study did not delve into the actual cost incurred by these 2 groups to focus on comparing analgesic and hemostasis effects during open reduction and plating of the DR.

There were several limitations to this study. First, the patient groups were small and only one female patient in the WALANT group was included, which may have reduced the generalizability of results. In addition, there may have been observer bias because the same surgeon was involved in fixation of fractures for both the WALANT group and the GA group. Finally, this study was not a randomized controlled trial and did not include the functional outcome of patients. Future studies with more study subjects and more female patients are required, especially the latter, to evaluate whether differences exist in terms of the effectiveness of WALANT as anesthesia between the 2 sex groups. There is also a need to standardize the method of measuring blood loss, so that an objective comparison may be made between using tourniquet versus epinephrine in the control of bleeding at the operation site. We would also like to expand the study of postoperative pain control among both groups and to evaluate whether the analgesic effect from WALANT is adequate for pain management during this period or whether additional analgesics are required.

The WALANT approach can provide adequate pain relief and good control of bleeding, resulting in a clear operative view with no adverse effects from lidocaine or epinephrine. In this study, patients who underwent fracture fixation using WALANT had a shorter waiting time to surgery and a shorter postoperative stay at the hospital compared with those who underwent GA. As such, the WALANT approach can be an alternative to anesthesia for the fixation of DR fractures.

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