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Research Article

Comparison of Peripheral Nerve Blocks vs. Local Tissue Infiltration for Wrist Surgery: Effect on Postoperative Outcomes

Ofelia L. Elvir-Lazo, M.D[1], Paul F. White, PhD, MD[1*], Dermot P. Maher, MD MS[1], Stuart H Kuschner, MD[2], David A Kulber MD[2], Myles J Cohen MD[2], Christine Pham, BA[1], Roya Yumul MD, PhD[1], Ronald H. Wender MD[1]

[1]*Department of Anesthesiology and Orthopedic [Hand] Surgery at Cedars Sinai Medical Center in Los Angeles and the White Mountain Institute, The Sea Ranch*

[2]*Department of Orthopedic [Hand] Surgery at Cedar Sinai Medical Center*

**Corresponding author: Dr. Paul F. White, PhD, MD, FANZCA, President, The White Mountain Institute, 41299 Tallgrass, The Sea Ranch, CA 95497, USA, Tel: 214-771-3775; Fax: 310-423-4119; Email: Paul.White@cshs.org or Whitemountainstitute@hotmail.com*

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Abstract

Background: Local anesthetics are frequently administered during superficial ambulatory surgery procedures to reduce intra- and postoperative pain scores and opioid requirements. We designed a study to compare the analgesic efficacy of a peripheral nerve block (PNB) to local tissue infiltration for elective wrist surgery. We hypothesized that the use of a PNB would provide more effective pain relief after surgery.

Methods: After obtaining Institutional Review Board (IRB) approval, the anesthesia and surgery records of 30 consenting outpatients undergoing wrist surgery with local anesthetic infiltration (n=15) or a PNB (n=15) were reviewed and the patients were asked to consent to completing a standardized follow-up questionnaire. Postoperative pain was assessed every 30min upon entering the postanesthesia care unit (PACU) and after discharge home using a numeric rating scale (NRS) score, with 0=no pain to 10=worst pain imaginable. In addition, the anesthesia and surgery times, the need for rescue (opioid) analgesic medication, postoperative side effects and complications, as well as overall satisfaction with their pain management and quality of recovery were recorded.

Results: The two groups had similar demographic characteristics, including anesthesia and surgery times, as well as time to discharge home. The Operating Room (OR) time was similar in both groups. The PNB group had significant lower pain scores ($p < 0.05$) on entry into the PACU and lower maximum pain scores ($p < 0.05$) prior to discharge home and upon arrival at their home. However, patient satisfaction with their pain management and quality of recovery did not differ between the two groups.

Conclusions: Compared to local anesthetic infiltration, regional anesthesia utilizing a PNB provided improved postoperative pain control in the early postoperative period without prolonging OR time or delaying discharge after outpatient wrist surgery.

Keywords: Postoperative Pain; Peripheral Nerve Block (PNB); Local Tissue Infiltration; Wrist Surgery

Introduction

In the ambulatory surgery setting, postoperative pain results in discomfort, insomnia, fatigue, delayed discharge home, and is the most frequent cause of unanticipated hospital admissions [1-6]. Pain management techniques are highly variable depending on the practice setting, patient co-morbidities, and the goals of the surgical care team [5]. Traditionally, opioid analgesics have been the primary drugs used for pain management during and after ambulatory surgery. However, opioid analgesics are associated with cardiorespiratory depression, postoperative nausea and vomiting (PONV), post-discharge nausea and vomiting (PDNV), constipation, ileus, bladder dysfunction, pruritus and sedation [7-11].

Local anesthetics are being increasingly utilized as part of a multimodal perioperative analgesic regimen in an effort to improve patient safety and reduce postoperative pain and opioid-related side effects [3,8,12-14]. However, the optimal route of local anesthetic administration (i.e., local tissue infiltration, wound instillation, peripheral nerve block [PNB]) for superficial outpatient procedures is not known. The purpose of this study was to compare the postoperative recovery profiles (e.g., pain scores, PONV, PDNV, patient satisfaction with pain management and quality of recovery) of outpatients who underwent open reduction and internal fixation (ORIF) of the wrist with either local tissue infiltration or a PNB. We hypothesized that the use of the PNB would provide superior postoperative pain control compared to tissue infiltration and lead to improved recovery outcomes.

Materials and Methods

The Cedars-Sinai Medical Center Institutional Review Board approved this study (No. Pro00019315) and it was registered at http://clinicaltrials.gov/show/NCT01110759. The anesthetic and surgical records of outpatients undergoing ORIF wrist surgery with local infiltration anesthesia or a PNB in 2011 were reviewed. A total of 30 patients who underwent wrist ORIF were enrolled in the study, with 15 patients receiving local infiltration and 15 receiving a PNB. Inclusion criteria included patient's ages 18-80 yrs who underwent an ORIF of the wrist under intravenous (IV) propofol sedation with local analgesia. The PNB and the local tissue infiltration were performed in the OR, immediately before the start of the surgical procedure.

The data obtained from the patient's chart included: demographic data and medical histories (including patient age, height, weight, American Society of Anesthesiologists [ASA] classification of physical health, history of motion sickness, and a history of PONV). Intraoperative data reviewed included anesthesia and surgery times, as well as the dosages of all anesthetic and analgesic drugs administered. For the PNB group, the total dose of local anesthetic administered ranged between 20-40 mL and for local tissue infiltration group the total dosage ranged from 5 to20 mL.

PACU data reviewed included time to discharge home, the incidence of PONV, and pain as assessed using an 11-point numeric rating scale (NRS), with 0 = no pain to 10 = the worst pain imaginable). Differences between anesthesia and surgery times represent 'anesthesia-control time' (which includes the time required to perform the PNB procedure).

Each patient received an invitation letter asking them to participate in this retrospective study and a follow-up telephone interview <4 weeks after their operation. An investigator who was blinded to the local anesthetic treatment regimen telephoned each patient to administer the standardized questionnaire which focused on pain management and recovery data in the post-discharge period.

Data gathered from the follow-up questionnaire included:

1. NRS pain score at the time of discharge and upon arrival at their home,
2. Need for additional [rescue] opioid and non-opioid analgesic medication (amount of pain medication required),
3. Time to first reported pain at the surgical site,
4. Nausea or vomiting after discharge (PDNV),
5. Any difficulty voiding after surgery,
6. Abnormal bowel function after surgery (e.g., constipation, diarrhea),
7. Worst aspect of the post-discharge recovery period,
8. Presence of headaches, dizziness, drowsiness, or fatigue after discharge,
9. Time taken to resume normal activities after surgery (e.g., work or school),
10. Overall satisfaction with their pain management and the quality of their recovery.

The evaluation for the presence of pain and other recovery data were qualitative (yes or no), if the patient answered yes then we asked them to quantify the severity using an 11-point NRS, with 0 = absence of the symptom to 10 = the worst symptom imaginable). Items #3 and #9 represented time in hours, and days-weeks, respectively, and Items #1 and 10 were quantitative using the previously described 11-point NRS. Item #7 was an open-ended question.

Statistical Analysis

A sample size of 15 patients per group was determined by power analysis based on the hypothesis that the PNB group will have 50% lower postoperative pain scores in the PACU and after discharge home compared to the local anesthetic infiltration group with a SD= 3, and a power of 80% and significance level of 0.05 (using 2-sided t-test). Student's t-test was used to compare the normally distributed continuous data, ANOVA was used to compare the continuous variables among the two treatment groups, and repeated measures (longitudinal analysis) for outcome variables across time, for analysis of numerical variables, the t-test or the Wilcoxon rank sum test (Mann-Whitney U test) were applied depending on the normality of the distributions of these data. Chi-square or Fisher's exact test were used to analyze the categorical variables. Data are presented as mean values ± SD, numbers (n), and percentages (%). P-values < 0.05 were considered statistically-significant.

Results

The demographic characteristics of the two local anesthetic treatment groups did not differ significantly except for BMI (Table 1). The total injected dosages of the local anesthetics lidocaine and bupivacaine were significantly larger in the PNB (vs. local tissue infiltration) group (p<0.05). Patients in the PNB group required a lower total dose of propofol for sedation during the surgical procedures (p<0.05) (Table 1).

Table 1. Demographics, Type of block, Anesthesia and Surgery Times, and Intraoperative Drug Dosages in the two local anesthetic treatment groups.

	Local Anesthetic Infiltration (n=15)	**Peripheral Nerve Block (PNB)** (n=15)
Gender (F/M)	7/8	11/4
Surgery site (left/right)	9/6	11/4
Age (yr)	54±11	59±15
ASA (I, II or III) (n)	4/10/1	5/7/3
History PONV (n)	2	2
Type of block (axillary/ interscalene) (n)	0/0	14/1
Specific times		
Anesthesia time (min)	137±55	155±23
Surgery time (min)	106±48	128±17
Discharge time (min)	112±70	107±68
Anesthesia-control time (min)#	32±12	40±35
Intraoperative drugs		
Propofol (mg)	408±170	249±186*
Midazolam(mg)	1.9±0.3	1.7±0.5
Fentanyl (mcg)	113±45	103±44
Bupivacaine 0.5% (ml)	6±2	30±10 *
Lidocaine 1% (ml)	7±3	14±10 *
Ketorolac 30mg (n) [%]	8[50]	4[26]
Fluids (ml)	796±259	896±348

Legend:

 # Difference between anesthesia and surgery time

Numbers (n), percentages [%], and mean values (± standard deviation)

** P-value < 0.05 compared to Local Anesthetic Infiltration group*

Importantly, the use of a PNB (40±35 min) did not significantly prolong the "anesthesia-control time" compared to the local infiltration group (32±12 min), p=0.41 (Table 1).

The two groups had similar anesthesia and surgery times, as well as recovery times to discharge home. However, the PNB group had significant lower pain scores (p< 0.05) on entry into the PACU and lower maximum pain scores (p< 0.05) prior to the time of discharge home than in the local infiltration group (Table 2). In addition, the PNB group required less 'rescue' opioid medication for pain management in the PACU (p<0.05) (Table 2). Common postoperative side effects in the PACU did not differ significantly between the two treatment groups (Table 2).

Table 2. Recovery characteristics in PACU for the two local anesthetic treatment groups.

	Local Anesthetic Infiltration (n=15)	**Peripheral Nerve Block** (n=15)
Side effects in the PACU		
Nausea and/or vomiting (n)[%] Rescue antiemetics (n) [%]	1[7] 3 [20]	1[7] 0
Rescue analgesics requirement		
Opioid analgesics (n) [%]		
in the PACU (prior to discharge) [%]	13[86]	6[40]*
Numeric pain rating scale score in PACU (0=none to 10=worst pain imaginable)		
Entering PACU	5±4	1±3 *
Pain at 30 min	5±3	3±4
Pain at 60 min	4±2	2±2
Pain at 90 min	4±2	3±1
Pain at 120 min	5±2	3±1
Highest level of pain prior to discharge	4±3	1±2 *

Legend:

Numbers (n), percentages [%], and mean values (± standard deviation)

** P-value < 0.05 compared to Local Anesthetic Infiltration group.*

Patients in the PNB group also had significant lower pain scores upon arrival home after surgery (p<0.05) (Table 3). However, the incidences of common post-discharge side effects were non-significantly lower in the PNB (vs. the local tissue infiltration group) (p = 0.3) (Table 3). The worst aspects of the post-discharge recovery period for both groups were inability to use their hand, followed by pain. (Table 3)

Finally, patient satisfaction with their pain management and quality of recovery scores [PNB 8.7±2 and Local Anesthetic Infiltration 8.0±2.8] did not differ significantly (p = 0.8) between the two local anesthetic treatment groups (Table 3).

Table 3. Recovery characteristics after Discharge, pain and side effects scores for the two local anesthetic treatment groups.

	Local Anesthetic Infiltration (n=15)	**Peripheral Nerve Block** (n=15)
Pain upon arriving home	5±3	3±3*
Post-discharge side effects		
Nausea (n) [%]	2 [13]	2[13]
Vomiting (n) [%]	1 [6]	0
Fatigue (n) [%]	6[40]	2 [13]
Constipation (n) [%]	1 [6]	1 [6]
Difficulty voiding (n) [%]	2 [13]	0
Headaches (n) [%]	2 [13]	1 [6]
Dizziness (n) [%]	0	1 [6]
Drowsiness (n) [%]	4 [26]	1 [6]
The worst aspect of the post-discharge recovery period		
Inability to use their hand (n) [%]	9 [60]	6[40]
Pain (n) [%]	10 [67]	5 [33]
Satisfaction with the pain management (0=highly dissatisfied, to 10=highly satisfied)	8.0±2.8	8.7±2
Quality of recovery (0=poor to 10= excellent)	8.5±2	9±1

Legend:

Numbers (n), percentages [%], and mean values (± standard deviation)

** P-value < 0.05 compared to Local Anesthetic Infiltration group.*

Discussion

Advances in analgesic and surgical techniques for patients undergoing superficial upper extremity ambulatory surgical procedures allows for an improved recovery profile. The optimal local anesthetic technique depends on the characteristics of the surgical procedure, patient co-existing conditions, patient and surgeon preferences, and experience and training of the anesthesiologist [12]. The implementation of an appropriate anesthetic technique can potentially improve patient safety and comfort while also improving OR efficiency [12].

Regional anesthesia for upper extremity surgery can include a wide array of regional anesthetic blocks (e.g., axillary, supra- and infraclavicular, interscalence, stellate ganglion blocks). Typical PNB blocks involve the use of one or more amide-type local anesthetics (e.g., lidocaine 1-2%, bupivacaine 0.2-0.5%, ropivacaine 0.15-0.3%) in total volumes ranging from 30 to50 mL. The effective utilization of regional anesthesia for upper extremity and hand surgery requires specialized training and the success rate may be enhanced by utilizing ultrasound-guidance. The uses of single-injection ultrasound guided PNBs have been demonstrated to provide reliable (>96%) surgical analgesia that continues into the early postoperative period [15]. Compared to general anesthesia, regional anesthesia for upper extremity hand and wrist surgeries allowed for fewer adverse events, faster recovery and better analgesia [16,17]. However, the benefits of regional anesthesia over general anesthesia were not observed beyond the first postoperative day [17].

Regional anesthesia with a PNB can provide superior postoperative analgesia with less PONV and PDNV [18]. Furthermore, an earlier publication suggested that the use of PNBs did not increase OR turnover times compared to general anesthesia [19]. The current comparative study suggests similar turnover times with the use of PNB and local infiltration analgesia because the anesthesia-control times were similar in both groups. The use of regional anesthesia is also associated with less tourniquet pain compared to intravenous regional analgesic techniques (e.g., Bier block) [18] or simple local tissue infiltration when a tourniquet is required. However, the introduction of relatively large volumes of local anesthetics into the perineural space for upper extremity PNB is associated with potential complications, including residual dense motor and sensory block and risk of systemic local anesthetic toxicity [20].

The subdermal infiltration of local anesthetics without procedural sedation presents a viable method of providing surgical analgesia to patients undergoing hand surgery in an office-based outpatient setting [21]. This type of anesthetic is often referred to as "wide-awake" analgesia as it avoids the use of IV sedative medications and a tourniquet. This local anesthetic technique allows for surgeons to communicate with the patient intraoperatively and to immediately check their repair (e.g., asking the patient to grip after a flexor tendon repair) [22]. This technique typically requires larger volumes of local anesthetics than those injected into the tissue at the surgical site when IV sedation is used (i.e., 'conscious sedation' or monitored anesthesia care) [22]. The use of local anesthetic solutions in combinations with the vasoconstrictor epinephrine has been safely used in hand surgery to achieve effective pain control and enhanced surgical hemostasis without increasing the risk of ischemia to a digit [23]. The adjunctive use of epinephrine can also significantly reduce the total volume of local anesthetic required as demonstrated in the current study.. Compared with intravenous regional anesthetic techniques (e.g., Bier blocks), local tissue infiltration provides equivalent analgesia with lower doses of local anesthetics, decreased tourniquet time, and decreased operating room time [24]. Therefore, it had been suggested that a simple technique like local tissue infiltration may offer advantages over more invasive routes of local anesthetic administration (e.g., PNBs) for superficial ambulatory surgical procedures [14].

Even for elderly patients, hand surgery is typically performed in an ambulatory or office-based setting [25,26]. Despite the widespread use of local anesthetics and adjunctive analgesic medications (e.g., non-steroidal anti-inflammatory drugs [NSAIDs], opioid analgesics, acetaminophen), many patients still experience inadequate postoperative pain control [27]. Outpatient hand surgery can be associated with post-discharge pain severe enough to actually interfere with sleep and cause significant discomfort in 30-40% of these patients [26,28]. In addition to PONV, inadequately controlled pain is the one of the leading cause of delayed discharge and unanticipated hospital admissions after ambulatory surgery [29]. A decrease in the amount of time a patient spends in the PACU following hand surgery will result in a decrease in perioperative costs and, more importantly, can provide for a better overall surgical experience for the patient [18].

This preliminary study has several shortcomings which could introduce bias on the part of both the patient and the investigators. Firstly, it was a non-randomized study design. The choice of local anesthetic technique was the result of a decision made by the surgeon and anesthesiologist on the day of surgery and this can contribute to a selection bias. Although neither the patients nor the providers were blinded to the local anesthetic treatment, the follow-up questionnaire was administered by an investigator who was unaware of the local anesthetic treatment group. However, the patient's assessment of their post-discharge pain and side effects, as well as their satisfaction with their pain management and overall quality of recovery as determined by the prospective administered post-discharge questionnaire was subject to potential recall bias. Finally, the small number of patients in each group (n=15) lead to inadequate power to properly analyze for differences in postoperative side effects, as well as other post-discharge outcome measures.

Conclusion

These data suggest that the administration of a PNB immediately prior to wrist surgery improves early postoperative pain control compared to simple tissue infiltration of the local anesthetic by the surgeon. The use of PNBs as an alternative to local tissue infiltration did not prolong the OR time, the length of the surgical procedure, or the time to discharge home after these wrist operations. Overall, the patients experienced a comparable level of satisfaction with their postoperative pain management and the quality of their recovery. Therefore, these preliminary data support the use of PNBs as part of a multimodal analgesic regimen for outpatient hand surgery [30]. Larger scale studies are still needed to determine the impact of using PNB on functional recovery after discharge home.

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