Preemptive Analgesia in Thumb Basal Joint Arthroplasty: Immediate Postoperative Pain with Preincision versus Postincision Local Anesthesia

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Abstract

Purpose Currently no guidelines exist for the timing of the injection of anesthetics in surgeries performed under general anesthesia to minimize postoperative pain. To better understand the role of timing of the injection of local anesthesia in hand surgery performed under general anesthesia, we evaluated the effect of pre- versus postincisional local analgesic injection on immediate postoperative pain experience. We hypothesize that the preincisional (preemptive) injection will result in decreased immediate postoperative pain experience and analgesic use when compared with postincisional injection.

Methods Consecutive cases of thumb basal joint arthroplasty performed over a 4-year period were retrospectively reviewed. During the first half of the study period, the surgical site was infiltrated with 0.5% bupivacaine at the completion of surgery following closure. During the second half of the study period, the surgical site was infiltrated with 0.5% bupivacaine prior to skin incision. Data collected included patient demographics, immediate postoperative recovery room (PACU) pain scores, and postoperative opioid consumption in morphine equivalents.

Results Two-tailed *t*-test identified no significant difference between the pre- and postincision cohorts relative to PACU entrance pain scores and time spent in the PACU. PACU exit pain scores were significantly lower in the preincision cohort. The mean PACU pain score was also significantly lower in the preincision cohort. PACU opioid consumption, converted into morphine equivalents, was found to be 211 mg in the preincision versus 299 mg in the postincision cohort.

Conclusion The preincisional (preemptive) injection of local anesthesia was found to result in lower pain scores during and upon exit of the PACU as compared with the postclosure group. In addition, the preincision cohort also trended toward lower opioid consumption while in the PACU. Consideration should be given to the routine use of preincision injection of local anesthesia to maximize pain relief in a multimodal pain strategy in hand surgical patients.

Level of Evidence Therapeutic level III.

Keywords

- preemptive
- analgesia
- BJA
- pre-incision
- anesthetic
- bupivacaine
- Marcaine

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Introduction

Optimal postoperative pain management is central to a surgical patient's comfort, limiting opioid consumption, minimizing length of stay, and maximizing patient satisfaction.^{1,2} Postoperative pain management is also paramount in hand surgery, where surgical interventions are often associated with significant pain, which, when inadequately treated, can adversely affect patient satisfaction, rehabilitation, and outcome.^{3–5} Local anesthetics are routinely used in the management of peri- and postoperative pain. These agents can be introduced into the surgical field in several ways, including preoperatively prior to incision, perioperatively, and postoperatively upon closure. In surgical cases performed under sedation, local anesthetics are injected prior to incision. However, in cases performed under general anesthesia, local anesthetics are often injected upon completion of the surgery and closure. The efficacy of the local anesthetic is based on several variables, including the type of anesthetic, the anesthetic duration of action, the concentration of the anesthetic, the location of the injection of the anesthetic, and the timing of anesthetic placement.

Preemptive analgesia is the concept of the delivery of an anesthetic prior to the initiation of noxious stimuli, such as the placement of a surgical incision. This technique theoretically potentiates the effects of an analgesic medication by limiting peripheral nerve activation to surgical tissue trauma and mitigating the recruitment and sensitization of pain pathways.⁶ Although significant research has been performed on preemptive analgesia in pain control following surgery, no study to date has looked at the role of preemptive local anesthesia in the acute postoperative pain experience of patients undergoing hand surgery, such as thumb basal joint arthroplasty,^{7–14} a common and painful hand surgical procedure.

The goal of this study was to evaluate the effect of preincisional (preemptive) local analgesic injection versus postincisional local analgesic injection on immediate postoperative pain experience. We hypothesize that the preincisional injection of local anesthetic will result in decreased immediate postoperative pain experience and analgesic use when compared with postincisional injection.

Materials and Methods

With institutional review board approval, all consecutive cases of thumb basal joint arthroplasty performed in the same way by a single surgeon, at the same surgical center, over a consecutive 4-year period (2012–2016), were retrospectively reviewed. Only cases during the study period utilizing the same thumb basal joint arthroplasty surgical technique were included. All patients underwent general anesthesia by the anesthesiologist alone, with additional local anesthetic placed pre- or postincisional by the surgeon. No patients included in this retrospective study received a regional block. The surgical technique in all cases consisted of a complete trapeziectomy through a volar Wagner incision followed by ligament reconstruction utilizing a split flexor carpi radialis tendon. The immediate postoperative dressing

was soft in all cases, without pinning or casting. Cases with concomitant procedures such as a carpal tunnel release or a thumb metacarpophalangeal joint procedure were excluded.

During the study period, the treating surgeon converted from postincisional anesthetic injection to preincisional. These cases were consecutive but not randomized. The postincisional cohort consisted of the injection of 0.5% of bupivacaine without epinephrine into the surgical site at the completion of the surgery and closure. The preincisional cohort consisted of the injection of 0.5% of bupivacaine without epinephrine into the surgical site prior to incision placement. The injection technique was the same in all cases consisting of 15 cm³ of bupivacaine in the trapeziectomy site and another 5 cm³ of the bupivacaine into the flexor carpi radialis harvest site.

Data collected included patient demographics, postanesthesia care unit (PACU) visual analog scale (VAS) pain scores (range: 0–10), and postoperative PACU opioid consumption. Patients in PACU were monitored according to hospital protocol. All patients had VAS pain scores assessed approximately every 10 to 15 minutes. Postoperative analgesia was administered according to hospital protocol by an anesthesiologist. Patients reporting poorly controlled pain received multimodal analgesia of varying quantities of the following medication(s): fentanyl, hydromorphone, oxycodone, hydrocodone, and codeine. PACU opioid consumption was converted into morphine equivalents using a web-based calculator (https://www.ohiopmp.gov/Portal/MED_Calculator.aspx). All retrospective data were collected by a blinded researcher.

Statistical Methods

A chi-squared test analyzed potential differences in sex ratio across experimental cohorts. A two-tailed *t*-test was used to analyze potential differences between study cohorts in age, mean PACU entrance pain score, mean PACU exit pain score, mean PACU pain score, and PACU opioid consumption (converted to morphine equivalence). An α of 0.05 was adopted for determination of statistical significance.

Results

Study cohorts consisted of 25 patients in the postincisional injection cohort and 24 patients in the preincisional injection cohort. The postincisional injection cohort was composed of 18 females and 7 males, with a mean age of 61.2 years. The preincisional analgesia cohort was composed of 16 females and 8 males, with a mean age of 61.6 years. Chi-squared analysis showed no significant difference in sex distribution between the study cohorts ($\chi^2 = 0.16$, $p = 0.69$), and *t*-test showed no significant difference in age between study cohorts ($t = -0.17$, $p = 0.86$).

Means and ranges for PACU entrance pain scores, PACU exit pain scores, mean PACU pain scores, and time spent in PACU is shown in ►Table 1. Two-tailed *t*-test showed that PACU exit pain scores were significantly lower in the preincision cohort ($p = 0.04$). Mean PACU pain score (mean of all PACU pain scores recorded during time in PACU) was also

Table 1 Pain scores on visual analog scale and morphine equivalents

Study group	Preincisional			Postincisional			p Value
	Average	Range	SD	Average	Range	SD	
PACU entrance pain score	0.79	0–8	2.56	1.04	0–10	2.89	0.74
PACU exit pain score	1.42	0–7	1.50	2.74	0–9	2.53	0.04
Mean PACU pain score	1.34	0–6	2.04	3.03	0–8.5	2.41	0.009
Time spent in PACU (min)	74.50	28–205	41.77	77.64	31–127	24.02	0.91
PACU morphine equivalents	211.18	0–727.6	300.07	299.24	0–731.8	264.41	0.25

Abbreviations: PACU, postanesthesia care unit; SD, standard deviation.

significantly lower in the preincision cohort ($p = 0.009$). No significant difference was seen between cohorts in PACU entrance pain scores ($p = 0.74$) and time spent in PACU ($p = 0.91$).

Means and ranges for opioid consumption in the PACU was converted into morphine equivalents and is listed in ► **Table 1**. The mean morphine equivalent dosage in the preincisional cohort was 211 versus 299 mg in the postincisional group. The difference was not statistically significant ($p = 0.25$).

Discussion

Pain control following hand surgery is multifactorial and can pose a significant challenge as is highlighted by the continued absence of a best practice model.⁵ Recent findings have indicated controversy in the efficacy of current postoperative pain management strategies in hand surgery as well as an ongoing opioid consumption crisis potentially fueled by ongoing opioid consumption crisis potentially fueled by nonspecific and/or excessive prescribing patterns.^{15,16}

The findings of this study indicate that preemptive local analgesia can lead to superior pain control in the acute postoperative period following thumb basal joint arthroplasty. These results correlate with those by Sai et al, who performed a randomized controlled trial analyzing the role of preemptive oral nonsteroidal anti-inflammatory drug (NSAID) use in the postoperative pain experience of 120 patients undergoing various hand surgeries, including 18 thumb basal joint arthroplasty cases. The authors reported a statistically significant decrease in severity and prevalence of immediate postoperative pain in patients who received preemptive analgesia.⁷ Similarly, in this study patients who received preemptive analgesia showed statistically significant decreases in mean and exit PACU pain scores in the acute postoperative period. Additionally, patients who received preemptive analgesia also exhibited a trend toward lower PACU opioid morphine equivalent administration by approximately one-third when compared with the preincisional group, although this finding was not statistically significant ($p = 0.25$).

Furthermore, it has also been shown that safe yet adequate pain control in the immediate postoperative period is important to overall patient satisfaction. Bot et al have shown that pain scores correlate well with opioid consumption and are inversely correlated with pain satisfaction scores.¹⁷ Coluzzi et al analyzed the effects of immediate postoperative pain

control on patient satisfaction following ambulatory hand surgery and found that an adverse event was the most significant predictor of patient disapproval. Coluzzi et al also reported that adequate pain control, sleep-pain interference less than 4/10, and lack of preoperative analgesic consumption were highly predictive of patient satisfaction.¹⁸ This information, along with the findings of this retrospective study, indicates that effective preincisional analgesia is more likely to increase patient satisfaction following hand surgery by improving postoperative pain.

Recent evidence indicates that preemptive analgesia may provide further benefits beyond immediate postoperative pain control. Yang et al found that use of preemptive analgesia prior to thoracotomy was associated with a significant lack of immune system suppression that is commonly seen in the immediate postoperative period, as well as significantly decreased rates of adverse pharmacologic side effects, decreased postoperative analgesic demands, and decreased length of hospital stay.¹¹

This study does have its limitations. As this was a retrospective consecutive case series, participants in this study were not randomized to preincisional or postclosure analgesia. Although analysis of patient characteristics showed no differences across the two treatment cohorts, it is possible that the cohorts were different in some way. Although the authors examined analgesic equivalents to determine opioid use postoperatively, the administration of postoperative opioids in the PACU was not standardized across study participants. Intraoperative analgesia was not controlled for, nor was it available to report. However, similar PACU entrance pain scores assume a similar starting point for the patients' immediate PACU pain experience. Additionally, bias may have affected the results of this study through use of a patient VAS for pain assessment. Although a gold standard for pain assessment is not available, previous research has shown that the VAS pain scale has good test-retest reliability and sufficient sensitivity to detect changes in pain over short periods.^{19,20} Study data were collected by a researcher blinded to the study treatment sequence, as well as the time point at which experimental treatment was altered. The authors believe that this construct minimized observer bias during the data collection process.

Though further research into preemptive analgesia is warranted, the study hypothesis was upheld as preemptive analgesia was found to result in lower pain scores and opioid

consumption in the PACU following thumb basal joint arthroplasty. Use of preemptive analgesia in the perioperative multimodal pain regimen in hand surgery could prove to be beneficial in optimizing patient experience and satisfaction.

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