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Multi-Modal Pain Control in Ambulatory Hand Surgery

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Take-Home Points

- While regional anesthesia is safe and effective for patients who undergo ambulatory hand surgery, patients often experience rebound pain as it wears off.
- We tested a multimodal approach for patients who underwent thumb CMC arthroplasty or ORIF of distal radius fracture.
- Patients were provided with a journal and asked to record medication usage, a NPS, and adverse effects. Seventy-nine patients completed the study.
- We found that adding ketorolac to the postoperative pain protocol, with detailed instructions, lowered narcotic usage in the first 4 postoperative days.
- Ketorolac potentially provides patients with improved pain control over the use of narcotic pain medication alone in an ambulatory hand surgery setting.

Regional anesthesia is a safe and effective modality of perioperative pain control in patients undergoing ambulatory hand procedures.¹⁻¹⁰ Often, as the regional block wears off, patients experience a rebound pain effect that can be challenging to manage.

We sought to determine if an organized, multimodal approach in patients undergoing thumb carpometacarpal

(CMC) arthroplasty or open reduction and internal fixation (ORIF) of distal radius fractures would provide better postoperative pain control. We hypothesized that this approach would significantly reduce postoperative pain and the need for narcotic pain medication compared with PRN dosing of oxycodone/acetaminophen alone.¹¹⁻¹⁴

Materials and Methods

Our study was approved by our Institutional Review Board. Informed consent was obtained from each patient. Patients presenting for elective thumb CMC arthroplasty or ORIF of the distal radius were screened for inclusion in a prospective, randomized study. Inclusion criteria included patients aged 18 to 65 years who could provide informed consent. Patients with chronic pain syndromes, long-term narcotic usage, chronic medical conditions precluding the use of opiates or nonsteroidal anti-inflammatory drugs (NSAIDs), and those who did not have a complete sensory and motor block postoperatively were excluded.

Patients were randomly divided into 1 of 4 study arms. Randomization was performed via sealed envelopes, which were opened in the recovery area when postoperative prescriptions were written. The group distribution was as follows: Group 1, Percocet 5 mg/325 mg alone (control); Group 2, oxycodone 5 mg, acetaminophen 325 mg administered separately; Group 3, oxycodone 5 mg, acetaminophen 325 mg, and oxycodone SR (OxyContin) 10 mg; and Group 4, oxycodone 5 mg, acetaminophen 325 mg, and ketorolac (Toradol) 10 mg (**Table 1**). Patients in the control group were instructed to take 1 or 2 tablets every 4 to 6 hours as needed for pain. Patients in the 3 experimental groups were given detailed instructions regarding when and how to take their medications. All patients were instructed to take 650 mg of acetaminophen every 6 hours. Patients were provided a sliding scale to assist in dosing their opioid medications according to their numeric pain score (NPS) (**Table 2**). Group 2 patients were given oxycodone 10 mg in the postanesthesia care unit (PACU) and instructed to take oxycodone 10 mg with acetaminophen 650 mg every 6 hours on a scheduled basis until their block wore off, then dose themselves using the NPS. Group 3 patients were given oxycodone 10 mg in the PACU and instructed to take oxycodone 10 mg with acetaminophen 650 mg every 6 hours and OxyContin 10 mg every 12 hours on a scheduled basis until their block wore off, then dose themselves using NPS. Group 4 patients were given oxycodone 10 mg postoperatively and ketorolac 30 mg intravenously in the PACU and instructed to take oxycodone 10 mg, acetaminophen 650 mg, and ketorolac 10 mg every 6 hours on a scheduled basis until their block wore off, then dose themselves using the NPS.

Patients were provided with a journal and asked to record their medication usage, NPS, and any adverse effects (nausea, vomiting, and uncontrolled pain were specifically mentioned) or complications for 5 days after their procedure. We also attempted to contact patients by telephone on each of the 5 days after their procedure to remind them to complete their logs. They were asked specifically if they were having difficulty with their medications. They were also asked specifically about nausea, vomiting, and over-sedation. If patients requested additional medication to help treat their pain, they were instructed to add an over-the-counter NSAID of their choice based on the label's suggested dosing.

All patients received a supraclavicular brachial plexus block using 0.75% ropivacaine under the supervision of an attending anesthesiologist experienced in regional anesthesia. Patients underwent thumb CMC arthroplasty utilizing complete resection of the trapezium followed by abductor pollicis longus suspensionplasty under the supervision of 1 of 3 fellowship-trained hand surgeons. ORIF of the distal radius was completed utilizing a volar approach and distal radius locking plate under the supervision of 1 of 3 fellowship-trained hand surgeons.

Primary outcome measures were the total number of oxycodone tablets taken daily and the average daily NPS. Secondary outcomes measured included adverse effects as noted above and the need for a trip to the emergency

department for unrelieved pain.

A power analysis was completed prior to the beginning of the study. To detect a difference of at least 1 on the NPS, we determined that 18 patients per group would provide 80% power. This was based on literature utilizing the visual analog scale (VAS), a 100-mm line on which patients can place a mark to describe the intensity of their pain. The standard deviation on the VAS is approximately 15 mm. To account for potential dropout, we elected to recruit 20 patients per group. Non-paired *t* tests were used to compare groups.

Results

One hundred and eighteen patients enrolled in the study. Of those, 79 patients completed and returned their summary logs (by group: 18 control, 20 oxycodone, 17 OxyContin, and 24 ketorolac). The remaining patients were excluded from the final analysis because they did not return their summary logs. Only 1 patient was excluded from the analysis because he did not have adequate regional anesthesia. Demographic data were analyzed and showed no significant differences between groups at the $P < .05$ level of significance. Surgical procedures were completed by 3 fellowship-trained hand surgeons. Distal radius fractures were performed using a volar approach. CMC arthroplasty was performed using a procedure that was standardized across surgeons. There were no between-surgeon differences in outcomes.

Average daily NPS (**Figure 1**) and the total number of oxycodone tablets taken (**Figure 2**) over the 5-day study period were recorded. Patients in the ketorolac group used fewer oxycodone tablets (19.3) than patients in the other 3 groups (24.4), $P = .11$, but the difference was not statistically significant. The maximum number of oxycodone tablets used was 71 in the Percocet group, 57 in the oxycodone and ketorolac groups, and 73 in the OxyContin group. The average daily NPS was lower in the ketorolac group during the period of medication use. This value only reached statistical significance on postoperative day 0 when the ketorolac group was compared with the OxyContin group ($P = .01$) and on postoperative day 1 when the ketorolac group was compared with the oxycodone group ($P = .04$). Complications (**Figure 3**) were greater in the non-ketorolac groups. One patient each in the oxycodone and OxyContin groups required a trip to the emergency department for pain control after their block wore off. Nausea and vomiting were present in each of the 4 groups but to a much greater degree in the Percocet and OxyContin groups; however, these results did not reach statistical significance ($P = .129$). Eleven of the 18 patients in the Percocet group required an additional NSAID (naproxen) and still did not achieve pain control similar to the other groups. This may explain why the average daily pain score in the Percocet group was lower than that in the oxycodone group, in which only 4 of the 20 patients supplemented with naproxen. Patients did, however, require many more oxycodone tablets to achieve pain control in the Percocet group. Over-sedation was reported in 3 patients in the oxycodone group and in 1 patient in the OxyContin group. No patients were found to have bleeding, renal, or other systemic complications.

Discussion

In this prospective, randomized study, we sought to determine whether a more organized approach to treating postoperative pain using a specific dosing regimen or opiates in conjunction with non-opiate medications would lead to improved pain control and a decreased need for opiates. We found that adding ketorolac to the postoperative pain regimen and outlining a more detailed set of instructions could lower narcotic usage in the first 4 postoperative days. In addition, adding ketorolac decreased other complications commonly seen with narcotic usage and was shown to be safe in our patient population.

Ketorolac has been shown to decrease narcotic pain medication usage in several surgical settings and across different surgical specialties. It is hypothesized that ketorolac potentiates the effects of narcotics.¹¹ Ketorolac given alone has a potent analgesic effect by acting as a strong non-selective cyclooxygenase inhibitor. The major drawback to ketorolac use has been its well-known side-effect profile. Ketorolac is renally excreted, and as such, should not be used in patients with renal insufficiency. In addition, ketorolac has been shown to cause increased gastrointestinal bleeding when used for >5 days.¹⁵ Caution should be taken when combining ketorolac with thromboprophylactic medications, especially in older patients.

Many surgeons use NSAIDs along with narcotics as part of a postoperative pain regimen. While this is often adequate for some procedures, when the surgery involves manipulating fractures, internal fixation, or resection arthroplasty, the variation in individual patient pain may call for a more robust protocol. Additionally, as surgeons expand to more complex procedures performed in the outpatient setting, evaluating different combinations of analgesics taken in a more structured manner may provide for improved pain control.

A major component of patient satisfaction is postoperative pain control.^{3-8,12,16,17} Regional anesthesia is an important tool that allows patients to undergo a surgical procedure with a greatly reduced amount of opioid pain medications. In addition, regional anesthesia can provide significant pain control after the patient has left the ambulatory surgery center, but this relief is short-lived because the medication is designed to lose effectiveness over time. As the effects of regional anesthesia wear off, patients can experience “rebound pain” with severe levels of pain that, on occasion, cannot be controlled with oral analgesics alone. The addition of ketorolac provided improved pain control when compared with the other regimens during this transition period when the regional anesthesia was becoming ineffective. In addition, because patients taking ketorolac used less narcotic medication, they experienced less nausea, vomiting, and over-sedation.

Additionally, patients were instructed to record their medication usage and pain scores on a prospective basis, with the hope of eliminating recall bias. A potential weakness is the inability to show significance for pain relief and reduced narcotic usage with the addition of ketorolac, although there was a trend toward significance. Many of the patients who enrolled in the trial did not return their medication logs. While these patients had to be excluded from data analysis, we continued enrollment until we obtained an adequate number of patients in each group. In addition, in the OxyContin group (Group 3), we could only recruit 17 participants, instead of the 18 needed based on our power study. Although this has a potential to alter the significance of our results, we do not feel this had a substantial impact on our results.

Many patients in the non-ketorolac groups supplemented their medication regimens with NSAIDs, which may have falsely lowered pain scores and narcotic usage. While this confounds our study results, we do not believe that it invalidates the conclusion that ketorolac can be an effective adjunct pain medication for use in patients undergoing ambulatory hand surgery.

The study examined postoperative pain control for only 2 procedures, thumb basal joint arthroplasty and distal radius fracture fixation, both commonly performed in the outpatient setting under regional anesthesia and both typically requiring narcotic pain medication. Perhaps the utilization of these medication regimens with different surgical procedures would have differing results.

We conclude that ketorolac potentially provides patients with improved pain control over the use of narcotic pain medications alone in the setting of ambulatory hand surgery.

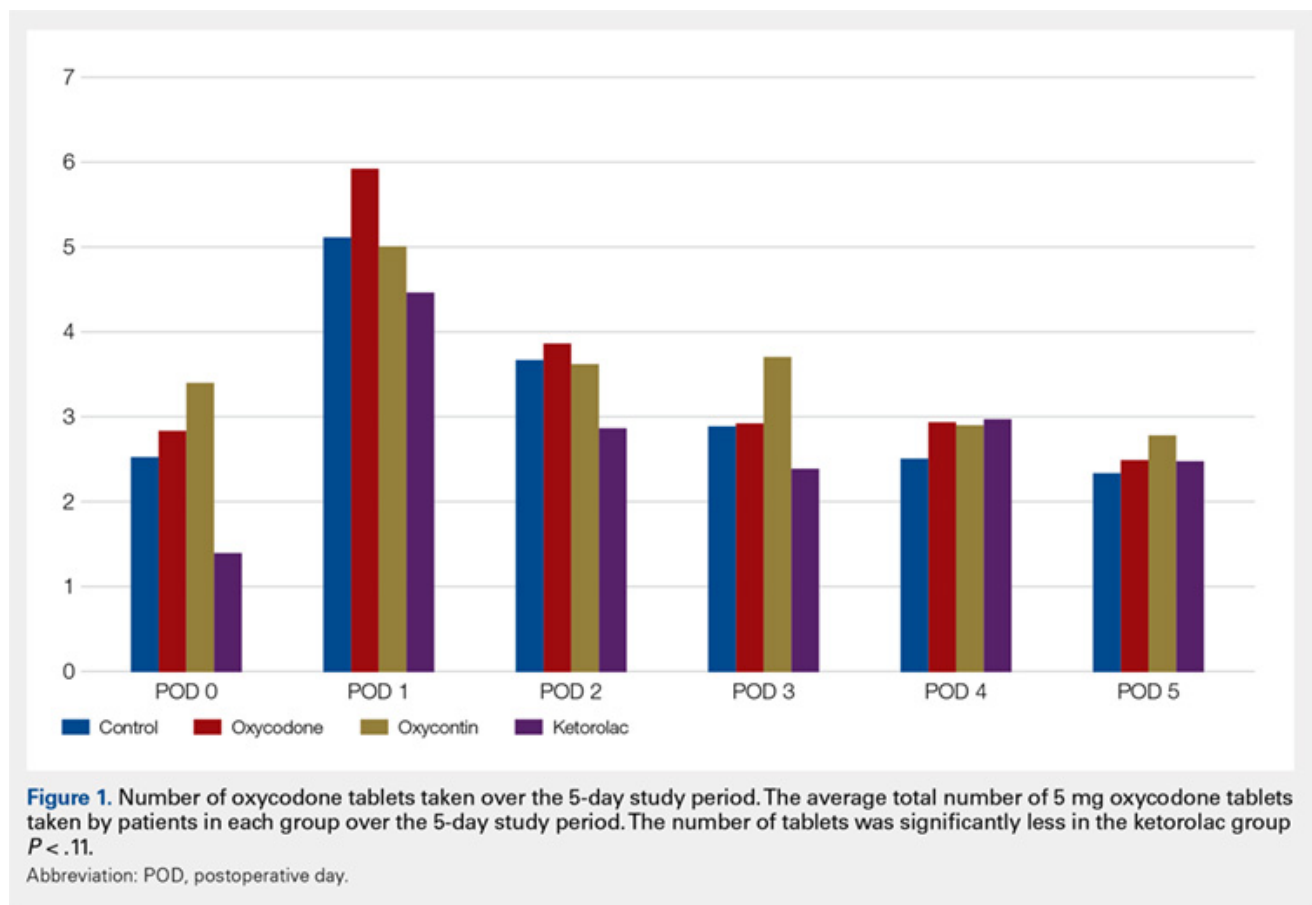
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Key Info

Figures/Tables

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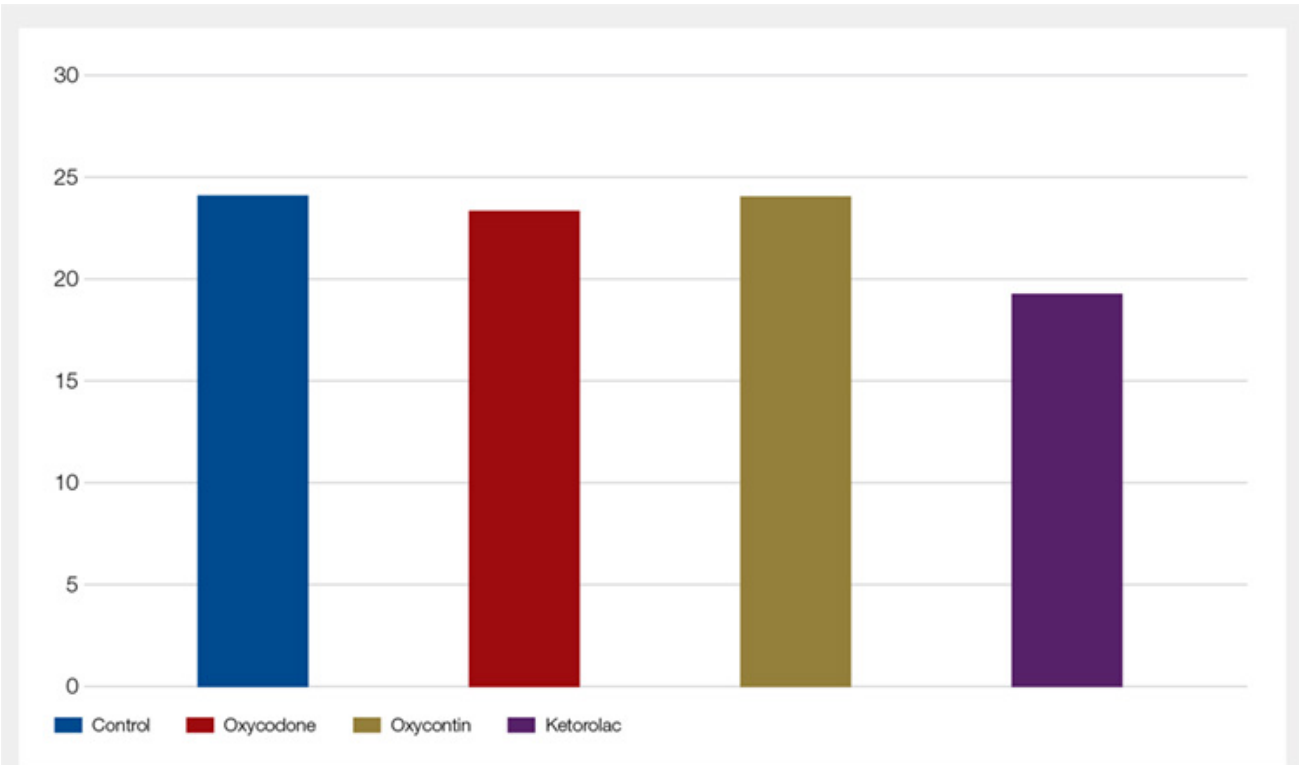


Figure 2. Average daily numeric pain scores. While taking ketorolac (postoperative day 0 to postoperative day 3), patients exhibited significantly lower pain scores than all other groups $P < .04$. Patients in the Percocet group showed lower pain scores than those in the oxycodone and Oxycontin groups (which may be explained by supplementation with naproxen in this group).

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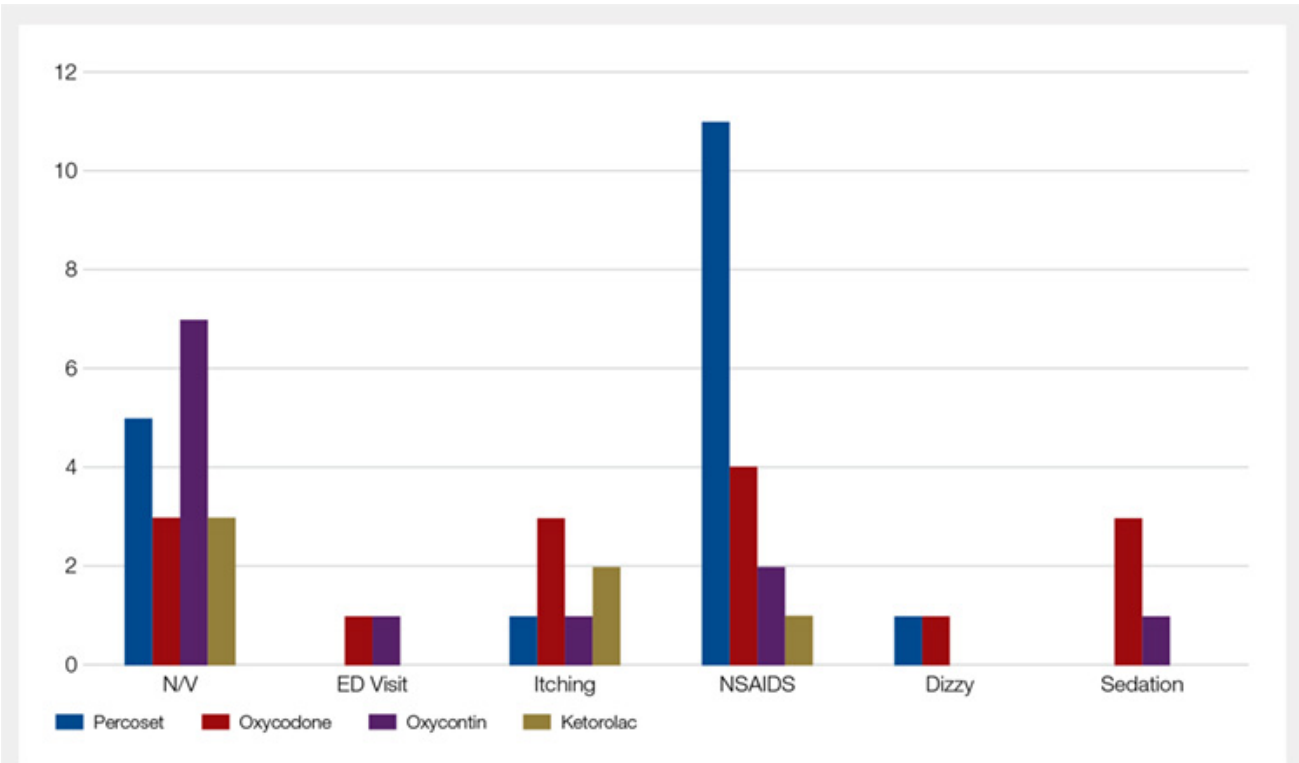


Figure 3. Complications. Nausea and vomiting were present in each of the 4 groups but to a greater extent in the Percocet and OxyContin groups. An emergency department visit to achieve adequate pain control was required in 2 patients (1 patient from each of the oxycodone and OxyContin groups).

Table 1. Patient Groups

Group	Anesthesia	Pain Medications
1 (standard treatment)	Brachial plexus block	Percocet (oxycodone and acetaminophen) 5-10 mg every 4-6 hours as needed for pain.
2	Brachial plexus block	1. Oxycodone 0-15 mg every 4-6 hours as needed for pain based on pain scale score. 2. Tylenol (Acetaminophen) 650 mg every 6 hours, scheduled.
3	Brachial plexus block	1. Oxycodone 0-15 mg every 4-6 hours as needed for pain based on numeric pain scale. 2. Tylenol (Acetaminophen) 650 mg every 6 hours, scheduled. 3. OxyContin (oxycodone sustained release) 10 mg twice a day, scheduled.
4	Brachial plexus block	1. Oxycodone 0-15 mg every 4-6 hours as needed for pain based on pain scale score. 2. Tylenol (Acetaminophen) 650 mg every 6 hours, scheduled. 3. Toradol (Ketorolac) 10mg every 6 hours, scheduled.

Table 2. Sliding Scale for Pain Control in the Experimental Groups

Pain Score	Oxycodone Dose
0-3	5 mg (1 tablet)

4-7	10 mg (2 tablets)
8-10	15 mg (3 tablets)

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