Perioperative Pain Control in Upper Extremity Surgery: Prescribing Patterns, Recent Developments, and Opioid-Sparing Treatment Strategies

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Abstract

Background: Perioperative pain management in hand and upper extremity surgery has become increasingly challenging following recent efforts to accelerate postoperative recovery, decrease length of stay, and maximize the number and complexity of surgical interventions provided in an ambulatory setting. This issue has been further complicated by the growing opioid epidemic in the United States and increasing insights into its detrimental effects on society. Practicing hand surgeons must acknowledge this ongoing public health crisis and adapt their clinical practices to minimize and optimize distribution of prescription opioids. **Methods/Results:** This review outlines current opioid prescribing patterns, recent developments, and treatment strategies designed to maintain effective perioperative analgesia in orthopedic upper extremity surgery while minimizing opioid delivery available for diversion, misuse, and abuse. **Conclusions:** The authors advise hand surgeons to utilize the strategies discussed in this review to assist in forming a unique, patient-specific postoperative analgesic regimen.

Keywords: Hand, opioid, postoperative, pain, upper extremity

Introduction

Perioperative pain management in hand and upper extremity surgery has become increasingly challenging following recent efforts to accelerate postoperative recovery, decrease length of stay, increase patient satisfaction, and maximize the number and complexity of surgical interventions provided in an ambulatory setting.¹¹ This issue has been further complicated by the growing opioid epidemic in the United States and increasing insights into its detrimental effects on society.¹⁴ Practicing hand surgeons must recognize this ongoing public health crisis and adapt their clinical practices to maintain adequate pain control while minimizing inadvertent contribution to the ongoing opioid epidemic. This review outlines treatment strategies designed to maintain effective perioperative analgesia in upper extremity surgery while minimizing opioid delivery available for diversion, misuse, and abuse.

The Opioid Epidemic

Unsubstantiated guidelines surrounding pain management released in the early-mid 1990s, in addition to advances in pharmaceuticals and intensified drug marketing, are com-

monly cited as provoking factors in the nascency of the opioid epidemic.¹³ These events led to a dramatic increase in prescription opioid utilization and consumption across the United States.¹³ Current reports estimate that opioid sales increased almost fourfold between 1999 and 2010, with 80% of the global opioid supply and 99% of the global hydrocodone supply being dispensed in the United States.¹⁴ This burgeoning dissemination and use of prescription opioids within the US healthcare system has led to unparalleled rates of opioid diversion, misuse, and abuse. Increases in prescription opioid utilization rates have roughly mirrored increases in prescription opioid morbidity and mortality.¹³ Nonmedical uses of prescription opioids have also imposed a significant cost burden on the US healthcare system, with related expenditures estimated to exceed \$50 billion annually.⁶

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Although opioids have been enduringly recognized as a standard of care in the treatment of both acute and palliative pain management, the scrutiny surrounding their excess dissemination and overutilization is clearly well deserved.¹³ This issue has been brought to national attention, with the current administration declaring a national opioid emergency.

Hand Surgery Prescribing Patterns

Adequate pain control following surgery is challenging; patients often present with preoperative pain and surgical interventions typically introduce substantial pain in the postoperative period. In addition, while excessive analgesia must be avoided, inadequate pain control can lead to insufficient rehabilitation, poor surgical outcome, increased morbidity, and decreased patient satisfaction.¹⁰ These challenges are magnified in the field of upper extremity surgery, where ambulatory surgery and decreased postoperative surveillance are increasingly becoming the standard of care.

Orthopaedic surgeons are currently reported as being the third highest specialty prescriber of opioids in the United States, writing 7.7% (6.1 million) of the 79.5 million opioid scripts written in 2009. In addition, Volkow et al report that more than 60% of the prescriptions delivered by orthopedic surgeons in 2009 were given to patients who had already received prescription opioids within the past month.¹⁹ Hand surgeons' prescribing patterns may have also contributed to the ongoing opioid epidemic, with current research estimating that 13% of opioid-naïve patients continue to fill opioid prescriptions 90 days after hand surgery.⁹ While this is likely a result of multiple factors, recent research aimed at quantifying opioid prescribing indicates that hand surgeons are inadvertently dispensing excess opioids in the postoperative period.^{2,5,12,17} Rogers et al conducted a prospective evaluation of prescribing patterns following upper extremity surgery in 250 patients and observed that oxycodone, hydrocodone, and propoxyphene constituted 95% of the prescribed medications, with surgeons most commonly providing 30 opioid pills following surgery. Overall, the 250-patient cohort was in possession of 4639 unused opioid pills at the 2-week postoperative timepoint.¹⁷ A similar study by Goyal et al evaluated opioid prescribing and consumption in 305 patients undergoing ambulatory hand and upper extremity surgery and found that patients were prescribed an average of 33 opioid pills and consumed an average of 19 pills, resulting in 44% of prescribed opioids (4276 pills) going unused. Importantly, more than three-quarters of the patients prescribed excess opioids reported that they chose to keep their unused medications indefinitely.⁵ This common opioid storage practice is relevant, as over two-thirds of surveyed patients engaging in prescription opioid abuse in 2010 reported diverting prescription opioids from a friend or relative.¹³ Kim et al carried out a prospective study on 1416 patients undergoing upper extremity surgery and observed

that approximately two-thirds of prescribed opioids went unutilized.¹² A similar study by Chapman et al reported that patients undergoing carpal tunnel release (CTR) were prescribed a mean of 21 pills at discharge and were observed to have utilized only 20% of the prescription opioids dispensed, with an average consumption of 4 opioid pills.²

These studies provide substantial evidence of pervasive opioid overprescribing practices by hand surgeons. Kim et al also surveyed hand surgeons on their observed opioid prescribing practices and found that most surgeons overprescribed opioids to avoid uncontrolled postoperative pain, minimize patient telephone calls, avoid emergency department visits for pain, and mitigate patient complaints.¹² These "defensive" prescribing methods must be recognized and addressed by all hand surgeons, as they are one of the many forces contributing to the opioid epidemic, facilitating excessive prescription opioids to become available for diversion and abuse.

Recent Developments: Optimal Upper Extremity Opioid Prescribing

The lack of consensus for postoperative prescription opioid therapy following upper extremity surgery in addition to mounting evidence illustrating the prevalence of excess opioid prescribing has prompted recent investigations into intervention-specific postoperative analgesic requirements. Chapman et al completed a prospective investigation of opioid requirements in a cohort of 277 patients following open CTR, observing that patients required on average 4.3 pills in the postdischarge period.² O'Neil et al carried out a similar prospective study in 98 patients undergoing distal radius fracture open reduction internal fixation (ORIF) and reported mean postoperative opioid consumption to be 14.6 pills.¹⁶ Dwyer et al evaluated average opioid consumption following both CTR ($n = 121$) and distal radius fracture ($n = 24$) and reported similar results, with these cohorts requiring 3 and 16 opioid pills, respectively, in the postoperative period.⁴ Perhaps the most influential and widely applicable of these investigations was carried out by Kim et al, who completed a large prospective study to delineate postoperative opioid consumption patterns following various shoulder, elbow, wrist, and hand surgeries. Postoperative opioid requirements reported by Kim et al, Chapman et al, Dwyer et al, and O'Neil et al are displayed in Table 1.^{2,4,12,16}

Kim et al utilized their opioid consumption data to create of a comprehensive set of intervention-specific opioid prescribing guidelines. The guidelines, as shown in Table 2, are as follows:

<10 opioid [pills] for hand and wrist soft-tissue surgical procedures, <20 opioid [pills] for hand and wrist fracture or joint surgical procedures, <15 opioid [pills] for elbow and forearm

Table 1. Postoperative Opioid Utilization Rates Following Hand and Upper Extremity Surgery.

Procedural intervention	Mean postoperative opioid consumption ^a	Source
Shoulder or arm	22.0 pills	Kim et al ¹²
Acromioplasty rotator cuff	21.4 pills	Kim et al ¹²
Humeral ORIF	53.5 pills	Kim et al ¹²
Distal clavicle resection	31.0 pills	Kim et al ¹²
Elbow or forearm	11.1 pills	Kim et al ¹²
Cubital tunnel release	8.9 pills	Kim et al ¹²
Lateral epicondyle debridement	13.5 pills	Kim et al ¹²
Distal biceps repair	11.1 pills	Kim et al ¹²
Wrist	7.5 pills	Kim et al ¹²
Carpal tunnel release	4.2 pills	Kim et al ¹²
Carpal tunnel release	4.3 pills	Chapman et al ²
Carpal tunnel release	3.0 pills	Dwyer et al ⁴
Distal radius ORIF	13.7 pills	Kim et al ¹²
Distal radius ORIF	14.6 pills	O'Neil et al ¹⁶
Distal radius ORIF	16.0 pills	Dwyer et al ⁴
De Quervain tenosynovitis	7.9 pills	Kim et al ¹²
Hand	7.7 pills	Kim et al ¹²
Trigger finger release	3.8 pills	Kim et al ¹²
Mass excision	4.3 pills	Kim et al ¹²
Metacarpal ORIF	9.6 pills	Kim et al ¹²
Finger pinning	8.1 pills	Kim et al ¹²
Carpometacarpal arthroplasty	21.5 pills	Kim et al ¹²
Tendon repair	14.5 pills	Kim et al ¹²

Source. Data taken from Kim et al,¹² Chapman et al,² O'Neil et al,¹⁶ and Dwyer et al.⁴

Note. ORIF = open reduction internal fixation.

^aOpioid consumption described in units of pills with the following opioid formulations considered equivalent and applicable: Percocet (oxycodone and acetaminophen) or an oxycodone 5-mg equivalent, Vicodin (acetaminophen and hydrocodone) or a hydrocodone 5-mg equivalent, and Tylenol #3 (acetaminophen and codeine) with 30 mg of codeine.

soft-tissue surgical procedures, <20 opioid [pills] for elbow and forearm fracture or joint surgical procedures, and <30 opioid [pills] for upper arm and shoulder surgical procedures.¹²

While further research is needed to define normal postoperative analgesic needs following all upper extremity surgeries, the groundbreaking findings reported in these studies provide early guidelines upon which all practicing hand surgeons should model their prescribing practices.

Opioid-Sparing Treatment Strategies

Preoperative

A thorough preoperative history and clear communication of reasonable perioperative expectations are vital to successful postoperative recovery and opioid cessation. In addition to a traditional upper extremity evaluation, hand surgeons must also screen patients for a history of substance use and dependence, as well as risk factors that can predispose to opioid-related morbidity or mortality. These risk factors include catastrophic thinking, personal or family history of substance

abuse, depression or other psychiatric illness, current tobacco use, young age, joint or fracture surgery, prior surgical interventions of the upper arm, unemployment, workers' compensation, and self-pay or Medicaid-insurance status.^{5,7,12,14} Helmerhorst et al reported that catastrophic thinking was the single-best predictor of prolonged opioid use following orthopedic trauma surgery.⁷ This has been supported by Dwyer et al, who observed that a Pain Catastrophizing Scale greater than 10 led to a significant increase in postoperative opioid consumption in patients undergoing CTR and distal radius fracture ORIF.⁴ These risk factors, when present, should be considered during preoperative planning of both surgical interventions and postoperative analgesic regimens.

Whenever possible, opioid-naïveté should be maintained in the preoperative period. This poses a significant challenge in upper extremity surgery, as many patients present with acute or chronic pathology that is extremely painful.¹⁴ Research indicates that preoperative opioid exposure is not only detrimental to postoperative pain control but also places patients at risk for poor outcomes following surgery.^{3,15} Cheah et al retrospectively analyzed postoperative opioid consumption in 262 patients undergoing anatomic

Table 2. Postoperative Opioid Prescribing Guidelines: Hand and Upper Extremity Surgery.

Procedural site and intervention	Recommended postoperative opioid dosing ^a
Shoulder or arm	
Soft tissue surgery	30 or fewer pills
Fracture surgery	30 or fewer pills
Joint surgery	30 or fewer pills
Elbow or forearm	
Soft tissue surgery	15 or fewer pills
Fracture surgery	20 or fewer pills
Joint surgery	20 or fewer pills
Wrist	
Soft tissue surgery	10 or fewer pills
Fracture surgery	20 or fewer pills
Joint surgery	20 or fewer pills
Hand	
Soft tissue surgery	10 or fewer pills
Fracture surgery	20 or fewer pills
Joint surgery	20 or fewer pills

Source. Guidelines taken from Kim et al.¹²

^aOpioid dosing described in units of pills with the following opioid formulations considered equivalent and applicable: Percocet (oxycodone and acetaminophen) or an oxycodone 5-mg equivalent, Vicodin (acetaminophen and hydrocodone) or a hydrocodone 5-mg equivalent, and Tylenol #3 (acetaminophen and codeine) with 30 mg of codeine.

and reverse total shoulder arthroplasty and observed that patients consuming short- or long-acting opioids preoperatively consumed significantly more opioids in the postoperative period.³ Morris et al evaluated 224 patients undergoing anatomic shoulder arthroplasty and observed that preoperative opioid exposure was associated with significantly worse functional outcomes following surgery and significantly lower patient satisfaction.¹⁵

Patient education in the preoperative period is also vital. Patients should be counseled on not only the intervention being carried out and its potential risks and benefits but also the typical postoperative pain experience and rehabilitation regimen associated with the procedure. Patients should be cautioned that some level of pain in the postoperative period is to be expected. In all preoperative evaluations, patients should be informed of the inherent risks of opioid analgesics as well as the ultimate goal of rapid opioid cessation.¹⁴ Patients should also be encouraged to utilize nonopioid analgesics, such as nonsteroidal anti-inflammatory drugs (NSAIDs) or acetaminophen, as first-line agents when experiencing pain.¹ The importance of this education was highlighted by Alter and Ilyas, who carried out a prospective, randomized study analyzing the effect of preoperative opioid counseling on postoperative opioid consumption. The authors found that patients undergoing CTR randomized to receive preoperative opioid counseling consumed significantly fewer (two-thirds less)

opioid pills in the acute postoperative period (POD 0-5), were more likely to utilize nonopioid analgesics, and experienced no significant difference in pain scores compared with patients who received no counseling.¹ The standardized preoperative counseling provided in this study was derived from 5 major recommendations: (1) identify risk factors for opioid abuse and addiction; (2) encourage patient to utilize nonopioid analgesics, such as acetaminophen or NSAIDs, prior to utilizing prescription opioids; (3) prior to initiation of opioid therapy, physicians should clearly define the expected length of opioid therapy and goals of opioid therapy; (4) when prescribing opioid analgesics, prescribe for the lowest dose and shortest duration of therapy that is efficacious; and (5) determine whether opioid analgesics are currently being prescribed by any other provider (PCP, pain management specialist, etc.) and coordinate expectations, goals, and duration of opioid therapy if indicated.¹

Hand surgeons who utilize these recommendations will likely reduce perioperative opioid consumption as well as risk of opioid diversion and chronic opioid use in their patient population. Perhaps more importantly, these strategies will aid in early recognition of patients who may need additional supervision in the postoperative period.

Perioperative

Hand surgeons have a wide array of perioperative anesthetic and analgesic techniques available that can aid in postoperative pain relief and perioperative opioid sparing. When selecting an anesthetic technique, surgeons should take into account the operative site, the duration and invasiveness of the proposed procedure, and the patient's presentation and medical comorbidities.¹¹ In patients presenting with no preoperative pain, preemptive analgesia, or administration of anesthetic prior to the initiation of surgical dissection, should be utilized. A randomized controlled study by Sai et al. analyzing the effects a brachial plexus block with or without preemptive analgesia observed that preoperative ampiroxicam resulted in significantly improved pain control and decreased opioid consumption following hand surgery.¹⁸

Hand surgeons have many intraoperative anesthetic and analgesic techniques available from which to choose, varying from wide-awake surgery with local anesthesia to general anesthesia. Common anesthetic techniques available in upper extremity surgery include wide awake local anesthesia no tourniquet technique, continuous peripheral nerve blocks, upper extremity regional blocks, and general anesthesia.¹¹ While anesthetic technique plays a vital role in postoperative recovery and length of stay, preliminary research indicates there is limited effect on postoperative opioid consumption when comparing intraoperative anesthetic techniques in hand surgery.^{2,12,16}

In all surgical patients, hand surgeons should utilize multimodal analgesia (MMA). MMA describes the utilization of adjunct analgesics with unique pharmacologic mechanisms of action to attain additive pain relief. A randomized, placebo-controlled, double-blinded study by Jo et al investigating the effect of MMA following arthroscopic shoulder surgery reported significantly decreased pain in the acute postoperative period as well as significantly decreased opioid consumption following surgery. The multimodal analgesic regimen used in this study included intra-articular and periarticular injection of ropivacaine, morphine, epinephrine, and hyaluronate.⁸

Surgical techniques can also be modified on a case-by-case basis in an effort to minimize postoperative pain and opioid consumption. Prolonged operative time and increased surgical invasiveness have been shown to have a significant correlation with increased opioid consumption following upper extremity surgery.^{5,12} As such, hand surgeons should establish preoperative plans that minimize operative time and decrease surgical dissection whenever possible, especially in cases where difficult postoperative analgesia is expected.

Surgeons are encouraged to consult with anesthesia colleagues in selecting an approach that maximizes pain relief and minimizes both anesthetic risk and opioid exposure in the perioperative period.

Postoperative

When hand surgeons plan to prescribe opioids in the post-discharge period, the surgeon and allied health providers should educate the patient on the inherent risks of opioid therapy. This counseling should include the warning signs of opioid tolerance, the risks of opioid dependence and abuse, the potential morbidity and mortality associated with coinciding alcohol or sedative use, and the risk of opioid diversion by family or friends. As with preoperative counseling, patients should be reminded of the ultimate goal of rapid opioid cessation and cautioned that experiencing some pain in the postoperative period is normal.^{1,14} Last, patients should be given clear instructions on proper medication safekeeping as well as how to dispose of any excess opioids determined unnecessary for postoperative recovery.¹² This education is vital, but current research indicates that it is often overlooked. Kim et al. report that only 75 (5.3%) of 1416 patients undergoing hand and upper extremity surgery were provided with disposal instructions for unused prescription opioids from their physicians, nurses, or pharmacists.¹²

Prior to opioid prescribing, the care team should review prescription drug monitoring databases, if available.¹⁴ Surgeon use of these databases prior to prescribing has become required by law in some states, and this requirement may become more common in wake of the current administra-

tion declaring the opioid epidemic a national public health emergency.¹⁴ Although these databases may prove to be cumbersome, they provide an impartial opioid prescription history that may otherwise be unavailable and their proper utilization protects practicing surgeons from potential claims of negligence.

Universal precautions for opioid therapy established by Webster and Fine should be employed in all patients requiring opioid analgesics following upper extremity surgery. These precautions include: (1) assessing the patient for risk of opioid abuse; (2) selecting the most appropriate opioid therapy; (3) closely monitoring for efficacy and tolerability of opioid therapy and detection of possible aberrant behavior; and (4) determining an alternate therapeutic plan if abuse or addiction is detected, or in the event of analgesic failure.²⁰

Close postoperative monitoring is vital to opioid-sparing strategies in the postoperative period. Although difficult in a high volume practice, more frequent follow-up allows for decreased dispensing of opioids as well as closer observation of opioid consumption and aberrant behaviors. Aberrant behaviors in the postoperative setting include early refill requests, missed clinic appointments, treatment non-compliance, and reports of lost or stolen prescriptions.¹⁴ In addition to personal recognition of these behaviors, hand surgeons can utilize postoperative screening assessments that further evaluate for risk of aberrant behavior secondary to opioid misuse and abuse.¹⁴

Kim et al observed that 28.3% of their cohort did not consume any prescribed opioids in the postoperative period and 56.1% of patients voluntarily concluded opioid consumption prior to completing their prescribed course. Perhaps most importantly, only 11.0% of the 1416 patient cohort reported utilizing the entirety of their initial opioid prescription following surgery.¹² Hand surgeons should keep this in mind when postoperative patients report uncontrolled pain and further analgesic needs after completing their initial opioid prescription. This presentation should serve as a red flag, prompting surgeons to initiate a standardized opioid taper protocol with an aim to provide the lowest effective dose and shortest possible duration of analgesic therapy.¹⁴ Upper extremity surgeons should also integrate tamper-resistant opioid formulations into this postoperative opioid protocol, with the understanding that these formulations are limited in their ability curb opioid misuse when utilized in the absence of other opioid prescribing strategies previously described.²⁰

Hand surgeons should consult pain management specialists when treating patients with opioid tolerance or analgesic failure secondary to chronic opioid use in the acute postoperative period. When an upper extremity patient is determined to be high risk for opioid diversion, surgeons can utilize opioid contracts and urine drug screens to help monitor analgesic therapy compliance. Last, patients who cannot be successfully weaned from opioid analgesics

following surgery should be referred to a pain/addiction specialist for co-management or transfer of care.²⁰

Conclusion

Substantial pain introduced in upper extremity musculoskeletal surgery, limitations in current analgesics, detrimental effects of inadequate analgesia following surgery, and the growing understanding of opioid misuse and addiction amid the opioid crisis make the approach to perioperative pain control highly complex. The authors advise hand surgeons to utilize the strategies discussed in this review to assist in forming a unique, patient-specific analgesic regimen that attains adequate perioperative analgesia and successful postoperative opioid cessation while minimizing opioids dispensed into the community available for misuse and abuse.

Ethical Approval

This study was approved by our institutional review board.

Statement of Human and Animal Rights

This article does not contain any studies with human or animal subjects.

Statement of Informed Consent

Informed consent was not necessary as this article does not contain any studies with human subjects.

Declaration of Conflicting Interests

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