10-19-2016

A Prospective Evaluation of Opioid Utilization After Upper-Extremity Surgical Procedures: Identifying Consumption Patterns and Determining Prescribing Guidelines.

Nayoung Kim
Thomas Jefferson University, nayoung.kim@jefferson.edu

Jonas L. Matzon
Thomas Jefferson University, jonas.matzon@rothmaninstitute.com

Jack Abboudi
Thomas Jefferson University, jack.abboudi@jefferson.edu

Christopher M. Jones
Thomas Jefferson University, christopher.jones@rothmaninstitute.com

William Kirkpatrick
Thomas Jefferson University, william.kirkpatrick@jefferson.edu

See next page for additional authors

Authors
Nayoung Kim, Jonas L. Matzon, Jack Abboudi, Christopher M. Jones, William Kirkpatrick, Charles Leinberry, Frederic Liss, Kevin F F. Lutsky, Mark L. Wang, Mitchell Maltenfort, and Asif M Ilyas

THE ORTHOPAEDIC FORUM

A Prospective Evaluation of Opioid Utilization After Upper-Extremity Surgical Procedures: Identifying Consumption Patterns and Determining Prescribing Guidelines

Nayoung Kim, BS, Jonas L. Matzon, MD, Jack Abboudi, MD, Christopher Jones, MD, William Kirkpatrick, MD, Charles F. Leinberry, MD, Frederic E. Liss, MD, Kevin F. Lutsky, MD, Mark L. Wang, MD, PhD, Mitchell Maltenfort, PhD, and Asif M. Ilyas, MD

Investigation performed at the Rothman Institute at the Thomas Jefferson University, Philadelphia, Pennsylvania

Background: Although adequate management of postoperative pain with oral analgesics is an important aspect of surgical procedures, inadvertent overprescribing can lead to excess availability of opioids in the community for potential diversion. The purpose of our study was to prospectively evaluate opioid consumption following outpatient upper-extremity surgical procedures to determine opioid utilization patterns and to develop prescribing guidelines.

Methods: All patients undergoing outpatient upper-extremity surgical procedures over a consecutive 6-month period had the following prospective data collected: patient demographic characteristics, surgical details, anesthesia type, and opioid prescription and consumption patterns. Analysis of variance and post hoc comparisons were performed using t tests, with the p value for multiple pairwise tests adjusted by the Bonferroni correction.

Results: A total of 1,416 patients with a mean age of 56 years (range, 18 to 93 years) were included in the study. Surgeons prescribed a mean total of 24 pills, and patients reported consuming a mean total of 8.1 pills, resulting in a utilization rate of 34%. Patients undergoing soft-tissue procedures reported requiring fewer opioids (5.1 pills for 2.2 days) compared with fracture surgical procedures (13.0 pills for 4.5 days) or joint procedures (14.5 pills for 5.0 days) ($p < 0.001$). Patients who underwent wrist surgical procedures required a mean number of 7.5 pills for 3.1 days and those

continued

Peer review: This article was reviewed by the Editor-in-Chief and one Deputy Editor, and it underwent blinded review by two or more outside experts. It was also reviewed by an expert in methodology and statistics. The Deputy Editor reviewed each revision of the article, and it underwent a final review by the Editor-in-Chief prior to publication. Final corrections and clarifications occurred during one or more exchanges between the author(s) and copyeditors.

Disclosure: There was no external funding source for this investigation. The **Disclosure of Potential Conflicts of Interest** forms are provided with the online version of the article.

who underwent hand surgical procedures required a mean number of 7.7 pills for 2.9 days, compared with patients who underwent forearm or elbow surgical procedures (11.1 pills) and those who underwent upper arm or shoulder surgical procedures (22.0 pills) ($p < 0.01$). Procedure type, anatomic location, anesthesia type, age, and type of insurance were also all significantly associated with reported opioid consumption ($p < 0.001$).

Conclusions: In this large, prospective evaluation of postoperative opioid consumption, we found that patients are being prescribed approximately 3 times greater opioid medications than needed following upper-extremity surgical procedures. We have provided general prescribing guidelines, and we recommend that surgeons carefully examine their patients' opioid utilization and consider customizing their opioid prescriptions on the basis of anatomic location and procedure type to prescribe the optimal amount of opioids while avoiding dissemination of excess opioids.

Although effective postoperative pain control is important, the U.S. Centers for Disease Control and Prevention (CDC) has reported that there is a growing epidemic of prescription painkiller abuse[1]. In 2007 alone, there were 27,658 accidental deaths related to prescription opioid overdose[2]. Furthermore, according to the American Society of Consultant Pharmacists, millions of pounds of "leftover" prescriptions go unused in patients' medicine cabinets each year in the United States[3]. Many factors contribute to this problem, including an increasingly aggressive culture of pain management, a lack of prescribing guidelines for physicians, inconsistent perioperative utilization of local anesthetics, and inadequate disposal instructions for patients[4].

Orthopaedic surgical procedures pose a unique challenge and opportunity in safe pain management. Specifically, orthopaedic surgical procedures often result in greater postoperative pain than other surgical procedures because of the manipulation of musculoskeletal tissue[5]. Orthopaedic surgeons routinely prescribe opioids for postoperative pain management, yet little is known about the typical opioid requirements for various orthopaedic procedures. During a 2014 American Academy of Orthopaedic Surgeons (AAOS) symposium, it was recognized through an audience survey that most orthopaedic surgeons do not know how many pills to prescribe to their patients and/or how many pills their patients actually take[6]. This may result in inconsistent and often excessive opioid-prescribing patterns. A greater understanding of opioid consumption patterns can result in more optimal and safer prescribing habits by physicians and can decrease the risk for overprescribing and potential diversion or abuse.

The purpose of our study was to prospectively evaluate opioid consumption following outpatient upper-extremity surgical procedures. The goal was to determine opioid utilization patterns to help to develop prescribing guidelines.

Materials and Methods

After obtaining institutional review board approval, 9 hand surgery fellowship-trained, board-certified orthopaedic surgeons practicing in a single private academic group prospectively collected postoperative opioid consumption data for 6 consecutive months (in April 2014 to October 2014). Data were collected via a standardized intake form. The surgeons were not blinded, were asked to continue their normal prescribing patterns, and were aware that the patients would be asked about their opioid consumption postoperatively. Nicotine use information was not collected. On the day of the surgical procedure, the surgeon recorded the following variables on the intake form: the patient's age and sex, the procedure's anatomic location (hand or wrist, forearm or elbow, and upper arm or shoulder), the procedure type (soft-tissue surgical procedure, joint surgical procedure, or fracture surgical procedure), the anesthesia type (local, sedation, general, and/or regional), the opioid type prescribed, and the quantity of the opioid prescribed.

Patients were included if they had an outpatient surgical procedure of the hand, wrist, elbow, forearm, or shoulder. Patients undergoing inpatient procedures were excluded. At the first postoperative visit, the following data were solicited directly from the patient by a member of the research team and were added to the standardized intake form: the quantity of the prescribed opioid used, the total days of opioid use, the reason for discontinuation (the opioids no longer being necessary or the side effects associated with the opioids), and the side effects (if any). Finally, patients were asked if opioid disposal instructions were given to them at any point in time. A research team member collected the intake form, and the data were subsequently entered into a central database.

The opioids prescribed and studied in this study included 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. For the purposes of this study, each of these prescription opioid pills was treated as equivalent to the other.

The following surgical data were collected: the type of procedure and the type of anesthesia. The type of procedure was subcategorized as a soft-tissue procedure (i.e., carpal tunnel or trigger finger release), fracture procedure (i.e., any fracture reduction with internal fixation), or joint procedure (i.e., arthroscopy, arthrodesis, or arthroplasty). The types of anesthesia were divided into local anesthesia, local anesthesia with sedation, regional anesthesia with or without sedation, and general anesthesia. Finally, patient demographic characteristics, such as age, sex, and type of insurance, were also collected.

Statistical Analysis

The overall data were examined by descriptive statistics between the means. The mean number of pills used and the mean total number of days used were calculated on the basis of patient demographic characteristics (age, sex, and insurance type), procedure, anesthesia, injection, and volume of injection. The percentage of the total prescription used was calculated by dividing the number of pills taken by the total number of pills prescribed. Single-factor analysis of variance (ANOVA) was conducted to assess significance ($p < 0.05$) between the categorical variables and the continuous variables (number of pills and number of days). Post hoc comparisons were performed using

TABLE I Summary of Opioids Taken on the Basis of the Collected Variables

Category	No. of Patients	No. with Data on Pills	Mean No. of Pills Taken	No. with Data on Days	Mean No. of Days Pills Were Taken	Percentage of Pills Taken
Age group						
18 to 19 yr	20	20	12.7	20	5.0	57.3
20 to 29 yr	103	102	12.7	98	4.1	45.8
30 to 39 yr	120	120	13.4	111	4.9	47.3
40 to 49 yr	200	199	10.0	186	3.6	29.8
50 to 59 yr	335	329	8.4	302	3.2	27.7
60 to 69 yr	335	332	6.8	308	2.6	21.7
70 to 79 yr	215	212	4.6	198	2.1	19.9
80 to 89 yr	84	81	3.2	73	1.6	12.8
90 to 100 yr	4	4	12.8	4	4.8	43.3
Sex						
Female	777	769	7.9	712	2.9	25.8
Male	639	631	8.6	589	3.4	30.8
Insurance						
Private	910	900	8.1	840	4.7	27.9
Medicare	372	367	5.4	340	3.0	19.8
Automotive Association	10	10	13.1	10	4.6	45.3
Workers' Compensation	116	113	16.0	103	7.2	52
Self-pay or Medicaid	8	8	25.6	8	7.5	66
Procedure type						
Soft tissue	904	893	5.1	839	2.2	20.9
Fracture	260	257	13.0	243	4.5	39.4
Joint	252	242	14.5	252	5.0	46.4
Procedure location						
Hand	593	586	7.7	557	2.9	27
Wrist	658	651	7.5	600	3.1	27
Elbow or forearm	141	141	11.1	128	4.0	35
Upper arm or shoulder	24	23	22.0	14	6.0	56.6
Anesthesia*						
Local	286	285	4.5	250	2.0	16.3
Local with sedation	601	590	5.7	542	2.6	25
Regional	172	172	15.0	151	4.8	42.7
General	337	333	12.5	315	4.0	38.2

*Twenty patients did not undergo any anesthesia.

t tests, with the p value for multiple pairwise tests adjusted by the Bonferroni correction.

Results

A total of 1,416 patients (639 male patients and 777 female patients) with a mean age of 56 years (range, 18 to 93 years) were included (Table I). Surgeons prescribed a mean total of 24 pills (median, 20 pills [range, 0 to 110 pills]) per surgical procedure. Overall, the mean postoperative reported opioid consumption was 8.1 pills (median, 4 pills [range, 0 to 90 pills]) for a mean time of 3.1 days, resulting in a utilization rate of 34%.

Overall Opioid Consumption Pattern

Overall, 28.3% of patients did not take any of their prescribed medications. An additional 56.1% of patients voluntarily discontinued the use of their prescription prior to its completion. In contrast, 11.0% of patients completed the entirety of their prescription, and 0.6% were still taking their medication at the time of their first postoperative visit. Finally, 4.0% did not wish to participate and did not respond.

Opioid Consumption by Age

The mean reported number of opioid pills consumed was highest (13.4 pills) among patients in the age group of 30

TABLE II Most Common Surgical Procedures by Procedure Type

Procedure	No. of Patients	Mean No. of Pills Taken
Soft tissue		
Carpal tunnel release	380	4.2
Trigger finger release	155	3.8
Mass excision	95	4.7
Fracture		
Distal radial open reduction internal fixation	114	13.7
Metacarpal open reduction internal fixation	46	9.6
Finger pinning	23	8.1
Joint		
Implant removal	39	12.3
Carpometacarpal arthroplasty	31	21.5
Tendon repair	28	14.5

to 39 years ($p < 0.001$ according to ANOVA). Although the ANOVA and visual inspection of the graph make it clear that there is a real trend, pairwise tests between adjacent age groups (adjusted for 8 multiple comparisons) were only significant ($p = 0.03$) for the age groups of 60 to 69 years and 70 to 79 years. In fact, 47.3% of patients in the age groups of 30 to 39 years consumed their entire prescription. Subsequently, there was a decrease in opioid consumption in each successive age interval thereafter (from the ages of 40 to 89 years), with the lowest amount consumed in the age group of 80 to 89 years. There was a paradoxical increase in opioid consumption in the age group of 90 to 100 years, although this was a small sample group of only 4 patients (Fig. 1).

Patients in the age range of 30 to 39 years had the highest reported mean opioid consumption for both soft-tissue procedures, at 11.6 pills, and joint procedures, at 19.2 pills. Patients in the age group of 18 to 19 years who received treatment for fracture fixation reported the highest mean consumption, at 18.9 pills.

On the basis of the anatomic location, patients in the age group of 18 to 19 years reported the highest mean opioid consumption for hand and wrist procedures (12.8 pills) and for elbow and forearm procedures (19.7 pills). Patients in the age group of 50 to 59 years showed the highest opioid consumption (32.5 pills) for upper arm and shoulder procedures. Lastly, patients in the age group of 20 to 29 years reported the highest mean opioid consumption (13.8 pills) for hand and wrist procedures.

Opioid Consumption by Sex

Male patients reported taking a mean number of 8.6 pills for 3.4 days, whereas female patients reported taking a mean number of 7.9 pills for 2.9 days postoperatively (Fig. 2). There was no significance in opioid consumption based on sex ($p = 0.20$).

Opioid Consumption by Insurance

Based on insurance type, patients who self-pay or have Medicaid reported consuming the greatest amount of opioids, at a mean number of 25.6 pills ($p < 0.001$ according to ANOVA) for 7.5 days. Patients with Workers' Compensation reported consuming the next greatest amount, with a mean consumption of 16 pills for 7.2 days. Patients with private insurance carriers consumed a mean number of 8.1 pills for 4.7 days, and Medicare patients, traditionally representing patients who are ≥65 years of age, reported having consumed the least

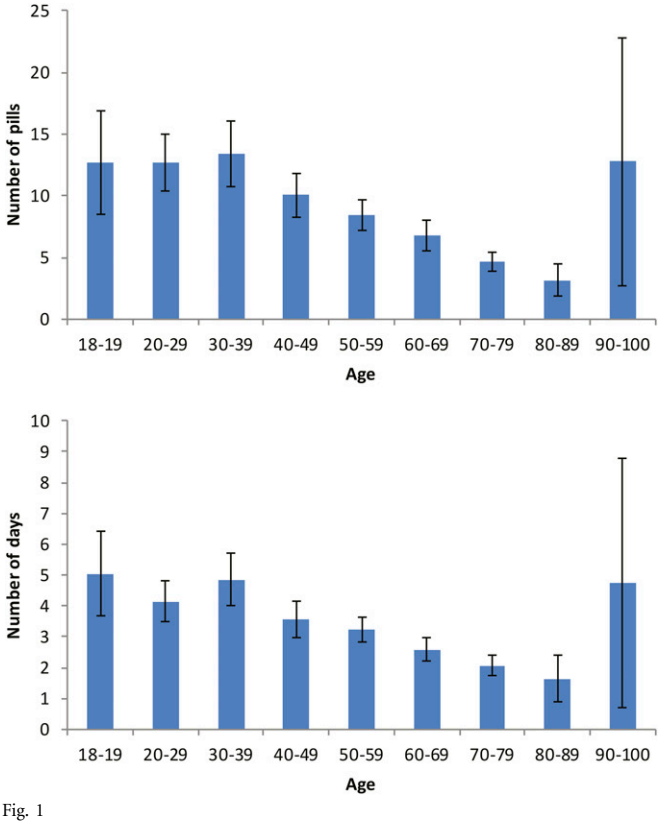


Fig. 1

The mean number of pills and days by age. The error bars indicate the standard deviation.

TABLE III Most Common Procedures by Anatomic Site

Procedure	No. of Patients	No. of Pills Taken
Hand		
Trigger finger release	155	3.8
Mass excision	58	4.3
Metacarpal open reduction internal fixation	46	9.6
Wrist		
Carpal tunnel release	380	4.2
Distal radial open reduction internal fixation	114	13.7
De Quervain tenosynovitis	40	7.9
Elbow or forearm		
Cubital tunnel release	42	8.9
Lateral epicondyle debridement	23	13.5
Distal biceps repair	13	11.1
Shoulder or upper arm		
Acromioplasty rotator cuff	7	21.4
Humeral open reduction internal fixation	4	53.5
Distal clavicle resection	2	31.0

amount, with a mean number of 5.4 pills for 3 days (Fig. 3). Post hoc comparisons between groups showed significant differences between patients with private insurance and those with Medicare ($p < 0.001$), between patients with private insurance and those with Workers' Compensation ($p < 0.001$), and between patients with Medicare and those with Workers' Compensation ($p < 0.001$).

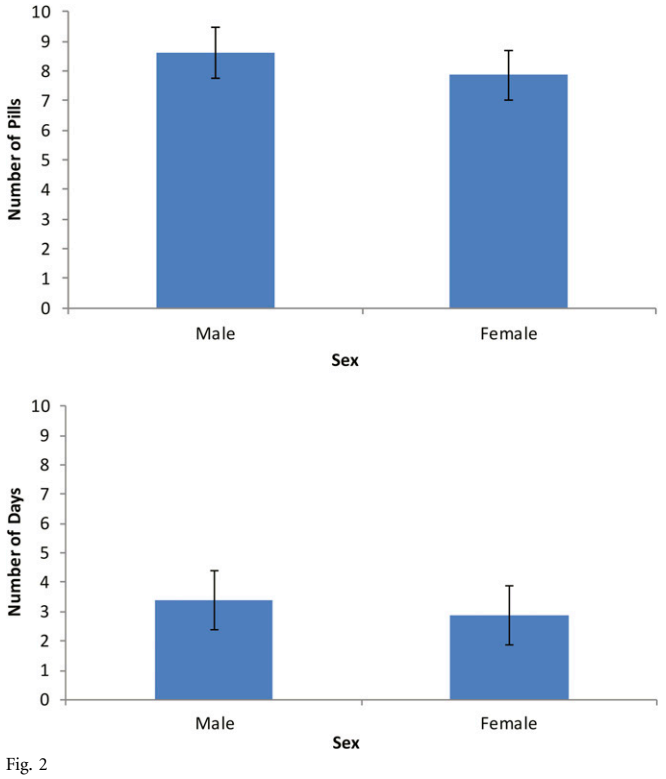


Fig. 2

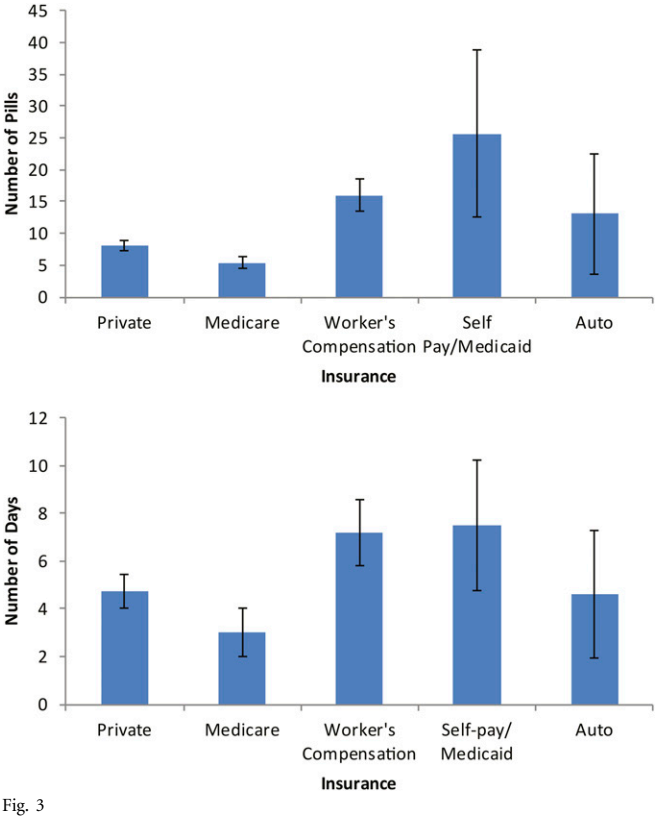
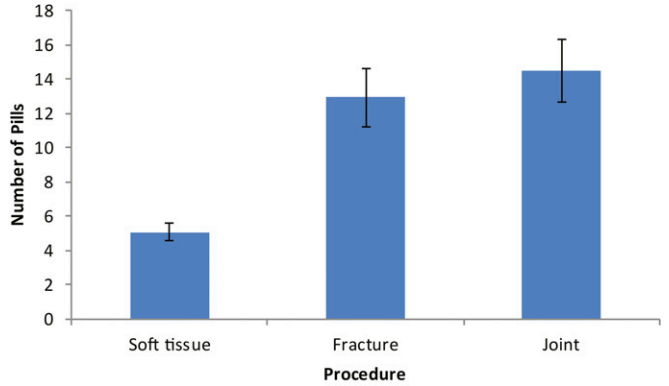
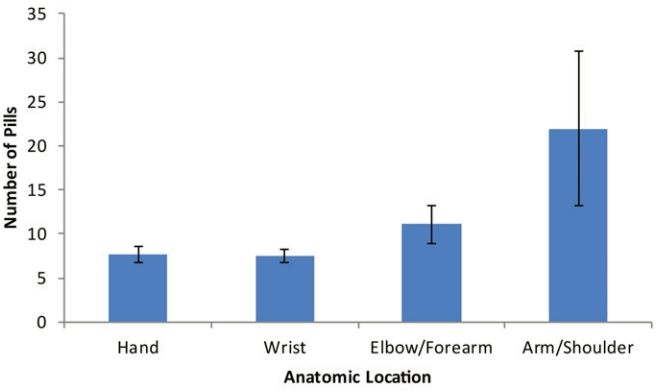
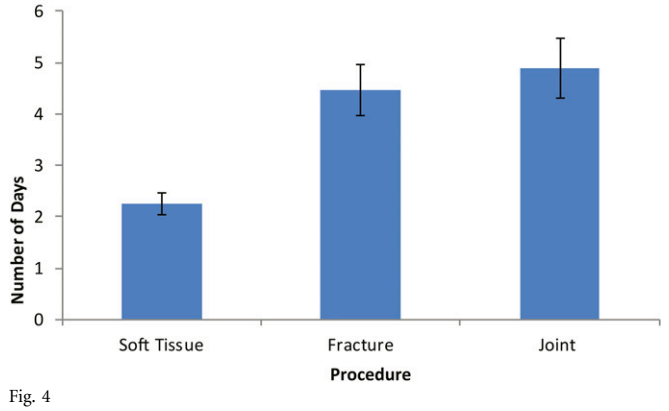


Fig. 3

Fig. 2 The mean number of pills and days by sex. The error bars indicate the standard deviation. **Fig. 3** The mean number of pills and days by insurance type. The error bars indicate the standard deviation. Auto = Automotive Association.







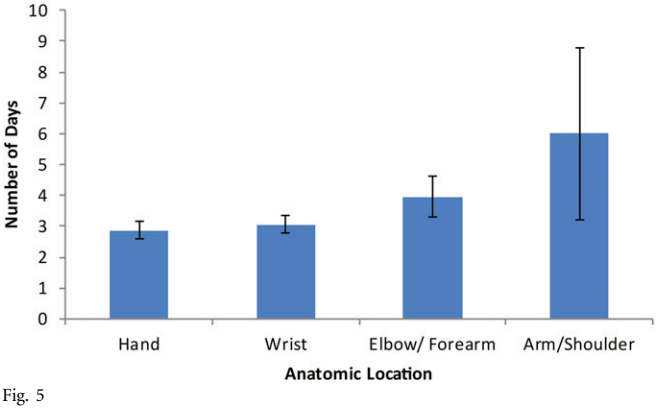


Fig. 4

Fig. 5

Fig. 4 The mean number of pills and days by procedure. The error bars indicate the standard deviation. **Fig. 5** The mean number of pills and days by anatomic location. The error bars indicate the standard deviation.

Opioid Consumption by Procedure Type

Patients who underwent soft-tissue procedures reportedly consumed the least amount of opioids postoperatively, with a mean number of 5.1 pills ($p < 0.001$, ANOVA) for 2.2 days, compared with those who underwent fracture procedures (13.0 pills for 4.5 days) or joint procedures (14.5 pills for 5.0 days) (Fig. 4). When compared with adjacent groups, there were significant differences between patients who underwent soft-tissue procedures and those who underwent fracture procedures ($p < 0.001$) and between patients who underwent soft-tissue procedures and those who underwent joint procedures ($p < 0.001$). The most common surgical procedures performed in these categories are listed in Table II.

Opioid Consumption by Anatomic Site

Patients who had undergone hand and wrist surgical procedures reported the least opioid consumption, with those who had undergone hand surgical procedures having a mean number of 7.7 pills for 2.9 days and those who had undergone wrist surgical procedures having a mean number of 7.5 pills for 3.1 days ($p < 0.001$). However, post hoc pairwise comparisons adjusted for 3 multiple comparisons showed significance for procedures on the wrist compared with those on the elbow ($p = 0.008$). Patients who had undergone upper arm and shoulder surgical procedures had the greatest mean reported opioid consumption with 22.0 pills for 6.0 days. Patients who had undergone elbow and forearm surgical procedures had a reported mean opioid consumption of 11.1 pills for 4.0 days (Fig. 5). The most common surgical procedures in these categories are listed in Table III.

Opioid Consumption by Anesthesia Type

Patients who had undergone surgical procedures with only local anesthesia reportedly consumed the fewest opioids ($p < 0.001$), at a mean number of 4.5 pills for 2.0 days, compared with patients who had undergone surgical procedures with anesthesia with sedation (5.7 pills for 2.6 days), those who had undergone surgical procedures with general anesthesia (12.5 pills for 4.0 days), and those who had undergone surgical procedures with regional anesthesia (15.0 pills for 4.8 days) (Fig. 6). When a post hoc pairwise comparison was used to compare adjacent groups (6 groups), all groups were found to be significant ($p < 0.001$), except when patients who underwent local anesthesia were compared with those who underwent local anesthesia with sedation ($p = 0.118$) and when patients who underwent regional anesthesia were compared with those who underwent general anesthesia ($p = 0.621$). However, it should be noted that patients typically undergoing general or regional anesthesia do so for more involved or painful surgical procedures such as fracture, joint, or upper arm

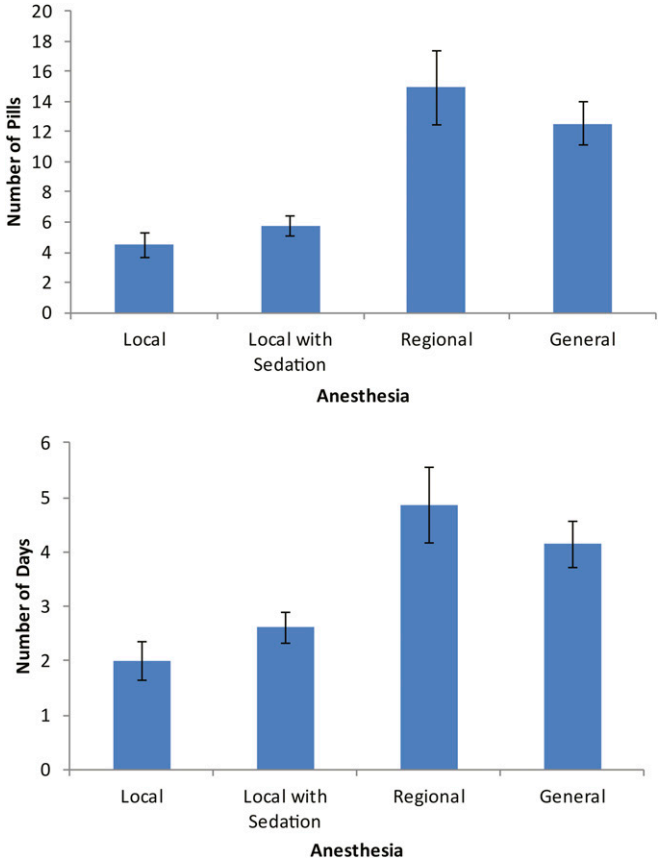


Fig. 6

The mean number of pills and days by anesthesia. The error bars indicate the standard deviation.

surgical procedures. Hence, the relationship between opioid consumption and anesthesia type is an inherently biased one.

Opioid Disposal Instructions

Only 5.3% of patients who filled their prescription received disposal information (n = 75). The sources of disposal information listed included the physician, recovery room nurses, and the pharmacy.

Discussion

There is a growing epidemic in the United States involving the misuse of prescription opioids. In 2013, *The Journal of the American Medicine Association* reported that there had been 38,329 drug overdose deaths in the United States in 2010, and 75.2% of these deaths involved prescription opioids[7]. Americans, who make up 4.6% of the world's population, consume 80% of the global opioid supply[8]. As the United States reports substantial opioid abuse, the number of opioid-related deaths continues to grow internationally with increasing availability of opioids[9]. A Global Burden of Diseases, Injuries, and Risk Factors Study found that there were an estimated 43,000 deaths worldwide in 2010 due to opioid abuse[10].

Several studies have shown that opioids are being inadvertently overprescribed to patients postoperatively across all specialties, but especially in orthopaedic surgical procedures[3,4,11]. Stanek et al.[12] studied opioid-prescribing patterns by implementing a new prescribing protocol for patients undergoing common upper-extremity surgical procedures. An educational card with a multimodal pain management plan was given to participating physicians with specific opioid recommendations. No narcotics were recommended for small procedures such as Mohs excisions, trigger finger releases, or retinacular cyst, nevi, lump, or bump excision. Ten narcotic pills were recommended for small procedures such as mucous cyst excisions, carpal tunnel releases, de Quervain releases, Dupuytren excisions, nonoperative hand fractures, and small joint arthrodeses. Twenty narcotic pills were recommended for wrist ganglion excisions, hand fracture fixation, basal joint arthroplasty, and tendon surgical procedures. Finally, 40 narcotic pills were recommended for larger surgical procedures such as wrist arthrodeses and reconstructions[12]. After implementing the new protocol, Stanek et al. found a decrease in opioid prescribing of 15% for trigger finger release, 20% for metacarpal fracture repair, 48% for wrist cyst excision, and 39% for de Quervain release[12].

In a study of 250 patients, Rodgers et al. evaluated patient pain control after elective outpatient upper-extremity surgical procedures and quantified the number of leftover pain medications up to 14 days postoperatively[11]. The authors found that bone procedures resulted in the greatest opioid consumption (14 pills) and soft-tissue procedures had the lowest consumption (9 pills). Overall, a mean of 10 opioid pills were consumed per patient, and 19 pills were left unused and available for potential abuse[11]. Similar results were found in our study, in which only 11.0% of 1,416 patients completed the entirety of their prescription. Moreover, surgeons in our series prescribed a mean number of 24 pills, but the reported mean postoperative consumption was only 8.1 pills, resulting in a utilization rate of 34%. The result was that 66% of the prescription was available for potential diversion or abuse. In fact, during our study period alone, with 9 surgeons over 6 months, a total of 21,788 theoretically unused prescribed opioid pills was delivered into the community. Results from the 2010 National Survey on Drug Use and Health showed that about 5.1 million drug users (of 22.6 million illicit drug users) used prescription pain relievers; only 1 in 6 or 17.3% recorded that they had received the drugs through a prescription from their doctor[13].

One of the challenges of excess opioid prescribing is safe disposal. Per the U.S. Food and Drug Administration (FDA), certain opioids can be flushed away, but others require deliberate elimination[14]. The FDA currently recommends that opioids be disposed of via pharmacy or community take-back programs or by mixing them in the household trash with substances such as coffee grounds or cat litter in a sealed bag. A complete list of which medicines can be flushed away is available on the FDA web site [14]. However, the U.S. Environmental Protection Agency (EPA) discourages flushing any medications away to avoid contamination of the water supply[15]. Unfortunately, unclear opioid disposal practices were

found to be common in our study population. Only 5.3% of the 1,416 patients received any disposal information for excess opioids from their physician, nurses, or pharmacists. McCauley et al. similarly reported findings from a web-based intervention study that was designed to improve patient knowledge of safe medication use, storage, and disposal[16]. Of 62 patients, they found that one-third were unaware of the unsafe nature of retained leftover opioid pills and almost half of their cohort did not know where to or how to properly dispose of prescription opioids[16]. In our cohort, 94% of patients did not receive safe disposal information. Medical staff should be more aware and vigilant in properly educating patients on safe disposal of excess opioid medication.

Patients undergoing orthopaedic surgical procedures have been shown to have higher pain postoperatively compared with those undergoing surgical procedures in other specialties[17-19]. Ringwalt et al. found that orthopaedic surgeons have the highest odds (7.1 to 1) of prescribing opioids to Medicare patients compared with other medical providers, such as dentists or emergency medicine physicians[20]. Yet it has been shown that orthopaedic surgeons have the highest patient return rate to the hospital for persistent postoperative pain[21]. Our findings support these facts, as the study surgeons were routinely prescribing in excess of their patients' needs and utilization. Upon informally surveying the participating surgeons, the most common reasons given for prescribing the amount that they did were to avoid undermanaging postoperative pain, to minimize patient calls, and to limit hospital readmissions. However, this "defensive" overprescribing increases the number of opioids in the community available for potential diversion or abuse. Based on our series, risk factors for increased opioid consumption include younger age (patients in the age group of 30 to 39 years consumed the greatest opioids), certain insurance types (self-pay, Medicaid, and Workers' Compensation), fracture or joint surgical procedures, and surgical procedures involving the upper arm.

Opioid consumption was found to be most strongly statistically related to procedure type and anatomic location. Therefore, based on our study findings, we recommend that surgeons consider these general guidelines for prescribing opioids postoperatively after outpatient upper-extremity surgical procedures to optimize the number of opioids dispensed: ≤10 opioids for hand and wrist soft-tissue surgical procedures, ≤20 opioids for hand and wrist fracture or joint surgical procedures, ≤15 opioids for elbow and forearm soft-tissue surgical procedures, ≤20 opioids for elbow and forearm fracture or joint surgical procedures, and ≤30 opioids for upper arm and shoulder surgical procedures.

There were some limitations to this study. First, because of the subjective nature of patient recall, some patients may have overestimated or may have underestimated the number of pills and/or number of days that the opioid was used. Furthermore, our study included all patients who were undergoing an upper-extremity procedure, and therefore, it may have included patients with chronic pain who were currently taking opioids and had a predisposed tolerance for opioids. In addition, information on preoperative nicotine use was not collected. Nicotine can potentially affect postoperative opioid consumption and pain experience. Lastly, a few patients did not fill out the entirety of the survey, thereby potentially skewing the results (specifically, of 1,416 enrolled patients, 16 patients did not report the total number of pills used, 115 patients did not report the total number of days that the pills were taken, and 56 patients did not report the reason for discontinuation).

In conclusion, the pattern of prescribing high volumes of opioid pills is a common practice among orthopaedic surgeons. Overprescribing delivers excess opioids into the community, leaving them vulnerable to potential diversion or abuse. To avoid overprescribing opioids and to limit potential abuse, surgeons should consider the patient's preoperative opioid experience and should establish prescribing standards on a case-by-case basis depending on the nature and location of the surgical procedure, the type of anesthesia, and the age of the patient. ■

Nayoung Kim, BS[1]
Jonas L. Matzon, MD[1]
Jack Abboudi, MD[1]
Christopher Jones, MD[1]
William Kirkpatrick, MD[1]
Charles F. Leinberry, MD[1]
Frederic E. Liss, MD[1]
Kevin F. Lutsky, MD[1]
Mark L. Wang, MD, PhD[1]
Mitchell Maltenfort, PhD[1]
Asif M. Ilyas, MD[1]

[1]Rothman Institute at the Thomas Jefferson University, Philadelphia, Pennsylvania

E-mail address for A.M. Ilyas: asif.ilyas@rothmaninstitute.com

References

1. Centers for Disease Control and Prevention, National Center for Injury Prevention and Control, Division of Unintentional Injury Prevention. Policy impact: prescription painkiller overdoses. 2011 Nov. http://www.cdc.gov/drugoverdose/pdf/policyimpact-prescriptionpainkillerod-a.pdf. Accessed 2016 Feb 1.
2. Okie S. A flood of opioids, a rising tide of deaths. N Engl J Med. 2010 Nov 18;363(21):1981-5.
3. Shrank WH. Our bulging medicine cabinets—the other side of medication nonadherence. N Engl J Med. 2011 Apr 28;364(17):1591-3.
4. Bates C, Laciak R, Southwick A, Bishoff J. Overprescription of postoperative narcotics: a look at postoperative pain medication delivery, consumption and disposal in urological practice. J Urol. 2011 Feb;185(2):551-5. Epub 2010 Dec 18.
5. Pasero C, McCaffery M. Orthopaedic postoperative pain management. J Perianesth Nurs. 2007 Jun;22(3):160-72, quiz: 172-3.
6. Stanton T. Symposium addresses pain management in the opioid epidemic. AAOS Now. 2014 Apr.
7. Jones CM, Mack KA, Paulozzi LJ. Pharmaceutical overdose deaths, United States, 2010. JAMA. 2013 Feb 20;309(7):657-9.
8. Manchikanti L, Singh A. Therapeutic opioids: a ten-year perspective on the complexities and complications of the escalating use, abuse, and nonmedical use of opioids. Pain Physician. 2008 Mar;11(2)(Suppl):S63-88.
9. Giraudon I, Lowitz K, Dargan PI, Wood DM, Dart RC. Prescription opioid abuse in the UK. Br J Clin Pharmacol. 2013 Nov;76(5):823-4.

10. Lozano R, Naghavi M, Foreman K, Lim S, Shibuya K, Aboyans V, Abraham J, Adair T, Aggarwal R, Ahn SY, Alvarado M, Anderson HR, Anderson LM, Andrews KG, Atkinson C, Baddour LM, Barker-Collo S, Bartels DH, Bell ML, Benjamin EJ, Bennett D, Bhalla K, Bikbov B, Bin Abdulhak A, Birbeck G, Blyth F, Bolliger I, Boufous S, Bucello C, Burch M, Burney P, Carapetis J, Chen H, Chou D, Chugh SS, Coffeng LE, Colan SD, Colquhoun S, Colson KE, Condon J, Connor MD, Cooper LT, Corriere M, Cortinovis M, de Vaccaro KC, Couser W, Cowie BC, Criqui MH, Cross M, Dabhadkar KC, Dahodwala N, De Leo D, Degenhardt L, Delossantos A, Denenberg J, Des Jarlais DC, Dharmaratne SD, Dorsey ER, Driscoll T, Duber H, Ebel B, Erwin PJ, Espindola P, Ezzati M, Feigin V, Flaxman AD, Forouzanfar MH, Fowkes FG, Franklin R, Fransen M, Freeman MK, Gabriel SE, Gakidou E, Gaspari F, Gillum RF, Gonzalez-Medina D, Halasa YA, Haring D, Harrison JE, Havmoeller R, Hay RJ, Hoen B, Hotez PJ, Hoy D, Jacobsen KH, James SL, Jasrasaria R, Jayaraman S, Johns N, Karthikeyan G, Kassebaum N, Keren A, Khoo JP, Knowlton LM, Kobusingye O, Koranteng A, Krishnamurthi R, Lipnick M, Lipshultz SE, Ohno SL, Mabweijano J, MacIntyre MF, Mallinger L, March L, Marks GB, Marks R, Matsumori A, Matzopoulos R, Mayosi BM, McAnulty JH, McDermott MM, McGrath J, Mensah GA, Merriman TR, Michaud C, Miller M, Miller TR, Mock C, Mocumbi AO, Mokdad AA, Moran A, Mulholland K, Nair MN, Naldi L, Narayan KM, Nasseri K, Norman P, O'Donnell M, Omer SB, Ortblad K, Osborne R, Ozgediz D, Pahari B, Pandian JD, Rivero AP, Padilla RP, Perez-Ruiz F, Perico N, Phillips D, Pierce K, Pope CA 3rd, Porrini E, Pourmalek F, Raju M, Ranganathan D, Rehm JT, Rein DB, Remuzzi G, Rivara FP, Roberts T, De León FR, Rosenfeld LC, Rushton L, Sacco RL, Salomon JA, Sampson U, Sanman E, Schwebel DC, Segui-Gomez M, Shepard DS, Singh D, Singleton J, Sliwa K, Smith E, Steer A, Taylor JA, Thomas B, Tleyjeh IM, Towbin JA, Truelsen T, Undurraga EA, Venketasubramanian N, Vijayakumar L, Vos T, Wagner GR, Wang M, Wang W, Watt K, Weinstock MA, Weintraub R, Wilkinson JD, Woolf AD, Wulf S, Yeh PH, Yip P, Zabetian A, Zheng ZJ, Lopez AD, Murray CJ. Global and regional mortality from 235 causes of death for 20 age groups in 1990 and 2010: a systematic analysis for the Global Burden of Disease Study 2010. Lancet. 2012 Dec 15;380(9859):2095-128.

11. Rodgers J, Cunningham K, Fitzgerald K, Finnerty E. Opioid consumption following outpatient upper extremity surgery. J Hand Surg Am. 2012 Apr;37(4):645-50. Epub 2012 Mar 10.

12. Stanek JJ, Renslow MA, Kalliainen LK. The effect of an educational program on opioid prescription patterns in hand surgery: a quality improvement program. J Hand Surg Am. 2015 Feb;40(2):341-6. Epub 2014 Dec 24.

13. Manchikanti L, Helm S 2nd, Fellows B, Janata JW, Pampati V, Grider JS, Boswell MV. Opioid epidemic in the United States. Pain Physician. 2012 Jul;15(3)(Suppl): ES9-38.

14. U.S. Food and Drug Administration. Disposal of unused medicines: what you should know. 2015 Oct. http://www.fda.gov/Drugs/ResourcesForYou/Consumers/BuyingUsingMedicineSafely/EnsuringSafeUseofMedicine/SafeDisposalofMedicines/ucm186187.htm. Accessed 2016 Feb 1.

15. Lin AY, Wang XH, Lin CF. Impact of wastewaters and hospital effluents on the occurrence of controlled substances in surface waters. Chemosphere. 2010 Oct;81(5):562-70. Epub 2010 Sep 20.

16. McCauley JL, Back SE, Brady KT. Pilot of a brief, web-based educational intervention targeting safe storage and disposal of prescription opioids. Addict Behav. 2013 Jun;38(6):2230-5. Epub 2013 Feb 4.

17. Chung F, Ritchie E, Su J. Postoperative pain in ambulatory surgery. Anesth Analg. 1997 Oct;85(4):808-16.

18. McGrath B, Elgendy H, Chung F, Kamming D, Curti B, King S. Thirty percent of patients have moderate to severe pain 24 hr after ambulatory surgery: a survey of 5,703 patients. Can J Anaesth. 2004 Nov;51(9):886-91.

19. Brunton LM, Laporte DM. Use of opioids in hand surgery. J Hand Surg Am. 2009 Oct;34(8):1551-4. Epub 2009 Jun 12.

20. Ringwalt C, Gugelmann H, Garrettson M, Dasgupta N, Chung AE, Proescholdbell SK, Skinner AC. Differential prescribing of opioid analgesics according to physician specialty for Medicaid patients with chronic noncancer pain diagnoses. Pain Res Manag. 2014 Jul-Aug;19(4):179-85. Epub 2014 May 7.

21. Coley KC, Williams BA, DaPos SV, Chen C, Smith RB. Retrospective evaluation of unanticipated admissions and readmissions after same day surgery and associated costs. J Clin Anesth. 2002 Aug;14(5):349-53.