European Journal of Orthopaedic Surgery & Traumatology (2022) 32:237–242
https://doi.org/10.1007/s00590-021-02951-z

ORIGINAL ARTICLE

The effect of the orthopaedic trauma association's (OTA) pain management guidelines on opioid prescriptions, pain control, and refills in outpatient orthopaedic trauma surgery

Lori Chambers[1] · **Johnna Jaynstein**[1] · **Joshua A. Parry**[1] · **Cyril Mauffrey**[1]

Received: 17 September 2020 / Accepted: 21 March 2021 / Published online: 30 March 2021

Abstract

Purpose To determine the effect of the Orthopaedic Trauma Association (OTA) pain management guidelines for acute musculoskeletal injuries on opioid prescription sizes, pain control, and refills.

Methods A prospective cohort study was performed at an academic urban level 1 trauma center. 90 patients undergoing outpatient orthopaedic trauma surgery were enrolled before and after the implementation of the OTA pain management guidelines. Adherence to guidelines, pain visual analog scale, and refills were recorded postoperatively and at the 2- and 6-week follow-up visit.

Results After implementation of the guidelines, the number of patients receiving oxycodone decreased from 100 to 27%, with these patients receiving the less potent hydrocodone, instead. The discharge morphine equivalent dose (MED) decreased from a median (interquartile range) of 225 (169–300) to 140 mg (140–210) ($p < 0.001$). More patients required refills in the guidelines group (42% vs. 20%), resulting in no difference in total MED prescribed (210 (140–280) vs. 225 (169–307)). Adherence to the guidelines occurred in 66% of patients. As-treated analysis of patients with adherent and non-adherent prescriptions found no detectable difference in pain control, number of opioid pills used, or refills at the 2-week and 6-week follow-up.

Conclusions In the midst of a national opioid crisis, adoption of the OTA's pain management guidelines for orthopaedic trauma surgery warrants further research to determine if it's implementation can reduce the size, variability, and duration of opioid prescriptions.

Level of evidence Level II, prospective cohort.

Keywords Opioids · Pain management guidelines · Orthopaedic trauma association · OTA · Opioid guidelines · Outpatient orthopaedic surgery

Introduction

The United States is currently facing an epidemic of opioid overdose deaths, which have increased by more 200% since the year 2000 [1]. This epidemic has been fueled by prescription opioid pain medications—medications for which orthopaedic surgeons are responsible for prescribing a large proportion of in the United States [2]. In light of this, the adoption of pain guidelines that decreases opioid prescription sizes and durations is an important first step in combating the opioid crisis [2]. Multiple studies have shown that postoperative opioid prescriptions after orthopaedic surgeries are highly variable and often excessive [1, 3, 4]. Our department previously performed a review of our own opioid prescribing practices, and found that discharge opioid prescription varied widely among similar surgeries with little difference between major and minor procedures [5]. The implementation of opioid prescribing guidelines has been shown to effectively standardize and reduce the volume of opioid prescriptions across multiple sub-specialties, however this data are currently lacking in the orthopaedic trauma literature [6, 7]. In 2019, an Orthopaedic Trauma Association (OTA) multi-disciplinary task force developed pain management guidelines for acute musculoskeletal injuries [8]. The purpose of this study was to prospectively monitor opioid prescriptions, pain control, and refills before and

✉ Joshua A. Parry
Joshua.alan.parry@gmail.com

[1] Department of Orthopedics, Denver Health Medical Center, 777 Bannock St, Denver, CO MC 0188, USA

after the implementation of these guidelines to determine if it successfully increased non-opioid prescriptions, decreased opioid prescription sizes, while not adversely affecting pain control or refill rates.

Materials and methods

After institutional review board approval, we prospectively enrolled consecutive consenting adult patients receiving outpatient orthopaedic trauma surgery over the course of 4 months before and after our department's implementation of the OTA's pain management guidelines. Patients that were chronic daily users of opioids (including tramadol) and those with less than 6 weeks of follow-up were excluded from the study. After implementation, a clinical research assistant educated consenting patients on the guidelines (Table 1) and answered all questions that patients had regarding them.

All surgeries were classified as major or minor as determined by the OTA pain management guidelines [8]. Major surgeries including complex peri-articular fractures, long bone fractures, and extensive soft tissue procedures, while minor surgeries including simple articular fractures, small bone fractures, or minimal soft tissue procedures.

Patients were surveyed preoperatively, at 2-week follow-up, and at 6-week follow-up. Preoperatively patients completed a survey including a pain visual analog score (VAS) and preoperative pain medication use. Patients were classified as either opioid naïve (no opioids in the last 6 months) or experienced (irregular opioid use during the last 6 months).

Postoperatively anesthetic blocks, discharge pain medication, and pain VAS were documented along with adherence of discharge prescriptions with the OTA guidelines. At the 2- and 6-week postoperative clinic visits, patients completed a survey that asked their pain VAS, if their pain had been controlled since surgery, if they were still using opioids, the number of opioids pills they had left, if they had required a refill, and the number of refills. The discharge morphine equivalent dose (MED), refill MED, and total MED prescribed were calculated.

A sample size calculation was performed based on our prior retrospective study [5]. To detect the observed difference of 130 MED in discharge prescriptions with a standard deviation of 200 MED for a two-sided test with an alpha level of 0.05 and a power of 0.8, 77 patients would be required. To account for a patient drop-out rate of 15%, we planned to enroll 90 patients.

Parametric and nonparametric statistical tests were used depending on the presence of non-normally distributed data as determined by the Shapiro-Wilks test. In this study, all continuous data collected were found to be non-normally distributed and is therefore presented as the median and interquartile range (IQR). Kruskal–Wallis test was used to compare nonparametric continuous variable data across groups. Wilcoxon Rank Sum test was used to compare nonparametric continuous data between specific groups. Fishers exact test was used to evaluate differences between categorical data. Variables associated with opioid refills at two weeks with a *P*-value less than 0.1 on univariate analysis were included in a stepwise backward logistic regression analysis. A *P*-value less than 0.05 was considered statistically significant. All analyses were carried out using JMP Pro version 14 statistical software (SAS; Cary, NC).

Table 1 The Orthopaedic trauma association's (OTA) pain management guidelines for major and minor surgeries

Status	Major surgery	Minor surgery
Post-discharge	**Oxycodone**/acetaminophen (5 mg/325 mg) 1 tab po **q 4 h PRN, #42 tabs**	**Hydrocodone**/acetaminophen (5 mg/325 mg) 1 tab po **q 6 h PRN, #28 tabs**
	Ibuprofen 600 mg po q 8 h × 7 d	Ibuprofen 600 mg po q 8 h × 7 d
	Gabapentin 100 mg po TID × 7 days	Gabapentin 100 mg 1 tab po TID × 7 days
	Scheduled acetaminophen **500 mg** po q12 h × **4 weeks** (can increase as combined opioid analgesic decreases)	Scheduled acetaminophen **1000 mg** po q12 h × **3 weeks** (can increase as combined opioid analgesic decreases)
Week 2	Refill opioid 1 tab po **q 4 h PRN, #42 tabs**	Refill opioid 1 tab po **q 8 h PRN, #21 tabs**
Week 3	Refill opioid 1 tab po **q 6 h PRN, #28 tabs**	Refill opioid 1 tab po **q 12 h PRN, #14 tabs**
Week 4	Refill opioid 1 tab po **q 6 h PRN, #21 tabs**	**No further opioid prescriptions**
		Ibuprofen and acetaminophen PRN as directed
Week 5	**No further opioid prescriptions**	
	Ibuprofen and acetaminophen PRN as directed	

Bolded words signify differences between major and minor surgeries

(*PRN* pr re nata, "as needed"; *TID* ter in die, "three timer per day"; *PO* per oral, "by mouth")

Results

Group differences

45 patients were enrolled before and after the planned implementation of the OTA pain management guidelines. There were 4 patients from the pre-guidelines group that were lost to follow-up and were excluded, leaving 86 patients for the analysis.

There were 12 major procedures, including open reduction and internal fixation (ORIF) of fractures of the calcaneus, humeral shaft, patella, tibial pilon, proximal humerus, and tibial plateau, quadricep tendon repair, and debridement of extensive soft-tissue lower extremity injuries/infections. There were 74 minor procedures included ORIF of fractures of the ankle, olecranon, tarsals, metatarsals, radius, and ulnar shaft fractures, debridement of limited soft-tissue injuries/infections, and implant removals.

The was no detectable difference between pre-guidelines and guidelines groups in terms of age, gender, ASA score, preoperative pain scores, surgical severity, prior opioid exposure, marijuana use, or perioperative anesthetic block (Table 2).

After implementation of the guidelines the use of non-opioid pain medications increased, including NSAIDs, acetaminophen, and gabapentin, while the number of patients receiving oxycodone decreased from 100 to 27%, with patients receiving the less potent opioid hydrocodone instead (Table 2). The guidelines groups had a lower median (interquartile range) discharge MED (140 mg (140–210) vs. 225 mg (169–300) ($p < 0.001$)), more patients requiring refills by two weeks (42% vs. 20%), but no difference in refill MED or total MED (discharge + refill MED).

On review of discharge prescriptions only 30 (66%) of the 45 patients were given prescriptions that were adherent to the guidelines. Due to the 44% lack of adherence and the similar refill and total MED between groups, an as-treated analysis of patients given prescriptions adherent and non-adherent to the guidelines was performed (Table 3). The adherent and non-adherent groups had no detectable difference in pain VAS, pain control, opioid use, or refills at the two- and six-week follow-up.

Variables associated with opioid refill prescriptions at 2 weeks

Variables associated with opioid refill on univariate analysis included opioid experienced hosts, increased preoperative pain VAS, receiving an anesthetic block, and not receiving an oxycodone prescription (Table 4).

Table 2 Comparison of patients treated before and after the adoption of the pain management guidelines

	Pre-Guidelines group ($n=41$)	Guidelines group ($n=45$)	Difference, 95% CI	*P*-value
Age	34 (27–48)	40 (30–55)	4, − 2 to 10	0.1
Male gender	27 (66%)	25 (56%)	− 10%, − 30 to 10%	0.3
ASA > 1	34 (83%)	38 (84%)	1%, − 14 to 17%	1
Major surgical class	6 (13%)	6 (15%)	1%, − 14 to 16%	1
Opioid experienced	24 (59%)	25 (56%)	− 3%, − 23 to 18%	0.8
Pre-Op VAS	5 (2–7)	4 (2–7)	0, − 1 to 1	0.7
Pre-Op daily MED in the opioid experienced	30 (25–45)	30 (20–30)	0, − 15 to 0	0.2
Anesthetic block	39 (87%)	35 (85%)	− 1%, − 16 to 14%	1
Oxycodone prescribed	41 (100%)	11 (27%)	− 73%, − 84 to − 55%	**< 0.001**
NSAIDs prescribed	15 (38%)	35 (80%)	42%, 21–59%	**< 0.001**
Gabapentin prescribed	1 (2%)	30 (67%)	64%, 46–76%	**< 0.001**
Discharge MED	225 (169–300)	140 (140 to 210)	− 60, − 85 to − 15	**< 0.001**
Refill at 2 weeks	8 (20%)	19 (42%)	− 22%, − 40 to − 3%	**0.03**
Refill at 6 weeks	1 (2%)	1 (2%)	0%, − 9 to 8%	1.0
Refill MED	150 (126–221)	105 (105 to 145)	− 25, − 105 to 15	0.1
Total MED (Discharge + Refills)	225 (169–307)	210 (140 to 280)	− 20, − 85 to 20	0.1
Adherence to guidelines	0 (0%)	30 (67%)	− 67%, − 78 to − 49%	**< 0.0001**

All continuous variables are presented as median (interquartile range)

CI confidence interval, *ASA* American society of anesthesiologists score, *VAS* visual analog scale, *MED* morphine equivalent dose, *NSAIDs* non-steroidal anti-inflammatory drugs

P-values less than 0.05 were considered statistically significant

Table 3 As-treated analysis at 2- and 6-week follow-up comparing patients given prescriptions that were non-adherent or adherent to the pain management guidelines

	Non-adherent group ($n=56$)	Adherent group ($n=30$)	Difference, 95% CI	*P*-value
2-week follow-up				
Pain VAS	3 (1–5)	3 (2–4)	0, − 1 to 1	0.6
Pain controlled since surgery?	38 (69%)	21 (78%)	− 9%, − 27 to 12%	0.4
Taking opioids?	51 (93%)	24 (89%)	4%, − 10 to 20%	0.6
# Opioids left	4 (0 to 10)	6 (0–11)	0, − 2 to 3	0.8
Refill?	15 (27%)	12 (40%)	− 13%, − 34 to 8%	0.2
Refill MED	135 (105–210)	105 (105–140)	− 10, − 70 to 15	0.2
6 week follow-up				
Pain VAS	3 (1–5)	3 (1–4)	0, − 1 to 1	0.4
Pain controlled since surgery?	42 (79%)	20 (80%)	− 1%, − 18 to 19%	8
Taking opioids	7 (13%)	4 (17%)	− 3%, − 22 to 13%	0.7
# Opioids left	1 (0–8)	0 (0–7)	0, − 2 to 0	0.4
Refill?	2 (4%)	0 (0%)	4%, − 8 to 11%	1
Refill MED	187 (150–225)			

All continuous variables are presented as median (interquartile range)

CI confidence interval, *ASA* American society of anesthesiologists score, *VAS* visual analog scale, *MED* morphine equivalent dose, *NSAIDs* non-steroidal anti-inflammatory drugs

P-values less than 0.05 were considered statistically significant

Table 4 Analysis of variables associated with opioid refill within 2 weeks of surgery

	Refill ($n=27$)	No refill ($n=59$)	Difference, 95% CI	Univariate *P*-value	Multivariate *P*-value	Multivariate Odds ratio, 95% CI
Age	36 (32–57)	38 (27–48)	− 3, − 10 to 4	0.3		
Male gender	14 (54%)	34 (62%)	− 7, − 29 to 15%	0.6		
Adherent to pain guidelines	12 (44%)	18 (31%)	14%, − 8 to 35%	0.2		
Major surgical class	4 (15%)	8 (14%)	1%, − 13 to 19%	1		
Opioid experienced	20 (74%)	29 (49%)	25%, 3–44%	**0.03**	**0.03**	**4.1 (1.1–15)**
Pre-Op VAS	6 (5–8)	3 (1–6)	3, 1–4	**0.003**	**0.0006**	**1.5 (1.2–1.9)**
Anesthetic block	27 (100%)	47 (80%)	20%, 5–30%	**0.01**	NS	
ASA > 1	24 (89%)	48 (81%)	8%, − 10 to 22%	0.5		
Oxycodone prescribed (vs. Hydrocodone)	12 (46%)	40 (71%)	− 25%, − 46 to − 2%	**0.04**	**0.01**	**0.2 (0.07–0.7)**
Discharge MED	145 (140–229)	187 (140–225)	0, − 15 to 47	0.7		

All continuous variables are presented as median (interquartile range)

CI confidence interval; *ASA* American society of anesthesiologists score; *VAS* visual analog scale; *MED* morphine equivalent dose; *NSAIDs* non-steroidal anti-inflammatory drugs, *NS* not significant on multivariate analysis

P-values less than 0.05 were considered statistically significant

On multivariate analysis, variables remaining significantly associated with refills included opioid experienced hosts (Odds ratio (OR) 4.1, 95% confidence interval (CI) 1.1–15; $p=0.03$), preoperative pain VAS (OR 1.5 per unit increase, CI 1.2–1.9; $p=0.0006$), and not receiving an oxycodone prescription (OR 0.2, CI 0.07–0.7).

Discussion

In this study we found that the implementation of the OTA pain management guidelines was associated with a decrease in discharge MED but not in total MED due to the higher number of refills in the guidelines group. However,

on as-treated analysis, patients with prescriptions adherent to the guidelines did not have detectable differences in pain control, opioid use, or refills at 2 or 6 weeks, although the sample sizes were small so clinical difference cannot be ruled out. On multivariate analysis, opioid refill within 2 weeks of surgery was only associated with opioid experienced hosts, preoperative VAS, and not receiving an oxycodone prescription.

Previously, a retrospective review of our departments postoperative opioid prescribing practices found a wide variation in opioid prescription sizes for similar surgeries with little differentiation between major and minor surgeries with many patients receiving opioid prescriptions that were considered inappropriately large (> 400 MED) [5]. These finding prompted our department to adopt the OTA's pain management guidelines in order to become better stewards of opioid prescriptions. There is currently limited data on the implementation of pain management guidelines in orthopaedic trauma surgery. In total joint arthroplasty literature it has been well established that such guidelines can decrease postoperative opioid prescriptions resulting in less unused opioids without negatively impacting pain control. The orthopaedic trauma population does have inherent differences with the total joint arthroplasty population, including a higher proportion of patients with disadvantaged socioeconomic status, psychiatric disorders, and drug abuse, therefore guidelines may have less success in this population [9–12]. The effect of the OTA multi-specialty task force pain management guidelines on clinical practice, to our knowledge, has not been investigated to date. Similar to the findings of implementing pain management guidelines in arthroplasty surgery, we found that the discharge MED was reduced with no detectable difference in measures of pain control or refills (on the as-treated analysis) at 2- or 6-week follow-up [13, 14].

The strengths of this study lie in its prospectively gathered data on pain control and opioid medication. This study is limited by its small size, heterogeneous surgeries, nonadherence, and short follow-up. Only 30 (66%) of the 45 patients in the guidelines group were given prescriptions that were adherent to the guidelines. This reflects the difficulties of implementing opioid guidelines in a busy academic trauma practice where postoperative prescriptions are executed by resident physicians. Due to this low adherence rate we performed an as-treated analysis to evaluate the effect of the guidelines on pain control and refills at the 2-week and 6-week follow-up visits and did not find any detectable difference between groups.

Another limitation is that while patients were asked if they were still using opioid medications and the number of tabs they had remaining, the same was not done for the non-opioid medications, so it is unknown whether patients actually were compliant with these medications. Also, a longer period of follow-up and a greater number of patients would be necessary to determine if these guidelines had an effect on chronic opioid use. A sample size estimation based on the incidence of continued opioid use at 6 weeks between groups (17% vs. 13%) determined that 2500 patients would be necessary to determine a significant difference in opioid use at 6 weeks with a power of 0.8 and an alpha of 0.05 on two-tailed analysis.

One limitation of pain management guidelines that consider medications only, is the lack of consideration of concurrent psychological issues. The presence of psychiatric disorders or increased psychological stress scores has been shown to affect pain, opioid use, and disability after trauma [15, 16]. Future guidelines may benefit from standardized screening of patients and treatment of concomitant psychological disorders. Our department is currently investigating this to hope to improve on our current pain guidelines.

Implementation of the OTA pain management guidelines for outpatient orthopaedic trauma surgeries predictably increased the prescribing of non-opioid pain medications, decreased oxycodone prescriptions, and the discharge MED of opioid prescriptions without appearing to affect pain control. A larger study with greater adherence to the guidelines is necessary to further evaluate these findings. In the midst of a national opioid crisis, adoption of the OTA's pain management guidelines for orthopaedic trauma surgery warrants further research to determine if it's implementation can reduce the size, variability, and duration of opioid prescriptions.

Funding This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors. The authors have no specific disclosures related to this study.

Declarations

Conflict of interest Cyril Mauffrey has the following disclosures: Abbott: Other financial or material support; Carbofix: Research support; Current Opinion in Orthopaedics: Editorial or governing board; DePuy, A Johnson & Johnson Company: Other financial or material support; International Orthopaedics: Editorial or governing board; La Societe Internationale de Chirurgie Orthopedique et de Traumatologie: Board or committee member; Orthopaedic Trauma Association: Board or committee member; osteomed: Research support; Patient safety in surgery: Editorial or governing board; Springer: Publishing royalties, financial or material support; Stryker: Paid consultant; Unpaid consultant; The European journal of orthopaedic surgery and traumatology: Editorial or governing board. Joshua Parry has the following disclosures: The European journal of orthopaedic surgery and traumatology: Editorial or governing board. None of the remaining authors have anything to disclose.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

This article does not contain any studies with human participants or animals performed by any of the authors.

Informed consent Informed consent was obtained from all individual participants included in the study.

References

1. Rudd RA, Aleshire N, Zibbell JE, Gladden RM (2016) Increases in drug and opioid overdose deaths—United States, 2000-2014. Cent Dis Control Prev Morb Mortal Wkly Rep 64:1378–1382
2. Morris BJ, Mir HR (2015) The opioid epidemic. J Am Acad Orthop Surg 23(5):267–271
3. Attum B, Rodriguez-Buitrago A, Harrison N et al (2018) Opioid prescribing practices by orthopaedic trauma surgeons after isolated femur fractures. J Orthop Trauma 32(3):e106–e111
4. Lindenhovious ALC, Helmerhorts GTT, Schnellen AC et al (2009) Differences in prescription of narcotic pain medication after operative treatment of hip and ankle fractures in the United States and the Netherlands. J. Trauma: Inj Infect Crit Care 67(1):160–164
5. Jaynstein J, Donnell A, Chambers L et al (2020) The effect of surgical pain severity, preoperative opioid use and patient characteristics on postoperative opioid prescriptions and refills in orthopedic surgery. Eur J Orthop Surg Traumatol 30(5):781–787
6. Nataraj N, Zhang K, Guy GP et al (2019) Identifying opioid prescribing patterns for high-volume prescribers via cluster analysis. Drug Alcohol Depend 197:250–254
7. Chou R, Gordon DB, De Leon-Casasola OA et al (2016) Management of postoperative pain: a clinical practice guideline from the American pain society, the American society of regional anesthesia and pain medicine, and the American society of anesthesiologists' committee on regional anesthesia, executive committee, and administrative council. J Pain 17(2):131–157
8. Hsu JR, Mir H, Wally MK et al (2019) Clinical practice guidelines for pain management in acute musculoskeletal injury. J Orthop Trauma 33(5):1
9. Hernandez NM, Parry JA, Taunton MJ (2017) Patients at risk: large opioid prescriptions after total knee arthroplasty. J Arthroplasty 32(8):2395–2398
10. Hernandez NM, Parry JA, Mabry TM et al (2018) Patients at risk: preoperative opioid use affects opioid prescribing, refills, and outcomes after total knee arthroplasty. J Arthroplasty 33(7):S142–S146
11. Stepan JG, Lovecchio FC, Premkumar A et al (2019) Development of an institutional opioid prescriber education program and opioid-prescribing guidelines. J Bone Jt Surg 101(1):5–13
12. Wyles CC, Hevesi M, Trousdale ER et al (2018) The 2018 Chitranjan S. Ranawat, MD Award: developing and implementing a novel institutional guideline strategy reduced postoperative opioid prescribing after TKA and THA. Clin Orthop Relat Res 477(1):104–113
13. Thiels CA, Hanson KT, Cima RR et al (2018) From data to practice: increasing awareness of opioid prescribing data changes practice. Ann Surg 267(3):e46–e47
14. Kahlenberg CA, Stepan JG, Premkumar A et al (2019) Institutional guidelines can decrease the amount of opioids prescribed after total joint replacement. HSS J ® 15(1):27–30
15. Helmerhorst GTT, Vranceanu AM, Vrahas M et al (2014) Risk factors for continued opioid use one to two months after surgery for musculoskeletal trauma. J Bone Jt Surg 96(6):495–499
16. Vranceanu AM, Bachoura A, Weening A et al (2014) Psychological factors predict disability and pain intensity after skeletal trauma. J Bone Jt Surg 96(3):e20