

Retrospective study of the effect of opioid prescribing guidelines on prescribing practices in pediatric orthopedic sports medicine patients having knee surgery: A single institution's experience

Jeffrey G. Stepan, MD, MSc; Christine Goodbody, MD; Kanupriya Kumar, MD; Kathryn DelPizzo, MD; Peter D. Fabricant, MD, MPH; Pamela Wendel, MD

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ABSTRACT

Objective: Guidelines for opioid prescription post-operatively exist; however, the majority of these are for adults. Nevertheless, opioid risks are present for pediatric patients also. This study investigates the effect of a single institution's guidelines on post-operative opioid prescribing for pediatric orthopedic patients undergoing knee surgery. We hypothesized that a standardized set of prescribing guidelines would result in a decrease in opioids prescribed at discharge home after these surgeries.

Design: Retrospective observational.

Setting: Urban, tertiary care, academic orthopedic hospital.

Patients: Pediatric, sports knee surgery, 23-month period.

Interventions: Guidelines were implemented institutionally for post-operative opioid prescribing practices. We reviewed all post-operative opioid prescriptions for pediatric patients undergoing sports knee surgery with two pediatric sports surgeons for the 11 months prior to the guidelines and 12 months afterwards, totaling 316 surgeries.

Main outcome measure: Oral morphine equivalents (OMEs) prescribed on discharge from the hospital before and after implementation of guidelines.

Results: There was a significant reduction in OMEs from 229 OMEs to 175 OMEs before and after opioid prescribing guidelines ($p < 0.001$). This is a decrease in approximately seven 5 mg oxycodone tablets per patient.

Conclusions: This study demonstrates that at our institution, with a pediatric patient population having sports knee surgery, prescribing guidelines reduced the number of opioids prescribed at discharge.

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INTRODUCTION

Opioid overdose is a common cause of unintentional death in the United States, and rates of opioid abuse have risen at an alarming rate in the past two decades.¹ Between 1991 and 2011, the number of prescriptions for opioids in the United States increased from 76 million to 219 million.^{2,3} Despite widespread recognition of this problem, the opioid epidemic continues, and the yearly rate of opioid overdose deaths continues to increase. In 2015,

33,091 deaths in the US involved an opioid-related overdose, which increased to 42,249 in 2016.⁴ This included 83 children aged 14 or under from any opioid and 60 of those from prescription opioids. In those aged 15-24, those numbers increase sharply, with 4,027 deaths from any opioid and 1,146 from prescription opioids specifically.

Orthopedics is second only to family/general medicine in volume of opioids prescribed and it tops the list of surgical specialties.⁵ Surgical fields have implemented and evaluated post-operative

pain medication prescribing guidelines, resulting in decreased opioid prescribing after a variety of surgical procedures,⁴ and this has begun to be replicated in the adult orthopedic population.^{2,5-10} However, there are limited data available on the effect of guidelines on pediatric orthopedic prescribing practices. These available data showed that the amount of opioid prescribed post-operatively at Boston Children's Hospital after orthopedic procedures decreased by 19 percent in 2016 as compared to 2015, after a statewide legislative change was made in the Massachusetts opioid prescription law.¹¹ Reducing opioids prescribed is intuitively important and this has been reinforced with data.¹²⁻¹⁴ One survey showed 80 percent of high school seniors who used prescription opioids nonmedically originally had legitimate prescriptions but were recreationally using leftover pills.¹⁵

The purpose of the present study was to determine the effect of implementing standardized prescribing guidelines on prescribing practices after pediatric and adolescent sports knee surgery. We hypothesized that a standardized prescribing guideline would result in a significant decrease in the number of opioids prescribed.

MATERIALS AND METHODS

This study was approved by the institutional review board prior to the initiation of data collection. This retrospective cohort study evaluated opioid prescribing practices after pediatric knee surgery at an urban tertiary care academic orthopedic hospital. The number of pills and total oral morphine equivalents (OMEs) prescribed were recorded for 11 months before and 12 months after the dissemination of post-operative prescribing guidelines. Opioid prescribing guidelines were based on the existing adult literature and expert opinion. First, a literature review was conducted to determine what is known regarding opioid intake after various subspecialties within orthopedic surgery.⁵ Informed by this review and clinical experience, the pediatric orthopedics division worked with an interdisciplinary team of pediatricians and pediatric anesthesiologists in order to develop consensus opioid prescribing practices for the most common pediatric procedures. The guidelines suggest a dose of oxycodone at 0.1 mg/kg every four to 6 hours with a 10 mg maximum dose. For patients who cannot swallow pills, this was prescribed as an elixir, but those who could take pills

Table 1. Guidelines for recommended number of pills prescribed

Recommended number of pills	Surgery type
20	Knee arthroscopy: -synovial biopsy or debridement -loose body removal -chondroplasty -partial meniscectomy -meniscal repair
40	Anterior cruciate ligament reconstruction Medial patellofemoral ligament reconstruction

were given a home supply based on which surgical procedure was performed as outlined in Table 1.

These guidelines were disseminated by email and announcement at conferences throughout the institution at the beginning of February 2017. There was a required online learning course with teaching videos by pain management specialists for all prescribers throughout the institution.

Prescriptions for discharge home after surgery were written by a wide range of providers. Ultimately, the attending surgeon was responsible for post-operative pain medication the patient was sent home with, but the prescriptions were written by a combination of orthopedic surgery residents, pediatric orthopedic surgery fellows, and physician assistants totaling 87 unique prescribers, 37 of which were physician assistants. The decision as to who wrote the prescription was based on staffing needs at the institution.

We included all post-operative opioid prescriptions written after knee arthroscopy queried from our electronic medical record the 11 months prior to the mandatory opioid education (3/1/2016 to 1/31/2017) and 12 months after guideline dissemination (2/14/2017 to 3/31/2018). Only 11 months of data were available prior to the release of the postoperative opioid guidelines, which was coincident to the beginning of the hospital electronic medical record (EMR). We also excluded 2 weeks of prescriptions surrounding the time of the implementation of the post-operative opioid guidelines (2/1/2017 to 2/13/2017). We included patients who had their surgery performed by one of the two pediatric orthopedic sports surgeons. The arthroscopic knee procedures included in our analysis were simple knee arthroscopy (to perform synovial biopsy or

debridement, loose body removal, chondroplasty, or partial meniscectomy), anterior cruciate ligament (ACL) reconstruction, medial patellofemoral ligament (MPFL) reconstruction, and meniscal repair. The patients were all part of our pediatrics service, meaning they were under the age of 19 years. The procedures chosen are most commonly performed on patients 12-19 years old at our institution, allowing us to focus on opioid prescriptions in the adolescent population.

Opioid prescriptions prescribed after guideline implementation were compared to those prescribed prior to the guidelines, with stratification based on the surgical procedure. The number of pills prescribed was recorded for each prescription. All prescriptions were converted into the total OME prescribed based on the following conversions: one tablet of hydrocodone 5 mg = 5 OMEs, one tablet of oxycodone 5 mg = 7.5 OMEs, one tablet of codeine 30 mg = 4.5 OMEs, and one tablet of hydromorphone 2 mg = 8 OMEs.¹² We also recorded whether patients were ambulatory or stayed overnight in the hospital.

We compared the OME prescribed between the two groups (pre- and post-guideline) using a Mann-Whitney U test due to the nonparametric nature of the data. We stratified this analysis based on the surgical procedure. A linear regression model was created with OMEs as the dependent variable. The model was created by force entry with independent variables being an overnight stay (yes vs. no), pre- or post-prescriber guideline, and type of surgery. We also calculated the percentage of prescriptions

in each timeframe that adhered to the guideline criteria. No *a priori* sample size calculation was performed, as all available patients were used for the study analysis.

RESULTS

There were 316 pediatric knee arthroscopic procedures that were prescribed opioids at our institution over the study period, 119 prior to guideline implementation, and 197 after guideline implementation. The number of patients who underwent simple knee arthroscopy, meniscus repair, ACL reconstruction, MPFL reconstruction, or had an overnight stay is noted in Table 2.

Overall, there was a significant reduction in the average number of opioids prescribed from 229 OMEs to 175 OMEs before and after the release of prescribing guidelines ($p < 0.001$). This corresponds to a decrease in approximately seven 5 mg oxycodone tablets. There were significant decreases in the number of opioids prescribed after each type of procedure (Table 3).

A linear regression model was created with OME's as a dependent variable. The model showed implementation of prescriber guidelines was associated with decreased amounts of opioids prescribed ($B = -59.9$, 95 percent CI: -84.4 to -35.4) when controlling for overnight stay and level of surgery. Whether a patient stayed overnight was not predictive of postoperative opioid prescription ($B = -26.3$, 95 percent CI: $-57.4.2$ to 4.8).

Table 2. Surgery type and overnight stay in patients before and after guideline implementation

	Pre-guideline	Post-guideline	Total
Surgery type			
Knee arthroscopy*	58 (48.7 percent)	62 (31.5 percent)	120 (37.9 percent)
Meniscus repair	8 (6.7 percent)	34 (17.3 percent)	42 (13.3 percent)
ACL reconstruction	20 (16.8 percent)	55 (27.9 percent)	75 (23.7 percent)
MPFL reconstruction	33 (27.7 percent)	46 (23.4 percent)	79 (25 percent)
Overnight stay?			
No	67 (56.3 percent)	126 (64 percent)	193 (61.1 percent)
Yes	52 (43.7 percent)	71 (36 percent)	123 (38.9 percent)
*Arthroscopic debridement, loose body removal, chondroplasty, partial meniscectomy.			

Table 3. Opioids prescribed before and after guideline implementation

	Pre-guideline OME [‡]	Post-guideline OME [‡]	P-value
Surgery type			
Knee arthroscopy [‡]	200 (60-800)	150 (40-450)	0.009*
Meniscus repair	250 (90-709.5)	150 (18-300)	0.029*
ACL reconstruction	225 (30-450)	180 (45-570)	0.322
MPFL reconstruction	225 (90-450)	225 (30-360)	0.003*

*Statistically significant at $\alpha < 0.05$.

[‡]Median (range).

[‡]Arthroscopic debridement, loose body removal, chondroplasty, partial meniscectomy.

Before guideline implementation, 50 percent of prescriptions adhered to the eventual guideline recommendations. In the post-implementation cohort, there was a 79 percent guideline adherence rate. When stratified by procedure comparing guideline adherence before and after their implementation, the compliance rate went from 35 to 65 percent after simple knee arthroscopy, from 75 to 95 percent after ACL reconstruction, from 76 to 94 percent after MPFL reconstruction, and 12.5 to 62 percent after meniscus repair.

DISCUSSION

This study shows that the institutional guidelines for post-operative prescriptions after pediatric ambulatory orthopedic knee surgery decrease the amount prescribed when considering both OMEs and the number of pills. This reduction was significant regardless of the patients staying overnight in the hospital or the type/severity of knee surgery performed.

A significant limitation of this study is that it is unknown what the optimal opioid prescriptions for a pediatric patient after these surgeries are. Our institution based these guidelines on expert opinion and the available, yet limited, literature, but no data were collected on how many pills were used post-operatively. We are currently undertaking a study to follow up with pediatric patients after the same surgeries to assess opioids used post-operatively. These data will allow us to better assess the effectiveness of our current guidelines.

Additional limitations include the retrospective nature of this study and reliance on data taken from electronic medical records at the time of discharge after surgery. By definition, no data were collected on if refills for opioids were given at post-operative visits and if so, how many pills.

Other limitations of the study include the wide variation that naturally occurs in the adolescent patient population in terms of weight and ability to swallow pills. Between these two variables, the patients' discharge prescriptions could vary based on factors other than which surgery was performed. These are common problems when studying this patient population which we tried to mitigate by discussing OMEs as well as the number of pills.

Prescribing guidelines may be an important step in managing the opioid crisis, especially at academic institutions where the prescribing provider may vary in the level of training and familiarity with the surgery and its expected level of postoperative pain. Future guidelines should come with education for prescribers about the opioid crisis and goals of postoperative opioid therapy. As this education improves, it may improve the somewhat varied rates of compliance with the guidelines noted in our study.

Institutional guidelines for prescribers decrease the number of opioids prescribed to pediatric patients after sports knee surgeries and, therefore, can be an important step in limiting access to opioids for misuse and abuse. This finding has implications globally as the opioid crisis spreads. Institutions should assess their prescribing habits and consider implementing guidelines to standardize practices.

Jeffrey G. Stepan, MD, MSc, Department of Orthopaedic Surgery and Rehabilitation Medicine, University of Chicago, Chicago, Illinois.

Christine Goodbody, MD, Department of Orthopaedic Surgery, Hospital for Special Surgery, New York, New York.

Kanupriya Kumar, MD, Department of Anesthesiology, Critical Care, and Pain Management, Hospital for Special Surgery, New York, New York; Department of Anesthesiology, Weill Cornell Medical College, New York, New York.

Kathryn DelPizzo, MD, Department of Anesthesiology, Critical Care, & Pain Management, Hospital for Special Surgery, New York, New York; Department of Anesthesiology, Weill Cornell Medical College, New York, New York.

Peter Fabricant, MD, MPH, Division of Pediatric Orthopaedic Surgery, Hospital for Special Surgery, New York, New York; Research Division, Hospital for Special Surgery, New York, New York; and Department of Orthopaedic Surgery, Weill Cornell Medical College, New York, New York.

Pamela Wendel, MD, Department of Anesthesiology, Critical Care, and Pain Management, Hospital for Special Surgery, New York, New York; Department of Anesthesiology, Weill Cornell Medical College, New York, New York; ORCID: <https://orcid.org/0000-0001-7181-8107>.

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