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Natural History of Opioid Use in Naive and Tolerant Patients in Revision Total Hip Arthroplasty

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ABSTRACT

Background: Opioid use after revision total hip arthroplasty (rTHA) has not been well characterized. The purpose of this study was to characterize preoperative, perioperative, and postoperative opioid use during rTHA.

Methods: Patients undergoing revision THA from 2010 to 2018 were screened for opioid use 3 months before revision surgery and tracked 24 months postoperatively. Patients were categorized as naïve or tolerant. Opioid prescriptions and average morphine milligram equivalents (MME) were compared between the two groups.

Results: One hundred twenty-four of 247 patients (50%) in the tolerant group averaged a preoperative MME of 23.7 mg/day. Postoperatively, tolerant patients received significantly higher daily MME at all time points, including at 3 months 31.4 versus 18.1 mg/day ($P < 0.001$), 6 months 19.9 versus 2.95 mg/day ($P < 0.001$), 12 months 14.3 versus 3.5 mg/day ($P < 0.001$), and 24 months 10.7 versus 2.17 mg/day ($P < 0.001$). Tolerant patients were more likely to have a prescription at 6 months (44% versus 22%), 12 months (41.4% versus 24%), and 24 months (38% versus 19.3%) ($P < 0.001$, $P = 0.002$, $P < 0.001$, respectively).

Discussion: Opioid-tolerant patients had higher postoperative MME requirements for longer recovery duration. Both groups reduced opioid use at 3 months and plateaued at 6 months. These findings can help the revision surgeon counsel patients and expectations.

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None of the following authors or any immediate family member has received anything of value from or has stock or stock options held in a commercial company or institution related directly or indirectly to the subject of this article: Dr. Lum, Dr. O'Connor, Dr. Holland, Gharib-Parsa, Barragan-Trejo, Park, Dr. Giordani, and Dr. Meehan.

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As the number of patients undergoing primary total hip arthroplasty (THA) surgery increases, so has the number of revisions.¹ Risks of complication after revision THA (rTHA) are higher than primary THA, including development of infection, dislocation, bleeding, neurovascular injury, and death.^{2,3} One aspect that has received attention recently is sustained opioid use after hip arthroplasty. Opioid use after hip arthroplasty has been associated with increased THA revision rates, poorer postoperative outcomes, and prolonged recovery.⁴⁻⁶ Although opioid-related

adverse events are well characterized in primary THA, there is a paucity of literature reporting on opioid use before and after rTHA.

The purpose of our study was to report our institution's preoperative, perioperative, and postoperative opioid consumption before, during, and after 2 years of recovery in patients who underwent revision THA. Evaluation was done to compare postoperative clinical measures, including opioid consumption, between opioid-naïve and tolerant patients.

Methods

After approval by the university institutional review board, 247 patients who underwent rTHA at a single academic quaternary care center between January 1, 2010, and September 1, 2018, were retrospectively identified by CPT code 27134 (revision of total hip arthroplasty, femoral and acetabular component). All patients older than 18 years, regardless of underlying diagnosis, anesthetic type, BMI, or American Society of Anesthesiologists score, were included.

Patient demographics were obtained including age, sex, height, weight, BMI, and date of birth. Chart review was conducted by three reviewers (A.G., A.B., J.Y.P.), which extracted patients' date of surgery and whether any opioid medications were prescribed to the patient 3 months before the revision THA surgery using an electronic medical record EPIC (Madison) at our tertiary-level institution. The patient's chart was then followed for an additional 24 months, and any opioid prescriptions were recorded. A fourth reviewer conducted quality control checks to verify accuracy of the data extracted (DTO). Our healthcare system contains both insurance capitated patients and non-capitated patients. The EMR records all prescriptions (including primary care and other specialists such as pain management) provided to the patient in our healthcare system, which most patients belong to. All opioids were identified, quantified, and reported in oral morphine milligram equivalents (MME). Patients were categorized as naïve or tolerant depending on whether they had a narcotic prescription in the 3 months preoperatively. Total MME was grouped into 3-month blocks for all patients and compared between patients who were naïve or tolerant.

The average age of the patients were 65.5 years for opioid-naïve and 63.5 years for opioid-tolerant. A total of 66 of 124 patients were female in the naïve group; 71 of 123 were female in the tolerant group. BMI was

28.3 kg/m³ for naïve and 29.1 kg/m³ for tolerant; duration of surgery was 185.5 minutes for naïve and 196.6 minutes for tolerant. Smoker status was 9.6% for naïve and 18.7% for tolerant. Length of stay was 4.03 days for naïve and 4.65 days for tolerant. Table 1 has all demographics listed. Patient age, surgery duration, BMI, diabetes, and functional status were not significantly different between naïve and tolerant groups ($P > 0.05$). Preoperatively, tolerant patients were significantly more likely to smoke (18.7% versus 9.6%) and had higher American Society of Anesthesiologists scores ($P = 0.031$, $P = 0.016$, respectively).

Two hundred forty-seven patients underwent two implant revision THA from 2010 to 2018. Of those, 123 patients (50%) were in the tolerant group with average preoperative MME of 23.7 mg/day.

Perioperative management was the same for all revision THAs. Patients underwent surgery using a posterolateral approach. Revision technique was at the discretion of the operating surgeon, and once completed, a multimodal analgesia protocol was used for all surgeries. Enoxaparin or warfarin was used for venothromboembolism prophylaxis with a 6-week duration.

Patients were prescribed a multimodal postoperative regimen of pain medications, including acetaminophen, NSAIDs such as celecoxib or ibuprofen, gabapentin or pregabalin, and hydrocodone or oxycodone. Patients were seen on postoperative day 10 to 14, day 42, day 90, and yearly follow-up thereafter. Closer follow-up was obtained depending on recovery status. Patients who continued to have pain could request refill pain medications by contacting the nursing staff, who had a physician provide a refill. Medication refills usually occurred during postoperative visits, but occasionally were requested through telephone or a patient online portal.

Statistical Analysis

Student t-test was used comparing quantitative parametric variables, oral MME, and length of stay between opioid-naïve and tolerant groups. Categorical non-parametric variables such as patients still on opioids were compared between groups using chi-square test because sample sizes were greater than 5.

Results

For the opioid-naïve group, postoperative average daily MME decreased from 18.6 mg/day in the first 3 months to

Table 1. Preoperative Patient Demographics

	Opioid-Naïve (N = 124)	Opioid-Tolerant (N = 123)	P
Age	65.5 years	63.5 years	0.19
Sex	66 female	71 female	0.77
BMI kg/m ³	28.3	29.1	0.26
Duration of surgery (minutes)	185.5	196.6	0.35
Smoker	9.6%	18.7%	0.04
Length of stay (d)	4.03	4.65	0.07
ASA 1	3	1	0.015
ASA 2	60	39	
ASA 3	57	81	
ASA 4	4	2	

ASA = American Society of Anesthesiologists Scale, BMI = body mass index, d = day

Patient age, surgery duration, BMI, diabetes, and functional status were not significantly different between naïve and tolerant groups ($P > 0.05$). Preoperatively, tolerant patients were significantly more likely to smoke (18.7% versus 9.6%) and had higher American Society of Anesthesiologists (ASA) scores ($P = 0.031$, $P = 0.016$, respectively).

3.0 mg/day at 6 months, 3.5 mg/day at 12 months, and 2.2 mg/day at 24 months. At 3 to 6 months, 22 of 124 patients (18%) were prescribed opioids; at 12 months, 30 of 124 (24%) were prescribed opioids; and at 24 months, 24 of 124 (19%) were on opioids (Table 2).

The opioid-tolerant group had a preoperative average daily MME of 23.7 mg/day, 31.4 mg/day at 3 months, 19.9 mg/day at 6 months, 14.3 mg/day at 12 months, and 10.7 mg/day at 24 months. At 3 to 6 months, 54 of 123 patients (44%) were prescribed opioids; at 12 months, 51

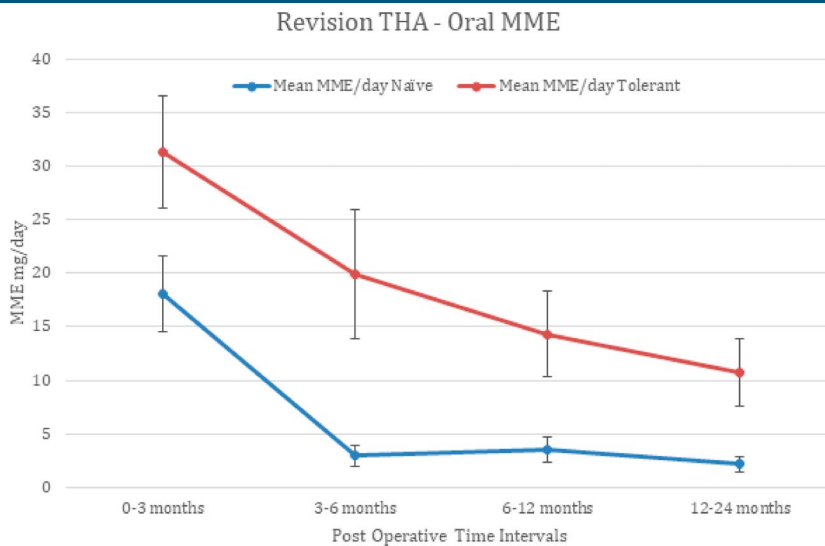
Table 2. Opioid Prescription Dosing in Revision Total Hip Arthroplasty Patients

Time Interval	Opioid-Naïve			Opioid-Tolerant			P	
	No. of Taking Opioids	% on Opioids	Avg MME (mg/day)	No. of Taking Opioids	% on Opioids	Avg MME (mg/day)	No. of Patients Taking Opioids (Tolerant v naïve)	Avg MME (mg/day) (tolerant v naïve)
3 Months preop	0		—	123		23.7	—	—
0-3 Months postop	117	94.3%	18.1	118	95.9%	31.4	$P = 0.62$	$P < 0.0001^*$
3-6 Months postop	22	17.7%	2.95	54	43.9%	19.9	$P < 0.0001^*$	$P < 0.0012^*$
6-12 Months postop	30	24.2%	3.5	51	41.4%	14.3	$P < 0.0029^*$	$P < 0.0005^*$
12-24 Months postop	24	19.4%	2.17	47	38.2%	10.7	$P < 0.0008^*$	$P < 0.0012^*$

MME = morphine milligram equivalents

Average MME expressed in milligrams/day. The tolerant group received a significantly higher average MME at each time point and required higher average MME at each postoperative time point and required a longer duration of prescriptions. At all postoperative time points, a significantly higher number of patients in the tolerant group required opioid prescriptions.

Figure 1



Graph demonstrating revision total hip arthroplasty patients. Opioid-tolerant patients had higher requirements of opioids for all time periods during the entire 2-year perioperative course. MME = morphine milligram equivalents

of 123 patients (41%) were prescribed opioids; and 47 of 123 patients (38%) were on opioids at 2-year duration.

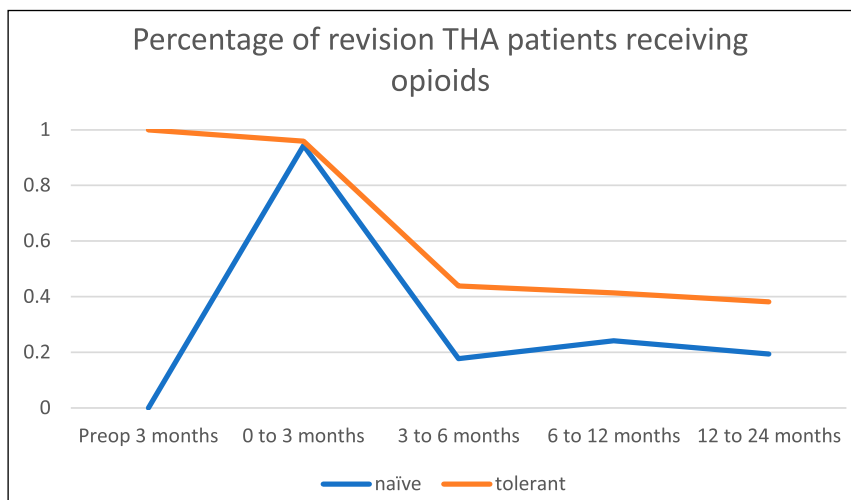
Compared with naïve patients, tolerant patients received significantly higher daily MME at all time points during the 2-year post-recovery period: at 3 months 31.4 mg/day versus 18.1 mg/day ($P < 0.001$), at 6 months 19.9 mg/d versus 3.0 mg/d ($P = 0.001$), at 12 months 14.3 mg/d versus 3.5 mg/d ($P < 0.001$), and at 24 months 10.7 mg/d versus 2.2 mg/d ($P = 0.001$) (Figure 1). Opioid-tolerant patients were also more likely to have an opioid prescription at all time points beyond 3 months; 44% versus 18% ($P <$

0.001), 12 months 41.4% versus 24.2% ($P = 0.043$), and 24 months 38.2% versus 19.4% ($P < 0.001$) (Figure 2).

Discussion

Patients who had been prescribed opioids preoperatively had markedly higher postoperative MME requirements at all time points after surgery and were more likely to continue to require an opioid prescription from 3 months until the end of the study period at 24 months, compared with opioid-naïve patients. This is similar to one of the early

Figure 2



Graph demonstrating percentage of opioid-naïve and tolerant patients who were still on opioids. Note the decline of opioid users between 3 to 6 months and the plateau of opioid users at 6 months and beyond. More opioid-tolerant patients required higher opioid dosages for longer duration.

studies to investigate opioid use after primary THA.⁷ They looked at a small cohort of 315 total joint arthroplasties, and reported prescription refills for opioid-naïve patients were 22% at 1 year and 64% for opioid-tolerant patients. They also described variable prescribing patterns and that many patients received opioid prescriptions from the surgeon and subsequently the primary care physician. Bedard et al⁸ investigated opioid use after total hip arthroplasty in over 37,000 patients and found not only opioid users were at risk of dependence at 1 year but non-opioid users at risk were female and patients younger than 50 years. Furthermore, the prescribing pattern for both opioid users and non-opioid users trended down to approximately 40% and 10% at 3 months and plateaued at 30% and 5% at 6 months, respectively. Our results for revision total hip arthroplasties appear to be very similar, with both tolerant and naïve groups reducing number of patients receiving opioids and the overall dosage at 3 months and plateauing at 6 months. While we know that patients receiving preoperative opioids will have higher narcotics requirements, the trend is that they still have an expected reduction in opioid use, albeit at a higher level. This helps guide the orthopaedic surgeon's expectations in opioid use during the postoperative recovery after revision THA.

Preoperative opioid use in rTHA has resulted in worse patient outcomes. Smith et al⁹ reported on 312 THA revision patients, of which 104 were opioid users preoperatively and found worse patient-reported outcomes and longer length of stay, specifically in Hip Disability and Osteoarthritis Outcome Score (HOOS) physical function, Patient-Reported Outcomes Measurement Information System (PROMIS), and physical short form 10A, at a mean follow-up of 12 months.

Our study, in addition to a few others, have reported suboptimal results in preoperative opioid users in revision THA; there have been some suggestions on how to treat the underlying problem. Deen et al¹⁰ reported on their success of reducing opioid dosing in both inpatient and outpatient settings in revision arthroplasty. With routine use of intraoperative ketamine, dexamethasone, ketorolac, acetaminophen, and peripheral nerve block catheter, they were able to reduce inpatient MME by 24% and outpatient MME by 64% over a 4-year period. Although many institutions use a similar protocol, intraoperative use of ketamine is controversial and not routinely used. This study along with others may offer a solution to this difficult problem.

We are the first study, to our knowledge, of reporting a temporal relationship to opioid use after revision THA, charting how opioid use varies with time, and that surgeons

can expect a notable decline in opioid use from 3 to 6 months. This can be helpful when counseling the patient about expectations of when to reduce and stop opioid medication during their recovery course. Furthermore, for patients who have been using opioids regularly for at least 3 months before undergoing revision THA surgery or who are opioid-tolerant, it is important to counsel them about the likelihood of needing higher doses initially and also the likelihood of gradually reducing the dosage starting from the third month to the sixth month after the surgery. By months 6 to 12 post operation, it is expected that approximately two-thirds of patients will no longer require opioids. It was still somewhat surprising that at 24 months after revision THA, 19% of opioid-naïve and 38% of opioid-tolerant groups were still receiving opioids, although the overall MME had continued to trend downward during that entire period. This information can help guide future expectations and postoperative pain management strategies to reduce the number of patients still requiring opioids.

A limitation to this study is that prescribing patterns and patient awareness during the study period were different than what these are today. The opioid epidemic was declared a national emergency on October 26, 2017, by President Trump. Since then, laws have come into effect to reduce the total amounts of opioids prescribed and have allowed patients to become aware of the negative adverse effects of opioid medication. This has likely reduced overall MME and total prescriptions given during postoperative recovery. Nevertheless, our results may help guide the surgeon on expectations for when to reduce and remove opioid medication from their post-recovery pain regimen. Another limitation of our study is that we did not have access to CURES, an opioid enforcement prescription verification tool in California, when we conducted the study because it was implemented in October 2018, shortly after we collected our data. In addition, we did not extract data related to non-opiate pain management. However, it is worth noting that our multimodal pain protocol during that period had minimal variations. Exploring the individual effects of each component of the multimodal pain regimen could be a valuable avenue for future research in this specific cohort. Other limitations include that we could only record prescriptions provided and were unable to record the exact dosage of pain medication taken by the patient. We have to make the assumption that patients who received another prescription had taken all that medication, and hence were asking for additional medication. Although this is a limitation, many other opioid studies have had to result to the same tactic.^{7,8,11} Finally, while our institution has a reasonably

captive patient population, patients may have gone to other outside institutions to receive opioid prescriptions that may not have been included.

In conclusion, our study highlights that patients who were prescribed opioids before revision total hip arthroplasty had higher postoperative opioid requirements and were more likely to continue opioid use through 2 years compared with opioid-naïve patients. However, both opioid-tolerant and opioid-naïve groups showed a decline in opioid use from 3 to 6 months postoperatively, with a plateau thereafter. Our findings can help guide surgeons' expectations for postoperative opioid use and counseling of patients during their recovery course. While limitations exist, such as changes in prescribing patterns and potential underreporting of outside opioid prescriptions, this study provides valuable insights for reducing opioid use in postoperative pain management and strategies in revision total hip arthroplasty.

References

1. Kurtz S, Ong K, Lau E, Mowat F, Halpern M: Projections of primary and revision hip and knee arthroplasty in the United States from 2005 to 2030. *J Bone Joint Surg Am* 2007;89:780-785
2. Postler A, Lützner C, Beyer F, Tille E, Lützner J: Analysis of total knee arthroplasty revision causes. *BMC Musculoskelet Disord* 2018;19:55.
3. Natsuhara KM, Shelton TJ, Meehan JP, Lum ZC: Mortality during total hip Periprosthetic joint infection. *J Arthroplasty* 2019;34:S337-S342.
4. Bedard NA, DeMik DE, Dowdle SB, Owens JM, Liu SS, Callaghan JJ: Preoperative opioid Use and its association with early revision of total knee arthroplasty. *J Arthroplasty* 2018;33:3520-3523.
5. Weick J, Bawa H, Dirschl DR, Luu HH: Preoperative opioid Use is associated with higher Readmission and revision rates in total knee and total hip arthroplasty. *J Bone Joint Surg Am* 2018;100:1171-1176.
6. Terhune EB, Hannon CP, Burnett RA, Della Valle CJ: Preoperative opioids and the dose-dependent effect on outcomes after total hip arthroplasty. *J Arthroplasty* 2022;37:S864-S870.
7. Zarling BJ, Yokhana SS, Herzog DT, Markel DC: Preoperative and postoperative opiate Use by the arthroplasty patient. *J Arthroplasty* 2016;31:2081-2084.
8. Bedard NA, Pugely AJ, Westermann RW, Duchman KR, Glass NA, Callaghan JJ: Opioid Use after total knee arthroplasty: Trends and risk factors for prolonged Use. *J Arthroplasty* 2017;32:2390-2394.
9. Smith E, Klemm C, Sabeh K, Tirumala V, Kwon YM: Patient-reported outcomes associated with preoperative opioid Use in revision total hip arthroplasty: A Propensity score-matched cohort study. *J Am Acad Orthop Surg* 2021;29:e330-e336.
10. Deen JT, Stone WZ, Gray CF, et al.: Revision arthroplasty does not require more opioids than Primaries: A review of prescribing Practices after implementation of a structured perioperative pain management strategy. *J Arthroplasty* 2020;35:2173-2176.
11. Bell KL, Detweiler M, Yayac M, Penna S, Chen AF: Preoperative opioid Use increases the cost of care in total joint arthroplasty. *J Am Acad Orthop Surg* 2021;29:310-316.