World Journal of Orthopedics

Submit a Manuscript: https://www.f6publishing.com

World J Orthop 2022 August 18; 13(8): 703-713

DOI: 10.5312/wjo.v13.i8.703

ISSN 2218-5836 (online)

ORIGINAL ARTICLE

Retrospective Cohort Study

Fluctuation of visual analog scale pain scores and opioid consumption before and after total hip arthroplasty

Vivek Singh, Alex Tang, Thomas Bieganowski, Utkarsh Anil, William Macaulay, Ran Schwarzkopf, Roy I Davidovitch

Specialty type: Orthopedics

Provenance and peer review: Invited article; Externally peer reviewed.

Peer-review model: Single blind

Peer-review report's scientific quality classification

Grade A (Excellent): 0
Grade B (Very good): B
Grade C (Good): C
Grade D (Fair): D
Grade E (Poor): 0

P-Reviewer: Oommen AT, India; Vyshka G, Albania; Yuan H, China

Received: October 1, 2021
Peer-review started: October 1, 2021
First decision: January 11, 2022
Revised: January 28, 2022
Accepted: July 22, 2022
Article in press: July 22, 2022
Published online: August 18, 2022

Vivek Singh, Alex Tang, Thomas Bieganowski, Utkarsh Anil, William Macaulay, Ran Schwarzkopf, Roy I Davidovitch, Department of Orthopedic Surgery, NYU Langone Orthopedic Hospital, New York, NY 10010, United States

Corresponding author: Vivek Singh, MD, Doctor, Department of Orthopedic Surgery, NYU Langone Orthopedic Hospital, 301 E 17th Street, New York, NY 10010, United States. vivek.singh@nyulangone.org

Abstract

BACKGROUND

Patients who undergo orthopedic procedures are often given excess opioid medication. Understanding the relationship between pain and opioid consumption following total hip arthroplasty (THA) is key to creating safe and effective opioid prescribing guidelines.

AIM

To evaluate the association between the quantity of opioid consumption in relation to pain scores both pre-and postoperatively in patients undergoing primary THA.

METHODS

We retrospectively reviewed patients who underwent primary THA from November 2018-May 2019 and answered both the visual analog scale (VAS) pain and opioid medication questionnaires pre-and postoperatively. Both surveys were delivered daily for 7-days before surgery through the first 30 postoperative days. Survey results were divided into preoperative, postoperative days 1-7, postoperative days 8-14, and postoperative days 15-30 for analysis. Mean opioid pill consumption and VAS pain scores in each time period were determined and compared to patients' preoperative status using hierarchical Poisson and linear regressions, respectively.

RESULTS

There were 105 patients included. Mean VAS pain scores were the highest preoperatively 7.41 ± 1.72. However, VAS pain scores significantly declined in each successive postoperative category compared to preoperative scores: postoperative day 1-7 (5.07 ± 1.79; $P < 0.001$), postoperative day 8-14 (3.60 ± 1.64; P

< 0.001), and postoperative day 15-30 (3.15 ± 1.63; P < 0.001). Mean opioid pill consumption preoperatively was 0.68 ± 1.29 pills. Compared to preoperative opioid consumption, opioid use was significantly greater between postoperative days 1-7 (1.51 ± 1.58; P = 0.001) and postoperative days 8-14 (1.00 ± 1.27; P = 0.043). Opioid consumption declined below preoperative levels between postoperative days 15-30 (0.35 ± 0.72; P = 0.160) which correlates with a VAS pain score of 3.15.

CONCLUSION

All patients experienced significant benefit and pain relief from having undergone THA. Average postoperative opioid consumption decreased below preoperative consumption between postoperative days 15-30, which was associated with a VAS pain score of 3.15. These results can be used to appropriately guide opioid prescribing practices and set patient expectations regarding pain management following THA.

Key Words: Opioids; Narcotics; Pain; Visual analog scale; Total hip arthroplasty

Core Tip: Our results should be used to appropriately guide opioid prescribing patterns and set patient expectations regarding expected pain management following total hip arthroplasty (THA). This will not only give patients a baseline to reference during their recovery but also limit redundant billing expenses related to unnecessary prescription of medication and avoidable outpatient visits due to post-operative pain. However, without further research that considers other patient factors that influence pain severity, our understanding of the independent impact of pain on opioid consumption after THA remains uncertain.

Citation: Singh V, Tang A, Bieganowski T, Anil U, Macaulay W, Schwarzkopf R, Davidovitch RI. Fluctuation of visual analog scale pain scores and opioid consumption before and after total hip arthroplasty. *World J Orthop* 2022; 13(8): 703-713

URL: https://www.wjgnet.com/2218-5836/full/v13/i8/703.htm

DOI: https://dx.doi.org/10.5312/wjo.v13.i8.703

INTRODUCTION

Total hip arthroplasty (THA) is one of the most common and successful orthopedic procedures[1]. Arguably one of the greatest improvements in THA peri-operative management over the last decade has been the continuous advancements in pain management regimens that have greatly improved the rate of recovery following the procedure[2-4]. However, due to the highly invasive nature of the procedure, postoperative pain becomes difficult to avoid entirely despite advancements in surgical techniques and perioperative protocols[5]. While joint-related pain is expected to steadily subside after surgical rehabilitation, numerous patients report persistent pain leading to the development of chronic pain postoperatively[6]. Furthermore, the amount of pain that patients experience may perhaps be the most important determinant of satisfaction after THA[7]. Some previous studies suggest that patients who consume more opioids report less satisfaction with pain relief and greater pain intensity[8,9].

Opioids have long been established as a primary analgesic modality for patients undergoing THA and are prescribed routinely for acute pain management following surgery[10]. However, opioid misuse remains a rapidly growing public health crisis which has led to a heightened focus on conservative prescribing patterns in orthopedic surgery[11]. Recent data suggests that the United States ranks number one among all other countries worldwide in daily narcotic consumption[12]. Specifically, orthopedic surgeons are the third-highest group of opioid prescribers among physicians, accounting for almost 8% of all opioid prescriptions in the United States[13]. Limiting access to unused medications while ensuring adequate pain management has been a proposed strategy for improving current prescription practices[14-16]. Although recent studies have highlighted a pattern of patients receiving excess opioid medication after undergoing various orthopedic procedures, there has been minimal evidence to suggest an optimal supply of pain medication postoperatively[16-23]. Therefore, in order to create a safe and effective prescribing guideline that minimizes the over-prescription of opioids and to effectively advise patients pre- and postoperatively, it is imperative to discern the relationship between pain severity and opioid consumption.

The visual analog scale (VAS) is a simple and frequently used method to quantify variations in pain intensity for both clinical and investigational purposes[24-26]. The assessment of pain is generally difficult due to its multifaceted subjective nature, which can vary among individuals. Despite this diversity, the VAS pain questionnaire is widely used in the literature and clinical practice. It is a simple

patient-reported outcome tool and requires relatively little patient training to measure pain scores. To our knowledge, no previous study has analyzed the relationship between VAS pain scores and perioperative opioid consumption in patients undergoing THA.

The purpose of this study is to evaluate the association between the quantity of opioid consumption in relation to VAS pain scores both pre- and postoperatively in patients undergoing primary THA. We hypothesize that both opioid consumption and VAS pain scores will decrease for all patients following surgery when compared to their preoperative status.

MATERIALS AND METHODS

Study design

A retrospective review of prospectively collected data was performed at a tertiary, urban, academic medical center to identify consecutive patients who underwent primary, elective THA from November 2018 to May 2019. The inclusion criteria comprised patients who answered both the VAS pain and opioid medication questionnaires pre- and postoperatively. Results from both surveys were separated into four time points for analysis (preoperative, postoperative days 1-7, postoperative days 8-14, and postoperative days 15-30). Patients under the age of 18, those undergoing THA for non-elective or oncologic reasons, revision THA, those who did not have a recorded response for both questionnaires, and any patient receiving opioid pain medications for conditions not related to their operative hip were excluded from this study. A total of 1142 primary THAs were performed at our institution within the period of interest, of which, 270 (24%) were performed by the senior author (Davidovitch RI). All cases included in this study were performed by the senior author (Davidovitch RI) utilizing a direct anterior approach with the assistance of fluoroscopy.

All patients participated in our institutional-wide comprehensive total joint pathway program, which encompasses standardized protocols for all aspects of perioperative care and postoperative rehabilitation. The records and existing data are de-identified and are part of our institutional quality improvement program; therefore, the present study was exempt from human-subjects review by our institutional review board.

Outcome measures

The primary outcomes measures included VAS pain scores and opioid consumption over time. VAS pain scores were calculated based on a 0 to 10 scale, with 0 representing no pain and 10 being the worst pain imaginable[24,25]. The VAS pain score was selected as an outcome measure based on its ability to detect immediate changes with a minimal clinically important difference (MCID) ranging from 1.86 to 2.36 for THA[25]. Opioid consumption was defined as the number of narcotic pills taken per day. The various opioids reported by patients included tramadol, hydromorphone, hydrocodone, oxycodone, and morphine sulfate[27]. Mean VAS pain scores and opioid pills consumed preoperatively were compared to the means on postoperative days 1-7, days 8-14, and days 15-30 to determine the time point at which postoperative opioid consumption decreases below preoperative consumption and its relation to VAS pain scores. Postoperative time points and the calculation of their means were chosen to provide a comparison to the baseline seven-day interval measured preoperatively.

Opioid-sparing pain protocol

Our institution implemented a novel opioid-sparing protocol for all patients undergoing THA beginning in October 2018 (Supplementary material). The previously established World Health Organization (WHO) analgesic ladder was used as a framework for the development of this novel protocol[28]. With the addition of this protocol, our healthcare providers and patients adhere to standardized order sets for the administration of multimodal analgesia medications throughout the perioperative period[4,29]. Within one month of planned THA, patients are evaluated at our institution's preadmission test center. Thorough medication reconciliation is performed and patients who are actively consuming opiates are advised and instructed to taper or discontinue its usage prior to undergoing surgery.

In the operating room, patients are given initial propofol infusions for sedation. Subsequently, patients receive a single dose of spinal anesthetic containing 0.5% ropivacaine or 0.5% bupivacaine. Prior to wound closure, patients are administered two separate homogenously diluted 60-cc injections by the operating surgeon. The first injection was a cocktail containing 20 cc of liposomal bupivacaine (one vial) mixed with 40 cc of 0.9% normal saline solution while the second injection was a cocktail containing 40 cc of non-liposomal bupivacaine (0.25% weight/volume) and 15 mg of ketorolac with 20 cc of 0.9% normal saline solution. All patients receive a total of two grams of intravenous (IV) tranexamic acid (TXA). One gram before surgical incision and another gram during surgical wound closure. Patients who could not receive IV TXA [contraindication for TXA administration: (1) Subarachnoid hemorrhage (2) Intravascular clotting; and (3) Known tranexamic acid hypersensitivity] received 3 g topically in the wound mixed in 100cc saline solution.

All patients receive similar postoperative multimodal analgesia medications during the immediate post-anesthesia care unit period, on the surgical floor, and discharge. Postoperative pain management was accomplished using mostly non-narcotic medications. Patient-controlled analgesia, as well intravenous opioid administration, was strongly discouraged, except in rare situations of breakthrough pain when alternatives had been exhausted. Additionally, patients receive a prescription of aspirin 81 mg twice daily as the primary deep venous thrombosis prophylaxis, which also has analgesic effects as part of our multimodal approach. Following discharge, patients are assessed for adequate pain control (and severity) at multiple time points *via* telephone and during scheduled follow-up visits.

Data collection

As part of our institutional standard of care, patients were preoperatively registered for an electronic patient engagement application (EPEA; Force Therapeutics, New York, NY) by clinical care coordinators at the time of surgical scheduling. The EPEA is a mobile and web-based technology that wirelessly delivers digital patient reported outcome questionnaires to patients at pre-defined time intervals. This application was used to collect VAS pain scores and quantity of opioid consumption daily for seven days before surgery through the first 30 postoperative days.

The collected baseline patient demographic data included gender, age, body mass index (BMI; kg/m^2), American Society of Anesthesiologists (ASA) classification, race, smoking status, length of stay (LOS; days), and surgical time (minutes). LOS was determined by calculating the difference between the time of admission and discharge following surgery. Surgical time was derived from calculating the time difference between the initial skin incision and the completion of skin closure. All demographic data were extracted from our institution's electronic data warehouse (Epic Caboodle. version 15; Verona, WI) using Microsoft SQL Server Management Studio 2017 (Redmond, WA).

Statistical analysis

All statistical analyses were performed using SPSS v25 (IBM Corporation, Armonk, New York). The data were organized using Microsoft Excel software. Baseline demographic characteristics of the study participants were tallied for each variable collected. Descriptive data are represented as means ± SD or counts (%). Hierarchical Poisson regression was used to compare mean opioid pill consumption preoperatively to postoperative days 1-7, days 8-14, and days 15-30. Hierarchical linear regression was used to compare VAS pain scores preoperatively to postoperative days 1-7, days 8-14, and days 15-30. The incidence rate ratio and exponentiated beta coefficients are also reported along with an associated 95% confidence interval (CI). A P value of less than 0.05 was considered to be statistically significant.

RESULTS

A total of 105 patients were identified who underwent primary THA *via* a direct anterior approach with the assistance of fluoroscopy. The majority of the study participants were female (63%), between the age 65-74 years old (38%), had a BMI < 30 kg/m^2 (62%), ASA class II (74%), Caucasian (90%), and non-smokers (68%). Additionally, the majority of the patients in this study had a surgical time spanning between 60-120 min (78%) and an in-hospital LOS of 1 day or less following surgery (75%). Full demographic details are highlighted in Table 1.

Opioid consumption and VAS pain scores

The average number of opioid pills consumed preoperatively was 0.68 ± 1.29. The number of opioids consumed between postoperative days 1-7 (1.51 ± 1.58; P = 0.001) and postoperative days 8-14 (1.00 ± 1.27; P = 0.043) was significantly greater when compared to patients' preoperative opioid consumption. However, opioid consumption between postoperative days 15-30 did not significantly differ from their preoperative status (0.35 ± 0.72; P = 0.160). This suggests that despite an initial rise in opioid requirements postoperatively, patients experience a decreased need for pain relief 15-30 postoperatively and in fact have a similar if not less opioid consumption in comparison to their preoperative opioid consumption level (Figure 1). These findings are summarized in Table 2.

The mean VAS pain score for the study participants preoperatively was 7.41 ± 1.72. This significantly differed from the VAS pain scores between postoperative days 1-7 (5.07 ± 1.79; P < 0.001), days 8-14 (3.60 ± 1.64; P < 0.001), and days 15-30 (3.15 ± 1.63; P < 0.001) (Table 3). The differences exceeded the proposed MCID for the VAS pain score, making these findings clinically significant. Furthermore, the mean VAS pain score between postoperative days 15-30 correlated with a decline in opioid consumption below patients' preoperative opioid consumption status. The average postoperative VAS pain score of patients who did not take opioids was approximately 3.50, which suggests that a general decline in pain occurs at roughly days 8-14 postoperatively and becomes much lower between postoperative days 15-30 (Figure 2). Additionally, there was a significant linear relationship between VAS pain scores and the number of opioid capsules consumed, which may indicate that as patients' perception of their pain intensified, their reliance on opioid pain medication increased accordingly (P < 0.001; Table 4).

Table 1 Patient demographics (*N* = 105)

Patient demographics (*N* = 105), *n* (%)	
Gender	
Male	39 (37)
Female	66 (63)
Age (yr)	
< 55	17 (16)
55-64	30 (29)
65-74	40 (38)
≥ 75	18 (17)
BMI (kg/m)^2	
Underweight (< 18.5)	2 (2)
Normal (18.5-24.9)	30 (29)
Overweight (25.0-29.9)	33 (31)
Obese (> 30)	40 (38)
ASA Classification	
I	9 (9)
II	78 (74)
III or IV	18 (17)
Race	
Caucasian	94 (90)
Non-caucasian	11 (10)
Smoking Status	
Current smoker	2 (2)
Former smoker	31 (30)
Never smoker	71 (68)
LOS (d)	
0	34 (32)
1	45 (43)
> 1	26 (25)
Surgical Time (min)	
< 60	20 (19)
60-120	82 (78)
> 120	3 (3)

DISCUSSION

Over the past few decades, the number of opioids prescribed to manage patients with chronic non-cancer related pain such as osteoarthritis has dramatically increased[16,18,30-33]. This reported rise carries substantial implications for orthopedic surgeons, as patients who undergo orthopedic procedures are prescribed more opioid medications on average than patients of most other specialties [13]. The impact of opioids has gained significant clinical and research interest given their potential to prognosticate postoperative outcomes and patient satisfaction. Recent evidence now suggests that opioids provide no additional benefits compared to non-opioid medications such as ibuprofen and acetaminophen to manage pain associated with osteoarthritis and have higher rates of adverse events [34-38]. Additionally, previous studies have also reported that patients who used more opioids postoperatively experienced less satisfaction and greater pain intensity irrespective of the procedure type[8,9]. Therefore, gaining a better understanding of the relationship between opioid use and pain is

Table 2 Number of opioid pills consumed per day (*N* = 105, 564 observations)

Time	Average daily opioid use (SD)	Incidence rate ratio (95%CI)	*P* value
Preop	0.68 (1.29)	---	---
Postop days 1-7	1.51 (1.58)	2.43 (1.44, 4.10)	**0.001**
Postop days 8-14	1.00 (1.27)	1.76 (1.02, 3.03)	**0.043**
Postop days 15-30	0.35 (0.72)	0.66 (0.36, 1.18)	0.160

SD: Standard deviation; CI: Confidence interval.

Table 3 Visual analog scale pain score (*N* = 105, 504 observations)

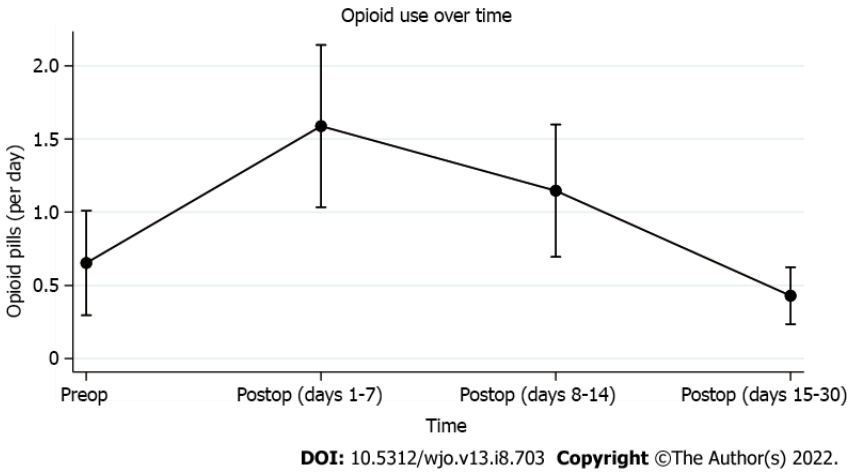
Time	Average VAS pain score (SD)	Beta coefficient (95%CI)	*P* value
Preop	7.41 (1.72)	---	---
Postop days 1-7	5.07 (1.79)	-3.00 (-3.34, -2.65)	**< 0.001**
Postop days 8-14	3.60 (1.64)	-4.43 (-4.79, -4.07)	**< 0.001**
Postop days 15-30	3.15 (1.63)	-5.21 (-5.57, -4.86)	**< 0.001**

VAS: Visual analog scale; SD: Standard deviation; CI: Confidence interval.

Table 4 Comparison of mean postop visual analog scale pain score and opioid use (*N* = 105)

	No opioid use (50.2%)	1 Opioid pill (22.3%)	2+ Opioid pills (27.5%)	*P* values
VAS pain score (SD)	3.48 (1.81)	4.30 (1.63)	5.32 (1.76)	**< 0.001**

SD: Standard deviation.

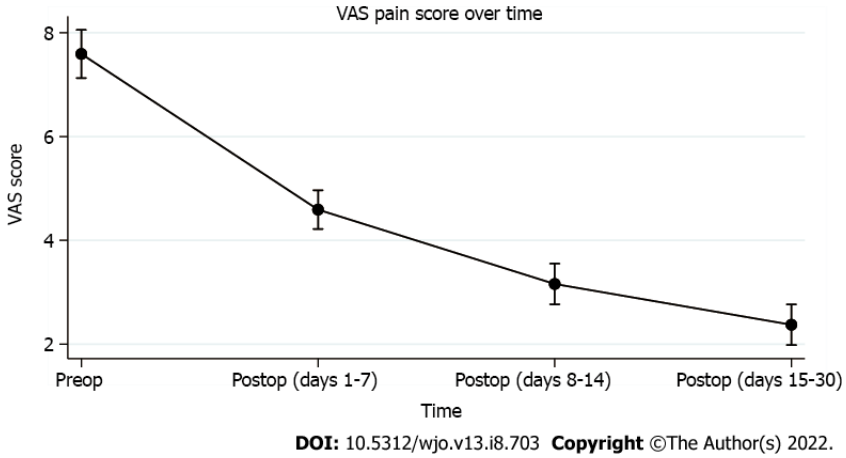


DOI: 10.5312/wjo.v13.i8.703

Figure 1 Mean opioid consumption over time.

essential given the shifting emphasis placed upon health safety and quality. The findings of the present study not only demonstrate that all patients achieve significant pain relief following THA, but that average postoperative opioid consumption decreased below preoperative consumption by days 15-30 postoperatively.

Bot *et al*[9] found that opioid use preoperatively along with lower patient self-efficacy were the best predictors of decreased satisfaction, and the administration of more opioids does not improve satisfaction with pain relief. This is consistent with our findings as patients reported higher VAS pain scores as their opioid intake increased. However, there have been few studies that have documented a correlation between greater opioid use and higher satisfaction with pain relief[39,40]. Carragee *et al*[41]



DOI: 10.5312/wjo.v13.i8.703

Figure 2 Mean visual analog scale pain score over time.

compared morphine use following a femur fracture in both the American and Vietnamese populations and found that although American patients used much more morphine in comparison to Vietnamese patients (30 mg/kg *vs* 0.9 mg/kg), they were less satisfied with their pain relief. Perhaps, drug dependence or addiction may be a confounding factor in achieving satisfaction with pain relief. Vranceanu *et al*[42] previously cited effective coping strategies (higher self-efficacy) as the most effective pain reliever. It may be that significant preoperative opioid intake reflects greater psychologic distress that translates to higher reported subjective pain scores postoperatively.

In our study, both opioid consumption and VAS pain scores decreased successively at each of the timeframes evaluated. This implies that patients needed fewer opioid pills as time progressed but were still able to achieve significant pain relief. Implementing standardized, evidence-based opioid prescribing protocols may optimize the number of opioid prescriptions provided to patients and are particularly paramount for patients at risk of transitioning from short-term to long-term opioid therapy postoperatively[4,16,43-45]. Interestingly, the VAS pain score between postoperative days 1-7 was less than patients' preoperative status; however, the number of opioid pills consumed was higher during postoperative days 1-7. We postulate this may be due to the increased perceived pain burden experienced by patients after undergoing such an invasive procedure.

The amount of opioids prescribed after orthopedic procedures vary widely in the literature, and only a few established guidelines exist that have standardized acceptable duration and magnitude of opioid use[17,46]. Our findings showed that patients ceased to depend on opioids between postoperative days 15-30 compared to their preoperative consumption status, which correlated to a mean VAS pain score of 3.15. This information can be used to set patient expectations and allows surgeons to tailor their prescribing habits based on pain intensity reported by their patients. However, other risk factors in addition to pain also need to be considered. Patients with mental health conditions, such as depression and anxiety are more likely to be prescribed opioids at both higher doses and for longer durations[47, 48]. Not only have previous studies reported that prolonged opioid use may induce depression, but also that depressed patients seek medical attention for pain more frequently, and are three times more likely to be prescribed chronic opioid therapy[49,50]. Rhon *et al*[51] found that the use of pain medication prior to surgery, younger age, female, lower socioeconomic status (education and household income), high health-seeking behavior, and presence of substance abuse, insomnia, or mental health disorders prior to surgery were all significant in predicting chronic opioid use after surgery. However, it is likely that a combination of these variables may provide a greater predictive value for determining the likelihood of chronic opioids following surgery.

A recent study by Cook *et al*[52] showed that nearly 40% of THA patients do not fill their opioid prescriptions after surgery and proposed that strong consideration should be given to alternative pain control methods. It has been previously documented that many patients who fill an opioid prescription do not use any pills[16], thus the true number of patients who require opioids following surgery is likely lower than the number of patients who fill a prescription. Ideally, opioid prescriptions after surgery should balance adequate pain management against the duration of treatment. Although their analysis did not include THA, Scully *et al*[46] proposed that the optimal length of opioid prescriptions for common orthopedic procedures is around 6 to 15 d. This is corroborated by the findings of our study as opioid consumption quantity reached below the preoperative levels between days 15-30 postoperatively.

This study is not without limitations. The retrospective nature of this study has the potential to introduce inherent bias. The study population was majority female and age 65 years or older which causes inherent selection bias. Both the opioid and pain surveys that were administered relied on self-reporting by the patients. Due to the nature of the self-reported survey, opioid dependence could be

undetected in our study cohort. All patients in this study underwent THA *via* the direct anterior approach by a single surgeon, thus our results may not be generalizable to patients who undergo THA *via* other surgical approaches. Additionally, we excluded any patients who underwent revision of their primary implant or were hospitalized due to any postoperative complications. These patients may be the heaviest postoperative users of opioids due to a difficult and prolonged recovery resulting in higher pain intensity. Indeed, most patients included in the present study had a LOS of less than two days, and further analyses may benefit from addressing how lengthened in-patient stays affect VAS and the subsequent prescription of opioids postoperatively. In addition, the pain threshold of each patient is different making the generalizability of our results relatively difficult. Although we accounted for all non-THA related pain indications, we could not quantify all possible pain events after surgery that could necessitate prescription opioid therapy. Theoretically, a patient could have obtained an opioid prescription after undergoing THA for an issue unrelated to their orthopedic procedure. Patients who have pre-existing psychiatric conditions, anxiety, and/or fear of pain may confound the data, as they are unlikely to show improvement in pain, regardless of pain score. We did not quantify both opioid and non-opioid oral analgesic use such as meloxicam and aspirin according to oral morphine equivalent or collect the duration of preoperative opioid use. In addition, our analysis of PO opioid medication did not take into account IV opioids received perioperatively. This study only considered opioid intake; therefore, analgesics consumed by patients that may reduce the need for opioid intake could have possibly skewed the results. Furthermore, while VAS scores may be generalizable, an individual's immediate post-operative opioid consumption is dictated by subjective measures such as anesthesia type could introduce confounding variables that are difficult to quantify[53]. Lastly, we did not account for patients who may have had unreported adverse effects (constipation, nausea, vomiting, hypotension, *etc.*) due to opioid consumption and stopped their intake during the postoperative periods evaluated in this study. Future investigations comparing multiple surgical approaches for THA and including patients from different regions of the country and various parts of the world would help further elucidate our findings. Despite these limitations, the results presented can aid surgeons' opioid prescribing patterns based on their patients' reported pain levels following THA.

CONCLUSION

All patients experienced significant pain relief from having undergone THA. The average postoperative opioid consumption decreased below preoperative opioid consumption status between days 15-30 postoperatively. This decline in opioid consumption was associated with a relative VAS pain score of 3.15. Our results should be used to appropriately guide opioid prescribing patterns and set patient expectations regarding expected pain management following THA. This will not only give patients a baseline to reference during their recovery but also limit redundant billing expenses related to unnecessary prescription of medication and avoidable outpatient visits due to post-operative pain. However, without further research that considers other patient factors that influence pain severity, our understanding of the independent impact of pain on opioid consumption after THA remains uncertain.

ARTICLE HIGHLIGHTS

Research background

The purpose of this study is to evaluate the association between the quantity of opioid consumption in relation to visual analog scale (VAS) pain scores both pre- and postoperatively in patients undergoing primary total hip arthroplasty (THA). The amount of opioids prescribed after orthopaedic procedures vary widely in the literature, and only a few established guidelines exist that have standardized acceptable duration and magnitude of opioid use. Our findings showed that patients ceased to depend on opioids between postoperative days 15-30 compared to their preoperative consumption status, which correlated to a mean VAS pain score of 3.15. This information can be used to set patient expectations and allows surgeons to tailor their prescribing habits based on pain intensity reported by their patients.

Research motivation

The impact of opioids has gained significant clinical and research interest given their potential to prognosticate postoperative outcomes and patient satisfaction. Therefore, gaining a better understanding of the relationship between opioid use and pain is essential given the shifting emphasis placed upon health safety and quality.

Research objectives

The purpose of this study is to evaluate the association between the quantity of opioid consumption in relation to VAS pain scores both pre- and postoperatively in patients undergoing primary THA. We hypothesize that both opioid consumption and VAS pain scores will decrease for all patients following

surgery when compared to their preoperative status.

Research methods

Administer surverys to aassociate VAS pain scores with opioiid pill consumption.

Research results

Our findings showed that patients ceased to depend on opioids between postoperative days 15-30 compared to their preoperative consumption status, which correlated to a mean VAS pain score of 3.15.

Research conclusions

This information can be used to set patient expectations and allows surgeons to tailor their prescribing habits based on pain intensity reported by their patients.

Research perspectives

Future research should aim to consider other patient factors that influence pain severity. Our current understanding of the independent impact of pain on opioid consumption after THA remains inconclusive.

FOOTNOTES

Author contributions: Singh V, Tang A, and Bieganowski T write the manuscript; Singh V collected the data; Singh V and Anil U did the analysis; Macaulay W did the edits. Schwarzkopf R and Davidovitch RI are responsible for conceptualization and manuscript editing.

Institutional review board statement: The present study retrospectively analysed de-identified data for institutional quality improvement initiative and was therefore exempted from human-subjects review by our Institutional Review Board.

Informed consent statement: Informed consent was not needed for this study. This was a quality improvement initiative at our institution.

Conflict-of-interest statement: Singh V, Tang A, Bieganowski T and Anil U have nothing to disclose. Macaulay W holds stock options in OrthoAlign. Schwarzkopf R is a paid consultant for Smith & Nephew and Intellijoint. He also has stock options in Gauss Surgical outside the submitted work. Davidovitch RI is a paid consultant for Radlink, Schaerer Medical, Exactech, and Medtronics.

Data sharing statement: The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

STROBE statement: The authors have read the STROBE Statement—checklist of items, and the manuscript was prepared and revised according to the STROBE Statement—checklist of items.

Country/Territory of origin: United States

ORCID number: Vivek Singh 0000-0003-2450-1785; Alex Tang 0000-0001-7086-4355; Thomas Bieganowski 0000-0002-1566-7962; Utkarsh Anil 0000-0003-1807-1926; William Macaulay 0000-0003-2684-0676; Ran Schwarzkopf 0000-0003-0681-7014; Roy I Davidovitch 0000-0003-4083-4205.

S-Editor: Wu YXJ
L-Editor: A
P-Editor: Wu YXJ

REFERENCES

1 **Learmonth ID**, Young C, Rorabeck C (2007) The operation of the century: total hip replacement. Lancet 370: 1508-1519 [DOI: 10.1016/S0140-6736(07)60457-7]
2 **Liu W**, Cong R, Li X, Wu Y, Wu H. Reduced opioid consumption and improved early rehabilitation with local and

intraarticular cocktail analgesic injection in total hip arthroplasty: a randomized controlled clinical trial. *Pain Med* 2011; **12**: 387-393 [PMID: 21266004 DOI: 10.1111/j.1526-4637.2010.01043.x]

3 **Yu SW**, Szulc AL, Walton SL, Davidovitch RI, Bosco JA, Iorio R. Liposomal Bupivacaine as an Adjunct to Postoperative Pain Control in Total Hip Arthroplasty. *J Arthroplasty* 2016; **31**: 1510-1515 [PMID: 26872584 DOI: 10.1016/j.arth.2016.01.004]

4 **Padilla JA**, Gabor JA, Schwarzkopf R, Davidovitch RI. A Novel Opioid-Sparing Pain Management Protocol Following Total Hip Arthroplasty: Effects on Opioid Consumption, Pain Severity, and Patient-Reported Outcomes. *J Arthroplasty* 2019; **34**: 2669-2675 [PMID: 31311667 DOI: 10.1016/j.arth.2019.06.038]

5 **Højer Karlsen AP**, Geisler A, Petersen PL, Mathiesen O, Dahl JB. Postoperative pain treatment after total hip arthroplasty: a systematic review. *Pain* 2015; **156**: 8-30 [PMID: 25599296 DOI: 10.1016/j.pain.0000000000000003]

6 **Beswick AD**, Wylde V, Gooberman-Hill R, Blom A, Dieppe P. What proportion of patients report long-term pain after total hip or knee replacement for osteoarthritis? *BMJ Open* 2012; **2**: e000435 [PMID: 22357571 DOI: 10.1136/bmjopen-2011-000435]

7 **Brokelman RBG**, van Loon CJM, Rijnberg WJ. Patient vs surgeon satisfaction after total hip arthroplasty. *J Bone Jt Surg - Ser B* 2003 [DOI: 10.1302/0301-620X.85B4.13411]

8 **Nota SP**, Spit SA, Voskuyl T, Bot AG, Hageman MG, Ring D. Opioid Use, Satisfaction, and Pain Intensity After Orthopedic Surgery. *Psychosomatics* 2015; **56**: 479-485 [PMID: 25624183 DOI: 10.1016/j.psym.2014.09.003]

9 **Bot AG**, Bekkers S, Arnstein PM, Smith RM, Ring D. Opioid use after fracture surgery correlates with pain intensity and satisfaction with pain relief. *Clin Orthop Relat Res* 2014; **472**: 2542-2549 [PMID: 24777731 DOI: 10.1007/s11999-014-3660-4]

10 **Chou R**, Fanciullo GJ, Fine PG. Clinical Guidelines for the Use of Chronic Opioid Therapy in Chronic Noncancer Pain. *J Pain* 2009; **10** [DOI: 10.1016/j.spinee.2010.01.027]

11 **Trasolini NA**, McKnight BM, Dorr LD. The Opioid Crisis and the Orthopedic Surgeon. *J Arthroplasty* 2018; **33**: 3379-3382.e1 [PMID: 30075877 DOI: 10.1016/j.arth.2018.07.002]

12 International Narcotics Control Board/ United Nations (2018) International Narcotics Control Board: Narcotic drugs estimated world requirements for 2018—statistics for 2017 [DOI: 10.18356/34f1db17-en-fr-es]

13 **Volkow ND**, McLellan TA, Cotto JH, Karithanom M, Weiss SR. Characteristics of opioid prescriptions in 2009. *JAMA* 2011; **305**: 1299-1301 [PMID: 21467282 DOI: 10.1001/jama.2011.401]

14 **Volkow ND**, McLellan TA. Curtailing diversion and abuse of opioid analgesics without jeopardizing pain treatment. *JAMA* 2011; **305**: 1346-1347 [PMID: 21467287 DOI: 10.1001/jama.2011.369]

15 **Bartels K**, Mayes LM, Dingmann C, Bullard KJ, Hopfer CJ, Binswanger IA. Opioid Use and Storage Patterns by Patients after Hospital Discharge following Surgery. *PLoS One* 2016; **11**: e0147972 [PMID: 26824844 DOI: 10.1371/journal.pone.0147972]

16 **Sabatino MJ**, Kunkel ST, Ramkumar DB, Keeney BJ, Jevsevar DS. Excess Opioid Medication and Variation in Prescribing Patterns Following Common Orthopaedic Procedures. *J Bone Joint Surg Am* 2018; **100**: 180-188 [PMID: 29406338 DOI: 10.2106/JBJS.17.00672]

17 **Bedard NA**, Sierra RJ, Mabry T. Opioids After Orthopaedic Surgery: There Is a Need for Universal Prescribing Recommendations: Commentary on an article by Matthew J. Sabatino, MD, MS, *et al*.: "Excess Opioid Medication and Variation in Prescribing Patterns Following Common Orthopaedic Procedures". *J Bone Joint Surg Am* 2018; **100**: e17 [PMID: 29406353 DOI: 10.2106/JBJS.17.01480]

18 **Bedard NA**, Sierra RJ, Mabry T. Opioids After Orthopaedic Surgery: There Is a Need for Universal Prescribing Recommendations: Commentary on an article by Matthew J. Sabatino, MD, MS, *et al*.: "Excess Opioid Medication and Variation in Prescribing Patterns Following Common Orthopaedic Procedures". *J Bone Joint Surg Am* 2018; **100**: e17 [PMID: 29406353 DOI: 10.2106/JBJS.17.01480]

19 **Traven SA**, Brinton DL, Woolf SK, Leddy LR, Gottschalk MB, Slone HS. Notable Variability in Opioid-prescribing Practices After Common Orthopaedic Procedures. *J Am Acad Orthop Surg* 2021; **29**: 219-226 [PMID: 32568996 DOI: 10.5435/JAAOS-D-19-00798]

20 **Kim N**, Matzon JL, Abboudi J, Jones C, Kirkpatrick W, Leinberry CF, Liss FE, Lutsky KF, Wang ML, Maltenfort M, Ilyas AM. A Prospective Evaluation of Opioid Utilization After Upper-Extremity Surgical Procedures: Identifying Consumption Patterns and Determining Prescribing Guidelines. *J Bone Joint Surg Am* 2016; **98**: e89 [PMID: 27869630 DOI: 10.2106/jbjs.15.00614]

21 **Adalbert JR**, Ilyas AM. Implementing Prescribing Guidelines for Upper Extremity Orthopedic Procedures: A Prospective Analysis of Postoperative Opioid Consumption and Satisfaction. *Hand (N Y)* 2021; **16**: 491-497 [PMID: 31441326 DOI: 10.1177/1558944719867122]

22 **O'Neil JT**, Wang ML, Kim N, Maltenfort M, Ilyas AM. Prospective Evaluation of Opioid Consumption After Distal Radius Fracture Repair Surgery. *Am J Orthop (Belle Mead NJ)* 2017; **46**: E35-E40 [PMID: 28235120]

23 **Chatha K**, Borroto W, Goss L, Ghisa C, Gilot G, Sabesan VJ. How orthopedic surgeons can impact opioid use and dependence in shoulder arthroplasty. *JSES Int* 2020; **4**: 105-108 [PMID: 32195471 DOI: 10.1016/j.jses.2019.10.113]

24 **Brokelman RB**, Haverkamp D, van Loon C, Hol A, van Kampen A, Veth R. The validation of the visual analogue scale for patient satisfaction after total hip arthroplasty. *Eur Orthop Traumatol* 2012; **3**: 101-105 [PMID: 22798966 DOI: 10.1007/s12570-012-0100-3]

25 **Danoff JR**, Goel R, Sutton R, Maltenfort MG, Austin MS. How Much Pain Is Significant? *J Arthroplasty* 2018; **33**: S71-S75.e2 [PMID: 29567002 DOI: 10.1016/j.arth.2018.02.029]

26 **Chapman CR**, Casey KL, Dubner R. Pain measurement: an overview. *Pain* 1985; **22**: 1-31 [DOI: 10.1016/0304-3959(85)90145-9]

27 **da Costa BR**, Nüesch E, Kasteler R, Husni E, Welch V, Rutjes AW, Jüni P. Oral or transdermal opioids for osteoarthritis of the knee or hip. *Cochrane Database Syst Rev* 2014; CD003115 [PMID: 25229835 DOI: 10.1002/14651858.CD003115.pub4]

28 **Anekar AA**, Cascella M. WHO Analgesic Ladder. 2022 May 15. In: StatPearls [Internet]. Treasure Island (FL): StatPearls

Publishing; 2022 Jan- [PMID: 32119322]
29 **Feng JE**, Mahure SA, Waren DP, Lajam CM, Slover JD, Long WJ, Schwarzkopf RM, Macaulay WB, Davidovitch RI. Utilization of a Novel Opioid-Sparing Protocol in Primary Total Hip Arthroplasty Results in Reduced Opiate Consumption and Improved Functional Status. *J Arthroplasty* 2020; **35**: S231-S236 [PMID: 32139187 DOI: 10.1016/j.arth.2020.02.009]
30 **Kaye AD**, Jones MR, Kaye AM, Ripoll JG, Galan V, Beakley BD, Calixto F, Bolden JL, Urman RD, Manchikanti L. Prescription Opioid Abuse in Chronic Pain: An Updated Review of Opioid Abuse Predictors and Strategies to Curb Opioid Abuse: Part 1. *Pain Physician* 2017; **20**: S93-S109 [PMID: 28226333 DOI: 10.36076/ppj.2017.s109]
31 **Kaye AD**, Jones MR, Kaye AM, et al (2017) Prescription opioid abuse in chronic pain: An updated review of opioid abuse predictors and strategies to curb opioid abuse (Part 2). Pain Physician [DOI: 10.36076/ppj.2017.s109]
32 **Manchikanti L**, Helm S 2nd, Fellows B, Janata JW, Pampati V, Grider JS, Boswell MV. Opioid epidemic in the United States. *Pain Physician* 2012; **15**: ES9-E38 [PMID: 22786464 DOI: 10.36076/ppj.2012/15/ES9]
33 **Weber KL**. The AAOS clinical practice guidelines. *J Am Acad Orthop Surg* 2009; **17**: 335-336 [PMID: 19474442 DOI: 10.5435/00124635-200906000-00001]
34 **Rozell JC**, Courtney PM, Dattilo JR, Wu CH, Lee GC. Preoperative Opiate Use Independently Predicts Narcotic Consumption and Complications After Total Joint Arthroplasty. *J Arthroplasty* 2017; **32**: 2658-2662 [PMID: 28478186 DOI: 10.1016/j.arth.2017.04.002]
35 **Zarling BJ**, Sikora-Klak J, Bergum C, Markel DC. How Do Preoperative Medications Influence Outcomes After Total Joint Arthroplasty? *J Arthroplasty* 2017; **32**: S259-S262 [PMID: 28578845 DOI: 10.1016/j.arth.2017.04.031]
36 **Kim K**, Chen KK, Roof M, Anoushiravani AA, Vigdorchik J, Schwarzkopf R. The effects of preoperative chronic opioid use in total hip arthroplasty. *J Clin Orthop Trauma* 2020; **11**: 73-78 [PMID: 32001989 DOI: 10.1016/j.jcot.2019.04.027]
37 **Busse JW**, Douglas J, Chauhan TS, Kobeissi B, Blackmer J. Perceptions and Impact of the 2017 Canadian Guideline for Opioid Therapy and Chronic Noncancer Pain: A Cross-Sectional Study of Canadian Physicians. *Pain Res Manag* 2020; **2020**: 8380171 [PMID: 32148601 DOI: 10.1155/2020/8380171]
38 **Busse JW**, Wang L, Guyatt GH. Meta-analysis of Opioids for Chronic Pain-Reply. *JAMA* 2019; **321**: 1936 [PMID: 31112257 DOI: 10.1001/jama.2019.2185]
39 **Decosterd I**, Hugli O, Tamchès E, Blanc C, Mouhsine E, Givel JC, Yersin B, Buclin T. Oligoanalgesia in the emergency department: short-term beneficial effects of an education program on acute pain. *Ann Emerg Med* 2007; **50**: 462-471 [PMID: 17445949 DOI: 10.1016/j.annemergmed.2007.01.019]
40 **Shill J**, Taylor DM, Ngui B, Taylor SE, Ugoni AM, Yeoh M, Richardson J. Factors associated with high levels of patient satisfaction with pain management. *Acad Emerg Med* 2012; **19**: 1212-1215 [PMID: 23035970 DOI: 10.1111/j.1553-2712.2012.01451.x]
41 **Carragee EJ**, Vittum D, Truong TP, Burton D. Pain control and cultural norms and expectations after closed femoral shaft fractures. *Am J Orthop (Belle Mead NJ)* 1999; **28**: 97-102 [PMID: 10067712]
42 **Vranceanu AM**, Ring D. Factors associated with patient satisfaction. *J Hand Surg Am* 2011; **36**: 1504-1508 [PMID: 21794990 DOI: 10.1016/j.jhsa.2011.06.001]
43 **Inacio MC**, Hansen C, Pratt NL, Graves SE, Roughead EE. Risk factors for persistent and new chronic opioid use in patients undergoing total hip arthroplasty: a retrospective cohort study. *BMJ Open* 2016; **6**: e010664 [PMID: 27130165 DOI: 10.1136/bmjopen-2015-010664]
44 **Earp BE**, Silver JA, Mora AN, Blazar PE. Implementing a Postoperative Opioid-Prescribing Protocol Significantly Reduces the Total Morphine Milligram Equivalents Prescribed. *J Bone Joint Surg Am* 2018; **100**: 1698-1703 [PMID: 30278000 DOI: 10.2106/JBJS.17.01307]
45 **Sabesan VJ**, Echeverry N, Dalton C, Grunhut J, Lavin A, Chatha K. The impact of state-mandated opioid prescribing restrictions on prescribing patterns surrounding reverse total shoulder arthroplasty. *JSES Int* 2021; **5**: 663-666 [PMID: 34223412 DOI: 10.1016/j.jseint.2021.04.009]
46 **Scully RE**, Schoenfeld AJ, Jiang W, Lipsitz S, Chaudhary MA, Learn PA, Koehlmoos T, Haider AH, Nguyen LL. Defining Optimal Length of Opioid Pain Medication Prescription After Common Surgical Procedures. *JAMA Surg* 2018; **153**: 37-43 [PMID: 28973092 DOI: 10.1001/jamasurg.2017.3132]
47 **Goplen CM**, Verbeek W, Kang SH, Jones CA, Voaklander DC, Churchill TA, Beaupre LA. Preoperative opioid use is associated with worse patient outcomes after Total joint arthroplasty: a systematic review and meta-analysis. *BMC Musculoskelet Disord* 2019; **20**: 234 [PMID: 31103029 DOI: 10.1186/s12891-019-2619-8]
48 **Braden JB**, Sullivan MD, Ray GT, Saunders K, Merrill J, Silverberg MJ, Rutter CM, Weisner C, Banta-Green C, Campbell C, Von Korff M. Trends in long-term opioid therapy for noncancer pain among persons with a history of depression. *Gen Hosp Psychiatry* 2009; **31**: 564-570 [PMID: 19892215 DOI: 10.1016/j.genhosppsych.2009.07.003]
49 **Sullivan MD**. Depression Effects on Long-term Prescription Opioid Use, Abuse, and Addiction. *Clin J Pain* 2018; **34**: 878-884 [PMID: 29505419 DOI: 10.1097/AJP.0000000000000603]
50 **Scherrer JF**, Salas J, Lustman PJ, Burge S, Schneider FD. Change in opioid dose and change in depression in a longitudinal primary care patient cohort. *Pain* 2015; **156**: 348-355 [PMID: 25599457 DOI: 10.1097/01.j.pain.0000460316.58110.a0]
51 **Rhon DI**, Snodgrass SJ, Cleland JA, Sissel CD, Cook CE. Predictors of chronic prescription opioid use after orthopedic surgery: derivation of a clinical prediction rule. *Perioper Med (Lond)* 2018; **7**: 25 [PMID: 30479746 DOI: 10.1186/s13741-018-0105-8]
52 **Cook DJ**, Kaskovich SW, Pirkle SC, Mica MAC, Shi LL, Lee MJ. Benchmarks of Duration and Magnitude of Opioid Consumption After Total Hip and Knee Arthroplasty: A Database Analysis of 69,368 Patients. *J Arthroplasty* 2019; **34**: 638-644.e1 [PMID: 30642706 DOI: 10.1016/j.arth.2018.12.023]
53 **Risitano S**, Indelli PF. Is "symmetric" gap balancing still the gold standard in primary total knee arthroplasty? *Ann Transl Med* 2017; **5**: 325 [PMID: 28861422 DOI: 10.21037/atm.2017.06.18]

Published by **Baishideng Publishing Group Inc**
7041 Koll Center Parkway, Suite 160, Pleasanton, CA 94566, USA
Telephone: +1-925-3991568
E-mail: bpgoffice@wjgnet.com
Help Desk: https://www.f6publishing.com/helpdesk
https://www.wjgnet.com